BEFORE THE METRO COUNCIL

AMENDING THE REGIONAL FRAMEWORK PLAN AND THE URBAN GROWTH MANAGEMENT FUNCTIONAL PLAN RELATING TO NATURE IN NEIGHBORHOODS	)))))	ORDINANCE NO. 05-1077C Introduced by Michael Jordan, Chief Operating Officer, with the concurrence of David Bragdon, Council President

WHEREAS, nature in neighborhoods is critical to maintaining and improving the high quality of life, livability, and standard of living enjoyed by the people of the Metro region; and

WHEREAS, the Metro Council has expressed, as one of four central goals for the region, the aspiration that, "The region's wildlife and people thrive in a healthy urban ecosystem," and identified this goal as a priority for action; and

WHEREAS, the Metro region places a high priority on the protection of its streams, wetlands, and floodplains to maintain access to nature, sustain and enhance native fish and wildlife species and their habitats, mitigate high storm flows and maintain adequate summer flows, provide clean water, and create communities that fully integrate the built and natural environment; and

WHEREAS, the Regional Framework Plan provides that Metro will adopt programs to maintain and improve water quality and to protect fish and wildlife habitat in the region; and

WHEREAS, Metro adopted Title 3 to the Urban Growth Management Functional Plan in 1998 to maintain and improve water quality and protect people and property from flood hazards; and

WHEREAS, Title 3 also provides for Metro to study and develop a program for the protection and conservation of fish and wildlife habitat; and

WHEREAS, the Metro Policy Advisory Committee, comprised of elected officials and other citizens representing the region's cities and counties, adopted a "Vision Statement" in 2000 ("MPAC Vision Statement") to guide, inform, and be the philosophical underpinnings for the study, identification, and development of a fish and wildlife habitat protection program; and

WHEREAS, the MPAC Vision Statement established an overall goal to conserve, protect, and restore a continuous ecologically viable streamside corridor system, from the streams' headwaters to their confluence with other streams and rivers, and with their floodplains in a manner that is integrated with the surrounding urban landscape; and

WHEREAS, the MPAC Vision Statement recognized that this vision would have to be achieved through conservation, protection, and appropriate restoration of streamside corridors through time; and

WHEREAS, the Nature in Neighborhoods initiative has been proposed in Resolution No. 05-3574, which provides for Metro to implement a coordinated regional program to ensure that the region's natural areas and greenspaces are restored and protected; and

WHEREAS, Metro has undertaken the development of a fish and wildlife habitat protection program as one element of the Nature in Neighborhoods initiative consistent with Statewide Planning Goal 5, which is intended "to protect natural resources and conserve scenic and historic areas and open spaces," and with Oregon Administrative Rules chapter 660, Division 23, adopted by the Land Conservation and Development Commission to implement Goal 5 (the "Goal 5 Rule"); and

WHEREAS, Metro analyzed city and county habitat protection programs and concluded that habitat protection standards varied widely from city to city, and that the most regionally consistent standards were those adopted by cities and counties to comply with Metro's Title 3 water quality standards; and

WHEREAS, Metro has completed a region-wide inventory of regionally significant fish and wildlife habitat comprising 80,000 acres that has been located and classified for its ecological value and mapped to provide an information base for the region; and

WHEREAS, Metro has conducted an analysis of the economic, social, environmental, and energy (ESEE) consequences of protecting or not protecting the inventoried habitat in two phases and has developed this fish and wildlife habitat protection program based on that analysis; and

WHEREAS, through the study and development of the fish and wildlife habitat protection program, Metro identified new scientific information relating to water quality, and is therefore also adopting much of this element of the Nature in Neighborhoods initiative pursuant to Statewide Planning Goal 6, which is intended, in relevant part, "to maintain and improve the quality of the . . . water . . . resources of the state;" and

WHEREAS, fish and wildlife depend on clean, clear water in order to thrive, and all actions that protect water from becoming polluted by increased sedimentation, increased temperature, excessive nitrogen and nutrient levels, toxic chemicals, and other such pollutants is necessarily and inseparably linked with providing healthy, ecologically viable and stable fish and wildlife habitat; and

WHEREAS, as stated in Exhibit C, this ordinance is in furtherance of a comprehensive program in the Metro region for water pollution control, as a matter of protecting the public health and safety;

WHEREAS, the Federal Water Pollution and Control Act Amendments of 1972, 33 U.S.C. §1251 et seq. (the "Clean Water Act"), directs the administrator of the United States Environmental Protection Agency "in cooperation with other Federal agencies, State water pollution control agencies, interstate agencies, and municipalities and industries involved, prepare or develop comprehensive programs for preventing, reducing, or eliminating the pollution of the navigable waters and ground waters and improving the sanitary condition of surface and underground waters. In the development of such comprehensive programs due regard shall be given to the improvements which are necessary to conserve such waters for the protection and propagation of fish and aquatic life and wildlife, recreational purposes, and the withdrawal of such waters for public water supply, agricultural, industrial, and other purposes." 33 U.S.C. §1252; and

WHEREAS, as stated in Exhibit C, this ordinance is in furtherance of a comprehensive program in the Metro region to conserve the region's waters for the protection and propagation of fish and wildlife, recreation purposes, and the withdrawal of such waters for public water supply, agricultural, industrial, and other purposes, as required by the Clean Water Act; and

WHEREAS, the Endangered Species Act, 16 U.S.C. §1531 et seq., was enacted “to provide a means whereby the ecosystems upon which endangered species and threatened species depend may be conserved, to provide a program for the conservation of such endangered species and threatened species . . . .” 16 U.S.C. §1531(b); and

WHEREAS, Metro has catalogued the endangered and threatened species within the Metro region and this ordinance is in furtherance of a comprehensive program to conserve the ecosystem upon which endangered and threatened species depend; and

WHEREAS, in adopting new functional plan requirements as part of the comprehensive Nature in Neighborhoods initiative, Metro is committed to protecting the interests of property owners by implementing Statewide Ballot Measure 37 through a fair, efficient, and open claims process to be adopted on or before the effective date of this Ordinance; and

WHEREAS, Metro recognizes that local governments’ implementation of the new functional plan requirements of the Nature in Neighborhoods initiative may give rise to Measure 37 claims by property owners against local governments and Metro is willing to assume responsibility for addressing those claims; now therefore

THE METRO COUNCIL ORDAINS AS FOLLOWS:

SECTION 1. The Regionally Significant Fish and Wildlife Habitat Inventory Map (the “Inventory Map”), attached hereto as Exhibit A and hereby incorporated by reference into this ordinance, is hereby adopted.

SECTION 2. Metro has analyzed the economic, social, environmental, and energy (ESEE) consequences that could result from a decision to allow, limit, or prohibit uses that conflict with the resource sites identified on the Inventory Map, consistent with Statewide Planning Goal 5 and OAR 660, Division 23. Based on Metro’s ESEE analysis, Metro has determined to allow some conflicting uses and to limit some conflicting uses, but not to prohibit any conflicting uses. Metro’s determination is reflected in tables 3.07-13b and 3.07-13c in Exhibit C to this ordinance. Sections 4 through 9 of this ordinance are hereby adopted to implement Metro’s determination to allow some conflicting uses and to limit some conflicting uses pursuant to Statewide Planning Goal 5.

SECTION 3. All parts of Sections 4 through 9 of this ordinance that require the region’s cities and counties to substantially comply with new requirements applicable to areas within the Metro Urban Growth Boundary on the date this ordinance is adopted are hereby also adopted to maintain and improve water quality pursuant to Statewide Planning Goal 6. In addition, all parts of Sections 4 through 9 of this ordinance that will require the region’s cities and counties to substantially comply with new requirements applicable to areas that will be identified as regionally significant riparian habitat that is brought within the Metro Urban Growth Boundary after the date this ordinance is adopted are hereby also adopted to maintain and improve water quality pursuant to Statewide Planning Goal 6.

SECTION 4. The Regional Framework Plan is amended as provided in Exhibit B, which is attached and hereby incorporated by reference into this ordinance.

SECTION 5. The Urban Growth Management Functional Plan, Metro Code chapter 3.07, is amended to add Title 13, entitled "Nature in Neighborhoods," as provided in Exhibit C, which is attached and hereby incorporated by reference into this ordinance.

SECTION 6. The Urban Growth Management Functional Plan, Metro Code chapter 3.07, is further amended as provided in Exhibit D, which is attached and hereby incorporated by reference into this ordinance.

SECTION 7. The Title 13 Nature in Neighborhoods Model Ordinance, attached as Exhibit E, is hereby adopted and incorporated by reference into this ordinance.

SECTION 8. The Findings of Fact and Conclusions of Law in Exhibit F (the "Findings") are hereby adopted and incorporated by reference into this ordinance. The Findings explain how this ordinance complies with state law, the Regional Framework Plan, and the Metro Code. All attachments to the Findings are part of the Findings and are also hereby incorporated by reference into this ordinance.

SECTION 9. The provisions of this ordinance are separate and severable. In the event that any one or more clause, sentence, paragraph, section, subsection, or portion of this ordinance or the application thereof to any city, county, person, or circumstance is held invalid, illegal, or unenforceable in any respect, the validity, legality, and enforceability of the remaining provisions of this ordinance or its application to other cities, counties, persons, or circumstances shall not be affected.

SECTION 10. The map revisions described in Exhibit G are hereby approved. The Chief Operating Officer shall prepare final copies of all maps adopted with this ordinance to reflect the map revisions described in Exhibit G and all other provisions of this ordinance. The Chief Operating Officer shall also produce an updated Attachment 5 to Exhibit F to reflect these map revisions. The Chief Operating Officer shall complete the updated table and final maps, including quadrangle 1:28,000 scale Inventory and HCA maps, and make them available to the public not later than the effective date of this ordinance.

SECTION 11. This ordinance shall take effect 90 days after it is adopted.

ADOPTED by the Metro Council this 29th day of September 2005.

David Bragdon, Council President

Attest:

Christina Billington, Recording Secretary

Approved as to Form:

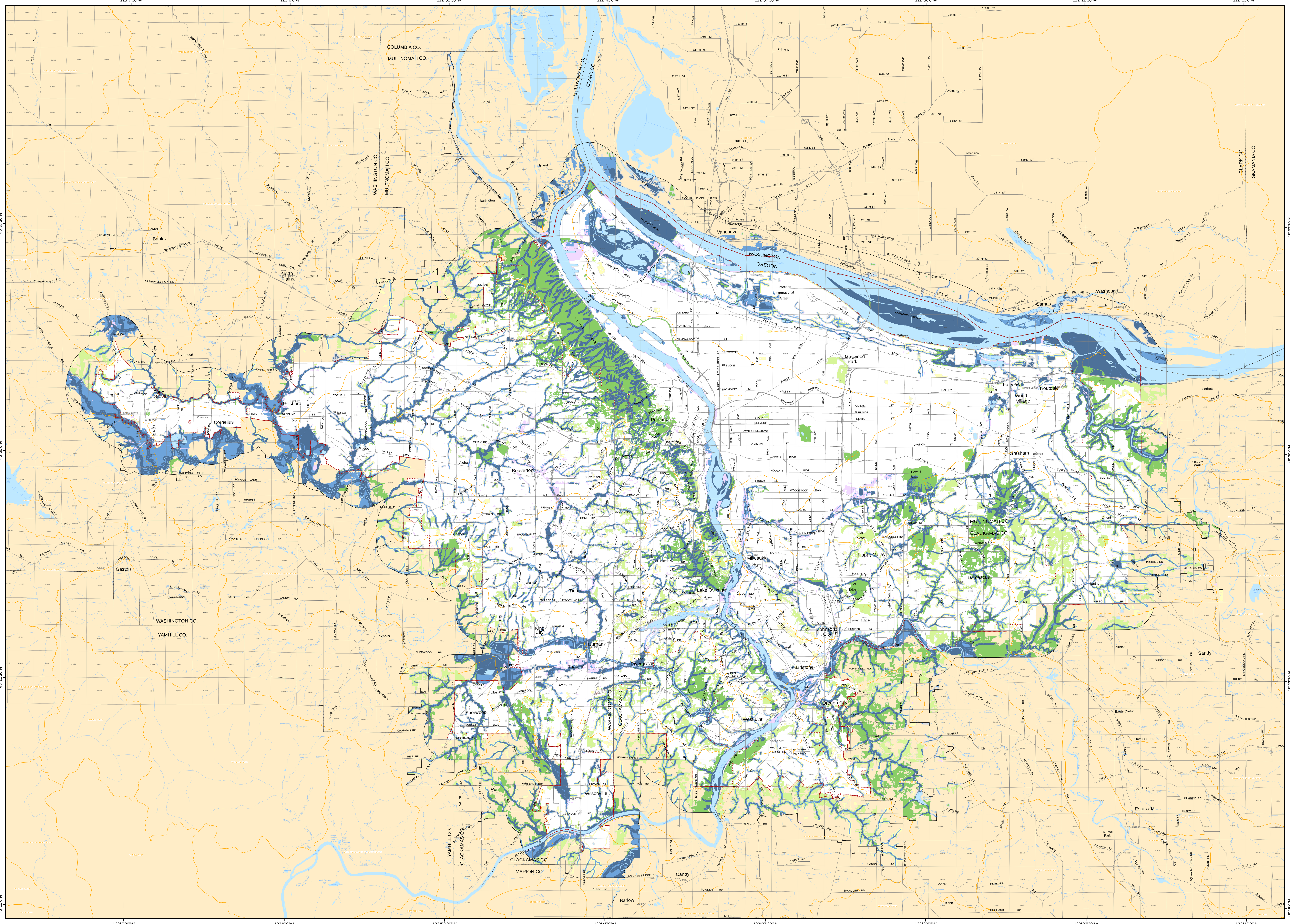
Daniel B. Cooper, Metro Attorney

M:\attorney\confidential\07 Land Use\04 2040 Growth Concept\03 UGMFP\02 Stream Protection (Title 3)\02 Goal 5\02 Program\Ord 05-1077B\Ord 05-1077B 071405.doc

EXHIBIT A—ORDINANCE NO. 05-1077C

REGIONALLY SIGNIFICANT FISH AND WILDLIFE HABITAT INVENTORY MAP (the "Inventory Map")

Available for review in the Metro Council's files (see map labeled "Ordinance No. 05-1077B," but note that additional revisions were approved as described in Section 10 of the ordinance) or from the Metro Data Resource Center, 600 N.E. Grand Ave., Portland, OR 97232. Electronic and printed copies of maps, in any reasonable scale and size required, may be purchased from the Data Resource Center. This map may also be available via Metro's website at: **www.metro-region.org/nature**.



Metro Fish and Wildlife Habitat Protection Program

Nature in Neighborhoods

Exhibit A to Ordinance No. 05-1077B

Regionally Significant Fish and Wildlife Habitat Inventory Map

- Area Outside Metro Jurisdiction
- Urban Growth Boundary
- Metro Boundary
- County Boundaries
- Section Lines
- River & Lake Areas
- Stream Centerlines
- Watersheds
- Resource Classification Boundary

The Resource Classification is based on September 2004 Inventory and Economic, Social, Environmental and Energy Analysis (ESEE) Data.

1 inch equals 1.39 miles

0 0.5 1 2 3 Miles

Wildlife Habitat

Resource Classes

- Riparian Corridors / Wildlife Habitat Class I
- Riparian Corridors/Wildlife Habitat Class II
- Riparian Corridors Class III
- Upland Wildlife Habitat Class A
- Upland Wildlife Habitat Class B
- Upland Wildlife Habiat Class C
- Impact Areas

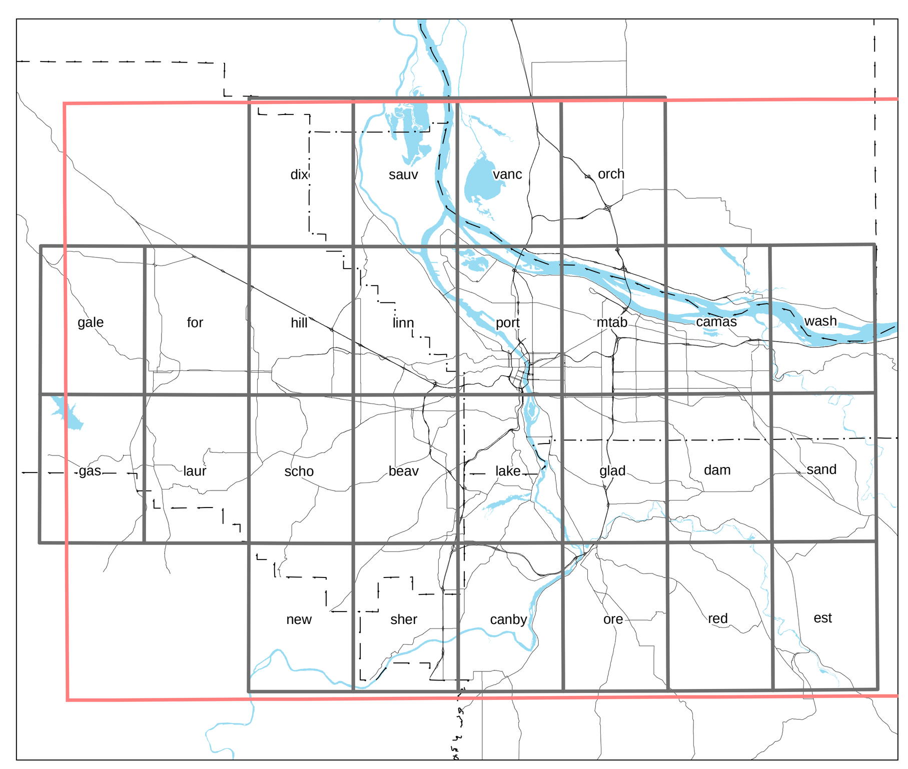
The information on this map was derived from digital databases on Metro's GIS. Care was taken in the creation of this map. Metro cannot accept any responsibility for errors, omissions, or positional accuracy. There are no warranties, expressed or implied, including the warranty of merchantability or fitness for a particular purpose, accompanying this product. However, notification of any errors will be appreciated.

R L I S

REGIONAL LAND INFORMATION SYSTEM

METRO

NATURAL RESOURCES PLANNING
600 NORTHEAST GRAND AVENUE | PORTLAND, OREGON 97232-2736
TEL (503) 797-1839 | FAX (503) 797-1911
habitat@metro.dst.or.us | www.metro-region.org/habitat



Location Map

Plot date: 8/5/2005 i:/gm/drc/share/carolh/05115/habitat_inventory

EXHIBIT B—ORDINANCE NO. 05-1077C

REGIONAL FRAMEWORK PLAN AMENDMENTS

NOTE: The Regional Framework Plan (RFP) was revised and updated by Ordinance No. 05-1086, approved by the Metro Council on August 18, 2005, and effective November 16, 2005. The following amendments are to the revised RFP adopted by Ordinance No. 05-1086.

Amendment 1. In the RFP Chapter entitled, "Summary of Growth Concept," the section entitled, "Open Spaces and Trail Corridors" shall be amended as follows:

Open Spaces and Trail Corridors

Recognition and protection of open spaces both inside the UGB and in rural reserves are reflected in the Growth Concept. The areas designated open space on the Concept map are parks, stream and trail corridors, wetlands and floodplains, largely undeveloped upland areas and areas of compatible very low-density residential development. Many of these natural features already have significant land set aside as open space. The Tualatin Mountains, for example, contain major parks such as Forest Park and Tryon Creek State Park and numerous smaller parks such as Gabriel Park in Portland and Wilderness Park in West Linn. Other areas are oriented toward wetlands and streams.

Designating these areas as open spaces has several effects. First, it removes these lands from the category of urban land that is available for development. The capacity of the UGB then has to be calculated without these areas, and plans to accommodate housing and employment have to be made without them. Second, these natural areas, along with key rural reserve areas, receive a high priority for purchase as parks and open space, through programs such as Metro's Open Spaces Acquisition program. Finally, ~~regulations should be~~ functional plan requirements have been developed~~,~~ to protect critical ~~natural areas that would not~~fish and wildlife habitat areas without conflicting with housing and economic goals. This will provide protection of environmentally critical ~~creek~~ areas, compatible ~~low-density~~ development of sensitive areas, and allow transfer of development rights from protected natural areas to other lands better suited for development.

Amendment 2. The "Fundamentals" section of RFP Chapter 1 entitled, "Land Use," shall be amended by inserting the following text after the paragraph referring to "Fundamental 2":

"Fundamental 3: Protect and restore the natural environment including fish and wildlife habitat, streams and wetlands, surface and ground water quality and quantity, and air quality."

Amendment 3. RFP Chapter 1 entitled, "Land Use," shall be amended by adding section 1.9.12, "Protection of Regionally Significant Fish and Wildlife Habitat," which shall provide as follows:

1.9.12 Conduct an inventory of regionally significant fish and wildlife habitat for all lands being considered for inclusion in the UGB, in order to:

a. Consider whether urbanization can occur consistent with policies that call for protection of regionally significant fish and wildlife habitat.

b. Limit future conflicts between urbanization and the protection of regionally significant fish and wildlife habitat by examining the impacts upon the ecological quality and integrity of such habitat whenever the Council has discretion to choose between potential lands to be added to the UGB.

Amendment 4. Section 1.10, entitled "Urban Design," shall be amended as follows:

1.10 Urban Design

It is the policy of the Metro Council to:

1.10.1 Support the identity and functioning of communities in the region through:

a. Recognizing and protecting critical open space features in the region.

b. Developing public policies that encourage diversity and excellence in the design and development of settlement patterns, landscapes and structures.

c. Ensuring that incentives and regulations guiding the development and redevelopment of the urban area promote a settlement pattern that:

i) Links any public incentives to a commensurate public benefit received or expected and evidence of private needs.

ii) Is pedestrian "friendly," encourages transit use and reduces auto dependence.

iii) Provides access to neighborhood and community parks, trails and walkways, and other recreation and cultural areas and public facilities.

iv) Reinforces nodal, mixed-use, neighborhood-oriented design.

v) Includes concentrated, high-density, mixed-use urban centers developed in relation to the region's transit system.

vi) Is responsive to needs for privacy, community, sense of place and personal safety in an urban setting.

vii) Facilitates the development and preservation of affordable mixed-income neighborhoods.

viii) Avoids and minimizes conflicts between urbanization and the protection of regionally significant fish and wildlife habitat.

1.10.2 Encourage pedestrian- and transit-supportive building patterns in order to minimize the need for auto trips and to create a development pattern conducive to face-to-face community interaction.

Amendment 5. RFP Chapter 3 entitled, "Parks, Natural Areas, Open Spaces And Recreational Facilities," shall be renamed, "Nature in Neighborhoods," and the policies therein shall be amended as follows:

3.1 Inventory of Park Facilities and Identification and Inventory of Regionally Significant Parks, Natural Areas, Open Spaces, Fish and Wildlife Habitat, Trails and Greenways

It is the policy of the Metro Council to:

3.1.1 Ensure coordinated protection and enhancement of natural functions such as water quality and wildlife habitat across jurisdictional boundaries by inventorying and identifying regionally significant parks, natural areas, open spaces, fish and wildlife habitat, vacant lands, trails and greenways at the watershed level using topographical, geologic and biologic functions and features, i.e., "landscape ecology."

3.1.2 Identify natural corridors that connect regionally significant parks, natural areas, open spaces, fish and wildlife habitat, trails and greenways. River and stream corridors, ridgelines, butte-tops, utility corridors, abandoned roads, and railroad rights-of-way will provide primary linkages.

3.1.3 Inventory lands outside the Urban Growth Boundary and Metro's jurisdictional boundary and identify them as prospective components of the Regional System when protection of these lands is determined to be of direct benefit to the region.

3.1.4 Identify urban areas which are deficient in natural areas and identify opportunities for acquisition and restoration.

3.1.5 Update the parks inventory (first completed in 1988) every five (5) years, including acreage, facilities, environmental education programs, cultural resources, existing school sites and other information as determined by Metro.

3.1.6 Inventory the urban forestry canopy, using appropriate landscape level techniques, such as remote sensing or aerial photo interpretation, on a periodic basis and provide inventory information to local jurisdictions.

3.2 Protection of Regionally Significant Parks, Natural Areas, Open Spaces, Fish and Wildlife Habitat, Trails and Greenways

It is the policy of the Metro Council to:

3.2.1 Continue developing a Regional System of Parks, Natural Areas, Open Spaces, Fish and Wildlife Habitat, Trails, and Greenways (the Regional System) to achieve the following objectives:

a) Protect the region's biodiversity;

b) Provide citizens opportunities for, primarily, natural resource dependent recreation and education;

c) Contribute to the protection of air and water quality and watershed health; and

d) Provide natural buffers and connections between communities.

3.2.2 Finance and coordinate protection and management of the Regional System across jurisdictional boundaries upon the advice of citizens, and in coordination with local governments and state and federal resource agencies and appropriate non-profit organizations.

3.2.3 Use strategies to protect and manage the Regional System ~~and regional Goal 5 resources~~ including, but not ~~be~~ limited to, acquisition, education, incentives, land use and environmental regulations. Implement these strategies regionally and coordinate and encourage these strategies to be implemented by local governments, special districts, businesses, non-profit organizations, and individuals.

3.2.4 Include lands inside and outside the UGB and Metro's jurisdiction in the Regional System when protection of these lands are determined to be of direct benefit to the region.

3.2.5 Collect and evaluate baseline data related to natural resource values of the ~~r~~Regional ~~s~~System to identify trends and to guide management decisions.

3.2.6 Seek to avoid fragmentation and degradation of components of the Regional System caused by new transportation and utility projects. If avoidance is infeasible, impacts shall be minimized and mitigated.

3.2.7 Work with the State of Oregon to update, reinvigorate and implement a Willamette River Greenway Plan for the metropolitan region, in conjunction with affected local governments.

3.2.8 Protect Fish and Wildlife Habitat to achieve the following objectives:

a. Performance objectives:

i) Preserve and improve streamside, wetland, and floodplain habitat and connectivity;

ii) Preserve large areas of contiguous habitat and avoid habitat fragmentation;

iii) Preserve and improve connectivity for wildlife between riparian corridors and upland wildlife habitat; and

iv) Preserve and improve special habitat of concern, including native oak habitats, native grasslands, wetlands, bottomland hardwood forests, and riverine islands.

b. Implementation objectives:

i) Increase the use of habitat-friendly development throughout the region; and

ii) Increase restoration and mitigation actions to compensate for adverse effects of new and existing development on ecological function.

3.3 Management of the Publicly-Owned Portion of the Regional System of Parks, Natural Areas, Open Spaces, Fish and Wildlife Habitat, Trails and Greenways

3.3.1 Assume management responsibility for elements of the publicly owned portion of the Regional System, as outlined in a functional plan to be developed.

3.3.2 Assume financial responsibility related to those portions of the publicly owned system which are managed by Metro.

3.3.3 Give local governments an opportunity to transfer existing publicly owned components of the Regional System to Metro and to acquire components of the Regional System with local resources.

3.3.4 Manage the publicly owned portion of the Regional System to protect fish, wildlife, and botanic values and to provide, primarily, natural resource dependent recreational and educational opportunities.

3.3.5 Acquire portions of the Regional System as financial resources allow by negotiating with willing sellers and using the power of eminent domain only in extraordinary circumstances.

3.3.6 Insure that public use is compatible with natural and cultural resource protection for components of the Regional System by creating Master/Management plans that strive to achieve that objective prior to formal public use.

3.3.7 Be responsive to recreation demands and trends identified in the State Comprehensive Outdoor Recreation Plan (SCORP), along with local government cooperators in the Regional System.

3.3.8 Develop master planning guidelines to assure consistency in the management of the Regional System.

3.3.9 Convene local government park providers to share information, review and analyze issues from time to time or in conjunction with the periodic update of the region-wide parks inventory and, if appropriate, develop recommendations related to:

a. Roles and responsibilities

b. Funding

c. Levels of service

d. Information needs

e. User trends and preferences

f. Technical assistance

g. Interagency coordination

h. Public involvement

i. Other topics as determined by Metro and local park providers

3.3.10 Pursue the identification and implementation of a long term, stable funding source to support the planning, acquisition, development, management and maintenance of the Regional System in cooperation with local governments.

3.4 Protection, Establishment and Management of a Regional Trails System
It is the policy of the Metro Council to:

3.4.1 Identify a Regional Trails System which shall be included in the Regional Transportation Plan.

3.4.2 Provide access to publicly owned parks, natural areas, open spaces, and greenways, where appropriate via the Regional Trails System.

3.4.3 Coordinate planning for the Regional Trails System with local governments, federal and state agencies, utility providers, and appropriate non-profit organizations.

3.4.4 Cooperate with citizens and other trail providers to identify and secure funding for development and operation of the Regional Trails System.

3.4.5 Encourage local governments to integrate local and neighborhood trail systems with the Regional Trails System.

3.5 Provision of Community and Neighborhood Parks, Open Spaces, Fish and Wildlife Habitat, Natural Areas, Trails and Recreation Programs
It is the policy of the Metro Council to:

3.5.1 Recognize that local governments remain responsible for the planning and provision of community and neighborhood parks, local open spaces, natural areas, sports fields, recreational centers, trails, and associated programs within their jurisdictions.

3.5.2 Encourage local governments to (i) adopt level of service standards for provision of parks, natural areas, trails, and recreational facilities in their local comprehensive plans; and (ii) locate and orient such parks, open spaces, natural areas, trails, etc., to the extent practical, in a manner which promotes non-vehicular access.

3.5.3 Encourage local governments to be responsive to recreation demand trends identified in the State Comprehensive Outdoor Recreation Plan (SCORP).

3.5.4 Encourage local governments to develop, adopt and implement Master Plans for local parks and trail systems, natural areas, and recreational programs.

3.5.5 Work in cooperation with local governments, state government, and private industry to establish a supplemental funding source for parks and open spaces acquisition, operations and maintenance.

3.5.6 Encourage local governments to identify opportunities for cooperation and cost efficiencies with non-profit organizations, other governmental entities, and local school districts.

3.5.7 Require that no urban reserve areas be brought into the UGB unless the Urban Reserve master plans demonstrate that planning requirements for the acquisition and protection of regionally significant fish and wildlife habitat and adequate land to meet or exceed locally adopted levels of service standards for the provision of public parks, natural areas, trails, and recreational facilities, be adopted in the local comprehensive plans.

3.5.8 Develop a functional plan in cooperation with local governments establishing the criteria which local governments address in adopting a locally determined "level of service standard," establishing region-wide goals for the provision of parks and open spaces in various urban design types identified in the 2040 Growth Concept and applying this to the portion of the region within the UGB and the urban reserves within Metro's jurisdiction when urban reserve conceptual plans are approved.

3.5.9 Work with local governments to promote a broader understanding of the importance of open spaces to the success of the 2040 Growth Concept and develop tools to assess open spaces on a parity with jobs, housing, and transportation targets in the Regional Framework Plan.

3.6 Participation of Citizens in Environmental Education, Planning, Stewardship Activities, and Recreational Services.

It is the policy of the Metro Council to:

3.6.1 Encourage public participation in natural, cultural and recreation resource management decisions related to the Regional System.

3.6.2 Provide educational opportunities to enhance understanding, enjoyment and informed use of natural, cultural, and recreational resources.

3.6.3 Provide and promote opportunities for the public to engage in stewardship activities on publicly owned natural resource lands and encourage cooperative efforts between Metro and private non-profit groups, community groups, schools and other public agencies.

3.6.4 Provide opportunities for technical assistance to private landowners for stewardship of components of the Regional System.

3.6.5 Work together with local governments with state, federal, non-profit and private partners to facilitate stewardship and educational opportunities on publicly owned natural resource lands.

3.6.6 Encourage local governments to provide opportunities for public involvement in the planning and delivery of recreational facilities and services.

3.6.7 Follow and promote the citizen participation values inherent in ~~RUGGO Goal 1, Objective 1~~Policy 1.13 and the Metro Citizen Involvement Principles.

Amendment 6. RFP Chapter 4 entitled, "Water Management," shall be renamed, "Watershed Health and Water Quality."

Amendment 7. The "Fundamentals" section of RFP Chapter 4 shall be amended by inserting the following text after the paragraph referring to "Fundamental 2":

"Fundamental 3: Protect and restore the natural environment including fish and wildlife habitat, streams and wetlands, surface and ground water quality and quantity, and air quality."

Amendment 8. Section 4.3 entitled, "Water Quality," shall be amended as follows:

4.3 Water Quality
It is the policy of the Metro Council to:

4.3.1 Protect, enhance, and restore the water quality of the region by:

a. Implementing and coordinating watershed-wide planning.

b. Promoting the protection of natural areas along waterways and encouraging continuous improvement of water quantity and quality through liaison with agencies that influence changes along streams, rivers and wetlands in the Metro region.

c. Establishing and maintaining vegetative corridors along streams.

d. Encouraging urban development practices that minimize soil erosion.

e. Implementing best management practices (BMPs).

f. ~~Maintaining vegetated buffers along riparian areas~~Establishing standards to conserve, protect, and enhance riparian fish and wildlife habitat.

g. Protecting wetlands values with sufficient buffers to maintain their water quality and hydrologic function.

Amendment 9. Section 4.6 entitled, "Fish and Wildlife Habitat Conservation," shall be deleted.

Amendment 10. The chart entitled, "Implementation Methods for the Regional Framework Plan," in RFP Chapter 8 entitled, "Implementation," shall be amended as follows:

Implementation Method for the Regional Framework Plan

Regional Framework Policy	Implementation Recommendation(s) or Requirements
Land Use	
1.1 Urban Form	• Metro Code 3.07, Urban Growth Management Functional Plan (UGMFP), Titles 1, 2, 6, 11 and 13~~1~~ • MTIP program • TOD program
1.2 Built Environment	• Metro Code 3.07, UGMFP, Titles 1 through 7, 11 and 12 ~~Titles 1 through 7, 11, and 12~~ • Regional Transportation Plan
1.3 Housing and Affordable Housing	• Metro Code 3.01, Urban Growth Boundary and Urban Reserve Procedures • Metro Code 3.07, UGMFP Titles 1, 7 and 11
1.4 Economic Opportunity	• Metro Code 3.07, UGMFP, Titles 1 and 4 ~~Titles 1 and 4~~
1.5 Economic Vitality	• ~~Title 1 of the UGMFP~~ Metro Code 3.07, UGMFP, Title 1
1.6 Growth Management	• Metro Code 3.01 UGB Amendment Procedures3.01.005 UGB Amendment Procedures • 3.01.020 Legislative Amendment Criteria • Metro Code 3.06 Policy & Purpose: Designating Functional Planning Areas • Metro Code 3.07, ~~Urban Growth Management Functional Plan:~~UGMFP, Titles 1 to 7, 11 and 12
1.7 Urban/Rural Transition	• Metro Code Chapter 3.01, UGB Amendment Procedures • 3.01.005 UGB Amendment Procedures • 3.01.020 Legislative Amendment Criteria • Metro Code 3.06, Policy & Purpose: Designating Functional Planning Areas • Metro Code 3.07, ~~Urban Growth Management Functional Plan~~UGMFP, Title 5 ~~Title 5~~

Regional Framework Policy	Implementation Recommendation(s) or Requirements
Land Use	
1.8 Developed Urban Land	• Metro Code 3.01, UGB Amendment Procedures • 3.01.005 UGB Amendment Procedures • 3.01.020 Legislative Amendment Criteria • Metro Code 3.06, Policy & Purpose: Designating Functional Planning Areas • Metro Code 3.07, ~~Urban Growth Management Functional Plan~~UGMFP, Titles 1 to 7 ~~Titles 1 to 7~~
1.9 Urban Growth Boundary	• Metro Code 3.01, UGB Amendment Procedures • 3.01.005 UGB Amendment Procedures • 3.01.020 Legislative Amendment Criteria • Metro Code 3.07, UGMFP, Title 13
1.10 Urban Design	• Metro Code 3.07, ~~Urban Growth Management Functional Plan~~UGMFP, Titles 1 and 13 ~~Title 1~~
1.11 Neighbor Cities	• Metro Code 3.07, ~~Urban Growth Management Functional Plan~~UGMFP, Title 5 ~~Title 5~~ • Signed Intergovernmental Agreements
1.12 Protection of Agriculture	• Metro Code Chapter 3.01 UGB Amendment Procedures • 3.01.005 • 3.01.020 Legislative Amendment Criteria
1.13 Participation of Citizens	• Resolution No. 97-2433 • Metro Code 2.12 Office of Citizen Involvement
1.14 School and Local Government Plan and Policy Coordination	• Metro Code 3.01.005.c(4), 3.01.030.a, UGB Amendment Procedures • Metro Code 3.07, ~~Urban Growth Management Functional Plan~~UGMFP, Title 11
1.15 Centers	• Metro Code 3.07, ~~Urban Growth Management Functional Plan~~ UGMFP, Title 6 ~~Title 6~~
1.16 Residential Neighborhoods	• Metro Code 3.07, ~~Urban Growth Management Functional Plan~~UGMFP, Title 12 ~~Title 12~~

Regional Framework Policy	Implementation Recommendation(s) or Requirements
Transportation	
2.1 Public Involvement	• Transportation Planning Public Involvement Policy • Metro Code 2.12.010, Office of Citizen Involvement: Creation and Purpose Regional Transportation Plan Policy 1.0
2.2 Intergovernmental Coordination	• Regional Transportation Plan Policy 2.0 • Metro Code, 3.07, Title 5
2.3 Urban Form	Regional Transportation Plan Policy 3.0
2.4 Consistency between Land Use and Transportation Planning	Regional Transportation Plan Policy 4.0
2.5 Barrier-Free Transportation	Regional Transportation Plan Policy 5.0
2.6 Interim Job Access and Reverse Commute Policy	Regional Transportation Plan Policy 5.1
2.7 Transportation Safety and Education	Regional Transportation Plan Policy 6.0
2.8 Natural Environment	Regional Transportation Plan Policy 7.0
2.9 Water Quality	• Regional Transportation Plan Policy 8.0 • Metro Code, 3.07, Title 3
2.10 Clean Air	Regional Transportation Plan Policy 9.0
2.11 Energy Efficiency	Regional Transportation Plan Policy 10.0
2.12 Regional Street Design	Regional Transportation Plan Policy 11.0
2.13 Local Street Design	Regional Transportation Plan Policy 12.0
2.14 Regional Motor Vehicle System	Regional Transportation Plan Policy 13.0
2.15 Regional Public Transportation System	Regional Transportation Plan Policy 14.05
2.16 Public Transportation Awareness and Education	Regional Transportation Plan Policy 14.2
2.17 Public Transportation Safety and Environmental Impacts	Regional Transportation Plan Policy 14.2
2.18 Regional Public Transportation Performance	Regional Transportation Plan Policy 14.3
2.19 Special Needs Public	Regional Transportation Plan Policies 14.4, 14.5 and 14.6

Regional Framework Policy	Implementation Recommendation(s) or Requirements
Transportation	
Transportation	
2.20 Regional Freight System	Regional Transportation Plan Policy 15.0
2.21 Regional Freight System Investments	Regional Transportation Plan Policy 15.1
2.22 Regional Bicycle System Connectivity	Regional Transportation Plan Policy 16.0
2.23 Regional Bicycle System Mode Share and Accessibility	Regional Transportation Plan Policy 16.1
2.24 Regional Pedestrian System	Regional Transportation Plan Policy 17.0
2.25 Regional Pedestrian Mode Share	Regional Transportation Plan Policy 17.1
2.26 Regional Pedestrian Mode Share	Regional Transportation Plan Policy 17.2
2.27 Transportation System Management	Regional Transportation Plan Policy 18.0
2.28 Regional Transportation Demand Management	Regional Transportation Plan Policy 19.0
2.29 Regional Parking Management	• Regional Transportation Plan Policy 19.1 • Metro Code, 3.07, Title 2 Regional Parking Policy
2.30 Peak Period Parking	Regional Transportation Plan Policy 19.2
2.31 Transportation Funding	Regional Transportation Plan Policy 20.0
2.32 2040 Growth Concept Implementation	Regional Transportation Plan Policy 20.1
2.33 Transportation System Maintenance and Preservation	Regional Transportation Plan Policy 20.2
2.34 Transportation Safety	Regional Transportation Plan Policy 20.3

Regional Framework Policy	Implementation Recommendation(s) or Requirements
~~Parks and Open Spaces~~Nature in Neighborhoods	
3.1 Inventory of Park Facilities and Identification and Inventory of Regionally Significant Parks, Natural Areas, Open Spaces, Fish and Wildlife Habitat, Trails and Greenways	• Parks Inventory completed, 1998, 2004 • Natural Areas Inventory conducted, 1997 • Metro Code 3.07, UGMFP, Title 13
3.2 Protection of Regionally Significant Parks, Natural Areas, Open Spaces, Fish and Wildlife Habitat, Trails and Greenways	• Resolution 02-3253, Regional Greenspaces System Concept Map • Metro Code 3.07, UGMFP, Title 13
3.3 Management of the Publicly Owned Portion of the Regional System of Parks, Natural Areas, Open Spaces, Fish and Wildlife Habitat, Trails and Greenways	• Metro Code 3.07, UGMFP, Title 13
3.4 Protection, Establishment and Management of a Regional Trails System	Resolution 02-3192, Regional Trails Plan
3.5 Provision of Community and Neighborhood Parks, Open Spaces, Natural Areas, Fish and Wildlife Habitat, Trails and Recreation Programs	• MPAC Report to Council, April 2001 • Metro Code 3.07, UGMFP, Title 13
3.6 Participation of Citizens in Environmental Education, Planning, Stewardship Activities and Recreational Services	Parks and Greenspaces Annual Volunteer Program Report to Council, 2001, 2002, 2003 and 2004

Regional Framework Policy	Implementation Recommendation(s) or Requirements
~~Water Management~~Watershed Health and Water Quality	
4.1 Water Supply	~~Metro Code, 3.07, Urban Growth Management Functional Plan, Title 3 Water Quality, Flood Management and Fish and Wildlife Conservation~~ • Regional Water Supply Plan: Chapter XII Recommended Final Plan Concept and Implementation Actions • Metro Code, 3.07, UGMFP, Titles 3 and 13
4.2 Overall Watershed Management	• Regional Water Supply Plan: Chapter XII Recommended Final Plan Concept and Implementation Actions • Metro Code, 3.07, UGMFP, Titles 3 and 13
4.3 Water Quality	• Regional Water Supply Plan: Chapter XII Table XII • Metro Code, 3.07, UGMFP, Titles 3 and 13~~Title 3 Water Quality, Flood Management and Fish and Wildlife Habitat~~
4.4 Stormwater Management	~~Metro Code 3.07, Urban Growth Management Functional Plan,~~ • ~~Title 3 Water Quality, Flood Management and Fish and Wildlife Conservation~~ Regional Water Supply Plan: Chapter XII • Metro Code, 3.07, UGMFP, Titles 3 and 13
4.5 Urban Planning and Natural Systems	• Regional Water Supply Plan: Chapter XII • Metro Code, 3.07, UGMFP, Titles 3 and 13
~~4.6 Fish and Wildlife Habitat Conservation~~	~~Metro Code 3.07, Urban Growth Management Functional Plan~~ ~~Title 3, Water Quality, Flood Management and Fish and Wildlife Conservation~~

Regional Framework Policy	Implementation Recommendation (s) or Requirements
Natural Hazards	
5.1 Earthquake Hazard Mitigation Measures	Resolution 03-3352 – Intergovernmental Agreement for Regional Emergency Management
5.2 Flood Hazard Mitigation Measures	• Resolution 03-3352 – Intergovernmental Agreement for Regional Emergency Management • Metro Code, 3.07, UGMFP, Title 3
5.3 Landslide Hazard Mitigation Measures	Resolution 03-3352 – Intergovernmental Agreement for Regional Emergency Management
5.4 Volcanic Hazard Mitigation Measures	Resolution 03-3352 – Intergovernmental Agreement for Regional Emergency Management
5.5 Wildland-Urban Interface Fire Mitigation Measures	Resolution 03-3352 – Intergovernmental Agreement for Regional Emergency Management
5.6 Severe Weather Hazard Mitigation Measures	Resolution 03-3352 – Intergovernmental Agreement for Regional Emergency Management
5.7 Biological Hazard Mitigation Measures	Resolution 03-3352 – Intergovernmental Agreement for Regional Emergency Management
5.8 Other Hazard Mitigation Measures	Resolution 03-3352 – Intergovernmental Agreement for Regional Emergency Management
5.9 Natural Disaster Response Coordination	Resolution 03-3352 – Intergovernmental Agreement for Regional Emergency Management

Regional Framework Policy	Implementation Recommendation(s) or Requirements
Clark County	
6.1 Coordination with Clark County	• Resolution No. 03-3388, Endorsing a Bi-State Coordination Committee to discuss and make recommendations about Land Use, Economic Development, Transportation and Environmental Justice Issues of Bi-state Significance; Bi-State Coordination Committee Charter and Bylaws • Resolution 03-3352 – Intergovernmental Agreement for Regional Emergency Management

Regional Framework Policy	**Implementation Recommendation(s) or Requirements**
Management	
7.1 Citizen Participation	• Metro Code section 2.12.010 • (Office of Citizen Involvement)
7.2 Metro Policy Advisory Committee and Joint Policy Advisory Committee on Transportation	Metro Charter Section 27, MPAC by-laws
7.3 Applicability of Regional Framework Plan Policies	Metro Charter, Chapter II, Section 5(2), ORS 268.380(1)
7.4 Urban Growth Boundary Management Plan	Metro Code 3.01.005 *et seq*., UGB and Urban Reserve Procedures
7.5 Functional Plans	• Metro Code 3.06.010 *et seq*. • Planning Procedure for Designating Functional Planning Areas and Activities • ORS 268.390
7.6 Periodic Review of Comprehensive Land Use Plans	Metro Code 3.01.005 *et seq*., UGB and Urban Reserve Procedures
7.7 Implementation Roles	• ORS 268.380 • Metro Charter, Chapter II
7.8 Performance Measures	Title 9 of the UGMFP, Metro Code 3.07.910 *et seq*.
7.9 Monitoring and Updating	
7.10 Environmental Education	

Regional Framework Policy	Implementation Recommendation(s) or Requirements
Implementation	
8.1 Implementation	• Metro Charter, Chapter II, Section 5(2)(e) • Metro Code 3.01,UGB and Urban Reserve Procedures and 3.07, UGMFP
8.2 Regional Funding and Fiscal Policy	
8.3 Schools	
8.4 Administration	Title 8 of the UGMFP, Metro Code 3.07.810 *et seq*.
8.5 Enforcement	Title 8 of the UGMFP, Metro Code 3.07.810 *et seq*.

M:\attorney\confidential\07 Land Use\04 2040 Growth Concept\03 UGMFP\02 Stream Protection (Title 3)\02 Goal 5\02 Program\03 Ord 05-1077B\Ord 05-1077B Ex B RFP amend REVISED 091905.doc

EXHIBIT C—ORDINANCE NO. 05-1077C

METRO CODE CHAPTER 3.07
URBAN GROWTH MANAGEMENT FUNCTIONAL PLAN

TITLE 13: NATURE IN NEIGHBORHOODS

<u>Section 1.</u> Intent

The purposes of this program are to (1) conserve, protect, and restore a continuous ecologically viable streamside corridor system, from the streams' headwaters to their confluence with other streams and rivers, and with their floodplains in a manner that is integrated with upland wildlife habitat and with the surrounding urban landscape; and (2) to control and prevent water pollution for the protection of the public health and safety, and to maintain and improve water quality throughout the region. This program:

A. Will achieve its purpose through conservation, protection, and appropriate restoration of riparian and upland fish and wildlife habitat through time, using a comprehensive approach that includes voluntary, incentive-based, educational, and regulatory elements;

B. Balances and integrates goals of protecting and enhancing fish and wildlife habitat, building livable Region 2040 communities, supporting a strong economy, controlling and preventing water pollution for the protection of the public health and safety, and complying with federal laws including the Clean Water Act and the Endangered Species Act;

C. Includes provisions to monitor and evaluate program performance over time to determine whether the program is achieving the program's objectives and targets, to determine whether cities and counties are in substantial compliance with this title, and to provide sufficient information to determine whether to amend or adjust the program in the future; and

D. Establishes minimum requirements and is not intended to repeal or replace existing requirements of city and county comprehensive plans and implementing ordinances to the extent those requirements already meet the minimum requirements of this title, nor is it intended to prohibit cities and counties from adopting and enforcing fish and wildlife habitat protection and restoration programs that exceed the requirements of this title.

<u>Section 2.</u> Inventory and Habitat Conservation Areas

The purpose of this section is to describe the geographic information system (GIS) data and maps that form the basis of Metro's fish and wildlife habitat protection and restoration program. This data and maps are referenced in various ways in this title, but may or may not be relevant within a city or county depending upon which implementation alternative the city or county chooses pursuant to subsection 3(B) of this title. The maps referred to in this title are representations of data contained within Metro's GIS system, operated by the Metro Data Resource Center, and references to such maps shall be interpreted as references to the maps themselves and to the underlying GIS data that the maps represent.

A. The Regionally Significant Fish and Wildlife Habitat Inventory Map (hereinafter the "Inventory Map"), attached hereto[1], identifies the areas that have been determined to contain regionally significant fish and wildlife habitat. The Inventory Map divides habitat into two general categories, riparian and upland wildlife, and further differentiates each habitat category into low, medium, and high value habitats.

B. The Habitat Conservation Areas Map, attached hereto[2], identifies the areas that are subject to the performance standards and best management practices described in Section 4 of this title, to the extent that a city or county chooses to comply with Section 3 of this title by using the Habitat Conservation Areas map, or a map that substantially complies with the Habitat Conservation Areas map. For such cities and counties, the Habitat Conservation Areas Map further identifies, subject to the map verification process described in subsections 3(G) and 4(D) of this title, which areas will be subject to high, moderate, and low levels of habitat conservation based on Metro Council's consideration of the results of the economic, social, environmental, and energy (ESEE) consequences of protecting or not protecting the habitat, public input, and technical review, and the Metro Council's subsequent decision to balance conflicting uses in habitat areas.

1. Table 3.07-13a describes how (1) Class I and II riparian habitat areas, and (2) Class A and B upland wildlife habitat areas within publicly-owned parks and open spaces, except for parks and open spaces where the acquiring agency clearly identified that it was acquiring the property to develop it for active recreational uses, located within the Metro boundary at the effective date of this title were designated as high, moderate, and low Habitat Conservation Areas.

2. Table 3.07-13b describes how Class I and II riparian habitat areas and Class A and B upland wildlife areas brought within the Metro UGB after the effective date of Ordinance No. 05-1077A will be designated as high, moderate, and low Habitat Conservation Areas. Section 6 of this title describes the procedures for how Table 3.07-13b and Section 4 of this title shall be applied in such areas.

C. Exempt International Marine Terminals

1. Marine dependent properties which would otherwise have been mapped as Habitat Conservation Areas do not appear on the Habitat Conservation Areas Map because the Metro Council concluded, based on its analysis of the economic, social, environmental, and energy implications of its decision, that the economic importance of such properties far outweighed the environmental importance of the properties as fish and wildlife habitat. The Metro Council applied the criteria described in subsection 2(C)(2) of this title to conclude that the following properties should not be considered Habitat Conservation Areas:

a. The International Terminal property, located at 12005 N. Burgard Way, Portland, Oregon, 97203;

b. Port of Portland Marine Terminal 4;

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[1] On file in the Metro Council office.
[2] On file in the Metro Council office.

c. Port of Portland Marine Terminal 5; and

d. Port of Portland Marine Terminal 6.

2. The Metro Council may, at its discretion, consider and adopt ordinances to exempt from the provisions of this title any additional properties along the Willamette and Columbia Rivers, or portions of such properties, where it can be demonstrated that:

a. The property is currently developed for use as an international marine terminal capable of mooring ocean-going tankers or cargo ships; and

b. The property is substantially without vegetative cover.

Section 3. Implementation Alternatives for Cities and Counties

A. Under Oregon law, upon acknowledgment of this program by the Oregon Land Conservation and Development Commission (LCDC), cities and counties wholly or partly within the Metro boundary shall apply the requirements of this title with respect to areas identified as riparian habitat on the Inventory Map and areas identified as upland wildlife habitat on the Inventory Map, according to the compliance deadlines established in Section 1 of Title 8 of this functional plan (Metro Code Section 3.07.810), rather than applying the requirements of division 23 of chapter 660 of the Oregon Administrative Rules ("OAR"), promulgated by LCDC, except that:

1. A city or county shall apply the requirements of division 23 of OAR chapter 660 in order to adopt comprehensive plan amendments or land use regulations that (i) would otherwise require compliance with division 23 of OAR chapter 660 but for the adoption of this title (i.e. amendments or regulations adopted to protect Goal 5 resources), and (ii) will limit development in areas not identified as riparian habitat on the Inventory Map, unless such provisions (a) are part of a program intended to comply with subsection 3(B)(3) of this title and apply only to areas identified as upland wildlife habitat on the Inventory Map (i.e., they do not apply to areas not identified as habitat); or (b) apply to areas identified as Class A or B upland wildlife habitat on the Inventory Map that are brought within the UGB after the effective date of Ordinance No. 05-1077B. Such a city or county shall seek acknowledgement of such provisions from LCDC or treat such provisions as post-acknowledgement plan amendments under ORS chapter 197;

2. A city or county that, prior to the effective date of this title, adopted any comprehensive plan amendments or land use regulations that (a) apply to areas identified as upland wildlife habitat on the Inventory Map but not identified as riparian habitat on the Inventory Map, (b) limit development in order to protect fish or wildlife habitat, and (c) were adopted in compliance with division 23 of OAR chapter 660, shall not repeal such amendments or regulations, nor shall it amend such provisions in a manner that would allow any more than a de minimis increase in the amount of development that could occur in areas identified as upland wildlife habitat; and

3. After a city or county has demonstrated that it is in substantial compliance with the requirements of this title, if the city or county wishes to adopt comprehensive plan amendments or land use regulations applicable to areas identified as riparian habitat on the Inventory Map that have the effect of imposing greater limits on development than those imposed by provisions that are in substantial compliance with the requirements of this title, such a city or county shall comply with the provisions of division 23 of OAR chapter 660, and shall seek acknowledgement of such provisions from LCDC or treat such provisions as post-acknowledgement plan amendments under ORS chapter 197.

B. Each city and county in the region shall either:

1. Amend its comprehensive plan and implementing ordinances to adopt the Title 13 Model Ordinance and the Metro Habitat Conservation Areas Map, and demonstrate compliance with the provisions of (a) subsection 4(A)(5) of this title, related to enhanced fish and wildlife protection and management of publicly-owned parks and open spaces that have been designated as natural areas and are not intended for future urban development, and (b) subsection 4(A)(8) of this title, related to the restoration of Habitat Conservation Areas when developed property is undergoing significant redevelopment; or

2. Demonstrate that its existing or amended comprehensive plan and existing, amended, or new implementing ordinances substantially comply with the performance standards and best management practices described in Section 4, and that maps that it has adopted and uses substantially comply with the Metro Habitat Conservation Areas Map; or

3. Demonstrate that it has implemented a program based on alternative approaches that will achieve protection and enhancement of Class I and II riparian habitat areas, and of Class A and B upland wildlife habitat areas in territory added to the Metro UGB after the effective date of Ordinance No. 05-1077, substantially comparable with the protection and restoration that would result from the application of a program that complied with subsections 3(B)(1) or 3(B)(2) of this title. A city or county developing such a program:

a. Shall demonstrate that its alternative program will provide a certainty of habitat protection and enhancement to achieve its intended results, such as by using proven programs and demonstrating stable and continuing funding sources sufficient to support elements of the program that require funding;

b. May assert substantial compliance with this provision by relying on either or both the city's or county's comprehensive plan and implementing ordinances and on the use of incentive based, voluntary, education, acquisition, and restoration programs, such as:

i. An existing tree protection ordinance;

ii. A voluntary program for tree protection, tree replacement, and habitat restoration;

iii. Habitat preservation incentive programs, such as programs that provide reduced development or storm water management fees and property taxes in return for taking measures to protect and restore habitat (including, for example, the Wildlife Habitat Special Tax Assessment Program, ORS 308A.400 through 308A.430, and the Riparian Habitat Tax Exemption Program, ORS 308A.350 through 308A.383);

iv. Habitat-friendly development standards to reduce the detrimental impact of storm water run-off on riparian habitat;

v. A local habitat acquisition program; and

vi. Maintaining and enhancing publicly-owned habitat areas, such as by:

(A) Using habitat-friendly best management practices, such as integrated pest management programs, in all regionally significant habitat areas within publicly-owned parks and open spaces;

(B) Ensuring that publicly-owned parks and open spaces that have been designated as natural areas and are not intended for future urban development are managed to maintain and enhance the quality of fish and wildlife habitat that they provide;

(C) Pursuing funding to support local park, open space, and habitat acquisition and restoration, such as with local bond measures, System Development Charge (SDC) programs, Federal Emergency Management Act (FEMA) grants, or other funding mechanisms; or

4. District Plans.

a. Adopt one or more district plans that apply over portions of the city or county, and demonstrate that, for the remainder of its jurisdiction, the city or county has a program that complies with either subsection 3(B)(1) or 3(B)(2) of this title. If a city or county adopts one or more district plans pursuant to this paragraph, it shall demonstrate that, within each district plan area, the district plan complies with subsection 3(B)(3) of this title. District plans shall be permitted under this subsection only for areas within a common watershed, or which are within areas in adjoining watersheds that share an interrelated economic infrastructure and development pattern. Cities and counties that choose to develop district plans are encouraged to coordinate such district plans with other entities whose activities impact the same watershed to which the district plan applies, including other cities and counties, special districts, state and federal agencies, watershed councils, and other governmental and non-governmental agencies.

b. The City of Portland shall develop a District Plan that complies with subsection 3(B)(4)(a), in cooperation with the Port of Portland, that applies to West Hayden Island; or

5. For a city or county that is a member of the Tualatin Basin Natural Resources Coordinating Committee (the "TBNRCC," which includes Washington County and the cities of Beaverton, Cornelius, Durham, Forest Grove, Hillsboro, King City, Sherwood, Tigard, and Tualatin), amend its comprehensive plan and implementing ordinances to comply with the maps and provisions of the TBNRCC Goal 5 Program, attached hereto[3] and incorporated herein by reference, adopted by the TBNRCC on April 4, 2005 (the "Tualatin Basin Program"), subject to the intergovernmental agreement entered into between Metro and the TBNRCC. All other provisions of this Section 3 of this title, as well as Section 6 of this title, shall still apply to each city and county that is a member of the TBNRCC. In addition, in order for a city or county that is a member of the TBNRCC to be in compliance with this functional plan, the following conditions must be satisfied:

a. Within the compliance timeline described in Paragraph 6 of the IGA, the TBNRCC and its members comply with the six steps identified in section B of Chapter 7 of the Tualatin Basin Program;

b. Clean Water Services approves and begins implementing its Healthy Streams Plan;

c. The TBNRCC members agree to renew and extend their partnership to implement the projects on the Healthy Streams Project List and target projects that protect and restore Class I and II Riparian Habitat, including habitat that extends beyond the Clean Water Services "vegetated corridors," and the TBNRCC shall continue to coordinate its activities with Metro and cooperate with Metro on the development of regional public information about the Nature in Neighborhoods Initiative;

d. The city or county has adopted provisions to facilitate and encourage the use of habitat-friendly development practices, where technically feasible and appropriate, in all areas identified as Class I and II riparian habitat areas on the Metro Regionally Significant Fish and Wildlife Habitat Inventory Map. Table 3.07-13c provides examples of the types of habitat-friendly development practices that shall be encouraged and considered;

e. The city or county has adopted provisions to allow for the reduction of the density and capacity requirements of Title 1 of the Urban Growth Management Functional Plan, Metro Code sections 3.07.110 to 170,

[3] On file in the Metro Council office.

consistent with Section 3(H) of this title. Particularly, the provisions shall (1) apply only to properties that were within the Metro urban growth boundary on January 1, 2002; (2) require the protection of regionally significant habitat on the property, such as via a public dedication or restrictive covenant; and (3) allow only for a reduction in the minimum number of units required to be built based on the amount of area protected as provided in part (2) of this paragraph. In addition, cities and counties will be required to report to Metro as provided in Section 3(H)(3) of this title;

f. The city or county complies with the provisions of subsections 3(B)(1) to 3(B)(3) of this title as those provisions apply to upland wildlife habitat in territory added to the Metro urban growth boundary after the effective date of this title. For example, (1) each city and county shall either adopt and apply Metro's Title 13 Model Ordinance to upland wildlife habitat in new urban areas, (2) substantially comply with the requirements of Section 4 of this title as it applies to upland wildlife habitat in new urban areas, or (3) demonstrate that it has implemented an alternative program that will achieve protection and enhancement of upland wildlife habitat in new urban areas comparable with the protection and restoration that would result from one of the two previous approaches described in this sentence; and

g. The TBNRCC and the city or county complies with the monitoring and reporting requirements of Section 5 of this title.

C. The comprehensive plan and implementing ordinances relied upon by a city or county to comply with this title shall contain clear and objective standards. A standard shall be considered clear and objective if it meets any one of the following criteria:

1. It is a fixed numerical standard, such as fixed distance (e.g. "50 feet") or land area (e.g. "1 acre");

2. It is a nondiscretionary requirement, such as a requirement that grading not occur beneath the dripline of a protected tree; or

3. It is a performance standard that describes the outcome to be achieved, specifies the objective criteria to be used in evaluating outcome or performance, and provides a process for application of the performance standard, such as a conditional use or design review process.

D. In addition to complying with subsection 3(C) of this section, the comprehensive plan and implementing ordinances that a city or county relies upon to satisfy the requirements of this title may include an alternative, discretionary approval process that is not clear and objective provided that the comprehensive plan and implementing ordinance provisions of such a process:

1. Specify that property owners have the choice of proceeding under either the clear and objective approval process, which each city or county must have pursuant to subsection 3(D) of this section, or under the alternative, discretionary approval process; and

2. Require a level of protection for, or enhancement of, the fish and wildlife habitat that meets or exceeds the level of protection or enhancement that would be achieved by following the clear and objective standards described in Section 3(D) of this title.

E. Use of Habitat-Friendly Development Practices In Regionally Significant Fish And Wildlife Habitat.

1. Each city and county in the region shall:

a. Identify provisions in the city's or county's comprehensive plan and implementing ordinances that prohibit or limit the use of the habitat-friendly development practices such as those described in Table 3.07-13c; and

b. Adopt amendments to the city's or county's comprehensive plan and implementing ordinances to remove the barriers identified pursuant to subsection 3(E)(1)(a) of this title, and shall remove such barriers so that such practices may be used, where practicable, in all regionally significant fish and wildlife habitat; provided, however that such practices shall not be permitted if their use is prohibited by an applicable and required State or Federal permit issued to a unit of local government having jurisdiction in the area, such as a permit required under the Clean Water Act, 33 U.S.C. §§1251 et seq., or the Safe Drinking Water Act, 42 U.S.C. §§300f et seq., and including conditions or plans required by such permit.

2. Metro shall provide technical assistance to cities and counties to comply with the provisions of this Section 3(E) of this title.

F. Cities and counties shall hold at least one public hearing prior to adopting comprehensive plan amendments, implementing ordinances, and maps implementing this title or demonstrating that existing city or county comprehensive plans, implementing ordinances, and maps substantially comply with this title. The proposed comprehensive plan amendments, implementing ordinances, and maps shall be available for public review at least 45 days prior to the public hearing.

G. The comprehensive plan provisions and implementing ordinances that each city or county amends, adopts, or relies on to comply with this title shall provide property owners with a reasonable, timely, and equitable process to verify the specific location of habitat areas subject to the provisions of the city's or county's comprehensive plan or implementing ordinances. It is the intent of this requirement that, in the majority of cases, the process be as simple and straightforward as possible and not result in a change that would require an amendment to the city's or county's comprehensive plan. Such process shall:

1. Allow a property owner, or another person with the property owner's consent, to confirm the location of habitat on a lot or parcel at any time, whether or not the property owner has submitted a specific request for a development permit, provided, however, that a city or county may impose a fee to cover the actual staff, equipment and other administrative costs of providing such a service;

2. As often as reasonably possible, provide a simple, default approach that allows a property owner to verify the location of habitat on a lot or parcel without having to hire an environmental consultant and without having to pay a significant processing or application fee;

3. Allow a property owner to present detailed documentation to verify the location of habitat on a lot or parcel, such as information collected and analyzed by an environmental consultant; and

4. Ensure that the process provides adequate opportunities for appeals and a fair and equitable dispute resolution process, consistent with state law.

H. Reducing Regional Density and Capacity Requirements to Allow Habitat Protection.

1. Notwithstanding the provisions of Metro Code section 3.07.140(A)(2), cities and counties may approve a subdivision or development application that will result in a density below the minimum density for the zoning district if:

a. The property lot or parcel was within the Metro UGB on January 1, 2002;

b. An area of the property lot or parcel to be developed has been identified as regionally significant fish and wildlife habitat on the Metro Inventory Map or as a significant resource on a local Goal 5 riparian, wetlands, or wildlife resource inventory map that had been acknowledged by the LCDC prior to the effective date of Metro Ordinance No. 05-1077; and

c. Such a decision will directly result in the protection of the remaining undeveloped regionally significant fish and wildlife habitat or significant resource located on the property lot or parcel, such as via a public dedication or a restrictive covenant.

2. The amount of reduction in the minimum density requirement that may be approved under this subsection 3(H) of this title shall be calculated by subtracting the number of square feet of regionally significant fish and wildlife habitat or significant resource that is permanently protected under subsection 3(H)(1)(c) of this title from the total number of square feet that the city or county otherwise would use to calculate the minimum density requirement for the property.

3. If a city or county approves a subdivision or development application that will result in a density below the minimum density for the zoning district pursuant to subsection 3(H)(1) of this title, then such city or county shall:

a. Be permitted an offset against the capacity specified for that city or county in Table 3.07-1 of the Metro Code. The amount of such offset shall be calculated by subtracting the difference between the number of dwelling units that the city or county approved to be built pursuant to subsection 3(H)(1) of this title and the minimum number of dwelling units that would have otherwise been required to be built on the property pursuant to the applicable minimum density requirements for the zoning district where the property is located; and

b. Report to Metro by April 15 of every year the number of approvals made pursuant to this subsection 3(H) of this title, including documentation that the factors in subsection 3(H)(1) had been satisfied for each such approval, and the capacity offsets that the city or county shall be afforded as a result of such approvals.

Section 4. Performance Standards and Best Management Practices for Habitat Conservation Areas

The following performance standards and best management practices apply to all cities and counties that choose to adopt or rely upon their comprehensive plans and implementing ordinances to comply, in whole or in part, with subsection 3(B)(2) of this title:

A. City and county comprehensive plans and implementing ordinances shall conform to the following performance standards and best management practices:

1. Habitat Conservation Areas shall be protected, maintained, enhanced, and restored as specified in this Section 4 of this title, and city and county development codes shall include provisions for enforcement of these performance standards and best management practices.

2. In addition to requirements imposed by this title, the requirements of Title 3 of the Urban Growth Management Functional Plan, Metro Code sections 3.07.310 to 3.07.360, as amended by Exhibit D to Ordinance No. 05-1077, shall continue to apply.

3. The performance standards and best management practices of this Section 4 of this title shall not apply:

a. When the application of such standards and practices would restrict or regulate farm structures or farming practices in violation of ORS 215.253 or ORS 561.191; or

b. In areas outside of the Metro UGB but within the Metro boundary at the effective date of this title:

i. When such standards and practices violate ORS 527.722 by prohibiting, limiting, regulating, subjecting to approval, or in any other way affecting forest practices on forestlands located outside of an acknowledged urban growth boundary, except as provided in ORS 527.722(2), (3) and (4); or

ii. Pursuant to ORS 196.107, in areas within Multnomah County and the Columbia River Gorge National Scenic Area, provided that Multnomah County has adopted and implements ordinances that are approved pursuant to sections 7(b) and 8(h) through 8(k) of the Columbia River Gorge National Scenic Area Act, 16 U.S.C. §§ 544e(b) and 544f(h) through 544f(k).

4. The performance standards and best management practices of this Section 4 of this title shall not apply to any use of residential properties if, as of the local program effective date:

   a. Construction of the residence was completed in compliance with all applicable local and state laws and rules for occupancy as a residence or the residence had been occupied as a residence for the preceding ten years; and

   b. Such uses would not have required the property owner to obtain a land use approval or a building, grading, or tree removal permit from their city or county.

5. Habitat Conservation Areas within publicly-owned parks and open spaces that have been designated as natural areas and are not intended for future urban development shall be protected and managed so that the quality of fish and wildlife habitat that they provide is maintained and enhanced, and that habitat-friendly best management practices, such as integrated pest management programs, are used in such areas.

6. Invasive non-native or noxious vegetation shall not be planted in any Habitat Conservation Area. The removal of invasive non-native or noxious vegetation from Habitat Conservation Areas shall be allowed. The planting of native vegetation shall be encouraged in Habitat Conservation Areas.

7. Except as provided in subsection 4(A)(8) of this title, routine repair, maintenance, alteration, rehabilitation, or replacement of existing structures, roadways, driveways, utilities, accessory uses, or other development within Habitat Conservation Areas may be allowed provided that:

   a. The project is consistent with all other applicable local, state, and federal laws and regulations;

   b. The project will not permanently or irreparably result in more developed area within a Habitat Conservation Area than the area of the existing development; and

   c. Native vegetation is maintained, enhanced and restored, if disturbed; other vegetation is replaced, if disturbed, with vegetation other than invasive non-native or noxious vegetation; and the planting of native vegetation and removal of invasive non- native or noxious vegetation is encouraged.

8. Notwithstanding subsection 4(A)(7) of this title, when a city or county exercises its discretion to approve zoning changes to allow a developed property that contains a Habitat Conservation Area to (1) change from an industrial or heavy commercial zoning designation to a residential or mixed-use/residential designation, or (2) increase the type or density and intensity of development in

any area, then the city or county shall apply the provisions of this Section 4 of this title, or provisions that will achieve substantially comparable habitat protection and restoration as do the provisions of this Section 4 of this title. This provision will help to insure that, when developed areas are redeveloped in new ways to further local and regional urban and economic development goals, property owners should restore regionally significant fish and wildlife habitat as part of such redevelopment.

9. Any activity within Habitat Conservation Areas that is required to implement a Federal Aviation Administration (FAA) - compliant Wildlife Hazard Management Plan (WHMP) on property owned by the Port of Portland within 10,000 feet of an Aircraft Operating Area, as defined by the FAA, shall be allowed provided that mitigation for any such projects is completed in compliance with mitigation requirements adopted pursuant to subsections 4(B)(1), 4(B)(2)(c), and 4(B)(3) of this title. In addition, habitat mitigation for any development within Habitat Conservation Areas on property owned by the Port of Portland within 10,000 feet of an Aircraft Operating Area, as defined by the FAA, shall be permitted at any property located within the same 6th Field Hydrologic Unit Code subwatershed as delineated by the Unites States Department of Agriculture's Natural Resources Conservation Service (NRCS) without having to demonstrate that on-site mitigation is not practicable, feasible, or appropriate.

10. Within Habitat Conservation Areas located in Multnomah County Drainage District No. 1, Peninsula Drainage District No. 1, Peninsula Drainage District No. 2, and the area managed by the Sandy Drainage Improvement Company, routine operations, repair, maintenance, reconfiguration, rehabilitation, or replacement of existing drainage and flood control facilities, and existing related facilities, including any structures, pump stations, water control structures, culverts, irrigation systems, roadways, utilities, accessory uses (such as off-load facilities that facilitate water-based maintenance), erosion control projects, levees, soil and bank stabilization projects, dredging and ditch clearing within the hydraulic cross-section in existing storm water conveyance drainageways, or other water quality and flood storage projects applicable to existing facilities and required to be undertaken pursuant to ORS chapters 547 or 554 or Titles 33 or 44 of the Code of Federal Regulations, shall be allowed provided that:

    a. The project is consistent with all other applicable local, state, and federal laws and regulations;

    b. The project does not encroach closer to a surface stream or river, wetland, or other body of open water than existing operations and development;

    c. Disturbed areas are replanted with vegetation and no bare soils remain after project completion; the planting of native vegetation and removal of invasive non- native or noxious vegetation is encouraged; and invasive non-native or noxious vegetation shall not be planted; and

    d. Each district submits an annual report, to all local permitting agencies in which the district operates, describing the projects the district completed in the previous year and how those projects complied with all applicable federal and state laws and requirements.

B. City and county comprehensive plans and implementing ordinances shall contain review standards applicable to development in all Habitat Conservation Areas that include:

1. Clear and objective development approval standards consistent with subsection 3(C) of this title that protect Habitat Conservation Areas but which allow limited development within High Habitat Conservation Areas, slightly more development in Moderate Habitat Conservation Areas, and even more development in Low Habitat Conservation Areas. Such standards shall allow (a) property owners to consider reduced building footprints and the use of minimal excavation foundation systems (e.g., pier, post or piling foundation), and (b) the flexible application of local code requirements that may limit a property owner's ability to avoid development in Habitat Conservation Areas, such as setback and landscaping requirements or limits on clustering and the transfer of development rights on-site. The habitat-friendly development practices described in Table 3.07-13c, which are intended to minimize the magnitude of the impact of development in Habitat Conservation Areas, shall be allowed, encouraged, or required to the extent that cities and counties can develop clear and objective standards for their use, unless their use is prohibited by an applicable and required State or Federal permit issued to a unit of local government having jurisdiction in the area, such as a permit required under the Clean Water Act, 33 U.S.C. §§1251 et seq., or the Safe Drinking Water Act, 42 U.S.C. §§300f et seq., and including conditions or plans required by such permit. The clear and objective development standards required by this paragraph also shall require that all development in Habitat Conservation Areas be mitigated to restore the ecological functions that are lost or damaged as a result of the development. Standards that meet the requirements of this subsection and subsection 3(C) of this title are provided in Section 7 of the Metro Title 13 Model Ordinance[4]; and

2. Discretionary development approval standards consistent with subsection 3(D) of this title that comply with subsections (a), (b), and (c) of this subsection. Standards that meet the requirements of this subsection and subsection 3(D) of this title are provided in Section 8 of the Metro Title 13 Model Ordinance.

   a. Avoid Habitat Conservation Areas.

      i. Development may occur within a Habitat Conservation Area only if a property owner demonstrates that no practicable alternatives to the requested development exist which will not disturb the Habitat Conservation Area;

      ii. When implementing this requirement to determine whether a practicable alternative exists, cities and counties shall include consideration of the type of Habitat Conservation Area that will be affected by the proposed development. For example, High Habitat Conservation Areas have been so designated because

[4] On file in the Metro Council office.

they are areas that have been identified as having lower urban development value and higher-valued habitat, while Low Habitat Conservation Areas have been so designated because they are areas that have been identified as having higher urban development value and lower-valued habitat; and

iii. Cities and counties shall allow flexibility in the application of local code requirements that may limit a property owner's ability to avoid development in Habitat Conservation Areas, such as setback and landscaping requirements or limits on clustering and the transfer of development rights on-site. Property owners shall also consider reduced building footprints and use of minimal excavation foundation systems (e.g., pier, post or piling foundation). The use of the techniques described in this paragraph shall be part of the alternatives analysis to determine whether any alternative to development within the Habitat Conservation Area is practicable; and

b. Minimize Impacts on Habitat Conservation Areas and Water Quality.

i. If there is no practicable alternative, limit the development to minimize, to the extent practicable, the detrimental impacts on Habitat Conservation Areas associated with the proposed development;

ii. When implementing this requirement to determine whether development has been minimized to the extent practicable, cities and counties shall include consideration of the type of Habitat Conservation Area that will be affected by the proposed development. For example, High Habitat Conservation Areas have been so designated because they are areas that have been identified as having lower urban development value and higher-valued habitat, while Low Habitat Conservation Areas have been so designated because they are areas that have been identified as having higher urban development value and lower-valued habitat; and

iii. The techniques described in subsection 4(B)(2)(a)(iii) shall be used to demonstrate that development within a Habitat Conservation Area has been minimized. In addition, the magnitude of the impact of development within Habitat Conservation Areas also shall be minimized, such as by use of the habitat-friendly development practices described in Table 3.07-13c, unless the use of such practices is prohibited by an applicable and required State or Federal permit issued to a unit of local government having jurisdiction in the area, such as a permit required under the Clean Water Act, 33 U.S.C. §§1251 et seq., or the Safe Drinking Water Act, 42 U.S.C. §§300f et seq., and including conditions or plans required by such permit; and

c. Mitigate Impacts on Habitat Conservation Areas and Water Quality.

When development occurs, require mitigation to restore the ecological functions that were lost or damaged as a result of the development, after taking into consideration the property owner's efforts to minimize the magnitude of the detrimental impacts through the use of the techniques described in Table 3.07-13c and through any additional or innovative techniques.

3. When development occurs within delineated wetlands, then the mitigation required under subsections 4(B)(1) and (2) of this title shall not require any additional mitigation than the mitigation required by state and federal law for the fill or removal of such wetlands.

C. City and county comprehensive plans and implementing ordinances shall include procedures to consider claims of hardship and to grant hardship variances for any property demonstrated to be converted to an unbuildable lot by application of any provisions implemented to comply with the requirements of this title.

D. Administering the Habitat Conservation Areas Map and Site-Level Verification of Habitat Location.

1. Each city and county shall be responsible for administering the Habitat Conservation Areas Map, or the city's or county's map that has been deemed by Metro to be in substantial compliance with the Habitat Conservation Areas Map, within its jurisdiction, as provided in this subsection 4(D) of this title.

2. The comprehensive plan and implementing ordinances amended, adopted or relied upon to comply with this subsection 4(D) of this title shall comply with subsection 3(G) of this title.

3. Verification of the Location of Habitat Conservation Areas. Each city and county shall establish a verification process consistent with subsections 4(D)(4) through 4(D)(6) of this title. The site-level verification of Habitat Conservation Areas is a three-step process. The first step is determining the boundaries of the habitat areas on the property, as provided in subsection 4(D)(4) of this title. The second step is determining the urban development value of the property, as provided in subsection 4(D)(5) of this title. The third step is cross-referencing the habitat classes with the urban development value of the property to determine whether the property contains High, Moderate, or Low Habitat Conservation Areas, or none at all, as provided in subsection 4(D)(6) of this title.

4. Habitat Boundaries.

a. Locating riparian habitat and determining its habitat class is a five-step process.

i. Step 1. Locate the water feature that is the basis for identifying riparian habitat:

(A) Locate the top of bank of all streams, rivers, and open water within 200 feet of the property;

(B) Locate all flood areas within 100 feet of the property (areas that were mapped as flood areas but were filled to a level above the base flood level prior to the local program effective date, consistent with all applicable local, state, and federal laws and regulations shall no longer be considered habitat based on their status as flood areas); and

(C) Locate all wetlands within 150 feet of the property based on the Local Wetland Inventory map (if completed) and on the Metro 2004 Wetland Inventory Map (available from the Metro Data Resource Center, 600 N.E. Grand Ave., Portland, OR 97232; 503-797-1742). Identified wetlands shall be further delineated consistent with methods currently accepted by the Oregon Division of State Lands and the U.S. Army Corps of Engineers.

ii. Step 2. Identify the vegetative cover status of all areas on the property that are within 200 feet of the top of bank of streams, rivers, and open water, are wetlands or are within 150 feet of wetlands, and are flood areas and within 100 feet of flood areas:

(A) Vegetative cover status shall be as identified on the Metro Vegetative Cover Map, attached hereto[5] and incorporated herein by reference. The vegetative cover type assigned to any particular area was based on two factors: the type of vegetation observed in aerial photographs and the size of the overall contiguous area of vegetative cover to which a particular piece of vegetation belonged. As an example of how the categories were assigned, in order to qualify as "forest canopy" the forested area had to be part of a larger patch of forest of at least one acre in size; and

(B) In terms of mapping the location of habitat, the only allowed corrections to the vegetative cover status of a property are those based on an area being developed prior to the local program effective date and those based on errors made at the time the vegetative cover status was determined based on analysis of the aerial photographs used to create the Metro Vegetative Cover Map (for the original map, the aerial photos used were Metro's summer 2002 photos) and application of the vegetative cover definitions provided in the footnotes to Table 3.07-13d.

iii. Step 3. Determine whether the degree that the land slopes upward from all streams, rivers, and open water within 200 feet

[5] On file in the Metro Council office.

of the property is greater than or less than 25% (using the methodology described in the Appendix to Exhibit A to Ordinance No. 00-839 re-adopting Title 3 of the Urban Growth Management Functional Plan).

iv. Step 4. Identify the habitat class (Class I, Class II, or none) of the areas within up to 200 feet of the identified water feature, consistent with Table 3.07-13d. Note that areas that have been identified as habitats of concern, as depicted on the Metro Habitats of Concern Map, attached hereto[6] and incorporated herein by reference, are all classified as Class I riparian habitat.

v. Step 5. Confirm that the development and vegetative cover status of areas within up to 200 feet of the identified water feature has not been altered without the required approval of the city or county since the local program effective date and, if it has, then verify the original habitat location using the best available evidence of its location on local program effective date.

b. For territory brought within the Metro UGB after the effective date of Metro Ordinance No. 05-1077, the location of upland wildlife habitat and its habitat class shall be as identified in Metro's habitat inventory of such territory performed pursuant to Section 6 of this title. The only factors that may be reviewed to verify the location of upland wildlife habitat shall be:

i. For territory that was within the Metro boundary on the effective date of Metro Ordinance No. 05-1077, whether regionally significant fish and wildlife habitat was removed, consistent with all other applicable local, state, and federal laws and regulations, prior to the date that the property was brought within the Metro UGB and, if so, then areas where habitat was removed shall not be identified as Habitat Conservation Areas;

ii. Whether errors were made at the time the vegetative cover status was determined based on (1) analysis of the aerial photographs used to determine the vegetative cover status, and (2) application of the vegetative cover definitions provided in the footnotes to Table 3.07-13d; and

iii. Whether there are discrepancies between the locations of property lot lines and the location of Habitat Conservation Areas, as shown on the Habitat Conservation Areas Map.

5. Urban Development Value of the Property. The urban development value of property designated as regionally significant habitat is depicted on the Metro Habitat Urban Development Value Map, attached hereto[7] and incorporated herein by reference. The Metro Habitat Urban Development Value Map is based

[6] On file in the Metro Council office.
[7] On file in the Metro Council office.

on an assessment of three variables, the land value of property, the employment value of property, and the Metro 2040 Design Type designation of property. Cities and counties shall make an upward adjustment of a property's urban development value designation (i.e. from low to medium or high, or from medium to high) if:

a. The Metro 2040 Design Type designation has changed from a category designated as a lower urban development value category to one designated as a higher urban development value category. Properties in areas designated as the Central City, Regional Centers, Town Centers, and Regionally Significant Industrial Areas are considered to be of high urban development value; properties in areas designated as Main Streets, Station Communities, Other Industrial Areas, and Employment Centers are of medium urban development value; and properties in areas designated as Inner and Outer Neighborhoods and Corridors are of low urban development value; or

b. The property, or adjacent lots or parcels, is owned by a regionally significant educational or medical facility and, for that reason, should be designated as of high urban development value because of the economic contributions the facility provides to the citizens of the region.

i. The following facilities are regionally significant educational or medical facilities, as further identified on the Regionally Significant Educational or Medical Facilities Map, attached hereto[8]:

(A) Clackamas Community College, 19600 S. Molalla Ave., Oregon City;

(B) Lewis & Clark College, 0615 S.W. Palatine Hill Rd, Portland;

(C) Marylhurst University, 17600 Hwy 43, in Lake Oswego;

(D) Mt. Hood Community College, 26000 S.E. Stark St., Gresham;

(E) Oregon Health Sciences University, 3181 SW Sam Jackson Park Rd., Portland;

(F) Oregon Health Sciences University, Portland South Waterfront, Portland;

(G) Oregon Health Sciences University/Oregon Graduate Institute, 20000 N.W. Walker, Hillsboro;

(H) Pacific University, 2043 College Way, Forest Grove;

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[8] On file in the Metro Council office.

(I) Portland Community College, Rock Creek Campus, 17865 N.W. Springdale Rd., Portland;

(J) Portland Community College, Sylvania Campus, 12000 S.W. 49th Ave, Portland;

(K) Providence St. Vincent Medical Center, 9115 SW Barnes Rd., Portland;

(L) Reed College, 3203 S.E. Woodstock Blvd., Portland; and

(M) University of Portland, 5000 N. Willamette Blvd., Portland

(N) Veterans Hospital, 3710 SW U.S. Veterans Hospital Rd., Portland.

ii. The Metro Council may add a property to the list of facilities identified in subsection 4(D)(5)(b)(i) in the future by adopting an ordinance amending that section if the Council finds that the use of the property:

(A) Supports the 2040 Growth Concept by providing a mixed-use environment that may include employment, housing, retail, cultural and recreational activities, and a mix of transportation options such as bus, bicycling, walking, and auto;

(B) Provides, as a primary objective, a service that satisfies a public need rather than just the consumer economy (i.e., producing, distributing, selling or servicing goods);

(C) Draws service recipients (e.g., students, patients) from all reaches of the region and beyond;

(D) Relies on capital infrastructure that is so large or specialized as to render its relocation infeasible; and

(E) Has a long-term campus master plan that has been approved by the city or county in which it is located.

6. Cross-Referencing Habitat Class With Urban Development Value. City and county verification of the locations of High, Moderate, and Low Habitat Conservation Areas shall be consistent with Tables 3.07-13a and 3.07-13b.

<u>Section 5.</u> Claims Pursuant to Oregon Laws 2005, Chapter 1

A. The purpose of this section is to provide for Metro to accept potential liability for claims filed against cities and counties pursuant to Oregon Laws 2005, Chapter 1, adopted by the voters in November 2004 by the approval of Ballot Measure 37, as a result of the cities' and counties' good faith implementation of this title. As a corollary of accepting financial and administrative responsibility for these claims, Metro seeks the authority and cooperation of cities and counties in the evaluation and settlement of claims.

B. Provided that cities and counties meet the requirements set out below, Metro shall indemnify a city or county for any claim made against a city or county based on its implementation of the requirements of this title. In order to receive the benefits of this provision, a city or county must:

1. Upon receipt of a written demand for compensation pursuant to Oregon Laws 2005, Chapter 1, from an owner of private real property located within its jurisdiction alleging that a comprehensive plan amendment or land use regulation adopted or relied upon to comply with the requirements of this title reduces the fair market value of the property, a city or county shall forward a copy of the demand to Metro no later than seven (7) days following receipt of the demand;

2. Reasonably cooperate with Metro throughout Metro's consideration and disposition of the claim, including promptly providing Metro with any information related to the property in question, to an assessment of its fair market value, or to the city's or county's adoption of the comprehensive plan amendment or land use regulation that is the basis of the Measure 37 demand; and

3. Substantially concur with Metro's recommendation regarding disposition of the claim, which disposition may include, but not be limited to, a cash payment or other compensation, a decision to modify, remove, or not apply the regulation, dismissal of the claim, and the imposition of appropriate conditions. Metro shall forward to the city or county Metro's recommended disposition of the claim within 120 days of Metro's receipt of notice of the claim from the city or county; provided, however, that if Metro does not provide such recommendation within the 120 day deadline then the city or county may dispose of the claim as it determines appropriate and Metro will neither indemnify the city or county for the claim nor use the city's or county's decision on the claim as a basis for finding that the city or county is not in compliance with this title. A city or county may also satisfy this requirement by entering into an intergovernmental agreement with Metro in order to grant Metro sufficient authority to implement, on the city or county's behalf, Metro's recommendation regarding the disposition of the claim.

Section 6. Program Objectives, Monitoring and Reporting

This section describes the program performance objectives, the roles and responsibilities of Metro, cities, counties, and special districts in regional data coordination and inventory maintenance, monitoring and reporting, and program evaluation.

A. The following program objectives are established:

1. Performance objectives:

a. Preserve and improve streamside, wetland, and floodplain habitat and connectivity;

b. Preserve large areas of contiguous habitat and avoid habitat fragmentation;

c. Preserve and improve connectivity for wildlife between riparian corridors and upland wildlife habitat; and

d. Preserve and improve special habitats of concern such as native oak habitats, native grasslands, wetlands, bottomland hardwood forests, and riverine islands.

2. Implementation objectives:

a. Increase the use of habitat-friendly development throughout the region; and

b. Increase restoration and mitigation actions to compensate for adverse effects of new and existing development on ecological function.

B. Program Monitoring and Evaluation.

1. Metro will monitor the region's progress toward meeting the vision of conserving, protecting, and restoring the region's fish and wildlife habitat and the intent of this title by:

a. Developing and monitoring regional indicators and targets as set forth in Table 3.07-13e to evaluate progress in achieving the four performance objectives described in subsection 5(A)(1) of this title;

b. Developing and monitoring regional indicators as set forth in Table 3.07-13e to evaluate progress in achieving the two implementation objectives described in subsection 5(A)(2) of this title;

c. Collaborating with local, state, and federal agencies and non-governmental organizations in carrying out field studies and data sharing to increase understanding of the health of the region's watersheds and to identify restoration opportunities and priorities; and

d. Preparing and presenting monitoring and program evaluation reports to Metro Council no later than December 31, 2006, and by December 31 of each even-numbered year thereafter.

2. Metro will practice adaptive management by using the results of monitoring studies and the availability of new information to assess whether the goals, objectives, and targets of this title are being achieved.

C. Reporting Requirements for Cities and Counties.

1. Cities and counties shall report to Metro no later than December 31, 2007, and by December 31 of each odd-numbered year thereafter on their progress in using voluntary and incentive-based education, acquisition, and restoration habitat protection efforts; and

2. At least 45 days prior to a city's or county's final public hearing on a proposed new or amended ordinance or regulation relating to protection of, or mitigation of damage to, habitat, trees or other vegetation, cities and counties shall mail written notice of the proposed ordinance or regulation to Metro. Cities and counties that require applications for land use approvals or a building, grading, or tree removal permits to include documentation that the development meets habitat, tree, or vegetation protection and mitigation requirements adopted by a special district, including any county service district established pursuant to ORS chapter 451, shall mail written notice to Metro of any proposed new or amended ordinance or regulation relating to protection of, or mitigation of damage to, trees or other vegetation that is proposed by such a special district at least 45 days prior to the special district's final public hearing on the proposed new or amended ordinance or regulation.

D. Regional data coordination and maintenance.

1. Metro will act as the regional coordinator for Geographic Information System (GIS) data used to create and maintain the Regionally Significant Fish and Wildlife Habitat Inventory Map and other data relevant to program implementation, monitoring, and evaluation. To carry out this role cities and counties shall provide Metro with local data in a timely fashion and in a form compatible with Metro's GIS program. To the extent that such data is collected by county service districts established pursuant to ORS chapter 451, then the county in which the county service district operates shall comply with this section. Such data shall include:

a. Adopted and revised Local Wetland Inventories approved by the Division of State Lands and those determined to be locally significant under ORS 197.279(3)(b);

b. Wetland mitigation sites approved by the Division of State Lands or U.S. Army Corps of Engineers;

c. For cities and counties that have not carried out Local Wetland Inventories, wetland boundaries delineated using accepted protocols by Division of State Lands or U.S. Army Corps of Engineers;

d. Revised or updated local surface stream inventories;

e. Revised or updated 100-year Federal Emergency Management Act (FEMA) flood area maps or revisions to the 1996 area of inundation maps to incorporate FEMA-approved floodplain map revisions or floodplain fills approved by the U.S. Army Corps of Engineers;

f. Completed restoration and enhancement projects; and

g. Revised or updated Metro's Habitats of Concern data layer.

2. Metro will periodically update its Regionally Significant Fish and Wildlife Habitat Inventory for use in program monitoring and evaluation. Metro will maintain a study area boundary one mile beyond the perimeter of the Metro boundary and Metro Urban Growth Boundary.

Section 7. Future Metro Urban Growth Boundary Expansion Areas

The Metro Inventory Map identifies regionally significant fish and wildlife habitat within the entire Metro boundary, including areas outside of the Metro UGB at the time this title was adopted. As described in section 2 of this title, the Metro Council has designated as Habitat Conservation Areas the regionally significant fish and wildlife habitat that has been identified as riparian Class I and II habitat within the Metro boundary. In addition, the Metro Council has also determined that the regionally significant fish and wildlife habitat identified as upland wildlife Class A and B habitat that is currently outside of the Metro UGB shall be designated as Habitat Conservation Areas at such time that those areas are brought within the Metro UGB. Territory where the Metro UGB may expand includes both areas within the current Metro boundary and areas outside of the current Metro boundary.

A. New Urban Territory That Was Previously Within the Metro Boundary.

The Metro Inventory Map already identifies the regionally significant upland wildlife Class A and B habitat in territory within the current Metro boundary but outside the current Metro UGB. At the time such territory is brought within the Metro UGB, consistent with Title 11 of this functional plan, Metro Code sections 3.07.1110 et seq., Metro shall update its inventory of regionally significant fish and wildlife habitat for such territory using the same methodology used by Metro to establish the Metro Inventory Map. Based on the updated Metro Inventory Map, Metro shall prepare a Habitat Conservation Areas Map for such new territory, as described in subsection 2(B) of this title, using the 2040 Design Types that are assigned to such territory to determine the area's urban development value.

B. New Urban Territory That Was Previously Outside of the Metro Boundary.

At the time such territory is brought within the Metro UGB, consistent with Title 11 of this functional plan, Metro Code sections 3.07.1110 et seq., Metro shall prepare an inventory of regionally significant fish and wildlife habitat for such territory using the same methodology used by Metro to establish the Metro Inventory Map. Upon adoption of such inventory, Metro shall update its Metro Inventory Map to include such information. Based on the updated Metro Inventory Map, Metro shall prepare a Habitat Conservation Areas Map for such new territory, as described in subsection 2(B) of this title, using the 2040 Design Types that are assigned to such territory to determine the area's urban development value.

C. Metro recognizes that the assigned 2040 Design Types may change as planning for territory added to the Metro UGB progresses, and that the relevant Habitat Conservation Area designations will also change as a result of the 2040 Design Type changes during such planning.

Table 3.07-13a: Method for Identifying Habitat Conservation Areas ("HCA")

Fish & wildlife habitat classification	***High Urban development value[1]***	***Medium Urban development value[2]***	***Low Urban development value[3]***	***Other areas: Parks and Open Spaces, no design types outside UGB***
Class I Riparian	Moderate HCA	High HCA	High HCA	High HCA / High HCA+[4]
Class II Riparian	Low HCA	Low HCA	Moderate HCA	Moderate HCA / High HCA+[4]
Class A Upland Wildlife	No HCA	No HCA	No HCA	No HCA / High HCA[5] / High HCA+[4]
Class A Upland Wildlife	No HCA	No HCA	No HCA	No HCA / High HCA[5] / High HCA+[4]

NOTE: The default urban development value of property is as depicted on the Metro Habitat Urban Development Value Map. The Metro 2040 Design Type designations provided in the following footnotes are only for use when a city or county is determining whether to make an adjustment pursuant to Section 4(E)(5) of this title.

[1] Primary 2040 design types: Regional Centers, Central City, Town Centers, and Regionally Significant Industrial Areas
[2] Secondary 2040 design types: Main Streets, Station Communities, Other Industrial Areas, and Employment Centers
[3] Tertiary 2040 design types: Inner and Outer Neighborhoods, Corridors
[4] Cities and counties shall give Class I and II riparian habitat and Class A and B upland wildlife habitat in parks designated as natural areas even greater protection than that afforded to High Habitat Conservation Areas, as provided in Section 4(A)(5) of this title.
[5] All Class A and B upland wildlife habitat in publicly-owned parks and open spaces, except for parks and open spaces where the acquiring agency clearly identified that it was acquiring the property to develop it for active recreational uses, shall be considered High HCAs.

Table 3.07-13b: Method for Identifying Habitat Conservation Areas ("HCA") in Future Metro Urban Growth Boundary Expansion Areas

Fish & wildlife habitat classification	***High Urban development value[1]***	***Medium Urban development value[2]***	***Low Urban development value[3]***	***Other areas: Parks and Open Spaces, no design types outside UGB***
Class I Riparian	Moderate HCA	High HCA	High HCA	High HCA / High HCA+[4]
Class II Riparian	Low HCA	Low HCA	Moderate HCA	Moderate HCA / High HCA+[4]
Class A Upland Wildlife	Low HCA	Moderate HCA	Moderate HCA	High HCA / High HCA[5] / High HCA+[4]
Class B Upland Wildlife	Low HCA	Low HCA	Moderate HCA	Moderate HCA / High HCA[5] / High HCA+[4]

NOTE: The default urban development value of property is as depicted on the Metro Habitat Urban Development Value Map. The Metro 2040 Design Type designations provided in the following footnotes are only for use when a city or county is determining whether to make an adjustment pursuant to Section 4(E)(5) of this title.

[1] Primary 2040 design types: Regional Centers, Central City, Town Centers, and Regionally Significant Industrial Areas
[2] Secondary 2040 design types: Main Streets, Station Communities, Other Industrial Areas, and Employment Centers
[3] Tertiary 2040 design types: Inner and Outer Neighborhoods, Corridors
[4] Cities and counties shall give Class I and II riparian habitat and Class A and B upland wildlife habitat in parks designated as natural areas even greater protection than that afforded to High Habitat Conservation Areas, as provided in Section 4(A)(5) of this title.
[5] All Class A and B upland wildlife habitat in publicly-owned parks and open spaces, except for parks and open spaces where the acquiring agency clearly identified that it was acquiring the property to develop it for active recreational uses, shall be considered High HCAs.

Table 3.07-13c. Habitat-friendly development practices.

Part (a): Design and Construction Practices to Minimize Hydrologic Impacts
1. Amend disturbed soils to original or higher level of porosity to regain infiltration and stormwater storage capacity. 2. Use pervious paving materials for residential driveways, parking lots, walkways, and within centers of cul-de-sacs. 3. Incorporate stormwater management in road right-of-ways. 4. Landscape with rain gardens to provide on-lot detention, filtering of rainwater, and groundwater recharge. 5. Use green roofs for runoff reduction, energy savings, improved air quality, and enhanced aesthetics. 6. Disconnect downspouts from roofs and direct the flow to vegetated infiltration/filtration areas such as rain gardens. 7. Retain rooftop runoff in a rain barrel for later on-lot use in lawn and garden watering. 8. Use multi-functional open drainage systems in lieu of more conventional curb-and-gutter systems. 9. Use bioretention cells as rain gardens in landscaped parking lot islands to reduce runoff volume and filter pollutants. 10. Apply a treatment train approach to provide multiple opportunities for storm water treatment and reduce the possibility of system failure. 11. Reduce sidewalk width and grade them such that they drain to the front yard of a residential lot or retention area. 12. Reduce impervious impacts of residential driveways by narrowing widths and moving access to the rear of the site. 13. Use shared driveways. 14. Reduce width of residential streets, depending on traffic and parking needs. 15. Reduce street length, primarily in residential areas, by encouraging clustering and using curvilinear designs. 16. Reduce cul-de-sac radii and use pervious vegetated islands in center to minimize impervious effects, and allow them to be utilized for truck maneuvering/loading to reduce need for wide loading areas on site. 17. Eliminate redundant non-ADA sidewalks within a site (i.e., sidewalk to all entryways and/or to truck loading areas may be unnecessary for industrial developments). 18. Minimize car spaces and stall dimensions, reduce parking ratios, and use shared parking facilities and structured parking. 19. Minimize the number of stream crossings and place crossing perpendicular to stream channel if possible. 20. Allow narrow street right-of-ways through stream corridors whenever possible to reduce adverse impacts of transportation corridors.
Part (b): Design and Construction Practices to Minimize Impacts on Wildlife Corridors and Fish Passage
1. Carefully integrate fencing into the landscape to guide animals toward animal crossings under, over, or around transportation corridors. 2. Use bridge crossings rather than culverts wherever possible. 3. If culverts are utilized, install slab, arch or box type culverts, preferably using bottomless designs that more closely mimic stream bottom habitat. 4. Design stream crossings for fish passage with shelves and other design features to facilitate terrestrial wildlife passage. 5. Extend vegetative cover through the wildlife crossing in the migratory route, along with sheltering areas.
Part (c): Miscellaneous Other Habitat-Friendly Design and Construction Practices
1. Use native plants throughout the development (not just in HCA). 2. Locate landscaping (required by other sections of the code) adjacent to HCA. 3. Reduce light-spill off into HCAs from development. 4. Preserve and maintain existing trees and tree canopy coverage, and plant trees, where appropriate, to maximize future tree canopy coverage.

Table 3.07-13d: Locating Boundaries of Class I and II Riparian Areas

Distance from Water Feature	Development/Vegetation Status[1]			
	Developed areas not providing vegetative cover[2]	Low structure vegetation or open soils[3]	Woody vegetation (shrub and scattered forest canopy)[4]	Forest Canopy (closed to open forest canopy)[5]
Surface Streams				
0-50’	Class II [6]	Class I [7]	Class I	Class I
50’-100’		Class II [6]	Class I	Class I
100’-150’		Class II if slope>25% [6]	Class II if slope>25% [6]	Class II [6]
150’-200’		Class II if slope>25% [6]	Class II if slope>25% [6]	Class II if slope>25% [6]
Wetlands (Wetland feature itself is a Class I Riparian Area)				
0-100’		Class II [6]	Class I	Class I
100’-150’				Class II [6]
Flood Areas				
Within 300’ of river or surface stream		Class I	Class I	Class I
More than 300’ from river or surface stream	[8]	Class II [6]	Class II [6]	Class I
0-100’ from edge of flood area			Class II [6, 9]	Class II [6]

[1] Development/vegetative cover status is identified on the Metro Vegetative Cover Map (on file in the Metro Council office). The vegetative cover type assigned to any particular area was based on two factors: the type of vegetation observed in aerial photographs and the size of the overall contiguous area of vegetative cover to which a particular piece of vegetation belonged.

[2] “Developed areas not providing vegetative cover” are areas that lack sufficient vegetative cover to meet the one-acre minimum mapping unit for any type of vegetative cover.

[3] “Low structure vegetation or open soils” means areas that are part of a contiguous area one acre or larger of grass, meadow, crop-lands, or areas of open soils located within 300 feet of a surface stream (low structure vegetation areas may include areas of shrub vegetation less than one acre in size if they are contiguous with areas of grass, meadow, crop-lands, orchards, Christmas tree farms, holly farms, or areas of open soils located within 300 feet of a surface stream and together form an area of one acre in size or larger).

[4] “Woody vegetation” means areas that are part of a contiguous area one acre or larger of shrub or open or scattered forest canopy (less than 60% crown closure) located within 300 feet of a surface stream.

[5] “Forest canopy” means areas that are part of a contiguous grove of trees of one acre or larger in area with approximately 60% or greater crown closure, irrespective of whether the entire grove is within 200 feet of the relevant water feature.

[6] Areas that have been identified as habitats of concern, as designated on the Metro Habitats of Concern Map (on file in the Metro Council office), shall be treated as Class I riparian habitat areas in all cases, subject to the provision of additional information that establishes that they do not meet the criteria used to identify habitats of concern as described in Metro’s Technical Report for Fish and Wildlife. Examples of habitats of concern include: Oregon white oak woodlands, bottomland hardwood forests, wetlands, native grasslands, riverine islands or deltas, and important wildlife migration corridors.

[7] Except that areas within 50 feet of surface streams shall be Class II riparian areas if their vegetation status is “Low structure vegetation or open soils,” and if they are high gradient streams. High gradient streams are identified on the Metro Vegetative Cover Map. If a property owner believes the gradient of a stream was incorrectly identified, then the property owner may demonstrate the correct classification by identifying the channel type using the methodology described in the Oregon Watershed Assessment Manual, published by the Oregon Watershed Enhancement Board, and appended to the Metro’s Riparian Corridor and Wildlife Habitat Inventories Report, Attachment 1 to Exhibit F to this ordinance.

[8] If development prior to the effective date of this title within a contiguous, undeveloped flood area (to include contiguous flood areas on adjacent properties) that was not mapped as having any vegetative cover has reduced the size of that contiguous flood area to less than one half of an acre in size, then the remaining flood area shall also be considered a developed flood area and shall not be identified as habitat.

[9] Only if within 300 feet of a river or surface stream.

Table 3.07-13e: Performance and Implementation Objectives and Indicators

<table>
<tr><th>Performance Objectives</th><th>Targets</th><th>Targeted Condition Based on 2004 Metro Inventory</th><th>Example Indicators</th></tr>
<tr><td rowspan="3">Performance Objective 1:

Preserve and improve streamside, wetland, and flood area habitat and connectivity.</td><td>1a. 10% increase in forest and other vegetated acres within 50 feet of streams (on each side) and wetlands in each subwatershed over the next 10 years (2015).</td><td>1a. 2004 Baseline Condition (regional data):
• 64% vegetated
• 14,000 vegetated acres
10% increase:
• 70% vegetated
• 1,400 acre increase in vegetation over 10 years</td><td rowspan="3">• Percentage of acres within 50 feet of streams (on each side) and wetlands with any vegetation
• Percentage of acres within 50 feet of streams (on each side) and wetlands with forest canopy
• Percentage of acres between 50 and 150 feet of streams (on each side) and wetlands with any vegetation
• Percentage of acres between 50 and 150 feet of streams (on each side) and wetlands with forest canopy
• Number of acres of Class I and II Riparian Habitat
• Percentage of flood area acres that are developed*

* “Developed” for purposes of this indicator means the methodology used in Metro’s Fish and Wildlife Inventory to identify developed flood areas.</td></tr>
<tr><td>1b. 5% increase in forest and other vegetated acres within 50 to 150 feet of streams (on each side) and wetlands in each subwatershed over the next 10 years (2015).</td><td>1b. 2004 Baseline Condition (regional data):
• 59% vegetated
• 15,250 vegetated acres
5% increase:
• 62% vegetated
• 760 acre increase in vegetation over 10 years</td></tr>
<tr><td>1c. No more than 10% increase in developed flood area acreage in each subwatershed over the next 10 years (2015).</td><td>1c. 2004 Baseline Condition (regional data):
• 10% of all flood area acres are developed
• 3,450 total acres of developed flood areas
10% increase:
• 3,800 total acres of developed flood areas</td></tr>
</table>

Performance Objectives	Targets	Targeted Condition Based on 2004 Metro Inventory	Example Indicators
Performance Objective 2: Preserve large areas of contiguous habitat and avoid fragmentation.	**2a.** *Preserve 75% of vacant Class A and B* upland wildlife habitat in each subwatershed over the next 10 years (2015).	**2a. 2004 Baseline Condition:** • 15,500 acres of vacant Class A and B upland wildlife habitat **75% retention:** • 11,600 acres of vacant Class A and B upland wildlife habitat remaining	• Number of acres of Class A habitat • Number of acres of Class B habitat • Number of wildlife habitat patches that contain 30 acres or more of upland wildlife habitat
	2b. Of the upland habitat preserved, *retain 80% of the number of patches 30 acres or larger* in each subwatershed over the next 10 years (2015).	**2b. 2004 Baseline Condition:** • 23,400 acres of upland habitat in 133 patches that contain 30 acres or more of upland wildlife habitat **80% retention:** 106 upland habitat patches that contain 30 acres or more of upland habitat	
Performance Objective 3: Preserve and improve connectivity for wildlife between riparian corridors and upland wildlife habitat.	**3a.** *Preserve 90% of forested wildlife habitat acres located within 300 feet of surface streams* in each subwatershed over the next 10 years (2015).	**3a. 2004 Baseline Condition:** • 28,300 acres within 1,453 patches of forested wildlife habitat located within 300 feet of surface streams **90% retention:** • 25,500 acres of forested wildlife habitat located within 300 feet of surface streams	• Number and miles of all wildlife corridors • Corridor quality: % of habitat acres within corridors with a vegetative width of 200 ft • Acres of wildlife patches with a connectivity score of 3 or greater • Acres and number of forested wildlife habitat patches (forest canopy or wetland with a total combined size greater than 2 acres) within 300 feet of surface streams compared to acres of the patches located outside of 300 feet of surface streams.

Performance Objectives	Targets	Targeted Condition Based on 2004 Metro Inventory	Example Indicators
Performance Objective 3 (continued):	**3b.** <u>*Preserve 80% of non-forested wildlife habitat acres located within 300 feet of surface streams*</u> in each subwatershed over the next 10 years (2015).	**3b. 2004 Baseline Condition:** 14,400 acres within 1,633 patches of non-forested wildlife habitat located within 300 feet of surface streams **80% retention:** 11,500 acres of non-forested wildlife habitat located within 300 feet of surface streams	• Acres and number of non-forested wildlife patches (shrub or low structure/open soils with a total combined size greater than 2 acres) located within 300 feet of a surface streams.
Performance Objective 4: Preserve and improve <u>special habitats of concern</u>.	**4a.** <u>*Preserve 95% of habitats of concern acres*</u> in each subwatershed over the next 10 years (2015).	**4a. 2004 Baseline Condition:** • 33% of all habitat designated as HOCs • 26,700 total acres of HOCs **95% retention:** • 25,400 total acres of HOCs	• Number of acres of wetland • Number of acres of white oak woodland • Number of acres of bottomland hardwood forest • Number of acres of vegetated riverine islands • Number of acres of key connector habitat (list out HOC connectors)

Implementation Objectives	Example Indicators
Implementation Objective A: Increase the use of <u>habitat-friendly development</u> throughout the region	• Number of jurisdictions that allow or require LID • Number of jurisdictions providing LID incentives • Percentage of region in forest canopy • Percentage of impervious area • B-IBI (benthic index of biological integrity) scores
Implementation Objective B: Increase <u>restoration and mitigation actions</u> to compensate of adverse effects of new and existing development on ecological function	• Number of restoration projects in one year • Number of mitigation projects in one year • Acres and distribution by resource class of habitat inventory • Number of culverts that need improvement • Number of watersheds in region with adopted action plans

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EXHIBIT C—ORDINANCE NO. 05-1077C

ATTACHMENT 1. HABITAT CONSERVATION AREAS MAP

Available for review in the Metro Council's files (see map labeled "Ordinance No. 05-1077B," but note that additional revisions were approved as described in Section 10 of the ordinance) or from the Metro Data Resource Center, 600 N.E. Grand Ave., Portland, OR 97232. Electronic and printed copies of maps, in any reasonable scale and size required, may be purchased from the Data Resource Center. This map may also be available via Metro's website at: **www.metro-region.org/nature**.

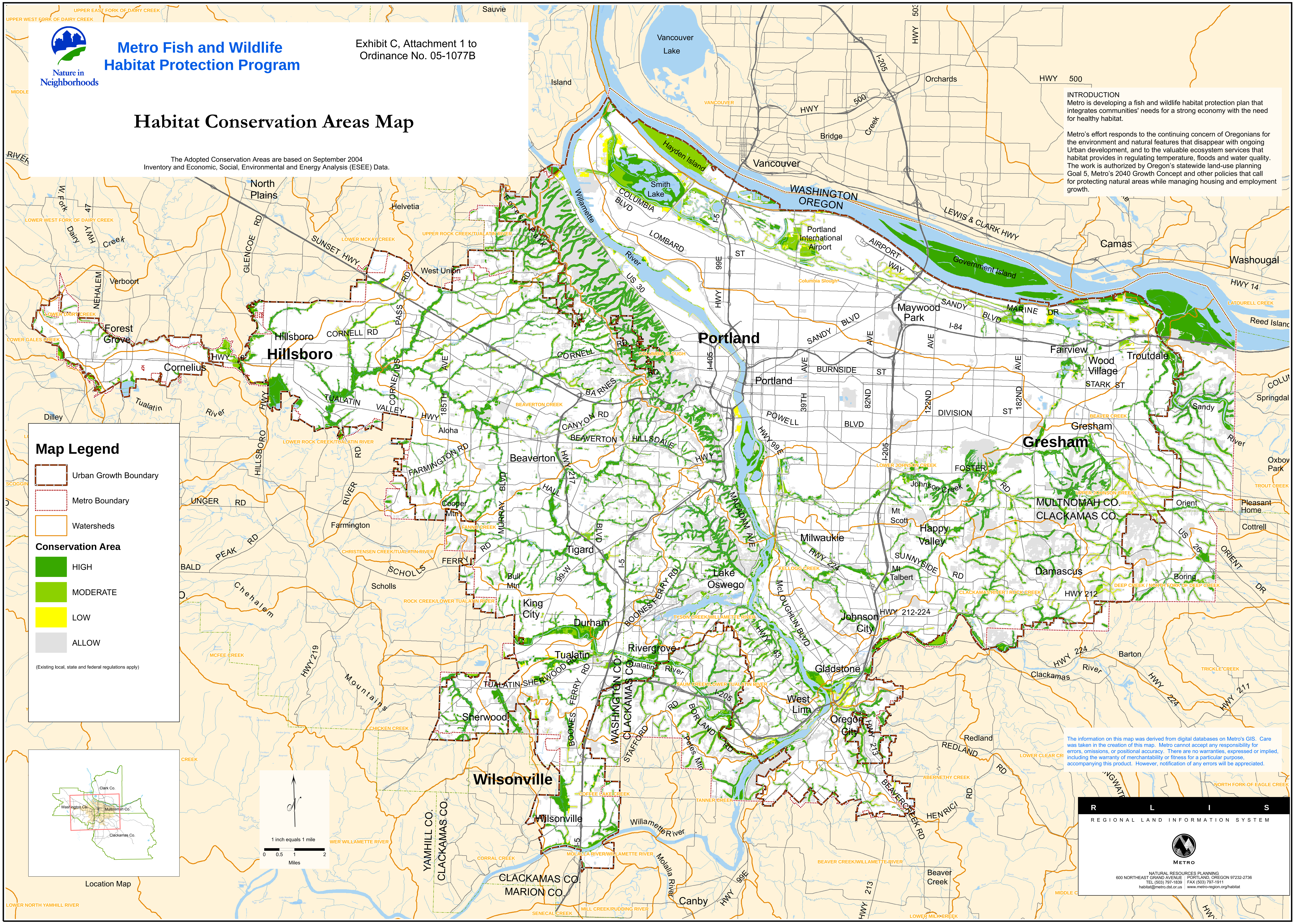

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EXHIBIT C—ORDINANCE NO. 05-1077C

ATTACHMENT 2. TUALATIN BASIN NATURAL RESOURCES COORDINATING COMMITTEE GOAL 5 PROGRAM (WITH MAPS)

The official copies of these documents, which were submitted with Ordinance No. 05-1077 as introduced on April 14, 2005, and have not been amended since submitted, are available in the Metro Council's files.

- Program Report
- Tualatin Basin program maps
- Clean Water Services Healthy Streams Plan
- Clean Water Services Design and Construction Standards

These documents are also available for review or purchase from the Metro Planning Department, 503-797-1555, 600 N.E. Grand Ave., Portland, OR 97232, and may be available by accessing the Washington County and Clean Water Services websites:

http://www.co.washington.or.us/deptmts/lut/planning/tualatin_basin.htm

http://www.CleanWaterServices.org

EXHIBIT C—ORDINANCE NO. 05-1077C

ATTACHMENT 3. METRO 2004 WETLAND INVENTORY MAP

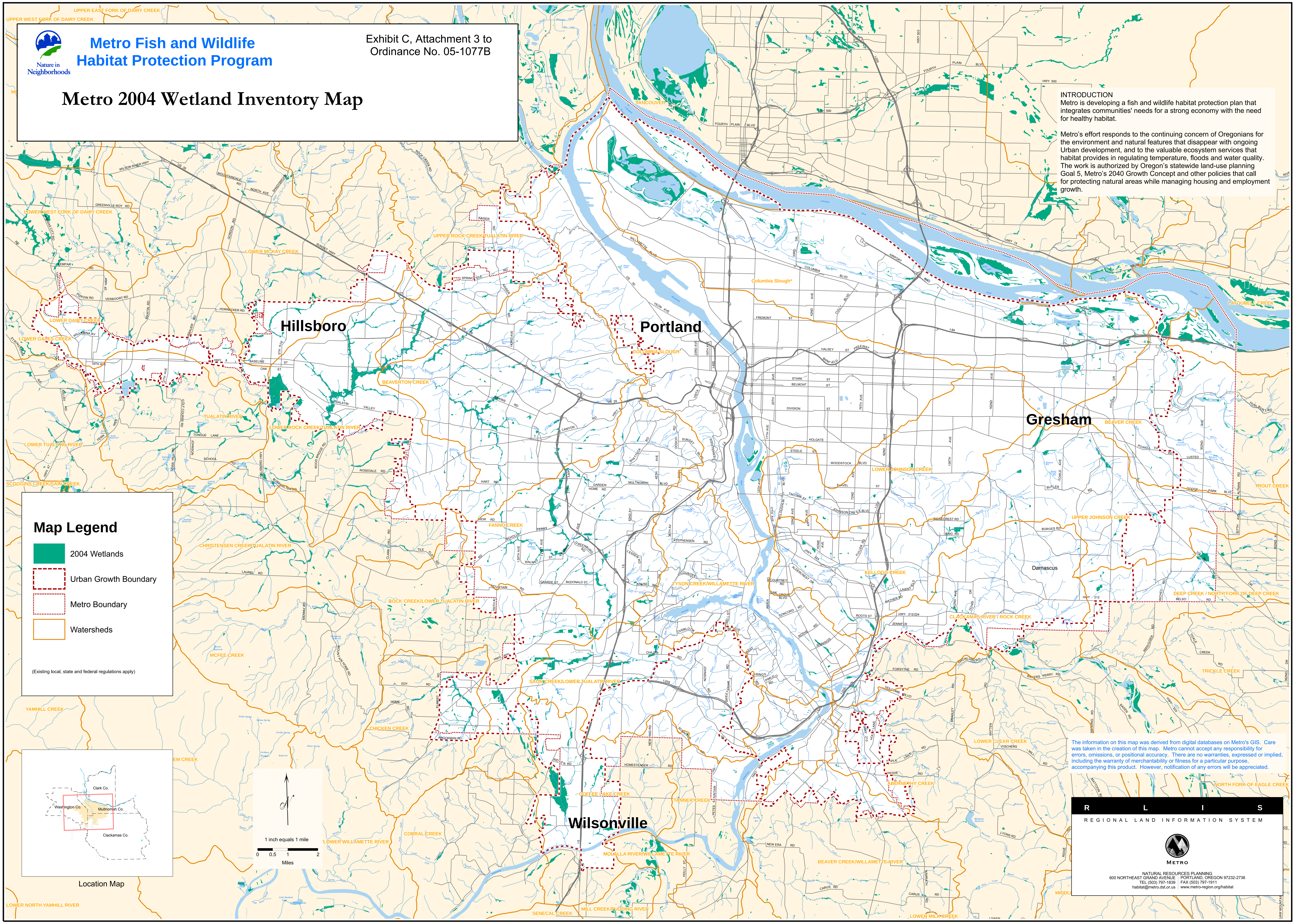
Available for review in the Metro Council's files (see map labeled "Ordinance No. 05-1077B") or from the Metro Data Resource Center, 600 N.E. Grand Ave., Portland, OR 97232. Electronic and printed copies of maps, in any reasonable scale and size required, may be purchased from the Data Resource Center. This map may also be available via Metro's website at: **www.metro-region.org/nature**.

Exhibit C, Attachment 3 to
Ordinance No. 05-1077B

Metro Fish and Wildlife
Habitat Protection Program

Nature in Neighborhoods

Metro 2004 Wetland Inventory Map



INTRODUCTION
Metro is developing a fish and wildlife habitat protection plan that integrates communities' needs for a strong economy with the need for healthy habitat.

Metro's effort responds to the continuing concern of Oregonians for the environment and natural features that disappear with ongoing Urban development, and to the valuable ecosystem services that habitat provides in regulating temperature, floods and water quality. The work is authorized by Oregon's statewide land-use planning Goal 5, Metro's 2040 Growth Concept and other policies that call for protecting natural areas while managing housing and employment growth.

Map Legend

- 2004 Wetlands
- Urban Growth Boundary
- Metro Boundary
- Watersheds

(Existing local, state and federal regulations apply)

Location Map

Clark Co.
Washington Co.
Multnomah Co.
Clackamas Co.

1 inch equals 1 mile
0 0.5 1 2
Miles

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EXHIBIT C—ORDINANCE NO. 05-1077C

ATTACHMENT 4. METRO HABITAT URBAN DEVELOPMENT VALUE MAP

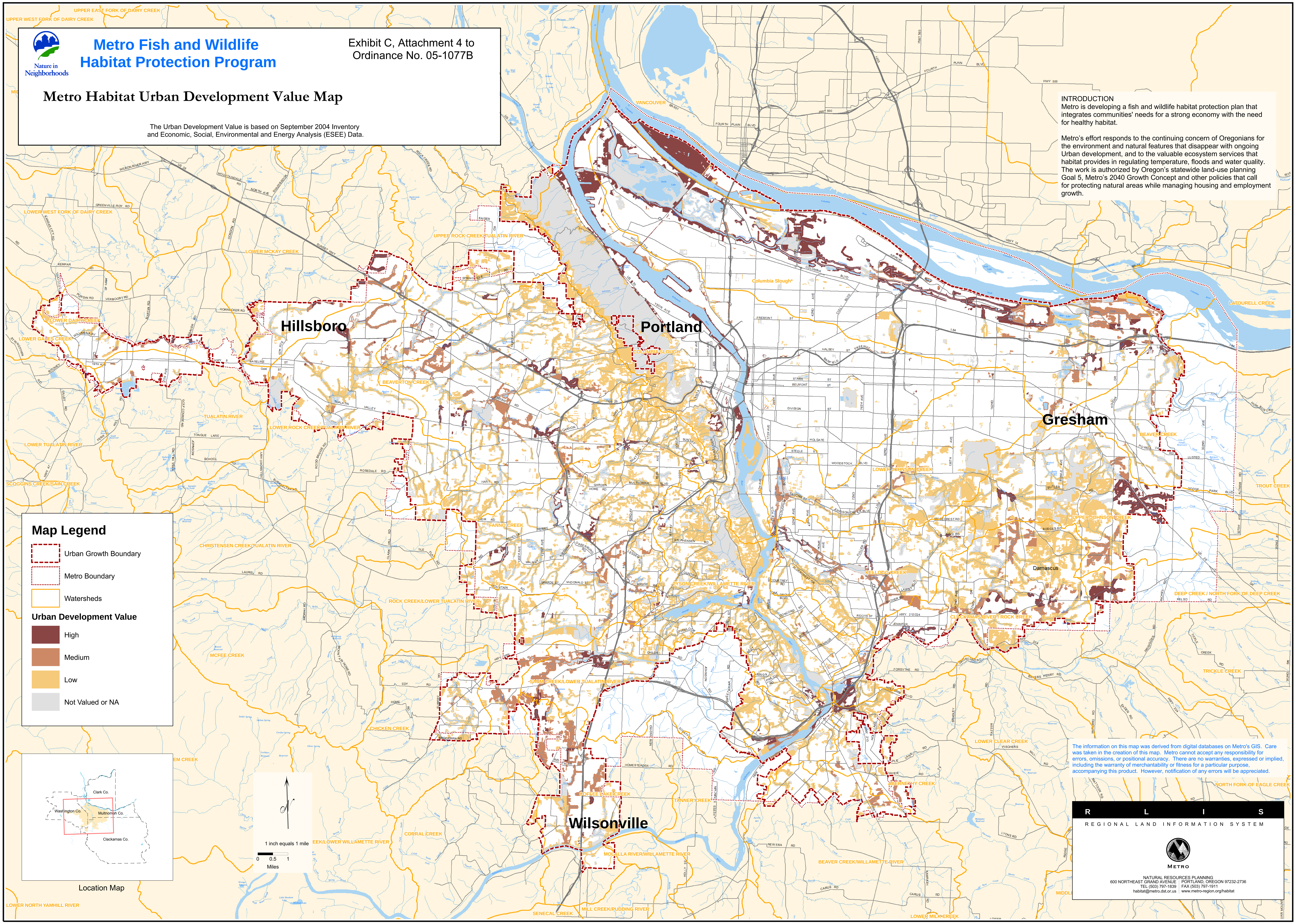
Available for review in the Metro Council's files (see map labeled "Ordinance No. 05-1077B") or from the Metro Data Resource Center, 600 N.E. Grand Ave., Portland, OR 97232. Electronic and printed copies of maps, in any reasonable scale and size required, may be purchased from the Data Resource Center.

Metro Fish and Wildlife Habitat Protection Program

Exhibit C, Attachment 4 to Ordinance No. 05-1077B

Metro Habitat Urban Development Value Map

The Urban Development Value is based on September 2004 Inventory and Economic, Social, Environmental and Energy Analysis (ESEE) Data.



INTRODUCTION

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EXHIBIT C—ORDINANCE NO. 05-1077C

ATTACHMENT 5. METRO VEGETATIVE COVER MAP

Available for review in the Metro Council's files (see map labeled "Ordinance No. 05-1077B," as amended by Technical Amendment No. 11, approved by the Council on September 22, 2005) or from the Metro Data Resource Center, 600 N.E. Grand Ave., Portland, OR 97232. Electronic and printed copies of maps, in any reasonable scale and size required, may be purchased from the Data Resource Center. This map may also be available via Metro's website at: **www.metro-region.org/nature**.

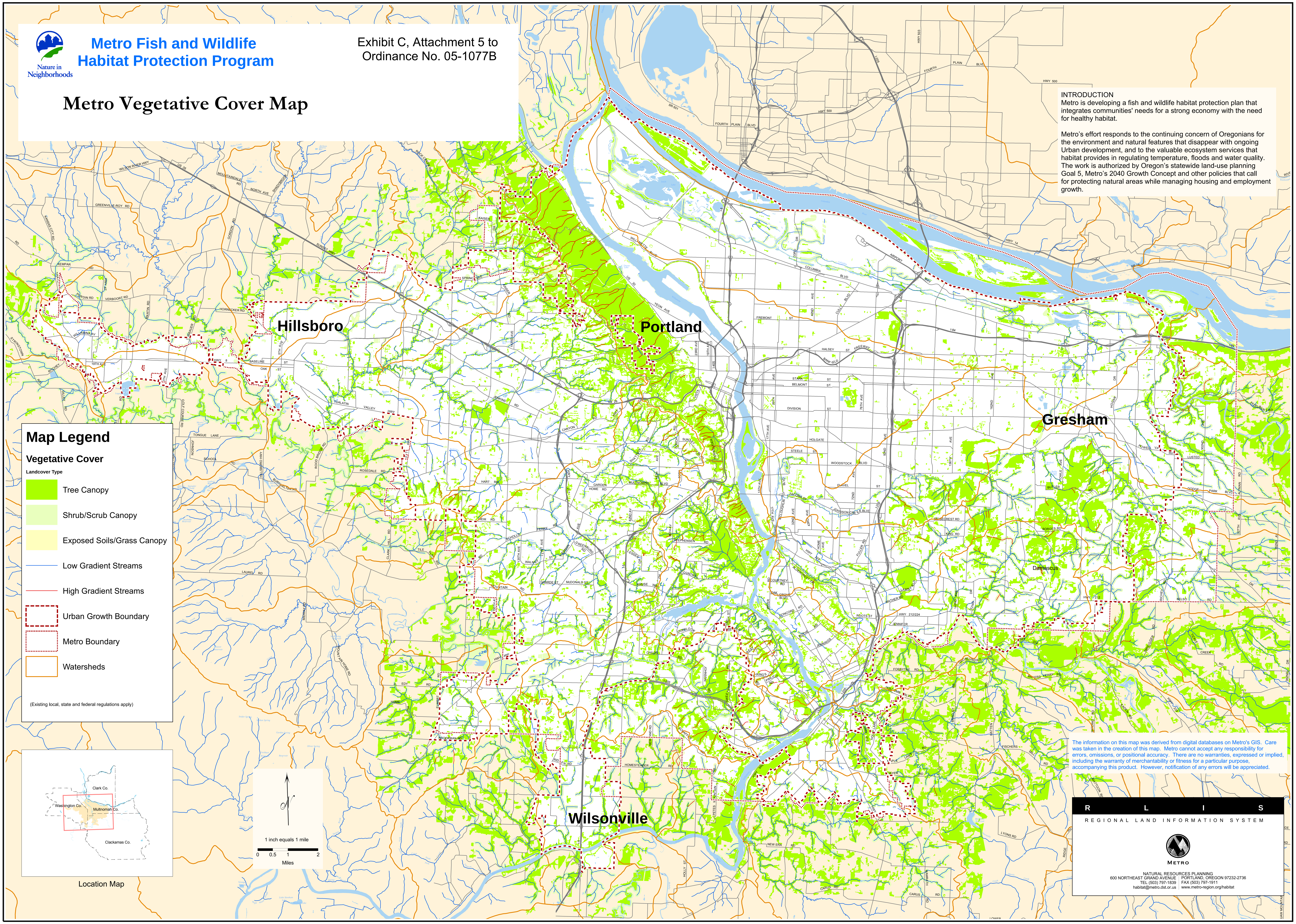

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EXHIBIT C—ORDINANCE NO. 05-1077C

ATTACHMENT 6. METRO HABITATS OF CONCERN MAP

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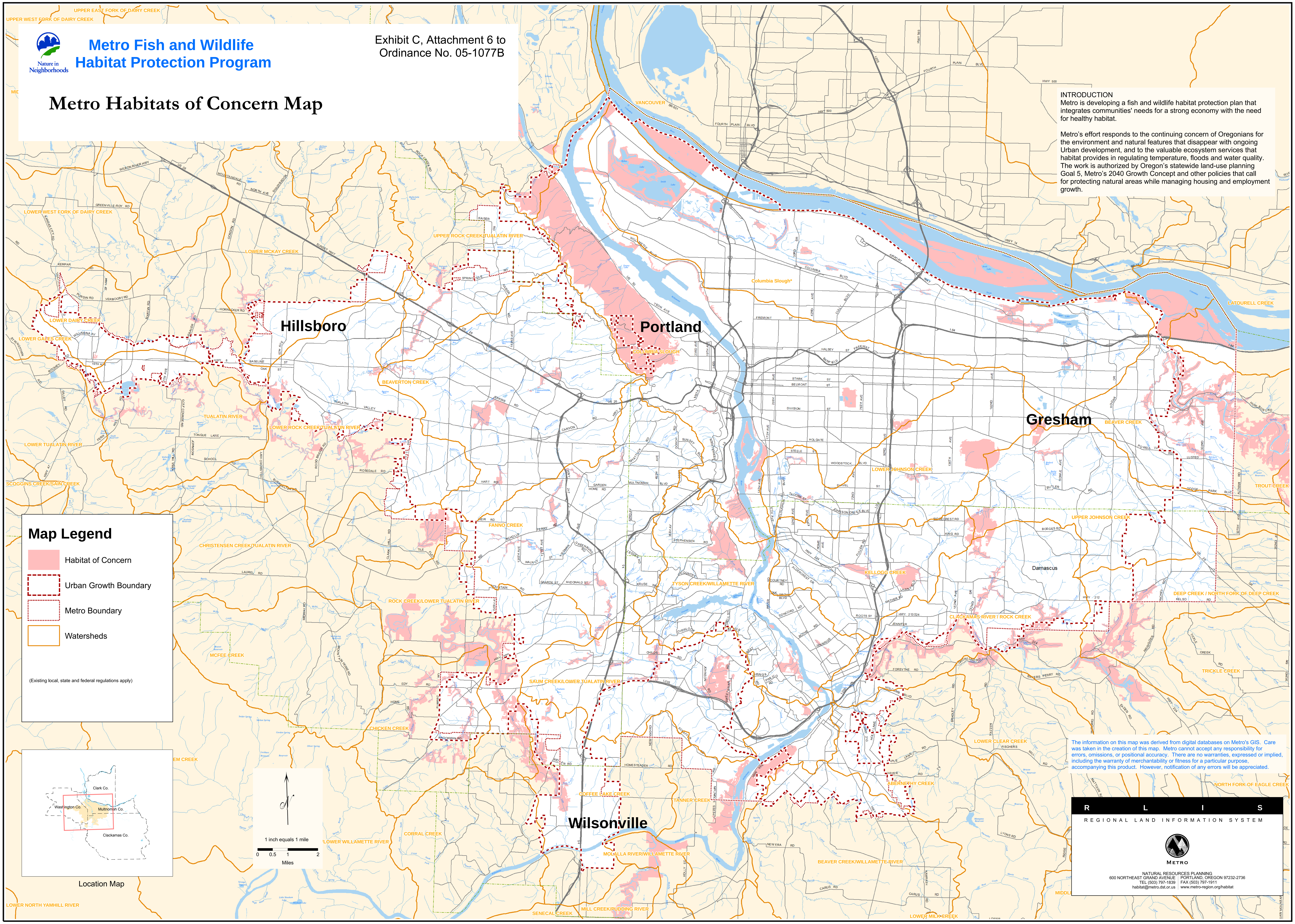

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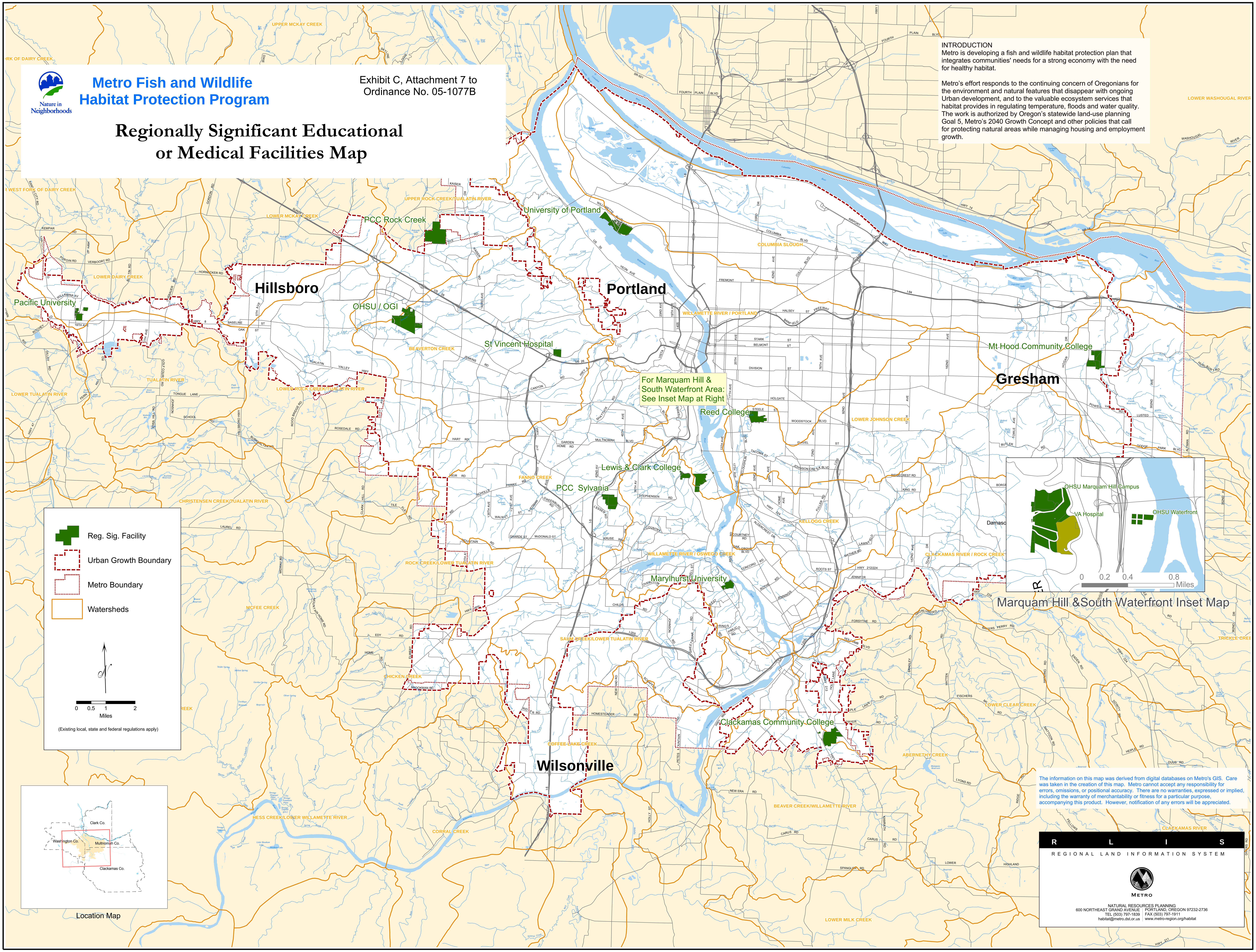

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Clackamas Community College

Regionally Significant Educational and Medical Facilities --Ordinance 05-1077C Attachment 7 to Exhibit C

Facility Taxlots

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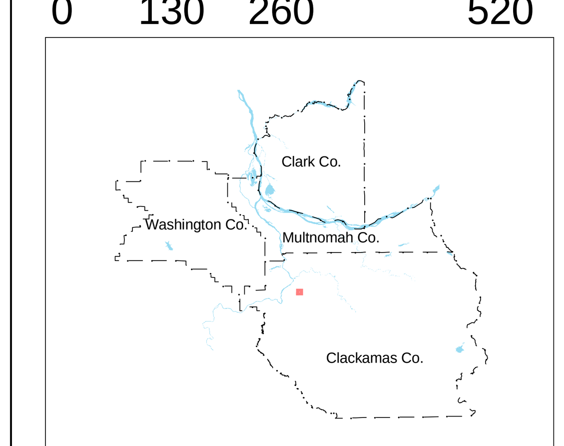

Location Map

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Lewis and Clark College

Regionally Significant Educational and Medical Facilities --Ordinance 05-1077C Attachment 7 to Exhibit C

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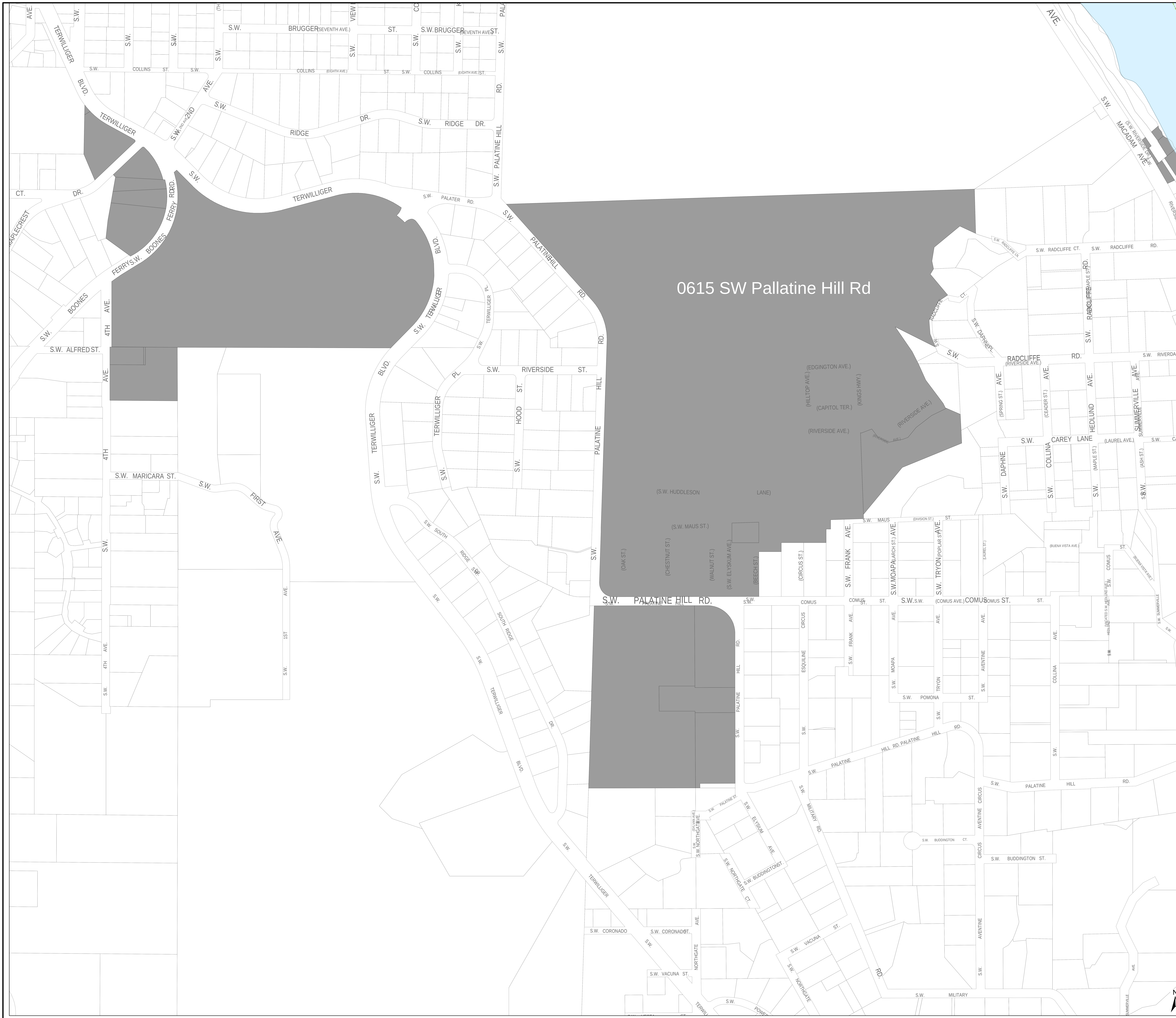

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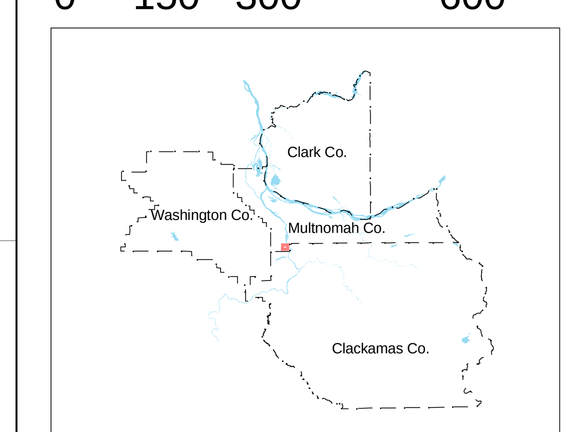

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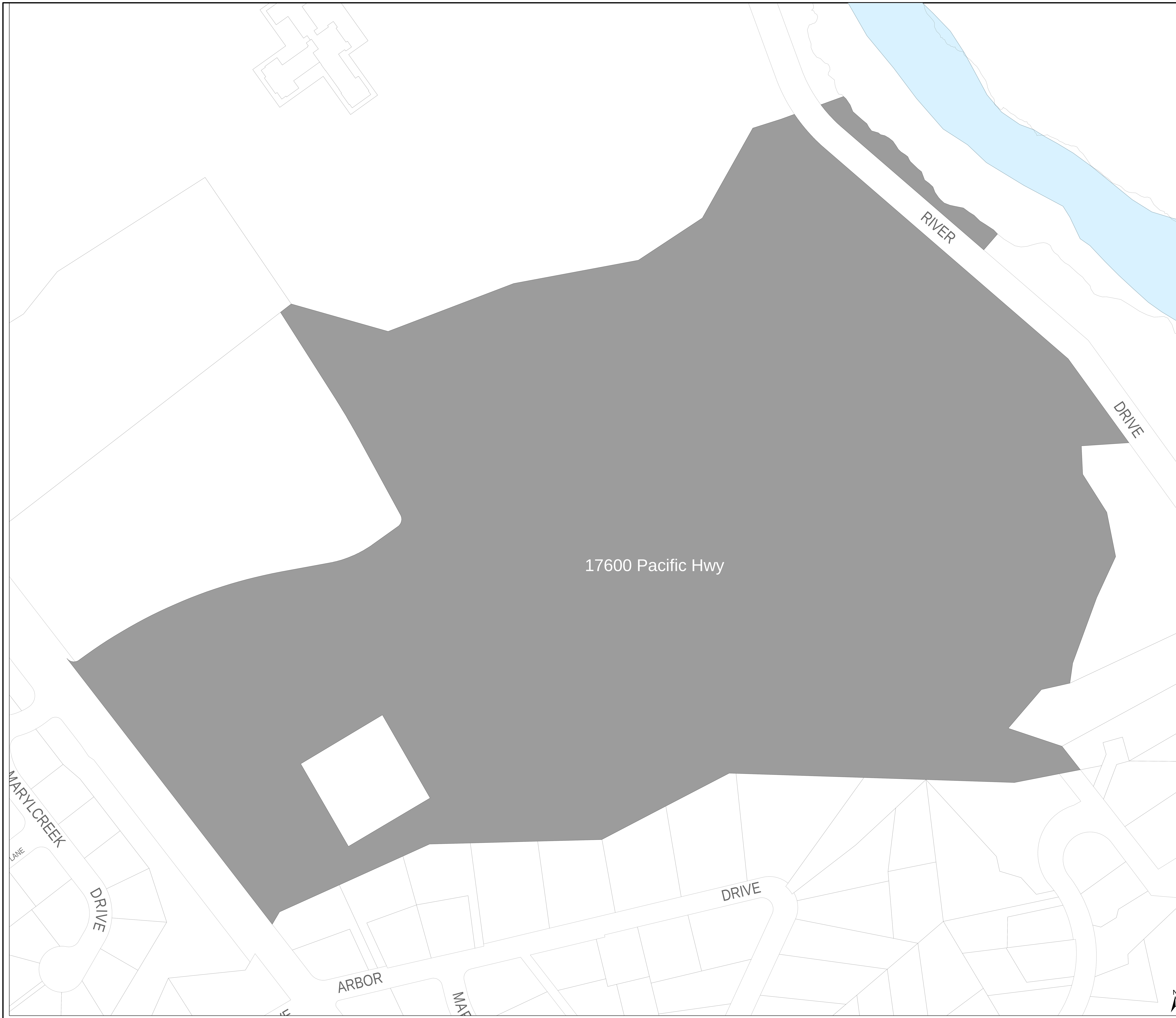

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Marylhurst University

Regionally Significant Educational and Medical Facilities --Ordinance 05-1077C Attachment 7 to Exhibit C

Facility Taxlots

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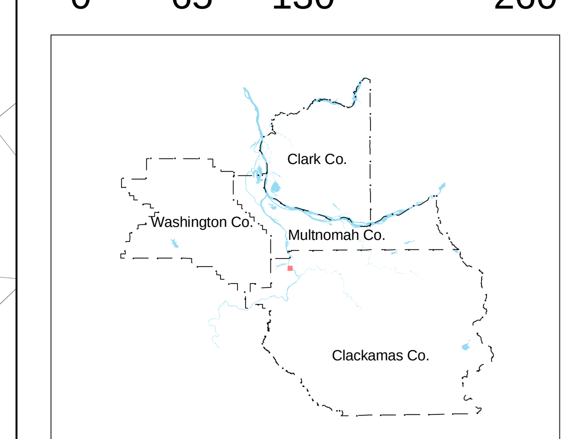

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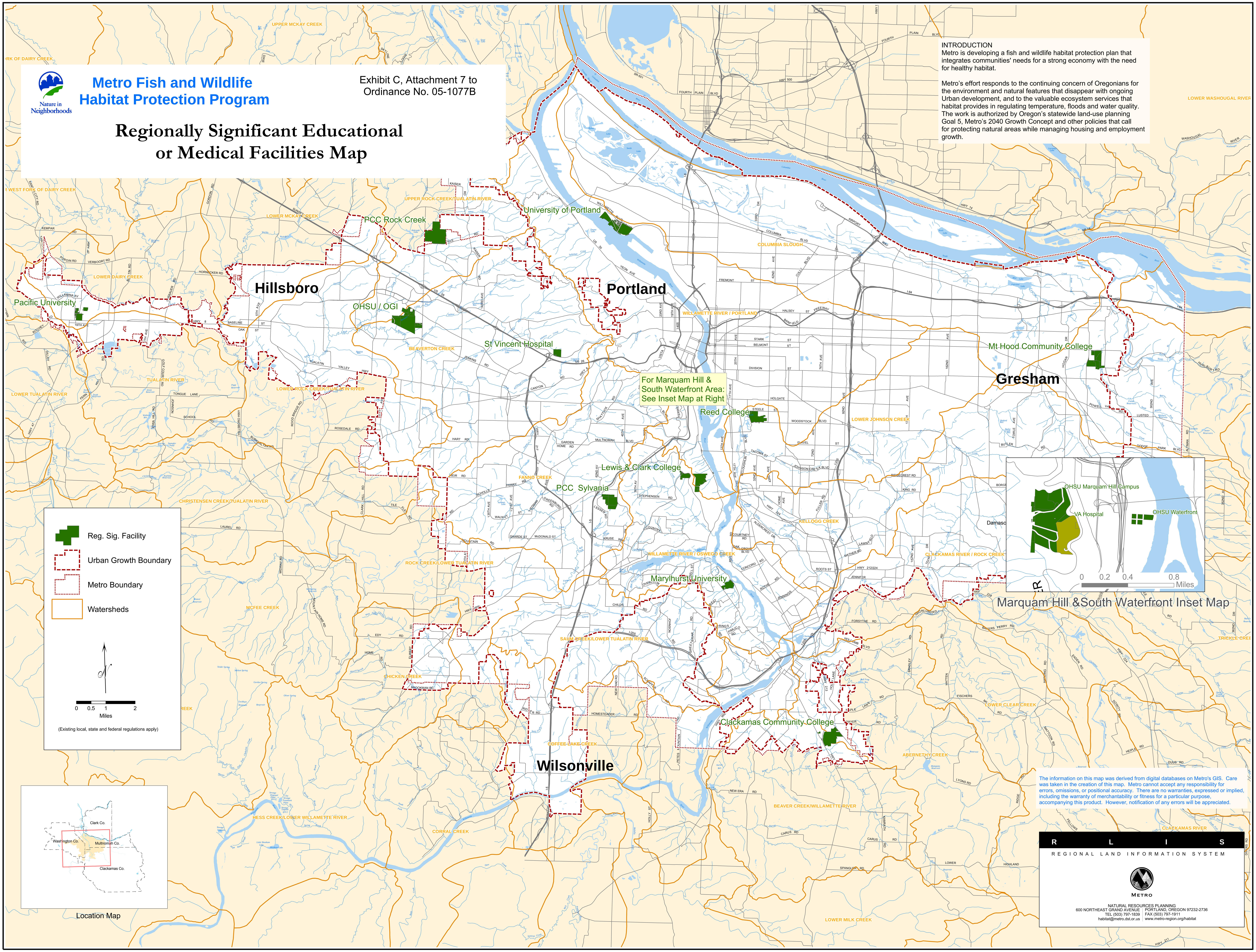

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Mt Hood Community College

Regionally Significant Educational and Medical Facilities --Ordinance 05-1077C Attachment 7 to Exhibit C

Facility Taxlots

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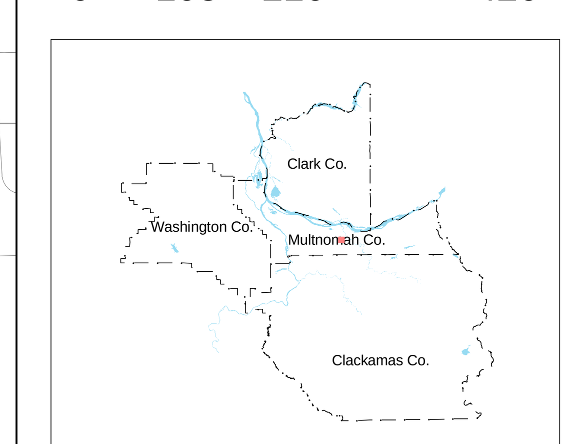

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Oregon Health Sciences University Marquam Hill Campus

Regionally Significant Educational and Medical Facilities
--Ordinance 05-1077C
Attachment 7 to Exhibit C

Facility Taxlots

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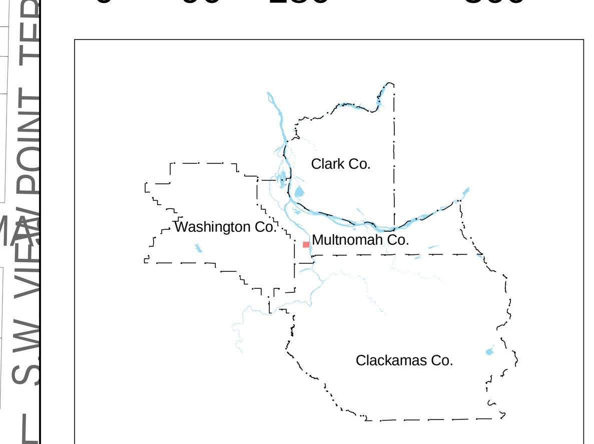

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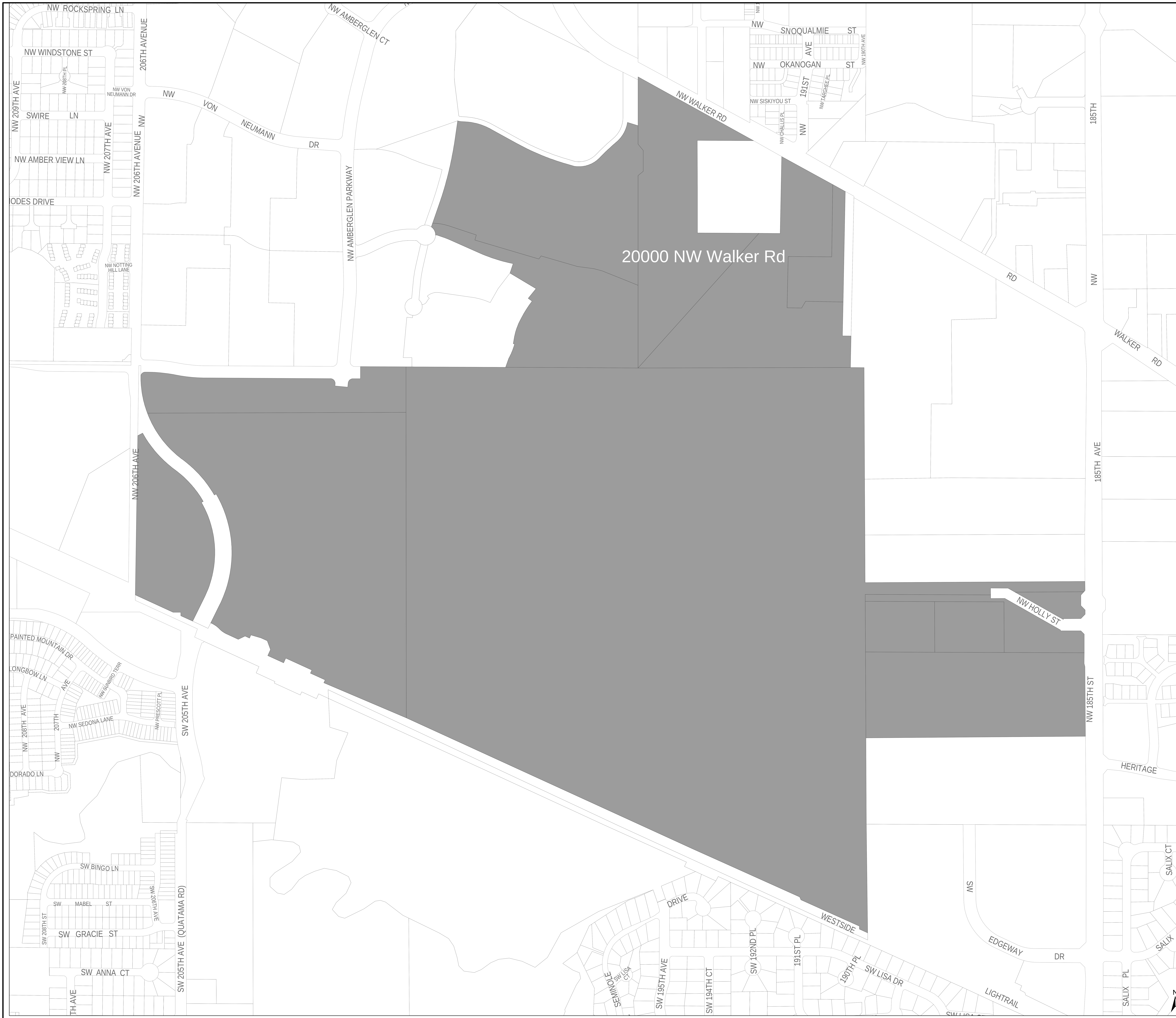

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REGIONAL LAND INFORMATION SYSTEM

Oregon Health Sciences University / Oregon Graduate Institute

Regionally Significant Educational and Medical Facilities --Ordinance 05-1077C Attachment 7 to Exhibit C

Facility Taxlots

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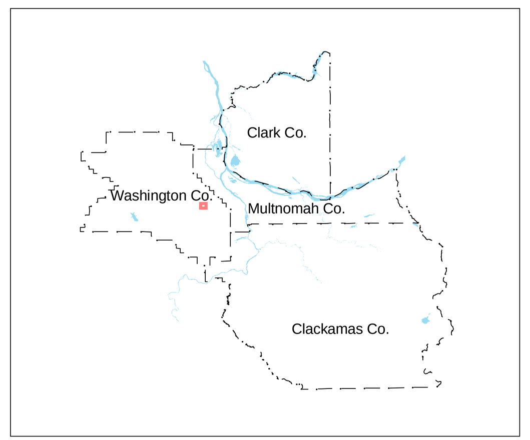

Location Map

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TEL (503) 797-1742 | FAX (503) 797-1909
drc@metro.dst.or.us | www.metro-region.org

RLIS
REGIONAL LAND INFORMATION SYSTEM

Oregon Health Sciences University Waterfront Campus

Regionally Significant Educational and Medical Facilities --Ordinance 05-1077C Attachment 7 to Exhibit C

Facility Taxlots

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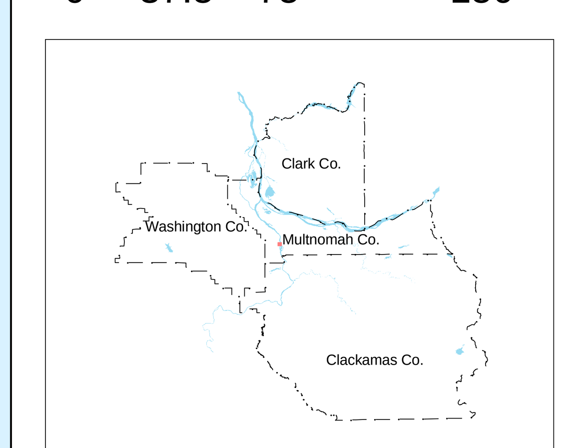

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R L I S
REGIONAL LAND INFORMATION SYSTEM

Pacific University

Regionally Significant Educational and Medical Facilities --Ordinance 05-1077C Attachment 7 to Exhibit C

Facility Taxlots

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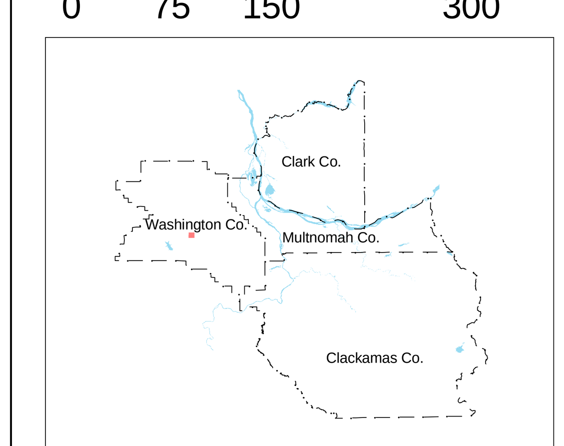

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R L I S
REGIONAL LAND INFORMATION SYSTEM

Portland Community College

Rock Creek Campus

Regionally Significant Educational and Medical Facilities --Ordinance 05-1077C Attachment 7 to Exhibit C

Facility Taxlots

Feet
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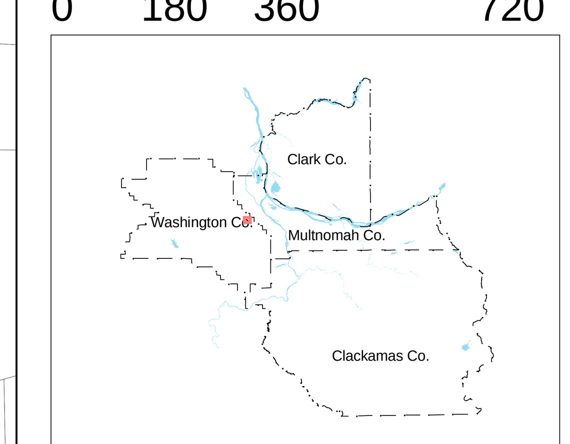

Location Map

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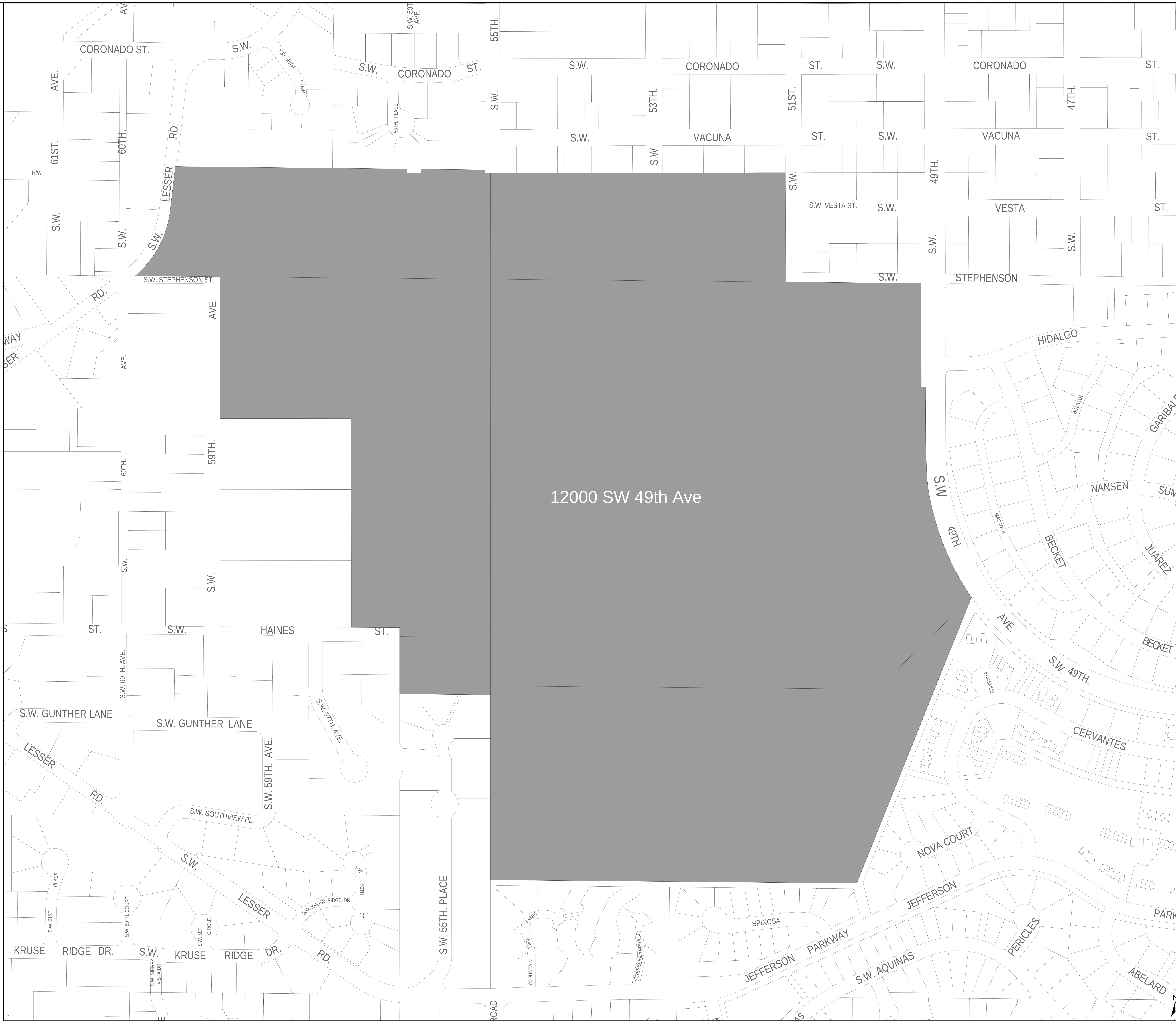

R L I S
REGIONAL LAND INFORMATION SYSTEM

Portland Community College

Sylvania Campus

Regionally Significant Educational and Medical Facilities --Ordinance 05-1077C Attachment 7 to Exhibit C

Facility Taxlots

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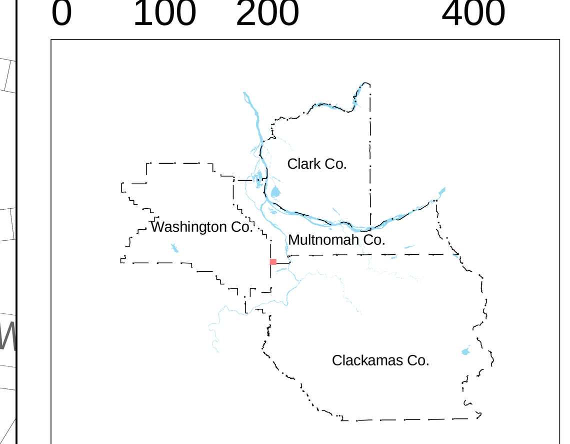

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RLIS
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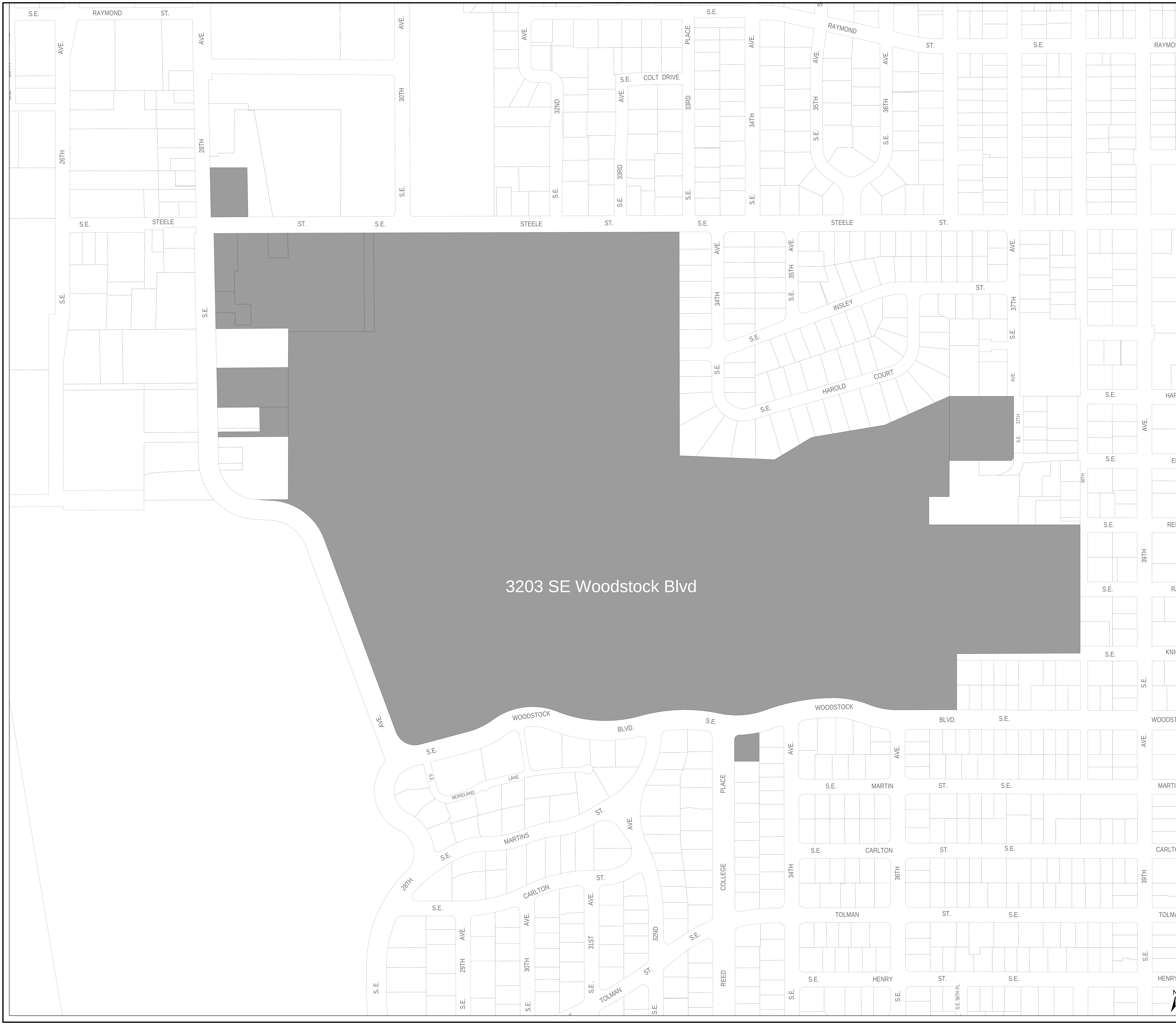
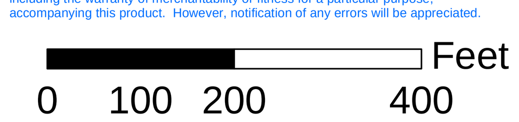
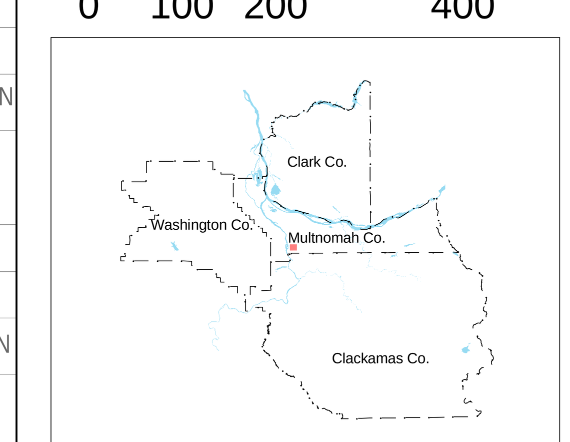
Reed College

Regionally Significant Educational and Medical Facilities --Ordinance 05-1077C Attachment 7 to Exhibit C







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REGIONAL LAND INFORMATION SYSTEM

St Vincent Hospital and Medical Center

Regionally Significant Educational and Medical Facilities --Ordinance 05-1077C Attachment 7 to Exhibit C

Facility Taxlots

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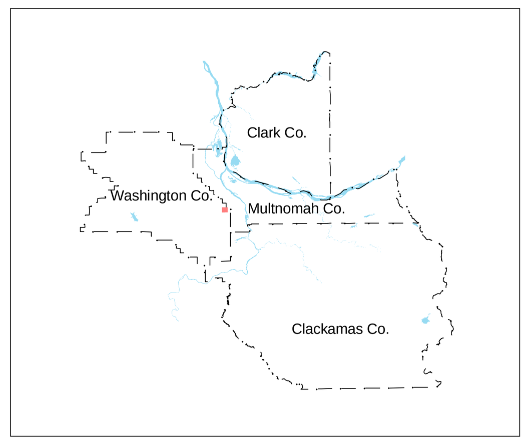

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University of Portland

Regionally Significant Educational and Medical Facilities --Ordinance 05-1077C Attachment 7 to Exhibit C

Facility Taxlots

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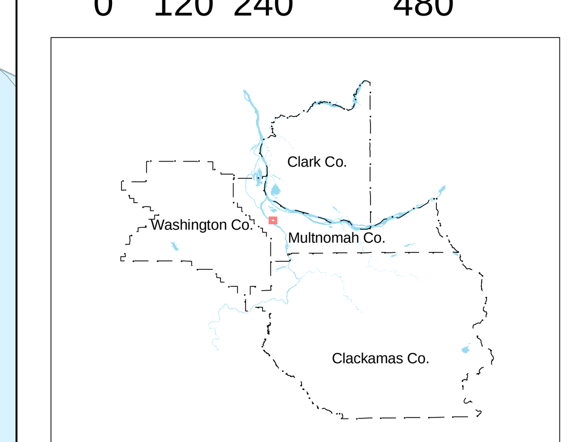

Location Map

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VA Medical Center

Regionally Significant Educational and Medical Facilities --Ordinance 05-1077C Attachment 7 to Exhibit C

Facility Taxlots

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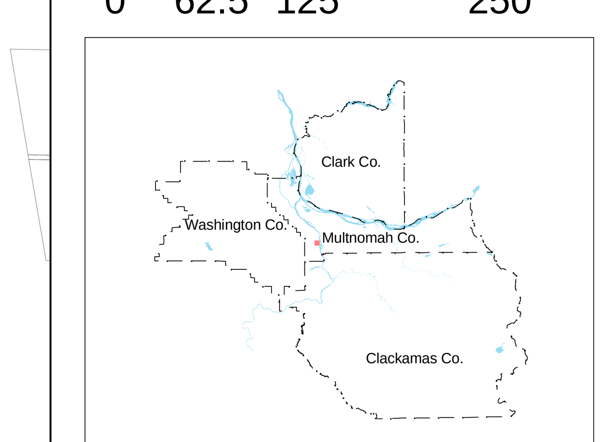

Location Map

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EXHIBIT D—ORDINANCE NO. 05-1077C

AMENDMENTS TO TITLES 3, 8, 10 AND 11 OF THE
URBAN GROWTH MANAGEMENT FUNCTIONAL PLAN

Amendment 1. Title 3 of the Urban Growth Management Functional Plan shall be renamed, "Water Quality and Flood Management."

Amendment 2. Metro Code Section 3.07.310, "Intent," shall be amended as follows:

To protect the beneficial water uses and functions and values of resources within the Water Quality and Flood Management Areas by limiting or mitigating the impact on these areas from development activities~~,~~ and protecting life and property from dangers associated with flooding ~~and working toward a regional coordination program of protection for Fish and Wildlife Habitat Areas~~.

Amendment 3. Metro Code Section 3.07.320, "Applicability," shall be amended as follows:

A. Title 3 applies to:

1. Development in Water Quality Resource and Flood Management Areas.

2. Development which may cause temporary or permanent erosion on any property within the Metro Boundary.

~~3. Development in Fish and Wildlife Habitat Conservation Areas when Metro's Section 3.07.350 analysis and mapping are completed.~~

B. Title 3 does not apply to work necessary to protect, repair, maintain, or replace existing structures, utility facilities, roadways, driveways, accessory uses and exterior improvements in response to emergencies provided that after the emergency has passed, adverse impacts are mitigated in accordance with the performance standards in Section 3.07.340.

Amendment 4. Metro Code Section 3.07.340, "Performance Standards," shall be amended as follows:

A. Flood Management Performance Standards.

1. The purpose of these standards is to reduce the risk of flooding, prevent or reduce risk to human life and property, and maintain functions and values of floodplains such as allowing for the storage and conveyance of stream flows through existing and natural flood conveyance systems.

2. All development, excavation and fill in the Flood Management Areas shall conform to the following performance standards:

a. Development, excavation and fill shall be performed in a manner to maintain or increase flood storage and conveyance capacity and not increase design flood elevations.

b. All fill placed at or below the design flood elevation in Flood Management Areas shall be balanced with at least an equal amount of soil material removal.

c. Excavation shall not be counted as compensating for fill if such areas will be filled with water in non-storm winter conditions.

d. Minimum finished floor elevations for new habitable structures in the Flood Management Areas shall be at least one foot above the design flood elevation.

e. Temporary fills permitted during construction shall be removed.

f. Uncontained areas of hazardous materials as defined by DEQ in the Flood Management Area shall be prohibited.

3. The following uses and activities are not subject to the requirements of subsection 2:

a. Excavation and fill necessary to plant new trees or vegetation.

b. Excavation and fill required for the construction of detention facilities or structures, and other facilities such as levees specifically designed to reduce or mitigate flood impacts. Levees shall not be used to create vacant buildable lands.

c. New culverts, stream crossings, and transportation projects may be permitted if designed as balanced cut and fill projects or designed to not significantly raise the design flood elevation. Such projects shall be designed to minimize the area of fill in Flood Management Areas and to minimize erosive velocities. Stream crossing shall be as close to perpendicular to the stream as practicable. Bridges shall be used instead of culverts wherever practicable.

B. Water Quality Performance Standards.

1. The purpose of these standards is to: (1) protect and improve water quality to support the designated beneficial water uses as defined in Title 10, and (2) protect the functions and values of the Water Quality Resource Area which include, but are not limited to:

a. Providing a vegetated corridor to separate Protected Water Features from development;

b. Maintaining or reducing stream temperatures;

c. Maintaining natural stream corridors;

d. Minimizing erosion, nutrient and pollutant loading into water;

e. Filtering, infiltration and natural water purification; and

f. Stabilizing slopes to prevent landslides contributing to sedimentation of water features.

2. Local codes shall require all development in Water Quality Resource Areas to conform to the following performance standards:

a. The Water Quality Resource Area is the vegetated corridor and the Protected Water Feature. The width of the vegetated corridor is specified in Table 3.07-3. At least three slope measurements along the water feature, at no more than 100-foot increments, shall be made for each property for which development is proposed. Depending on the width of the property, the width of the vegetated corridor will vary.

b. Water Quality Resource Areas shall be protected, maintained, enhanced or restored as specified in Section 3.07.340(B)(2).

c. Prohibit development that will have a significant negative impact on the functions and values of the Water Quality Resource Area, which cannot be mitigated in accordance with subsection 2(f).

d. ~~Vegetative cover native to the Metro Area~~Native vegetation shall be maintained, enhanced or restored, if disturbed, in the Water Quality Resource Area. Invasive non-native or noxious vegetation may be removed from the Water Quality Resource Area~~ and replaced with native cover~~. ~~Only n~~Use of native vegetation shall be ~~used ~~encouraged to enhance or restore the Water Quality Resource Area. This shall not preclude construction of energy dissipaters at outfalls consistent with watershed enhancement, and as approved by local surface water management agencies.

e. Uncontained areas of hazardous materials as defined by DEQ in the Water Quality Resource Area shall be prohibited.

f. Cities and counties may allow development in Water Quality Resource Areas provided that the governing body, or its designate, implement procedures which:

i. Demonstrate that no practicable alternatives to the requested development exist which will not disturb the Water Quality Resource Area; and

ii. If there is no practicable alternative, limit the development to reduce the impact associated with the proposed use; and

iii. Where the development occurs, require mitigation to ensure that the functions and values of the Water Quality Resource Area are restored.

g. Cities and counties may allow development for repair, replacement or improvement of utility facilities so long as the Water Quality Resource Area is restored consistent with Section 3.07.340(B)(2)(d).

h. The performance standards of Section 3.07.340(B)(2) do not apply to routine repair and maintenance of existing structures, roadways, driveways, utilities, accessory uses and other development.

3. For lots or parcels which are fully or predominantly within the Water Quality Resource Area and are demonstrated to be unbuildable by the vegetative corridor regulations, cities and counties shall reduce or remove vegetative corridor regulations to assure the lot or parcel will be buildable while still providing the maximum vegetated corridor practicable. Cities and counties shall encourage landowners to voluntarily protect these areas through various means, such as conservation easements and incentive programs.

C. <u>Erosion and Sediment Control</u>.

1. The purpose of this section is to require erosion prevention measures and sediment control practices during and after construction to prevent the discharge of sediments.

2. Erosion prevention techniques shall be designed to prevent visible and measurable erosion as defined in Title 10.

3. To the extent erosion cannot be completely prevented, sediment control measures shall be designed to capture, and retain on-site, soil particles that have become dislodged by erosion.

D. <u>Implementation Tools to Protect Water Quality and Flood Management Areas</u>.

1. Cities and counties shall either adopt land use regulations, which authorize transfer of permitted units and floor area to mitigate the effects of development restrictions in Water Quality and Flood Management Areas, or adopt other measures that mitigate the effects of development restrictions.

2. Metro encourages local governments to require that approvals of applications for partitions, subdivisions and design review actions be conditioned upon one of the following:

a. Protection of Water Quality and Flood Management Areas with a conservation easement;

b. Platting Water Quality and Flood Management Areas as common open space; or

c. Offer of sale or donation of property to public agencies or private non-profits for preservation where feasible.

3. Additions, alterations, rehabilitation or replacement of existing structures, roadways, driveways, accessory uses and development in the Water Quality and Flood Management Area may be allowed provided that:

a. The addition, alteration, rehabilitation or replacement is not inconsistent with applicable city and county regulations, and

b. The addition, alteration, rehabilitation or replacement does not encroach closer to the Protected Water Feature than the existing structures, roadways, driveways or accessory uses and development, and

c. The addition, alteration, rehabilitation or replacement satisfies Section 3.07.340(C) of this title.

d. In determining appropriate conditions of approval, the affected city or county shall require the applicant to:

i. Demonstrate that no reasonably practicable alternative design or method of development exists that would have a lesser impact on the Water Quality Resource Area than the one proposed; and

ii. If no such reasonably practicable alternative design or method of development exists, the project should be conditioned to limit its disturbance and impact on the Water Quality Resource to the minimum extent necessary to achieve the proposed addition, alteration, restoration, replacement or rehabilitation; and

iii. Provide mitigation to ensure that impacts to the functions and values of the Water Quality Resource Area will be mitigated or restored to the extent practicable.

4. Cities and counties may choose not to apply the Water Quality and Flood Management Area performance standards of Section 3.07.340 to development necessary for the placement of structures when it does not require a grading or building permit.

5. Metro encourages cities and counties to provide for restoration and enhancement of degraded Water Quality Resource Areas through conditions of approval when development is proposed, or through incentives or other means.

6. Cities and counties shall apply the performance standards of this title to Title 3 Wetlands as shown on the Metro Water Quality and Flood Management Areas Map and locally adopted Water Quality and Flood Management Areas maps. Cities and counties may also apply the performance standards of this title to other wetlands.

E. Map Administration.

Cities and counties shall amend their comprehensive plans and implementing ordinances to provide a process for each of the following:

1. Amendments to city and county adopted Water Quality and Flood Management Area maps to correct the location of Protected Water Features, Water Quality Resource Areas and Flood Management Areas. Amendments shall be initiated within 90 days of the date the city or county receives information establishing a possible map error.

2. Modification of the Water Quality Resource Area upon demonstration that the modification will offer the same or better protection of water quality, the Water Quality and Flood Management Area and Protected Water Feature.

3. Amendments to city and county adopted Water Quality and Flood Management Area maps to add Title 3 Wetlands when the city or county receives significant evidence that a wetland meets any one of the following criteria:

   a. The wetland is fed by surface flows, sheet flows or precipitation, and has evidence of flooding during the growing season, and has 60 percent or greater vegetated cover, and is over one-half acre in size;

      or the wetland qualifies as having "intact water quality function" under the 1996 Oregon Freshwater Wetland Assessment Methodology; or

   b. The wetland is in the Flood Management Area, and has evidence of flooding during the growing season, and is five acres or more in size, and has a restricted outlet or no outlet;

      or the wetland qualifies as having "intact hydrologic control function" under the 1996 Oregon Freshwater Wetland Assessment Methodology; or

   c. The wetland or a portion of the wetland is within a horizontal distance of less than one-fourth mile from a water body which meets the Department of Environmental Quality definition of "water quality limited water body" in OAR Chapter 340, Division 41.

   Examples of significant evidence that a wetland exists that may meet the criteria above are a wetland assessment conducted using the 1996 Oregon Freshwater Wetland Assessment Methodology, or correspondence from the Division of State Lands that a wetland determination or delineation has been submitted or completed for property in the city or county.

4. Cities and counties are not required to apply the criteria in Section 3.07.340(E)(3) to water quality or stormwater detention facilities.

Amendment 5. Metro Code Section 3.07.350, "Fish and Wildlife Habitat Conservation Area," shall be repealed.

Amendment 6. Metro Code Section 3.07.360, "Metro Model Ordinance Required," shall be amended as follows:

Metro shall adopt a Water Quality and Flood Management Areas Model Ordinance and map. The Model Ordinance shall represent one method of complying with this title. The Model Ordinance shall be advisory, and cities and counties are not required to adopt the Model Ordinance, or any part thereof, to substantially comply with this title. However, cities and counties which adopt the Model Ordinance in its entirety and a Water Quality and Flood Management Areas Map shall be deemed to have substantially complied with the requirements of this title.

~~Section 3.07.350 of this title shall be implemented by adoption of new functional plan provisions. The Metro Council may adopt a Fish and Wildlife Habitat Conservation Areas Model Ordinance and Map for protection of regionally significant fish and wildlife habitat.~~

Amendment 7. Metro Code Section 3.07.370, "Variances," shall be repealed.

Amendment 8. Metro Code Section 3.07.810, "Compliance With the Functional Plan," shall be amended as follows:

A. The purpose of this section is to establish a process for determining whether city or county comprehensive plans and land use regulations comply with requirements of the Urban Growth Management Functional Plan. The Council intends the process to be efficient and cost-effective and to provide an opportunity for the Metro Council to interpret the requirements of its functional plan. Where the terms "compliance" and "comply" appear in this title, the terms shall have the meaning given to "substantial compliance" in Section 3.07.1010~~(rrr)~~.

B. Cities and counties shall amend their comprehensive plans and land use regulations to comply with the functional plan, or an amendment to the functional plan, within two years after its acknowledgement by the Land Conservation and Development Commission, or after such other date specified in the functional plan. The Chief Operating Officer shall notify cities and counties of the compliance date.

C. Notwithstanding subsection ~~A~~B of this section, cities and counties shall amend their comprehensive plans and land use regulations to comply with Sections 3.07.310 to 3.07.340 of Title 3 of the Urban Growth Management Functional Plan by January 31, 2000, and with the requirements in Sections 3.07.710 to 3.07.760 of Title 7 of the Urban Growth Management Functional Plan by January 18, 2003.

D. Cities and counties that amend their comprehensive plans or land use regulations after the effective date of the functional plan shall make the amendments in compliance with the functional plan. After one year following acknowledgement of a functional plan requirement adopted or amended by the Metro Council after January 1, 2005, cities and counties that amend their comprehensive plans and land use regulations shall make such amendments in compliance with the new functional plan requirement. The Chief Operating Officer shall notify cities and counties of the effective date.

E. ~~Cities and counties whose comprehensive plans and land use regulations do not yet comply with a functional plan requirement adopted or amended prior to December 12, 1997, shall make land use decisions consistent with that requirement.~~ If ~~the~~a functional plan requirement was adopted or amended by the Metro Council after December 12, 1997, cities and counties whose comprehensive plans and land use regulations do not yet comply with the requirement shall, after one year following acknowledgment of the requirement, make land use decisions consistent with that requirement. Notwithstanding the previous sentence, however, cities and counties whose comprehensive plans and land use regulations do not yet comply with the requirements of Title 13 of this chapter, Metro Code sections 3.07.1310 to 3.07.1360, shall make land use decisions consistent with those requirements after two years following their acknowledgment. The Chief Operating Officer shall notify cities and counties of the date upon which functional plan requirements become applicable to land use decisions at least 120 days before that date. The notice shall specify which functional plan requirements become applicable to land use decisions in each city and county. For the purposes of this subsection, "land use decision" shall have the meaning of that term as defined in ORS 197.015(10).

F. An amendment to a city or county comprehensive plan or land use regulation shall be deemed to comply with the functional plan if no appeal to the Land Use Board of Appeals is made within the 21-day period set forth in ORS 197.830(9), or if the amendment is acknowledged in periodic review pursuant to ORS 197.633 or 197.644. If an appeal is made and the amendment is affirmed, the amendment shall be deemed to comply with the functional plan upon the final decision on appeal. Once the amendment is deemed to comply with the functional plan, the functional plan shall no longer apply to land use decisions made in conformance with the amendment.

G. An amendment to a city or county comprehensive plan or land use regulation shall be deemed to comply with the functional plan as provided in subsection F only if the city or county provided notice to the Chief Operating Officer as required by Section 3.07.820(A).

<u>Amendment 9.</u> Metro Code Section 3.07.1010, "Definitions," shall be amended as follows:

For the purpose of this functional plan, the following definitions shall apply:

(a) "Accessibility" means the amount of time required to reach a given location or service by any mode of travel.

(b) "Accessway" means right-of-way or easement designed for public access by bicycles and pedestrians, and may include emergency vehicle passage.

(c) "Alternative modes" means alternative methods of travel to the automobile, including public transportation (light rail, bus and other forms of public transportation), bicycles and walking.

(d) "Balanced cut and fill" means no net increase in fill within the floodplain.

(e) "Bikeway" means separated bike paths, striped bike lanes, or wide outside lanes that accommodate bicycles and motor vehicles.

(f) "Boulevard design" means a design concept that emphasizes pedestrian travel, bicycling and the use of public transportation, and accommodates motor vehicle travel.

(g) "Calculated capacity" means the number of dwelling units and jobs that can be contained in an area based on the calculation required by this functional plan.

(h) "Capacity expansion" means constructed or operational improvements to the regional motor vehicle system that increase the capacity of the system.

(i) "Comprehensive plan" means the all inclusive, generalized, coordinated land use map and policy statement of cities and counties defined in ORS 197.015(5).

(j) "Connectivity" means the degree to which the local and regional street systems in a given area are interconnected.

(k) "DBH" means the diameter of a tree measured at breast height.

(l) “Design flood elevation” means the elevation of the 100-year storm as defined in FEMA Flood Insurance Studies or, in areas without FEMA floodplains, the elevation of the 25-year storm, or the edge of mapped flood prone soils or similar methodologies.

(m) “Design type” means the conceptual areas described in the Metro 2040 Growth Concept text and map in Metro's regional goals and objectives, including central city, regional centers, town centers, station communities, corridors, main streets, inner and outer neighborhoods, industrial areas, and employment areas.

(n) “Designated beneficial water uses” means the same as the term as defined by the Oregon Department of Water Resources, which is: an instream public use of water for the benefit of an appropriator for a purpose consistent with the laws and the economic and general welfare of the people of the state and includes, but is not limited to, domestic, fish life, industrial, irrigation, mining, municipal, pollution abatement, power development, recreation, stockwater and wildlife uses.

(o) “Development” means any man-made change defined as buildings or other structures, mining, dredging, paving, filling, or grading in amounts greater than ten (10) cubic yards on any lot or excavation. In addition, any other activity that results in the removal of more than 10 percent of the vegetation in the Water Quality Resource Area on the lot is defined as development, for the purpose of Title 3 except that ~~more~~ less than 10 percent removal of vegetation on a lot must comply with Section 3.07.340(C) - Erosion and Sediment Control. In addition, any other activity that results in the removal of more than either 10 percent or 20,000 square feet of the vegetation in the Habitat Conservation Areas on the lot is defined as development, for the purpose of Title 13. Development does not include the following: (1) Stream enhancement or restoration projects approved by cities and counties; (2) Farming practices as defined in ORS 30.930 and farm use as defined in ORS 215.203, except that buildings associated with farm practices and farm uses are subject to the requirements of Titles 3 and 13; and (3) Construction on lots in subdivisions meeting the criteria of ORS 92.040(2).

(p) “Development application” means an application for a land use decision, limited land decision including expedited land divisions, but excluding partitions as defined in ORS 92.010(7) and ministerial decisions such as a building permit.

(q) “Ecological functions” means the biological and hydrologic characteristics of healthy fish and wildlife habitat. Riparian ecological functions include microclimate and shade, streamflow moderation and water storage, bank stabilization and sediment/pollution control, sources of large woody debris and natural channel dynamics, and organic material sources. Upland wildlife ecological functions include size of habitat area, amount of habitat with interior conditions, connectivity of habitat to water resources, connectivity to other habitat areas, and presence of unique habitat types.

~~(q) “DLCD Goal 5 ESEE” means a decision process local governments carry out under OAR 660-023-0040.~~

(r) “Emergency” means any man-made or natural event or circumstance causing or threatening loss of life, injury to person or property, and includes, but is not limited to, fire, explosion, flood, severe weather, drought earthquake, volcanic activity, spills or releases of oil or hazardous material, contamination, utility or transportation disruptions, and disease.

(s) "Enhancement" means the process of improving upon the natural functions and/or values of an area or feature which has been degraded by human activity. Enhancement activities may or may not return the site to a pre-disturbance condition, but create/recreate processes and features that occur naturally.

(t) "Fill" means any material such as, but not limited to, sand, gravel, soil, rock or gravel that is placed in a wetland or floodplain for the purposes of development or redevelopment.

(u) "Flood Areas" means those areas contained within the 100-year floodplain and floodway as shown on the Federal Emergency Management Agency Flood Insurance Maps and all lands that were inundated in the February 1996 flood.~~"Fish and Wildlife Habitat Conservation Area" means the area defined on the Metro Water Quality and Flood Management Area Map to be completed and attached hereto[1]. These include all Water Quality and Flood Management Areas that require regulation in order to protect fish and wildlife habitat. This area has been mapped to generally include the area 200 feet from top of bank of streams in undeveloped areas with less than 25% slope, and 100 feet from edge of mapped wetland on undeveloped land.~~

(v) "Flood Management Areas" means all lands contained within the 100-year floodplain, flood area and floodway as shown on the Federal Emergency Management Agency Flood Insurance Maps and the area of inundation for the February 1996 flood. In addition, all lands which have documented evidence of flooding.

(w) "Floodplain" means land subject to periodic flooding, including the 100-year floodplain as mapped by FEMA Flood Insurance Studies or other substantial evidence of actual flood events.

(x) "Full street connection" means right-of-way designed for public access by motor vehicles, pedestrians and bicycles.

~~(y) "Functions and values of stream corridors" means stream corridors have the following functions and values: water quality retention and enhancement, flood attenuation, fish and wildlife habitat, recreation, erosion control, education, aesthetic, open space and wildlife corridor.~~

(y) "Growth Concept Map" means the conceptual map demonstrating the 2040 Growth Concept design types attached to this plan[2].

(z) "Habitat Conservation Area" or "HCA" means an area identified on the Habitat Conservation Areas Map and subject to the performance standards and best management practices described in Section 4 of Title 13.

(aa) "Habitat-friendly development" means a method of developing property that has less detrimental impact on fish and wildlife habitat than does traditional development methods. Examples include clustering development to avoid habitat, using alternative materials and designs such as pier, post, or piling foundations designed to minimize tree root disturbance, managing storm water on-site to help filter rainwater and recharge groundwater sources, collecting rooftop water in rain barrels for reuse in site landscaping and gardening, and reducing the amount of effective impervious surface created by development.

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[1] On file in the Metro Council office.
[2] On file in the Metro Council office.

(bb) “Habitats of Concern” means the following unique or unusually important wildlife habitat areas as identified based on cite specific information provided by local wildlife or habitat experts: Oregon white oak woodlands, bottomland hardwood forests, wetlands, native grasslands, riverine islands or deltas, and important wildlife migration corridors.

~~(aa)~~(cc) “Hazardous materials” means materials described as hazardous by Oregon Department of Environmental Quality.

~~(bb)~~(dd) “Implementing ordinances or regulations” means any city or county land use regulation as defined by ORS 197.015(11) which includes zoning, land division or other ordinances which establish standards for implementing a comprehensive plan.

~~(cc)~~(ee) “Improved pedestrian crossing.” An improved pedestrian crossing is marked and may include signage, signalization, curb extensions and a pedestrian refuge such as a landscaped median.

~~(dd)~~(ff) “Invasive non-native or noxious vegetation” means plants listed as nuisance plants or prohibited plants on the Metro Native Plant List as adopted by Metro Council resolution because they are plant species that have been introduced and, due to aggressive growth patterns and lack of natural enemies in the area where introduced, spread rapidly into native plant communities~~, or which are not listed on the Metro Native Plant List as adopted by Metro Council resolution~~.

(gg) “Land Conservation and Development Commission” or “LCDC” means the Oregon Land Conservation and Development Commission.

~~(ee)~~(hh) “Landscape strip” means the portion of public right-of-way located between the sidewalk and curb.

(ii) “Land use regulation” means any local government zoning ordinance, land division ordinance adopted under ORS 92.044 or 92.046 or similar general ordinance establishing standards for implementing a comprehensive plan, as defined in ORS 197.015.

~~(ff)~~(jj) “Level-of-service (LOS)” means the ratio of the volume of motor vehicle demand to the capacity of the motor vehicle system during a specific increment of time.

(kk) “Local program effective date” means the effective date of a city’s or county’s new or amended comprehensive plan and implementing ordinances adopted to comply with Title 13 of the Urban Growth Management Functional Plan, Sections 1 to 6 of Exhibit C to Ordinance No. 05-1077. If a city or county is found to be in substantial compliance with Title 13 without making any amendments to its comprehensive plan or land use regulations, then the local program effective date shall be the effective date of Ordinance No. 05-1077. If a city or county amends its comprehensive plan or land use regulations to comply with Title 13, then the local program effective date shall be the effective date of the city’s or county’s amendments to its comprehensive plan or land use regulations, but in no event shall the local program effective date be later than two years after Title 13 is acknowledged by LCDC. For territory brought within the Metro UGB after the effective date of Metro Ordinance No. 05-1077, the local program effective date shall be the effective date of the ordinance adopted by the Metro Council to bring such territory within the Metro UGB.

~~(gg)~~(ll) “Local trips.” Local vehicle trips are trips that are five miles or shorter in length.

~~(hh)~~(mm)"Median" means the center portion of public right-of-way, located between opposing directions of motor vehicle travel lanes. A median is usually raised and may be landscaped, and usually incorporates left turn lanes for motor vehicles at intersections and major access points.

~~(ii)~~(nn) "Metro" means the regional government of the metropolitan area, the elected Metro Council as the policy setting body of the government.

~~(jj)~~(oo) "Metro boundary" means the jurisdictional boundary of Metro, the elected regional government of the metropolitan area.

~~(kk)~~(pp)"Metro Urban Growth Boundary" or "Metro UGB" means the urban growth boundary as adopted and amended by the Metro Council, consistent with state law.

~~(ll)~~(qq) "Mitigation" means the reduction of adverse effects of a proposed project by considering, in the following order: (1) avoiding the impact all together by not taking a certain action or parts of an action; (2) minimizing impacts by limiting the degree or magnitude of the action and its implementation; (3) rectifying the impact by repairing, rehabilitating or restoring the ~~e~~affected environment; (4) reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action by monitoring and taking appropriate measures; and (5) compensating for the impact by replacing or providing comparable substitute water quality resource areas or habitat conservation areas.

~~(mm)~~(rr)"Mixed use" means comprehensive plan or implementing regulations that permit a mixture of commercial and residential development.

~~(nn)~~(ss) "Mixed-use development" includes areas of a mix of at least two of the following land uses and includes multiple tenants or ownerships: residential, retail and office. This definition excludes large, single-use land uses such as colleges, hospitals, and business campuses. Minor incidental land uses that are accessory to the primary land use should not result in a development being designated as "mixed-use development." The size and definition of minor incidental, accessory land uses allowed within large, single-use developments should be determined by cities and counties through their comprehensive plans and implementing ordinances.

~~(oo)~~(tt) "Mobility" means the speed at which a given mode of travel operates in a specific location.

~~(pp)~~(uu)"Mode-split target" means the individual percentage of public transportation, pedestrian, bicycle and shared-ride trips expressed as a share of total person-trips.

~~(qq)~~(vv)"Motor vehicle" means automobiles, vans, public and private buses, trucks and semi-trucks, motorcycles and mopeds.

~~(rr)~~(ww)"Multi-modal" means transportation facilities or programs designed to serve many or all methods of travel, including all forms of motor vehicles, public transportation, bicycles and walking.

~~(ss)~~(xx) "Narrow street design" means streets with less than 46 feet of total right-of-way and no more than 28 feet of pavement width between curbs.

~~(tt)~~(yy) "Native vegetation" or "native plant" means any vegetation ~~native to the Portland metropolitan area or~~ listed as a native plant on the Metro Native Plant ~~l~~List as adopted by Metro Council resolution and any other vegetation native to the Portland metropolitan area provided that it is not listed as a nuisance plant or a prohibited plant on the Metro Native Plant List.

~~(uu)~~(zz)"Net acre" means an area measuring 43.560 square feet which excludes:

- Any developed road rights-of-way through or on the edge of the land; and
- Environmentally constrained areas, including any open water areas, floodplains, natural resource areas protected under statewide planning Goal 5 in the comprehensive plans of cities and counties in the region, slopes in excess of 25 percent and wetlands requiring a Federal fill and removal permit under Section 404 of the Clean Water Act. These excluded areas do not include lands for which the local zoning code provides a density bonus or other mechanism which allows the transfer of the allowable density or use to another area or to development elsewhere on the same site; and
- All publicly-owned land designated for park and open spaces uses.

~~(vv)~~(aaa)"Net developed acre" consists of 43,560 square feet of land, after excluding present and future rights-of-way, school lands and other public uses.

(bbb) "Net vacant buildable land" means all vacant land less all land that is: (1) within Water Quality Resource Areas; (2) within Habitat Conservation Areas; (3) publicly owned by a local, state or federal government; (4) burdened by major utility easements; and (5) necessary for the provision of roads, schools, parks, churches, and other public facilities.

~~(ww)~~(ccc)"Perennial streams" means all primary and secondary perennial water ways as mapped by the U.S. Geological Survey.

~~(xx)~~(ddd)"Performance measure" means a measurement derived from technical analysis aimed at determining whether a planning policy is achieving the expected outcome or intent associated with the policy.

~~(yy)~~(eee)"Person-trips" means the total number of discrete trips by individuals using any mode of travel.

~~(zz)~~(fff)"Persons per acre" means the intensity of building development by combining residents per net acre and employees per net acre.

~~(aaa)~~(ggg)"Practicable" means available and capable of being done after taking into consideration cost, existing technology, and logistics in light of overall project purpose. As used in Title 13 of this functional plan, "practicable" means available and capable of being done after taking into consideration cost, existing technology, and logistics in light of overall project purpose and probable impact on ecological functions.

~~(bbb)~~(hhh)"Primarily developed" means areas where less than 10% of parcels are either vacant or underdeveloped.

~~(ccc)~~(iii)"Protected Water Features"

Primary Protected Water Features shall include:

- Title 3 wetlands; and

- Rivers, streams, and drainages downstream from the point at which 100 acres or more are drained to that water feature (regardless of whether it carries year-round flow); and

- Streams carrying year-round flow; and

- Springs which feed streams and wetlands and have year-round flow; and

- Natural lakes.

Secondary Protected Water Features shall include intermittent streams and seeps downstream of the point at which 50 acres are drained and upstream of the point at which 100 acres are drained to that water feature.

~~(ddd)~~(jjj)"Redevelopable land" means land on which development has already occurred which, due to present or expected market forces, there exists the strong likelihood that existing development will be converted to more intensive uses during the planning period.

~~(eee)~~(kkk)"Regional Goals and Objectives" are the land use goals and objectives that Metro is required to adopt under ORS 268.380(1).

~~(fff)~~(lll) "Regional vehicle trips" are trips that are greater than five miles in length.

(mmm) "Regionally significant fish and wildlife habitat" means those areas identified on the Regionally Significant Fish and Wildlife Habitat Inventory Map, adopted in Section 2 of Title 13, as significant natural resource sites.

~~(ggg)~~(nnn)"Restoration" means the process of returning a disturbed or altered area or feature to a previously existing natural condition. Restoration activities reestablish the structure, function, and/or diversity to that which occurred prior to impacts caused by human activity.

~~(hhh)~~(ooo)"Retail" means activities which include the sale, lease or rent of new or used products to the general public or the provision of product repair or services for consumer and business goods. Hotels or motels, restaurants or firms involved in the provision of personal services or office space are not considered retail uses.

~~(iii)~~(ppp)"Riparian area" means the water influenced area adjacent to a river, lake or stream consisting of the area of transition from an hydric ecosystem to a terrestrial ecosystem where the presence of water directly influences the soil-vegetation complex and the soil-vegetation complex directly influences the water body. It can be identified primarily by a combination of geomorphologic and ecologic characteristics.

~~(jjj)~~(qqq)"Routine repair and maintenance" means activities directed at preserving an existing allowed use or facility, without expanding the development footprint or site use.

~~(kkk)~~(rrr)"Shared-ride" means private passenger vehicles carrying more than one occupant.

~~(lll)~~(sss)"Significant increase in Single Occupancy Vehicle (SOV) capacity for multi-modal arterials." An increase in SOV capacity created by the construction of additional general purpose lanes totaling ½ lane miles or more in length. General purpose lanes are defined as through travel lanes or multiple turn lanes. This also includes the construction of a new general purpose highway facility on a new location. Lane tapers are not included as part of the general purpose lane. Significant increases in SOV capacity should be assessed for individual facilities rather than for the planning area.

~~(mmm)~~(ttt)“Significant increase in Single Occupancy Vehicle (SOV) capacity for regional through-route freeways.” Any increase in SOV capacity created by the construction of additional general purpose lanes other than that resulting from a safety project or a project solely intended to eliminate a bottleneck. An increase in SOV capacity associated with the elimination of a bottleneck is considered significant only if such an increase provides a highway section SOV capacity greater than ten percent over that provided immediately upstream of the bottleneck. An increase in SOV capacity associated with a safety project is considered significant only if the safety deficiency is totally related to traffic congestion. Construction of a new general purpose highway facility on a new location also constitutes a significant increase in SOV capacity. Significant increase in SOV capacity should be assessed for individual facilities rather than for the planning area.

~~(nnn)~~(uuu)“Significant negative impact” means an impact that affects the natural environment, considered individually or cumulatively with other impacts on the Water Quality Resource Area, to the point where existing water quality functions and values are degraded.

~~(ooo)~~(vvv)“Single occupancy vehicle (SOV)” means private passenger vehicles carrying one occupant.

~~(ppp)~~(www)“Straight-line distance” means the shortest distance measured between two points.

~~(qqq)~~(xxx)“Stream” means a body of running water moving over the earth’s surface in a channel or bed, such as a creek, rivulet or river. It flows at least part of the year, including perennial and intermittent streams. Streams are dynamic in nature and their structure is maintained through build-up and loss of sediment.

~~(rrr)~~(yyy)“Substantial compliance” means city and county comprehensive plans and implementing ordinances, on the whole, conform with the purposes of the performance standards in the functional plan and any failure to meet individual performance standard requirements is technical or minor in nature.

~~(sss)~~(zzz)“Target capacities” means the capacities in Table 3.07-1 required to be demonstrated by cities and counties for compliance with Title 1, Section 3.07.120.

~~(ttt)~~(aaaa)“Target densities” means the average combined household and employment densities established for each design type in the RUGGO 2040 Growth Concept.

~~(uuu)~~(bbbb)“Title 3 Wetlands” means wetlands of metropolitan concern as shown on the Metro Water Quality and Flood Management Area Map and other wetlands added to city or county adopted Water Quality and Flood Management Area maps consistent with the criteria in Title 3, Section 3.07.340(E)(3). Title 3 wetlands do not include artificially constructed and managed stormwater and water quality treatment facilities.

~~(vvv)~~(cccc)“Top of bank” means the same as “bankfull stage” defined in OAR 141-085-0010~~(2)~~.

~~(www)~~(dddd)“Traffic calming” means street design or operational features intended to maintain a given motor vehicle travel speed.

(eeee) “Urban development value” means the economic value of a property lot or parcel as determined by analyzing three separate variables: assessed land value, value as a property that could generate jobs (“employment value”), and the Metro 2040 design type designation of property. The urban development value of all properties containing regionally significant fish and wildlife habitat is depicted on the Metro Habitat Urban Development Value Map referenced in Section 4(E) of Title 13.

(ffff) “Urban Growth Boundary” or “UGB” means an urban growth boundary adopted pursuant to ORS chapter 197.

~~(xxx)~~(gggg)“Underdeveloped parcels” means those parcels of land with less than 10% of the net acreage developed with permanent structures.

~~(yyy)~~(hhhh)“Utility facilities” means buildings, structures or any constructed portion of a system which provides for the production, transmission, conveyance, delivery or furnishing of services including, but not limited to, heat, light, water, power, natural gas, sanitary sewer, stormwater, telephone and cable television.

~~(zzz)~~(iiii)“Vacant land” means land identified in the Metro or local government inventory as undeveloped land.

~~(aaaa)~~(jjjj)“Variance” means a discretionary decision to permit modification of the terms of an implementing ordinance based on a demonstration of unusual hardship or exceptional circumstance unique to a specific property.

~~(bbbb)~~(kkkk)“Visible or measurable erosion.” Visible or measurable erosion includes, but is not limited to:

- Deposits of mud, dirt sediment or similar material exceeding one-half cubic foot in volume on public or private streets, adjacent property, or onto the storm and surface water system, either by direct deposit, dropping discharge, or as a result of the action of erosion.

- Evidence of concentrated flows of water over bare soils; turbid or sediment laden flows; or evidence of on-site erosion such as rivulets on bare soil slopes, where the flow of water is not filtered or captured on the site.

- Earth slides, mudflows, earth sloughing, or other earth movement that leaves the property.

(llll) “Water feature” means all rivers, streams (regardless of whether they carry year-round flow, i.e., including intermittent streams), springs which feed streams and wetlands and have year-round flow, Flood Management Areas, wetlands, and all other bodies of open water.

~~(cccc)~~(mmmm)“Water Quality and Flood Management Area” means an area defined on the Metro Water Quality and Flood Management Area Map, to be attached hereto[3]. These are areas that require regulation in order to mitigate flood hazards and to preserve and enhance water quality. This area has been mapped to generally include the following: stream or river channels, known and mapped wetlands, areas with flood-prone soils adjacent to the stream, floodplains, and sensitive water

[3] On file in Metro Council office.

areas. The sensitive areas are generally defined as 50 feet from top of bank of streams for areas of less than 25% slope, and 200 feet from top of bank on either side of the stream for areas greater than 25% slope, and 50 feet from the edge of a mapped wetland.

~~(dddd)~~(nnnn)"Water Quality Resource Areas" means vegetated corridors and the adjacent water feature as established in Title 3.

~~(eeee)~~(oooo)"Wetlands." Wetlands are those areas inundated or saturated by surface or ground water at a frequency and duration sufficient to support and under normal circumstances do support a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs and similar areas. Wetlands are those areas identified and delineated by a qualified wetland specialist as set forth in the 1987 Corps of Engineers Wetland Delineation Manual.

~~(ffff)~~(pppp)"Zoned capacity" means the highest number of dwelling units or jobs that are allowed to be contained in an area by zoning and other city or county jurisdiction regulations.

Amendment 10. Metro Code Section 3.07.1120, "Urban Growth Boundary Amendment Urban Reserve Plan Requirements," shall be amended as follows:

All territory added to the Urban Growth Boundary as either a major amendment or a legislative amendment pursuant to Metro Code chapter 3.01 shall be subject to adopted comprehensive plan provisions consistent with the requirements of all applicable titles of the Metro Urban Growth Management Functional Plan and in particular this Title 11. The comprehensive plan provisions shall be fully coordinated with all other applicable plans. The comprehensive plan provisions shall contain an urban growth plan diagram and policies that demonstrate compliance with the RUGGO, including the Metro Council adopted 2040 Growth Concept design types. Comprehensive plan amendments shall include:

A. Provision for annexation to the district and to a city or any necessary service districts prior to urbanization of the territory or incorporation of a city or necessary service districts to provide all required urban services.

B. Provision for average residential densities of at least 10 dwelling units per acre of net ~~developable residential acre~~vacant buildable land in zones in which residences are allowed, or other density prescribed by the Council in the ordinance adding the territory to the UGB~~lower densities which conform to the 2040 Growth Concept Plan design type designation for the area~~.

C. Demonstrable measures that will provide a diversity of housing stock that will fulfill needed housing requirements as defined by ORS 197.303. Measures may include, but are not limited to, implementation of recommendations in Title 7 of the Urban Growth Management Functional Plan.

D. Demonstration of how residential developments will include, without public subsidy, housing affordable to households with incomes at or below area median incomes for home ownership and at or below 80 percent of area median incomes for rental as defined by U.S. Department of Housing and Urban Development for the adjacent urban jurisdiction. Public subsidies shall not be interpreted to mean the following: density bonuses, streamlined permitting processes, extensions to the time at which systems development charges (SDCs) and other fees are collected, and other exercises of the regulatory and zoning powers.

E. Provision for sufficient commercial and industrial development for the needs of the area to be developed consistent with 2040 Growth Concept design types. Commercial and industrial designations in nearby areas inside the Urban Growth Boundary shall be considered in comprehensive plans to maintain design type consistency.

F. A conceptual transportation plan consistent with the applicable provision of the Regional Transportation Plan, Title 6 of the Urban Growth Management Functional Plan, and that is also consistent with the protection of natural resources either identified in acknowledged comprehensive plan inventories or as required by Title 3 of the Urban Growth Management Functional Plan. The plan shall, consistent with OAR Chapter 660, Division 11, include preliminary cost estimates and funding strategies, including likely financing approaches.

G. Identification~~,~~ and mapping ~~and a funding strategy for protecting~~of areas to be protected from development due to fish and wildlife habitat protection, water quality enhancement and mitigation, and natural hazards mitigation,~~.~~ including, without limitation, all Habitat Conservation Areas, Water Quality Resource Areas, and Flood Management Areas. A natural resource protection plan to protect fish and wildlife habitat, water quality enhancement areas, and natural hazard areas shall be completed as part of the comprehensive plan and zoning for lands added to the Urban Growth Boundary prior to urban development. The plan shall include zoning strategies to avoid and minimize the conflicts between planned future development and the protection of Habitat Conservation Areas, Water Quality Resource Areas, Flood Management Areas, and other natural hazard areas. The plan shall also include a preliminary cost estimate and funding strategy, including likely financing approaches, for options such as mitigation, site acquisition, restoration, enhancement, ~~or~~ and easement dedication to ensure that all significant natural resources are protected.

H. A conceptual public facilities and services plan for the provision of sanitary sewer, water, storm drainage, transportation, parks and police and fire protection. The plan shall, consistent with OAR Chapter 660, Division 11, include preliminary cost estimates and funding strategies, including likely financing approaches.

I. A conceptual school plan that provides for the amount of land and improvements needed, if any, for school facilities on new or existing sites that will serve the territory added to the UGB. The estimate of need shall be coordinated with affected local governments and special districts.

J. An urban growth diagram for the designated planning area showing, at least, the following, when applicable:

1. General locations of arterial, collector and essential local streets and connections and necessary public facilities such as sanitary sewer, storm sewer and water to demonstrate that the area can be served;

2. Location of steep slopes and unbuildable lands including but not limited to wetlands, floodplains and riparian areas;

3. Location of Habitat Conservation Areas;

~~3~~4. General locations for mixed use areas, commercial and industrial lands;

~~4~~5. General locations for single and multi-family housing;

~~5~~6. General locations for public open space, plazas and neighborhood centers; and

~~6~~7. General locations or alternative locations for any needed school, park or fire hall sites.

K. The plan amendments shall be coordinated among the city, county, school district and other service districts.

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EXHIBIT E—ORDINANCE NO. 05-1077C

METRO CODE CHAPTER 3.07
URBAN GROWTH MANAGEMENT FUNCTIONAL PLAN

TITLE 13 MODEL ORDINANCE

Table of Contents

Section 1. Intent
The purpose of this ordinance is to comply with Section 4 of Title 13 of Metro's Urban Growth Management Functional Plan.

A. To protect and improve the following functions and values that contribute to fish and wildlife habitat in urban streamside areas:

   1. Microclimate and shade;

   2. Stream-flow moderation and water storage;

   3. Bank stabilization, sediment and pollution control;

   4. Large wood recruitment and retention and channel dynamics; and

   5. Organic material sources.

B. To protect and improve the following functions and values that contribute to upland wildlife habitat in new urban growth boundary expansion areas:

   1. Large habitat patches

   2. Interior habitat

   3. Connectivity and proximity to water; and

   4. Connectivity and proximity to other upland habitat areas

C. To establish High, Moderate, and Low Habitat Conservation Areas (HCA) to implement the performance standards of Title 13 of the Urban Growth Management Functional Plan.

D. To provide clear and objective standards and a discretionary review process, applicable to development in Habitat Conservation Areas, in accordance with Statewide Land Use Planning Goal 5.

E. To allow and encourage habitat-friendly development, while minimizing the impact on fish and wildlife habitat functions.

F. To provide mitigation standards for the replacement of ecological functions and values lost through development in Habitat Conservation Areas.

Section 2. Applicability

A. This ordinance applies to all properties containing mapped Habitat Conservation Areas (HCA).

B. All applicants must provide Construction Management Plans, in accordance with Section 5 of this ordinance.

C. Where applicants are proposing development entirely outside of the HCA, but within 100 feet of its boundary, applicants must verify this boundary through the procedures outlined in Section 9 of this ordinance.

D. Where applicants are proposing development within the HCA, they must comply with the Development Standards found in Section 6 and Section 7 of this ordinance, and the Map Verification procedures found in Section 9 of this ordinance. Conditioned Uses, and Activities that are exempt from these requirements, may be found in Section 3 of this ordinance.

E. Applicants proposing to partition or subdivide properties containing HCA must comply with the partition and subdivision standards found in Section 6(F) of this ordinance, or the Discretionary standards in Section 7 of this ordinance; as well as the Map Verification procedure in Section 9 of this ordinance.

F. The Development Standards found in Sections 6 and 7 of this ordinance do not apply to development that occurs entirely outside of any portion of the HCA.

G. The requirements of this ordinance apply in addition to other applicable local, state, regional, and federal development requirements, including those for Water Quality Resource Areas and Flood Management Areas; except that:

1. Applicants using the discretionary review process in Section 7 of this ordinance do not need to engage in any additional review process for Water Quality Resource Areas; and

2. This ordinance shall not impose any mitigation requirements for wetlands beyond those required by federal and state law.

H. "Development," "Partition," and "Subdivision" are defined in Section 11 of this ordinance.

Section 3. Exempt Uses and Conditioned Activities

The following uses and activities are exempt from the requirements of this chapter:

A. Change of ownership.

B. Where construction of a residence was completed before January 1, 2006, the owners or residents shall not be restricted from engaging in any development that was allowed prior to September 22, 2005; unless such development required obtaining a land use decision, or a building, erosion control, or grading permit.

C. A building permit for a phased development project for which the applicant has previously met the application requirements, so long as the site for new construction was identified on the original permit and no new portion of the HCA will be disturbed.

D. Where a property has been subdivided under subsection 6(F) of this ordinance, and the mitigation requirements of subsection 6(E) (and, if appropriate, subsections 7(B) and 7(C)) have been completed for the subdivision, development on the individual lots may proceed without further review under this ordinance. Similarly, where a property has been subdivided under subsection 7(D) of this ordinance, and the mitigation requirements of subsection 7(D) have been completed for the subdivision, development on the individual lots may proceed without further review under this ordinance.

E. Limited types of development, redevelopment, operations, and improvements, including the following:

1. Maintenance, alteration, expansion, repair and replacement of existing structures provided that the building footprint is not increased.

2. The alteration, expansion, or replacement of existing structures, provided that:

   a. The alteration, expansion, or replacement of a structure will not intrude more than 500 sq. ft. into the HCA in addition to the area defined as the building footprint as of January 1, 2006; and

   b. The new intrusion into the HCA is no closer to the protected water feature than the pre-existing structure or improvement.

3. Minor encroachments not to exceed 120 sq. ft. of impervious surface such as accessory buildings, eave overhangs, exterior building improvements for access and exiting requirements, or other similar features.

4. Temporary and minor clearing not to exceed 200 square feet for the purpose of site investigations and pits for preparing soil profiles, provided that such areas are restored to their original condition when the investigation is complete.

5. Up to 10% of vegetative cover within the original mapped HCA on a lot or parcel may be removed, provided that no more than 20,000 square feet is removed; and provided that if more than 10% has been removed at the time of a development application, the review process shall use the original mapped HCA, subject to map verification, as the basis for determining the Maximum Disturbance Area in Section 6(C) of this ordinance and Mitigation standards in Sections 6(E) and 7(B), 7(C), 7(D)(1)(b) and 7(D)(2)(d) of this ordinance.

6. Maintenance of existing gardens, pastures, lawns and landscape perimeters, including the installation of new irrigation systems within existing gardens, pastures, lawns, and landscape perimeters.

7. Removal of plants identified as nuisance or prohibited plants on the *Metro Native Plant List* and the planting or propagation of plants identified as native plants on the *Metro Native Plant List*. Handheld tools must be used to remove nuisance or prohibited plants, and after such removal all open soil areas greater than 25 square feet must be replanted.

8. Farming practices and farm uses on land within an exclusive farm use zone established under ORS 215.203, within an area designated as marginal land under ORS 197.247 (1991 Edition), or on other agricultural lands, except that this exemption does not apply to buildings associated with farm practices or farm uses. "Farming practice" as used in this subsection shall have the meaning set out in ORS 30.930. "Farm use" as used in this subsection shall have the meaning set out in ORS 215.203.

9. Forest practices on forestlands situated outside the Metro UGB, except as provided in ORS 527.722(2), (3), and (4). "Forest practices" and "forestlands" as used in this subsection shall have the meaning set out in ORS 30.930.

10. Maintenance, alteration, repair, and replacement of roads and utilities when no additional incursion into the HCA is proposed.

11. Maintenance and repair of existing streets, railroads, shipping terminals, and utilities within rights-of-way, easements, and access roads.

12. Existing water-dependent uses that can only be carried out on, in, or adjacent to water because they require access to the water for waterborne transportation or recreation.

13. Operation, maintenance, and repair of manmade water control facilities such as irrigation and drainage ditches, constructed ponds or lakes, wastewater facilities, and stormwater pretreatment facilities.

14. Projects with the sole purpose of restoring or enhancing wetlands, streams, or fish and wildlife habitat areas, provided that the project is part of an approved local, state, or federal restoration or enhancement plan.

15. Low-impact outdoor recreation facilities for public use, outside of Water Quality Resource Areas, including, but not limited to, multi-use paths, access ways, trails, picnic areas, or interpretive and educational displays and overlooks that include benches and outdoor furniture, provided that the facility meets the following requirements:

    a. It contains less than 500 sq. ft. of new impervious surface; and,

    b. Its trails shall be constructed using non-hazardous, pervious materials, with a maximum width of four feet.

F. Emergency procedures or activities undertaken which are necessary to remove or abate hazards and nuisances or for the protection of public health, safety and welfare; provided that such remedial or preventative action must take place within a timeframe too short to allow for compliance with the requirements of this ordinance. After the emergency, the person or agency undertaking the action shall fully restore any impacts to the HCA resulting from the emergency action. Hazards that may be removed or abated include those required to maintain aircraft safety.

G. Multnomah County Drainage District - Within Habitat Conservation Areas located in Multnomah County Drainage District No. 1, Peninsula Drainage District No. 1, Peninsula Drainage District No. 2, and the area managed by the Sandy Drainage Improvement Company, routine operations, repair, maintenance, reconfiguration, rehabilitation, or replacement of existing drainage and flood control facilities, and existing related facilities, including any structures, pump stations, water control structures, culverts, irrigation systems, roadways, utilities, accessory uses (such as off-load facilities that facilitate water-based maintenance), erosion control projects, levees, soil and bank stabilization projects, dredging and ditch clearing within the hydraulic cross-section in existing storm water conveyance drainageways, or other water quality and flood storage projects applicable to existing facilities and required to be undertaken pursuant to ORS chapters 547 or 554 or Titles 33 or 44 of the Code of Federal Regulations, shall be allowed, provided that:

    1. The project is consistent with all other applicable local, state, and federal laws and regulations;

2. The project does not encroach closer to a surface stream or river, wetland, or other body of open water than existing operations and development;

3. Disturbed areas are replanted with vegetation and no bare soils remain after project completion; the planting of native vegetation and removal of invasive non-native or noxious vegetation is encouraged; invasive non-native or noxious vegetation shall not be planted; and,

4. Each district submits an annual report, to all local permitting agencies in which the district operates, describing the projects the district completed in the previous year and how those projects complied with all applicable federal and state laws and requirements.

H. Wildlife Hazard Management Areas - Any activity that is required to implement a Federal Aviation Administration (FAA)-compliant Wildlife Hazard Management Plan (WHMP) on property owned by the Port of Portland within 10,000 feet of an Aircraft Operating Area, as defined by the FAA, shall not have to comply with subsections 6(B-D), 7(D)(1)(a)(3) and (4), or 7(D)(2)(b), (c) and (e) of this ordinance. For disturbance within the HCA on property owned by the Port of Portland within 10,000 feet of an Aircraft Operating Area, as defined by the FAA, the applicant shall choose, at its sole discretion, between complying with subsection 6(E) of this ordinance or complying with subsection 7(C), or subsections 7(D)(1)(b) and 7(D)(2)(d) of this ordinance. Mitigation required pursuant to subsection 6(E) or 7(C), or 7(D)(1)(b) and 7(D)(2)(d) of this ordinance as part of any development within the HCA on property owned by the Port of Portland within 10,000 feet of an Aircraft Operating Area, as defined by the FAA, shall be permitted at any property located:

   1. Within the same 6th Field Hydrologic Unit Code subwatershed as delineated by the United States Department of Agriculture's Natural Resources Conservation Service (NRCS) if on-site mitigation would conflict with FAA-compliant WHMP; or

   2. Outside of the same 6th Field Hydrologic Unit Code subwatershed as delineated by the United States Department of Agriculture's Natural Resources Conservation Service (NRCS) only if the applicant follows the discretionary review process in section 7 of this ordinance.

Section 4. Prohibitions

A. The planting of any invasive non-native or noxious vegetation is prohibited within the HCA.

B. Outside storage of materials is prohibited within the HCA, unless such storage began before the effective date of this ordinance; or, unless such storage is approved during development review under either Section 6 or Section 7 of this ordinance.

Section 5. Construction Management Plans

In order to ensure that trees and vegetation within HCAs are not damaged during construction, all applicants, even those not developing within an HCA, shall provide a construction management plan that includes the following information:

A. Location of site access and egress that construction equipment will use;

B. Equipment and material staging and stockpile areas;

C. Erosion and sediment control measures; and

D. Measures to protect trees and other vegetation located within the HCA, but outside of the disturbance area approved under the provisions of section 6 or section 7 of this ordinance.

Section 6. Development Standards
The development standards described in this section apply to all development and redevelopment that occurs entirely, or partially, within Habitat Conservation Areas, unless such development is exempt under Section 3, or, unless the applicant chooses to follow the discretionary process in Section 7 of this ordinance. This section also applies to subdivisions and partitions of properties that contain HCAs.

Application for a land use, building, grading, land division, or other development permit through the clear and objective process may be an administrative decision. [*Insert city/county decision-type here*.]

A. **Application Requirements.** Applications for a building permit or development permit must provide a development plan and accompanying narrative explanation that includes the following information in addition to any other building permit or development permit requirements. All of the application requirements must be met prior to approval of a building or development permit.

   1. Applicants must verify the HCA on their property as described in Section 9 of this ordinance.

   2. For the entire subject property (HCA and non-HCA), applicants must submit a scale map of the property that includes:

      a. Location of all High, Moderate, and Low HCAs on the property;

      b. Outline of any existing disturbance area, including the location of existing adjacent streets and paved areas, utilities, culverts, stormwater management facilities, or bridges;

      c. Location of any wetlands or water bodies on the property, including a delineation of the Water Quality Resource Area;

      d. Location of 100 year floodplain and floodway boundary as defined by the Federal Emergency Management Agency (FEMA) and the area of the 1996 flood inundation; and

      e. Topography shown by contour lines of 2-ft. intervals for slopes less than 15% and by 10 ft. intervals for slopes 15% or greater. On properties that are two acres or larger, such a contour map is required only for the portion of the property to be developed.

   3. Detailed site plan of proposed development outlining total disturbance area, including, proposed building footprints, site property improvements, utilities and landscaping.

   4. The following additional information shall be provided about the HCA:

      a. For properties containing less than one acre of HCA, the location of all trees within the HCA that are greater than six inches diameter at breast height (DBH), shall be identified by size and species. For properties containing one acre or more of HCA, the applicant may approximate the number of trees and the diameter range, and provide a listing of the dominant species;

      b. For proposed disturbance areas containing less than one acre of HCA, all trees with a diameter of six inches or greater that will be removed shall be specifically identified as to diameter at breast height (DBH) and species. For proposed disturbance areas containing one acre or more of HCA an approximate of the number of trees, their diameters and the dominant species; and

c. If grading will occur within the HCA, a grading plan showing the proposed alteration of the ground at 1-ft. vertical contours in areas of slopes less than 5%, and 2-ft. vertical contours in areas of slopes 6-15%, and at 5-ft. vertical contours of slopes 15% or greater.

B. **Methods for avoiding Habitat Conservation Areas.** The following habitat-friendly development practices may be used to avoid or minimize development within HCAs by allowing flexible site design. [*Cities/counties shall allow the following methods to avoid, or minimize, development within HCAs*]:

1. ***Building setback flexibility*** to avoid, or minimize, development within HCAs. The minimum building setback of the base zone may be reduced to any distance between the base zone minimum and zero, unless this reduction conflicts with applicable fire or life safety requirements.

2. ***Flexible landscaping requirements*** to avoid, or minimize, development within HCAs.

   a. Landscaping requirements, apart from those required for parking lots or street berms, may be met by preserving the HCA.

   b. Facilities that infiltrate stormwater onsite, including the associated piping, may be placed within the HCA so long as the forest canopy and the areas within the driplines of the trees are not disturbed. Such facilities may include, but are not limited to, vegetated swales, rain gardens, vegetated filter strip, and vegetated infiltration basins. Only native vegetation may be planted in these facilities.

3. ***Flexible Site Design*** (On-site Density Transfer) to avoid or minimize development within HCAs.

   a. *Residential.* For residential development proposals on lands with a HCA, a transfer of density within the property site is permitted. [*Cities/counties may establish the appropriate percentage of density that may be transferred, provided that it is not less than 50% of the maximum density that would have been permitted in the portion of property within the HCA under the applicable zoning code requirements.]*

   b. In order to accommodate the transferred density, dimensional standards and lot sizes may be adjusted by no more than 30 percent. [*Cities/counties may set the percentage of the adjustment, provided that it is no lower than 20%.*]

   c. *Commercial and Industrial Zones.* For on-site density transfers in Commercial or Industrial zones, the transfer credit is 10,000 sq. ft floor area ratio (FAR) per acre of land within the HCA.

   d. *Mixed-Use Zones.* Within mixed-use zones the density transfer credit can be factored using either 3(a) or 3(c) above, depending on the type of development proposed.

   e. All remaining HCA shall be permanently restricted from development and maintained for habitat functions, such as by making a public dedication or executing a restrictive covenant.

4. ***Site Capacity Incentives.*** The following site capacity standards provide flexibility in the design of land divisions in order to allow ways to better protect HCAs.

   a. Density bonus if HCA is protected. In multi-family residential zones, a 25 percent density bonus may be allowed for any development of four (4) or more dwelling units if 75 percent or more of the HCA on a site is permanently preserved, such as by making a public dedication or executing a restrictive covenant. The bonus density shall be in addition to the base density allowed in the applicable zoning district.

   b. All area within a HCA, or any portion of it, may be subtracted from the calculations of net size for purposes of determining the minimum number of units that must be built on the property, provided that such area is protected, such as by making a public dedication or executing a restrictive covenant. This provision may only be applied to properties that were inside the Metro UGB on January 1, 2002.

5. *[Cities/Counties may allow the following tools for avoiding or minimizing development in HCAs]:*

   Transfer of development rights (off-site) in residential zones. Transfer of development rights preserves development opportunities and reduces development pressure on environmentally-sensitive properties. The regulations described below allow development rights to be transferred from properties with HCAs to off-site areas that can accommodate the additional density without environmental conflict. Transfer of development rights between properties is allowed as follows. “Development rights” are the number of potential dwelling units that would be allowed on the property by the base zone.

   a. Sending properties. Properties where at least 50 percent of the property is within a HCA may transfer development rights.

   b. Receiving Properties.

   Option 1: All properties in 2040 Mixed-Use areas may receive development rights from sending properties except:

      i. Where any portion of the receiving property is within an HCA; or

      ii. Where any portion of the receiving property is in the undeveloped 100-year floodplain as currently defined by the Federal Emergency Management Agency (FEMA).

   Option 2: City or county may identify receiving properties upon adoption of this ordinance to be selected using the criteria in Option 1. The resulting map or criteria to identify receiving properties may include fewer properties than Option 1.

   a. Maximum density. The density of the receiving property may not exceed 200 percent of the allowable density of the receiving property.

   b. In order to accommodate the transferred density, dimensional standards and lot sizes may be adjusted by no more than 30 percent.

   c. Transfer procedure. Transfer of development rights is allowed as follows:

i. Covenant required. The owner of the sending property must execute a covenant with the authorizing authority that reflects the reduced development potential on the sending property. The covenant must be recorded before approval of the final plan. Density transfers shall be recorded on the title of the sending lot in the HCA and on the title of the transfer (receiving) property.

ii. Sending property included. The sending property must be a part of the application for development on the receiving property. A copy of the covenant for the sending property must be included with the application.

iii. City or county may purchase development rights from sending properties to place in a development rights bank for later sale to developers to use on receiving properties.

C. **Development within HCAs.** The following development standards apply to all development that occurs within the HCA except for exempt uses and conditioned activities addressed in Section 3 of this ordinance and utility facilities addressed in subsection 6(D) of this ordinance. If all development occurs outside of an HCA on a property, these standards do not apply. These standards also do not apply to development that occurs pursuant to the standards established by the alternative discretionary development standards in Section 7 of this ordinance. (Note: Applicants seeking to develop within a Water Quality Resource Area must utilize either the discretionary standards located in Section 7 of this ordinance or the review standards for Metro's Title 3 Water Quality Resource Areas).

1. ***Disturbance area limitations*** to minimize impact to HCA.

a. *Single-family residential.* The maximum disturbance area (MDA) allowed within HCAs is determined by subtracting the area of the lot or parcel outside of the HCAs from the total disturbance area (TDA) calculated as described in Table 1 below.
(TDA – Area outside the HCA = MDA)

i. Moderate and Low HCAs are subject to the same disturbance area limitations.

ii. Calculation of maximum disturbance area. If a lot or parcel includes both High and Moderate/Low HCAs then:

(A) If there is more High HCA than Moderate/Low HCA on the lot or parcel, then the MDA shall be calculated as if all of the Moderate/Low and High HCA were High, per Table 1 below; or

(B) If there is more Moderate/Low HCA than High HCA on the lot or parcel, then the MDA shall be calculated as if all of the Moderate/Low and High HCA were Moderate/Low, per Table 1 below.

iii. Location of MDA. If a lot or parcel includes different types of HCAs, then:

(A) The amount of development that may occur within the High HCA is equal to the total disturbance area minus the area of the lot or parcel outside of the High HCA (TDA – non-High HCA = MDA). If the area of the lot or parcel outside the High HCA is greater than the total disturbance area, then development shall not occur within the High HCA:

(Area outside High HCA > TDA = no development in High HCA);

(B) The amount of development that may occur within the Moderate HCA is equal to the total disturbance area minus the area of the lot or parcel outside of the High and Moderate HCA (TDA – (Low HCA + non-HCA) = MDA). If the area of the lot or parcel outside the Moderate HCA is greater than the total disturbance area, then development shall not occur within the Moderate HCA:

(Area outside Moderate HCA > TDA = no development in Moderate HCA);

and

(C) The amount of development that may occur within the Low HCA is equal to the total disturbance area minus the area of the lot or parcel outside of the High, Moderate and Low HCA (TDA – non-HCA = MDA). If the area of the lot or parcel outside the Low HCA is greater than the total disturbance area, then development shall not occur within the Low HCA:

(Area outside Low HCA > TDA = no development in Low HCA).

Table 1. HCA Total Disturbance Area Limitations for SFR.

HCA type	**Total Disturbance Area**
High	50 percent of the lot area, up to maximum of 5,000 sq. ft.
Moderate/Low	65 percent of the lot area, up to maximum of 6,000 sq. ft.

b. *All other zones.* The maximum disturbance area (MDA) allowed by right within Low, Moderate and High HCAs in these zones is found in Table 2 below; this MDA is subject to the mitigation requirements described in subsection 6(E) of this ordinance.

Table 2. HCA Disturbance Area Limitations for all zones other than SFR.

HCA type	**Maximum Disturbance Area**
High	10 percent of HCA on site
Moderate	15 percent of HCA on site
Low	50 percent of HCA on site

c. Development within an HCA in accordance with the provisions of this ordinance shall not result in a change of the HCA status of such developed areas on a property. In the case of a later development request seeking to develop within previously undisturbed HCAs on a property where a prior development request was subject to the provisions of this ordinance, the calculation of the MDA allowed on the property shall be based on the location of the HCA, notwithstanding the location of any authorized development within the HCA.

2. ***Protection of habitat during site development.*** During development of any site containing a HCA, the following standards apply:

a. Work areas shall be marked to reduce potential damage to the HCA.

b. Trees in HCAs shall not be used as anchors for stabilizing construction equipment.

c. Native soils disturbed during development shall be conserved on the property.

d. An erosion and sediment control plan is required and shall be prepared in compliance with requirements set forth in the [*locally adopted Title 3 erosion control regulations*];

e. Prior to construction, the HCA that is to remain undeveloped shall be flagged, fenced, or otherwise marked and shall remain undisturbed.

f. All work on the property shall conform to the Construction Management Plan described in Section 5 of this ordinance.

D. **Utility facility standards.** The following disturbance area limitations apply to new utilities, private connections to existing or new utility lines, and upgrade

a. The disturbance area for utility facility connections to utility facilities is no greater than 10 feet wide.

b. The disturbance area for the upgrade of existing utility facilities is no greater than 15 feet wide.

c. The disturbance area for new underground utility facilities is no greater than 25 feet wide and disturbs no more than 200 linear feet of Water Quality Resource Area, within any 1,000 linear foot stretch of Water Quality Resource Area; provided that this disturbance area shall be restored with the exception of necessary access points to the utility facility.

d. No fill or excavation is allowed within the ordinary high water mark of a stream, unless a permit is obtained from the US Army Corps of Engineers through the Standard Local Operating Procedures for Endangered Species (SLOPES) process.

e. Mitigation is required as described in subsection E below.

E. **Mitigation requirements for disturbance in HCAs.** In order to achieve the goal of reestablishing forested canopy that meets the ecological values and functions described in section 1(A) of this ordinance, tree replacement and vegetation planting are required when development intrudes into a HCA according to the following standards, except for wetlands mitigation requirements imposed by state and federal law.

1. ***Required plants and plant densities.*** All trees, shrubs and ground cover must be native plants selected from the *Metro Native Plant List*. An applicant must meet Mitigation Option 1 or 2, whichever results in more tree plantings; except that where the disturbance area is one acre or more, the applicant shall comply with Mitigation Option 2:

a. *Mitigation Option 1.* In this option, the mitigation requirement is calculated based on the number and size of trees that are removed from the site. Trees that are removed from the site must be replaced as shown in Table 3. Conifers must be replaced with conifers. Bare ground must be planted or seeded with native grasses or herbs. Non-native sterile wheat grass may also be planted or seeded, in equal or lesser proportion to the native grasses or herbs.

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Table 3. Tree Replacement

Size of tree to be removed (inches in diameter)	Number of trees and shrubs to be planted
6 to 12	2 trees and 3 shrubs
13 to 18	3 trees and 6 shrubs
19 to 24	5 trees and 12 shrubs
25 to 30	7 trees and 18 shrubs
over 30	10 trees and 30 shrubs

b. *Mitigation Option 2.* In this option, the mitigation requirement is calculated based on the size of the disturbance area within a HCA. Native trees and shrubs are required to be planted at a rate of five (5) trees and twenty-five (25) shrubs per every 500 square feet of disturbance area (calculated by dividing the number of square feet of disturbance area by 500, and then multiplying that result times five trees and 25 shrubs, and rounding all fractions to the nearest whole number of trees and shrubs; for example, if there will be 330 square feet of disturbance area, then 330 divided by 500 equals .66, and .66 times five equals 3.3, so three trees must be planted, and .66 times 25 equals 16.5, so 17 shrubs must be planted). Bare ground must be planted or seeded with native grasses or herbs. Non-native sterile wheat grass may also be planted or seeded, in equal or lesser proportion to the native grasses or herbs.

2. ***Plant size.*** Replacement trees must be at least one-half inch in caliper, measured at 6 inches above the ground level for field grown trees or above the soil line for container grown trees (the one-half inch minimum size may be an average caliper measure, recognizing that trees are not uniformly round), unless they are oak or madrone which may be one gallon size. Shrubs must be in at least a 1-gallon container or the equivalent in ball and burlap and must be at least 12 inches in height.

3. ***Plant spacing.*** Trees shall be planted between 8 and 12 feet on-center and shrubs shall be planted between 4 and 5 feet on center, or clustered in single species groups of no more than four (4) plants, with each cluster planted between 8 and 10 feet on center. When planting near existing trees, the dripline of the existing tree shall be the starting point for plant spacing measurements.

4. ***Plant diversity.*** Shrubs must consist of at least two (2) different species. If 10 trees or more are planted, then no more than 50% of the trees may be of the same genus.

5. ***Location of mitigation area.*** All vegetation must be planted on the applicant's site within the HCA or in an area contiguous to the HCA; provided, however, that if the vegetation is planted outside of the HCA then the applicant shall preserve the contiguous area by executing a deed restriction, such as a restrictive covenant. *(Note: an off-site mitigation option is provided in a streamlined discretionary review process).*

6. ***Invasive vegetation.*** Invasive non-native or noxious vegetation must be removed within the mitigation area prior to planting.

7. ***Tree and shrub survival.*** A minimum of 80% of the trees and shrubs planted shall remain alive on the fifth anniversary of the date that the mitigation planting is completed.

8. ***Monitoring and reporting.*** Monitoring of the mitigation site is the ongoing responsibility of the property owner. Plants that die must be replaced in kind. For a period of five years, the property

owner must submit an annual report to (list appropriate city or county department) documenting the survival of the trees and shrubs on the mitigation site. *[Optional: the city or county may require the property owner to post a performance bond in the amount sufficient to cover costs of plant material and labor associated with site preparation, planting, and maintenance in lieu of the monitoring and reporting requirement.]*

9. To enhance survival of the mitigation plantings, the following practices are required:

   a. Mulching. Mulch new plantings a minimum of three inches in depth and 18 inches in diameter to retain moisture and discourage weed growth.

   b. Irrigation. Water new plantings one inch per week between June 15th to October 15th, for the three years following planting.

   c. Weed control. Remove, or control, non-native or noxious vegetation throughout maintenance period.

10. To enhance survival of tree replacement and vegetation plantings, the following practices are recommended:

    a. Planting season. Plant bare root trees between December 1st and February 28th, and potted plants between October 15th and April 30th.

    b. Wildlife protection. Use plant sleeves or fencing to protect trees and shrubs against wildlife browsing and resulting damage to plants.

F. **Standards for Partitions and Subdivisions.** The purpose of this section is to allow for partitions in a manner that limits the total amount of allowable development within HCAs on the partitioned parcels; and to require that new subdivision plats delineate and show the Moderate and High HCAs as a separate unbuildable tract.

1. ***Standards for Partitions containing HCAs*:**

   a. When partitioning a property into parcels, an applicant shall verify the boundaries of the HCA on the property according to Section 9 of this ordinance.

   b. Applicants who are partitioning, but are not simultaneously developing their property, do not need to comply with Section 5 of this ordinance.

   c. When partitioning a property into parcels there shall be no more than a 30% percentage point difference in the percentage of HCA on the parcels; for example, a partition that produces two parcels, one that is 55% HCA and the other that is 35% HCA is permissible; whereas a partition that produces two parcels, one that is 75% HCA and the other that is 30% HCA is not permissible. However, an applicant may partition a property such that at least 90% of the original property's High HCA and 80% of its moderate HCA is on a separate unbuildable parcel, protected by a restrictive covenant or a public dedication.

   d. Subsequent development on any parcels containing HCAs shall comply with Section 5, and the development standards of either section 6 or section 7 of this ordinance.

2. ***Standards for Subdivisions containing HCAs*:**

   a. Applicants who are subdividing, but not developing, must verify the location of the HCA boundary according to Section 9 of this ordinance, and comply with this subsection 6(F); such applicants do not need to comply with Section 5 of this ordinance. Applicants who are subdividing, but not developing, property may:

      i. Complete the mitigation requirements of subsection 6(E) of this ordinance (and, if appropriate, subsections 7(B) and 7(C)) and thereby exempt all subsequent development on lots containing HCA from further review under this ordinance; or

      ii. Not complete the mitigation requirements of subsections 6(E), 7(B), or 7(C) of this ordinance, thus requiring that any subsequent development within an HCA be subject to this ordinance.

   b. Applicants who are subdividing and developing properties must comply with Sections 5, 6, and 9 of this ordinance.

   c. When a property containing any HCA is subdivided, this ordinance requires that new subdivision plats delineate and show the Moderate and High HCA as a separate unbuildable tract according to the following process:

      i. The applicant must place at least 90% of the High HCA and 80% of the Moderate HCA in a separate tract.

         (A) If over 50% of the HCA on a property is of a High designation, the entire calculation is for High (i.e., 90% of the HCA must be placed within a separate tract).

         (B) If over 50% of the HCA on a property is of a Moderate designation, the entire calculation is for Moderate (i.e., 80% of the HCA must be placed within a separate tract).

      ii. If the tract is adjacent to the backyard for residences, the minimum backyard requirement is reduced to 10 ft.

      iii. The standards for subdivisions in Moderate and High HCAs shall apply in addition to the requirements of the city/county land division ordinance and zoning ordinance.

      iv. Prior to preliminary plat approval, the Moderate and/or High HCA shall be shown as a separate tract, which shall not be a part of any lot used for construction of a dwelling unit.

      v. Prior to final plat approval, ownership of the HCA tract shall be identified to distinguish it from lots intended for sale. The tract may be identified as any one of the following:

         (A) Private natural area held by the owner or homeowners association by a restrictive covenant; or

         (B) For residential subdivisions, private natural area subject to an easement conveying storm and surface water management rights to the city/county and preventing the owner of the tract from activities and uses inconsistent with the purpose of this ordinance; or

(C) At the owner's option, public natural area where the tract has been dedicated to the city/county or other governmental unit, or a private non-profit with the mission of land conservation.

Section 7. Alternative Discretionary Development Standards

Applicants may choose to use the alternative discretionary development standards provided in this section rather than the development standards provided in section 6 of this ordinance. There are four discretionary review processes provided in this section: subsection A provides discretionary review for an applicant seeking only to partition a property; subsection B provides discretionary review for an applicant who will comply with the development standards in section 6 of this ordinance, except that the applicant seeks to meet the mitigation requirements of that section on a different property from the property on which a HCA will be disturbed; subsection C provides discretionary review for an applicant who will comply with the development standards in section 6 of this ordinance, except that the applicant seeks to meet the mitigation requirements of that section by proportionally varying the number and size of plants required to be planted; and subsection D provides general discretionary review standards applicable to an applicant seeking some other type of discretionary approval of development that will disturb an HCA.

A. **Discretionary Review for Partitions.** An applicant seeking to partition land in ways that do not accord with the standards established in Section 6(F)(1) may seek review under this subsection 7(A).

1. The applicant shall verify the boundaries of the HCAs on the property according to Section 9 of this ordinance.

2. The applicant shall submit the following application materials:

a. A scale map of the entire property that includes:

i. Location of all High, Moderate, and Low HCA on the property;

ii. Location of any wetlands or water bodies on the property, including a delineation of the Water Quality Resource Area;

iii. Location of 100 year floodplain and floodway boundary as defined by the Federal Emergency Management Agency (FEMA) and the area of the 1996 flood inundation; and

iv. A delineation of the proposed partition.

b. A written and documented explanation of how and why the proposed partition satisfies the approval criteria in subsection 7(A)(3). Such written documentation shall include an alternatives analysis of different possible partition plans, based on the characteristics and zoning of the property.

3. Approval Criteria. A partition shall be approved under this subsection 7(A) provided that the applicant demonstrates that it is not practicable to comply with the partition standards in Section 6(F)(1) of this ordinance, and that the applicant's partition plan will result in the smallest

practicable percentage point difference in the percentage of HCA on the parcels created by the partition (this will minimize the amount of allowable disturbance areas within HCAs on the parcels, assuming that the development standards in this Section 6 were applied to future development on such parcels).

4. Subsequent development on any parcels created by the partition and containing HCAs shall comply with all provisions of this ordinance, except that the map verification completed and approved as part of the partition may be used to satisfy the requirements of section 9 of this ordinance for any such development.

B. **Discretionary Review To Approve Off-Site Mitigation.** An applicant seeking discretionary approval only for off-site mitigation within the same subwatershed (6th Field Hydrologic Unit Code), but who will comply with all other provisions of Section 6 of this ordinance, may seek review under this subsection 7(B). (An applicant who seeks to conduct the mitigation in a different subwatershed may apply for such approval under subsection 7(D) of this ordinance.)

1. The applicant shall submit:

   a. A calculation of the number of trees and shrubs the applicant is required to plant under Section 6(E) of this ordinance; and

   b. A map and accompanying narrative that details the following:

      i. The number of trees and shrubs that can be planted on-site;

      ii. The on-site location where those trees and shrubs can be planted;

      iii. An explanation of why it is not practicable for the remainder of the mitigation to occur on-site; and

      iv. The proposed location for off-site mitigation and documentation that the applicant can carry out and ensure the success of the mitigation, including documentation that the applicant possesses legal authority to conduct and maintain the mitigation, such as having a sufficient ownership interest in the mitigation site, and, if the mitigation is not within a HCA, documentation that the mitigation site will be protected after the monitoring period expires, such as through the use of a restrictive covenant.

2. Approval Criteria. Off-site mitigation shall be approved under this subsection 7(B) provided that the applicant has demonstrated that it is not practicable to complete the mitigation on-site and that the applicant has documented that it can carry out and ensure the success of the off-site mitigation on a property within the same subwatershed (6th Field Hydrologic Unit Code) as the related disturbed HCA.

3. Mitigation approved under this subsection 7(B) of this ordinance shall be subject to all of the requirements of subsection 6(E) of this ordinance, except for the requirements of subsection 6(E)(5) of this ordinance.

C. **Discretionary Review To Approve Mitigation That Varies the Number and Size of Trees and Shrubs.** An applicant seeking discretionary approval only to proportionally vary the number and size of trees and shrubs required to be planted under subsection 6(E), for example to plant fewer larger trees and shrubs or to plant more smaller trees and shrubs, but who will comply with all other provisions of Section 6 of this ordinance, may seek review under this subsection 7(C).

1. The applicant shall submit:

    a. A calculation of the number of trees and shrubs the applicant would be required to plant under Section 6(E) of this ordinance;

    b. The numbers and sizes of trees and shrubs that the applicant proposes to plant;

    c. An explanation of why the numbers and sizes of trees and shrubs that the applicant proposes to plant will achieve, at the end of the fifth year after initial planting, comparable or better mitigation results as the results that would be achieved if the applicant complied with all of the requirements of subsection 6(E) of this ordinance. Such explanation shall be prepared and signed by a knowledgeable and qualified natural resources professional or a certified landscape architect and shall include discussion of site preparation including soil additives and removal of invasive and noxious vegetation, plant diversity, plant spacing, planting season, and immediate post-planting care including mulching, irrigation, wildlife protection, and weed control; and

    d. The applicant's mitigation site monitoring and reporting plan.

2. Approval Criteria. A request to vary the numbers and sizes of trees and shrubs to be planted shall be approved if the applicant demonstrates that the proposed planting will achieve, at the end of the fifth year after initial planting, comparable or better mitigation results as the results that would be achieved if the applicant complied with all of the requirements of subsection 6(E) of this ordinance. Such determination shall take into consideration all of the information required to be submitted under subsection 7(C)(1) of this ordinance.

3. Mitigation approved under this subsection 7(C) of this ordinance shall be subject to the requirements of subsections 6(E)(4) through 6(E)(9) of this ordinance, and it is recommended that such mitigation also follow the practices recommended in subsection 6(E)(10) of this ordinance.

D. **Discretionary Review.** An applicant seeking discretionary approval to undertake any development activity within a HCA that does not comply with subsection 6 of this ordinance and is not described in subsections 7(A), (B), or (C) of this ordinance may file an application under this section 7(D) of this ordinance.

1. **Application Requirements.** The applicant shall provide all items described in subsection 6(A) of this ordinance, except that, for utility projects undertaken by public utilities across property that is not owned by the utility, the utility shall not be required to map or provide any information about the property except for the area within 300 feet of the location of the proposed disturbance area of the utility's project, and the applicant shall also provide all of the following:

    a. ***Impact Evaluation and Alternatives Analysis.*** An impact evaluation and alternatives analysis is required to determine compliance with the approval criteria and to evaluate development alternatives for a particular property. The alternatives must be evaluated on the basis of their impact on the HCA, the ecological functions provided by the HCA on the property, and off-site impacts within the subwatershed (6^{th} Field Hydrologic Unit Code) where the property is located. The impact evaluation shall include all of the following items:

i. Identification of the ecological functions of riparian habitat found on the property as described in Table 4 of this ordinance and the habitat connectivity ecological functions described in subsection 7(D)(1)(a)(ii)(C) and (D) of this ordinance.

ii. For upland habitat in areas to be added to the Metro urban growth boundary areas after October 1, 2005, identification of the impact the proposed development would have on the following ecological functions provided by upland wildlife habitat:

(A) Habitat patch size;

(B) Interior habitat;

(C) Connectivity of the habitat to water; and

(D) Connectivity of the habitat to other habitat areas.

Table 4. Ecological functional values of riparian corridors.

Ecological function	**Landscape features providing functional values**
Microclimate and shade	Forest canopy or woody vegetation within **100 feet** of a stream; a wetland[1]; or a flood area[2].
Streamflow moderation and water storage	A wetland or other water body[3] with a hydrologic connection to a stream; or a flood area[2].
Bank stabilization, sediment and pollution control	All sites within **50 feet** of a surface stream; Forest canopy, woody vegetation, or low structure vegetation/open soils within **100 feet** of a stream or a wetland; or forest canopy, woody vegetation, or low structure vegetation/open soils within a flood area; and, Forest canopy, woody vegetation, or low structure vegetation/open soils within **100-200 feet** of a stream if the slope is greater than 25%.
Large wood and channel dynamics	Forest canopy within **150 feet** of a stream or wetland; or within a flood area; and The channel migration zone is defined by the floodplain, but where there is no mapped floodplain a default of **50 feet** is established to allow for the channel migration zone.
Organic material sources	Forest canopy or woody vegetation within **100 feet** of a stream or wetland; or within a flood area.

[1]Refers to "hydrologically-connected wetlands," which are located partially or wholly within ¼ mile of a surface stream or flood area.
[2]Developed floodplains are not identified as HCAs because they do not provide primary ecological functional value.
[3]"Other water body" could include lakes, ponds, reservoirs, or manmade water feature that is not a water quality facility or farm pond.

iii. Evaluation of alternative locations, design modifications, or alternative methods of development to determine which options reduce the significant detrimental impacts on the HCAs and the ecological functions provided on the property. At a minimum, the following approaches must be considered:

(A) The techniques described in subsection 6(B) of this ordinance;

(B) Multi-story construction;

(C) Minimizing building and development footprint;

(D) Maximizing the use of native landscaping materials; and

(E) Minimal excavation foundation systems (e.g., pier, post or piling foundation).

iv. Determination of the alternative that best meets the applicable approval criteria and identification of significant detrimental impacts that are unavoidable.

b. ***Mitigation Plan.*** The purpose of a mitigation plan is to compensate for unavoidable significant detrimental impacts to ecological functions that result from the chosen development alternative as identified in the impact evaluation. However, when development occurs within delineated wetlands, then the mitigation required under subsection 7(D)(2)(d) shall not require any additional mitigation than the mitigation required by state and federal law for the fill or removal of such wetlands.

i. An applicant may choose to develop a mitigation plan consistent with the requirements of subsection 6(E) of this ordinance. If an applicant so chooses, then the applicant shall submit a mitigation plan demonstrating such compliance.

ii. If an applicant chooses to develop an alternative mitigation plan that would not comply with the requirements of subsection 6(E) of this ordinance, including, for example, a proposal to create an alternative plant community type such as an oak savannah or a low-structure plant community, or where an applicant demonstrates that a portion of identified HCA on its property provides only impaired ecological functions, then the applicant shall submit a mitigation plan that includes all of the following:

(A) An explanation of how the proposed mitigation will adequately compensate for the impacts to ecological functions described in the impact evaluation required by subsection 7(D)(1)(a). The applicant may use the mitigation that would be required under subsection 6(E) of this ordinance as the baseline mitigation required to compensate for disturbance to a HCA that provides an average level of ecological functions. Such explanation shall include:

(1) If the applicant uses the mitigation that would be required under subsection 6(E) of this ordinance as the baseline mitigation required to compensate for disturbance to a HCA, then the applicant shall submit a calculation of the number of trees and shrubs the applicant would be required to plant under subsection 6(E) of this ordinance;

(2) A site plan showing where the specific mitigation activities will occur and the numbers and sizes of trees and shrubs that the applicant proposes to plant; and

(3) A discussion of site preparation including soil additives and removal of invasive and noxious vegetation, plant diversity, plant spacing, planting season, and immediate post-planting care including mulching, irrigation, wildlife protection, and weed control.

(B) Documentation of coordination with appropriate local, regional, special district, state, and federal regulatory agencies.

(C) A list of all parties responsible for implementing and monitoring the mitigation plan and, if mitigation will occur off-site, the names of the owners of property where mitigation plantings will occur.

(D) The applicant's mitigation site monitoring and reporting plan.

(E) If the proposed mitigation will not be conducted on-site, the applicant shall submit a map and accompanying narrative that details the following:

(1) The number of trees and shrubs that can be planted on-site;

(2) The on-site location where those trees and shrubs can be planted;

(3) An explanation of why it is not practicable for the remainder of the mitigation to occur on-site; and

(4) The proposed location for off-site mitigation and documentation that the applicant can carry out and ensure the success of the mitigation, including documentation that the applicant possesses legal authority to conduct and maintain the mitigation, such as having a sufficient ownership interest in the mitigation site, and, if the mitigation is not within a HCA, documentation that the mitigation site will be protected after the monitoring period expires, such as through the use of a restrictive covenant.

(F) If the mitigation area is off-site and not within the same subwatershed (6^{th} Field Hydrologic Unit Code) as the related disturbed HCA, the applicant shall submit an explanation of why it is not practicable to conduct the mitigation within the same subwatershed and of why and how, considering the purpose of the mitigation, the mitigation will provide more ecological functional value if implemented outside of the subwatershed.

(G) An implementation schedule, including timeline for construction, mitigation, mitigation maintenance, monitoring, reporting and a contingency plan. If the applicant is proposing any in-stream work in fish-bearing streams as part of the mitigation project, then the applicant shall submit documentation that such work will be done in accordance with the Oregon Department of Fish and Wildlife in-stream work timing schedule.

c. The Impact Evaluation and Alternatives Analysis required by subsection 7(D)(1)(a) and the Mitigation Plan required by subsection 7(D)(1)(b) shall be prepared and signed by either (1) a knowledgeable and qualified natural resource professional, such as a wildlife biologist, botanist, or hydrologist, or (2) a civil or environmental engineer registered in Oregon to design public sanitary or storm systems, storm water facilities, or other similar facilities. The application shall include a description of the qualifications and experience of all persons that contributed to the Impact Evaluation and Alternatives Analysis and to the Mitigation Plan, and, for each person that contributed, a description of the elements of such reports to which the person contributed.

2. **Approval Criteria.**

   a. All application requirements in subsection 7(D)(1) shall be met.

   b. ***Avoid.*** An applicant shall first avoid the intrusion of development into the HCA to the extent practicable. The development that is proposed must have less detrimental impact to HCAs than other practicable alternatives, including significantly different practicable alternatives that propose less development within HCAs. If there is more than one type of HCA on a property then the applicant shall first avoid the intrusion of development into the higher-valued HCA, to the extent practicable, and the development that is proposed must have less detrimental impact to the higher-valued HCAs than other practicable alternatives. To avoid development in HCAs, and to the extent practicable, applicants shall use the approaches described in subsection 7(D)(1)(a)(iii).

   c. ***Minimize.*** If the applicant demonstrates that there is no practicable alternative that will not avoid disturbance of the HCA, then the development proposed by the applicant within the HCA shall minimize detrimental impacts to the extent practicable. If there is more than one type of HCA on a property then the development within higher-valued HCAs shall be considered more detrimental than development within lower-valued HCAs.

      i. Development must minimize detrimental impacts to ecological functions and loss of habitat consistent with uses allowed by right under the base zone, to the extent practicable;

      ii. To the extent practicable within the HCA, the proposed development shall be designed, located, and constructed to:

         (A) Minimize grading, removal of native vegetation, and disturbance and removal of native soils by using the approaches described in subsection 6(C)(2), reducing building footprints, and using minimal excavation foundation systems (e.g., pier, post or piling foundation);

         (B) Minimize adverse hydrological impacts on water resources such as by using the techniques described in Part (a) of Table 5, unless their use is prohibited by an applicable and required State or Federal permit issued to a unit of local government having jurisdiction in the area, such as a permit required under the federal Clean Water Act, 33 U.S.C. §§1251 et seq., or the federal Safe Drinking Water Act, 42 U.S.C. §§300f et seq., and including conditions or plans required by such permit;

         (C) Minimize impacts on wildlife corridors and fish passage such as by using the techniques described in Part (b) of Table 5; and

         (D) Consider using the techniques described in Part (c) of Table 5 to further minimize the impacts of development in the HCA.

Table 5. Habitat-friendly development practices.[1]

Part (a): Design and Construction Practices to Minimize Hydrologic Impacts
1. Amend disturbed soils to original or higher level of porosity to regain infiltration and stormwater storage capacity. 2. Use pervious paving materials for residential driveways, parking lots, walkways, and within centers of cul-de-sacs. 3. Incorporate stormwater management in road right-of-ways. 4. Landscape with rain gardens to provide on-lot detention, filtering of rainwater, and groundwater recharge. 5. Use green roofs for runoff reduction, energy savings, improved air quality, and enhanced aesthetics. 6. Disconnect downspouts from roofs and direct the flow to vegetated infiltration/filtration areas such as rain gardens. 7. Retain rooftop runoff in a rain barrel for later on-lot use in lawn and garden watering. 8. Use multi-functional open drainage systems in lieu of more conventional curb-and-gutter systems. 9. Use bioretention cells as rain gardens in landscaped parking lot islands to reduce runoff volume and filter pollutants. 10. Apply a treatment train approach to provide multiple opportunities for storm water treatment and reduce the possibility of system failure. 11. Reduce sidewalk width and grade them such that they drain to the front yard of a residential lot or retention area. 12. Reduce impervious impacts of residential driveways by narrowing widths and moving access to the rear of the site. 13. Use shared driveways. 14. Reduce width of residential streets, depending on traffic and parking needs. 15. Reduce street length, primarily in residential areas, by encouraging clustering and using curvilinear designs. 16. Reduce cul-de-sac radii and use pervious vegetated islands in center to minimize impervious effects, and allow them to be utilized for truck maneuvering/loading to reduce need for wide loading areas on site. 17. Eliminate redundant non-ADA sidewalks within a site (i.e., sidewalk to all entryways and/or to truck loading areas may be unnecessary for industrial developments). 18. Minimize car spaces and stall dimensions, reduce parking ratios, and use shared parking facilities and structured parking. 19. Minimize the number of stream crossings and place crossing perpendicular to stream channel if possible. 20. Allow narrow street right-of-ways through stream corridors whenever possible to reduce adverse impacts of transportation corridors.
Part (b): Design and Construction Practices to Minimize Impacts on Wildlife Corridors and Fish Passage
1. Carefully integrate fencing into the landscape to guide animals toward animal crossings under, over, or around transportation corridors. 2. Use bridge crossings rather than culverts wherever possible. 3. If culverts are utilized, install slab, arch or box type culverts, preferably using bottomless designs that more closely mimic stream bottom habitat. 4. Design stream crossings for fish passage with shelves and other design features to facilitate terrestrial wildlife passage. 5. Extend vegetative cover through the wildlife crossing in the migratory route, along with sheltering areas.

[1] These development practices represent the state of scientific knowledge at the time of this ordinance's enactment, if more effective habitat-friendly practices become available, they should be used.

Part (c): Miscellaneous Other Habitat-Friendly Design and Construction Practices
1. Use native plants throughout the development (not just in HCA). 2. Locate landscaping (required by other sections of the code) adjacent to HCA. 3. Reduce light spill-off into HCAs from development. 4. Preserve and maintain existing trees and tree canopy coverage, and plant trees, where appropriate, to maximize future tree canopy coverage.

d. ***Mitigate.*** If the applicant demonstrates that there is no practicable alternative that will not avoid disturbance of the HCA, then development must mitigate for adverse impacts to the HCA. All proposed mitigation plans must meet the following standards.

i. The mitigation plan shall demonstrate that it compensates for detrimental impacts to ecological functions provided by HCAs, after taking into consideration the applicant's efforts to minimize such detrimental impacts through the use of the techniques described in Table 5 and through any additional or innovative techniques. A mitigation plan that requires the amount of planting that would be required under subsection 6(E) of this ordinance based on the amount of proposed disturbance area within the HCA, and that otherwise complies with all of the mitigation requirements in subsection 6(E) of this ordinance, shall be considered to have satisfied the requirements of this subsection 7(D)(2)(d) of this ordinance.

ii. Mitigation shall occur on the site of the disturbance, to the extent practicable. Off-site mitigation shall be approved if the applicant has demonstrated that it is not practicable to complete the mitigation on-site and that the applicant has documented that it can carry out and ensure the success of the off-site mitigation, as described in subsection 7(B)(1)(b)(iv) of this ordinance. In addition, if the off-site mitigation area is not within the same subwatershed (6^{th} Field Hydrologic Unit Code) as the related disturbed HCA, the applicant shall demonstrate that it is not practicable to complete the mitigation within the same subwatershed and that, considering the purpose of the mitigation, the mitigation will provide more ecological functional value if implemented outside of the subwatershed. Mitigation shall not be allowed outside of the Metro jurisdictional boundary.

iii. All re-vegetation plantings shall be with native plants listed on the *Metro Native Plant List.*

iv. All in-stream work in fish-bearing streams shall be done in accordance with the Oregon Department of Fish and Wildlife in-stream work-timing schedule.

v. A mitigation maintenance plan shall be included and shall be sufficient to ensure the success of the planting, and compliance with the plan shall be a condition of development approval.

e. ***Municipal Water Utility Facilities Standards.*** Except as provided within this subsection, in addition to all other requirements of subsection 7(D)(2) of this ordinance, municipal potable water, storm water (drainage) and wastewater utility facilities may be built, expanded, repaired, maintained, reconfigured, rehabilitated, replaced or upsized if not exempted in

Section 3 of this ordinance. These facilities may include but are not limited to water treatment plants, wastewater treatment plants, raw water intakes, pump stations, transmission mains, conduits or service lines, terminal storage reservoirs, and outfall devices provided that:

i. Such projects shall not have to comply with the requirements of subsection 7(D)(2)(b) of this ordinance, provided that, where practicable, the project does not encroach closer to a water feature than existing operations and development, or for new projects where there are no existing operations or development, that the project does not encroach closer to a water feature than practicable;

ii. Best management practices will be employed that accomplish the following:

(A) Account for watershed assessment information in project design;

(B) Minimize the trench area and tree removal within the HCA;

(C) Utilize and maintain erosion controls until other site stabilization measures are established, post-construction;

(D) Replant immediately after backfilling or as soon as effective;

(E) Preserve wetland soils and retain soil profiles;

(F) Minimize compactions and the duration of the work within the HCA;

(G) Complete in-water construction during appropriate seasons, or as approved within requisite Federal or State permits;

(H) Monitor water quality during the construction phases, if applicable; and

(I) Implement a full inspection and monitoring program during and after project completion, if applicable.

Section 8. Variances

A. The purpose of this Section is to ensure that compliance with this ordinance does not cause unreasonable hardship. To avoid such instances, the requirements of this ordinance may be varied. Variances are also allowed when strict application of this ordinance would deprive an owner of all economically viable use of land.

B. This Section applies in addition to the standards governing proposals to vary the requirements of the base zone.

C. Notice of variance applications shall be provided:

1. Upon receiving an application to vary the requirements of this ordinance, the notice shall be provided to all property owners within *[insert appropriate distance consistent with state law and other local notice provisions]* of the subject property inside the urban growth boundary, and within [*insert appropriate distance consistent with state law and other local notice provisions*] feet of the subject property outside the urban growth boundary, to Metro, to any neighborhood or

community planning organization recognized by the [*city/county*] and whose boundaries include the property, and to any watershed council recognized by the Oregon Watershed Enhancement Board and whose boundaries include the property.

2. Within seven (7) days of a decision on the variance, notice of the decision shall be provided to Metro, to any neighborhood or community planning organization recognized by the [*city/county*] and whose boundaries include the property, to any watershed council recognized by the Oregon Watershed Enhancement Board and whose boundaries include the property, and to any other person required to receive notice of such a decision under state law.

D. **Hardship Variance.** Variances to avoid unreasonable hardship caused by the strict application of this ordinance are permitted subject to the criteria set forth in this section. To vary from the requirements of this ordinance, the applicant must demonstrate the following:

1. The variance is the minimum necessary to allow the proposed use or activity;

2. Unless the proposed variance is from mitigation under Section 6(E) or mitigation under Section 7(B), (C), or (D)(1)(b) and D(2)(d), the proposed use will comply with those standards, as applicable; and

3. The proposed use complies with the standards of the base zone.

E. **Buildable Lot Variance.** A variance to avoid the loss of all economically viable use of a lot that is partially inside a HCA is permitted. Applicants must demonstrate the following:

1. Without the proposed variance, the applicant would be denied economically viable use of the subject property. To meet this criterion, the applicant must show that:

   a. The proposed use cannot meet the standards in Section 8(D) (hardship variance); and

   b. No other application could result in permission for an economically viable use of the subject property. Evidence to meet this criterion shall include a list of uses allowed on the subject property.

2. The proposed variance is the minimum necessary to allow for the requested use;

3. The proposed variance will comply with Section 6(E) or 7(B), (C), or D(1)(b) and D(2)(d) (mitigation); and

4. The proposed use complies with the standards of the base zone.

F. **Variance Conditions.** Conditions may be imposed to limit any adverse impacts that may result from granting any variance.

Section 9. Map Administration and HCA Verification

A. **Exempt development.** Development that is outside of any HCA and no closer than 100 feet to the border of an HCA (including all impervious surfaces and landscaping), based on the HCA map, may proceed without having to comply with this section or any other portion of this ordinance except for

Section 5, Construction Management Plan. *[Note: At the time a city or county adopts this model ordinance and its HCA map, such city or county may decrease the 100 feet "safe harbor" distance provided in this section to no fewer than 25 feet provided that it conducts additional analysis to correct any misalignment errors of the type described in section 9(E)(2) of this ordinance and adopts sufficient findings of fact to justify such corrections.]*

B. Verification of the location of HCAs as described in this section shall not be considered a comprehensive plan amendment. [*Note: Adjustment of the mapped HCA shall only proceed as provided in this ordinance.]*

C. Map verification is available to correct for mistakes in the location of HCAs on properties. Map verification shall not be used to dispute whether identified HCAs provide the ecological functions that they are assumed to provide based on the ecological criteria used to identify them. If an applicant believes that a properly identified HCA does not provide the ecological functions that it has been identified as providing, then the applicant may use the discretionary review process to decrease the amount of mitigation required for disturbing such an area.

D. The map verification requirements described in this section 9 of this ordinance shall be met at the time an applicant requests a building permit, grading permit, tree removal permit, land division approval, or some other land use decision. A property owner, or another person with the property owner's consent, may request to verify the location of HCAs on a real property lot or parcel pursuant to this Section 9 of this ordinance at other times, but whether the *[city/county]* processes such request shall be at the Planning Director's sole discretion, based on staff availability, funding resources, and policy priorities. If a person receives a verification separate from a simultaneous request for a building permit, grading permit, tree removal permit, land division approval, or some other land use decision, then the person may use the verification to satisfy the requirements of this section at any time up until five years after the date the verification was issued.

E. Notwithstanding any other provisions of this Section 9 of this ordinance, for utility projects undertaken by public utilities across property that is not owned by the utility, the utility shall not be required to map or provide any information about the property except for the area within 300 feet of the location of the proposed disturbance area of the utility's project.

F. **Basic Verification Approaches.** The basic verification approaches described in subsections 9(F)(1) through (3) of this ordinance are available for applicants who believe either (1) that the HCA map is accurate, (2) that there is a simple incongruity between the HCA map and the boundary lot lines of a property, or (3) that the property was developed prior to *[insert date—either the effective date of this ordinance or two years after acknowledgement of the regional program, whichever is earlier]*.

1. ***Applicant Believes HCA Map is Accurate.*** An applicant who believes that the HCA map is accurate may comply with this subsection 9(F)(1) of this ordinance. The applicant shall submit the following information regarding the real property lot or parcel:

    a. A detailed property description;

    b. A copy of the applicable HCA map;

    c. A summer 2005 aerial photograph of the property, with lot lines shown, at a scale of at least 1 map inch equal to 50 feet for lots of 20,000 or fewer square feet, and a scale of 1 map inch equal to 100 feet for larger lots (available from the Metro Data Resource Center, 600 N.E. Grand Ave., Portland, OR 97232; 503-797-1742);

d. The information required to be submitted under Section 6 or 7 of this ordinance if the applicant proposes development within any HCA under those provisions; and

e. Any other factual information that the applicant wishes to provide to support map verification.

2. ***Obvious Misalignment Between Mapped Habitat and Property Lot Lines.*** In some cases, the mapped vegetative cover layer in the GIS database might not align precisely with the tax lot layer that shows property lines, resulting in a HCA map that is also misaligned with tax lot lines. An applicant who believes that the HCA map is inaccurate based on such an obvious misalignment may comply with this subsection 9(F)(2) of this ordinance. The applicant shall submit the following information regarding the real property lot or parcel:

   a. The information described in subsections 9(F)(1)(a) through (e) of this ordinance; and

   b. A documented demonstration of the misalignment between the HCA map and the property's tax lot boundary lines. For example, an applicant could compare the boundary lot lines shown for roads within 500 feet of a property with the location of such roads as viewed on the aerial photograph of the area surrounding a property to provide evidence of the scale and amount of incongruity between the HCA maps and the property lot lines, and the amount of adjustment that would be appropriate to accurately depict habitat on the property.

3. ***Property Developed Between Summer 2002 and [Insert date of Approval of Regional Program].*** Where a property was developed between the summer of 2002 (when the aerial photo used to determine the regional habitat inventory was taken) and *[insert date that the regional program was approved]*, the applicant shall submit the following information regarding the real property lot or parcel:

   a. The information described in subsection 9(F)(1)(a) through (e) of this ordinance;

   b. A summer 2002 aerial photograph of the property, with lot lines shown, at a scale of at least 1 map inch equal to 50 feet for lots of 20,000 or fewer square feet, and a scale of 1 map inch equal to 100 feet for larger lots (available from the Metro Data Resource Center, 600 N.E. Grand Ave., Portland, OR 97232; 503-797-1742);

   c. Any approved building permits or other development plans and drawings related to the development of the property that took place between summer 2002 and *insert date that the regional program was approved]*; and

   d. A clear explanation and documentation, such as supporting maps or drawings or an more recent aerial photograph, indicating the new development that has occurred and where previously identified habitat no longer exists because it is now part of a developed area.

4. ***Decision Process.*** The Planning Director's map verification decision made pursuant to this subsection 9(F) of this ordinance may be an administrative decision. The Planning Director's decision shall be based on consideration of the information submitted by the applicant, any information collected during a site visit to the lot or parcel, any information generated by prior

map verifications that have occurred on adjacent properties, and any other objective factual information that has been provided to the Planning Director.

G. **Detailed Verification Approach.** All applicants who believe that the HCA map is inaccurate for a reason other than as described in subsections 9(F)(2) and (3) may file a verification request consistent with this subsection 9(G) of this ordinance.

1. ***Application requirements.*** The applicant shall submit a report prepared and signed by either (1) a knowledgeable and qualified natural resource professional, such as a wildlife biologist, botanist, or hydrologist, or (2) a civil or environmental engineer registered in Oregon to design public sanitary or storm systems, storm water facilities, or other similar facilities. Such report shall include:

    a. A description of the qualifications and experience of all persons that contributed to the report, and, for each person that contributed, a description of the elements of the analysis to which the person contributed;

    b. The information described in subsections 9(F)(1)(a) through (e) of this ordinance;

    c. The information described in subsections 9(F)(2)(b) and 9(F)(3)(b) through (d) of this ordinance, if the applicant believes such information is relevant to the verification of habitat location on the subject lot or parcel;

    d. Additional aerial photographs if the applicant believes they provide better information regarding the property, including documentation of the date and process used to take the photos and an expert's interpretation of the additional information they provide;

    e. A map showing the topography of the property shown by contour lines of 2 foot intervals for slopes less than 15% and by 10 foot intervals for slopes 15% or greater; and

    f. Any additional information necessary to address each of the verification criteria in subsection 9(G)(4) of this ordinance, a description of where any HCAs are located on the property based on the application of the verification criteria in subsection 9(G)(4) of this ordinance, and factual documentation to support the analysis.

2. ***Notice requirements.*** Upon receipt of a completed application pursuant to this subsection 9(G) of this ordinance, the Planning Director shall provide notice of the map verification application to Metro, to the owners of record of property on the most recent property tax assessment roll where such property is located within 100 feet of the subject property, *[Note: A city or county may increase the 100 feet neighbor notification requirement if it so chooses]* to any neighborhood or community planning organization recognized by the governing body and whose boundaries include the property, and to any watershed council recognized by the Oregon Watershed Enhancement Board and whose boundaries include the property. The notice provided by the jurisdiction shall comply with the notice requirements of ORS 197.763. The Planning Director shall accept written public comments regarding the matter during a public comment period.

3. ***Decision process.*** The Planning Director shall apply the verification criteria in subsection 9(G)(4) of this ordinance to confirm the location of any HCAs based on the HCA map, the information submitted by the applicant, any information received during the public comment period, and any additional information readily available, including information collected during a

site visit to the lot or parcel. The applicant and all persons that submitted written comments shall be provided with a written explanation of the Planning Director's decision.

4. ***Verification Criteria.*** The verification of the location of HCAs shall be according to the four-step process described in this subsection 9(G)(4) of this ordinance. A verification application shall not be considered complete and shall not be granted unless all the information required to be submitted with the verification application has been received.

   a. ***Step 1. Verifying boundaries of inventoried riparian habitat.*** Locating habitat and determining its riparian habitat class is a four-step process:

      i. Locate the Water Feature that is the basis for identifying riparian habitat.

         (A) Locate the top of bank of all streams, rivers, and open water within 200 feet of the property.

         (B) Locate all flood areas within 100 feet of the property.

         (C) Locate all wetlands within 150 feet of the property based on the Local Wetland Inventory map (if completed) and on the Metro 2002 Wetland Inventory Map (available from the Metro Data Resource Center, 600 N.E. Grand Ave., Portland, OR 97232; 503-797-1742). Identified wetlands shall be further delineated consistent with methods currently accepted by the Oregon Division of State Lands and the U.S. Army Corps of Engineers.

      ii. Identify the vegetative cover status of all areas on the property that are within 200 feet of the top of bank of streams, rivers, and open water, are wetlands or are within 150 feet of wetlands, and are flood areas and within 100 feet of flood areas.

         (A) Vegetative cover status shall be as identified on the Metro Vegetative Cover Map (available from the Metro Data Resource Center, 600 N.E. Grand Ave., Portland, OR 97232; 503-797-1742).

         (B) The vegetative cover status of a property may be adjusted only if (1) the property was developed prior to the time the regional program was approved (see subsection 9(F)(3) of this ordinance, above), or (2) an error was made at the time the vegetative cover status was determined. To assert the latter type of error, applicants shall submit an analysis of the vegetative cover on their property using summer 2002 aerial photographs and the definitions of the different vegetative cover types provided in Section 11 of this ordinance.

      iii. Determine whether the degree that the land slopes upward from all streams, rivers, and open water within 200 feet of the property is greater than or less than 25% (using the methodology as described in *[insert a reference to the city or county code section that describes the methodology used to identify Water Quality Resource Areas pursuant to Title 3 of the Urban Growth Management Functional Plan]*); and

      iv. Identify the riparian habitat classes applicable to all areas on the property using Table 6 and the data identified in subsections 9(G)(4)(a)(i) through (iii).

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Table 6: Method for Locating Boundaries of Class I and II Riparian Areas.

Distance from Water Feature	Development/Vegetation Status[1]			
	Developed areas not providing vegetative cover	**Low structure vegetation or open soils**	**Woody vegetation (shrub and scattered forest canopy)**	**Forest Canopy (closed to open forest canopy)**
Surface Streams				
0-50’	Class II	Class I[2]	Class I	Class I
50’-100’		Class II[3]	Class I	Class I
100’-150’		Class II[3] if slope>25%	Class II[3] if slope>25%	Class II[3]
150’-200’		Class II[3] if slope>25%	Class II[3] if slope>25%	Class II[3] if slope>25%
Wetlands (Wetland feature itself is a Class I Riparian Area)				
0-100’		Class II[3]	Class I	Class I
100’-150’				Class II[2]
Flood Areas				
Within 300’ of river or surface stream		Class I	Class I	Class I
More than 300’ from river or surface stream	[4]	Class II[3]	Class II[3]	Class I
0-100’ from edge of flood area			Class II[3, 5]	Class II[3]

[1] The vegetative cover type assigned to any particular area was based on two factors: the type of vegetation observed in aerial photographs and the size of the overall contiguous area of vegetative cover to which a particular piece of vegetation belonged. As an example of how the categories were assigned, in order to qualify as “forest canopy” the forested area had to be part of a larger patch of forest of at least one acre in size.

[2] Except that areas within 50 feet of surface streams shall be Class II riparian areas if their vegetation status is “Low structure vegetation or open soils,” and if they are high gradient streams. High gradient streams are identified on the Metro Vegetative Cover Map. If a property owner believes the gradient of a stream was incorrectly identified, then the property owner may demonstrate the correct classification by identifying the channel type using the methodology described in the Oregon Watershed Assessment Manual, published by the Oregon Watershed Enhancement Board, and appended to the Metro’s Riparian Corridor and Wildlife Habitat Inventories Report, Attachment 1 to Exhibit F to Metro Ordinance No. 05-1077C.

[3] Areas that have been identified as habitats of concern, as designated on the Metro Habitats of Concern Map (on file in the Metro Council office), shall be treated as Class I riparian habitat areas in all cases, subject to the provision of additional information that establishes that they do not meet the criteria used to identify habitats of concern as described in Metro’s Technical Report for Fish and Wildlife. Examples of habitats of concern include: Oregon white oak woodlands, bottomland hardwood forests, wetlands, native grasslands, riverine islands or deltas, and important wildlife migration corridors.

[4] If development prior to the effective date of Metro Ordinance No. 05-1077C within a contiguous, undeveloped flood area (to include contiguous flood areas on adjacent properties) that was not mapped as having any vegetative cover has reduced the size of that contiguous flood area to less than one half of

an acre in size, then the remaining flood area shall also be considered a developed flood area and shall not be identified as habitat.
[5] Only if within 300 feet of a river or surface stream.

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b. ***Step 2. Verifying boundaries of inventoried upland habitat in future urban growth boundary expansion areas.*** Upland habitat was identified based on the existence of contiguous patches of forest canopy, with limited canopy openings. The "forest canopy" designation is made based on analysis of aerial photographs, as part of determining the vegetative cover status of land within the region. Upland habitat shall be as identified on the HCA map unless corrected as provided in this subsection.

   i. Except as provided in subsection 9(G)(4)(b)(ii), vegetative cover status shall be as identified on the Metro Vegetative Cover Map used to inventory habitat at the time the area was brought within the urban growth boundary (available from the Metro Data Resource Center, 600 N.E. Grand Ave., Portland, OR 97232; 503-797-1742).

   ii. The only allowed corrections to the vegetative cover status of a property are as follows:

      (A) To correct errors made when the vegetative status of an area was determined based on analysis of the aerial photographs used to inventory the habitat at the time the area was brought within the urban growth boundary. For example, an area may have been identified as "forest canopy" when it can be shown that such area has less than 60% canopy crown closure, and therefore should not have been identified as "forest canopy." The perimeter of an area delineated as "forest canopy" on the Metro Vegetative Cover Map may be adjusted to more precisely indicate the dripline of the trees within the canopied area provided that no areas providing greater than 60% canopy crown closure are de-classified from the "forest canopy" designation. To assert such errors, applicants shall submit an analysis of the vegetative cover on their property using the aerial photographs that were used to inventory the habitat at the time the area was brought within the urban growth boundary and the definitions of the different vegetative cover types provided in Section 11 of this ordinance; and

      (B) To remove tree orchards and Christmas tree farms from inventoried habitat; provided, however, that Christmas tree farms where the trees were planted prior to 1975 and have not been harvested for sale as Christmas trees shall not be removed from the habitat inventory.

   iii. If the vegetative cover status of any area identified as upland habitat is corrected pursuant to subsection 9(G)(4)(b)(ii)(A) to change the status of an area originally identified as "forest canopy," then such area shall not be considered upland habitat unless it remains part of a forest canopy opening less than one acre in area completely surrounding by an area of contiguous forest canopy.

c. ***Step 3. Urban Development Value of the Property.*** The urban development value of property designated as regionally significant habitat is depicted on the Metro Habitat Urban Development Value Map (available from the Metro Data Resource Center, 600 N.E. Grand Ave., Portland, OR 97232; 503-797-1742).

i. A property's urban development value designation shall be adjusted upward if the Metro 2040 Design Type designation for the property lot or parcel has changed from a category designated as a lower urban development value category to one designated as a higher urban development value category. 2040 Design Type designations are identified on the Metro 2040 Applied Concept Map (also available from the Metro Data Resource Center, 600 N.E. Grand Ave., Portland, OR 97232; 503-797-1742).

ii. Properties in areas designated on the 2040 Applied Concept Map as the Central City, Regional Centers, Town Centers, and Regionally Significant Industrial Areas are considered to be of high urban development value; properties in areas designated as Main Streets, Station Communities, Other Industrial Areas, and Employment Centers are of medium urban development value; and properties in areas designated as Inner and Outer Neighborhoods and Corridors are of low urban development value.

iii. As designated in Title 13 of Metro's Urban Growth Management Functional Plan, properties owned by a regionally significant educational or medical facility are designated as high urban development value.

d. ***Step 4. Cross-Reference Habitat Class With Urban Development Value.*** City and county verification of the locations of High, Moderate, and Low Habitat Conservation Areas shall be consistent with Tables 7 and 8.

Table 7: Method for Identifying Habitat Conservation Areas ("HCA")

Fish & wildlife habitat classification	**High Urban development value[1]**	**Medium Urban development value[2]**	**Low Urban development value[3]**	**Other areas: Parks and Open Spaces, no design types outside UGB**
Class I Riparian	Moderate HCA	High HCA	High HCA	High HCA / High HCA+[4]
Class II Riparian	Low HCA	Low HCA	Moderate HCA	Moderate HCA / High HCA+[4]
Class A Upland Wildlife	No HCA	No HCA	No HCA	No HCA / High HCA[5] / High HCA+[4]
Class B Upland Wildlife	No HCA	No HCA	No HCA	No HCA / High HCA[5] / High HCA+[4]

NOTE: The default urban development value of property is as depicted on the Metro Habitat Urban Development Value Map. The Metro 2040 Design Type designations provided in the following footnotes are only for use when a city or county is determining whether to make an HCA adjustment.

[1]Primary 2040 design type: Regional Centers, Central City, Town Centers, and Regionally Significant Industrial Areas
[2]Secondary 2040 design type: Main Streets, Station Communities, Other Industrial areas, and Employment Centers
[3]Tertiary 2040 design type: Inner and outer neighborhoods, Corridors
[4]Cities and counties shall give Class I and II riparian habitat and Class A and B upland wildlife habitat in parks designated as natural areas even greater protection than that afforded to High Habitat Conservation Areas.
[5]All Class A and B upland wildlife habitat in publicly-owned parks and open spaces, except for parks and open spaces where the acquiring agency clearly identified that it was acquiring the property to develop it for active recreational uses, shall be considered High HCAs.

Table 8: Method for Identifying Habitat Conservation Areas ("HCA") in Future Urban Growth Boundary Expansion Areas

Fish & wildlife habitat classification	High Urban development value[1]	Medium Urban development value[2]	Low Urban development value[3]	Other areas: Parks and Open Spaces, no design types outside UGB
Class I Riparian	Moderate HCA	High HCA	High HCA	High HCA / High HCA+[4]
Class II Riparian	Low HCA	Low HCA	Moderate HCA	Moderate HCA / High HCA+[4]
Class A Upland Wildlife	Low HCA	Moderate HCA	Moderate HCA	High HCA / High HCA[5] / High HCA+[4]
Class B Upland Wildlife	Low HCA	Low HCA	Moderate HCA	Moderate HCA / High HCA[5] / High HCA+[4]

NOTE: The default urban development value of property is as depicted on the Metro Habitat Urban Development Value Map. The Metro 2040 Design Type designations provided in the following footnotes are only for use when a city or county is determining whether to make an HCA adjustment.

[1]Primary 2040 design types: Regional Centers, Central City, Town Centers, and Regionally Significant Industrial Areas

[2]Secondary 2040 design types: Main Streets, Station Communities, Other Industrial areas, and Employment Centers

[3]Tertiary 2040 design types: Inner and outer neighborhoods, Corridors

[4]Cities and counties shall give Class I and II riparian habitat and Class A and B upland wildlife habitat in parks designated as natural areas even greater protection than that afforded to High Habitat Conservation Areas.

[5]All Class A and B upland wildlife habitat in publicly-owned parks and open spaces, except for parks and open spaces where the acquiring agency clearly identified that it was acquiring the property to develop it for active recreational uses, shall be considered High HCAs.

Section 10. Severability

The provisions of this ordinance are severable. If any section, clause, or phrase of this ordinance is adjudged to be invalid by a court of competent jurisdiction, the decision of that court shall not affect the validity of the remaining portions of this ordinance.

Section 11. Definitions

Unless specifically defined in this section, words or phrases used in this ordinance shall be interpreted to give them the same meaning as they have in common usage and to give this ordinance its most reasonable application.

Building site - The area on a lot or parcel that is designated to contain a structure, impervious surface, or non-native landscaping.

Building footprint - The area that is covered by buildings or other roofed structures. A roofed structure includes any structure more than 6 feet above grade at any point, and that provides an impervious cover over what is below. Building footprint also includes uncovered horizontal structures such as decks, stairways and entry bridges that are more than 6 feet above grade. Eaves are not included in building coverage. Underground facilities and structures are defined based on the foundation line.

Developed areas not providing vegetative cover - are areas that lack sufficient vegetative cover to meet the one-acre minimum mapping units of any other type of vegetative cover.

Developed flood area – A flood area (a) upon which a building or other structure has been located, or (b) that is an uncovered, hard-surfaced area or an area covered with a perforated hard surface (such as

“Grasscrete”) that is able to withstand vehicular traffic or other heavy-impact uses; provided, however, that graveled areas shall not be considered developed flood areas.

Development - Any man-made change defined as buildings or other structures, mining, dredging, paving, filling, or grading in amounts greater than ten (10) cubic yards on any lot or excavation. In addition, any other activity that results in the removal of more than: either 10 percent or 20,000 square feet of the vegetation in the Habitat Conservation Areas on the lot is defined as development. When individual trees are removed, the area contained within the tree’s drip line shall be the basis for calculating the square footage of vegetation removed.

Development does not include the following: (a) Stream enhancement or restoration projects approved by cities and counties; or (b) Farming practices as defined in ORS 30.930 and farm use as defined in ORS 215.203, except that buildings associated with farm practices and farm uses are subject to the requirements of this ordinance.

Disturb - Man-made changes to the existing physical status of the land, which are made in connection with development. The following uses are excluded from the definition:

- enhancement or restoration of the Water Quality Resource Area;
- planting native cover identified in the Metro Native Plant List.

Disturbance Area - An area that contains all temporary and permanent development, exterior improvements, and staging and storage areas on the site. For new development the disturbance area must be contiguous. The disturbance area does not include agricultural and pasture lands or naturalized areas.

Dripline - The outermost edge of a tree’s canopy; when delineating the drip line on the ground, it will appear as an irregularly shaped circle defining the canopy’s perimeter.

Ecological functions - The primary biological and hydrologic characteristics of healthy fish and wildlife habitat. Riparian ecological functions include microclimate and shade, streamflow moderation and water storage, bank stabilization and sediment/pollution control, sources of large woody debris and natural channel dynamics, and organic material sources. Upland wildlife ecological functions include size of habitat area, amount of habitat with interior conditions, connectivity of habitat to water resources, connectivity to other habitat areas, and presence of unique habitat types.

Effective Impervious Area - A subset of total impervious area that is hydrologically connected via sheet flow or discrete conveyance to a drainage system or receiving body of water

Emergency - Any man-made or natural event or circumstance causing or threatening loss of life, injury to person or property, and includes, but is not limited to, fire, explosion, flood, severe weather, drought earthquake, volcanic activity, spills or releases of oil or hazardous material, contamination, utility or transportation disruptions, and disease.

Engineer - A registered professional engineer licensed by the State of Oregon.

Enhancement - The process of improving upon the natural functions and/or values of an area or feature that has been degraded by human activity. Enhancement activities may or may not return the site to a pre-disturbance condition, but create/recreate beneficial processes and features that occur naturally.

Erosion - Erosion is the movement of soil particles resulting from actions of water or wind.

Fill - Any material such as, but not limited to, sand, gravel, soil, rock or gravel that is placed in a wetland or floodplain for the purposes of development or redevelopment.

Flood areas - Those areas contained within the 100-year floodplain and floodway as shown on the Federal Emergency Management Agency Flood Insurance Maps and all lands that were inundated in the February 1996 flood (note that areas that were mapped as flood areas but were filled to a level above the base flood level prior to September 30, 2005, consistent with all applicable local, state, and federal laws shall no longer be considered habitat based on their status as flood areas).

Flood Management Areas - All lands contained within the 100-year floodplain, flood area and floodway as shown on the Federal Emergency Management Agency Flood Insurance Maps and the area of inundation for the February 1996 flood. In addition, all lands which have documented evidence of flooding**.**

Floodplain - The land subject to periodic flooding, including the 100-year floodplain as mapped by FEMA Flood Insurance Studies or other substantial evidence of actual flood events.

Floodway - The portion of a watercourse required for the passage or conveyance of a given storm event as identified and designated by the (identify name) city/county pursuant to this Ordinance. The floodway shall include the channel of the watercourse and the adjacent floodplain that must be reserved in an unobstructed condition in order to discharge the base flood without flood levels by more than one foot.

Floor Area Ratio (FAR) - The amount of floor area in relation to the amount of site area, expressed in square feet. For example, a floor area ratio of 2 to 1 means two square feet of floor area for every one square foot of site area.

Forest canopy - Areas that are part of a contiguous grove of trees of one acre or larger in area with approximately 60% or greater crown closure, irrespective of whether the entire grove is within 200 feet of the relevant water feature.

Habitat Conservation Area or HCA - An area identified on the Habitat Conservation Areas Map and subject to the development standards.

Habitat-friendly development - A method of developing property that has less detrimental impact on fish and wildlife habitat than does traditional development methods. Examples include clustering development to avoid habitat, using alternative materials and designs such as pier, post, or piling foundations designed to minimize tree root disturbance, managing storm water on-site to help filter rainwater and recharge groundwater sources, collecting rooftop water in rain barrels for reuse in site landscaping and gardening, and reducing the amount of effective impervious surface created by development.

Invasive non-native or noxious vegetation - Plant species that are listed as nuisance plants or prohibited plants on the Metro Native Plant List as adopted by Metro Council resolution because they are plant species that have been introduced and, due to aggressive growth patterns and lack of natural enemies in the area where introduced, spread rapidly into native plant communities.

Lot - Lot means a single unit of land that is created by a subdivision of land. (ORS 92.010).

Low structure vegetation or open soils - Areas that are part of a contiguous area one acre or larger of grass, meadow, crop-lands, or areas of open soils located within 300 feet of a surface stream (low structure vegetation areas may include areas of shrub vegetation less than one acre in size if they are contiguous with areas of grass, meadow, crop-lands, orchards, Christmas tree farms, holly farms, or areas of open soils located within 300 feet of a surface stream and together form an area of one acre in size or larger).

Mitigation - The reduction of adverse effects of a proposed project by considering, in the order: a) avoiding the impact all together by not taking a certain action or parts of an action; b) minimizing impacts by limiting the degree or magnitude of the action and its implementation; c) rectifying the impact by repairing, rehabilitating or restoring the affected environment; d) reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action by monitoring and taking appropriate measures; and e) compensating for the impact by replacing or providing comparable substitute water quality resource areas or habitat conservation areas.

Native vegetation or native plant - Vegetation listed as a native plant on the Metro Native Plant List as adopted by Metro Council resolution and any other vegetation native to the Portland metropolitan area provided that it is not listed as a nuisance plant or a prohibited plant on the Metro Native Plant List.

Open space - Land that is undeveloped and that is planned to remain so indefinitely. The term encompasses parks, forests and farmland. It may also refer only to land zoned as being available to the public, including playgrounds, watershed preserves and parks.

Owner or property owner - The person who is the legal record owner of the land, or where there is a recorded land sale contract, the purchaser thereunder.

Parcel - Parcel means a single unit of land that is created by a partitioning of land. (ORS 92.010).

Partition - Partition means to divide land into two or three parcels of land within a calendar year. (ORS 92.010)

Phased development project - A phased development plan includes the following:

- A site plan showing the proposed final development of the site and phases, including the initial and interim phases.
- A written statement describing each phase, including the potential uses, and the approximate timeline for each phase of development.

Practicable - means available and capable of being done after taking into consideration cost, existing technology, and logistics in light of overall project purpose and probable impact on ecological functions. The practicability of a development option shall include consideration of the type of HCA that will be affected by the proposed development. For example, High HCAs have been so designated because they are areas that have been identified as having lower urban development value and higher-valued habitat, so it should be more difficult to show that alternative development options that avoid the habitat are not practicable. On the other hand, Low HCAs have been so designated because they are areas that have been identified as having higher urban development value and lower-valued habitat, so it should be less difficult to show that alternative development options that avoid the habitat are not practicable.

Redevelopment – Development that occurs on sites that have previously been developed.

Restoration - The process of returning a disturbed or altered area or feature to a previously existing natural condition. Restoration activities reestablish the structure, function, and/or diversity to that which occurred prior to impacts caused by human activity.

Riparian - Those areas associated with streams, lakes and wetlands where vegetation communities are predominately influenced by their association with water.

Routine repair and maintenance - Activities directed at preserving an existing allowed use or facility, without expanding the development footprint or site use.

Set-back adjustment - The placement of a building a specified distance away from a road, property line or protected resource.

Significant negative impact - An impact that affects the natural environment, considered individually or cumulatively with other impacts on the HCA, to the point where existing fish and wildlife habitat functional values are degraded.

Statewide Land Use Planning Goal 5 - Oregon's statewide planning goal that addresses open space, scenic and historic areas, and natural resources. The purpose of the goal is to conserve open space and protect natural and scenic resources.

Steep slopes - Steep slopes are those slopes that are equal to or greater than 25%. Steep slopes have been removed from the "buildable lands" inventory and have not been used in calculations to determine the number of acres within the urban growth boundary that are available for development.

Stormwater pre-treatment facility - Any structure or drainage way that is designed, constructed, and maintained to collect and filter, retain, or detain surface water run-off during and after a storm event for the purpose of water quality improvement.

Stream - A body of running water moving over the earth's surface in a channel or bed, such as a creek, rivulet or river. It flows at least part of the year, including perennial and intermittent streams. Streams are dynamic in nature and their structure is maintained through build-up and loss of sediment.

Structure - A building or other major improvement that is built, constructed or installed, not including minor improvements, such as fences, utility poles, flagpoles or irrigation system components, that are not customarily regulated through zoning codes.

Subdivision - A Subdivision of land means to divide land into four or more lots within a calendar year. (ORS 92.010).

Top of Bank - The same as "bankful stage" defined in OAR 141-85-010.

Urban Development Value - The economic value of a property lot or parcel as determined by analyzing three separate variables: assessed land value, value as a property that could generate jobs ("employment value"), and the Metro 2040 design type designation of property. The urban development value of all properties containing regionally significant fish and wildlife habitat is depicted on the Metro Habitat Urban Development Value Map

Urban Growth Boundary or UGB - means an urban growth boundary adopted pursuant to ORS chapter 197.

Utility facilities - Buildings, structures or any constructed portion of a system which provide**s** for the production, transmission, conveyance, delivery or furnishing of services including, but not limited to, heat, light, water, power, natural gas, sanitary sewer, stormwater, telephone and cable television. Utility facilities do not include stormwater pre-treatment facilities.

Variance - means a discretionary decision to permit modification of the terms of an implementing ordinance based on a demonstration of unusual hardship or exceptional circumstances unique to a specific property.

Water-dependent - A use which can be carried out only on, in, or adjacent to water because it requires access to the water for waterborne transportation or recreation. Water-dependent also includes development, which by its nature, can be built only on, in, or over water. Bridges supported by piers or pillars, as opposed to fill, are water-dependent development.

Water feature - All rivers, streams (regardless of whether they carry year-round flow, i.e., including intermittent streams), springs which feed streams and wetlands and have year-round flow, Flood Management Areas, wetlands, and all other bodies of open water.

Water Quality Resource Area - is an area identified by a city or county as a Water Quality Resource Area in order to comply with Title 3 of Metro's Urban Growth Management Functional Plan, Metro Code sections 3.07.310- 3.07.370.

Watershed - A watershed is a geographic unit defined by the flows of rainwater or snowmelt. All land in a watershed drains to a common outlet, such as a stream, lake or wetland.

Wetlands - Wetlands are those areas inundated or saturated by surface or ground water at a frequency and duration sufficient to support and under normal circumstances do support a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs and similar areas. Wetlands are those areas identified and delineated by a qualified wetland specialist as set forth in the 1987 Corps of Engineers Wetland Delineation Manual.

Woody vegetation - Areas that are part of a contiguous area one acre or larger of shrub or open or scattered forest canopy (less than 60% crown closure) located within 300 feet of a surface stream.

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EXHIBIT F—ORDINANCE NO. 05-1077C

FINDINGS OF FACT AND CONCLUSIONS OF LAW

By approving this ordinance, Metro adopts a new title (Title 13, "Nature in Neighborhoods") to the Urban Growth Management Functional Plan ("UGMFP"), amends the Regional Framework Plan, amends other provisions of the UGMFP, and adopts a model ordinance for use by cities and counties, at their option, to comply with the new provisions of the UGMFP. Metro adopts this ordinance to implement certain provisions of Statewide Planning Goals 5 and 6 within the Metro region. As described in these Findings of Fact and Conclusions of Law ("Findings"), Metro's adoption of this ordinance complies with Oregon land use planning statutes, statewide land use planning goals, administrative rules adopted by the Land Conservation and Development Commission to implement the statewide land use planning goals, and the Regional Framework Plan.

These Findings are intended to explain how this ordinance complies with applicable laws and goals in general. These Findings supplement the extensive decision record for this multi-year planning effort, and are supported by the facts in the decision record. That record includes all documents in the public record for Metro Resolution Nos. 00-2965, 01-3087A, 01-3141C, 02-3176, 02-3177A, 02-3195, 02-3218A, 03-3332, 03-3376B, 04-3440A, 04-3488, 04-3489A, 04-3506A, 05-3557, 05-3574A, and 05-3577A, all of which were adopted by the Council in the course of developing this ordinance. Some of the most critical documents supporting Metro's adoption of this ordinance are included as attachments to these Findings. Metro has relied on the attached documents and information in the record in developing this ordinance.

FINDINGS OF COMPLIANCE WITH STATEWIDE PLANNING GOALS

As noted above, Metro adopts this ordinance to implement certain provisions of Statewide Planning Goals 5 and 6 within the Metro region. These Findings will therefore start with Metro's compliance with those goals, and then address compliance with the other goals in numerical order.

Goal 5. Open Spaces, Scenic and Historic Areas and Natural Resources

Division 23 of Chapter 660 of the Oregon Administrative Rules (the "Goal 5 Rule") establishes procedures and criteria for complying with Goal 5. The Goal 5 Rule provides that "Metro may adopt one or more regional functional plans to address all applicable requirements of Goal 5 . . . for one or more resource categories and to provide time limits for local governments to implement the plan." OAR 660-023-0080(3). In order to adopt a Goal 5 program, local governments must follow a three-part process. The first part is to conduct an inventory of Goal 5 resources within the jurisdiction. OAR 660-023-0030. The second part is to conduct an analysis of the economic, social, environmental, and energy (ESEE) consequences of protecting or not protecting such inventoried resources (the "ESEE Analysis"), and to decide whether to allow, limit, or prohibit uses that conflict with the preservation of the inventoried resources (the "ALP Decision"). OAR 660-023-0040. The third part is to develop a program to achieve Goal 5 consistent with the government's ALP Decision. OAR 660-023-0050.

A. Metro's Inventory Process

The Goal 5 Rule describes a four-step process for conducting an inventory of Goal 5 resources. Metro's resources inventory is described in detail in Attachment 1 to these Findings which includes two documents, the *Metro's Riparian Corridor and Wildlife Habitat Inventories, August 2005* (the "Inventory Report") and the *Addendum and Update to Metro's Riparian Corridor and Wildlife Habitat Inventories, September 2005*, (the "Inventory Addendum"). The Inventory Report and the Inventory Addendum also refer to, and rely on, *Metro's Technical Report for Fish and Wildlife Habitat, April 2005* (the "Technical Report," included as Attachment 2 to these Findings). The Inventory Report, Inventory Addendum, and Technical Report, including their final recommendations, findings, and conclusions, are hereby incorporated by reference as part of these Findings. As described in detail in the Inventory Report and Inventory Addendum, Metro followed the inventory process required by the Goal 5 Rule to inventory two types of Goal 5 resources within the Metro region: riparian corridors (OAR 660-023-0090) and wildlife habitat (OAR 660-023-0110). Metro exercised its discretion under OAR 660-023-0080(3) not to inventory other Goal 5 resources.

Specifically, following the Goal 5 Rule's four-step inventory process (OAR 660-023-0030), and as fully described in the Inventory Report and Inventory Addendum, Metro collected information about riparian corridors and wildlife habitat, determined that the information it had collected was adequate, determined the significance of resource sites, and, by adoption of this ordinance, hereby adopts a list of regionally significant resource sites. Those sites are depicted on the Regionally Significant Fish and Wildlife Habitat Inventory Map (the "Inventory Map"), attached as Exhibit A to this ordinance. As fully described in the Inventory Report, Inventory Addendum, and Technical Report, the Council finds that Metro's inventory of riparian corridors and wildlife habitat complies with Goal 5.

B. Metro's ESEE Analysis and "Allow-Limit-Prohibit" Decision Process

The second step of the process required by the Goal 5 Rule is to analyze the economic, social, environmental, and energy (ESEE) consequences that could result from a decision to allow, limit, or prohibit a use that conflicts with identified Goal 5 resources. OAR 660-023-0040(1). The rule provides a four-step process for conducting the ESEE Analysis: (1) identify conflicting uses, (2) determine impact areas; (3) analyze the ESEE consequences; and (4) determine whether to allow, limit, or prohibit conflicting uses for significant resource sites.

Metro conducted its ESEE Analysis in two phases. Metro's ESEE Analysis is described in detail in Attachments 3 and 4 to these Findings, *Metro's Phase I ESEE Analysis, April 2005*, and *Metro's Phase II ESEE Analysis, April 2005* (collectively, "Metro's ESEE Reports"). Except as otherwise provided in the text of this Exhibit F to this ordinance, Metro's ESEE Reports, including their final recommendations, findings, and conclusions, are hereby incorporated by reference as part of these Findings. As described in detail in Metro's ESEE Reports, Metro followed the ESEE analysis process required by the Goal 5 Rule for all inventoried regionally significant fish and wildlife habitat.

The first step of the required ESEE analysis is to identify conflicting uses. Chapter 3 of *Metro's Phase I ESEE Analysis* describes how Metro identified conflicting uses and how Metro's approach complies with the Goal 5 Rule. Metro used its seven generalized regional zones to group similar conflicting uses. *ESEE Phase I Analysis*, page 24.

The second step of the required ESEE analysis is to determine the “impact area” surrounding the significant resources. Chapter 2 of *Metro’s Phase I ESEE Analysis* describes how Metro identified impact areas and how Metro’s approach complies with the Goal 5 Rule.

The third step of the required ESEE analysis is to analyze the ESEE consequences that could result from a decision to allow, limit, or prohibit conflicting uses within significant resources. Chapters 4 through 7 of *Metro’s Phase I ESEE Analysis* describe, respectively, the general economic, social, environmental, and energy consequences of allowing, limiting, or prohibiting such conflicting uses within regionally significant fish and wildlife habitat, and Chapter 8 of the Phase I Report describes the likely tradeoffs that will result from a decision to allow, limit, or prohibit conflicting uses for significant resources. In order to aid in its analysis, Metro differentiated its inventory of regionally significant fish and wildlife habitat by habitat type and quality, creating six habitat categories (Riparian Class I, II and III, and Upland Wildlife Class A, B and C). In Table 8-1 of the Phase I Report, Metro summarized the ESEE consequences of allowing, limiting, or prohibiting conflicting uses on each of the different habitat categories, as well as on impact areas. In addition, Appendix D to the Phase I Report provides a matrix that further summarizes the ESEE consequences of allowing, limiting, or prohibiting conflicting uses by habitat category and by generalized regional zoning designations. This analysis allowed Metro to assess the ESEE consequences that would apply to similarly situated resource sites; that is, significant resources of the same habitat type and class are similarly situated, and Metro then analyzed such properties that are subject to the same generalized regional zoning designations.

The Phase II Report completed Metro’s ESEE Analysis. Although not required by the Goal 5 Rule, the Metro Council directed staff to prepare multiple program approaches and to assess the ESEE consequences of each approach, based on criteria developed during Phase I of the ESEE analysis, in order to make as informed an ALP Decision as possible. As part of the Phase II Report, Metro also considered applicable requirements of the statewide goals and acknowledged plan requirements. In particular, Metro assessed the effect that existing non-regulatory programs have on regionally significant fish and wildlife habitat (Phase II Report, pages 9-13) and the effect that existing regulatory requirements, including locally adopted Goal 5 programs, have on significant habitat (Phase II Report, pages 25-33; and *Local Plan Analysis: A review of Goal 5 protection in the Metro region (August 2002)*, adopted by the Council with its approval of Resolution No. 02-3218A, August 8, 2002).

Based upon Metro’s two-phase ESEE analysis and advice from citizens, Metro advisory committees, local governments, and other interested parties, Metro has made its ALP Decision, which is reflected below and in this ordinance. As described in the ESEE Reports, there are many factors weighing for and against allowing, limiting, or prohibiting conflicting uses within significant resources. Metro has weighed and considered those factors to make a balanced ALP Decision that seeks to conserve and preserve the highest value and most critical habitat, ensure that the Metro region’s economy continues to thrive, protects and improves the region’s water quality and prevents water pollution, and respects property rights. The Council finds that none of the significant resources are of such importance relative to conflicting uses to support a decision to prohibit such conflicting uses. The Council finds that conflicting uses should be limited in some significant resources and allowed in others. Reflecting Metro’s balancing of competing factors in making its ALP Decision, Metro has structured its ALP Decision using a matrix that differentiates the significant resources by habitat class and type and by its urban development value. The following chart summarizes Metro’s ALP Decision:

Fish & Wildlife Habitat Classification	**High Urban Development Value**	**Medium Urban Development Value**	**Low Urban Development Value**	**Other Areas**
	Primary 2040 components[1], high employment value, or high land value[4, 5]	Secondary 2040 components[2], medium employment value, or medium land value[4]	Tertiary 2040 components[3], low employment value, or low land value[4]	Parks and Open Spaces, no design types outside UGB
Class I Riparian/Wildlife	ML / A[6]	SL	SL	SL / SL+[7]
Class II Riparian/Wildlife	LL/ A[6]	LL	ML	ML / SL+[7]
Class III Riparian/Wildlife	A	A	A	A
Class A Upland Wildlife	A / LL[8]	A / ML[8]	A / ML[8]	A / SL[8, 9] / SL+[7, 8]
Class B Upland Wildlife	A / LL[8]	A / LL[8]	A / ML[8]	A / SL[8, 9] / SL+[7, 8]
Class C Upland Wildlife	A	A	A	A
Impact Areas	A	A	A	A

Key: SL = strictly limit; ML = moderately limit; LL = lightly limit; and A = allow.

[1] Primary 2040 components: Regional Centers, Central City, Town Centers, and Regionally Significant Industrial Areas
[2] Secondary 2040 components: Main Streets, Station Communities, Other Industrial areas, and Employment Centers
[3] Tertiary 2040 components: Inner and outer neighborhoods, Corridors
[4] Land value excludes residential lands.
[5] Regionally significant educational or medical facilities, as identified by Metro, are also designated as high urban development value because of the special economic and social contributions they provide and because they are frequently located in areas designated as Tertiary or Secondary 2040 components, and therefore would not necessarily receive the economic ranking they deserve; see Exhibit C, Section 4(D)(5)(b).
[6] Apply allow treatment to the International Terminal (IT) site and Port of Portland Terminals 4, 5 and 6 because Council finds the special economic importance of those sites outweighs its resource values.
[7] Apply more strict protection (SL+) to parks designated as natural areas in Class I and II riparian habitat, and to future parks designated as natural areas in Class A and B upland wildlife habitat brought within the urban growth boundary after the program's effective date.
[8] Apply these limit decisions for Class A and B upland wildlife habitat in areas brought within the urban growth boundary after the program's effective date.
[9] Apply SL designations to all Class A and B upland wildlife habitat in publicly owned parks and open spaces, except for parks and open spaces where the acquiring agency clearly identified that it was acquiring the property to develop it for active recreational uses.
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As described above, this ALP Decision is a balanced decision that limits conflicting uses in the most critical habitat, which is the Class I and II riparian habitat. Metro is not limiting development in wildlife habitat because the economic and social impacts of such a decision, as well as the impact on meeting the region's housing and employment needs, would be too significant compared with the value of such protections. Instead, Metro is developing aggressive non-regulatory programs to conserve and preserve such habitat, and will work closely with cities and counties in the region to do the same. In addition, Metro is adopting a "no rollbacks" requirement to ensure that existing, locally adopted and acknowledged Goal 5 programs that limit development in upland wildlife habitat are not repealed or weakened. Metro's "allow" decision for wildlife habitat applies only to areas within the current UGB. I future UGB expansion areas the economic and social impacts are not as significant because advance planning can reduce conflicts and help ensure that vibrant new communities are created. Such areas are not yet slated for development, and there are not the same, concrete development expectations. For that reason, Metro has decided that a limit decision is appropriate within Class A and B upland wildlife habitat in future UGB expansion areas (but not within Class C habitat, which includes the smallest and most disconnected patches of habitat). Finally, Metro has made allow decisions in all Class III riparian habitat and in impact areas. Class III habitat consists primarily of developed flood areas that provide just one essential habitat function—water storage during flood events. The Council finds that the environmental benefits of limiting redevelopment of such areas is not commensurate with their economic value. Similarly, the Council finds that the environmental benefits of limiting conflicting uses in impact areas, which are not themselves habitat areas, are outweighed by the economic and social consequences that would result from such development limits.

In addition, publicly owned parks that are managed as natural areas are the backbone of the region's best functioning fish and wildlife habitat. The positive environmental consequences of limiting conflicting uses in such areas far outweighs any negative consequences of such a decision. For that reason, Metro has made a "strictly limit-plus" decision for such areas.

Metro has made two important modifications to its general ALP Decision in order to better calibrate its weighing and balancing of ESEE consequences. First, Metro has made an allow decision for four international marine terminals: the International Terminal site and Port of Portland Terminals 4, 5 and 6. Metro makes this allow decision because these terminals are currently developed for use as international marine terminals capable of mooring ocean-going tankers and cargo ships, and therefore have an especially critical role in supporting the region's economy, and in consideration that these terminals are substantially without vegetative cover, and therefore provide significantly less environmental value as habitat.

Second, Metro modifies its limit decision slightly to the extent that it affects owners of existing, developed residential properties. The modification allows such owners to undertake in the future any activity that they can currently undertake without having to obtain a land use approval or a building, grading, or tree removal permit from their city or county. The environmental consequences of imposing new limits on such activities would be to prevent certain activities that might harm the ecological functions being provided by such areas. However, the most harm done to habitat is due to significant property development, and the properties affected by this decision are already developed with residences. Thus, the environmental benefit of imposing new limits on such activities is relatively small. On the other hand, imposing any new limits on activities that homeowners can undertake today without having to seek permission could result in thousands of homeowners being confused regarding the new rules, resenting the new limits on their liberty to use their properties, and would thereby undermine Metro's efforts to encourage behavior that would benefit habitat areas in ways that regulations cannot. The Council therefore finds that imposing new limits on activities that homeowners can undertake today without having to obtain a permit would have significant detrimental social consequences that are not outweighed by the beneficial environmental consequences of imposing such new limits.

As described above and as supported by the record in this matter, the Council finds that Metro's ESEE Analysis and ALP Decision comply with Goal 5.

C. Metro's Program to Achieve Goal 5

The final step of the Goal 5 process is to develop a program to implement the ALP Decision. The Goal 5 Rule provides that Metro may adopt a functional plan to address the applicable requirements of the Goal and the Goal 5 Rule, and that, after acknowledgement by LCDC, local governments in the region shall apply the requirements of the functional plan, rather than the requirements of the Goal 5 Rule. OAR 660-023-0080(3). Exhibit C to this ordinance is a new Title 13 to the Metro Urban Growth Management Functional Plan and is adopted to provide cities and counties with new requirements that address compliance with Goal 5 with respect to the regionally significant fish and wildlife habitat identified by Metro.

Metro is in a unique position as a regional government with authority to adopt functional plan provisions with which all 25 cities and three counties in the region must comply. Metro has designed its program in recognition of the diversity of those cities and counties. Rather than adopting a one-size-fits-all approach, Metro's program offers considerable flexibility for local governments to develop their own approaches to conserve and protect regionally significant fish and wildlife habitat. In addition, for a jurisdiction without the resources necessary to develop its own innovative approach, Metro has also developed a model ordinance, attached as Exhibit E to this ordinance, that a jurisdiction can adopt "off the shelf" to comply with the new functional plan requirements.

The Goal 5 Rule requires that, when a government has decided to protect a resource site, the measures it takes to limit conflicting uses must contain clear and objective standards. See OAR 660-023-0050(2). Metro has satisfied this requirement by including clear and objective development standards in the model ordinance (see Exhibit E, Section 6) and, for jurisdictions that choose not to adopt the model ordinance, the functional plan requires that their programs contain clear and objective standards that meet the requirements of OAR 660-023-0050(2) (see Exhibit C, Section 3(C)). The Goal 5 Rule also provides that, in addition to providing clear and objective standards, local governments may also provide alternative review standards that are not clear and objective and make them available for use at a property owner's option. See OAR 660-023-0050(3). Metro has provided such discretionary approval standards in the model ordinance (see Exhibit E, Section 7) and, for jurisdictions that choose not to adopt the model ordinance, the functional plan allows their programs to also include discretionary approval standards (see Exhibit C, Section 3(D)).

As noted above, the Goal 5 Rule provides that, upon acknowledgement of this ordinance by the Oregon Land Conservation and Development Commission, cities and counties within the Metro region shall apply the requirements of this ordinance with respect to inventoried Goal 5 resources, rather than applying the requirements of the Goal 5 Rule. See OAR 660-023-0080(3). Metro has included a provision in this ordinance, subsection 3(A) of Exhibit C, to clarify the application of that provision. First, and most critically, the Council finds that the provisions of this ordinance are to establish a floor of habitat protection for the region and shall not limit any jurisdiction from providing a greater level of habitat protection than that required by this ordinance. See subsection 1(D) of Exhibit C. Second, because Metro has made a limit decision for areas Metro has designated as Habitat Conservation Areas (HCAs), the Council finds that cities and counties in the region shall apply the requirements of this ordinance, rather than the requirements of the Goal 5 Rule, with respect to the protection of such HCAs. Third, as describe above, this ordinance allows cities and counties the option to comply with its requirements by developing their own innovative habitat protection program. To the extent that such a program includes protection of Metro-inventoried habitat resources in addition to HCAs, the Council finds that cities and counties shall only have to comply with the requirements of this ordinance (i.e., to show that their overall program provides habitat protection comparable to that which would be provided if they were to adopt a program that complied with the performance standards included in this ordinance for the protection of HCAs). The Council finds that such cities and counties shall not be required to comply with the Goal 5 Rule. Fourth, except as described above in this paragraph, the Council finds that cities and counties that wish to adopt new provisions to protect any other areas not identified as HCAs shall do so only by complying with the Goal 5 Rule. Finally, fifth, the Council finds that existing, locally-adopted and acknowledged Goal 5 programs that limit development in Metro-inventoried upland wildlife habitat areas are critical to provide limited protections for such habitat and, for that reason, the Council finds that such programs shall not be repealed or weakened.

D. The Tualatin Basin Natural Resources Coordinating Committee

In June 2002, Metro entered into an intergovernmental agreement ("IGA") with a consortium of local governments from the Tualatin River watershed. The local governments had entered into their own IGA earlier that year to form the Tualatin Basin Natural Resources Coordinating Committee ("TBNRCC"). The municipal members of the TBNRCC included Washington County and the cities of Beaverton, Cornelius, Durham, Forest Grove, Hillsboro, King City, North Plains, Sherwood, Tigard, and Tualatin. The TBNRCC also included the Tualatin Hills Parks and Recreation District and Clean Water Services. The TBNRCC was formed to pool the resources of the member governments to conduct their own ESEE analysis using Metro's inventory of regionally significant fish and wildlife habitat, to make their own ALP Decision, and to develop their own program to achieve Goal 5, all in compliance with the Goal 5 Rule. Metro agreed to allow, and work with, the TBNRCC to do so, provided that the program eventually developed by the TBNRCC was likely to result in the conservation, protection, and restoration of a "continuous ecologically viable streamside corridor system, from the streams' headwaters to their confluence with other stream and rivers, and with their floodplains in a manner that is integrated with the surrounding urban landscape," and that it was likely to improve the condition of regionally significant habitat basin-wide, and in each subwatershed in the basin.

The TBNRCC's ESEE analysis and ALP decision are described in detail in Attachment 6 to these Findings, the *TBNRCC Goal 5 ESEE Analysis*, *March 2005* (the "TBNRCC ESEE Analysis"). As described in detail in the TBNRCC ESEE Analysis, and as summarized in the recitals of TBNRCC Resolution and Order No. 2005-01, adopted by the TBNRCC on April 4, 2005, the Council finds that the TBNRCC followed and complied with the ESEE analysis and ALP decision process required by the Goal 5 Rule for all inventoried regionally significant fish and wildlife habitat. For that reason, the TBNRCC ESEE Analysis and TBNRCC Resolution and Order No. 2005-01, including the TBNRCC's final recommendations, findings, and conclusions described therein, are hereby incorporated by reference as part of these Findings.

The first step of the required ESEE analysis is to identify conflicting uses. Chapter 2 and pages 2 and 3 of Chapter 6 of the TBNRCC ESEE Analysis describe how the TBNRCC identified conflicting uses and how its approach complies with the Goal 5 Rule. The second step of the required ESEE analysis is to determine the "impact area" surrounding the significant resources. Page 12 of Chapter 1 of the TBNRCC ESEE Analysis describes how the TBNRCC identified impact areas and how its approach complies with the Goal 5 Rule.

The third step of the required ESEE analysis is to analyze the ESEE consequences that could result from a decision to allow, limit, or prohibit conflicting uses within significant resources. Chapters 3 through 6 of the TBNRCC ESEE Analysis describe the economic, social, environmental, and energy consequences of allowing, limiting, or prohibiting such conflicting uses within regionally significant fish and wildlife habitat. The TBNRCC approach progressed from a general, basin-wide ESEE analysis (see Chapter 3) to a site-specific analysis (see Chapter 4). Based on information learned during the site-level analysis, the TBNRCC further revised its basin-wide analysis (Chapter 5). Finally, the TBNRCC revised all of its analysis and its ALP decision a final time during a second phase of its basin-wide analysis (Chapter 6).

The TBNRCC ESEE analysis and ALP Decision took a different approach, in many respects, than did Metro in its analysis and decision. For example, the TBNRCC defined the entire Tualatin Basin watershed as part of the impact area. In addition, though the TBNRCC describes its ALP Decision as being a "limit" decision for the entire watershed, including its impact areas, the program that has been adopted does not include the imposition of any new land use regulations. Traditionally, within the State of Oregon Land Use Program, Goal 5 program decisions have focused exclusively on the application of land use regulations to limit or prohibit conflicting uses. The TBNRCC ALP Decision and associated program decision depends upon a larger range of permissible elements for Goal 5 program decisions as provided for by the Goal 5 rule. Specifically, the Goal 5 rule definition of "program" includes examples of program elements that go beyond traditional land use regulations. See 660-023-0010 (6). For example, the definition refers to program elements for such things as "preferential assessments, or acquisition of land or development rights." The TBNRCC uses these broader revenue-based elements as integral parts of its Goal 5 limit program decision. For example, the TBNRCC limit program decision relies on revenue elements to fund an aggressive habitat restoration program with a dedicated funding source. Likewise, the TBNRCC's program will encourage the voluntary use of low impact development techniques that will limit the impact of conflicting uses and benefit habitat. Additionally, the TBNRCC's limit program decision consciously anticipates, through community education, individual choices and voluntary low impact development practices, that significant additional site-by-site limitations to conflicting uses will be achieved. Finally, although prevailing Tualatin Basin land use regulations that were put in place to comply with Title 3 of the Urban Growth Management Functional Plan, adopted pursuant to Goals 6 and 7, will not be changed as part of its program, those regulations do provide additional program elements to the overall TBNRCC limit program decision.

The TBNRCC limit decision and program is different than that applied by Metro to other parts of the region. Nonetheless, after carefully reviewing the TBNRCC program, the Council finds that, provided the TBNRCC complies with certain conditions, its program meets the standards required in the IGA between Metro and the TBNRCC. See Metro Resolution No. 05-3577A. Although the TBNRCC has taken a very different approach to conserving, protecting, and enhancing regionally significant fish and wildlife habitat, the Council also finds that the TBNRCC's approach is consistent with Metro's ESEE Analysis and ALP Decision, because its combination of existing regulatory requirements and the application of an aggressive habitat restoration program with a dedicated funding source is likely to result in the conservation, protection, and enhancement of regionally significant habitat commensurate with the habitat conservation, protection, and enhancement that Metro's program is likely to produce.

For these reasons, the Council finds that the TBNRCC ESEE Analysis, ALP Decision, and Program to Achieve Goal 5 all comply with Goal 5.

E. Other Goal 5 requirements

1. Notice and Land Owner Involvement

The Goal 5 Rule, OAR 660-023-0060, requires:

- That local governments "provide timely notice to landowners and opportunities for citizen involvement during the inventory and ESEE process;"

- That the "[n]otification and involvement of landowners, citizens, and public agencies occur at the earliest possible opportunity whenever a Goal 5 task is undertaken;" and

- That local governments "comply with their acknowledged citizen involvement program, with statewide goal requirements for citizen involvement and coordination, and with other applicable procedures in statutes, rules, or local ordinances."

The Metro Charter establishes the Metro Office of Citizen Involvement, a citizen's committee and a citizen involvement process to develop and maintain programs and procedures to aid communication between citizens and the Metro Council. See Metro Charter Section 27. Policy 1.13 of the Regional Framework Plan ("RFP") makes it the policy of the Metro Council to encourage public participation in Metro land use planning and to follow and promote the citizen participation values inherent in the RFP and the Metro Citizen Involvement Principles. The Metro Council approved Principles of Citizen Involvement by the adoption of Resolution No. 97-2433. Those principles include valuing active citizen participation, respecting and considering all citizen input, encouraging opportunities that reflect the rich diversity of the region, promoting participation of individuals and community, business, and special interest groups, providing understandable, timely, and broadly distributed communications to encourage citizen participation, organizing involvement activities to make the best use of citizens' time and effort, responding to citizens' perspectives and insights in a timely manner, and coordinating interdepartmental and interjurisdictional activities.

In compliance with the policies in the RFP and Metro's Citizen Involvement Principles, citizen involvement has been a key element in Metro's development of this ordinance to conserve, protect and restore regionally significant fish and wildlife habitat. At each stage of the process required by the Goal 5 Rule, Metro has engaged, informed, and sought input, feedback, and comments from the public, interested parties, and representatives from local governments, the State, and federal agencies. This has come in the form of extensive public outreach efforts, as well as by bringing items up for review and discussion before Metro's standing advisory committees, such as the Metropolitan Policy Advisory Committee (MPAC, consisting primarily of local elected officials from across the region), the Metropolitan Technical Advisory Committee (MTAC, consisting of planning experts from local governments, interested parties, and citizens from across the region), and the Water Resources Policy Advisory Committee (WRPAC); and before committees created specifically to assist with the development of this program, such as the Goal 5 Technical Advisory Committee, the Economic Technical Advisory Committee, the Independent Economic Advisory Board (appointed in coordination with the Northwest Power Planning Council), the Goal 5 Social Review Committee (to help Metro analyze the social consequences as part of the ESEE analysis), the Program Implementation Work Group, and the Model Ordinance Subcommittee. Metro has also engaged in extensive public outreach at each stage of the process required by the Goal 5 Rule, and, through that process, has received extensive input and comments from citizens, local governments, and other interested parties. Metro has not just heard that input and comments, but has carefully considered it, and it has played a vital role in shaping the development of this ordinance and Metro's overall Nature in Neighborhoods program.

Metro's public involvement process is summarized at pages 6 through 9 of *Metro's Riparian Corridor and Wildlife Habitat Inventories, August 2005* and on page 5 of the *Addendum and Update to Metro's Riparian Corridor and Wildlife Habitat Inventories, August 2005*. As described in those documents, and as supported by the record in this matter, which documents extensive citizen involvement throughout the five-year planning process, the Council finds that Metro has complied with the citizen involvement requirements of the Goal 5 Rule (OAR 660-

023-0060), the Metro Charter, the Metro Regional Framework Plan, and Metro's Principles of Citizen Involvement.

2. Buildable Lands Affected

The Goal 5 Rule provides that "[i]f measures to protect significant resource sites . . . affect the inventory of buildable lands in acknowledged plans required by Goals 9, 10 and 14, [Metro], prior to or at the next periodic review, shall . . ." amend the UGB to provide additional buildable lands to make up for the loss, redesignate land to replace the lost buildable land, or take a combination of both of those steps. See OAR 660-023-0070. The Council does not believe that this program will have a significant effect on the existing buildable lands inventory. The program requirements do not prohibit development on any property and provide a mechanism to allow development that would otherwise be limited if it can be shown that the program's standard limits were not "available and capable of being done after taking into consideration the cost, existing technology, and logistics in light of overall project purpose and probable impact on ecological functions." See Exhibit C, Section 4(B)(2) and Exhibit D, Amendment 9, definition of "practicable" on page 13. Metro will track the program closely, however, and, to the extent that the program's measures to protect regionally significant fish and wildlife habitat affect Metro's inventory of buildable lands in Metro's acknowledged plans required by Goals 9, 10 and 14, then at Metro's next required periodic review the Council will amend the UGB to provide additional buildable lands, redesignate lands to increase the supply of buildable lands within the UGB, or take a combination of both of those steps.

Goal 6. Air, Water and Land Resources Quality

In 1998, Metro adopted Title 3 to the Urban Growth Management Functional Plan to create Water Quality Resource Areas and Flood Management Areas. See Metro Code Sections 3.07.310 through 3.07.370 ("Title 3"). Title 3, adopted pursuant to Goals 6 and 7, created uniform Water Quality Resource Area buffers around rivers and streams in the region, and required that property owners seeking to develop such areas do everything practicable to avoid them, but if unavoidable that they then minimize development of those areas and mitigate for such development. Since the adoption of Title 3, water quality problems have persisted in the region. The Oregon Department of Environmental Quality, for example, has released a draft Total Maximum Daily Load rule addressing bacteria, temperature, mercury, and other water quality problems throughout the Willamette River Basin. That rule, which is anticipated to be issued later this year, will apply to most of the rivers and streams in the Metro region.

In addition, through Metro's science literature review undertaken in the course of developing this ordinance, Metro has learned a great deal more about how vegetated riparian areas surrounding rivers and streams can help reduce, moderate, or reverse such water quality problems. See, e.g., Technical Report, Attachment 2, at pp. 12-14, 21-23, 40-41, 49-50, 52-55, and 71-73. Through its review, Metro learned that riparian vegetation farther from rivers and streams than the standard-sized Title 3 Water Quality Resource Area buffers is essential to maintain and improve water quality. In fact, Metro specifically identified (1) microclimate and shade (i.e., preventing poor water quality caused by elevated stream temperatures) and (2) bank stabilization and pollution control as two of the five critical ecological functional values used to identify riparian habitat. Moreover, degraded water quality and altered microclimate were two of the environmental consequences described in detail in the ESEE analysis. In addition, one of the factors on which the different program options were assessed during Phase II of the ESEE analysis was how much each option would help the region comply with the Clean Water Act. See

Metro Phase I ESEE Report, Attachment 3, at pp. 127-29, 133-34, and 139-140; Metro Phase II ESEE Report, Attachment 4, at pp. 132-36.

For these reasons, the Council finds that the protection of riparian habitat areas provided in this ordinance will play a critically important role to help protect and improve the water quality of the region's rivers and streams. Metro is therefore adopting those portions of this ordinance to protect and improve water quality, pursuant to Goal 6.

Goal 6 requires that water pollutants and contaminants from future development, when combined with waste and discharges from existing development, shall not threaten to violate, or violate applicable state or federal water quality statutes, rules and standards. See OAR 660-015-000(6). The goal further provides that the discharge of such pollutants and contaminants shall not exceed the carrying capacity of water resources within watersheds, degrade such resources, or threaten their availability. One of the implementation methods and devices listed in the goal for meeting the goal's requirements is the use of land use controls and ordinances. The Council finds that this ordinance is necessary in order to comply with Goal 6 and that it complies with Goal 6.

Goal 1. Citizen Involvement

Goal 1 requires development of a citizen involvement program that insures the opportunity for all citizens to be involved in all phases of the land use planning process. For the reasons described above regarding Metro's compliance with the citizen involvement requirements of the Goal 5 Rule, the Council finds that Metro has complied with Goal 1.

Goal 2. Land Use Planning

A. Consistency With The Regional Framework Plan

The Regional Framework Plan[1] establishes eight fundamental value statements to synthesize the 2040 Growth Concept and regional policies. Fundamental 3 is to "[p]rotect and restore the natural environment including fish and wildlife habitat, streams and wetlands, surface and ground water quality and quantity, and air quality." In addition, the RFP directly calls for the development of regulations to protect critical fish and wildlife habitat areas. See, e.g., RFP, "Summary of 2040 Growth Concept," at page 5. More specifically, RFP Policy 4.6, entitled, "Fish and Wildlife Habitat Conservation," provides that "It is the policy of the Metro Council to [e]stablish standards to conserve, protect, and enhance fish and wildlife habitat by . . . identifying regionally significant fish and wildlife habitat[,] . . . determining performance standards for habitat protection[, and] . . . promoting coordination of regional watershed planning." This ordinance represents the culmination of Metro's implementation of Policy 4.6, and the Council finds that it complies with that policy.

In addition to Policy 4.6, Chapter 4 of the RFP also establishes policies related to watershed management and water quality. For example, Policy 4.2, "Overall Watershed Management,"

[1] The Metro Council adopted Ordinance No. 05-1086 on August 18, 2005, to make technical amendments to the RFP. That ordinance did not change any RFP policies, but did delete extensive prefatory discussions and reorganized the RFP to make it more easily readable, accessible, and usable for the public, local governments, Metro, and the State. Those RFP technical amendments are not effective until November 16, 2005. The Council finds that there is no substantive difference between the current RFP and the revised RFP that will become effective on November 16, 2005. For that reason, these Findings refer to the text and policy numbers in the revised RFP that will become effective on November 16, 2005.

states that it is the Metro Council's policy to "manag[e] watersheds to protect, restore and ensure to the maximum extent practicable the integrity of streams, wetlands and floodplains, and their multiple biological, physical and social values," and Policy 4.3, "Water Quality," states that it is the Metro Council's policy to both establish and maintain vegetative corridors and buffers along streams. The Council finds that this ordinance complies with, and will further, both of those policies.

Chapter 3 of the RFP, entitled "Parks, Natural Areas, Open Spaces, Trails and Recreational Facilities," also includes several policies that relate to this ordinance. For example, this ordinance supports and complies with Policies 3.1 and 3.2, calling, respectively, for inventories and the protection of parks, natural areas, open spaces, and greenways. The Council finds that this ordinance complies with Chapter 3 of the RFP.

In addition, the RFP also is replete with references to the importance of open space and access to nature in the orderly development of the region, goals that this ordinance will directly support. For example:

- Policy 1.1, "Urban Form," establishes a policy to balance growth by maintaining "a compact urban form, with easy access to nature,"

- Policy 1.10, "Urban Design," establishes a policy to "[s]upport the identity and functioning of communities in the region through . . . recognizing and protecting critical open space features in the region," and

- In the Transportation Chapter, Policies 2.8, "The Natural Environment," and 2.9, "Water Quality," establish policies, respectively, to protect the region's natural environment and water quality.

As required by the Goal 5 Rule, the development of this ordinance has involved the consideration and balancing of several competing objectives and interests—classified for purposes of analysis into economic, social, environmental, and energy-related categories. The nature of this decision as one of balance is also reflected in the consideration of the policies in the RFP. For example, as noted above, Policy 1.1 calls for "a compact urban form." As described in section E(2) of the Goal 5 compliance discussion, above, it is possible that the provisions of this ordinance could reduce the housing or employment capacity of some lands within the UGB, which could result in a future decision to expand the UGB. Although we do not believe this ordinance will have such an impact, the Council has considered that possibility and, balancing the competing objective of having a compact urban form with the objective of protecting healthy, functioning fish and wildlife habitat and keeping nature in neighborhoods, we have determined that the provisions of this ordinance represent the best approach for the region.

For these reasons, and as supported by the record in this matter, the Council finds that this ordinance complies with the RFP.

In addition, however, the Council has identified the need for certain amendments to the RFP, as provided in Exhibit B to the ordinance. Many of those amendments simply reflect that, through adoption of this ordinance, the Council has now developed functional plan provisions to protect and enhance fish and wildlife habitat. Additionally, some of the amendments reorganize the RFP to include the principles and policies reflected in this ordinance in more logical and appropriate parts of the RFP. For example, Chapter 3 is renamed, "Nature in Neighborhoods," and the protection of fish and wildlife habitat is incorporated into its provisions. Three of the amendments to the RFP add new policies.

First, Amendment 3 of Exhibit B adds new RFP Policy 1.9.12, as part of the RFP's "Urban Growth Boundary" policies, establishing it to be the Council's policy to "[c]onduct an inventory of regionally significant fish and wildlife habitat for all lands being considered for inclusion in the UGB." The policy provides that this inventory will be used in two ways. The first is for the Council to "[c]onsider whether urbanization [of an area] can occur consistent with policies that call for protection of regionally significant fish and wildlife habitat." The second is so that, when the Council is making UGB expansion decisions, it can, to the extent possible, "[l]imit future conflicts between urbanization and the protection of regionally significant fish and wildlife habitat by examining the impacts upon the ecological quality and integrity of such habitat whenever the Council has discretion to choose between potential lands to be added to the UGB." The Council finds that this new policy will allow it to make more informed, better decisions about future UGB expansions, consistent with the Statewide Planning Goals and with the other policies of the RFP.

Second, Amendment 4 of Exhibit B adds new RFP Policy 1.10.1(c)(viii), as part of the RFP's "Urban Design" policies, adding that the RFP is intended to promote a settlement pattern that, in addition to the existing seven objectives, also "[a]voids and minimizes conflicts between urbanization and the protection of regionally significant fish and wildlife habitat." The addition of this item as another of the objectives of urban design in the region simply raises this objective to the level of several other similar objectives, such as encouraging pedestrian-friendly development (Policy 1.10.1(c)(ii)) or mixed use, neighborhood-oriented design (Policy 1.10.1(c)(iv). The Council finds that this is an appropriate objective for urban design in the region and is consistent with the Statewide Planning Goals and with the other policies in the RFP.

Third, Amendment 5 of Exhibit B includes the addition of new RFP Policy 3.2.8, as part of the RFP section that will now be entitled, "Protection of Regionally Significant Parks, Natural Areas, Open Spaces, Fish and Wildlife Habitat, Trails and Greenways." The new policy establishes the performance and implementation objectives of the fish and wildlife protection program. In addition, the reference to the development of fish and wildlife habitat protection standards that was formerly in RFP Policy 4.6 has been incorporated into Policies 3.1 (regarding inventorying parks, open spaces and habitat), 3.2 (protecting the same), and 4.3 ("Water Quality"), and Policy 4.6 has been deleted. The Council finds that it is appropriate to incorporate these provisions into the new "Nature in Neighborhoods" chapter of the RFP and that they are consistent with the Statewide Planning Goals and with the other policies in the RFP.

For the reasons described in the these Findings for why all of the elements of this ordinance are consistent with the Statewide Planning Goals, the Council finds that the RFP amendments in Exhibit B, all of which are made as a result of developing this ordinance pursuant to Goal 5 and the Goal 5 Rule, are consistent with the Statewide Planning Goals and with the other policies in the RFP.

B. Coordination With Local Governments

Metro has engaged in extensive outreach and coordination with local governments in the development of this ordinance. At each step of the Goal 5 Rule process, Metro has consulted with the Metropolitan Policy Advisory Committee, which includes elected officials representing local governments across the region, and with the Metropolitan Technical Advisory Committee, which includes planning staff and other technical representatives from local governments across the region. In addition, as reflected in the record, Metro has received, considered, responded to, and, in many instances, amended the program and this ordinance in response to, comments and suggestions directly submitted by local governments. As the record reflects, this effort has included considerable coordination with several special districts, in addition to cities and counties, including extensive coordination with the Port of Portland, the Multnomah County Drainage District and other drainage districts, Clean Water Services in Washington County, and Water Environment Services in Clackamas County. A significant result of that coordination is reflected in several specific provisions of this ordinance that directly address how this ordinance will apply to such entities.

Of particular note, in terms of Metro's coordination with local governments, was the intergovernmental agreement entered into between Metro and the Tualatin Basin Natural Resources Coordinating Committee. As described in section D of the Goal 5 compliance discussion, above, Metro entered into this IGA in order to allow the TBNRCC to use Metro's inventory of regionally significant fish and wildlife habitat but to conduct its own ESEE analysis, make its own allow-limit-prohibit decision, and develop its own Goal 5 program. Two Metro Councilors served as ex-officio members of the TBNRCC, and Metro staff attended nearly all of the meetings of the TBNRCC's steering committee, which was made up of staff representing all of the TBNRCC members. As a result of this partnership, the Tualatin Basin was able to develop a comprehensive, watershed-based program that is likely to achieve results comparable to those expected throughout the rest of the region. The Council finds that this partnership worked exceptionally well.

Furthermore, in the last three months, Metro staff, some Metro Councilors, and the chair of MPAC (Lake Oswego City Councilor Jack Hoffman) have appeared before the Clackamas County Council and at city council meetings in nearly all of the cities in the region that are not part of the TBNRCC (including Damascus, Fairview, Gladstone, Happy Valley, Lake Oswego, Milwaukie, Portland, Troutdale, West Linn, Wilsonville, and Wood Village), in order to explain the ordinance directly to them and solicit their comments and suggestions. In fact, Chair Hoffman and Metro staff have appeared before many of those bodies twice in the last three months, once prior to the Council's approval of the initial amendments to this ordinance in May 2005, and again after the Council's May amendments, in June and July 2005. The Council's process in adopting those amendments to Exhibit E itself provides an excellent example of how Metro has coordinated with local governments. When the Council approved initial amendments to the ordinance in May 2005, representatives of several jurisdictions raised reservations about whether Exhibit E was as clear as it needed to be and whether it would be easy to implement. Those representatives indicated that they needed more time to fully consider its implications. Therefore, at the request of MTAC and MPAC, the Council appointed a special Model Ordinance work group that included many of the local government representatives that had expressed concerns, and the Council directed the work group to recommend any changes the work group thought were necessary to improve the Model Ordinance. The work group met weekly from late May until early July and recommended a complete overhaul of the Model Ordinance, and the Council adopted the work group's recommendations in July 2005.

For the reasons described above, the Council finds that Metro has complied with the Goal 2 requirement that it coordinate with local governments in the development of this ordinance.

Goals 3 and 4. Agricultural Lands and Forest Lands

This program applies to identified fish and wildlife habitat areas both inside the Metro UGB and outside the Metro UGB but inside Metro's jurisdictional boundary. Goals 3 and 4 do not apply to lands inside the UGB. In addition, the new functional plan performance standards adopted in this ordinance are not applicable, either inside or outside the UGB, when their application would restrict or regulate farm structures or farming practices in violation of ORS 215.253 or ORS 561.191. With respect to forest practices in areas outside the UGB, the new functional plan performance standards adopted in this ordinance are not applicable when such standards and practices would violate ORS 527.722 by prohibiting, limiting, regulating, subjecting to approval, or in any other way affecting forest practices on forestlands located outside of the UGB. The Council finds that this ordinance complies with Goals 3 and 4.

Goal 7. Areas Subject to Natural Disasters and Hazards

This ordinance is not being adopted to implement Goal 7 although its adoption could help to mitigate the possibility of, or effects of, floods or landslides in the region. Although Goal 7 is arguably not applicable to this ordinance, to the extent it is applicable the Council finds that this ordinance complies with Goal 7.

Goal 8. Recreation Needs

This ordinance is not being adopted to implement Goal 8 although its adoption could help to protect certain areas that could, in the future, satisfy recreational needs of the citizens of the region. Although Goal 8 is arguably not applicable to this ordinance, to the extent it is applicable the Council finds that this ordinance complies with Goal 8.

Goal 9. Economic Development

This goal is not applicable to Metro's decision in this matter. Nevertheless, the economic impact of Metro's decision was thoroughly analyzed as part of Metro's ESEE Analysis, and was considered by the Council when it weighed and balanced the ESEE factors, made its ALP Decision, and developed its program. Moreover, as the record shows, Metro undertook extensive outreach to organizations committed to economic development in the region such as the Portland Business Alliance, the Westside Economic Alliance, and the Columbia Corridor Association, and the final program approved by the Council reflects the input that Metro received from those organizations.

Goals 10 and 14. Housing and Urbanization

As described above in subsection E(2) of the discussion of compliance with Goal 5, the Council acknowledges that this ordinance could have an effect on the region's inventory of buildable lands. The Council does not believe that its affect will be significant, however, because the provisions of this ordinance do not prohibit development on any property and provide a mechanism to allow development that would otherwise be limited if it can be shown that the program's standard limits were not "available and capable of being done after taking into consideration the cost, existing technology, and logistics in light of overall project purpose and probable impact on ecological functions." See Exhibit C, Section 4(B)(2) and Exhibit D, Amendment 9, definition of "practicable" on page 13. Of course, Metro will closely monitor the impact of this ordinance on the buildable lands supply, and will accurately account for its impact in Metro's buildable lands inventory reports. As required by Oregon law, to the extent that this ordinance results in a reduction in buildable lands, Metro will address that reduction, and the need to provide additional buildable lands, at its next periodic review of the Metro UGB.

The Council also recognizes that some of the policies it is adopting as part of this ordinance could result in the need for a larger UGB expansion in the future in order to provide the necessary and required supply of buildable lands. Such could be the result, for example, of the provisions of Exhibit C of this ordinance that require the designation of upland wildlife habitat in future UGB expansion areas as Habitat Conservation Areas, and of this ordinance's amendments to Chapter 1 of the RFP and to Title 11 of the functional plan, which establish policies that seek to avoid the creation of conflicts between HCAs and urbanization. The Council finds that these provisions are necessary and appropriate in order to ensure that the region continues to provide its residents with the high quality of life, including access to nature, open spaces, and high water quality, that they currently enjoy, and to ensure that future generations may also enjoy it. For these reasons, and as supported by the record in this matter, the Council finds that this ordinance complies with Goals 10 and 14.

Goal 11. Public Facilities and Services

This ordinance is not being adopted to implement Goal 11 although its adoption could help to protect certain areas that could, in the future, satisfy recreational needs of the citizens of the region. In addition, this ordinance includes several provisions intended to accommodate the special needs associated with the provision of utility services and of utility service providers. Thus, to the extent Goal 11 is applicable, the Council finds that this ordinance complies with Goal 11.

Goal 12. Transportation

This ordinance is not being adopted to implement Goal 12. As noted above, the Transportation chapter of the RFP makes it Metro's policy for transportation services to be provided in a manner that will protect the region's natural environment and water quality. Thus, to the extent Goal 12 is applicable, the Council finds that this ordinance complies with Goal 12.

Goal 13. Energy

Metro examined in detail the energy consequences of a decision to limit conflicting uses on significant fish and wildlife habitat resources in the ESEE analysis, and weighed and balanced those consequences when it made its ALP decision and developed this ordinance. (See, e.g., Chapter 7, pages 144-158, of the Phase I ESEE Analysis and pages 122-126 of the Phase II ESEE Analysis.) Based on that examination and on the record in this matter, the Council finds that this ordinance complies with Goal 13.

Goal 15. Willamette Greenway

Goal 15 is intended to protect, conserve, enhance, and maintain the many different, and sometimes competing, qualities and values provided by the Willamette River Greenway. Those qualities include natural, scenic, historical, agricultural, economic, and recreational qualities of lands along the river. Goal 15 specifically provides that Greenway plans adopted pursuant to the Goal shall protect significant fish and wildlife habitat. Thus, in many respects, the objectives of Goal 15 are the same as the objectives of Goal 5—to protect significant fish and wildlife habitat, but to make protection and program decisions in the context of weighing and balancing competing interests and values, including economic, social, energy, and environmental impacts of those decisions. In addition, to the extent that there is any inconsistency between the Goals, the Goal 5 Rule explicitly provides that the requirements of Goal 15 shall supersede the requirements of Goal 5. For these reasons, the Council finds that this ordinance complies with Goal 15.

Goals 16, 17, 18 and 19. Estuarine Resources, Coastal Shorelands, Beaches and Dunes, and Ocean Resources

These goals are not applicable to Metro's decision in this matter.

CONCLUSION

For the reasons described in these Findings, and as supported by the record in this matter, the Council finds that this ordinance complies with Oregon land use planning statutes, statewide land use planning goals, administrative rules adopted by the Land Conservation and Development Commission to implement the statewide land use planning goals, and the Regional Framework Plan.

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EXHIBIT F—ORDINANCE NO. 05-1077C

ATTACHMENT 1.

Part 1:
ADDENDUM AND UPDATE TO
METRO'S RIPARIAN CORRIDOR AND WILDLIFE
HABITAT INVENTORIES REPORT, AUGUST 2005

Part 2:
METRO'S RIPARIAN CORRIDOR AND WILDLIFE
HABITAT INVENTORIES REPORT, AUGUST 2005

These reports are available for review in the Metro Council's files (see copies referenced in Technical Amendment No. 17, approved by the Council on September 22, 2005) or on Metro's website: **http://www.metro-region.org/nature**. In addition, copies may be requested from the Metro Planning Department, 600 N.E. Grand Ave., Portland, OR 97232, or by calling 503-797-1555.

Addendum and update to

Metro's Riparian Corridor and Wildlife Habitat Inventories

AUGUST 2005

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1. Why the update is needed

This document is an addendum to update Metro's riparian corridor and wildlife habitat inventories. In 2002, Metro Council adopted draft maps of regionally significant fish and wildlife habitat via Resolution #02-3176 and 02-3177A, with the intention of updating the inventories as needed prior to adopting a final Goal 5 ("Nature in Neighborhoods") ordinance. The inventories have now been updated, as outlined below.

The Goal 5 rule states that an inventory must contain information on location, quantity, and quality of fish and wildlife habitat. Metro's intention is to provide the region with the best inventory information possible, while recognizing that the inventory is fluid and will never be perfect. The information contained herein improves the inventories' information regarding quality, quantity, and location of regionally significant fish and wildlife habitat.

The underlying criteria for the fish and wildlife habitat model have not changed (presented in the primary inventory document, updated August 2005). Changes to Metro's 2001 fish and wildlife habitat inventory are categorized in three ways: updates with new information; corrections involving either initial mapping errors or changes that have occurred since the inventory was last conducted; and combining the fish and wildlife habitat inventories to produce a single program for each resource area. The following section describes these changes.

2. New or improved information incorporated into the inventories

The following new or improved information has been incorporated into Metro's fish and wildlife habitat inventories.

New watersheds (Hydrologic Unit Codes, or HUCs) developed by USGS now re-delineate each watershed boundary (Figure 1). Statistics reported here use the new HUC delineations. At the time that Metro Council passed the resolutions determining regionally significant fish and wildlife habitat, the formal Natural Resource Conservation Service's watershed delineations through the Hydrologic Unit Code (HUC) system were not yet complete for this region. The formal HUCs are now complete, and for the purpose of data consistency, Metro will use the new HUCs beginning with this inventory iteration.

Metro conducted global GIS and data updates such as re-digitized forest canopy, new aerial photographs, streamline corrections, etc. These help Metro provide the best available information on quality, quantity and location of fish and wildlife habitat. New floodplain data was incorporated from several jurisdictions (e.g., Tualatin Basin; Portland). In addition, new stream and wetland layers from several jurisdictions were incorporated (e.g., City of Portland, Clean Water Services, City of Gresham).

3. Map corrections

Metro has solicited and processed hundreds of map verifications and corrections based on specific information from landowners, agencies, and local jurisdictions. Most jurisdictions in the Tualatin Basin carefully reviewed the maps and provided corrections in 2003-2004, to facilitate the coordinated

Tualatin Basin fish and wildlife habitat work, which is on a faster time-track than Metro's current Nature in the Neighborhoods process. Non-private party entities that submitted substantial map corrections include:

- Beaverton
- Columbia Corridor
- Cornelius
- Fairview
- Forest Grove
- Gresham
- Hillsboro
- Lake Oswego
- Port of Portland
- Tigard
- Troutdale
- Tualatin
- Wilsonville
- Wood Village

Metro also processed a large number of map corrections submitted by private parties or their representatives. Corrections often included items such as vegetation that has recently been removed, new development, stream realignments, forest canopy corrections, and similar issues. Each map correction is assigned a case number and entered into a master database. An ongoing map corrections process will be an important part of Metro's inventory maintenance and staff will continue to maintain the map with the most current information possible, keeping careful records on what corrections were made, why, and on behalf of whom.

4. Combining the riparian corridors and wildlife habitat inventories

As part of Metro's Environmental, Social, Economic and Energy (ESEE) process and to avoid developing two different program approaches for the same spot on the map, Metro re-ran the inventories in September 2004 (with map corrections) and then combined the riparian corridors and wildlife habitat inventories as described in the Phase I ESEE analysis (Resolution #03-3376B, Phase I ESEE). The "first cut" was high-value riparian habitat. The qualitative and quantitative descriptions in the main Inventory document are still quite useful for characterizing fish and wildlife habitat conditions by watershed. This addendum is simply an update on the inventory so that the process can be completed. The underlying data for the two separate inventories is still retained for future assessment.

5. Update on public participation process

A great deal of public participation and consultation has occurred since the 2001 inventory report was completed, summarized in the following public information documents available online through Metro's website or though Metro's Goal 5 public affairs records documents:

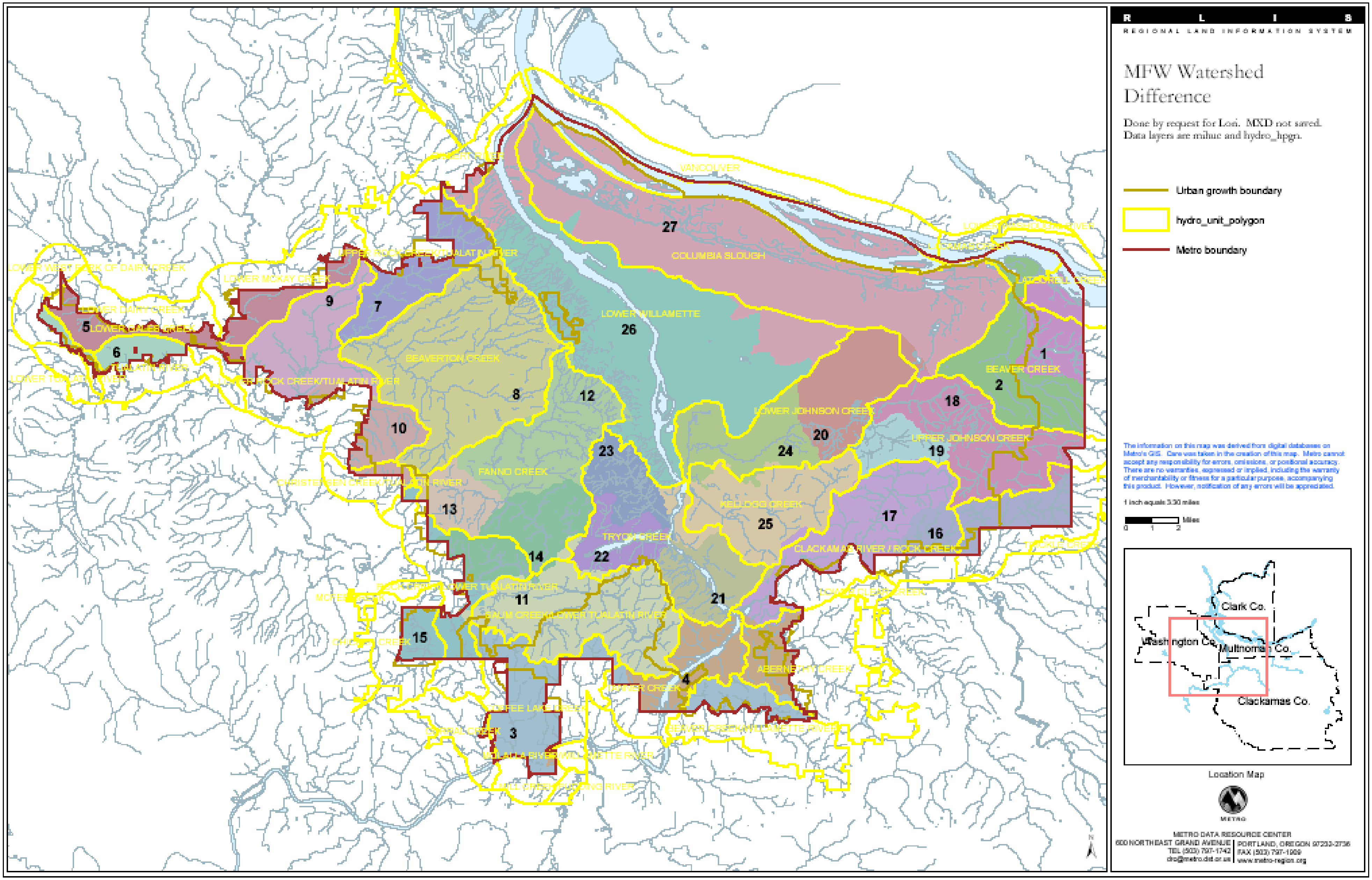
- **Public comment report, May 2004 (addendum) –** an introduction and comment summary table to describe the public comments received by Metro after the interim May 2004 comment report, from May 13 to May 20. This includes testimony received at the May 20 Metro Council hearing. The report contains copies of individual comments.
- **Public comment executive summary, May 2004 –** an executive summary and comment summary table to describe the public comments received by Metro through May 2004.
- **Public comment report, May 2004 –** a compilation of all public comments received by Metro through May 2004. In addition to the items in the executive summary, the report contains copies of individual comments.
- **Public comment executive summary, March 2004 –** an executive summary and comment summary table to describe the public comments received by Metro through March 2004.
- **Public comment report, March 2004 –** a compilation of all public comments received by Metro through March 2004. In addition to the items in the executive summary, the report contains copies of individual comments.
- **Public notice for metro area –** the version of the public notice mailed in February 2004 that shows Metro's regional fish and wildlife habitat inventory and talks about protection options for the region as a whole.
- **Public notice for Tualatin Basin –** the version of the public notice mailed in February 2004 that talks specifically about the Tualatin Basin proposal for protecting habitat.
- **Protecting the nature of the region –** an overview of Metro's fish and wildlife habitat protection efforts, including a description of the three-step planning process currently in progress. Step 1 involved an inventory of regionally significant habitat that was approved by the Metro Council in 2002. Step 2, an analysis of the economic, social, environmental and energy (ESEE) consequences of protecting - or not protecting - regionally significant fish and wildlife habitat, was completed in May 2004. Step 3 is beginning now and will result in adoption of a regional fish and wildlife habitat protection program.
- **Glossary –** terms used in describing Metro's habitat protection program.

In addition, Metro's website includes a new interactive mapping tool. The tool includes the data Metro used to develop the habitat inventory. For more information, call Natural Resources Planning at (503) 797-1839, fax (503) 797-1911 or send e-mail to habitat@metro-region.org. The hearing impaired can call TDD (503) 797-1804.

6. New watershed data

Tables 1 and 2 present the revised information on quality, quantity, and location of regionally significant fish and wildlife habitat. The total numbers are slightly different due to the complexities of GIS operations involved, which can create small variations.

Figure 1. Comparison of Metro's 2002 (black numbers) and 2005 (light-colored lines) HUC watershed units. At the time of the 2002 inventory version, NRCS hydrologic unit codes (HUCs) were unavailable, but were subsequently available for the 2005 inventory.



7. Summary

Metro has re-visited the fish and wildlife habitat inventories with improved information on quality, quantity and location of regionally significant fish and wildlife habitat, as presented in Figure 1 and Tables 1 and 2 here. The maps associated with the inventory are part of the "Nature in Neighborhoods" ordinance the Metro Council will consider for adoption in Fall 2005. This update will supplement both the primary inventory document as well as the maps depicting regionally significant habitat.

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Table 1. Quantity of fish and wildlife habitat in Metro region by watershed (includes open water).

Sub-watershed name	Acres in watershed and Metro jurisdiction	Habitat acres in watershed	Resource as % sub-watershed area	Resource as % total resource area
ABERNETHY CREEK	3,552	1,458	41%	1.5%
BEAVER CREEK	13,997	5,589	40%	5.9%
BEAVER CREEK/WILLAMETTE RIVER	2,777	535	19%	0.6%
BEAVERTON CREEK	24,212	5,762	24%	6.1%
CHICKEN CREEK	2,144	540	25%	0.6%
CHRISTENSEN CREEK/TUALATIN RIVER	735	279	38%	0.3%
CLACKAMAS RIVER / ROCK CREEK	13,710	5,334	39%	5.7%
COFFEE LAKE CREEK	7,678	2,170	28%	2.3%
COLUMBIA SLOUGH	37,060	7,898	21%	8.4%
CORRAL CREEK	130	41	32%	0.0%
DEEP CREEK / NORTH FORK OF DEEP CREEK	4,485	1,568	35%	1.7%
FANNO CREEK	20,184	4,612	23%	4.9%
GILBERT RIVER	742	677	91%	0.7%
KELLOGG CREEK	11,067	2,137	19%	2.3%
LACAMAS CREEK	43	43	100%	0.0%
LATOURELL CREEK	2,069	1,747	4%	1.9%
LOWER DAIRY CREEK	3,611	832	23%	0.9%
LOWER GALES CREEK	747	274	37%	0.3%
LOWER JOHNSON CREEK	15,859	2,967	19%	3.2%
LOWER MCKAY CREEK	3,822	629	16%	0.7%
LOWER ROCK CREEK/TUALATIN RIVER	12,744	2,362	19%	2.5%
LOWER WEST FORK OF DAIRY CREEK	64	21	33%	0.0%
LOWER WILLAMMETTE	40,182	12,151	30%	12.9%
MOLALLA RIVER/WILLAMETTE RIVER	40	7	18%	0.0%
ROCK CREEK/LOWER TUALATIN RIVER	5,931	1,716	29%	1.8%
SAUM CREEK/LOWER TUALATIN RIVER	14,696	5,603	38%	6.0%
TANNER CREEK	5,839	2,281	39%	2.4%
TRYON CREEK/WILLAMETTE RIVER	16,389	5,851	36%	6.2%
TUALATIN RIVER	2,073	228	11%	0.2%
UPPER JOHNSON CREEK	15,116	6,409	42%	6.8%
UPPER ROCK CREEK/TUALATIN RIVER	8,040	2,695	34%	2.9%
COLUMBIA RIVER ISLANDS	10,095	9,732	96%	10.3%
Grand Total	**299,830**	**94,148**	**31%**	**100.0%**

Table 2. Quality of fish and wildlife habitat in Metro region by watershed (includes open water).

Sub-watershed	Riparian I	Riparian II	Riparian III	Wildlife A	Wildlife B	Wildlife C	Total
ABERNETHY CREEK	377	179	62	203	500	136	1,458
BEAVER CREEK	3,297	375	79	976	369	493	5,589
BEAVER CREEK/WILLAMETTE RIVER	82	115	19	15	178	127	535
BEAVERTON CREEK	2,168	741	450	1,146	802	455	5,762
CHICKEN CREEK	294	76	22	69	34	44	540
CHRISTENSEN CREEK/TUALATIN RIVER	42	10	5	171	0	52	279
CLACKAMAS RIVER / ROCK CREEK	1,361	810	188	1,207	1,026	741	5,334
COFFEE LAKE CREEK	837	305	53	172	460	343	2,170
COLUMBIA SLOUGH	4,477	1,313	624	291	427	765	7,898
CORRAL CREEK	11	0	0	25		5	41
DEEP CREEK / NORTH FORK OF DEEP CREEK	281	340	19	93	563	271	1,568
FANNO CREEK	1,712	634	334	357	1,152	424	4,612
GILBERT RIVER	232	5	1	438	0	1	677
KELLOGG CREEK	585	268	127	386	518	253	2,137
LACAMAS CREEK	43						43
LATOURELL CREEK	1,307	8	0	293	109	31	1,747
LOWER DAIRY CREEK	312	258	33	16	75	138	832
LOWER GALES CREEK	156	79	10	1	17	12	274
LOWER JOHNSON CREEK	919	283	492	908	284	81	2,967
LOWER MCKAY CREEK	342	99	50	5	39	93	629
LOWER ROCK CREEK/TUALATIN RIVER	1,308	426	94	69	243	221	2,362
LOWER WEST FORK OF DAIRY CREEK	1	5			1	14	21
LOWER WILLAMETTE	5,362	435	523	5,436	190	204	12,151
MOLALLA RIVER/WILLAMETTE RIVER		1				6	7
ROCK CREEK/LOWER TUALATIN RIVER	677	255	65	327	258	134	1,716
SAUM CREEK/LOWER TUALATIN RIVER	1,674	678	278	788	1,690	496	5,603
TANNER CREEK	726	250	156	567	388	193	2,281
TRYON CREEK	1,748	1,062	331	1,039	1,170	501	5,851
TUALATIN RIVER	163	34	13	2	0	16	228
UPPER JOHNSON CREEK	1,641	677	76	1,414	1,958	643	6,409
UPPER ROCK CREEK/TUALATIN RIVER	1,020	325	46	618	428	257	2,695
VANCOUVER	125	0					125
COLUMBIA RIVER ISLANDS	9,550	91	67	20		4	9,732
Grand Total	**42,832**	**10,139**	**4,218**	**17,051**	**12,878**	**7,155**	**94,273**

Metro's Riparian Corridor and Wildlife Habitat Inventories

August 2005

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Introduction

Metro has completed its Goal 5 inventory, following the Goal 5 rule, for riparian corridors and wildlife habitat within its jurisdiction. The Goal 5 rule defines an ***inventory*** as "a survey, map, or description of one or more resource sites…that includes information about the resource values and features associated with such sites." The Goal 5 rule provides specific guidance on the inventory process for local governments to follow. The rule describes a standard inventory process, which involves four steps, and specific rules for each of the fifteen Goal 5 resource categories addressed in the rule. An optional inventory approach, known as a "safe harbor," satisfies certain requirements under the standard process (OAR 660-23-020 (1)). The Goal 5 rule allows for the inventory process to be conducted for a "single site, for sites in a particular geographical area, or for the entire jurisdiction or urban growth boundary (UGB), and a single inventory process may be followed for multiple resource categories that are being considered simultaneously" (OAR 660-23-030 (1)).

The Goal 5 rule includes guidance for Metro in addressing the Goal 5 rule on a regional basis. The rule allows Metro to identify regional resources, defined as "…a site containing a significant Goal 5 resource, including but not limited to a riparian corridor, wetland, or open space area, which is identified as a regional resource on a map identified by Metro ordinance" (OAR 660-23-080 (1)(b)). Goal 5 identifies "riparian corridors" and "wildlife habitat" as two resources among many. Local governments are required to address all Goal 5 resources, but Metro may address those that the Metro Council determines to be regionally significant. The Metro Council concluded that riparian corridors and wildlife habitat are the corresponding resources that constitute regional fish and wildlife habitat consistent with Title 3. Metro has pursued identification of both riparian corridors and wildlife habitat – but separately – in order to ensure that there is independent verification of each resource type.

A regional approach to inventorying natural resources requires a consistent level of data and analysis across the entire Metro region. Metro's Goal 5 inventory is based on the best available information that can be applied consistently at a regional scale. In this document we include: a discussion of Metro's inventory methodology and how it complies with the Goal 5 rule; an analysis of existing riparian corridors and wildlife habitats by resource site; a description of the adequacy of Metro's inventories in terms of location, quantity and quality; and a discussion of Metro's significance and regional resource recommendations.

Goal 5 inventory process

Metro used the standard Goal 5 process, modified by specific requirements in the rule, to inventory riparian corridors (see *Definition of Riparian Corridor* section) and wildlife habitat (see *Definition of Wildlife Habitat* section) within its jurisdiction. The standard inventory process involves four steps:

1. *Collect information about Goal 5 resource sites*. The rule specifically notes that "existing and available information" is what drives the inventory process (OAR 660-023-030(2)). Therefore, information that could be obtainable through expensive field studies is not required (OAR 660-23-090 (4).

2. *Determine the adequacy of the information.* The inventory is deemed adequate if it provides location, quality, and quantity of the resource in question (OAR 660-023-030(3)). The inventory includes a map of resource areas, information about relative value of sites compared to others, and relative abundance or scarcity. A "site" is a particular area where resources are located. Local governments may divide the riparian corridor into a series of stream segments or reaches and regard these as individual sites (OAR 660-023-090(3)).

3. *Determine the significance of resource sites.* Once the adequacy of the information is determined, a significance determination must be made based on: (1) the location, quality, and quantity of the resource; (2) special significance criteria; and (3) additional criteria adopted by a local government (OAR 660-023-0030(4)(a), (b), & (c)). Scientific knowledge of the functions and values of riparian areas and upland wildlife habitat plays a critical role in determining resource significance. All sites that are deemed significant by local governments are included on a list of significant Goal 5 resources referred to as a "resource list" or "adopted inventory." All resources included in the adopted inventory are subject to the remaining steps of the process.

4. *Determine regional resources*. The Goal 5 rule gives Metro the authority to complete the Goal 5 process for "regional resources." A regional resource, as defined by the Goal 5 rule, is a "site containing a significant Goal 5 resource, including, but not limited to a riparian corridor, wetland, or open space area…." (OAR 660-023-080(1)(b)).

Riparian corridors and wildlife habitats identified as regional resources then proceed through the remaining Goal 5 process. These steps include an analysis of the economic, social, environmental, and energy (ESEE) consequences of protecting or not protecting a resource, and development of a Goal 5 protection program. Title 3, Section 5 of Metro's Urban Growth Management Functional Plan contains additional steps.

This chapter describes how Metro addressed the four steps in the Goal 5 inventory process for riparian and wildlife habitat resources.

Metro's advisory committees

Metro Advisory Committees play an ongoing and vital role in Metro's Goal 5 process. Citizens – that is, members of the public that are not representing a particular organization – are members of each committee; the number of citizens on each committee described below are indicated in brackets. Metro has more than a dozen committees that advise the Metro Council, Executive Officer, Auditor and staff on various matters of Metro's responsibility. Membership on these committees is varied, based on the purpose of each committee.

The Goal 5 Technical Advisory Committee (Goal 5 TAC) is composed of more than 20 representatives from local jurisdictions, natural resource agencies such as ODFW, USFWS DEQ and NMFS, consulting firms, and private citizens. The committee was formed at the inception of Metro's Goal 5 efforts in 1999 to provide technical support and review of the process. Many of the same members have been on the committee throughout the process, adding an invaluable level of detailed knowledge and consistency that would not otherwise be possible. This committee has provided substantial input into Metro's Goal 5 inventory process and will continue to do so through subsequent phases of the Goal 5 process. [1 citizen member]

A new Goal 5 advisory committee was formed in spring 2002 to address the economic issues involved with weighing the consequences of development of sites within the riparian corridors and wildlife habitat inventories. This committee, called the Goal 5 ETAC (Economic Technical Advisory Committee), will work with Metro's staff and consultant to provide information and advice on the Environmental, Social, Economic and Energy (ESEE) consequences of allowing, limiting, or prohibiting development. The Goal 5 ETAC is composed of 22 members.

Other committees that provide feedback or recommendations relating to Metro's Goal 5 inventory process include:

- Metro Policy Advisory Committee (MPAC) – charter-mandated committee of local government representatives and citizens who consult on policy issues, especially those related to services provided by local governments, and advise Metro Council on the Regional Framework Plan and other Metro services. [three citizen members]
- Metro Technical Advisory Committee (MTAC) – committee of planners, citizens and business representatives that provide detailed technical support to MPAC for shaping land use policies. [three citizen members]
- Water Resources Policy Advisory Committee (WRPAC) - committee of water and sewer district representatives, environmental groups, federal and state natural resources agencies, business and residents advising the Metro Council on water resource matters. [four citizen members]
- Metro Committee for Citizen Involvement – 27-member citizen committee assisting in the development, implementation and evaluation of Metro's citizen involvement activities. Metro's home-rule charter mandates this committee. [27 citizen members]

Metro's public participation process

Public involvement has been a key element in Metro's efforts to conserve, protect and restore riparian corridors and wildlife habitat as resources of regional significance (i.e., Goal 5), described below.

Spring 1999 Two series of workshops and a set of public open houses were conducted. The project team identified the following key stakeholder groups as critical to the process: citizens/neighborhood activists; watershed organizations; business/development representatives; local government officials; state/federal/tribal government officials; and environmental/non-profit organizations. These stakeholders were contacted and encouraged to distribute information to their mailing lists and participate in the public workshops. Media advisories and press releases were sent to local and regional print media, with articles and pre-event notices appearing in The Oregonian, The Beaverton Times, The Clackamas Review, The Daily Journal of Commerce, and smaller community newspapers. Metro's technical advisory committee members were also encouraged to promote the events. A more detailed description of this outreach process is available in Metro's Streamside CPR handbook (Metro 1999).

February 2000 144,000 inserts were mailed to the public via utility billings. Approximately 45,000 notices were mailed to landowners whose properties fell partially or wholly within the initial inventory.

February 2000 Meetings with the region's 27 local governments (councils and planning commissions) to explain the draft inventory program were held, as well as a series of open houses around the region.

Public comments from this outreach resulted in a revised Goal 5 inventory process, undertaken in early 2001, to identify existing ecological functions on a more site-specific basis rather than a generalized buffer width program, ultimately yielding the current inventory. The public outreach component of the current effort includes the following:

2001 Several opinion surveys were conducted in 2001, including a May 2001 Davis and Hibbits phone survey commissioned by Metro, an October 2001 Moore Information survey sponsored by KGW-TV and the Portland Tribune, and an informal "SurveyPoint" poll available by phone and on Metro's website. Results from all three studies demonstrated that Metro residents place great value on protecting natural resources and maintaining the region's quality of life. Results of these surveys are available from Metro by request.

Early 2001 A preliminary inventory map was reviewed by local governments and the public from February through April.

2001-2002 Metro's "Coffee Talks" were a series of 93 public outreach forums held in various locales throughout the urban region during non-business hours, to promote accessibility to the general public. Coffee Talks were held from September 2001 through January 2002 with discussions about the urban growth boundary, natural resource protection, and transportation; the public was notified through a variety of means similar to the earlier outreach efforts – approximately 1,000 brochures were mailed to businesses and business leaders, neighborhood associations, citizen participatory organizations, civic and community groups, chambers of commerce, local jurisdictions, and advocacy groups. In addition, approximately 90,000 citizens received an October 2001 "Let's Talk" about fish and wildlife newsletter, including some 45,000 property owners with identified Riparian areas. The Coffee Talks were also advertised via local radio, television, and newspapers. An important component of these talks involved whether the public thought it was important to protect fish and wildlife habitat in the urban region and if so, how this should be accomplished. This public feedback was distributed to Metro staff and Councilors for consideration in the planning process. The executive summary from these talks is available from Metro. One important outcome of this process was indication of strong public support for Metro's efforts to maintain and enhance natural habitat areas.

March 2002 Metro held a regional conference and series of localized workshops to garner public opinion and participation entitled "Let's Talk." The conference was held on March 14 with community workshops over the following weekend. Metro undertook a major notification process to encourage attendance to these activities, including the fall 2001 Natural Resource Protection mailing of nearly 90,000 to property owners and interested parties; press releases to major and local newspapers; partnership with KGW, a major local television station; and follow-up calls to neighborhood associations, business interests and many other parties to encourage participation (also part of the Coffee Talk outreach, above). Scholarships were offered to parties that could not afford conference registration fees, which covered part of Metro's cost for the conference. About 2,400 people attended the conference and workshops. Partial results were tabulated and immediately distributed to Metro staff and Council so that public opinion could help guide the current process. The final conference report has just been completed; once again, the results confirmed the importance of natural resource protection to the area's citizens, and interest in several strategies for natural resource protection emerged – perhaps most notably, financial incentives for protection as well as disincentives for failing to protect these resources.

June-Aug. 2002	Nearly 20,000 notices were mailed to property owners whose land fell partially or wholly within the current riparian corridor or wildlife habitat, who had not previously been notified because of the revised mapping or new wildlife habitat inventory information. The letter invited interested citizens and property owners to speak with Metro staff and make comments at several upcoming meetings of the Metro Natural Resource Committee and Council. In addition, some 800 citizens who had indicated an interest in receiving on-going Natural Resource Protection updates were sent a postcard mailer about the additional Natural Resource Committee and Council meetings. Planning electronic mail (email) notices of workshops, hearings or other activities have also been sent to interested for the past two years.

Review information about Metro's Goal 5 inventory process on Metro's website: http://www.metro-region.org/habitat/habitat_home.html.

Collection of information about riparian resource sites

Metro, following the Goal 5 rule's standard inventory process, collected information about streams, water areas, wetlands, riparian areas, and fish habitat to assist in delineating and mapping the region's riparian corridors.

The Goal 5 inventory process began in 1999 as part of the draft Streamside CPR (Conservation, Protection and Restoration) Report (Metro 1999). The Water Quality and Flood Management map, adopted as part of Metro's Urban Growth Management Functional Plan (Title 3) served as the starting point, or base map, for the Goal 5 inventory (Title 3 Functional Plan Map). The map included water features such as primary and secondary water features[1] including streams, rivers, lakes, and wetlands. Also mapped were the 100-year FEMA floodplain, areas flooded in 1996 (the 1996 area of inundation), and steep slopes (over 25 percent) adjacent to water features. This base map was compiled using Metro's extensive Geographic Information System (GIS) database layers and was edited through local jurisdiction review and public input. Appendix 1 is a data dictionary, including variable descriptions.

Metro incorporated a classification scheme for organizing streams into groups that share key characteristics, known as Channel Habitat Types (CHT) (GWEB 1999). The classification scheme used stream confinement[2] and stream gradient[3] to determine CHT. Eleven channel habitat types were originally identified within the region, as described in Table 1. Based on the comments of technical reviewers, these eleven channel habitat types were combined into three main categories: headwater streams (high), mid-section streams (middle), and floodplain and rivers (low). The benefit of incorporating such a classification system is that it can serve as the foundation for a more detailed inventory of stream and watershed conditions.[4]

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[1] Primary water features include Title 3 wetlands; rivers, streams, and drainages downstream from the point at which 100 acres or more are drained to that water feature (regardless of whether it carries year-round flow); and streams carrying year-round flow; springs which feed streams and wetlands and have year-round flow; and natural lakes. Secondary water features include intermittent streams and seeps downstream of the point at which 50 acres are drained and upstream of the point at which 100 acres are drained to that water feature.

[2] Confinement is a characterization of a channel's cross-sectional profile. It represents a stream's potential interactions with its floodplain. The Oregon Watershed Enhancement Board ("OWEB," formerly the Govern'or's Watershed Enhancement Board, or "GWEB") protocol defines confinement classes according to the ratio of floodplain width to channel (bankfull width).

[3] Gradient refers to the angle, or slope, at which the stream runs downhill.

[4] Metro applied the OWEB channel typing system as used in OWEB's Oregon Watershed Assessment Manual, July 1999, to differentiate high gradient streams from low and moderate gradient streams in Metro's scoring system for riparian ecological functions. See Table 4 on page 18.

Table 1. Channel Habitat Types within the Metro region.

Channel type code	Name	Channel type category
FP1	Low gradient large floodplain channel	Low
FP2	Low gradient medium floodplain channel	Low
LUS	Low gradient unconfined	Low
AF	Alluvial fan channel	Low
MH/MC	Moderate gradient confined headwater channel	Middle
MH/MV/BC	Moderate gradient headwater channel, moderately steep narrow valley channel, bedrock canyon channel	Middle
LC	Low gradient confined channel	Middle
LM	Low gradient moderately confined channel	Middle
MM	Moderate gradient moderately confined channel	Middle
VH	Very steep headwater	High
SV/BC/MV	Steep narrow valley channel, bedrock canyon channel, moderately steep narrow valley channel	High

Additional improvements to the Goal 5 inventory base map were made during 2000 and the early part of 2001 to improve the accuracy and consistency of regional information on streams and land cover. For example, Metro converted its stream GIS data layer to a stream routing database (streamroute), which more accurately represents stream location, supports the use of advanced GIS operations, and allows data sharing with state and federal organizations. Current wetland information obtained from local jurisdictions was used to update and augment the National Wetlands Inventory GIS coverage (Appendix 2). Another improvement to the Goal 5 inventory of resource features was the delineation of forest canopy along streams, rivers and other water features, as well as upland forest patches. A companion piece to the forest cover – the delineation of woody vegetation, low structure vegetation and undeveloped soils within 300 feet of streams – was completed in the spring of 2001.

An abbreviated sequence of events leading to the current riparian corridors inventory is summarized below:

- In February 2001, maps displaying the location of resource features such as flood areas, lakes, wetlands, streams, steep ravines, and forest canopy were made available to local governments and the general public for review and comment. Metro requested information to improve the accuracy of the features represented on the maps. The maps were made available as hard copies and as downloadable files on the internet via Metro's file transfer protocol (FTP) server.
- In June 2001, staff presented draft criteria for mapping riparian corridors and three pilot area maps. These criteria and pilot maps were reviewed by the WRPAC, Goal 5 TAC, MTAC and other Metro advisory committees. MTAC and WRPAC and the Metro Natural Resource Committee recommended that the criteria were adequate to warrant region-wide mapping for further review of the criteria.
- In the summer of 2001, Metro Council Natural Resource Committee directed staff to prepare a set of riparian corridor maps for the entire region.
- In the fall of 2001, staff presented a draft map of riparian corridors based on the criteria for WRPAC and other Metro advisory committee review.
- In November 2001, WRPAC recommended that all areas on the draft riparian corridors map (areas identified as providing both primary and secondary ecological functions) be deemed both significant and regionally significant resources.
- On November 21, 2001 Metro's Natural Resource Committee directed that changes to the criteria be made including showing developed floodplains as secondary, not primary function for streamflow moderation and water storage and not at all for large wood and channel dynamics and revising the organic material function adding undisturbed soils within 50 feet.
- On November 28, 2001, MTAC considered the draft riparian corridor maps. MTAC recommended that Metro allow a basin approach where a coordinated, intergovernmental basin-wide effort was made to address all resources identified by Metro as being significant and regional.

- In late November 2001, Metro received a critique of its draft technical report for Goal 5 from the City of Hillsboro; Metro responded to all criticisms by December 12, 2001. The critique did not result in alteration of any of the riparian functional criteria, but did result in several corrections in the technical report.
- On December 12, 2001, MPAC recommended that the Metro Council:
  (a) Revise the criteria for identifying riparian corridors as recommended by the Metro Natural Resource Committee,
  (b) Designate all areas identified through the revised criteria as regionally significant, and
  (c) Explore the basin approach.
- On December 13, 2001, the Metro Council considered all recommendations, including MPAC's recommendation, and approved Resolution No. 01-3141C (Appendix 3). This resolution accepted the riparian corridor criteria, concluded that several mapping changes (developed floodplains, organic materials) should be made, directed that a basin approach should be explored and that all riparian resources meeting the criteria should be considered as both significant and regionally significant, consistent with State Goal 5.
- On May 16, 2002, the Metro Council approved Resolution No. 02-3195 (Appendix 3), authorizing the Executive Officer to sign an intergovernmental agreement with the Tualatin Basin Natural Resource Coordinating Committee concerning a basin approach with the Tualatin River basin.
- The current riparian corridor maps have been revised as directed in Resolution No. 01-3141C (Appendix 3) for developed floodplains (Appendix 6) and organic materials. In addition:
  (a) Extensive map corrections have been made;
  (b) The map geographic extent has been increased to include areas one mile outside the Metro jurisdictional boundary and all Urban Growth Boundary Alternative Analysis sites. (This data is provided for analytical purposes, as Metro has no jurisdiction in these areas unless annexed to Metro.)
- In June 2002, MTAC, WRPAC, MPAC, the Goal 5 TAC, and Metro Natural Resources Committee considered a recommendation concerning the draft riparian corridor inventory and voted to support proposed Resolution No. 02-3176 (Appendix 3), for the purpose of adopting a draft map of regionally significant fish habitat (riparian corridors) pursuant to Resolution No. 01-3141C (Appendix 3). The Metro Council is scheduled to consider riparian corridors under proposed Resolution No. 02-3176 in late July 2002.

Metro received and reviewed numerous map corrections from local jurisdictions, property owners and other interested parties. Included in these changes was incorporation of local wetlands inventory information (see Appendix 2). Metro staff applied a consistent set of map change protocols to these requests. Some of the proposed corrections were represented on the February 2001 maps, and additional corrections were received as a result of public review of the maps in the spring of 2001. When documentation was adequate, Metro corrected its GIS data layers depicting resource features. Other proposed corrections that lacked adequate documentation will be considered in on-going updates of Metro's GIS data layers. Metro is continuing to accept map change requests and is making every attempt to see that Goal 5 maps are as accurate and complete as possible.

In fall 2001 Metro conducted U.S. Fish and Wildlife Service-funded fieldwork to assess the riparian corridor inventory's ability to identify valuable riparian resources. Processing the data for this research is time-consuming and the results are not yet complete; however, the conceptual underpinnings for this fieldwork are described in the section below entitled "Fieldwork to assess mapping criteria."

Table 2 below describes the Goal 5 inventory resource features that were used the construction of regional criteria for delineation of riparian corridors. GIS metadata (descriptions of collection methodologies for each data layer) or their locations are included in Appendix 4.

Table 2. Goal 5 riparian corridor inventory resource features.

Resource Features	Description
Flood Areas	Areas covered by the 100-year floodplain mapped for the Federal Emergency

Resource Features	Description
(FEMA/1996)*	Management Administration and/or areas mapped as inundated during the 1996 flood event by the Army Corps of Engineers, excluding ponded areas as noted by local governments.
Forest Canopy*	Land covered by forest canopy in patches generally larger than one acre in size. Delineated at a scale of 1:4800 using 2000 aerial photos and generalized criteria by the Metro Data Resource Center.
Steep Slopes*	Slopes greater than 25 percent occurring within 200 horizontal feet of the stream centerline or bank where mapped using the slope calculation method within the Arc-Info software program and using the 7½-minute USGS topographic map data.
Wetlands*	Wetlands mapped by the National Wetland Inventory and later updated as a part of the Title 3 water quality process. Additionally modified to incorporate information from local government review and local wetland inventories (see Appendix 2). Wetlands are considered hydrologically connected if the wetland boundary begins within ¼ mile of a riparian corridor.
Open Water*	Open water surface areas of lakes, ponds, and some rivers from the USGS 7½-minute quadrangle map data, from Metro stream modeling data of topography and as modified by review by cities and counties in the region.
Stream Centerlines*	Central channels or central braids of streams included on Metro's stream network. The network is composed of streams appearing on USGS digital line graph data, supplemented by stream model and edited for accuracy using air photos by Data Resource Center. The network includes minor edits to incorporate local information received through the Title 3 map review process and subsequent public reviews.
Stream Links*	Portions of streams that are non-surface, historic, or inferred and determined by examination of aerial photographs and comments from cities and counties in the region. Help to associate fragmented surface streams and drainage basins with downstream areas.
Culverts*	Stream crossings by roads and other transportation facilities but excluding stream links. Prepared by Metro Transportation Department, 2000 using road network, stream network and field inspections.
Proposed Stream Corrections*	Stream segments identified for removal, addition or relocation by local agencies.
Other Proposed Corrections*	Flood areas, wetlands, slopes, forest canopies or water bodies proposed for removal, addition or relocation by local agencies.
Woody vegetation and open space	Woody vegetation, or low structure vegetation/undeveloped soils mapped within 300 feet of streams and wetlands. Delineated at a scale of 1:4800 using 2000 aerial photos and generalized criteria by the Metro Data Resource Center.
Riparian Values Layers**	Represents resource features receiving values for one or more of the five ecological functions appearing in the riparian scoring matrix. The matrix is included in Metro's Resolution No. 01-3087A (Appendix 3). These layers were derived using the Goal 5 inventory features and the riparian scoring matrix. There is a layer for each individual function and a layer depicting cumulative score for all features.
Satellite land cover	Satellite derived land cover data. Data at 25 x 25 meter (80 x 80 feet) pixels for 17 land cover classifications.

Source: Metro 2001. See Appendix 4 for GIS metadata for each data layer.
*Goal 5 inventory features that were subject of a formal local government and general public review from February to April 2001.
**See Definition of Riparian Corridor section for more detail on the riparian values layers.

Metro has incorporated the best available information in its GIS database to accurately depict, at a regional scale, the location and quantity of Goal 5 resource features. The addition of the vegetation data layer adds information about the quality of mapped Goal 5 resource features (*see Adequacy of Information section*).

Consultations

At a minimum, the Goal 5 rule requires that local governments consult with the following sources:

(a) Oregon Department of Forestry stream classification maps;
(b) United States Geological Service (USGS) 7.5 minute quadrangle maps;
(c) National Wetlands Inventory maps;
(d) Oregon Department of Fish and Wildlife (ODFW) maps indicating fish habitat;
(e) Federal Emergency Management Agency (FEMA) flood maps; and
(f) Aerial photographs (OAR 660-23-090 (4))

Table 3 below describes these consultations and others undertaken by Metro in the inventory process.

Table 3. Agency consultations and information sources for riparian corridor inventory.

Agency	Information Type
Clean Water Services (Tualatin Basin)	• Rapid Stream Assessment point data (450 sampling sites) • Benthic Index of Biological Integrity sampling sites and data • Reports on watersheds, water quality status and trends, fish distribution and fish habitat • Stream location information
Ecotrust	• Landsat TM landcover type information
Federal Emergency Management Agency	• 100-year flood maps
Independent Multidisciplinary Science Team (IMST)	• Provided peer-review and comments on Metro's Technical Report for Goal 5 (now named "Metro's Technical Report for Fish and Wildlife Habitat").
Local governments	• Local plan Goal 5 inventories, review of Metro GIS base feature layers for accuracy and completeness • Members of several local jurisdictions on Goal 5 Technical Advisory Committee and other advisory committees
National Marine Fisheries Service	• Critical habitat for listed salmon species • Reports on salmon and trout ecology • Member on Goal 5 Technical Advisory Committee
Natural Resources Conservation Service	• Oregon Hydrology Group working to identify watersheds by USGW Hydrologic Unit Code system • U.S. Department of Agriculture and NRCS certified soil surveys
Oregon Department of Environmental Quality	• Water quality model code and handbook • 303(d) listed streams and lakes • Water quality index sampling points and data • Benthic index of biological integrity protocol and data • Total Maximum Daily Loads (TMDLs) for Tualatin Basin • Reports on environmental site cleanup information, Portland Harbor, brownfield sites, underground tanks, wastewater permits • Member on Goal 5 Technical Advisory Committee
Oregon Department of Fish and Wildlife	• Anadromous and other fish species distribution at 1:100,000 scale (statewide data) • ODFW Aquatic Inventories Project, habitat and reach data coverage • ODFW Natural Resources Information Management Program fish habitat distribution data at 1:24,000 scale • Threatened, endangered, and sensitive wildlife species habitat information

Agency	Information Type
	• Fish and wildlife species status information • Willamette Valley vegetation, 1:24,000 scale • Willamette Valley dams and barriers • Fish Passage Program data re: road culverts with fish passage problems on state and county roads • Big game winter range • Members on Goal 5 Technical Advisory Committee
Oregon Department of Forestry	• DOF stream classification maps • DOF fish presence and distribution • DOF sensitive bird site inventories
Oregon Natural Heritage Program	• record files of rare, threatened, and endangered plant and animal species within metro study area
Oregon Progress Board	• Water quality data used in the Oregon State of the Environment Report
Pacific Northwest Ecosystem Research Consortium	• procedures and data bases for evaluating Willamette Valley habitats for wildlife species • 1850 historic vegetation • land use/land cover projected at 10 year increments through 2050 • demographic, hydrologic, physiographic, base grids and land use/land cover spatial data for Willamette Valley
Port of Portland	• Wetland location on Port properties; floodplain information
Spencer B. Gross, Inc.	• Aerial photos, natural color ortho-rectified digital imagery with a pixel size of 2, 4, 10 and 20 feet. Metro area covered in 726 section tiles.
U. S. Fish and Wildlife Service	• National Wetlands Inventory maps • Threatened, endangered, and sensitive wildlife species habitat information • Fish and wildlife species status information • Oregon Endangered Species Consultation Handbook • Federally listed and proposed endangered and threatened species, candidate species, and species of concern
U.S. Environmental Protection Agency	• Terrestrial vertebrate species of the Willamette River basin, species-habitat relationships matrix • Pacific States Marine Fisheries Commission/EPA Streamnet data for anadromous fish distribution • Streamnet Pacific NW water quality sampling data for streams and lakes • Toxic Release Inventory (1985-1999) • Better Assessment Science Integrating Point and Nonpoint Sources (BASINS) for environmental information, watershed and water quality planning
United States Geological Service	• 7.5 quadrangle maps • USGS 1:24,000 10 meter digital elevation data (terrain model) • USGS Hydrologic Unit Code system • USGS reports and GIS data on water quality, toxins, habitat, hydrology, and groundwater for the Willamette Basin
Watershed Councils	• Watershed assessments and plans
Xerces Society	• Invertebrate species in the metro area • Benthic Index of Biological Integrity report for Lower Clackamas, Sandy rivers

Definition of riparian corridor

The previous section described how potential Goal 5 resources were inventoried and mapped. This section describes the methodology Metro used to identify riparian corridors. The Goal 5 rule defines a riparian corridor as a "Goal 5 resource that includes the water areas, fish habitat, adjacent riparian areas, and wetlands within the riparian area boundary." The rule does not provide guidance on how to identify the width of the riparian corridor. It only states that the riparian corridor boundary is an “imaginary line that is a certain distance upland from the top of bank” (660-23-090(1)). The Goal 5 rule allows a jurisdiction flexibility in defining the riparian corridor, the area for which a significance determination must be made.

Methodology for mapping riparian corridors

Metro has taken an ecological functions approach to define the riparian corridor based on its extensive scientific literature review (Metro 2002). This approach, described below, combines GIS mapping technology, scientific recommendations, and fieldwork for an inventory that encompasses the entire Metro region. It is intended to inform policymakers and the public about resource features in the landscape that provide some service or function to the riparian ecosystem. The methodology assigns values to resource features that allows comparison of their cumulative importance to riparian health.

As described in Metro’s Technical Report for Fish and Wildlife Habitat, April 2005, the riparian area refers to the land and vegetation adjacent to waterbodies such as streams, rivers, wetlands and lakes that are influenced by perennial or intermittent water. The spatial extent or width of the riparian area is difficult to delineate. Naiman and Decamps (1997) describe the riparian area as encompassing

> “The stream channel between the low and high water marks and that portion of the terrestrial landscape from the high water mark toward the upland where vegetation may be influenced by elevated water tables or flooding and the ability of the soils to hold water.”

Gregory et al. (1991) further describes riparian areas as “three-dimensional zones of direct interaction between terrestrial and aquatic ecosystems,” the boundaries of which “extend outward to the limits of flooding and upward into the canopy of streamside vegetation.”

Kauffman et al (2001) encourage a functional approach to defining the “riparian zone,” stating that “from an ecosystem perspective, riparian zones are defined in terms of their multiple functional roles as the interface between aquatic and terrestrial environments.” According to Kauffman et al (2001), “interactions between terrestrial and aquatic ecosystems include modifications of microclimate (e.g., light, temperature, and humidity), alteration of nutrient inputs from hill slopes, contribution of organic matter to streams and floodplains, and retention of inputs.”

According to the scientific literature reviewed, riparian corridors provide important ecological benefits for fish and wildlife including:

1. Microclimate and shade
2. Streamflow moderation and water storage
3. Bank stabilization, sediment and pollution control
4. Large wood and channel dynamics
5. Organic matter input
6. Riparian wildlife habitat and connectivity[5]

[5] Wildlife habitat is excluded from the riparian corridor inventory, and is addressed under the inventory for wildlife habitat under OAR 660-23-110.

The biological integrity of the riparian corridor depends, in part, on the width and condition of the riparian area, helps dictate stream functions and ultimately the type of species that can live in and around streams. Several recent literature reviews have addressed the effectiveness of various widths for maintaining specific riparian functions for both protecting water quality and preserving the biologic integrity of the riparian corridor. Metro's Technical Report for Fish and Wildlife Habitat lists a range of recommended minimum riparian area widths for fish and wildlife habitat (Table 7 in Metro's Technical Report for Fish and Wildlife Habitat, April 2005).

The ecological functions listed above provide the basis for Metro's delineation of riparian corridors. In the spring of 2001, Metro launched an effort to map the ecological functions of riparian corridors and the specific resource features that are associated with these functions. Features include stands of trees, woody vegetation, meadows, wetlands, steep slopes, and flood areas that are located along the region's stream and rivers. The recommended riparian corridor widths from Metro's Technical Report for Fish and Wildlife Habitat were used to help develop a set of mapping criteria and are summarized in Table 4. The full matrix for mapping riparian corridors is in Appendix 5

In December 12, 2001, the Metro Policy Advisory Committee (MPAC) recommended that the Metro Council revise the riparian corridor criteria for identifying riparian corridors as identified by the Metro Natural Resource Committee and designate all identified through the revised criteria as regionally significant. On December 13, 2001, the Metro Council considered all recommendations, including MPAC's recommendation, and approved Resolution 01-3141C (Appendix 3). This resolution accepted the riparian corridor criteria, concluded that several mapping changes (developed floodplains, organic materials) should be made, and that all riparian resources meeting the criteria should be considered as both significant and regionally significant, consistent with State Goal 5. Metro subsequently created and implemented a methodology for identifying developed floodplains (Appendix 6); the current riparian corridor maps have been revised as directed in resolution 01-3141C for developed floodplains and organic materials. In addition, extensive map corrections have been made and the map geographic extent has been increased to include areas one mile outside the Metro jurisdictional boundary and all UGB Alternative Analysis sites (this data is provided for analytical purposes as Metro has no jurisdiction in these areas unless annexed to Metro).

Table 4. Riparian corridors ecological functions and criteria for receiving a primary score.

Ecological function	Criteria for receiving a primary score	Criteria for receiving a secondary score
Microclimate and shade	Forest or woody vegetation within **100 feet** of a stream; a wetland[1]; or a flood area[2].	Forest or woody vegetation that is contiguous to the primary area (which is 100 feet) and extends outward to **780** feet.
Streamflow moderation and water storage	A wetland or other water body[3] with a hydrologic connection to a stream; or a flood area.	Forest, woody vegetation, or low structure vegetation/undeveloped soils within **300 feet**[4] of a stream; or forest that is contiguous to the riparian corridor (starts within **300 feet**[5] but extends beyond); or developed floodplains.
Bank stabilization, sediment and pollution control	A 50-foot band is included within the riparian corridor as a default to maintain basic functions. All sites within **50 feet** of a surface stream receive a primary score. Forest, woody vegetation, or low structure vegetation/undeveloped soils within **100 feet**[6] of a stream or a wetland; or forest, woody vegetation, or low structure vegetation/ undeveloped soils[8] within a flood area. Forest, woody vegetation, or low structure vegetation/undeveloped soils within **100-200 feet** of a stream if the slope is greater than 25%.	Forest, woody vegetation, or low structure vegetation/undeveloped soils located on a slope greater than 25%, that starts within **175** feet[7] of a stream and runs to the first effective break in slope.
Large wood and channel dynamics	Forest within **150 feet** of a stream or wetland; or within a flood area. The channel migration zone is basically defined by the floodplain, but where there is no mapped floodplain a default of **50 feet** was selected to allow for the channel migration zone[9].	Forest within **150 to 262 feet** of a stream; or developed floodplains.
Organic material sources	Forest or woody vegetation within **100 feet** of a stream or wetland; or within a flood area.	Forest or woody vegetation within **100 to 170 feet** of a stream.

Source: Metro 2001.
[1]Here we refer to "hydrologically-connected wetlands," which are located partially or wholly within ¼ mile of a surface stream or flood area.
[2]Developed floodplains are not included as a regional resource since they do not receive a primary ecological function score.
[3]"Other water body" could include lakes, ponds, reservoirs, or manmade water feature that is not a water quality facility or farm pond.
[4]All upland forests, vegetation, and undeveloped soils help to moderate streamflow and store water. Staff used 300 feet here because some data layers for landcover types do not extend past 300 feet from a stream.
[5]Forest landcover is the only type that extends beyond 300 feet in the Metro database and thus excludes other types.
[6]Metro's science paper indicates 100 feet as a suitable average distance for vegetation contributing to filtering.
[7]175 feet was chosen due to the method used for mapping riverine slopes.
[8]The woody vegetation and low structure vegetation/undeveloped soils are mapped to 300 feet, the forest is mapped to the edge of the floodplain.
[9]Application of the default to maintain basic functions will be limited to low and moderate gradient channel types.

An example of Metro's mapping technique can be illustrated by examining the ecological function of microclimate and shade. Trees and other vegetation along streams provide a microclimate that is uniquely different from upland areas because of its proximity to water. This unique microclimate influences soil moisture, temperature and relative humidity, which allows for an increase in plant diversity and a variety of food and cover opportunities for fish and wildlife. Trees and other vegetation along streams also provide shade, which moderates the amount of light reaching the stream and helps to regulate water temperature.

According to the scientific literature, the minimum riparian area width needed to provide for microclimate ranges from 75 feet to 787 feet, and from 33 feet to 250 feet for shade (on each side of the stream). Based on the scientific literature, Metro used 100 feet as the area (on each side of the stream) where trees and other woody vegetation make a significant contribution to riparian function (microclimate and shade). Using GIS mapping technology, forest and woody vegetation within 100 feet of a surface stream, a hydrologically connected wetland, or an area subject to flooding were mapped. However, forest and woody vegetation beyond 100 feet also provide riparian function, according to the scientific literature, but to a lesser degree. These areas were also mapped to the outer range of the widths recommended by the literature, in this case 780 feet.

Metro devised a scoring system to rate the landscape features according to their contribution to riparian function. Based on distances recommended in the scientific literature, landscape features were considered either primary or secondary for ecological function. For example, trees and other woody vegetation contributing to riparian function within the first 100 feet are considered primary features and given six points. Trees and other woody vegetation beyond 100 feet and up to 780 feet still provide some ecological function according to the scientific literature, and are considered secondary features and assigned one point to reflect the reduced, but still valuable, ecological functions provided. Each of the other functions listed above (streamflow moderation, organic input, etc.) went through a similar process that linked land features with the ecological function they support, based on primary and secondary functions.

The scores are additive for any given landscape feature and reflect relative ecological function at any given point on the map. For example, a point on a map could contribute significantly to all five functions listed above and receive a score of 30 (five primary functions times six points each). Another point on the map may receive primary scores for three functions (three primary functions times six points) plus secondary functions for up to two other functions (18 points for primary functions, plus two points for secondary functions). Still another point on the map may receive only a single point for one secondary function. Table 4 and Appendix 5 describe the criteria used to evaluate each ecological function, the contributing land features, and the criteria for mapping those features.

Metro's methodology for mapping ecological functions has undergone extensive public review. The methodology was first applied to three nine square mile study areas: Bronson Creek, Johnson Creek, and Wilsonville. These study area maps were presented to Metro's Natural Resources Committee in May 2001. After a period of extensive public review, Metro Council adopted the methodology as part of Resolution 01-3087A (Appendix 3) and directed staff to produce maps applying the methodology on a regional basis.[6]

The resulting regional maps were presented to Metro's Natural Resources Committee in September 2001 and show areas with primary functions in gradations of green, with the darkest green providing the most function, the lightest green providing the least. Secondary functions are shown in gradations of fuchsia. This mapping methodology provides a valuable tool for defining riparian corridors, for identifying significant resource and regional resources, and for focusing the area of analysis (for quality data) within resource sites. It will also provide valuable information for locating potential restoration sites.

[6] Review included the Goal 5 Technical Advisory Committee, Metro Technical Advisory Committee, Water Resources Policy Advisory Committee, and Metro Policy Advisory Committee.

Collection of information about wildlife habitat resource sites

In public hearings before Metro Council Natural Resources Committee and in recommendations from the Metro Policy Advisory Committee (MPAC), Metro Technical Advisory Committee (MTAC), Metro Goal 5 Technical Advisory Committee (Goal 5 TAC) and the Water Resources Policy Advisory Committee (WRPAC), Metro Council was urged to complete the analysis of potential regionally significant wildlife habitat and combine that information with the mapping of regionally significant riparian corridors

Metro, following the Goal 5 rule's standard inventory process, collected information about forested areas, low-structure vegetation, streams, water areas and wetlands to assist in delineating and mapping the region's important wildlife habitats.

The current Goal 5 wildlife habitat inventory process began in 2001. In February 2001, pilot maps were made available on Metro's ftp website for review by interested parties. In July 2001, Metro Council adopted Resolution No. 01-3087A (Appendix 3) directing staff to apply functional science-based criteria to determine Goal 5 fish and Wildlife habitat areas. The criteria and mapping methodology are described in the section below, entitled "Mapping Technology for Wildlife Habitats."

An abbreviated sequence of events leading to the current wildlife habitat inventory is summarized below:

- In early 2001, pilot maps were made available on Metro's ftp site for review by interested parties.
- In fall 2001, in public hearings before Metro Council Natural Resources Committee (NRC) and in recommendations from the Metro Policy Advisory Committee (MPAC), Metro Technical Advisory Committee (MTAC), Metro Goal 5 Technical Advisory Committee (Goal 5 TAC) and the Water Resources Policy Advisory Committee (WRPAC), Metro Council was urged to complete the analysis of potential regionally significant wildlife habitat and combine that information with the mapping of regionally significant riparian corridors.
- In fall 2001, Metro conducted U.S. Fish and Wildlife Service-funded fieldwork to assess the original model's ability to appropriately assign value to habitat patches. The results of this fieldwork, described in the section entitled "Fieldwork to assess mapping criteria" below, provided guidance for adjusting the model to more accurately reflect the region's wildlife habitat values. These changes included redefining patches based on substantially closed canopy forest plus all vegetation within 300' of waterways and omitting the species richness criterion from the model.
- In December 2001, Council adopted Resolution No. 01-3141C (Appendix 3) directing staff to complete additional work necessary to inventory and map regional wildlife habitat and present that information to Metro Council in early 2002.
- In response, staff produced the following products:
  - An analysis of existing Goal 5 data, reports and regulations from cities and counties
  - A methodology and criteria for identifying wildlife habitat and maps applying those criteria to the region
  - A map identifying Goal 5 resource sites and Goal "wildlife habitat" within those sites to serve as the basis for identifying regionally significant wildlife habitats
  - An inventory narrative (this document) including information on the location, quantity and quality of the potential resources sites identified on the map
  - A map of potentially significant wildlife habitat
  - A summary of recommended criteria for identifying and defining regionally significant wildlife habitat (see Table 7 and Appendix 5)
  - A map depicting wildlife habitat that could be adopted as "regional resources" under the Goal 5 administrative rule

- In February 2002, staff presented draft criteria to the Metro Council Natural Resource Committee for identifying Goal 5 wildlife habitat based on information contained in “Metro’s Technical Report for Fish and Wildlife Habitat” (formerly entitled “Metro’s Scientific Literature Review for Goal 5”)
- In a subsequent step to the wildlife habitat mapping process, Metro requested information on species and habitats of concern through several advisory committees and by contacting local experts knowledgeable in the region’s wildlife habitats (see Table 7; section below entitled “Species and Habitats of Concern”).
- In May 2002, the inventory was revised to reflect a larger study area, habitats of concern, and several relatively minor alterations to refine the inventory. These maps were made available via Metro’s FTP server.
- In summer 2002, MPAC, MTAC, and the Goal 5 TAC recommended identifying all wildlife habitats on the map as significant and recommended Option 2 (see Table 7 and Appendix 5) for regional significance. However, WRPAC recommended identifying all wildlife habitats on the map as significant but recommended Option 1 for regional significance. Also during this period a series of public hearings were held to provide information to interested parties and obtain public opinion.

The map of regionally significant riparian corridors and wildlife habitat that staff produced is a draft map which will provide the basis for conducting subsequent steps in the Goal 5 process including the economic, social, environmental and energy consequences analysis and the Program to Achieve Goal 5. Metro Council reserves the opportunity to minimally or substantially alter the draft map prior to adoption of a final map of regionally significant fish and wildlife habitat areas and Program to Achieve Goal 5, after public comment and review.

Table 5 below describes the Goal 5 inventory resource features that were used the construction of regional criteria for delineation of wildlife habitats. Appendix 5 shows the full criteria matrix used to map wildlife habitats on Metro’s GIS system.

Table 5. Goal 5 wildlife habitat inventory resource features.

Resource Features	Description
Forest Canopy*	Land covered by forest canopy in patches generally larger than one acre in size. Delineated at a scale of 1:4800 using 2000 aerial photos and generalized criteria by the Metro Data Resource Center.
Wetlands*	Wetlands mapped by the National Wetland Inventory and later updated as a part of the Title 3 water quality process. Additionally modified to incorporate information from local government review and local wetland inventories (see Appendix 2).
Stream Centerlines*	Central channels or central braids of streams included on Metro's stream network. The network is composed of streams appearing on USGS digital line graph data, supplemented by stream model and edited for accuracy using air photos by Data Resource Center. The network includes minor edits to incorporate local information received through the Title 3 map review process and subsequent public reviews.
Stream Links*	Portions of streams that are non-surface, historic, or inferred and determined by examination of aerial photographs and comments from cities and counties in the region. Help to associate fragmented surface streams and drainage basins with downstream areas.
Proposed Stream Corrections*	Stream segments identified for removal, addition or relocation by local agencies.
Other Proposed Corrections*	Flood areas, wetlands, slopes, forest canopies or water bodies proposed for removal, addition or relocation by local agencies.
Woody vegetation and open space	Woody vegetation, or low structure vegetation/undeveloped soils mapped within 300 feet of streams and wetlands. Delineated at a scale of 1:4800 using 2000 aerial photos and generalized criteria by the Metro Data Resource Center.
Wildlife Habitat Values Layers	Represents resource features receiving values for one or more of the four criteria identified in the Goal 5 Technical Report. These layers were derived

	using the Goal 5 inventory features and the wildlife habitat scoring matrix. There is a layer for each individual criterion and a layer depicting cumulative score for all features.
Habitats of Concern Layer	Site-specific information collected from a variety of knowledgeable sources and digitized in a separate GIS layer (see Table 7 and section below entitled "Species and Habitats of Concern").
Species of Concern Layer	Species of concern sightings for species listed under the federal or state Endangered Species Act or identified by the Oregon Natural Heritage Program as at-risk (see Table 7 and section below entitled "Species and Habitats of Concern").

Source: Metro 2001. See Appendix 4 for GIS metadata for each data layer.
*Goal 5 inventory features that were subject of a formal local government and general public review from February to April 2001.

Metro has incorporated the best available information in its GIS database to accurately depict, at a regional scale, the location and quantity of Goal 5 resource features. The addition of the species of concern and habitats of concern data layers, combined with field studies, add information about the quality of mapped Goal 5 resource features (*see Adequacy of Information section*).

Consultations

At a minimum, the Goal 5 rule requires that local governments shall obtain current habitat inventory information from the Oregon Department of Fish and Wildlife (ODFW) and other state and federal agencies. These inventories shall include at least the following:

(a) Threatened, endangered, and sensitive wildlife species habitat information;
(b) Sensitive bird site inventories;
(c) Wildlife species of concern and/or habitats of concern identified and mapped by ODFW (e.g., big game winter range and migration corridors, golden eagle and prairie falcon next sites, and pigeon springs (OAR 660-23-110 (1))

Table 6 below describes these consultations and others undertaken by Metro in the inventory process.

Table 6. Agency consultations and information sources for wildlife habitat inventory.

Agency	Information Type
Army Corps of Engineers	• 1978 "Regional Urban Wildlife Habitat Maps" to supplement Habitats of Concern information
Audubon Society of Portland / Coalition for a Livable Future	• Mike Houck is a member of the Goal 5 Technical Advisory Committee and is Chair of the Natural Resources Working Group; comments on all aspects of program, including model criteria and scoring. • Species of Concern and Habitats of Concern information
Bob Altman, American Bird Conservancy	• Sensitive species and sensitive species habitat information (also linked with Partners in Flight, Oregon/Washington chapter)
Charlotte Corkran, local herptile expert/consultant	• Sensitive species location information • Vertebrate species list in Tualatin Basin
Clean Water Services (Tualatin Basin)	• Reports on watersheds, fish distribution and fish habitat
Defenders of Wildlife (in cooperation with ODFW)	• Information on restoration and enhancement practices for rare habitats in the Willamette Valley

Agency	Information Type
Ecotrust	• Landsat TM landcover type information
Independent Multidisciplinary Science Team (IMST)	• Provided peer-review and comments on Metro's Technical Report for Goal 5 (now named "Metro's Technical Report for Fish and Wildlife Habitat").
Local governments	• Local plan Goal 5 inventories, review of Metro GIS base feature layers for accuracy and completeness • Members of various governments on Goal 5 Technical Advisory Committee (including cities of Beaverton, Portland, Troutdale, Lake Oswego, Tualatin; and Clackamas, Washington, and Multnomah counties) and other advisory committees • Input on Habitats of Concern, Species of Concern, model formulation and refinement, scoring system
Members of GTAC (Greenspaces Technical Advisory Committee) and G5TAC (Goal 5 Technical Advisory Committee)	• Habitats of Concern request for information
Metro Parks and Greenspaces Department	• Metro Greenspaces Master Plan, including corridor information; Habitats of Concern; Species of Concern information
National Marine Fisheries Service	• Member of Goal 5 Technical Advisory Committee (Marc Liverman)
Numerous regional wildlife experts, including the fish and wildlife agencies, PSU, OSU, consultants	• Development of Vertebrate Species List
Oregon Cooperative Fish and Wildlife Unit, Oregon State University	• Sensitive species surveys (obtained via ODFW)
Oregon Department of Environmental Quality	• Member of Goal 5 Technical Advisory Committee (Don Yon)
Oregon Department of Fish and Wildlife	• Wildlife species status information; threatened, endangered, and sensitive wildlife species occurrence and habitat requirement information • Information on at-risk wildlife habitat types in the Willamette Valley • Information on restoration and enhancement of at-risk wildlife habitat types in the Willamette Valley • Wildlife Diversity Plan • Willamette Valley vegetation, 1:24,000 scale • Big game winter range • 2 Members on Goal 5 Technical Advisory Committee
Oregon Department of Forestry	• DOF stream classification maps
Oregon Natural Heritage Program	• Record files of rare, threatened, and endangered plant and animal species within metro study area • ONHP species status rankings for species list • Consultation regarding Habitats of Concern
Pacific Northwest Ecosystem Research Consortium	• Procedures and data bases for evaluating Willamette Valley habitats for wildlife species • 1850 historic vegetation • Land use/land cover projected at 10 year increments through 2050 • Demographic, hydrologic, physiographic, base grids and land use/land cover spatial data for Willamette Valley
Partners in Flight	• Status and conservation of state sensitive grassland bird species • Conservation strategy for landbirds in coniferous forests and

Agency	Information Type
	lowlands and valleys of western Oregon and Washington
Port of Portland	• Site-specific information regarding Habitats of Concern
Spencer B. Gross, Inc.	• Aerial photos, natural color ortho-rectified digital imagery with a pixel size of 2, 4, 10 and 20 feet. Metro area covered in 726 section tiles.
Tualatin Hills Parks and Recreation District	• Information on Habitats of Concern and comments on model scoring criteria
U.S. Environmental Protection Agency	• Terrestrial vertebrate species of the Willamette River basin, species-habitat relationships matrix
U.S. Fish and Wildlife Service	• National Wetlands Inventory maps • Federally listed and proposed endangered and threatened species, candidate species, and species of concern • Threatened, endangered, and sensitive wildlife species habitat and sighting location information • Oregon Endangered Species Consultation Handbook • Member on Goal 5 Technical Advisory Committee
United States Geological Service	• 7.5 quadrangle maps • USGS 1:24,000 10 meter digital elevation data (terrain model) • Breeding Bird Survey information
URS Corporation (Lynn Sharp, local wildlife habitat expert)	• Information on Habitats of Concern
Watershed Councils	• Watershed assessments and plans
Wetlands Conservancy	• Habitats of Concern request for information
Xerces Society	• Invertebrate species in the metro area

Definition of wildlife habitat

The previous section described how potential Goal 5 resources were inventoried and mapped. This section describes the methodology Metro used to identify wildlife habitats. The Goal 5 rule defines wildlife habitat as "an area upon which wildlife depend in order to meet their requirements for food, water, shelter, and reproduction. Examples include wildlife migration corridors, big game winter range, and nesting and roosting sites" (OAR 660-023-0110(1)(b)). The rule does not provide specific guidance on how to identify significant wildlife habitats other than referring to the standard inventory process (OAR 660-23-030) and minimum consultation requirements outlined in OAR 660-23-110. The Goal 5 rule allows a jurisdiction flexibility in defining the area for which a significance determination must be made.

Mapping methodology for wildlife habitats

As the agency responsible for identifying regionally significant wildlife habitat, it is not feasible to visit each potential site during the inventory process. Field surveys are encouraged but not required by the Goal 5 rule. Therefore, Metro has taken a multi-tiered approach to identify the region's important wildlife habitats based on a combination of (1) best available scientific literature; (2) GIS modeling; (3) field studies to address the Goal 5 rule to determine the location, quantity and quality of potential resource sites, as well as the adequacy of that information; and (4) local expertise to identify locations of sensitive species and habitats. This approach, described in Table 7, combines GIS mapping technology, scientific recommendations, and fieldwork for an inventory that encompasses the entire Metro region. It is intended to inform policymakers and the public about resource features in the landscape that provide habitat to meet wildlife requirements for food, water, shelter and reproduction. The methodology assigns values to resource features that allows comparison of their cumulative importance to the regional wildlife habitat network.

According to the scientific literature reviewed, important ecological characteristics of wildlife habitat include the following:

1. Terrestrial habitat is important for many wildlife species. Important guidelines in developing a conservation plan for wildlife habitat are:
   - large patches are better than smaller patches
   - interior habitat is more important to at-risk species than edge habitat
   - connectivity to other patches is important
   - connectivity and/or proximity to water is important
   - unique or at-risk habitats deserves special consideration
2. Native vegetation plays a critical role in a watershed, particularly the longitudinal and lateral connectivity of the riparian corridor. In general, native wildlife species prefer native plants.
3. Downed wood and snags (or large woody debris), frequently found in natural ecosystems but often lacking in disturbed environments, are crucial in providing high quality habitat in both aquatic and terrestrial ecosystems.
4. Habitat fragmentation is a critical issue; buffers and surrounding land use play an important role in maintaining the functions of remaining habitat.

The ecological characteristics listed above provide the basis for Metro's delineation of wildlife habitat. In early 2001, Metro launched an effort to map wildlife habitat based on specific resource features that are associated with these characteristics. Features include stands of trees, woody vegetation, meadows, and wetlands located within the region. The recommended wildlife habitat criteria from Metro's Technical Report for Fish and Wildlife Habitat were used to help develop a set of mapping criteria and these are summarized in Table 7 (see also Appendix 5).

A GIS model developed through Metro's Parks and Greenspaces Department served as the starting point, or base map, for the Goal 5 inventory (original model). Vegetation data for the original model was derived from satellite imagery (24-m rasters). The original model was based on four criteria: habitat patch size (minimum patch size of 2 acres unless considered a Habitat of Concern, described below), proximity to water sources, proximity to other natural areas, and an Oregon Natural Heritage Program-derived species richness criterion. After reviewing the scientific literature and available local research a fifth criterion measuring forest interior, derived from Metro-region field data, was incorporated into the model. The original inventory map, which included habitat patches composed of natural land cover such as forest, shrub and grassy areas, as well as water features including streams and wetlands, was compiled using Metro's extensive Geographic Information System (GIS) database layers. Each habitat patch was ranked within the universe of habitat patches and assigned a score for each of the four model criteria, relative to other habitat patches. Sites were subsequently separated into three quality classes, of up to three possible points, for each criterion (see Table 7 footnotes for more information).

Table 7. Wildlife habitat characteristics and criteria for GIS model scoring.

Habitat characteristic	Criteria for scoring
Habitat patch size	The size value for a patch is calculated by: 1. Calculating the area in acres for all type 1 patches[7] using a GIS system. Assigning all type 1 patches a value of 1 to 3 based on their distribution within three classes derived by finding natural breaks using a GIS system[8].
Habitat interior (minimizes edge habitat)	The interior value for a patch is calculated by: 1. Defining an interior zone for all type 1 patches by using a GIS system to draw internal buffers of 200 feet for each. 2. Calculating the interior zone area (if any) in acres for all type 1 patches using a GIS system. Assigning all type 1 patches an interior value of 1 to 3 based on their distribution within three classes derived by finding natural breaks using a GIS system.
Connectivity and proximity to water resources	The connectivity to water value for a patch is calculated by: 1. Calculating the area of all type 1 and 2 patches that is less than 300 feet from of a source of water[9] using a GIS system. 2. Deriving the "connectivity to water" ratio of each type 1 patch. This is done by dividing the patch area inside 300 feet by the patch area greater than 300 feet away from a stream. (Inside 300 / outside 300 = "connectivity to water" ratio) 3. Deriving the "adjusted connectivity to water" ratio of each type 2 patch. The area inside 300 feet is divided by two to create an adjusted total. The adjusted amount is divided by the patch area greater than 300 feet away from a stream. ((Inside 300 / 2) / outside 300 = "adjusted connectivity to water" ratio) Assigning all type 1 and 2 patches a connectivity to water value of 1 to 3 based on the distribution of their ratios within three classes derived by finding natural breaks using a GIS system.
Connectivity and proximity to other patches	The Connectivity/Proximity value for a patch is calculated as follows: 1. Perform a nearest neighbor operation GIS operation that measures the average distance from each type 1 and 2 patch to other patches within ¼ mile of their perimeters.* 2. Assigning all type 1 and 2 patches a connectivity/proximity value of 1 to 3 based on their distribution within three classes derived by finding natural breaks using a GIS system. *General fragmentation also affects the overall score to a lesser degree. The more fragmented a patch the lower the score.
Habitats of concern and habitats for unique and sensitive species	A habitat of concern is a unique or unusually important wildlife habitat area. They are identified based on site-specific information provided by local wildlife or habitat experts. Habitats of concern can be smaller than 2 acres, and will be included in the inventory if falling into one or more of the following categories: Any patch specifically identified as a Priority Conservation Habitat by ODFW, USFWS, or other agencies or local wildlife experts. Priority conservation habitats are Oregon white oak savannas and woodlands, native prairie grasslands, wetlands, and bottomland hardwood forests. Any patch of natural land cover identified by ODFW, USFWS, or other agencies or local wildlife experts as a riverine island or delta important to wildlife. Specifically delineated habitat areas that provide life-history requirements of sensitive, threatened or endangered wildlife species or Great Blue Heron rookeries (for example, nesting habitat for an existing population of native turtles); habitats that support at-risk plants; or habitats that provide unusually important wildlife functions, such as major wildlife crossings/pathways or a key migratory pathway, such as an elk migratory corridor.

[7] Type 1 patches are defined as any forest landcover, forested wetland, or nonforested wetland with a total combined size greater than 2 acres. Where different cover types are contiguous they are considered to be part of a single larger patch. Type 2 patches are defined as any shrubland/scrubland or grassland/open soils landcover in a tract greater than 2 acres, within 300 feet off a surface stream.

[8] The Jenkins method for finding natural breaks was used. This method creates classes based on natural groupings of data values. Features are divided into classes whose boundaries are set where there are relatively big jumps in the data values.

[9] A source of water is defined as any surface river or stream, wetland, or other water body.

The scoring range within each criterion was determined by natural breaks in the data, as identified by the Jenk method; this method creates classes based on natural groupings of data values. Field data confirmed that the breaks were logical, justifiable, and provided a means of differentiating sites from one another based on model criteria and ecological value.

The scores are additive for any given habitat patch and reflect relative wildlife habitat value for each of the habitat patches identified on the map. A habitat patch may receive a score from 1-3 for each of the four model criteria, for a maximum of 12 possible points (four criteria times three points; see Appendix 5). However, in reality the highest score was ten and the low score was two due to the interactions of the criteria (for example, very large patches tend not to have as high a rating for water availability per unit area). Scores were adjusted downward one point to allow for an easily understandable point range of 1-9.

An example of Metro's mapping technique can be illustrated by examining the ecological function of interior habitats (see Metro's Technical Report for Fish and Wildlife Habitat, April 2005). Edge effects are the detrimental effects associated with the edge of a habitat patch, including human disturbance, non-native species invasion, reduced food resources, increased wildlife mortality and decreased bird nest success. Interior habitat is the part of a habitat patch that is sufficiently distant from the edge such that negative edge effects are reduced or eliminated.

The scientific literature indicates a wide range of edge effect distances, depending on such factors as what species or what effect is being examined and geographic location. Edge effects may be stronger in urban areas because of the high contrast between natural and human-associated environments. In the Portland metro region, research shows that non-native bird and plant species are substantially reduced beyond 200 ft from the edge of a habitat patch. Based on this data, Metro used GIS mapping technology to construct a 200-ft buffer to the interior of forest and forest/wetland habitat patches. The acreage of interior habitat was calculated for each patch; many long, linear patches contained no interior habitat and fell within the lowest point category. Interior-containing patches of the same size but different shapes may receive 2 or 3 points, depending on how much interior habitat is in the patch.

Metro's methodology for mapping wildlife habitats has undergone extensive public review. The methodology was first applied to three nine square mile study areas: Bronson Creek, Johnson Creek, and Wilsonville. These study area maps were presented to Metro's Natural Resources Committee in May 2001. After a period of extensive public review, Metro Council adopted the methodology as part of Resolution 01-3087A (Appendix 3) and directed staff to produce maps applying the methodology on a regional basis.[10]

Metro's model accounts for edge effects and habitat quality, as verified by scientific fieldwork conducted in 2001. The habitat attributes positively associated with increasing scores[11] in Metro's GIS model include:

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[10] Review included the Goal 5 Technical Advisory Committee, Metro Technical Advisory Committee and Metro Policy Advisory Committee.

[11] For more detailed statistical findings, see Metro's Riparian /Corridors Inventory (Metro 2002).

- More downed wood and logs
- More food resources
- A wider variety of food resources
- Food availability over longer periods
- Fewer non-native trees
- Fewer non-native shrubs
- Fewer non-native herbs
- Increased structural diversity
- More wildlife cover available throughout the year
- More nesting and denning sites (snags, root wads, rocky crevices, etc.)
- Less human disturbance onsite or nearby
- Better wildlife diversity onsite
- More year-round availability of water
- Healthier stream channel morphology
- More vegetative cover near water sources
- More types of water resources (streams, wetlands, etc.)

Thus, the wildlife habitat model does account for habitat quality.

Species and Habitats of Concern

To identify wildlife habitat in a biologically meaningful way, habitat must be linked to wildlife use. In 2001 Metro created a species list of all vertebrates typically occurring in the region on a yearly basis (Appendix 7). The species list is based on the opinion of more than two dozen local wildlife experts, and links species to habitat types via species-habitat associations based on Johnson and O'Neil's (2001) scheme. The purpose of Metro's Species List is threefold:

1. To identify fish and wildlife species that occur in the Metro region.
2. To identify the relative importance of various types of habitat to fish and wildlife species.
3. To describe the biodiversity of the Metro region.

There are 294 known native vertebrate species in the Metro region. Ninety-three percent use riparian areas, with 45 percent dependent on those areas to meet life history requirements. Eighty-nine percent of all terrestrial species in the Metro region use upland habitats, with 28 percent depending on these habitats.

In the Metro region several species of wildlife species are listed as threatened under the federal and state Endangered Species Acts. There are also numerous species that are identified as at risk both by the state and federal agencies. However, in this region we still have substantial wildlife habitat worth protecting and restoring for the purpose of retaining existing species and preventing future ESA listings.

The Goal 5 rule states that the wildlife habitat inventory process shall contain, at a minimum, threatened, endangered, and sensitive wildlife species habitat information; sensitive bird site inventories; and wildlife species of concern and/or habitats of concern identified and mapped by ODFW. For each resource site Metro has gathered existing and new data on sensitive species sighting locations, sensitive bird sites, and wildlife species and habitats of concern; linked sensitive wildlife species to their habitat needs; and estimated the amount of potential habitat available. These procedures are described in the following section.

Species of Concern: data sources, limitations and applications. Metro has gathered information from a variety of knowledgeable sources including ODFW, ORNHP, Metro Parks and Greenspaces, Audubon Society of Portland, local wildlife experts, and our own fieldwork that documents known sensitive species sightings, sensitive bird site inventories, and wildlife species of concern (hereafter termed "Species of Concern"). The current Species of Concern inventory includes a total of 344 sightings, including 43 sensitive plant locations included at the request of USFWS. About a quarter of these sightings are from our own data, a third each from ODFW and ORNHP, and the remainder from a variety of local experts. Note that many of these sightings fall outside of designated resource sites, reflecting the importance of the natural lands surrounding the urban region. These sightings were mapped as a GIS coverage that can be overlaid on the existing wildlife habitat inventory. When possible, species sightings were linked directly to a wildlife habitat patch in the current inventory, but in many cases this was not possible due to lack of data precision. For this and other reasons described below, there are limitations to the data and its availability. Thus in this Goal 5 inventory we present Species of Concern data in a non-specific manner by resource site, listing what is known to have been sighted within the watershed(s). We also estimate the amount of existing habitat for sensitive species. This is consistent with the Goal 5 rule, which requires sensitive wildlife species *habitat* information. Where sufficient information was available, we also mapped specific areas known to provide critical habitat to a sensitive species, and these are included as one type of "Habitats of Concern" (described below).

Sensitive species data for the metro region is sparse and has not been systematically collected for all species by any entity. There are good reasons for the lack of data; first, it would be prohibitively expensive to scientifically conduct biologically valid surveys for the region and would take more resources than any one agency has at this time. It would also be very time-consuming, probably taking years to accomplish even with adequate financial resources. In fact, although our data sources extended back as far as the 1800s, we included only species sightings since the inception of the Goal 5 rule in the early 1970's. Second, sensitive species are rare and difficult to detect by nature, making such surveys even more difficult. The most appropriate types of surveys would measure reproductive success and species-habitat associations, and these are very intensive types of studies in which researchers are typically only able to consider one or a few species at a time. Third, habitat patches not preserved as parks or open spaces typically contain multiple tax lot owners. Permission would need to be gained in advance to inventory each patch, and not all landowners would be willing to give such permission. As a result, sensitive species sightings would be biased towards public lands, but public lands are already protected to varying degrees thus are not as vulnerable to loss compared to unprotected lands. Fourth, such surveys may be limited to one or two seasons of the year, depending on the suite of species. For example, ODFW has identified the entire group of Neotropical migratory songbirds as a sensitive group in the Willamette Valley (Goggans and Boulay 1999), but these species only breed here, migrating south of the US border to overwinter. Adding further difficulty, some sensitive species information may not be generally released to the public due to potential harm to sensitive wildlife species, thus greatly complicating protection schemes.

Although these drawbacks limit the existing data's appropriateness in judging the relative value of different habitat patches, such data can provide useful information for sensitive species management within each resource site by linking sensitive species' habitat needs to the amount of available habitat.

Metro's Vertebrate Species List (Appendix 7) includes state, federal, and Oregon Natural Heritage Program (ORNHP) sensitive species status information, as well as species-habitat relationship information for each sensitive species based on Johnson and O'Neil's (2001) information. The section below entitled "Sensitive species accounts" provides a brief species account for each sensitive species. The steps for including Species of Concern sightings in the inventory were as follow:

1. Use Metro's Vertebrate Species List to identify Species of Concern known to occur in the region, and the habitat(s) with which each species is closely associated.
2. Gather sensitive species data from knowledgeable sources, including: ODFW, USFWS, Oregon Natural Heritage Program, and other sources of field data.
3. Map Species of Concern sightings using GIS. Use a 3-tiered coding system to indicate how certain we are that the species was actually detected in a particular habitat patch. In the inventory narrative, indicate which Species of Concern have occurred in each resource site since 1972 (the 1972 cut-off was selected by consensus of the Goal 5 Technical Advisory Committee; this time frame generally matches the inception of the Goal 5 rule).
4. Crosswalk habitat patches contained in the Wildlife Habitat inventory with Johnson and O'Neil's (2001) habitat classification scheme to obtain a generalized estimate of the amount of each habitat type available within each resource site.

Of the 48 extant (still existing in the metro region; seven more are extirpated) non-fish species on the Species of Concern list, 73 percent are habitat specialists (most often riparian, oak or grassland). Specialization on a habitat type is indicated by a double XX in the Habitat Type column of Appendix 7. Of those sensitive species that are not considered habitat specialists, most depend on large wood or snags, resources that tend to decline in small habitat patches and in urban areas (Cline and Phillips 1983; Booth et al. 1997; May et al. 1997; Maser et al. 1988).

Evidence links sensitive species declines to sensitive habitat declines in our region. For example, native grasslands have virtually disappeared from the metro region, and birds depending on this habitat show substantial declines over the past several decades (Table 8). However, although long-term (since 1966) population trends for bird species are available through Breeding Bird Surveys (Sauer et al. 2001), many sensitive species in the metro region now occur in numbers too low to estimate trends through this source. Nonetheless, changes over time can be detected for species still occurring in sufficient abundance to allow estimation, and trends for the Portland-area route may be compared with statewide trends, as shown in Table 8. Note that these population trend changes are *per year* – some of these declines over the long term are quite precipitous; for example, California Quail Breeding Bird Survey detections are declining at an average rate of nearly eleven percent per year. These trends can be viewed on the following USGS website:

http://www.mbr-pwrc.usgs.gov/bbs/bbs.html

The route for the Portland metro region is ORE-002, Tualatin. It cuts a 24-mile swath through the central/south-central Portland metro region; birds are surveyed each year at the same points, every half mile.

Table 8. Long-term Breeding Bird Survey trends for grassland specialists occurring in the metro region. Trends represent percent change per year.

Species	Portland region trend (% decline per year)	Statewide trend (% change per year)
California Quail	-10.6	No significant change
Common Yellowthroat	-3.5	+ 3.6
Vesper Sparrow	Numbers too low to estimate	No significant change
Savannah Sparrow	-6.3	No significant change
Western Meadowlark	Numbers too low to estimate	No significant change
Ring-necked Pheasant*	-8.0	-2.0

* Breeding Bird Survey trends from 1966 through 2000 (statewide trends through 1999).
** Non-native species included to illustrate effects of habitat loss.

Species trends in the Portland area compared to statewide trends confirm that as a group, grassland-dependent bird species are faring poorly in the metro region, both in their own right and compared to statewide trends. Vesper Sparrows were last detected during Breeding Bird Surveys in 1988, and Western Meadowlarks, Oregon's state bird, were last detected in 1968. These birds were formerly relatively common breeders here. Agricultural lands are typically where grassland-dependent species may presently be found in our region, adding to the importance of retaining low-structure vegetation within 300' of waterways in the regional wildlife habitat system.

Sensitive Species Accounts

Below is a brief account of the habitat needs and reason(s) for sensitive status for each sensitive species on Metro's list, synthesized with permission from ODFW, USFWS, The Nature Conservancy, and NatureServe Explorer (featuring data derived from state Natural Heritage Program conservation data centers). Species' scientific names are given in Metro's Vertebrate Species List (Appendix 7). At the time of this writing a new "Birds of Oregon" book is being compiled by David Marshall, and a partial draft list of Oregon species accounts is available online at http://www.osu.orst.edu/pubs/birds/bogr/accounts.htm. Further wildlife information may be obtained via Johnson and O'Neil (2001).

Cope's Giant Salamanders need streams and seepages in moist conifer forests. Restricted distribution and habitat destruction, as well as potential demand by collectors because of rare status, are listed as reasons for sensitive status (ODFW 1996). Habitat specialist: riparian wetlands.

Cascade and Columbia Torrent ("Seep") salamanders need cold clear springs and small headwater streams (especially those associated with old-growth forests). Very sensitive to microclimate conditions, and die if they dry out. ODFW cites lack of adequate protection for headwater streams and spring habitats as a reason for sensitive status, commenting that this may result in extinctions. Effective conservation of this species should include headwater riparian buffers (ODFW 1996). Habitat specialist: riparian wetlands.

Clouded Salamanders occur in forests and forest openings, especially those created by fire. They occur under loose bark in decayed snags and logs, and ODFW cites loss of snags and large woody debris and older forest structures as a reason for their decline (ODFW 1996). This species is not a habitat specialist but relies on specific habitat elements, including large wood.

Oregon Slender Salamanders are most common in mature and old-growth forest, but also occur in second growth. These salamanders are associated with dead and decaying wood; they also occur on talus areas. Loss of snags and large woody debris and habitat fragmentation are cited as reasons for sensitive status (ODFW 1996). This species is not a habitat specialist but relies on specific habitat elements, including large wood.

Western Toads occur in humid areas with dense cover, and rely on damp woody debris or burrows during dry weather. They breed in springs, ponds, shallow areas of lakes, and slow moving streams. Possible causes for decline include increases in UV-B radiation or pathogenic funguses, according to ODFW. Given their life history requirements, it is also likely that loss of large woody debris and microclimate changes associated with loss of riparian forests negatively affect this species (ODFW 1996). Habitat specialist: water, herbaceous and riparian wetlands.

Tailed Frogs take about 12 years to reach reproductive maturity, the longest development period of any frog. These animals require cold, fast-flowing perennial streams in forested areas. Adults feed on invertebrates from rocks and downed logs near streams, and are only active during periods of very high humidity. This species has the lowest known temperature requirements and the narrowest temperature ranges of any of our region's frog species. Reasons cited for population declines are environmental changes, including sedimentation and water temperature increases; they disappear from logged or disturbed areas, presumably due to water temperature and microclimatic changes causing local extinctions. These problems are exacerbated by habitat fragmentation. Conservation efforts should include elimination of timber harvest adjacent to aquatic habitats used by these animals, and provision of buffer strips along streams (ODFW 1996). Habitat specialist: riparian wetlands.

Northern Red-legged Frogs inhabit marshes, ponds, and streams with little or no flow, and use seasonal waters if wet until late May or early June. Stems below the water line are needed for egg attachment. These frogs often use dense hardwood stands with heavy ground cover. Possible causes cited for decline include displacement by introduced bullfrogs and pesticide and herbicide runoff (ODFW 1996). Habitat specialist: water, herbaceous and riparian wetlands, westside lowlands coniferous-hardwood forests.

Oregon Spotted Frogs (extirpated) are a highly aquatic species that is now absent from the western side of the Cascade Mountains; they disappeared from the Willamette Valley in the 1950's. It was once common here, and may still occur in isolated sites in western Oregon or Washington that lack bullfrogs. These animals require marshy pond or lake edges, or algae-covered stream overflow pools; in our area they occurred along the edges of slow-moving streams. Their extirpation coincides with the introduction and spread of bullfrogs, which probably predate tadpoles and adults. They are sensitive to toxins (ODFW 1996). Habitat specialist: water, herbaceous and riparian wetlands.

Painted Turtles are one of two native Pacific Northwest turtles, and require slow-moving or still, shallow waters with soft bottoms, basking sites, and an abundance of aquatic vegetation. They may colonize seasonally flooded areas near permanent water. Nesting occurs in soft soil in open areas up to several hundred yards from water. These animals need floating logs for basking sites. Possible reasons for decline include lack of recruitment, possibly due to hatching predation by bullfrogs; habitat destruction; declines in the quality and quantity of wetlands; and human actions including shooting and collecting. Nonnative turtles such as Red-eared sliders pose a threat in terms of transmitting pathogens. Conservation measures should include keeping habitats as free of bullfrogs and carp as possible, prevention of shooting the animals, and prevention of the release of nonnative turtles (ODFW 1996). Habitat specialist: water, herbaceous wetlands.

Western Pond Turtles in our area are the Northwestern subspecies. They require marshes, sloughs, oxbows, ponds, vernal pools, slow-moving sections of rivers and streams, and some reservoirs. They need basking sites such as floating logs, plants, and vegetation mats, as well as rocks, and mud banks. They may hibernate in soil or duff up to 1,600 feet from water; egg-laying may occur up to 1,300 feet overland, with holes dug in moist soil, typically in clayey soils with sparse grass/forb vegetation. Reasons cited for decline may include nest destruction from farm and development practices and aquatic, riparian, and upland (nesting) habitat destruction. Dams, drainage, channelization, and other hydrologic alterations are other possible reasons, generally resulting in simplified riparian ecosystems. Carp, which eat native plants, and reed canary grass invasions are other reasons cited, as well as mortality due to humans from shooting, cars, collection, and an upper respiratory disease. Conservation measures include those cited for Painted turtles (ODFW 1996). Habitat specialist: water, herbaceous and riparian wetlands.

Sharptail Snakes need conifer forest or oak-grassland edges, often near streams or damp areas of stable talus slopes. They may be found in moist rotting logs, moist talus, and under rocks, boards, or other objects. They feed on slugs. These reptiles are rare, declining, and now occur only in isolated populations, putting them at risk of large-scale extirpation. Reasons cited for decline include habitat destruction through urban development, logging, and other land use practices that reduce or destroy decaying logs and other cover (ODFW 1996). This species is not a habitat specialist but relies on specific habitat elements, including large wood.

Horned Grebes regularly occur inland during migration, but are not known to breed in our area. The need marshy areas and wet meadows. Reasons cited for decline include extremely limited population numbers and unstable breeding area conditions. Habitat specialist: water and herbaceous wetlands (ODFW 1996). BBS population trends: Portland route and statewide: insufficient data. US: no significant change.

California Condor occurred in the distant past in Oregon, as detected by the Lewis and Clark expedition. During the Pleistocene era (10,000 to 100,000 years ago) the condor ranged throughout the west; with the extinction of the large Pleistocene Era mammals, condors declined in range and numbers. Another large decline occurred when European settlers arrived on the West Coast, and accelerated during the gold rush of 1849. Current captive breeding and reintroduction programs are underway. Habitat and prey loss, power line deaths, and toxins are implicated in their extirpation. There are currently 58 birds in the wild, and first wild-laid condor chick in 18 years hatched successfully this year (USFWS 2001). No BBS data.

Dusky Canada Geese are medium-large, very dark geese and comprise one of seven subspecies of Canada Goose wintering in western Oregon. They do not breed here, but regularly overwinter in the Willamette Valley. These birds feed in pastures and certain agricultural crops, and rest on water rather closer to brush and trees than other subspecies. Reasons cited for this subspecies' decline include low population numbers, poor recruitment due to predation on the nesting area, and hunting mortality. Management issues have arisen due to conflicts between all Canada Geese and agricultural uses. Hunting restrictions are currently in place (ODFW 1996). Habitat specialist: water, herbaceous wetlands, agricultural lands. No BBS data for subspecies.

Aleutian Canada Geese are another subspecies of Canada Geese; they use the Willamette Valley and Sauvie Island as stopover habitat, and some may winter in western Oregon. In the Willamette Valley, they use pastures and croplands that are in grasses and grains. These birds were federally listed as endangered in 1967, but reclassified to threatened in 1990; a recovery plan has been in place for some time, and included establishment of the Nestucca Bay National Wildlife Refuge on the Oregon Coast. Numbers of the western population have been built up.

The primary reasons cited for their decline is predation by introduced foxes in their northern breeding grounds (ODFW 1996). Habitat specialist: water, herbaceous wetlands, agricultural lands. No BBS data for subspecies.

Harlequin Ducks migrate between turbulent mountain streams and the ocean. Pairs have been observed during the breeding season in the Clackamas River. These birds need clean, fast-flowing water with an abundance of riffles and rapids and a mixture of rocky stream bottoms. The eat macroinvertebrates. They nest beneath multi-layered forest canopies in a variety of forest ages. They seem to prefer streams with minimal human activities. This species has low population numbers and low reproduction rates. Potential reasons for decline include forest removal, road building, and other disturbances resulting in altered hydrology, because these birds nest near water and need good macroinvertebrate communities in the stream (ODFW 1996). Habitat specialist: water, riparian wetlands. No BBS data.

Bufflehead are rare breeders in Oregon and the sensitive status only applies to the breeding population; it is unlikely that they breed in our area. They winter throughout the state. During breeding season they require deep water lakes in montane forested areas; during winter they use lowland lakes and estuaries. They are a cavity-nester. Reasons for decline include low population numbers, shortage of natural cavities (loss of snags), and perhaps recreational activities. They will use artificial nest boxes (ODFW 1996). Habitat specialist: water, herbaceous wetlands. BBS population trends: Portland route insufficient data; statewide no significant change; US no significant change.

Barrow's Goldeneyes, like bufflehead, are only considered sensitive during breeding and likely do not breed here. They use montane lake habitats most of the year in Oregon. They are cavity nesters and consumer invertebrates. They are sensitive due to low population numbers combined with reliance on cavities for nesting. They will use artificial nest boxes (ODFW 1996). Habitat specialist: water. BBS population trends: Portland route and statewide, insufficient data; US no significant change.

White-tailed Kites are included here because they appear to be undergoing a range expansion to our area, and now occur in the Willamette Valley with some regularity. In the US, this species was nearly extinct by 1930 or earlier, but has now reoccupied parts of its range, with Oregon breeding records beginning in 1977. These birds prefer savanna, open woodlands, marshes, and agricultural fields, where they typically nest in trees near a marsh. They are not on the state or federal fish and wildlife agencies' at-risk species lists, but are listed as "critically imperiled" during the breeding season by the Oregon Natural Heritage Program (NatureServe Explorer 2001). Habitat specialist: agricultural lands. BBS population trends: Portland route and statewide, insufficient data; US no significant change.

Bald Eagle immatures are often mistaken for Golden Eagles, because they do not attain white heads and tails until they are four or five years old. There are numerous recent breeding records in our area. During breeding season they need large, fish-supporting water bodies with large trees nearby for nesting. These trees are typically within a mile of water and are among the tallest in a stand. They return to the same nest area year after year. Habitat loss, PCB contamination, and residues from the pesticide DDT (now banned but still present in the Willamette Valley) are some of the reasons for this species' decline. DDT residues bioaccumulate in fat, and because Bald Eagles are high up in the food web they accumulate more of this poison, which prevents calcium uptake and results in egg-crushing during incubation. This remains a problem on the lower Columbia River. Many birds are also shot (ODFW 1996). Habitat specialist: water. BBS population trends: Portland route, insufficient data; statewide insufficient data (but trend looks positive); US +10.6%/year.

Northern Goshawks are found in a variety of mature forests, and nest in areas with dense overhead foliage or high canopy cover created by tall trees (typically old-growth). They occur in the Willamette Valley during migration and winter, where they sometimes migrate over or stop in non-forested habitats. They appear to need large habitat patches, and that combined with the need for old-growth forest are likely factors in their decline. Pesticides and human disturbance are also implicated (ODFW 1996). This species is not a specialist as defined in our habitat scheme, but depends primarily on mature and old-growth forest. BBS population trends: Portland route insufficient data; statewide –14.3%/year; US no significant change.

Merlin are a widespread species of falcon that migrate from the north to overwinter in the Willamette Valley, typically in agricultural areas. Although not listed as at-risk by the state or federal wildlife agencies, this species is identified by the Oregon Natural Heritage Program as imperiled in Oregon during the breeding season. Merlin were known to breed historically in our area, but modern-day breeding here is unconfirmed. Merlin have been negatively impacted by pollution, including organochlorine pesticides such as DDT; populations in some areas of the US are now increasing. Habitat loss is also implicated in their population declines (NatureServe Explorer 2001). This species is not considered to be a habitat specialist. BBS population trends: Portland route and statewide, insufficient data; US no significant change.

American Peregrine Falcons are, happily, recovering in our area and now regularly nest on certain Portland bridges, where they catch and eat other birds, especially pigeons. The banning of certain pesticides and carefully planned reintroduction have greatly aided their recovery here. In the Pacific Northwest, they also nest on natural shelves, ledges, and potholes. Their habitat needs are extremely variable. As with Bald Eagles, they are high in the food web and are vulnerable to toxins; these birds were nearly extirpated from the lower 48 states, and their continuing recovery is largely attributed to the ban of organochlorine pesticides such as DDT (ODFW 1996). This species is not considered to be a habitat specialist. BBS population trends: Portland route and statewide, insufficient data; US + 54%/year.

Mountain Quail are largely extirpated from the metro area, although there have been one or two undocumented reports of recent occurrences in the west hills (per Eric Scheuering, Oregon Natural Heritage Program). They prefer hilly, shrubby habitats during the breeding season and usually nest within a few hundred meters of water. These birds are the only seasonally migratory quail in the US, often moving into the lowlands for winter. Declines in northwestern Oregon are suspected, but undocumented; they are still hunted in western Oregon (NatureServe Explorer 2001). The reasons for their present scarcity are not clear. This species is not considered to be a habitat specialist. Portland route: insufficient data. Statewide and US: no significant trend detected.

Band-tailed Pigeons are a large, beautiful native woodland pigeon that tend to use montane coniferous forests and oak woodlands. These birds need mineral springs and mineral graveling sites, especially during nesting, and display strong site fidelity to both mineral and nest areas. They move around based on food availability, and although forest nesters they often forage in towns and agricultural areas, sometimes visiting backyard feeders. Pacific Coast populations have declined steeply, losing an estimated 60% of the population in the last three or four decades. Declines are likely associated with widespread changes in forest landscapes and hunting that continues today; low reproductive rates are also a factor. More studies are needed on this sensitive species (NatureServe Explorer 2001). Habitat specialist: riparian wetlands, westside lowlands coniferous-hardwood forests, oak. BBS population trends: Portland route –3.7%/year; statewide –1.8%/year; US –2.4%/year.

Northern Pygmy Owls are charming little owls about the size of the robin – which they eat, along with other birds and a variety of small mammals, reptiles, and insects. They are unusual for an owl in that they are primarily daytime animals. They are most common along forest edges and openings, and nest in tree cavities. They may be sensitive to habitat patch size and that, combined with their dependence on woodpecker-excavated snags and mixed-age forests, probably contribute to their decline (ODFW 1996). Habitat specialist: westside lowlands coniferous-hardwood forests. Portland route: no data; statewide: insufficient data; US: +3.6%/year.

Northern Spotted Owls are extirpated from our area due to declines in habitat quality, quantity, and increased fragmentation. They are generally associated with old-growth forests and need uneven-aged, multilayered canopies. It is unlikely that they will re-occur here unless their habitat needs change or unless we are able to provide large, old-growth forest patches in the future. (ODFW 1996) No BBS data.

Common Nighthawks were once quite common in our area, but are virtually extirpated as a breeding species now. Nighthawks undergo one of the longest migration distances of any North American bird. Preferring open (often aquatic) habitats with abundant aerial insects, these birds formerly nested on graveled rooftops in the Portland area, but this dropped off precipitously by the 1980's. Nighthawks historically nested on gravely islands of the Willamette River, and may still nest on large riverine islands today (per Birds of Oregon website cited above). Riparian habitat loss, insecticides, loss of nesting substrate (river islands and gravel rooftops), car collisions, and the spread of crows (nest predators) into urban areas are possible reasons for their decline here (NatureServe Explorer 2001). This species is not considered to be a habitat specialist in the Johnson and O'Neil scheme, but individuals are often found near water.

Lewis' Woodpeckers are considered sensitive only to breeding populations, and are now extirpated as a breeding species in our area, but in the past were summer residents in every part of the state. They are sometimes associated with post-burn areas. These birds are declining throughout their range, probably due to oak/Ponderosa pine and cottonwood habitat loss; they need open areas for foraging (they often flycatch) and large trees for nesting. Nest-site competition from European Starlings, fire and flood control are also probably factors (ODFW 1996). Habitat specialist: oak.

Acorn Woodpeckers are oak-obligates, requiring forests with at least an oak component. They need open areas under a high canopy; park-like development in oak groves with the lower vegetation layers removed actually provide desirable habitat for this species. These birds store acorns in excavated holes in thick bark or soft dead wood. They also flycatch and sap-feed. Their presence is well-known at Pacific University in Forest Grove; although the species is declining, the populations here are actually a result of a northward range expansion over the past 40 years. The large oak trees required for this species are hundreds of years old, and most of the oak habitat in our region has been lost. Urbanization is implicated (ODFW 1996). Habitat specialist: oak.

Pileated Woodpeckers, the largest of Pacific Northwest woodpeckers, are widespread but declining. They are considered an indicator species for mature and old-growth national forests in Oregon, although they also use younger forests at times. They require a very large area for nesting and foraging. In western Oregon this species can forage in forests greater than 40 years old, but need 70-year old forests for nesting or roosting, a likely reason for their decline, along with habitat loss and fragmentation. They require an abundance of logs and snags for foraging, another likely reason for their decline (ODFW 1996). This species is not a habitat specialist but relies on specific habitat elements, including large wood.

Yellow-billed Cuckoos, relatives of the familiar roadrunner, were formerly common along the Columbia River west of the cascades, but they are extirpated from our area now. Western states populations' have nearly completely collapsed. These birds need large riparian forests, especially those with cottonwood overstories and willow understories; such formerly extensive habitats are largely vanished from the metro area at present, and where cottonwood is present it tends to be invaded by nonnative blackberries rather than willow. Habitat loss is the most likely reason for their decline. These losses are attributed to conversion of riparian habitats to urbanization, agriculture, drainage, grazing, and disconnection from or development of the floodplain (cottonwoods are typically floodplain-associated). Pesticides and insect control may also be factors (ODFW 1996). Habitat specialist: riparian wetlands.

Olive-sided Flycatchers' "quick-three-beers" song is familiar to many birdwatchers. These birds nest along the edges of lakes, rivers, and beaver meadows and in open forest sites that have been cleared or burned. In our area they are typically found in a large habitat patch with older trees on the edges, a clearing in the middle, and one or more tall snags on which to perch and flycatch. They are widespread across North America and are declining substantially throughout their range. These are one of our longest distance migrants and as such, typically only get one chance at nesting because they arrive late and leave early. Potential causes for this species' decline include fire suppression, urban development, and deforestation along migration routes and on wintering grounds (The Nature Conservancy 1998a). Habitat specialist: westside lowland coniferous-hardwood forests. BBS population trends: Portland route –10.3%/year; statewide –5.0%/year; US –3.8%/year.

Willow Flycatchers are strongly associated with brushy riparian areas of willow and similar shrubs. They breed in our area along streams and other aquatic habitats, and are known to migrate along habitats similar to their breeding sites. They are susceptible to Brown-headed Cowbird parasitism, which reduces reproductive success. Habitat destruction and fragmentation are through to be the principal causes of decline in the west (The Nature Conservancy 1999b). Habitat specialist: riparian wetlands. BBS population trends: Portland route –8.6%/year (the data graph shows a steady decline to zero by 1996); statewide –5.6%/year; US –1.3%/year.

Streaked Horned Larks are grassland obligates, and the nearly complete loss of native grasslands in our area are the most likely reason for their decline here. They were formerly very common breeders in western Oregon, but are now severely depleted in population numbers and are virtually extirpated as a breeding species in the metro region; a few do breed here in very specific areas, and a few also winter here. The sensitive status only applies to breeding populations of this subspecies. These birds need sparsely vegetated open fields, and don't mind inhabiting disturbed areas such as overgrazed pastures; they dig a nest cavity in dry ground with sparse vegetation. Urban development and changes in farming practices are cited as likely reasons for this species' decline; for example, many former pastures are now producing grass seeds, and high nest mortality may result from farm practices such as mowing (ODFW 1996). Habitat specialist: grasslands.

Purple Martins are large, colony-nesting swallows that live along rivers and other water bodies and migrate south for the winter. They require unobstructed airspace to capture high-flying insects. They are cavity nesters and readily nest in artificial nest boxes; at present, the majority in our area are here because of nest boxes. Competition from other species – for nest cavities and foraging space – are among the likely factors for their decline, along with scarcity of nesting cavities. Nonnative European Starlings and House Sparrows probably usurp many suitable cavities prior to this species' arrival on the breeding grounds (ODFW 1996). Habitat specialist: water.

Western Bluebirds are considered a sensitive species in western Oregon interior valleys during the breeding season. This formerly common species has declined dramatically over the past seven decades, and is now confined to scattered sites of suitable habitat with artificial nest boxes. Through efforts such as the Prescott Bluebird Recovery Project in our area, the number of young bluebirds fledged per year has risen steadily over the past five years, with over 1,700 young fledged in 2001 due directly to citizen efforts. Bluebirds are cavity nesters, and their initial decline coincides with the spread of the more aggressive European Starling, which takes over cavity sites. Habitat and snag loss, insect control, and urbanization are other factors implicated in this species' decline (ODFW 1996). Habitat specialist: oak.

Yellow-breasted Chats are the largest of our warblers, and are long-distance migrants. They breed in second growth, shrubby old pastures, thickets, bushy areas, and low wet areas near water sources. They are widespread in the US but are virtually gone from our urban region. Threats to this species include habitat loss due to conversion to agricultural and urban land uses, and cowbird parasitism may also pose a threat. Habitat specialist: riparian wetlands (The Nature Conservancy 1998b). BBS population trends: Portland route –13.0%/year; statewide no significant change; US no significant change.

Oregon Vesper Sparrow is the Pacific Northwest subspecies of the widespread Vesper Sparrow; these birds winter south of the US border. This formerly common species' population is greatly reduced and fragmented, perhaps associated with loss of agricultural lands in our area and changes in farming practices; they are vulnerable to nest loss due to farming equipment. Loss of native grasslands due to urbanization is almost certainly a major factor in their decline here. They still apparently breed here, but only in a very few sites (ODFW 1996). Habitat specialist: grasslands, agricultural lands. BBS population trends: Portland route numbers too low to estimate; statewide no significant change; US –1.1%/year.

Tricolored Blackbirds are rare in our area, but apparently breed in at least one location. They are a colonial nester. In Oregon, these birds are typically found in cattail marshes or in Himalayan blackberry stands bordering wetlands. Reasons cited for sensitive status are small population numbers combined with inconsistent distribution patterns, making habitat protection difficult (ODFW 1996). Habitat specialist: herbaceous wetlands.

Western Meadowlarks are our state bird and were once quite common in the metro region but sadly, breed here only in very rare cases today. Virtually complete loss of native grasslands in our area has depleted this species. Farming practices are also implicated in this insect-eating, ground-nesting species, as is predation by birds and mammals. They appear to be prone to cowbird parasitism. Habitat development for these birds should include providing a variety of grassland types and heights, sparse woody cover, and high forb and grass cover. Protection of known nesting areas should be a priority wherever this species breeds in our area (The Nature Conservancy 1999a). Habitat specialist: grasslands, agricultural lands. BBS population trends: Portland route insufficient data (last occurred during 1968 survey); statewide no significant change; US –0.5%/year.

Yuma Myotis in western Oregon consists of a subspecies, *Myotis ymanensis saturatus*. Apparently widespread in Oregon this species, like many other bat species, will use human-made structures. They occur in urban, riparian, and mature conifer habitats in northwest Oregon, but are particularly associated with water, over which they feed. Little population data is available, and this species' status as a sensitive species appears to be somewhat uncertain. However, this species is especially noisy during rearing of the young, and as a result many colonies have been extirpated or destroyed as pests or through vandalism (ODFW 1996). This species is not considered to be a habitat specialist, although individuals are often seen near water.

Long-legged Myotis in western Oregon consist of the subspecies *Myotis volans longicrus*. As with Yuma Myotis, these bats are widespread in Oregon. In our area they can be found in agricultural, riparian, oak woodlands, and mature conifer forests. Maternity roosts have been found in snags and hollow trees, and maternity and hibernation sites are limited by microclimate (temperature and humidity). This species is listed as sensitive due to absence of information combined with dependence on snags, decadent trees, old and abandoned buildings, bridges, and caves for roosting and hibernacula; most of these components are declining in terms of presence and availability. Human disturbance is also an issue, as is true for all bats that hibernate, because disturbance interferes with energy and fat storage balances during hibernation periods. Riparian protection has also been found to be inadequate (ODFW 1996). Habitat specialist: westside lowland coniferous-hardwood forests.

Fringed Myotis are known to use a variety of habitats including forests, woodlands, and grasslands; nursery colonies and roosts occur in caves, mines, buildings, etc., but more studies are needed to detail their habitat needs. They are considered sensitive due to general rarity and susceptibility to human disturbance (ODFW 1996). This species is not considered to be a habitat specialist, although little is known about life history characteristics.

Long-eared Myotis in our area are the subspecies occurring west of the Cascades, known as *Myotis evotis pacificus*. These bats probably occur statewide in forested and riparian areas, and winter in Oregon, at least in low numbers. Similar to other Myotis species, Long-eared Myotis maternity roosts and hibernation sites occur in buildings, caves and mines. Their status as a sensitive species is somewhat uncertain due to lack of information, but this forest-dwelling bat is likely at risk due to habitat loss, including maternity and hibernation roosts. General dependence on snags, decadent trees, and coarse woody debris also puts them at risk, as does human disturbance. Unlike some other bat species, these bats tend to glean insects off of bark, etc., potentially putting them more at risk due to insecticides than non-gleaners (ODFW 1996). This species is not a habitat specialist but relies on specific habitat elements, including large wood.

Silver-haired Bats are fairly large bats that occur most commonly in forests. These beautiful bats are most abundant in old-growth Douglas-fir/Western hemlock forests and apparently need high snag densities. They roost in cavities in snags, old-growth bark crevices, and similar natural types of habitat; maternity roosts are almost exclusively in cavities and crevices in snags and trees. They forage over water. Silver-haired and other forest bats are assumed to be declining based on habitat loss. In our area, declines in forest cover, snags and large wood, and aquatic habitats are potential reasons for their decline (ODFW 1996). Habitat specialist: westside lowland coniferous-hardwood forests.

Hoary bats are solitary bats except during migration and mother-young associations. This species prefers deciduous and coniferous forests and woodlands, where it needs dense foliage above and open flying room below. Roosts and hibernacula may be found in rock crevices, tree trunks or cavities, and sometimes in a squirrel's nest or moss clump. Females may show high site fidelity. Forested habitat and snag losses are potential reasons for their decline in our area (NatureServe Explorer 2001). This species is not a habitat specialist but relies on specific habitat elements, including large wood.

Pacific Western (Townsend's) Big-eared Bats really do have very large ears, and the subspecies encountered west of the Cascades is *Plecotus townsendii townsendii*. They occur in a variety of habitats across the state, but the fragmented nature of their population reflects habitat fragmentation. This species is declining seriously in Oregon, with population declines of 58 percent west of the Cascades since 1975-85. These bats need undisturbed roost, nursery, and hibernation sites, with specific microclimate conditions. Disturbance and habitat destruction are cited as potential reasons for their decline; population declines are occurring in disturbed sites, whereas protected sites contain stable or increasing populations (ODFW 1996). Habitat specialist: water.

Western Gray Squirrels are the largest native squirrel with the bushiest tail in western states. It is often confused with the nonnative Eastern Gray Squirrel, which is likely much more common here now; to distinguish the two, look for silvery frosting, reddish on the backs of the ears, and general absence of reddish elsewhere on the native squirrel. Western Gray Squirrels occur in mixed age forests dominated by pine and/or oaks, and this habitat is greatly reduced in our area. They do occur in urban areas with adjoining natural habitat, and need connectivity in the canopy layer; they typically occur within 600 feet of water, where they eat pine seeds, acorns and hazelnuts. Washington State is currently considering a threatened status for this species. Reasons cited for this species' decline include very substantial habitat loss, fire suppression causing shifts in forest composition from oak to conifer, competition from nonnative species (particularly in urban areas), and forest fragmentation (ODFW 1996). Habitat specialist: oak.

Camas Pocket Gophers are restricted to the Willamette Valley, where habitat has been substantially altered by urbanization and intensive agriculture. These solitary, relatively short-lived (3-year lifespan) animals are important ecosystem components as prey and because they influence soils, habitat heterogeneity, plant diversity, and soil productivity. They use unforested areas with rich soils in lower elevations, where they build complex tunnel systems. Their limited geographic range, combined with habitat loss/alteration, put them at risk (NatureServe Explorer 2001). Habitat specialist: agricultural lands.

White-footed Voles are a species of mouse occur only in western Oregon (primarily west of the Willamette Valley) and northwestern California. They are probably burrowing animals, but little is known about this extremely uncommon species. They occur in a variety of forest conditions, apparently along streams with an alder component, often in heavy cover consisting of downed logs and/or brush. It is considered at-risk due to its general rarity. In our area it is likely that habitat loss, including loss of large wood, contribute to their rarity (ODFW 1996). This species is not a habitat specialist but relies on specific habitat elements, including large wood.

Red Tree Voles' range is limited to western Oregon and possibly northwestern California, where they are thought to have very limited dispersal capability. This species' optimum habitat is old-growth Douglas-fir, although other coniferous forests may be used. Red Tree Voles are also associated with high percent canopy cover, high stump density, and shorter snags and logs. Presumably their sensitive status is due to loss of formerly widespread old-growth coniferous forests, as well as habitat fragmentation (NatureServe Explorer 2001). Habitat specialist: westside lowland coniferous-hardwood forests, oak.

Habitats of Concern: data sources, limitations and applications.

Unlike Species of Concern, Habitats of Concern may add acreage to the inventory or increase an existing habitat patch's relative value in the inventory. The formal criteria for Habitats of Concern are in Appendix 5, and the list of Habitats of Concern that have been accepted into the wildlife habitat inventory is in Appendix 8. The steps for identifying Habitats of Concern are outlined below.

First, Metro consulted with Oregon Department of Fish and Wildlife, US Fish and Wildlife Service, and other conservation organizations, as well as the Goal 5 Technical Advisory Committee to develop criteria for identifying Habitats of Concern. Based on these consultations, the following three categories were acknowledged as appropriate for identifying Habitats of Concern.

The first category recognizes regionally at-risk, or priority conservation, habitats. These habitats are at risk because they formerly covered much more extensive areas, and they tend to be declining in quality where they still remain. Oregon Department of Fish and Wildlife identifies grasslands, deciduous forests (oak and riparian), aquatic habitats, and urban natural area corridors as the top four Willamette Valley habitats at risk (Goggans and Boulay 1999). The Oregon Biodiversity Project, in which ODFW and USFWS are partners, identifies native prairie grasslands, oak habitats, wetlands, and bottomland hardwood forest as conservation priorities in the Willamette Valley (Defenders of Wildlife 2000). The Oregon-Washington chapter of Partners in Flight (ODFW and USFWS are partners; Partners in Flight 2000) considers grassland-savanna, oak woodland, and riparian forests to be priority conservation habitats. From these sources we conclude that native oak habitats, native grasslands, wetlands, and bottomland hardwood forests are priority conservation habitats. Less than one percent of historic Willamette Valley native oak and grassland habitats still exists. Over 70 percent of the bottomland hardwood forests have been lost. In the Willamette Valley, various sources document wetland losses between 40-57 percent of original, with continuing losses of more than 500 wetland acres per year.

Wetlands are a Habitat of Concern in our area and we have excellent GIS data on this important resource. However, the GIS process used to model wildlife habitat patches set forth a minimum patch size of two acres, resulting in the omission of a substantial number of wetlands smaller than two acres. These small wetlands are known to be disproportionately important to the region's wildlife. For example, small wetlands are often free of non-native bullfrogs, unlike many larger wetlands; bullfrogs routinely eat amphibians and their egg masses, ducklings, and young turtles, as well as competing with native species for food and other habitat resources. To address this modeling drawback we added wetlands less than two acres that were excluded from the Wildlife Habitat modeling process into the inventory as Habitats of Concern. The result is that all wetlands in the wetland data layer – which consists of the National Wetlands Inventory, augmented or corrected by local wetland inventory information received by Metro (Appendix 2) – are included either in the Wildlife Habitat inventory or added as an HOC.

The second category recognizes the extraordinary and unique value of riverine islands and delta areas. Riverine islands and deltas provide unique habitat for migrating and nesting shorebirds, waterfowl, nesting terns and gulls, and other wildlife through enriched food resources, sand and mudflats, and protection from predators and disturbance (Iverson et al. 1996; Elliott et al. 1998; Fleskes et al. 2002). Macroinvertebrate communities are denser and more diverse around river islands and deltas (Thorp 1992). Bald eagles winter, breed, and forage on islands in our area, as strongly indicated by sensitive species data we collected and by researchers elsewhere in the Pacific Northwest (Garrett et al. 1993; Elliott et al. 1998; Watson and Pierce 1998; Parrish et al. 2001). Channel complexity and large wood, which are linked to island formation, have been substantially reduced from historic levels; protecting these areas is vital to maintaining healthy ecosystems and the species that depend upon them (Thorp 1992).

The third category recognizes known habitat patches providing unique or critical wildlife functions. Patches providing unique or critical wildlife functions are submitted and considered on a site-by-site basis for their importance in the inventory. Such habitats include areas that provide unusually important wildlife functions, such as major wildlife crossings/pathways or a key migratory pathway, such as an elk migratory corridor. Also eligible are important migratory stopover areas such as grassy hilltops, inter-patch connectors, and biologically or geologically unique areas such as rocky outcrops or talus slopes important to many herptiles and bats. Habitat vital for the life-history requirements of a sensitive wildlife species (for example, nesting or key passage habitat for an existing population of native turtles) or Great Blue Heron rookeries, or habitats that support at-risk plants, also fall into this category. These habitat areas submitted to Metro must be specifically delineated and submitted by wildlife experts or other knowledgeable parties.

Metro requested Habitats of Concern information through the Goal 5 Technical Advisory Committee, Greenspaces Technical Advisory Committee, ODFW, USFWS, Oregon Natural Heritage Program, and various wildlife experts, parks providers, and local jurisdictions (see Consultations, Table 6). Submitted sites were clearly delineated on a map or described in such a way as to allow precise mapping, and rationale given for their inclusion in the inventory as a

Habitat of Concern. Metro evaluated proposed HOCs based on the criteria described above and in Appendix 5 (see also Appendix 8). Sites or portions of sites that did not appear to meet the criteria were excluded, based on examination of the submitted information, criteria matrix, aerial photographs, and other GIS data resources. The Habitats of Concern maps and data were subsequently provided to local jurisdictions' planning directors for review and comment.

Habitats of Concern were mapped as a separate GIS layer and overlaid on the current (GIS-modeled) wildlife habitat inventory. The assumption is that all Habitats of Concern are, by their relative value or scarcity, high value habitats. A majority of submitted sites were already included in the inventory; in fact, only 1.3% of the entire wildlife habitat inventory consisted of HOCS outside of modeled habitat patches. Most HOCs also scored relatively highly in the model, providing positive feedback to the wildlife habitat modeling process and affirming the importance of these sites. However, some sites that did not score highly in the model – for example, low-structure vegetation along important connectivity corridors – were appropriately identified as highly important wildlife resources, providing a means to test and address potential GIS model shortcomings.

Fieldwork to assess mapping criteria

The Goal 5 rule specifically notes that "existing and available information" drives the inventory process, thus no field studies to validate inventory methods are required. However, Metro has undertaken a research program designed to test the GIS model on which its Goal 5 Inventory is based. Outside funding was required to develop the program and was not obtained until August 2001 (from USFWS), thus only partial findings will be available in time for Metro Council's determination of regional significance. The purpose of this study is to evaluate the model so that Metro can proceed with appropriate conservation, protection and/or restoration measures, and/or to identify potential imperfections in the model that can be corrected or improved. The ultimate goal is adaptive management based on biology.

Briefly, the field studies include three components. The first component relates to the wildlife habitat inventory (analyses completed), and the second and third relate to the riparian corridors inventory (analyses not yet completed).

1) Wildlife Habitat Assessments (WHAs): Metro revised an existing methodology (WHA; Appendix 9) based on extensive input from Oregon Department of Fish and Wildlife, U.S. Fish and Wildlife Service, and the City of Portland (who has extensively used a previous version of the methodology). This assessment relies on a team of biologists walking through a site, discussing its characteristics and scoring it based on the quality of water resources, vegetation (wildlife cover, food, native vs. nonnative plants, and structural complexity), and human influences. The revised method was successfully field-checked against quantitative data collected at 54 study sites in 1999 (Hennings 2001). It was also performed on 102 additional randomly selected natural areas. Abbreviated results for this part of the study and are presented in the next section.

2) Rapid Stream Assessment Technique (RSAT): Metro modified an existing qualitative methodology with help from other experts (e.g., Clean Water Services and Michael Cole of ABR. This procedure also relies on a biological team to measure parameters such as stream bank erosion, sedimentation within the channel, channel substrate composition, etc. It focuses on capturing the deleterious effects associated with urbanization. RSATs were conducted at all B-IBI sites (described next); sites will be scored and the scores compared against GIS model-generated scores to test for correlations with GIS model scores, similar to the statistical analyses employed to check the Wildlife Habitat model. We will also examine relationships between instream conditions and macroinvertebrate communities (see item 3).

3) Benthic Index of Biological Integrity (B-IBI): A B-IBI looks at the composition of the macroinvertebrate communities living at the bottom of a stream, compared to what is found in relatively undisturbed conditions. Macroinvertebrates are useful indicators of instream conditions because different types of macroinvertebrates respond differently to a variety of environmental parameters (e.g. sedimentation, stream temperatures, dissolved oxygen, etc.). Thus what is in the stream, and what is missing, reveals a great deal of information about stream habitat conditions. We sampled invertebrates at 55 sites in the Metro region based on Oregon Department of Environmental Quality's current methodologies; the samples will be analyzed by Dr. Judith Li's invertebrate lab at Oregon State University, but this data will not be available

until a later date. B-IBI scores will be correlated with GIS model scores to test for relationships. Because altered hydrology is known to negatively influence macroinvertebrate communities, we do not expect to see a tremendously strong correlation between B-IBI scores and GIS model scores (research throughout the US shows a typical downward B-IBI trend line with increasing urbanization). However, we hypothesize that sites with high GIS model scores will also receive higher B-IBI scores, after accounting for the level of urbanization in the watershed.

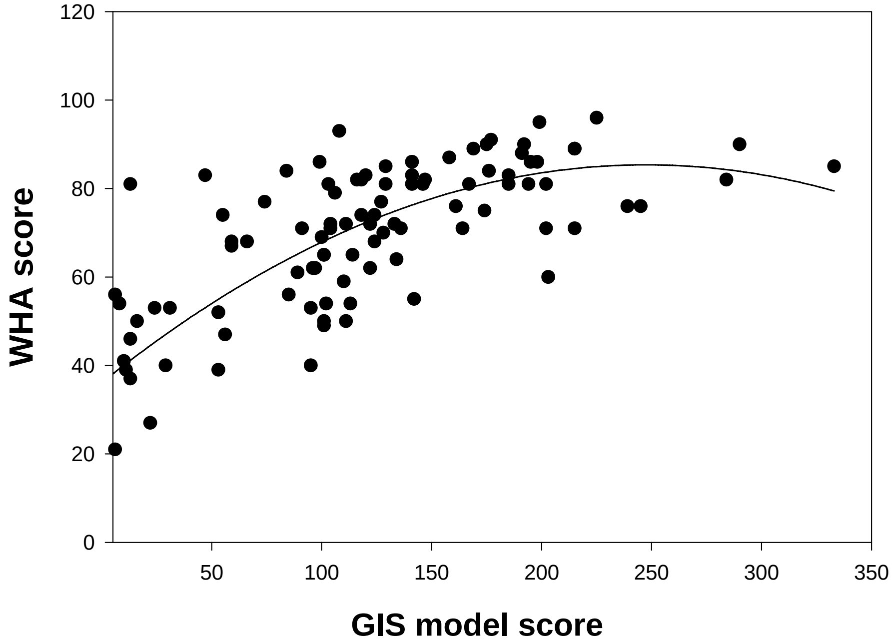
Results of Wildlife Habitat Assessments.
To test the substantially revised WHA protocol (Appendix 9), field crews first assessed 54 study sites for which we had quantitative plant data from 1999 (Hennings 2001). This quantitative data, including structural complexity and the relative amounts of native versus nonnative plants, was distilled into a "megavariable," or a cluster of variables that were statistically related both to one another and to bird communities. As scores for the megavariable increased, bird diversity and species richness increased, while the percentage of nonnative birds decreased. The protocol worked very well, based on linear regression of WHA scores against 1999 field scores ($p < 0.0001$, $r^2 = 0.62$). Thus, the WHA is an appropriate technique to measure the effectiveness of the GIS model in identifying habitat patches important to birds and presumably, other wildlife.

Metro subsequently conducted habitat assessments on 102 randomly selected habitat patches. A predetermined criterion for inclusion in the selection pool was that some part of each patch must include or be adjacent to public lands of some sort, so that field crews would have the ability to access the patch. Field crews also routinely asked for and received permission from landowners to enter the patch.

We statistically assessed (a) WHA scores versus each individual model criterion, and (b) WHA scores versus the model's overall performance. We examined scatterplots and conducted correlation analyses, simple linear regression (for individual variables) and multiple linear regression (for appropriate variable combinations) analyses to determine the significance of each criterion in the GIS model. Except for the species richness criterion, all model variables showed a relatively strong, statistically significant relationship ($p < 0.0001$) with field-based scores. The ONHP species richness criterion was statistically unrelated to field-based scores ($p > 0.1$), possibly due to the large spatial scale at which this data was mapped. The ONHP species richness model is currently being refined, and may well prove useful in the future. Mallow's cP statistic (a variable selection technique) suggested that the most appropriate model included four criteria: habitat patch size, interior habitat, connectivity to other patches, and water resources (Figure 1). The results of these analyses provided input into model refinement.

Field studies also revealed that some habitat patches were poorly defined due to the relatively large (24 m) raster size inherent in the satellite data used in the original model. In such cases we did not conduct WHAs but moved on to the next randomly selected habitat patch that was accurately delineated. However, this revealed the necessity to more accurately define patches based on hand-digitized forest canopy and low-structure vegetation, and the subsequent model version reflected this change.

Figure 1. Wildlife Habitat Assessment (WHA) field-based scores versus revised GIS Wildlife Habitat Model scores (based on size, interior habitat, proximity to other patches, and water resources).



To date Metro has reviewed the scientific literature pertaining to wildlife and habitats in urban ecosystems, created a corresponding model rating existing habitats in the region, and field-tested the model to assess its validity. We have adjusted the model to reflect our findings; the revised GIS wildlife habitat model is ecologically valid based on local field data. The success of the revised model scores in predicting "better" habitats – that is, the good structural complexity, higher percentage of native plants, and good food and water resources associated with enriched native bird communities – allows us to confidently proceed with inventorying the region's wildlife habitats. It provides important information concerning quantity and location of wildlife habitat patches and allows us to differentiate sites based on habitat quality.

Resource site analyses

Definition of resource sites (aggregations of subwatersheds)

The Goal 5 rule defines a "resource site" as "…a particular area where resources are located. A site may consist of a parcel or lot or portion thereof or may include an area consisting of two or more contiguous lots or parcels" OAR 660-23-010 (10). The Goal 5 rule also states that the inventory process may be followed for "a single site, for sites in a particular geographical area, or for the entire jurisdiction or urban growth boundary…." OAR 660-23-030(1). Metro has taken an ecological approach to defining resource sites by delineating subwatersheds and using these geographically specific areas as a focal point (i.e., resource site) for gathering and analyzing information on location, quality and quantity of the resource. A subwatershed is a subdivision within watersheds using the Hydrologic Unit Code (HUC) system, which is described below (see also Appendix 10).

The classic definition of a watershed is any area of land from which water, sediment, and organic and dissolved materials drain to a common point, such as a stream, river, pond, lake or ocean. Watersheds are hierarchical in nature, with small ones nesting within larger ones. In the mid-1970s, the U.S. Geological Survey (USGS) developed a standardized hydrologic unit system, referred to as the Hydrologic Unit Code (HUC) system. A hydrologic unit is a drainage area delineated to nest in a multi-level, hierarchical drainage system. The underlying concept of this system is a topographically defined set of drainage areas, based on scientific hydrologic and mapping principles, organized in a nested hierarchy by size. The advantage of this system is that it is nationally consistent, allowing for efficient sharing of information and resources and assuring the geospatial database is usable with other related Geographic Information System (GIS) databases (NRCS 2000). For these reasons, Metro chose to use the HUC system of delineating watersheds to allow future watershed planning efforts to be standardized and compatible with information generated by other agencies. Due to the standardized size of each unit, this system also allows for more accurate comparisons of watersheds across the region.

The HUC system initially divided the country into 21 regions, 222 sub-regions, 352 basins and 2,149 sub-basins. A hierarchical hydrologic unit code containing 2-digits for each of these four levels was assigned to the hydrologic units, forming the basis for the 8-digit hydrologic unit code. The geographic area (sub-basin) represented by the 8-digit standardized code is too large to adequately serve many types of water resource analysis and management needs. To address this problem, the Natural Resources Conservation Service (NRCS) mapped watersheds (5^{th} level) in the early 1980s for use in natural resource planning. In the mid-1990s, the NRCS along with State agency conservation partners, began a national initiative to delineate and digitize watershed (5^{th} level) and sub-watersheds (6^{th} level). Table 9 shows the six different levels of hydrologic units, the name, average size and an example of the hydrologic numeric coding. Appendix 10 includes information on HUCs, including definitions, HUC standards and maps of 4^{th}, 5^{th}, and 6^{th} field HUCs within the Metro boundary.

Table 9. Hydrologic Unit Code System

Hydrologic Unit Level (field)	Name of level	Size	Example	
			Name	Numeric Code
1	Region (21 units mapped)	Average: 177,560 sq. mi.	Pacific Northwest	**17**
2	Sub-region (222 units mapped)	Average: 16,800 sq. mi.	Willamette River	17**09**
3	Basin (352 units mapped)	Average: 10,596 sq. mi.	Willamette River	1709**00**
4	Sub-basin (2,149 units mapped)	Average: 450,000 acres	Lower Willamette River	170900**12**
5	Watershed (22,000 estimated units mapped)	40,000-250,000 acres	Johnson Creek	17090012**01**
6	Sub-watershed (160,000 estimated units mapped)	10,000-40,000 acres	Kelley Creek	1709001201**02**

Source: NRCS 2000, Metro 2001

Sub-watersheds (6th level HUC) have not yet been delineated by the NRCS for the geographic area within Metro's jurisdiction. Therefore, Metro contracted with Ecotrust to delineate sub-watersheds within its jurisdiction using the HUC system mapping protocol. These delineated areas have not been reviewed by NRCS, but are sufficient for Metro's purpose of collecting and analyzing inventory information.

Table 10 shows the 11 watersheds and 41 subwatersheds that are either fully or partially within Metro's jurisdictional boundary. Some of these watersheds, such as Corral Creek and Chicken Creek, intersect the Metro boundary by only a small area. For ease of data collection and analysis, any subwatershed with less than 3,000 acres inside Metro's boundary is combined with an adjacent subwatershed that has a hydrologic relationship, if possible. In some cases, the sub-watersheds may be adjacent but without a hydrologic relationship. For example, Council Creek and Middle Tualatin River-Gales Creek (Cornelius/Forest Grove area) are combined, but are located in different watersheds (5th level HUC): Dairy Creek and Gales Creek (respectively). The cities of Cornelius and Forest Grove are split by these watersheds.

Combining the smaller subwatershed areas in Metro's boundary resulted in 27 resource sites, as shown in Table 11. The resource site analysis that follows this section provides more information on which subwatersheds were joined for data collection and analysis.

Table 10. HUC watersheds and subwatersheds in the Metro region.

WATERSHED (5th field HUC)	SUB-WATERSHED (6th field HUC)	12 digit HUC code	Total Acres	Acres in Metro
Columbia Gorge Tributaries West	Columbia River	170800010605	8,703.7	2,057.7
Gordon Creek/ Lower Sandy River	Lower Sandy River	170800012805	6,233.3	3,654.6
	Beaver Creek	170800012806	11,581.7	10,336.5
Scappoose Creek	Lower Willamette River	170900120201	32,898.7	32,899.0
	Columbia Slough	170900120202	54,396.3	53,571.9
	Multnomah Channel	170900120203	27,825.2	1,037.6
Johnson Creek	Johnson Creek- Sunshine Creek	170900120101	14,120.2	12,372.9
	Kelley Creek	170900120102	3,175.6	3,175.6
	Middle Johnson Creek	170900120103	8,949.4	8,949.5
	Lower Johnson Creek-Willamette River	170900120104	5,950.1	5,950.2
	Lake Oswego	170900120105	4,168.7	4,168.7
	Tryon Creek	170900120106	4,356.4	4,356.4
	Johnson Creek- Crystal Springs Creek	170900120107	7,844.6	7,844.6
	Mount Scott Creek	170900120108	11,809.5	11,809.6
Lower Clackamas River	North Fork Deep Creek	170900112205	8,757.7	2,644.3
	Richardson Creek	170900112206	17,969.2	3,821.2
	Rock Creek-Clackamas River	170900112208	14,103.1	11,120.6
Abernethy Creek	Corral Creek	170900070401	18,024.7	207.7
	Willamette River-Boeckman Creek	170900070402	19,678.9	7,283.4
	Beaver Creek	170900070403	20,476.0	2,867.1
	Abernethy Creek-Holcomb Creek	170900070404	21,388.4	3,180.3
	Willamette River- Lower Tualatin River	170900070405	6,589.2	5,356.3
Senecal Creek/Mill Creek	Molalla River	170900090105	5,977.6	125.632
Lower Tualatin River	Lower Tualatin River-Lake Oswego Canal	170900100501	15,230.8	15,230.9
	Upper and Middle Fanno Creek	170900100502	11,183.3	11,183.4
	Summer Creek	170900100503	3,900.6	3,769.1
	Lower Fanno Creek	170900100504	9,395.9	8,453.8
	Cedar Creek	170900100505	5,723.3	1,528.4
	Chicken Creek	170900100506	4,033.5	133.5
	Rock Creek (South Washington Co.)	170900100507	4,952.3	2,102.3
	Lower Tualatin River-Willamette River	170900100508	7,859.8	475.1
Rock Creek/Tualatin River	Middle Rock Creek-Tualatin River	170900100401	16,833.4	7,300.1
	Beaverton Creek	170900100402	24,296.7	24,296.8
	Lower Rock Creek-Tualatin River	170900100403	7,557.0	7,496.4
	Middle Tualatin River-Davis Creek	170900100404	6,801.9	1,220.7
	Middle Tualatin River-Gordon Creek	170900100405	9,043.4	3,594.8
	Lindow Creek	170900100407	10,210.0	752.5
Dairy Creek	West Fork Dairy Creek	170900100106	12,297.7	36.1
	Council Creek	170900100107	12,255.9	2,924.9
	McKay Creek	170900100108	20,443.0	3,842.7
Gales Creek	Middle Tualatin River-Gales Creek	170900100206	13,863.7	2,747.2

Source: Metro 2001

Table 11. Resource sites.

Resource site #	Sub-watershed name	Acres in Metro
1	Lower Sandy River-Columbia River	5,712.3
2	Beaver Creek-Sandy River	10,336.5
3	Willamette River-Boeckman Creek	7,616.7
4	Willamette River-Lower Tualatin River	11,403.7
5	Council Creek	5,708.2
6	McKay Creek	3,842.7
7	Middle Rock Creek-Tualatin River	7,300.1
8	Beaverton Creek	24,296.8
9	Lower Rock Creek-Tualatin River	8,717.2
10	Middle Tualatin River-Gordon Creek	4,347.3
11	Lower Tualatin River-Lake Oswego Canal	15,230.9
12	Upper and Middle Fanno Creek	11,183.4
13	Summer Creek	3,769.1
14	Lower Fanno Creek	8,453.8
15	Rock Creek (So. Washington Co.)	4,239.3
16	Richardson Creek	6,465.5
17	Rock Creek-Clackamas River	11,120.6
18	Johnson Creek-Sunshine Creek	12,372.9
19	Kelley Creek	3,175.6
20	Middle Johnson Creek	8,949.5
21	Lower Johnson Creek-Willamette River	5,950.2
22	Lake Oswego	4,168.7
23	Tryon Creek	4,356.4
24	Johnson Creek-Crystal Springs	7,844.6
25	Mount Scott Creek	11,809.6
26	Lower Willamette River	32,899.0
27	Columbia Slough	54,609.5

The sections that follow provide a summary of the information collected for each resource site. The number assigned to each resource site (1-27) corresponds to each map generated for Metro's Goal 5 inventory. The information is organized into eight sections by watershed (5^{th} level HUC) as listed below.

- Columbia Gorge Tributaries West and Gordon Creek/Sandy River watersheds
- Abernethy Creek and Senecal Creek/Mill Creek watersheds
- Dairy Creek and Gales Creek watersheds
- Rock Creek/Tualatin River watershed
- Lower Clackamas River watershed
- Johnson Creek watershed
- Lower Tualatin River watershed
- Scappoose Creek watershed

The data gathered for Metro's inventory provides location, quality and quantity information for riparian corridors and wildlife habitat, which is required by the Goal 5 rule. All data in this document are based on Metro's jurisdictional boundary. Each section provides a summary of general watershed information. For example, Table A-1 provides information about the subwatersheds within each watershed, the HUC code, and the acres inside Metro's jurisdictional boundary.

Other information contained in the various tables presented in each section include the following, where available:

- Miles of DEQ 303(d) listed streams
- Road density
- Miles of stream with known anadromous fish presence
- Acres of wetlands and floodplains
- Stream miles by channel type and total stream miles
- Vegetation types within 300 feet of a stream
- Number of building permits since 1996
- Characteristics of stream miles by resource site
- Riparian vegetation by resource site
- Regional zoning by resource site
- Acres within resource site by jurisdiction
- Acres providing ecological function within the riparian corridor
- Breakdown of ecological scores by acre
- Wildlife habitat by resource site
- Breakdown of wildlife model patch scores by resource site
- Breakdown of wildlife patch model scores by criteria
- Estimates of land cover type by resource site
- Estimates of wildlife habitat type availability by resource site
- Information on Habitats of Concern by resource site
- Information on Species of Concern sightings by resource site

The data tables for each 5th field HUC and resource site follow a textual description of the resource characteristics. **Note that all data relates to the area of the subwatershed that is contained within Metro's jurisdictional boundary.** Summary data tables are at the end of the Resource Site Analysis section. These tables allow easier comparison of the relative quantity and quality of riparian corridor and wildlife resources among resource sites.

Appendix 11 includes a bibliography of water quality reports. Also included are color site maps for the region (north, east, south and west sections), as well as black and white maps for each resource site depicting riparian and wildlife habitat inventory information.

A. Gordon Creek/Lower Sandy River and Columbia Gorge Tributaries West

General watershed information

Resource sites in the Gordon Creek/Lower Sandy River and Columbia Gorge Tributaries West Watersheds include:

- Lower Sandy River-Columbia River subwatersheds (combined)
- Beaver Creek-Sandy River subwatershed

Watershed assessments and plans

Bureau of Planning, City of Portland, 1989. *The Columbia Corridor Industrial/Environmental Mapping Project, April 20, 1989,* City of Portland: Portland, Oregon.

Community and Economic Development Department, City of Gresham, 1988. *Inventory of Significant Natural Resources and Open Spaces*, City of Gresham: Gresham, Oregon.

Stark, Daniel, 2001. *West of the Sandy River Rural Area, Natural Resource Inventory and ESEE Report*, Fishman Environmental Services: Portland, Oregon.

Watershed councils and related groups

Beaver Creek, Friends of, 104 SE Kibling Street, Troutdale 97060, 503-667-4960, Carolyn Taylor

Columbia Children's Arboretum Preservation Committee, 9509 NE 13th Ave., Portland 97211, Martha Johnson

Sandy Basin Watershed Council, PO Box 868, Sandy 97055, (503) 630-2382, FAX (503) 630-2341

Sandy River, Friends of, 503-663-2672, Rob Galasso

Wetlands, Friends of, 503-253-6247, Alice Blatt

Data descriptions

Table A-1 provides information about the subwatersheds within each watershed, the HUC code, and the acres inside Metro's jurisdictional boundary. Keying in on the resource site number will show how the subwatersheds are aggregated into the resource sites listed above.

The Gordon Creek/Lower Sandy River watershed contains two subwatersheds that are partially located within Metro's boundary: Lower Sandy River and Beaver Creek-Sandy River, comprising a total of 13,991 acres within Metro's jurisdictional boundary. Within the Columbia Gorge Tributaries West watershed, only a portion of one subwatershed (Columbia River) is in Metro's boundary (2,058 acres). The Columbia River subwatershed is combined with the Lower Sandy River subwatershed to comprise one resource site (now referred to the Lower Sandy River-Columbia River subwatershed, or Resource Site #1). The Beaver Creek-Sandy River subwatershed stands alone as a resource site (Resource Site #2).

Tables A-1 and A-2 provide general description about the 5th field and 6th field HUCs. Below these tables are descriptions of the riparian and wildlife habitat resources resource site.

Watershed data tables

Table A-1. Watersheds (5th level HUC), subwatersheds (6th level HUC), and acres within Metro jurisdictional boundary.

Watershed (5th level HUC)	5th field HUC code	Resource site #	Subwatershed (6th level HUC)	6th field HUC code	Acres in Metro
Gordon Creek/Lower Sandy River	1708000128	1	Lower Sandy River	170800012805	3,654.6
		2	Beaver Creek-Sandy River	170800012806	10,336.5
Columbia Gorge Tributaries West	1708000106	1	Columbia River	170800010605	2,057.7

Table A-2. Resource sites: general information.

General information	Lower Sandy-	Beaver Creek-
Miles of DEQ 303(d) listed streams	6.9	4.6
Road density (road miles/square miles in subwatershed)	3.8	9.4
Miles of stream with known anadromous fish presence+A5	6.0	11.2
Acres of hydrologically connected wetlands	304.4	202.7
Total acres of wetlands	318.3	205.8
Acres of floodplains (100 year FEMA + 1996 inundation area)	1,563.8	2,173.0
Acres of developed floodplains	40.8	59.6
Building permits since 1996 (number)	24.0	1,354.0

Table A-3. Characteristics of stream miles by resource site.

Resource site	Stream miles by channel type		Miles of stream links*	Miles of streams not categorized by channel type	Total stream miles
	Low to medium	*High*			
Lower Sandy-Columbia Rivers	11.2	4.1	0.1	8.3	23.7
Beaver Creek-Sandy River	17.0	0.0	10.7	17.7	45.4

*Stream links are links between surface streams and may be piped or culverted.

Table A-4. Riparian vegetation by resource site.

Resource site	Vegetation types within 300 feet of a stream (acres)			Forested vegetation >300 feet from a stream
	Low structure vegetation/intact topsoil	Non-forest woody vegetation	Forested vegetation	
Lower Sandy-Columbia Rivers	493.9	81.2	709.6	1,075.5
Beaver Creek-Sandy River	789.1	47.6	736.7	540.0

Table A-5. Regional zoning by resource site.

Resource site	Acres by zone within each resource site						
	Commercial	Industrial	Multi-family residential	Public/open space	Rural	Single family residential	Mixed use
Lower Sandy-Columbia Rivers	11.1	2.0	0.0	1,649.3	3,511.4	319.6	20.9
Beaver Creek-Sandy River	345.5	303.8	854.4	1,601.5	2,872.8	3,390.0	578.0

SITE #1: Lower Sandy River-Columbia River subwatershed

Named tributaries: Columbia River, Columbia Side Channel, Beaver Creek, Sandy River, Smith Creek
Communities within the subwatershed: Troutdale, unincorporated Multnomah County (see Table A-6)
Total acreage within Metro's boundary: 5,712.3 (combines Lower Sandy River and Columbia River subwatersheds)
Total acres within riparian corridor: 3,495.8

This site contains two percent of the area comprising Metro's jurisdictional boundary. About seven percent of the site is in the City of Troutdale, with the remainder in unincorporated Multnomah County (Table A-6).

This site is the least developed of all of the resource sites, with approximately 3.8 miles of road per square mile (Table A-2). Reflecting the rural nature of this resource site, the zoning is dominated by rural and public lands/open space (Table A-5); only 24 building permits have been issued here since 1996 (Table A-2).

Riparian resources. This resource site is rich with riparian resources, containing 24 total stream miles (Table A-3), or about 0.0041 miles of non-piped streams per acre (Table 12); only two resource sites contain higher stream densities. The low number of stream links suggest that few surface streams have been piped underground (Table A-3). However, seven miles, or 30 percent of total stream miles, are listed by the DEQ as 303(d) quality-limited (Tables A-2 and A-3). Anadromous fish are known to be present in six stream miles in this site (Table A-2). Low to medium gradient streams are most common here, reflected by the site's strong floodplain (27 percent of total) and wetland (six percent of total) components (Table A-2 and A-3). Less than three percent of the floodplain is developed.

The riparian corridor inventory reflects these characteristics, with this site ranking first among all sites in terms of the percentage of land (61%) within the site that is part of the riparian corridor inventory (Table 12). However, because of the relatively limited amount of this site's land falling within Metro's boundary, it contributes only about four percent of the region's total riparian resources (Table 13).

The quality of the riparian resources is high for this site, with about 40 percent of the acreage that falls within the riparian corridor inventory receiving primary scores for at least three of the five ecological functions (Table A-9). Sixty-three percent of the site's riparian corridors receive at least one primary ecological function score (Table A-9). This reflects, in part, the site's strong forest component (Tables A-4 and A-12), with the highest percentage of land receiving a primary score for *Large wood and channel dynamics* (Table A-8; see also Table 4 and Appendix 5 for description of ecological functions mapping). *Bank stabilization and pollution control* and *Streamflow moderation and water storage* are also key primary functions provided within this resource site. High amounts of streams, wetlands and forest make this site a very valuable natural resource in the region.

Wildlife habitat resources.
As is often the case, the factors that make this a valuable riparian resource site are also important to wildlife. Including Habitats of Concern, half of the lands in this site fall within the wildlife

habitat inventory, ranking it highest among all 27 resource sites (Table 16). Within model patches, a majority – about 65 percent – fall within the top third of the point range (Table A-10). Of the four criteria in the GIS model, this site is most strongly correlated with connectivity, with 86 percent receiving the top score (Table A-11). Notice that all wildlife habitats received low habitat interior scores, and this reflects the high level of stream resources and their linear nature (Table A-11). However, the relatively high percentage receiving mid-range size scores reflects the strong level of connectivity within the site.

Habitat types in this resource site are dominated by conifer/hardwood forest cover, but open water, riparian habitats, grasslands and agriculture also comprise a significant proportions (Table A-15). This site contributes 318 acres of wetlands, or four percent of the region's total, ranking seventh among the 27 resource sites. Herbaceous wetlands are the dominant type.

Species of Concern. Five Species of Concern sighting locations fall within the site. Each sighting may include one or more species; if a species occurs more than once in the resource site it is only listed once here. These include the following species:

- Northern Red-legged Frog
- Bald Eagle
- Pileated Woodpecker

There are very likely many other Species of Concern using this resource site, particularly those relying on Open Water, Herbaceous Wetlands, and forested habitats (see Table A-15). Examples of species likely to occur in this site may be found by referencing the species list in Appendix 7 and identifying the species with a double "XX" under each habitat type. General species needs and potential reasons for their decline are identified in the *Sensitive Species Accounts* section above. More detailed information on all species' needs can be obtained through Johnson and O'Neil (2001).

Habitats of Concern. A majority of the riparian corridor and wildlife areas are also identified as Habitats of Concern, attesting to their importance in the regional system of Goal 5 resources. Part of the Columbia River falls within the resource site, encompassing several important riverine islands (Gary, Flag, and part of Chatham Islands) that are HOCs. The Sandy River Delta provides invaluable wildlife habitat. The Habitats of Concern include substantial wetlands and bottomland hardwood forest. Several parks, including the Sandy River Delta parks complex, Troutdale Community Park, Lewis and Clark State Park, Dabney State Park, and some Metro-owned properties provide a significant amount of protection to these riparian areas. Sixty-six percent of all model patches are identified as Habitats of Concern (primarily bottomland hardwood forest and wetlands), and Habitats of Concern outside of model patches comprise about 14% of total inventoried wildlife habitat acreage (Table A-13).

The following Habitats of Concern are partially or wholly within this resource site. Using the Unique ID # (UID), please refer to Appendix 8 for information concerning each Habitat of Concern:

- UID numbers: 19, 90, 91, 92

Resource site data tables: Riparian Corridors

Table A-6. Acres within resource site by jurisdiction.

Jurisdiction	Acres within subwatershed
Troutdale	378.8
Unincorporated Multnomah County	5,333.6

Table A-7. Acres in Metro and riparian corridor.

Resource site	Total acres within Metro	Total acres within riparian corridor
Lower Sandy-Columbia Rivers	5,712.3	3,498.3

Table A-8. Number of acres within riparian corridor providing ecological function.

Resource site:	Ecological function	*Primary Value*		*Secondary Value*	
		Acres*	% of Total**	Acres	% of Total
Lower Sandy-Columbia Rivers	Microclimate & shade	615.8	17.6%	943.2	27.0%
	Streamflow moderation & water storage	1,610.8	46.0%	1,840.2	52.6%
	Bank stabilization & pollution control	1,637.9	46.8%	424.6	12.1%
	Large wood & channel dynamics	1,916.8	54.8%	196.4	5.6%
	Organic material sources	735.4	21.0%	137.7	3.9%

*Number of acres scored within the riparian corridor for each function
**Percent of total acres within the riparian corridor

Table A-9. Breakdown of ecological scores.

Resource site	Ecological Score	Acres	% of Total Acres
Lower Sandy-Columbia Rivers	1 to 5	1,306.7	37.4%
	6 to 11	251.6	7.2%
	12 to 17	558.3	16.0%
	18 to 23	686.3	19.6%
	24 to 29	387.3	11.1%
	30	308.1	8.8%
	Total acres	3,498.3	100.0%

Resource site data tables: Wildlife Habitat

Table A-10. Breakdown of total wildlife model patch scores.*

Resource site: Lower Sandy-Columbia Rivers	Number of acres in each wildlife score category									Total wildlife model patch acres in inventory
	1	2	3	4	5	6	7	8	9	
Model score	3.0	11.0	193.9	387.5	151.1	134.0	1,609.9	0.0	0.0	2,490.4
Percent of total	0.1%	0.4%	7.8%	15.6%	6.1%	5.4%	64.6%	0.0%	0.0%	100.0%

*Does not include Habitats of Concern outside of model patches.

Table A-11. Breakdown of total wildlife patch model scores by criteria.[1]

Resource site: Lower Sandy-Columbia Rivers	Number of acres by score for each model criterion												Total wildlife model patch acres in inventory
	Size[2]			Interior[2]			Water[3]			Connectivity			
	1	2	3	1	2	3	1	2	3	1	2	3	
Model score	620.3	1,408.1	0.0	1,874.9	0.0	0.0	150.6	1,899.4	375.4	38.6	305.1	2,146.7	2,490.4
Percent of total acres in inventory	24.9%	56.5%	0.0%	75.3%	0.0%	0.0%	6.0%	76.3%	15.1%	1.5%	12.3%	86.2%	na

[1]Does not include Habitats of Concern outside of model patches.

[2]These numbers do not add up to 100.0% because Type 2 patches (low structure vegetation within 300 feet of streams and wetlands) were not ranked for these criteria.

[3]These numbers do not add up to 100% because not all patches contained or were near water resources.

Table A-12. Breakdown of total wildlife model patch area by 2000 Metro photo interpretation landcover and known wetlands.*

Resource site: Lower Sandy-Columbia Rivers	Low structure vegetation within 300 feet of stream		Forested vegetation	Forested wetlands	Grass/shrub wetlands within 300 feet of a stream	Other wetlands	Total wildlife model patch acres in inventory
	Low structure vegetation/ intact topsoil	Non-forest woody vegetation					
Acres	422.5	39.6	1,722.8	44.1	84.8	176.6	2,490.4
Percent of total	17.0%	1.6%	69.2%	1.8%	3.4%	7.1%	100.0%

*Does not include Habitats of Concern outside of model patches.

Table A-13. Total acres of inventoried wildlife habitat by type and total Species of Concern (SOCs).

Resource site: Lower Sandy-Columbia Rivers	Wildlife patches (acres)	HOCs inside Wildlife patches (acres)*	HOCs outside Wildlife patches (including wetlands <2 acres)	Total inventoried wildlife habitat acres	Total SOCs
Acres	2490.4	1894.2	392.6	2883.1	5
Percent of total	86.4%	65.7%	13.6%	100.0%	N/A

*Habitats of Concern.

Table A-14. Total area of model patches and Habitats of Concern by 1998 Landsat Landcover Area.

Resource Site: Lower Sandy-Columbia Rivers / Landcover type:	Total area of wildlife model patches	Total area of HOCs outside of modeled patches (including wetlands <2 acres)	Percent of total inventoried habitat
Water	63.37	8.8	2.5%
Barren	38.39	35.1	2.5%
Low structure agriculture	242.78	6.8	8.7%
High structure agriculture	41.36	0.2	1.4%
Deciduous closed canopy	597.10	15.9	21.3%
Mixed closed canopy	899.28	2.7	31.3%
Conifer closed canopy	88.23	0.5	3.1%
Deciduous open canopy	33.25	5.8	1.4%
Mixed open canopy	43.01	0.8	1.5%
Conifer open canopy	2.77	0.0	0.1%
Deciduous scattered canopy	28.80	6.4	1.2%
Mixed scattered canopy	16.07	2.1	0.6%
Conifer scattered canopy	4.11	0.0	0.1%
Closed canopy shrub	38.13	14.5	1.8%
Open canopy shrub	14.38	5.3	0.7%
Scattered canopy shrub	25.05	8.7	1.2%
Meadow/grass	265.95	279.1	18.9%
Not classified	48.42	0.0	1.7%
Total	**2,490.43**	**392.6**	**100.0%**

The table below provides estimates of each type of the habitats described in Metro's Technical Report for Fish and Wildlife Habitat, based on Johnson and O'Neil's (2001) habitat scheme. These numbers are provided for subwatershed comparison purposes and represent *estimates* of available habitat type. Several data types were used to compile this table, and the data sources vary in their precision. For example, the satellite data sources are less accurate than hand-digitized forest canopy cover. There is also slight overlap between certain habitat types. For example, Riparian Wetlands (RWET) are also partially included in Westside Lowland Coniferous Hardwood/Westside Oak and Douglas-fir (WLCH/WODF) because some wetlands also contain forest, and Open Water (WATR) is not always considered part of habitat patches. Therefore, the sums of these habitat types are slightly different from the "Total wildlife habitat acres in inventory" shown in Table 16. Nonetheless, these numbers provide a generalized means of comparing the quality and quantity of habitat available to wildlife among and between subwatersheds. Note also that the estimates for Westside Grasslands (WEGR) probably represent grasslands that are not native rather than true native grasslands, which are largely extirpated from the metro region.

Table A-15. Wildlife habitat availability[1] based on Johnson & O'Neil's (2001) habitat types and species-habitat associations.

Resource site: Lower Sandy-Columbia Rivers	Habitat type						
	WATR[2]	HWET[3]	RWET[3]	TOTWET[3]	WLCH/ WODF[4]	WEGR	AGPA
Total acres	618.9	261.4	44.1	318.3	1,746.7	598.5	291.1
Percent of total	21.5%	9.1%	1.5%	11.0%	60.6%	20.8%	10.1%

[1]See Table A-14 for land cover types and crosswalk to Johnson and O'Neil's classification scheme.

[2]Note that patch type and data limitations result in an underestimation of open water habitats. For example, medium and small sized stream surfaces are excluded.

[3]Note that HWET and RWET do not represent the full suite of wetlands because some wetlands <2 acres were added in as Habitats of Concern, and some wetlands could not be associated with herbaceous or forested habitats. TOTWET represents the best estimate of all existing wetlands because it includes Habitats of Concern.

[4]Data limitations make it impossible to distinguish between these two habitat types at this time, and no comprehensive oak habitat survey has been conducted for the region. However, known oak habitats are also included in HOCs (see Appendix 10).

SITE #2: Beaver Creek- Sandy River subwatershed

Named tributaries: Beaver Creek, Columbia River, Columbia Side Channel, Kelly Creek, Sandy River
Communities within the subwatershed: Gresham, Troutdale, unincorporated Multnomah County
Total acreage within Metro's boundary: 10,336.5
Total acres within riparian corridor: 3,655.5

This site contains three percent of the area comprising Metro's jurisdictional boundary. Almost half (47 percent) of the site is in unincorporated Multnomah County, with the remainder in the cities of Gresham (37 percent) and Troutdale (16) (Table A-16).

Within the overarching watershed this resource site is more developed than the Lower Sandy-Columbia River, with 9.4 miles of road per square mile (Table A-2). The primary zoning is for single family residential, but there is also substantial rural and public/open space (Table A-5). Substantial development has occurred over the last few years; there have been 1,354 building permits issued since 1996 (Table A-2).

Riparian resources. The riparian corridor inventory comprises about 36 percent of the site's total land within the Metro boundary (Table 12). This site contributes about four percent of the region's total riparian resources (Table 13).

This resource site, similar to Site #1, is rich with riparian resources, containing more than 45 total stream miles (Table A-3). Non-piped stream density is slightly lower than Site #1, at 0.0034 miles per acre; the site ranks 15th among the 27 resource sites (Table 12). The miles of stream links, at 10.7, represents approximately 24 percent of the total number of stream miles, suggesting a significant amount of surface streams have been piped or culverted (Table A-3). However, a smaller proportion of streams are DEQ 303(d) water-quality listed in this site than in Site #1 (13 percent; Tables A-2 and A-3). Anadromous fish are known to be present in more than 11 stream miles (Table A-2). Low gradient streams are most common here, reflected by the site's strong floodplain (21 percent of total) and wetland (two percent of total) components (Tables A-2 and A-3). About three percent of the floodplain is developed, well below the average of 10.3 percent (Table 14).

The quality of the riparian resources is very high for this site, with about 58 percent of the acreage that falls within the riparian corridor inventory receiving primary scores for at least three of the five ecological functions (Table A-19). More than 75 percent of the site's riparian corridors receive at least one primary ecological function score (Table A-19). This reflects the site's strong forest component (Tables A-4 and A-22), with the highest percentage of land receiving a primary score for *Large wood and channel dynamics* (Table A-18; see also Table 4 and Appendix 5 for description of ecological functions mapping). *Bank stabilization and pollution control* and *Streamflow moderation and water storage* are also key primary functions provided within this resource site. High amounts of streams, wetlands and forest make this site a very valuable natural resource in the region.

Wildlife habitat resources.
Including Habitats of Concern, 24 percent of the lands in this site fall within the wildlife habitat inventory, ranking it 15th of the 27 resource sites (Table 16). Within model patches, 15 percent

fall within the top third of the point range, in contrast to Site #1 (Table A-20). Of the four criteria in the GIS model, this site tends to score low in size and habitat interior, moderate in water, and medium or high in connectivity (Table A-21). As with Site #1, the low habitat interior scores probably reflect the high level of stream resources and their linear nature (Table A-11). In general, this site's wildlife habitat resources are smaller and less connected than those in Site #1.

Habitat types in this resource site are co-dominated by conifer/hardwood forest cover and open water, with the most open water in this site of all 27 resource sites except Site #27, Columbia Slough. However, grasslands and agricultural lands also provide important habitat (Table A-25). This site contributes 206 acres of wetlands, or more than two percent of the region's total, ranking 12th among the 27 resource sites.

Species of Concern. Five Species of Concern sighting locations fall within the site. Each sighting may include one or more species; if a species occurs more than once in the resource site it is only listed once here. These include the following species:

- Painted turtle
- Northwestern pond turtle
- Red-legged frog
- Pileated woodpecker
- *Rorippa columbiae* (plant species)

There are very likely many other Species of Concern using this resource site, particularly those relying on Open Water, Herbaceous Wetlands, and forested habitats (see Table A-25). Examples of species likely to occur in this site may be found by referencing the species list in Appendix 7 and identifying the species with a double "XX" under the habitat. General species needs and potential reasons for their decline are identified in the *Sensitive Species Accounts* section above. More detailed information on all species' needs can be obtained through Johnson and O'Neil (2001).

Habitats of Concern.
The following Habitats of Concern are partially or wholly within this resource site. Using the Unique ID # (UID), please refer to Appendix 8 for information concerning each Habitat of Concern:

- UID numbers: 19, 89, 90, 91, 92, 143

Resource site data tables: Riparian Corridors

Table A-16. Acres within resource site by jurisdiction.

Jurisdiction	Acres within subwatershed
Gresham	3,845.0
Troutdale	1,617.8
Unincorporated Multnomah County	4,873.6

Table A-17. Acres in Metro and riparian corridor.

Resource site	Total acres within Metro	Total acres within riparian corridor
Beaver Creek-Sandy River	10,336.6	3,666.8

Table A-18. Number of acres within riparian corridor providing ecological function.

Resource site:	Ecological function	*Primary Value*		*Secondary Value*	
		Acres*	% of Total**	Acres	% of Total
Beaver Creek-Sandy River	Microclimate & shade	689.9	18.8%	527.4	14.4%
	Streamflow moderation & water storage	2,148.4	58.6%	1,455.3	39.7%
	Bank stabilization & pollution control	2,366.4	64.5%	117.3	3.2%
	Large wood & channel dynamics	2,586.8	70.5%	151.8	4.1%
	Organic material sources	927.4	25.3%	127.6	3.5%

*Number of acres scored within the riparian corridor for each function
**Percent of total acres within the riparian corridor

Table A-19. Breakdown of ecological scores.

Resource site	Ecological Score	Acres	% of Total Acres
Beaver Creek-Sandy River	1 to 5	906.4	24.7%
	6 to 11	186.1	5.1%
	12 to 17	444.9	12.1%
	18 to 23	1,260.6	34.4%
	24 to 29	483.0	13.2%
	30	385.9	10.5%
	Total acres	3,666.8	100.0%

Resource site data tables: Wildlife Habitat

Table A-20. Breakdown of total wildlife model patch scores.*

Resource site: Beaver Creek-Sandy River	Number of acres in each wildlife score category: 1	2	3	4	5	6	7	8	9	Total wildlife model patch acres in inventory
Model score	13.0	124.1	518.7	302.5	336.0	502.3	321.7	0.0	0.0	2,118.3
Percent of total	0.6%	5.9%	24.5%	14.3%	15.9%	23.7%	15.2%	0.0%	0.0%	100.0%

*Does not include Habitats of Concern outside of model patches.

Table A-21. Breakdown of total wildlife model patch scores by criteria.*

Resource site:	Number of acres by score for each model criterion												Total wildlife model patch acres in inventory
	Size[2]			Interior[2]			Water[3]			Connectivity			
Beaver Creek-Sandy River	1	2	3	1	2	3	1	2	3	1	2	3	
Model score	1,220.6	87.7	0.0	1,115.1	0.0	0.0	26.6	1,538.1	498.5	230.9	911.2	976.3	2,118.3
Percent of total acres in inventory	57.6%	4.1%	0.0%	52.6%	0.0%	0.0%	1.3%	72.6%	23.5%	10.9%	43.0%	46.1%	na

[1]Does not include Habitats of Concern outside of model patches.

[2]These numbers do not add up to 100.0% because Type 2 patches (low structure vegetation within 300 feet of streams and wetlands) were not ranked for these criteria.

[3]These numbers do not add up to 100% because not all patches contained or were near water resources.

Table A-22. Breakdown of total wildlife model patch area by 2000 Metro photo interpretation landcover and known wetlands.*

Resource site: Beaver Creek-Sandy River	Low structure vegetation within 300 feet of stream: Low structure vegetation/ intact topsoil	Non-forest woody vegetation	Forested vegetation	Forested wetlands	Grass/shrub wetlands within 300 feet of a stream	Other wetlands	Total wildlife model patch acres in inventory
Acres	766.1	44.0	1,118.9	100.9	42.4	46.0	2,118.3
Percent of total	36.2%	2.1%	52.8%	4.8%	2.0%	2.2%	100.0%

*Does not include Habitats of Concern outside of model patches.

Table A-23. Total acres of inventoried wildlife habitat by type and total Species of Concern (SOCs).

Resource site: Beaver Creek-Sandy River	Wildlife patches (acres)	HOCs inside Wildlife patches (acres)*	HOCs outside Wildlife patches (including wetlands <2 acres)	Total inventoried wildlife habitat acres	Total SOCs
Acres	2118.3	943.7	317.3	2435.6	5
Percent of total	87.0%	38.7%	13.0%	100.0%	N/A

*Habitats of Concern.

Table A-24. Total area of model patches and Habitats of Concern by 1998 Landsat Landcover Area.

Resource Site: Beaver Creek-Sandy River / Landcover type:	Total area of wildlife model patches	Total area of HOCs outside of modeled patches (including wetlands <2 acres)	Percent of total inventoried habitat
Water	43.02	22.6	2.7%
Barren	115.19	61.9	7.3%
Low structure agriculture	179.60	1.1	7.4%
High structure agriculture	118.11	0.8	4.9%
Deciduous closed canopy	745.09	17.6	31.3%
Mixed closed canopy	232.26	2.9	9.7%
Conifer closed canopy	46.98	0.4	1.9%
Deciduous open canopy	126.95	14.2	5.8%
Mixed open canopy	40.29	0.8	1.7%
Conifer open canopy	5.80	0.0	0.2%
Deciduous scattered canopy	59.08	8.4	2.8%
Mixed scattered canopy	30.89	1.4	1.3%
Conifer scattered canopy	5.63	0.2	0.2%
Closed canopy shrub	70.99	8.0	3.2%
Open canopy shrub	28.25	5.1	1.4%
Scattered canopy shrub	35.85	5.2	1.7%
Meadow/grass	234.01	166.6	16.4%
Not classified	0.31	0.0	0.0%
Total	**2,118.33**	**317.3**	**100.0%**

The table below provides estimates of each type of the habitats described in Metro's Technical Report for Fish and Wildlife Habitat, based on Johnson and O'Neil's (2001) habitat scheme. These numbers are provided for subwatershed comparison purposes and represent *estimates* of available habitat type. Several data types were used to compile this table, and the data sources vary in their precision. For example, the satellite data sources are less accurate than hand-digitized forest canopy cover. There is also slight overlap between certain habitat types. For example, Riparian Wetlands (RWET) are also partially included in Westside Lowland Coniferous Hardwood/Westside Oak and Douglas-fir (WLCH/WODF) because some wetlands also contain forest, and Open Water (WATR) is not always considered part of habitat patches. Therefore, the sums of these habitat types are slightly different from the "Total wildlife habitat acres in inventory" shown in Table 16. Nonetheless, these numbers provide a generalized means of comparing the quality and quantity of habitat available to wildlife among and between subwatersheds. Note also that the estimates for Westside Grasslands (WEGR) probably represent grasslands that are not native rather than true native grasslands, which are largely extirpated from the metro region.

Table A-25. Wildlife habitat availability[1] based on Johnson & O'Neil's (2001) habitat types and species-habitat associations.

Resource site:	Habitat type						
Beaver Creek-Sandy River	WATR[2]	HWET[3]	RWET[3]	TOTWET[3]	WLCH/ WODF[4]	WEGR	AGPA
Total acres	1,195.4	88.4	100.9	205.8	1,339.0	475.1	299.6
Percent of total	49.1%	3.6%	4.1%	8.4%	55.0%	19.5%	12.3%

[1]See Table A-24 for land cover types and crosswalk to Johnson and O'Neil's classification scheme.

[2]Note that patch type and data limitations result in an underestimation of open water habitats. For example, medium and small sized stream surfaces are excluded.

[3]Note that HWET and RWET do not represent the full suite of wetlands because some wetlands <2 acres were added in as Habitats of Concern, and some wetlands could not be associated with herbaceous or forested habitats. TOTWET represents the best estimate of all existing wetlands because it includes Habitats of Concern.

[4]Data limitations make it impossible to distinguish between these two habitat types at this time, and no comprehensive oak habitat survey has been conducted for the region. However, known oak habitats are also included in HOCs (see Appendix 10).

B. Abernethy Creek (and a small portion of Senecal Creek/Mill Creek)

General watershed information

Resource sites in the Abernethy Creek watershed include:

- Willamette River-Boeckman Creek (combined – Corral Creek, Molalla River & Willamette River-Boeckman Creek)
- Willamette River-Lower Tualatin River (combined – Abernethy Creek-Holcomb Creek, Beaver Creek, Willamette River-Lower Tualatin River subwatersheds)

Watershed assessments and plans

Bureau of Planning, City of Portland, 2001. *Portland's Willamette River Atlas*, City of Portland: Portland, Oregon.

Lev, Esther, 2001. *Wildlife Habitat Inventory for the Willamette River,* Environmental Consulting: Portland, Oregon.

Oregon Department of Fish and Wildlife (ODFW) and Unified Sewage Agency (USA), 1995. *Distribution of Fish and Crayfish and Measurement of Available Habitat in the Tualatin River Basin, Final Report of Research,* ODFW: Portland, Oregon and Unified Sewage Agency: Hillsboro, Oregon.

Tualatin River Watershed Council, 1999. *Tualatin River Watershed, Action Plan,* Tualatin River Watershed Council: Hillsboro, Oregon.

Tualatin Watershed Council, 2001. *Tualatin River Watershed Atlas,* Tualatin Watershed Council: Hillsboro, Oregon.

United States Geological Service (USGS), 2000. *Willamette Basin Ground-Water Study,* USGS: Portland, Oregon.

USGS, 1995. *NAWQA Willamette Basin Study,* USGS: Portland, Oregon.

Willamette Basin Task Force, Pacific Northwest River Basins Commission, 1969. *The Willamette Basin, Comprehensive Study of Water and Related Land Resources,* Pacific Northwest River Basins Commission: Portland, Oregon.

Willamette Basin Task Force, Pacific Northwest River Basins Commission, 1997. *The Willamette Basin, Recommendations to Governor John Kitzhaber,* Willamette River Basin Task Force: Portland, Oregon.

Willamette Restoration Initiative, 2001. *Restoring A River of Life, The Willamette Restoration Strategy Overview, February 2001,* Willamette Restoration Initiative: Portland, Oregon.

Willamette Restoration Initiative, 2001. *Restoring A River of Life, The Willamette Restoration Strategy – Recommendations for the Willamette Basin Supplement to the Oregon Plan for Salmon and Watersheds, February 2001,* Willamette Restoration Initiative: Portland, Oregon.

Watershed councils and related groups

Newell Creek Canyon, Friends of, PO Box 3, Oregon City 97045, 503-655-6471, James Dalton

Tualatin Watershed Council, 1080 SW Baseline, Bldg. B, Suite B-2, Hillsboro 97123, (503) 681-0953, FAX (503) 681-9772

Tualatin River National Wildlife Refuge, City of Sherwood, 90 NW Park Street, Sherwood 97140, 503-625-5522, Joan Patterson

Tualatin River Rangers, USA, 155 N First Ave., Hillsboro 97124, 503-640-3516, Linda Kelly

Tualatin Riverkeepers, 16340 SW Beef Bend Road, Sherwood 97140, 503-590-5813, Lauri Mullen

Upper Willamette River, Friends of, 541-752-3942, Sarvahara Judd
Wetlands, Friends of, 503-253-6247, Alice Blatt
Willamette River Restoration Committee, 541-484-9466, Timothy Green

Data descriptions
Table B-1 provides information about the subwatersheds within each watershed, the HUC code, and the acres inside Metro's jurisdictional boundary. Keying in on the resource site number will show how the subwatersheds are aggregated into the resource sites listed above.

The Abernethy Creek watershed contains five subwatersheds that are partially located within Metro's boundary: Corral Creek, Willamette River-Boeckman Creek, Beaver Creek, Abernethy Creek-Holcomb Creek, and Willamette River – Lower Tualatin River. Within the Senecal Creek/Mill Creek watershed, only a portion of one subwatershed (Molalla River) is in Metro's boundary. The Corral Creek, Willamette River-Boeckman Creek, and Molalla River subwatersheds are combined to comprise one resource site (now referred to the Willamette River-Boeckman Creek subwatershed, or Resource Site #3). The Beaver Creek, Abernethy Creek-Holcomb Creek, and Willamette River-Lower Tualatin River subwatersheds are combined and referred to as the Willamette-Lower Tualatin River subwatershed, or Resource Site #4.

Tables B-1 and B-2 provide general description about the 5^{th} field and 6^{th} field HUCs. Below these tables are descriptions of the riparian and wildlife habitat resources resource site.

Watershed data tables

Table B-1. Watersheds (5th level HUC), subwatersheds (6th level HUC), and acres within Metro jurisdictional boundary.

Watershed (5th level HUC)	5th field HUC code	Resource site #	Subwatershed (6th level HUC)	6th field HUC code	Acres in Metro
Abernathy Creek	170900704	3	Corral Creek	170900070401	207.7
			Willamette River-Boeckman Creek	170900070402	7,283.4
		4	Beaver Creek	170900070403	2,867.1
			Abernathy Creek-Holcomb Creek	170900070404	3,180.3
			Willamette River-Lower Tualatin River	170900070405	5,356.3
Senecal Creek/Mill Creek	170900901	3	Molalla River	170900090105	125.6

Table B-2. Resource sites: general information.

General information	Willamette River-	Willamette-Lower
Miles of DEQ 303(d) listed streams	1.5	6.0
Road density (road miles/square miles in subwatershed)	8.7	11.6
Miles of stream with known anadromous fish presence	2.0	8.6
Acres of hydrologically connected wetlands	362.5	85.7
Total acres of wetlands	365.0	85.7
Acres of floodplains (100 year FEMA + 1996 inundation area)	411.2	1,172.3
Acres of developed floodplains	32.8	229.4
Building permits since 1996 (number)	808.0	2,093.0

Table B-3. Characteristics of stream miles by resource site.

Resource site	Stream miles by channel type		Miles of stream links*	Miles of streams not categorized by channel type	Total stream miles
	Low to medium	*High*			
Willamette River-Boeckman Creek	4.5	0.1	9.4	17.7	31.5
Willamette-Lower Tualatin Rivers	14.6	3.1	7.5	17.8	43.0

*Stream links are links between surface streams and may be piped or culverted.

Table B-4. Riparian vegetation by resource site.

Resource site	Vegetation types within 300 feet of a stream (acres)			Forested vegetation >300 feet from a stream
	Low structure vegetation/intact topsoil	Non-forest woody vegetation	Forested vegetation	
Willamette River-Boeckman Creek	675.1	33.0	514.8	766.5
Willamette-Lower Tualatin Rivers	469.9	79.9	1,052.7	1,685.4

Table B-5. Regional zoning by resource site.

Resource site	Acres by zone within each resource site						
	Commercial	Industrial	Multi-family residential	Public/open space	Rural	Single family residential	Mixed use
Willamette River-Boeckman Creek	815.8	1,224.8	1,246.6	4.0	3,548.2	371.4	0.0
Willamette-Lower Tualatin Rivers	725.7	598.0	580.3	0.0	4,806.1	4,273.1	0.0

SITE #3: Willamette River-Boeckman Creek subwatershed

Named tributaries: Boeckman Creek, Coffee Lake Creek, Corral Creek, Mill Creek, Molalla River, Newland Creek, Seely Ditch, Willamette River
Communities within the subwatershed: Wilsonville, unincorporated Clackamas County, unincorporated Multnomah County, unincorporated Washington County
Total acreage within Metro's boundary: 7,616.7 (includes combined – Corral Creek, Molalla River & Willamette River-Boeckman Creek subwatersheds)
Total acreage within riparian corridor: 2,251.7

This site contains three percent of the area comprising Metro's jurisdictional boundary. More than half of the site falls within the City of Wilsonville (58 percent), with another four percent in Tualatin, 15 percent in unincorporated Clackamas County, and 23 percent in unincorporated Multnomah County (Table B-6).

This site contains 8.7 miles of road per square mile, falling in the second quartile (26-50 percent of maximum) of the range of development compared to other resource sites (Table B-2). It is somewhat less developed than the other resource site in the B group. The zoning is dominated by rural development types, but industrial and multi-family residential uses are also important (Table B-5). More than 800 building permits have been issued in this site since 1996 (Table B-2).

Riparian resources. Approximately 22 percent of the land in this site is part of the riparian corridor inventory (Table 12), lower than the regional average of 31 percent; it contributes 2.4 percent of the region's total riparian resources (Table 13).

This resource site contains 31.5 total stream miles, with about 0.0029 non-piped stream miles per acre, ranking it 18th among all resource sites. Thirty percent of all stream miles are stream links, suggesting that a substantial amount of original streams have been piped or culverted (Table 12). However, only seven percent of non-piped stream miles are 303(d) quality-limited (Tables B-2 and B-3). Anadromous fish are known to be present in two stream miles (Table B-2). The floodplain and wetland areas each comprise approximately five percent of the total area within Metro's jurisdiction; about eight percent of the floodplain is developed (Table B-2).

The quality of the riparian resources is moderate for this site, with about 31 percent of the acreage within the riparian corridor inventory receiving primary scores for at least three of the five ecological functions. Fifty-three percent of the site's riparian corridors receive at least one primary ecological function score (Table B-9). More acreage within 300 feet of streams is in low-structure, non-woody vegetation than in woody and forested vegetation (Table B-4). Reflecting this, the highest percentage of land receiving a primary score is *Bank stabilization and pollution control* (Table B-8; see also Table 4 and Appendix 5 for description of ecological functions mapping). *Large wood and channel dynamics, Streamflow moderation and water storage, and Organic material sources* are also important primary functions provided within this resource site.

Wildlife habitat resources.
Including Habitats of Concern, 27 percent of the lands in this site fall within the wildlife habitat inventory, ranking it 10th of the 27 resource sites (Table 16). Within model patches, 24 percent fall within the top third of the point range (Table B-10). Of the four criteria in the GIS model,

this site tends to score low in size and habitat interior, moderate to high in water, and moderate to high in connectivity (Table B-11). In general, this site's wildlife habitats are characterized by well-connected habitat patches with good water resources.

Habitat types in this resource site are dominated by conifer/hardwood forest cover, but wetlands and agricultural lands also provide substantial habitat (Table B-15). This site contributes 365 acres of wetlands, or more than four percent of the region's total, ranking fifth among the 27 resource sites.

Species of Concern. Two Species of Concern sighting locations fall within the site. Each sighting may include one or more species; if a species occurs more than once in the resource site it is only listed once here. These include the following species:

- Red-legged frog
- Band-tailed Pigeon
- Pileated Woodpecker

There are very likely many other Species of Concern using this resource site, particularly those relying on Herbaceous Wetlands, and forested habitats (see Table B-15). Examples of species likely to occur in this site may be found by referencing the species list in Appendix 7 and identifying the species with a double "XX" under the habitat. General species needs and potential reasons for their decline are identified in the *Sensitive Species Accounts* section above. More detailed information on all species' needs can be obtained through Johnson and O'Neil (2001).

Habitats of Concern.
The following Habitats of Concern are partially or wholly within this resource site. Using the Unique ID # (UID), please refer to Appendix 8 for information concerning each Habitat of Concern:

- UID numbers: 152, 153, 156

Resource site data tables: Riparian Corridors

Table B-6. Acres within resource site by jurisdiction.

Jurisdiction	Acres within subwatershed
Tualatin	281.3
Wilsonville	4,387.7
Unincorporated Clackamas County	1,165.2
Unincorporated Washington County	1,782.6

Table B-7. Acres in Metro and riparian corridor.

Resource site	Total acres within Metro	Total acres within riparian corridor
Willamette River-Boeckman Creek	7,616.8	2,248.1

Table B-8. Number of acres within riparian corridor providing ecological function.

Resource site:	Ecological function	*Primary Value*		*Secondary Value*	
		Acres*	% of Total**	Acres	% of Total
Willamette River-Boeckman Creek	Microclimate & shade	443.2	19.7%	690.3	30.7%
	Streamflow moderation & water storage	626.1	27.9%	1,468.9	65.3%
	Bank stabilization & pollution control	974.9	43.4%	31.1	1.4%
	Large wood & channel dynamics	859.0	38.2%	118.6	5.3%
	Organic material sources	579.5	25.8%	75.5	3.4%

*Number of acres scored within the riparian corridor for each function
**Percent of total acres within the riparian corridor

Table B-9. Breakdown of ecological scores.

Resource site	Ecological Score	Acres	% of Total Acres
Willamette River-Boeckman Creek	1 to 5	1,058.1	47.1%
	6 to 11	288.3	12.8%
	12 to 17	196.0	8.7%
	18 to 23	202.6	9.0%
	24 to 29	321.0	14.3%
	30	182.1	8.1%
	Total acres	2,248.1	100.0%

Resource site data tables: Wildlife Habitat

Table B-10. Breakdown of total wildlife model patch scores.*

Resource site: Willamette River-Boeckman Creek	Number of acres in each wildlife score category									Total wildlife model patch acres in inventory
	1	2	3	4	5	6	7	8	9	
Model score	36.7	128.1	361.1	282.0	417.2	320.8	277.6	217.5	0.0	2,041.0
Percent of total	1.8%	6.3%	17.7%	13.8%	20.4%	15.7%	13.6%	10.7%	0.0%	100.0%

*Does not include Habitats of Concern outside of model patches.

Table B-11. Breakdown of total wildlife patch model scores by criteria.*

Resource site:	Number of acres by score for each model criterion												Total wildlife model patch acres in inventory
	Size[2]			Interior[2]			Water[3]			Connectivity			
	1	2	3	1	2	3	1	2	3	1	2	3	
Willamette River-Boeckman Creek	1,258.0	252.2	0.0	1,276.5	0.0	0.0	244.0	985.1	721.0	243.3	813.4	984.3	2,041.0
Percent of total acres in inventory	61.6%	12.4%	0.0%	62.5%	0.0%	0.0%	12.0%	48.3%	35.3%	11.9%	39.9%	48.2%	na

[1]Does not include Habitats of Concern outside of model patches.

[2]These numbers do not add up to 100.0% because Type 2 patches (low structure vegetation within 300 feet of streams and wetlands) were not ranked for these criteria.

[3]These numbers do not add up to 100% because not all patches contained or were near water resources.

Table B-12. Breakdown of total wildlife model patch area by 2000 Metro photo interpretation landcover and known wetlands.*

Resource site: Willamette River-Boeckman Creek	Low structure vegetation within 300 feet of stream		Forested vegetation	Forested wetlands	Grass/shrub wetlands within 300 feet of a stream	Other wetlands	Total wildlife model patch acres in inventory
	Low structure vegetation/ intact topsoil	Non-forest woody vegetation					
Acres	496.8	34.0	1,176.4	86.0	132.4	115.4	2,041.0
Percent of total	24.3%	1.7%	57.6%	4.2%	6.5%	5.7%	100.0%

*Does not include Habitats of Concern outside of model patches.

Table B-13. Total acres of inventoried wildlife habitat by type and total Species of Concern (SOCs).

Resource site: Willamette River-Boeckman Creek	Wildlife patches (acres)	HOCs inside Wildlife patches (acres)*	HOCs outside Wildlife patches (including wetlands <2 acres)	Total inventoried wildlife habitat acres	Total SOCs
Acres	2041.0	273.7	20.0	2061.0	2
Percent of total	99.0%	13.3%	1.0%	100.0%	N/A

*Habitats of Concern.

Table B-14. Total area of model patches and Habitats of Concern by 1998 Landsat Landcover Area.

Resource Site: Willamette River-Boeckman Creek Landcover type:	Total area of wildlife model patches	Total area of HOCs outside of modeled patches (including wetlands <2 acres)	Percent of total inventoried habitat
Water	18.79	0.1	0.9%
Barren	150.60	5.7	7.6%
Low structure agriculture	359.22	2.8	17.6%
High structure agriculture	26.00	0.1	1.3%
Deciduous closed canopy	179.76	0.4	8.7%
Mixed closed canopy	258.91	0.5	12.6%
Conifer closed canopy	198.48	0.3	9.6%
Deciduous open canopy	160.40	2.5	7.9%
Mixed open canopy	214.22	0.7	10.4%
Conifer open canopy	69.07	0.3	3.4%
Deciduous scattered canopy	68.78	1.4	3.4%
Mixed scattered canopy	38.56	0.6	1.9%
Conifer scattered canopy	10.24	0.6	0.5%
Closed canopy shrub	74.50	0.2	3.6%
Open canopy shrub	44.53	1.3	2.2%
Scattered canopy shrub	59.79	1.5	3.0%
Meadow/grass	109.14	1.2	5.4%
Not classified	0.00	0.0	0.0%
Total	**2,040.99**	**20.0**	**100.0%**

The table below provides estimates of each type of the habitats described in Metro's Metro's Technical Report for Fish and Wildlife Habitat, based on Johnson and O'Neil's (2001) habitat scheme. These numbers are provided for subwatershed comparison purposes and represent estimates of available habitat type. Several data types were used to compile this table, and the data sources vary in their precision. For example, the satellite data sources are less accurate than hand-digitized forest canopy cover. There is also slight overlap between certain habitat types. For example, Riparian Wetlands (RWET) are also partially included in Westside Lowland Coniferous Hardwood/Westside Oak and Douglas-fir (WLCH/WODF) because some wetlands also contain forest, and Open Water (WATR) is not always considered part of habitat patches. Therefore, the sums of these habitat types are slightly different from the "Total wildlife habitat acres in inventory" shown in Table 16. Nonetheless, these numbers provide a generalized means of comparing the quality and quantity of habitat available to wildlife among and between subwatersheds. Note also that the estimates for Westside Grasslands (WEGR) probably represent grasslands that are not native rather than true native grasslands, which are largely extirpated from the metro region.

Table B-15. Wildlife habitat availability[1] based on Johnson & O'Neil's (2001) habitat types and species-habitat associations.

Resource site:	Habitat type						
Willamette River-Boeckman Creek	WATR[2]	HWET[3]	RWET[3]	TOTWET[3]	WLCH/ WODF[4]	WEGR	AGPA
Total acres	123.5	247.8	86.0	365.0	1,205.6	217.4	388.1
Percent of total	6.0%	12.0%	4.2%	17.7%	58.5%	10.5%	18.8%

[1]See Table B-14 for land cover types and crosswalk to Johnson and O'Neil's classification scheme.

[2]Note that patch type and data limitations result in an underestimation of open water habitats. For example, medium and small sized stream surfaces are excluded.

[3]Note that HWET and RWET do not represent the full suite of wetlands because some wetlands <2 acres were added in as Habitats of Concern, and some wetlands could not be associated with herbaceous or forested habitats. TOTWET represents the best estimate of all existing wetlands because it includes Habitats of Concern.

[4]Data limitations make it impossible to distinguish between these two habitat types at this time, and no comprehensive oak habitat survey has been conducted for the region. However, known oak habitats are also included in HOCs (see Appendix 10).

SITE #4: Willamette River-Lower Tualatin River subwatershed

Named tributaries: Abernethy Creek, Beaver Creek, Canfield Creek, Holcomb Creek, Mud Creek, Newell Creek, Tanner Creek, Tualatin River, Willamette River
Communities within the subwatershed: Oregon City, West Linn, unincorporated Clackamas County
Total acreage within Metro's boundary: 11,403.7 (combined – Abernethy Creek-Holcomb Creek, Beaver Creek, Willamette River-Lower Tualatin River subwatersheds)
Total acreage within riparian corridor: 4,159.3
Other information: One dam with no known fishway

This site contains four percent of the area comprising Metro's jurisdictional boundary. Forty-one percent of this site is in Oregon City, 17 percent in West Linn, and the remainder (42 percent) is in unincorporated Clackamas County (Table B-16).

This site contains 11.6 miles of road per square mile; although more developed than the other Group B resource site, this site also falls within the second quartile (26-50 percent of maximum) of the range of development compared to all other sites (Table B-2). Rural and single family residential zoning dominates this site almost equally, compared to primarily rural in the other Group B site (Table B-5). More than 2,000 building permits have been issued here since 1996 (Table B-2).

Riparian resources. Thirty-seven percent of this site is part of the riparian corridor inventory (Table 12), and it contributes about four and one-half percent of the region's total riparian resources (Table 13).

This resource site contains 43 total stream miles, or 0.0031 miles of non-piped streams per acre, ranking it 17th among all resource sites. About eight miles, or 17 percent, are stream links and may be piped or culverted – although non-piped stream density is similar, the proportion of stream links in this site is smaller compared to Site #3 (Tables 12 and B-3). About 17 percent of non-piped stream miles are listed by the DEQ as 303(d) quality-limited, more than double that of Site #3 (Tables B-2 and B-3). Anadromous fish are known to be present in approximately nine stream miles (Table B-2). Of streams that are categorized, low to medium gradients are most common; 28 percent of the site is floodplain, and two percent is wetland (Table B-2 and B-3). Twenty percent of the floodplain is developed, substantially higher than the proportion in Site #3; in fact, this site ranks 8th among all 27 resource sites in terms of floodplain development (Table 14).

About 31 percent of this site's acreage within the riparian corridor inventory received primary scores for at least three of the five ecological functions. Over half of the site's riparian resources are limited to secondary functions, a high proportion compared to the previous three sites (Table B-19). The highest percentage of land receiving a primary score was evenly divided between *Large wood and channel dynamics* and *Bank stabilization and pollution control* (Table B-18; see also Table 4 and Appendix 5 for description of ecological functions mapping).

Wildlife habitat resources.
Including Habitats of Concern, 28 percent of the lands in this site fall within the wildlife habitat inventory, ranking it ninth of the 27 resource sites (Table 16). Within model patches, only eight percent fall within the top third of the point range (Table B-20). Of the four criteria in the GIS

model, this site tends to score low in size and habitat interior, moderate in water resources, and high in connectivity (Table B-21). In general, this site's wildlife habitats are characterized by well-connected (but not very large) habitat patches with moderate water resources.

Habitat types in this resource site are strongly dominated by conifer/hardwood forest cover, but Open Water also provides substantial habitat (Table B-25). This site contributes 86 acres of wetlands, or more one percent of the region's total, ranking 20th among the 27 resource sites.

Species of Concern. Ten Species of Concern sighting locations fall within the site. Each sighting may include one or more species; if a species occurs more than once in the resource site it is only listed once here. These include the following species:

- Painted turtle
- Western pond turtle
- Band-tailed Pigeon
- Pileated Woodpecker
- Great Blue Heron nesting colony
- Peregrine Falcon
- *Aster curtus* (plant species)
- *Delphinium leucophaeum* (plant species)

There are very likely many other Species of Concern using this resource site, particularly those relying on Open Water and forested habitats (see Table B-15). Examples of species likely to occur in this site may be found by referencing the species list in Appendix 7 and identifying the species with a double "XX" under the habitat. General species needs and potential reasons for their decline are identified in the *Sensitive Species Accounts* section above. More detailed information on all species' needs can be obtained through Johnson and O'Neil (2001).

Habitats of Concern.
The following Habitats of Concern are partially or wholly within this resource site. Using the Unique ID # (UID), please refer to Appendix 8 for information concerning each Habitat of Concern:

- UID numbers: 119, 145, 148, 149, 150

Resource site data tables: Riparian Corridors

Table B-16. Acres within resource site by jurisdiction.

Jurisdiction	Acres within subwatershed
Oregon City	4,661.5
West Linn	1,900.7
Unincorporated Clackamas County	4,841.6

Table B-17. Acres in Metro and riparian corridor.

Resource site	Total acres within Metro	Total acres within riparian corridor
Willamette-Lower Tualatin Rivers	11,403.7	4,172.2

Table B-18. Number of acres within riparian corridor providing ecological function.

Resource site:	Ecological function	*Primary Value*		*Secondary Value*	
		Acres*	% of Total**	Acres	% of Total
Willamette-Lower Tualatin Rivers	Microclimate & shade	639.9	15.3%	1,588.8	38.1%
	Streamflow moderation & water storage	998.9	23.9%	3,016.7	72.3%
	Bank stabilization & pollution control	1,652.7	39.6%	474.3	11.4%
	Large wood & channel dynamics	1,617.6	38.8%	318.5	7.6%
	Organic material sources	699.8	16.8%	220.4	5.3%

*Number of acres scored within the riparian corridor for each function
**Percent of total acres within the riparian corridor

Table B-19. Breakdown of ecological scores.

Resource site	Ecological Score	Acres	% of Total Acres
Willamette-Lower Tualatin Rivers	1 to 5	2,281.1	54.7%
	6 to 11	292.0	7.0%
	12 to 17	318.1	7.6%
	18 to 23	658.1	15.8%
	24 to 29	408.2	9.8%
	30	214.7	5.1%
	Total acres	4,172.2	100.0%

Resource site data tables: Wildlife Habitat

Table B-20. Breakdown of total wildlife model patch scores.*

Resource site: Willamette-Lower Tualatin Rivers	Number of acres in each wildlife score category									Total wildlife model patch acres in inventory
	1	2	3	4	5	6	7	8	9	
Model score	41.6	237.2	385.7	191.2	371.6	1,736.6	28.5	240.3	0.0	3,232.5
Percent of total	1.3%	7.3%	11.9%	5.9%	11.5%	53.7%	0.9%	7.4%	0.0%	100.0%

*Does not include Habitats of Concern outside of model patches.

Table B-21. Breakdown of total wildlife model patch scores by criteria.*

Resource site: Willamette-Lower Tualatin Rivers	Number of acres by score for each model criterion												Total wildlife model patch acres in inventory
	Size[2]			Interior[2]			Water[3]			Connectivity			
	1	2	3	1	2	3	1	2	3	1	2	3	
Model score	1,859.5	897.8	0.0	2,118.9	240.3	0.0	800.1	1,979.6	291.4	384.6	747.3	2,100.6	3,232.5
Percent of total acres in inventory	57.5%	27.8%	0.0%	65.6%	7.4%	0.0%	24.8%	61.2%	9.0%	11.9%	23.1%	65.0%	na

[1]Does not include Habitats of Concern outside of model patches.

[2]These numbers do not add up to 100.0% because Type 2 patches (low structure vegetation within 300 feet of streams and wetlands) were not ranked for these criteria.

[3]These numbers do not add up to 100% because not all patches contained or were near water resources.

Table B-22. Breakdown of total wildlife model patch area by 2000 Metro photo interpretation landcover and known wetlands.*

Resource site: Willamette-Lower Tualatin Rivers	Low structure vegetation within 300 feet of stream		Forested vegetation	Forested wetlands	Grass/shrub wetlands within 300 feet of a stream	Other wetlands	Total wildlife model patch acres in inventory
	Low structure vegetation/ intact topsoil	Non-forest woody vegetation					
Acres	401.9	73.3	2,678.2	18.1	12.1	48.9	3,232.5
Percent of total	12.4%	2.3%	82.9%	0.6%	0.4%	1.5%	100.0%

*Does not include Habitats of Concern outside of model patches.

Table B-23. Total acres of inventoried wildlife habitat by type and total Species of Concern (SOCs).

Resource site: Willamette-Lower Tualatin Rivers	Wildlife patches (acres)	HOCs inside Wildlife patches (acres)*	HOCs outside Wildlife patches (including wetlands <2 acres)	Total inventoried wildlife habitat acres	Total SOCs
Acres	3232.5	767.8	7.7	3240.3	10
Percent of total	99.8%	23.7%	0.2%	100.0%	N/A

*Habitats of Concern.

Table B-24. Total area of model patches and Habitats of Concern by 1998 Landsat Landcover Area.

Resource Site: Willamette-Lower Tualatin Rivers Landcover type:	Total area of wildlife model patches	Total area of HOCs outside of modeled patches (including wetlands <2 acres)	Percent of total inventoried habitat
Water	31.60	3.7	1.1%
Barren	172.38	0.3	5.3%
Low structure agriculture	98.22	0.0	3.0%
High structure agriculture	11.73	0.0	0.4%
Deciduous closed canopy	664.16	0.4	20.5%
Mixed closed canopy	701.24	0.9	21.7%
Conifer closed canopy	283.85	0.6	8.8%
Deciduous open canopy	507.43	0.3	15.7%
Mixed open canopy	111.03	0.1	3.4%
Conifer open canopy	13.81	0.3	0.4%
Deciduous scattered canopy	132.08	0.1	4.1%
Mixed scattered canopy	68.51	0.0	2.1%
Conifer scattered canopy	13.50	0.2	0.4%
Closed canopy shrub	148.87	0.3	4.6%
Open canopy shrub	57.70	0.0	1.8%
Scattered canopy shrub	96.57	0.2	3.0%
Meadow/grass	119.24	0.5	3.7%
Not classified	0.60	0.0	0.0%
Total	**3,232.52**	**7.7**	**100.0%**

The table below provides estimates of each type of the habitats described in Metro's Metro's Technical Report for Fish and Wildlife Habitat, based on Johnson and O'Neil's (2001) habitat scheme. These numbers are provided for subwatershed comparison purposes and represent *estimates* of available habitat type. Several data types were used to compile this table, and the data sources vary in their precision. For example, the satellite data sources are less accurate than hand-digitized forest canopy cover. There is also slight overlap between certain habitat types. For example, Riparian Wetlands (RWET) are also partially included in Westside Lowland Coniferous Hardwood/Westside Oak and Douglas-fir (WLCH/WODF) because some wetlands also contain forest, and Open Water (WATR) is not always considered part of habitat patches. Therefore, the sums of these habitat types are slightly different from the "Total wildlife habitat acres in inventory" shown in Table 16. Nonetheless, these numbers provide a generalized means of comparing the quality and quantity of habitat available to wildlife among and between subwatersheds. Note also that the estimates for Westside Grasslands (WEGR) probably represent grasslands that are not native rather than true native grasslands, which are largely extirpated from the metro region.

Table B-25. Wildlife habitat availability[1] based on Johnson & O'Neil's (2001) habitat types and species-habitat associations.

Resource site:	Habitat type						
Willamette-Lower Tualatin Rivers	WATR[2]	HWET[3]	RWET[3]	TOTWET[3]	WLCH/ WODF[4]	WEGR	AGPA
Total acres	575.7	61.0	18.1	85.7	2,498.5	274.1	109.9
Percent of total	17.8%	1.9%	0.6%	2.6%	77.1%	8.5%	3.4%

[1]See Table B-24 for land cover types and crosswalk to Johnson and O'Neil's classification scheme.

[2]Note that patch type and data limitations result in an underestimation of open water habitats. For example, medium and small sized stream surfaces are excluded.

[3]Note that HWET and RWET do not represent the full suite of wetlands because some wetlands <2 acres were added in as Habitats of Concern, and some wetlands could not be associated with herbaceous or forested habitats. TOTWET represents the best estimate of all existing wetlands because it includes Habitats of Concern.

[4]Data limitations make it impossible to distinguish between these two habitat types at this time, and no comprehensive oak habitat survey has been conducted for the region. However, known oak habitats are also included in HOCs (see Appendix 10).

C. Dairy Creek and Gales Creek

General watershed information

Resource sites within the Dairy Creek Watershed include:

- Council Creek subwatershed (combines West Fork Dairy Creek, Council Creek, Middle Tualatin River-Gales Creek subwatersheds)
- McKay Creek subwatershed

Watershed assessments and plans

Breuner, Nancy, 1998. *Gales Creek Watershed Assessment Project,* Tualatin River Watershed Council: Hillsboro, Oregon.

Bureau of Land Management, U.S. Department of the Interior (BLM), 1999. *Dairy-McKay Watershed Analysis,* BLM, Salem District Office, Tillamook Resource Area: Tillamook, Oregon.

Lev, Esther, 1990. *Inventory of Wetlands, Riparian and Upland Wildlife Habitat Areas in Hillsboro, Oregon,* Environmental Consulting: Portland, Oregon.

Oregon Department of Fish and Wildlife (ODFW) and Unified Sewage Agency (USA), 1995. *Distribution of Fish and Crayfish and Measurement of Available Habitat in the Tualatin River Basin, Final Report of Research,* ODFW: Portland, Oregon and Unified Sewage Agency: Hillsboro, Oregon.

Tualatin River Watershed Council, 1999. *Tualatin River Watershed, Action Plan,* Tualatin River Watershed Council: Hillsboro, Oregon.

Tualatin Watershed Council, 2001. *Tualatin River Watershed Atlas,* Tualatin Watershed Council: Hillsboro, Oregon

Watershed councils and related groups

Banks Watershed Council, P.O. Box 428, Banks 97106

Fernhill Marsh Wetland Management Council, PO Box 373, Forest Grove 97116, 503-357-2319, Greg Johnson

Tualatin WC, 1080 SW Baseline, Bldg. B, Suite B-2, Hillsboro 97123, (503) 681-0953, FAX (503) 681-9772

Tualatin River National Wildlife Refuge, City of Sherwood, 90 NW Park Street, Sherwood 97140, 503-625-5522, Joan Patterson

Tualatin River Rangers, USA, 155 N First Ave., Hillsboro 97124, 503-640-3516, Linda Kelly

Tualatin Riverkeepers, 16340 SW Beef Bend Road, Sherwood 97140, 503-590-5813, Lauri Mullen

Wetlands, Friends of, 503-253-6247, Alice Blatt

Yamhill Basin Council, 2200 SW 2nd Street, McMinnville 97128, 503-472-6403, Melissa Leoni

Data descriptions

Table C-1 provides information about the subwatersheds within each watershed, the HUC code, and the acres inside Metro's jurisdictional boundary. Keying in on the resource site number will show how the subwatersheds are aggregated into the resource sites listed above.

The Dairy Creek watershed contains three subwatersheds that are partially located within Metro's boundary: West Fork Dairy Creek, Council Creek, and McKay Creek. Within the Gales

Creek watershed, one subwatershed (Middle Tualatin River – Gales Creek) is in Metro's boundary. The West Fork Dairy Creek, Council Creek, and Middle Tualatin River-Gales Creek subwatersheds are combined to comprise one resource site (now referred to the Council Creek subwatershed, or Resource Site #5). The McKay Creek subwatershed comprises Resource Site #6.

Tables C-1 and C-2 provide general description about the 5th field and 6th field HUCs. Below these tables are descriptions of the riparian and wildlife habitat resources resource site.

Watershed data tables

Table C-1. Watersheds (5th level HUC), subwatersheds (6th level HUC), and acres within Metro jurisdictional boundary.

Watershed (5th level HUC)	5th field HUC code	Resource site #	Subwatershed (6th level HUC)	6th field HUC code	Acres in Metro
Dairy Creek	1709001001	5	West Fork Dairy Creek	170900100106	36.1
			Council Creek	170900100107	2,924.9
		6	McKay Creek	170900100108	3,842.7
Gales Creek	1709001002	5	Middle Tualatin River-Gales Creek	170900100206	2,747.2

Table C-2. Resource sites: general information.

General information	Council	McKay
Miles of DEQ 303(d) listed streams	6.0	1.1
Road density (road miles/square miles in subwatershed)	12.7	12.8
Miles of stream with known anadromous fish presence	2.0	1.1
Acres of hydrologically connected wetlands	255.6	138.9
Total acres of wetlands	256.5	138.9
Acres of floodplains (100 year FEMA + 1996 inundation area)	626.0	344.9
Acres of developed floodplains	24.2	26.4
Building permits since 1996 (number)	1,016.0	1,055.0

Table C-3. Characteristics of stream miles by resource site.

Resource site	Stream miles by channel type		Miles of stream links*	Miles of streams not categorized by channel type	Total stream miles
	Low to medium	*High*			
Council Creek	10.4	0.0	5.4	5.4	21.3
McKay Creek	5.2	0.0	3.8	3.0	12.1

*Stream links are links between surface streams and may be piped or culverted.

Table C-4. Riparian vegetation by resource site.

Resource site	Vegetation types within 300 feet of a stream (acres)			Forested vegetation >300 feet from a stream
	Low structure vegetation/intact topsoil	Non-forest woody vegetation	Forested vegetation	
Council Creek	518.4	2.7	167.4	140.6
McKay Creek	303.5	3.8	127.3	73.9

Table C-5. Regional zoning by resource site.

Resource site	Acres by zone within each resource site						
	Commercial	Industrial	Multi-family residential	Public/open space	Rural	Single family residential	Mixed use
Council Creek	275.9	838.5	643.6	5.1	1,426.8	1,617.3	137.2
McKay Creek	557.5	1,201.5	73.8	0.0	178.7	1,680.2	125.8

SITE #5: Council Creek subwatershed

Named streams/rivers: Council Creek, Dairy Creek, Gales Creek, McKay Creek, Tualatin River
Communities within the subwatershed: Cornelius, Forest Grove, Hillsboro, unincorporated Washington County
Total acreage within Metro's boundary: 5,708.1 (combined – West Fork Dairy Creek, Council Creek, Middle Tualatin River-Gales Creek)
Total acres within riparian corridor: 1,142.3

This site contains two percent of the area comprising Metro's jurisdictional boundary. Fifty-three percent of the site is in the City of Forest Grove, 21 percent is in Cornelius, and less than one percent falls in the City of Hillsboro. The remainder (26 percent) is in unincorporated Washington County (Table C-6).

This resource site, similar to the other site in Group C, falls near the midpoint of the range of development compared to other sites, with 12.7 miles of roads per square mile (Table C-2). Single family residential is the dominant zoning pattern, followed closely by rural; industrial and residential uses are also important in this resource site (Table C-5). Agriculture is a common land use. Over a thousand building permits have been issued here since 1996 (Table C-2).

Riparian resources. Compared to the previous four resource sites, the two sites within Group C contain relatively smaller proportions of riparian resources. Lands within the riparian corridor inventory comprise about 20 percent of total lands in this subwatershed. The site contributes less than one percent of the region's riparian corridors, but that statistic is influenced by the relatively small amount of Site #5's area falling within the Metro boundary (Tables 12 and 13).

This resource site contains approximately 21 total stream miles (Table C-3), or 0.0028 miles of non-piped streams per acre, ranking it 20th among the 27 resource sites (Table 12). About 25 percent of all stream miles are stream links, suggesting a relatively high amount of piping/culverting (Table C-3); 38 percent of non-piped streams are DEQ 303(d) water-quality limited (Tables C-2 and C-3). The dominant stream gradient in this resource site is low to medium (Table C-3); 11 percent of the site is in the floodplain, with more than four percent of the land covered by wetland resources (Table C-2). Less than four percent of the floodplain is developed. Anadromous fish are known to be present in two stream miles (Table C-2).

About 38 percent of the acreage that falls within the riparian corridor inventory in this site received primary scores for at least three of the five ecological functions (Table C-9). Seventy-three percent of the site's riparian corridors receive at least one primary ecological function score, reflecting the relatively rural/agricultural nature of this resource site that tends toward more vegetation near the stream compared to urbanized areas (Table C-9). Low structure vegetation/intact topsoil is the dominant vegetation cover within 300 ft of streams (Table C-4). The percentage of land receiving a given primary score was divided relatively evenly between *Large wood and channel dynamics* and *Streamflow moderation and water storage* (Table C-8). However, *Bank stabilization and pollution control* and *Organic material sources* were also important primary functions (Table C-8; see also Table 4 and Appendix 5 for description of ecological functions mapping).

Wildlife habitat resources.
Including Habitats of Concern, 16 percent of the lands in this site fall within the wildlife habitat inventory, ranking it 25th of the 27 resource sites (Table 16). Within model patches, only seventeen percent fall within the top third of the point range (Table C-10). Of the four criteria in the GIS model, this site tends to score low in size and habitat interior, moderate to high in water resources, and moderate in connectivity (Table C-11). In general, this site's wildlife habitat patches are characterized by moderate fragmentation with fairly good water resources.

Habitat types in this resource site are co-dominated by conifer/hardwood forest cover, agricultural lands and wetlands (Table C-15). Wetlands are a very important habitat type in this resource site, comprising an estimated 28 percent of lands. Despite the relatively small amount of acreage falling within the Metro boundary, the site contributes three percent of the region's total wetlands, ranking 10th among the 27 resource sites.

Species of Concern. Two Species of Concern sighting locations fall within the site. Each sighting may include one or more species; if a species occurs more than once in the resource site it is only listed once here. These include the following species:

- Great Blue Heron nesting colony
- Western Meadowlark
- Acorn Woodpecker
- Northern Goshawk
- Merlin

There are very likely many other Species of Concern using this resource site, particularly those relying on wetlands, forested habitats and agricultural lands, which often serve as a surrogate for native grassland habitats (for example, the Meadowlark and Merlin sightings; see Table C-15). Examples of species likely to occur in this site may be found by referencing the species list in Appendix 7 and identifying the species with a double "XX" under the habitat. General species needs and potential reasons for their decline are identified in the *Sensitive Species Accounts* section above. More detailed information on all species' needs can be obtained through Johnson and O'Neil (2001).

Habitats of Concern.
The following Habitats of Concern are partially or wholly within this resource site. Using the Unique ID # (UID), please refer to Appendix 8 for information concerning each Habitat of Concern:

- UID numbers: 38, 39, 41, 43, 44, 45, 46, 165

Resource site data tables: Riparian Corridors

Table C-6. Acres within resource site by jurisdiction.

Jurisdiction	Acres within subwatershed
Cornelius	1,190.5
Forest Grove	3,040.6
Hillsboro	0.6
Unincorporated Washington County	1,471.1

Table C-7. Acres in Metro and riparian corridor.

Resource site	Total acres within Metro	Total acres within riparian corridor
Council Creek	5,708.2	1,142.4

Table C-8. Number of acres within riparian corridor providing ecological function.

Resource site:	Ecological function	*Primary Value*		*Secondary Value*	
		Acres*	% of Total**	Acres	% of Total
Council Creek	Microclimate & shade	146.4	12.8%	120.8	10.6%
	Streamflow moderation & water storage	655.4	57.4%	443.0	38.8%
	Bank stabilization & pollution control	542.6	47.5%	9.8	0.9%
	Large wood & channel dynamics	716.9	62.8%	26.5	2.3%
	Organic material sources	401.1	35.1%	14.1	1.2%

*Number of acres scored within the riparian corridor for each function
**Percent of total acres within the riparian corridor

Table C-9. Breakdown of ecological scores.

Resource site	Ecological Score	Acres	% of Total Acres
Council Creek	1 to 5	309.3	27.1%
	6 to 11	106.2	9.3%
	12 to 17	298.5	26.1%
	18 to 23	54.0	4.7%
	24 to 29	274.9	24.1%
	30	99.5	8.7%
	Total acres	1,142.4	100.0%

Resource site data tables: Wildlife Habitat

Table C-10. Breakdown of total wildlife model patch scores.*

Resource site: Council Creek	Number of acres in each wildlife score category: 1	2	3	4	5	6	7	8	9	Total wildlife model patch acres in inventory
Model score	23.7	56.0	315.7	93.0	143.6	114.8	154.5	0.0	0.0	901.4
Percent of total	2.6%	6.2%	35.0%	10.3%	15.9%	12.7%	17.1%	0.0%	0.0%	100.0%

*Does not include Habitats of Concern outside of model patches.

Table C-11. Breakdown of total wildlife patch model scores by criteria.*

Resource site:	Number of acres by score for each model criterion												Total wildlife model patch acres in inventory
	Size[2]			Interior[2]			Water[3]			Connectivity			
Council Creek	1	2	3	1	2	3	1	2	3	1	2	3	
	484.5	0.0	0.0	315.6	0.0	0.0	7.4	502.8	363.3	108.6	545.1	247.7	901.4
Percent of total acres in inventory	53.7%	0.0%	0.0%	35.0%	0.0%	0.0%	0.8%	55.8%	40.3%	12.0%	60.5%	27.5%	na

[1]Does not include Habitats of Concern outside of model patches.

[2]These numbers do not add up to 100.0% because Type 2 patches (low structure vegetation within 300 feet of streams and wetlands) were not ranked for these criteria.

[3]These numbers do not add up to 100% because not all patches contained or were near water resources.

Table C-12. Breakdown of total wildlife model patch area by 2000 Metro photo interpretation landcover and known wetlands.*

Resource site: Council Creek	Low structure vegetation within 300 feet of stream: Low structure vegetation/ intact topsoil	Low structure vegetation within 300 feet of stream: Non-forest woody vegetation	Forested vegetation	Forested wetlands	Grass/shrub wetlands within 300 feet of a stream	Other wetlands	Total wildlife model patch acres in inventory
Acres	414.0	2.9	238.5	29.5	87.1	129.4	901.4
Percent of total	45.9%	0.3%	26.5%	3.3%	9.7%	14.4%	100.0%

*Does not include Habitats of Concern outside of model patches.

Table C-13. Total acres of inventoried wildlife habitat by type and total Species of Concern (SOCs).

Resource site: Council Creek	Wildlife patches (acres)	HOCs inside Wildlife patches (acres)*	HOCs outside Wildlife patches (including wetlands <2 acres)	Total inventoried wildlife habitat acres	Total SOCs
Acres	901.4	230.4	11.1	912.5	2
Percent of total	98.8%	25.3%	1.2%	100.0%	N/A

*Habitats of Concern.

Table C-14. Total area of model patches and Habitats of Concern by 1998 Landsat Landcover Area.

Resource Site: Council Creek Landcover type:	Total area of wildlife model patches	Total area of HOCs outside of modeled patches (including wetlands <2 acres)	Percent of total inventoried habitat
Water	49.23	0.0	5.4%
Barren	66.91	4.4	7.8%
Low structure agriculture	238.12	2.7	26.4%
High structure agriculture	40.57	0.0	4.4%
Deciduous closed canopy	51.57	0.1	5.7%
Mixed closed canopy	70.59	0.5	7.8%
Conifer closed canopy	28.77	0.2	3.2%
Deciduous open canopy	28.08	0.4	3.1%
Mixed open canopy	21.57	0.7	2.4%
Conifer open canopy	2.37	0.1	0.3%
Deciduous scattered canopy	48.26	0.6	5.4%
Mixed scattered canopy	32.61	0.4	3.6%
Conifer scattered canopy	4.47	0.0	0.5%
Closed canopy shrub	24.43	0.0	2.7%
Open canopy shrub	21.71	0.2	2.4%
Scattered canopy shrub	45.55	0.3	5.0%
Meadow/grass	126.60	0.6	13.9%
Not classified	0.02	0.0	0.0%
Total	**901.41**	**11.1**	**100.0%**

The table below provides estimates of each type of the habitats described in Metro's Technical Report for Fish and Wildlife Habitat, based on Johnson and O'Neil's (2001) habitat scheme. These numbers are provided for subwatershed comparison purposes and represent estimates of available habitat type. Several data types were used to compile this table, and the data sources vary in their precision. For example, the satellite data sources are less accurate than hand-digitized forest canopy cover. There is also slight overlap between certain habitat types. For example, Riparian Wetlands (RWET) are also partially included in Westside Lowland Coniferous Hardwood/Westside Oak and Douglas-fir (WLCH/WODF) because some wetlands also contain forest, and Open Water (WATR) is not always considered part of habitat patches. Therefore, the sums of these habitat types are slightly different from the "Total wildlife habitat acres in inventory" shown in Table 16. Nonetheless, these numbers provide a generalized means of comparing the quality and quantity of habitat available to wildlife among and between subwatersheds. Note also that the estimates for Westside Grasslands (WEGR) probably represent grasslands that are not native rather than true native grasslands, which are largely extirpated from the metro region.

Table C-15. Wildlife habitat availability[1] based on Johnson & O'Neil's (2001) habitat types and species-habitat associations.

Resource site:	Habitat type						
Council Creek	WATR[2]	HWET[3]	RWET[3]	TOTWET[3]	WLCH/ WODF[4]	WEGR	AGPA
Total acres	20.7	216.5	29.5	256.5	291.2	194.9	281.4
Percent of total	2.3%	23.7%	3.2%	28.1%	31.9%	21.4%	30.8%

[1]See Table C-14 for land cover types and crosswalk to Johnson and O'Neil's classification scheme.

[2]Note that patch type and data limitations result in an underestimation of open water habitats. For example, medium and small sized stream surfaces are excluded.

[3]Note that HWET and RWET do not represent the full suite of wetlands because some wetlands <2 acres were added in as Habitats of Concern, and some wetlands could not be associated with herbaceous or forested habitats. TOTWET represents the best estimate of all existing wetlands because it includes Habitats of Concern.

[4]Data limitations make it impossible to distinguish between these two habitat types at this time, and no comprehensive oak habitat survey has been conducted for the region. However, known oak habitats are also included in HOCs (see Appendix 10).

SITE #6: McKay Creek subwatershed

Named streams/rivers: Dairy Creek, McKay Creek, Warble Gulch
Communities within the subwatershed: Hillsboro, unincorporated Washington County
Total acreage within Metro's boundary: 3,842.7
Total acres within the riparian corridor: 677.9

This site contains one percent of the area comprising Metro's jurisdictional boundary. Most of this site (91 percent) is in the City of Hillsboro, with the remainder in unincorporated Washington County (Table C-16).

This resource site falls close to the midpoint of development compared to all other sites, with 12.8 miles of road per square mile (Table C-2). Zoning is primarily single family residential and industrial (Table C-5). More than a thousand building permits have been issued here since 1996 (Table C-2).

Riparian resources. As with the other resource site in Group C, Site #6 contains a relatively smaller proportion of riparian resources compared to the first four resource sites described. Lands within the riparian corridor inventory comprise about 17 percent of total lands in this subwatershed (Table 12). The site contributes less than one percent of the region's riparian corridors, but that statistic is influenced by the relatively small amount of Site #6's area falling within the Metro boundary (Tables 12 and 13).

This resource site has a relatively low stream density, with approximately 12 total stream miles, or 0.0022 miles of non-piped streams per acre, ranking it 23rd out of the 27 resource sites (Table 12). About 31 percent of all stream miles are stream links, suggesting a relatively high amount of piping/culverting (Table C-3); 13 percent of non-piped streams are DEQ 303(d) water-quality limited (Tables C-2 and C-3). The dominant stream gradient in this resource site is low to medium (Table C-3); nine percent of the site is in the floodplain, with approximately four percent of the land covered by wetland resources (Table C-2). Less than eight percent of the floodplain is developed. Anadromous fish are known to be present in one stream mile (Table C-2).

Forty-four percent of the acreage that falls within the riparian corridor inventory in this site received primary scores for at least three of the five ecological functions (Table C-19). Seventy-one percent of the site's riparian corridors receive at least one primary ecological function score, reflecting the relatively rural/agricultural nature of this resource site that tends toward more vegetation near the stream compared to urbanized areas (Table C-19). Low structure vegetation/intact topsoil is the dominant vegetation cover within 300 ft of streams; however, there is relatively more forest cover along streams here than in Site #5 (Table C-4). The percentage of land receiving a given primary score was divided relatively evenly between *Large wood and channel dynamics*, *Bank stabilization and pollution control*, and *Streamflow moderation and water storage* (Table C-18). However, *Organic material sources* were also important primary functions (Table C-18; see also Table 4 and Appendix 5 for description of ecological functions mapping).

Wildlife habitat resources.
Including Habitats of Concern, 13 percent of the lands in this site fall within the wildlife habitat inventory, ranking it last among the 27 resource sites. However, note that the small amount of

this site's land within the Metro boundary may not be characteristic of the entire subwatershed (Table 16). Within model patches, only ten percent fall within the top third of the point range (Table C-20). Of the four criteria in the GIS model, this site tends to score low in size and habitat interior, moderate to high in water resources, and moderate in connectivity, similar to the other resource site in Group C (Table C-21). In general, this site's wildlife habitat patches are characterized by moderate fragmentation with fairly good water resources.

Habitat types in this resource site are co-dominated by conifer/hardwood forest cover, agricultural lands and wetlands (Table C-25). Similar to Site #5, wetlands are a very important habitat type in this resource site, comprising an estimated 29 percent of lands in the resource site. Relative to the site's amount of land within the Metro boundary, it contributes a relatively large percentage of the region's total wetlands (two percent) and ranks 15th among the 27 resource sites.

Species of Concern. There are no recorded Species of Concern sighting locations within this resource site. However, it is likely that this simply indicates a lack of survey data. There are very likely Species of Concern using this resource site, particularly those relying on wetlands, forested habitats and agricultural lands, which often serve as a surrogate for native grassland habitats (see Table C-25). Examples of species likely to occur in this site may be found by referencing the species list in Appendix 7 and identifying the species with a double "XX" under the habitat. General species needs and potential reasons for their decline are identified in the *Sensitive Species Accounts* section above. More detailed information on all species' needs can be obtained through Johnson and O'Neil (2001).

Habitats of Concern.
The following Habitats of Concern are partially or wholly within this resource site. Using the Unique ID # (UID), please refer to Appendix 8 for information concerning each Habitat of Concern:

UID numbers: 40, 45, 46, 47, 59, 60

Resource site data tables: Riparian Corridors

Table C-16. Acres within resource site by jurisdiction.

Jurisdiction	Acres within subwatershed
Hillsboro	3,500.6
Unincorporated Washington County	336.7

Table C-17. Acres in Metro and riparian corridor.

Resource site	Total acres within Metro	Total acres within riparian corridor
McKay Creek	3,842.7	635.8

Table C-18. Number of acres within riparian corridor providing ecological function.

Resource site:	Ecological function	*Primary Value*		*Secondary Value*	
		Acres*	% of Total**	Acres	% of Total
McKay Creek	Microclimate & shade	137.1	21.6%	53.1	8.3%
	Streamflow moderation & water storage	361.6	56.9%	254.5	40.0%
	Bank stabilization & pollution control	334.0	52.5%	0.0	0.0%
	Large wood & channel dynamics	384.0	60.4%	10.0	1.6%
	Organic material sources	274.9	43.2%	3.3	0.5%

*Number of acres scored within the riparian corridor for each function
**Percent of total acres within the riparian corridor

Table C-19. Breakdown of ecological scores.

Resource site	Ecological Score	Acres	% of Total Acres
McKay Creek	1 to 5	182.2	28.7%
	6 to 11	56.3	8.8%
	12 to 17	120.3	18.9%
	18 to 23	19.6	3.1%
	24 to 29	151.4	23.8%
	30	106.0	16.7%
	Total acres	635.8	100.0%

Resource site data tables: Wildlife Habitat

Table C-20. Breakdown of total wildlife model patch scores.*

Resource site: McKay Creek	Number of acres in each wildlife score category									Total wildlife model patch acres in inventory
	1	2	3	4	5	6	7	8	9	
Model score	20.3	54.2	152.9	68.0	40.3	97.4	21.5	28.0	0.0	482.7
Percent of total	4.2%	11.2%	31.7%	14.1%	8.4%	20.2%	4.5%	5.8%	0.0%	100.0%

*Does not include Habitats of Concern outside of model patches.

Table C-21. Breakdown of total wildlife model patch scores by criteria.*

Resource site: McKay Creek	Number of acres by score for each model criterion												Total wildlife model patch acres in inventory
	Size[2]			Interior[2]			Water[3]			Connectivity			
	1	2	3	1	2	3	1	2	3	1	2	3	
Model score	234.1	28.0	0.0	179.0	0.0	0.0	2.4	234.2	225.8	148.1	266.2	68.4	482.7
Percent of total acres in inventory	48.5%	5.8%	0.0%	37.1%	0.0%	0.0%	0.5%	48.5%	46.8%	30.7%	55.1%	14.2%	na

[1]Does not include Habitats of Concern outside of model patches.

[2]These numbers do not add up to 100.0% because Type 2 patches (low structure vegetation within 300 feet of streams and wetlands) were not ranked for these criteria.

[3]These numbers do not add up to 100% because not all patches contained or were near water resources.

Table C-22. Breakdown of total wildlife model patch area by 2000 Metro photo interpretation landcover and known wetlands.*

Resource site: McKay Creek	Low structure vegetation within 300 feet of stream		Forested vegetation	Forested wetlands	Grass/shrub wetlands within 300 feet of a stream	Other wetlands	Total wildlife model patch acres in inventory
	Low structure vegetation/ intact topsoil	Non-forest woody vegetation					
Acres	220.6	0.0	125.2	58.9	69.9	8.2	482.7
Percent of total	45.7%	0.0%	25.9%	12.2%	14.5%	1.7%	100.0%

*Does not include Habitats of Concern outside of model patches.

Table C-23. Total acres of inventoried wildlife habitat by type and total Species of Concern (SOCs).

Resource site: McKay Creek	Wildlife patches (acres)	HOCs inside Wildlife patches (acres)*	HOCs outside Wildlife patches (including wetlands <2 acres)	Total inventoried wildlife habitat acres	Total SOCs
Acres	482.7	74.6	1.6	484.4	0
Percent of total	99.7%	15.4%	0.3%	100.0%	N/A

*Habitats of Concern.

Table C-24. Total area of model patches and Habitats of Concern by 1998 Landsat Landcover Area.

Resource Site: McKay Creek / Landcover type:	Total area of wildlife model patches	Total area of HOCs outside of modeled patches (including wetlands <2 acres)	Percent of total inventoried habitat
Water	0.00	0.0	0.0%
Barren	49.76	0.0	10.3%
Low structure agriculture	162.02	0.7	33.6%
High structure agriculture	2.70	0.0	0.6%
Deciduous closed canopy	39.44	0.1	8.2%
Mixed closed canopy	37.90	0.0	7.8%
Conifer closed canopy	16.86	0.0	3.5%
Deciduous open canopy	26.87	0.0	5.6%
Mixed open canopy	24.52	0.0	5.1%
Conifer open canopy	3.50	0.0	0.7%
Deciduous scattered canopy	20.48	0.0	4.2%
Mixed scattered canopy	9.21	0.0	1.9%
Conifer scattered canopy	3.08	0.0	0.6%
Closed canopy shrub	15.51	0.1	3.2%
Open canopy shrub	11.54	0.0	2.4%
Scattered canopy shrub	19.15	0.0	4.0%
Meadow/grass	40.18	0.6	8.4%
Not classified	0.00	0.0	0.0%
Total	**482.73**	**1.6**	**100.0%**

The table below provides estimates of each type of the habitats described in Metro's Technical Report for Fish and Wildlife Habitat, based on Johnson and O'Neil's (2001) habitat scheme. These numbers are provided for subwatershed comparison purposes and represent estimates of available habitat type. Several data types were used to compile this table, and the data sources vary in their precision. For example, the satellite data sources are less accurate than hand-digitized forest canopy cover. There is also slight overlap between certain habitat types. For example, Riparian Wetlands (RWET) are also partially included in Westside Lowland Coniferous Hardwood/Westside Oak and Douglas-fir (WLCH/WODF) because some wetlands also contain forest, and Open Water (WATR) is not always considered part of habitat patches. Therefore, the sums of these habitat types are slightly different from the "Total wildlife habitat acres in inventory" shown in Table 16. Nonetheless, these numbers provide a generalized means of comparing the quality and quantity of habitat available to wildlife among and between subwatersheds. Note also that the estimates for Westside Grasslands (WEGR) probably represent grasslands that are not native rather than true native grasslands, which are largely extirpated from the metro region.

Table C-25. Wildlife habitat availability[1] based on Johnson & O'Neil's (2001) habitat types and species-habitat associations.

Resource site:	Habitat type						
McKay Creek	WATR[2]	HWET[3]	RWET[3]	TOTWET[3]	WLCH/ WODF[4]	WEGR	AGPA
Total acres	0.0	78.1	58.9	138.9	182.0	71.6	165.5
Percent of total	0.0%	16.1%	12.2%	28.7%	37.6%	14.8%	34.2%

[1]See Table C-24 for land cover types and crosswalk to Johnson and O'Neil's classification scheme.

[2]Note that patch type and data limitations result in an underestimation of open water habitats. For example, medium and small sized stream surfaces are excluded.

[3]Note that HWET and RWET do not represent the full suite of wetlands because some wetlands <2 acres were added in as Habitats of Concern, and some wetlands could not be associated with herbaceous or forested habitats. TOTWET represents the best estimate of all existing wetlands because it includes Habitats of Concern.

[4]Data limitations make it impossible to distinguish between these two habitat types at this time, and no comprehensive oak habitat survey has been conducted for the region. However, known oak habitats are also included in HOCs (see Appendix 10).

D. Rock Creek/Tualatin River

General watershed information
Resource sites in the Rock Creek/Tualatin River Watershed include:
- Middle Rock Creek-Tualatin River subwatershed
- Beaverton Creek subwatershed
- Lower Rock Creek-Tualatin River subwatershed (combined with Middle Tualatin River-Davis Creek)
- Middle Tualatin River-Gordon Creek subwatershed (combined with Lindow Creek)

Watershed assessments and plans

Bureau of Land Management, U.S. Department of the Interior (BLM), 2001. *Middle Tualatin-Rock Creek Watershed Analysis,* BLM, Salem District Office, Tillamook Resource Area: Tillamook, Oregon.

Brown and Caldwell, 1999. *Beaverton Creek Watershed Management Plan.* Unified Sewage Agency: Hillsboro, Oregon.

Lev, Esther, 1990. *Inventory of Wetlands, Riparian and Upland Wildlife Habitat Areas in Hillsboro, Oregon,* Environmental Consulting: Portland, Oregon.

Oregon Department of Fish and Wildlife (ODFW) and Unified Sewage Agency (USA), 1995. *Distribution of Fish and Crayfish and Measurement of Available Habitat in the Tualatin River Basin, Final Report of Research,* ODFW: Portland, Oregon and Unified Sewage Agency: Hillsboro, Oregon.

Tualatin River Watershed Council, 1999. *Tualatin River Watershed, Action Plan,* Tualatin River Watershed Council: Hillsboro, Oregon.

Tualatin Watershed Council, 2001. *Tualatin River Watershed Atlas,* Tualatin Watershed Council: Hillsboro, Oregon

Unified Sewage Agency, 1996. *Subbasin Strategies Plans for Upper Rock, Bronson and Willow Creeks,* Unified Sewage Agency: Hillsboro, Oregon.

Walker and Macy, Landscape Architects and Planners, 1989. *Jackson Bottom, Concept Master Plan,* City of Hillsboro, Unified Sewage Agency: Hillsboro, Oregon.

Watershed councils and related groups

Cedar Mill Creek Watershed Watch, 503-292-8713, Gretchen Vadnais

Golf Creek, Friends of, 7277 SW Barnes Road, Portland 97225, 503-292-4549, Bridget McCarthy

Jackson Bottom, Friends of, 503-647-3286, Faun Hosey

Jackson Bottom Wetlands Preserve, 123 W Main Street, Hillsboro 97123, 503-681-6206, Patrick Willis

Rock Creek Environmental Center, 503-690-5402, Bob Mann

Rock Creek Watershed Council, 16747 Timber Road, Vernonia 97064, 503-429-2401, Maggie Belmore

Tualatin Watershed Council, 1080 SW Baseline, Bldg. B, Suite B-2, Hillsboro 97123, (503) 681-0953, FAX (503) 681-9772

Tualatin River National Wildlife Refuge, City of Sherwood, 90 NW Park Street, Sherwood 97140, 503-625-5522, Joan Patterson

Tualatin River Rangers, USA, 155 N First Ave., Hillsboro 97124, 503-640-3516, Linda Kelly

Tualatin Riverkeepers, 16340 SW Beef Bend Road, Sherwood 97140, 503-590-5813, Lauri Mullen
Wetlands, Friends of, 503-253-6247, Alice Blatt
Yamhill Basin Council, 2200 SW 2nd Street, McMinnville 97128, 503-472-6403, Melissa Leoni

Data descriptions

Table D-1 provides information about the subwatersheds within each watershed, the HUC code, and the acres inside Metro's jurisdictional boundary. Keying in on the resource site number will show how the subwatersheds are aggregated into the resource sites listed above.

All six of the subwatersheds fall within the same 5th field HUC (Rock Creek/Tualatin River), but they are divided into four resource sites. The Middle Rock Creek-Tualatin River subwatershed comprises the resource site with the same name (Resource Site #7). Similarly, the Beaverton Creek subwatershed also comprises its namesake resource site (Resource Site #8). Resource Site #9 is comprised of two subwatersheds, Lower Rock Creek-Tualatin River and Middle Tualatin River-Davis Creek; this is called Lower Rock Creek-Tualatin River. Resource Site #10, Middle Tualatin River-Gordon Creek, combines its namesake with Lindow Creek.

Tables D-1 and D-2 provide general description about the 5th field and 6th field HUCs. Below these tables are descriptions of the riparian and wildlife habitat resources resource site.

Watershed data tables

Table D-1. Watersheds (5th level HUC), subwatersheds (6th level HUC), and acres within Metro jurisdictional boundary.

Watershed (5th level HUC)	5th field HUC code	Resource site #	Subwatershed (6th level HUC)	6th field HUC code	Acres in Metro
Rock Creek/Tualatin River	1709001004	7	Middle Rock Creek-Tualatin River	170900100401	7,300.1
		8	Beaverton Creek	170900100402	24,296.8
		9	Lower Rock Creek-Tualatin River	170900100403	7,496.4
			Middle Tualatin River-Davis Creek	170900100404	1,220.7
		10	Middle Tualatin River-Gordon Creek	170900100405	3,594.8
			Lindow Creek	170900100407	752.5

Table D-2. Resource sites: general information.

General information	Middle Rock Creek-Tualatin River	Beaverton Creek	Lower Rock Creek-Tualatin River	Middle Tualatin River-Gordon Creek
Miles of DEQ 303(d) listed streams	4.5	34.8	4.6	3.0
Road density (road miles/square miles in subwatershed)	10.2	15.3	12.6	12.1
Miles of stream with known anadromous fish presence	4.5	0.0	4.6	0.4
Acres of hydrologically connected wetlands	198.6	588.7	918.5	37.8
Total acres of wetlands	199.9	599.8	918.5	38.1
Acres of floodplains (100 year FEMA + 1996 inundation area)	239.2	1,246.1	854.3	83.7
Acres of developed floodplains	8.2	421.9	16.6	13.5
Building permits since 1996 (number)	2,704.0	6,183.0	1,579.0	765.0

Table D-3. Characteristics of stream miles by resource site.

Resource site	Stream miles by channel type		Miles of stream links*	Miles of streams not categorized by channel type	Total stream miles
	Low to medium	*High*			
Middle Rock Creek-Tualatin River	7.4	5.9	2.2	14.5	30.0
Beaverton Creek	31.6	6.5	20.9	42.9	101.9
Lower Rock Creek-Tualatin River	13.5	0.0	7.7	11.6	32.8
Middle Tualatin River-Gordon Creek	2.7	1.6	0.8	11.0	16.1

*Stream links are links between surface streams and may be piped or culverted.

Table D-4. Riparian vegetation by resource site.

Resource site	Vegetation types within 300 feet of a stream (acres)			Forested vegetation >300 feet from a stream
	Low structure vegetation/intact topsoil	Non-forest woody vegetation	Forested vegetation	
Middle Rock Creek-Tualatin River	682.8	71.7	744.7	923.0
Beaverton Creek	1,141.9	114.0	1,743.8	2,457.0
Lower Rock Creek-Tualatin River	726.4	9.0	451.5	278.6
Middle Tualatin River-Gordon Creek	343.8	20.3	216.2	363.5

Table D-5. Regional zoning by resource site.

Resource site	Acres by zone within each resource site						
	Commercial	Industrial	Multi-family residential	Public/open space	Rural	Single family residential	Mixed use
Middle Rock Creek-Tualatin River	748.7	801.0	751.3	5.2	2,798.8	1,608.0	177.1
Beaverton Creek	1,774.6	1,187.3	2,277.0	103.5	1,250.7	12,211.4	2,065.6
Lower Rock Creek-Tualatin River	1,777.5	1,729.8	649.9	15.7	79.0	3,944.9	413.5
Middle Tualatin River-Gordon Creek	257.5	37.7	237.5	0.0	1,323.3	2,037.0	0.0

SITE #7: Middle Rock Creek-Tualatin River subwatershed

Named tributaries: Abbey Creek, Rock Creek
Communities within the subwatershed: Beaverton, Hillsboro, Portland, unincorporated Washington County
Total acreage within Metro's boundary: 7,300.1
Total acreage within riparian corridor: 2,421.2

This site contains two percent of the area comprising Metro's jurisdictional boundary. About 23 percent of the site is in the City of Hillsboro, seven percent in the City of Portland, less than one percent in Beaverton, with the remainder in unincorporated Multnomah and Washington counties (32 and 39 percent, respectively) (Table D-6).

This resource site falls in the second quartile (26 to 50 percent of maximum) of the range of development compared to other sites, with 10.2 miles of road per square mile (Table D-2). Rural zoning strongly dominates land use, but single family residential zoning is also important; commercial, industrial and multi-family residential uses also cover substantial acreage (Table D-5). More than 2,700 building permits have been issued here since 1996 (Table D-2).

Riparian resources. The percentage of this site in riparian corridors is 33 percent, comparable to Site #4 (Willamette River – Lower Tualatin River) (Table 12). The site contributes approximately three percent of the region's riparian corridors (Table 13).

This resource site has approximately 30 total stream miles, or slightly less than 0.0038 miles of non-piped streams per acre, ranking it seventh among the 27 resource sites (Table 12). Only approximately seven percent of all stream miles are stream links, suggesting a relatively low amount of piping/culverting (Table D-3); 16 percent of non-piped streams are DEQ 303(d) water-quality limited, the lowest of any site in Group D (Tables D-2 and D-3). The site contains a mixture of stream gradients (Table D-3). Slightly over three percent of the site is in the floodplain, with approximately three percent of the land covered by wetland resources (Table D-2). Slightly more than three percent of the floodplain is developed, most similar to Site #9 in this group. Anadromous fish are known to be present in five stream miles (Table D-2).

Twenty-seven percent of the acreage that falls within the riparian corridor inventory in this site received primary scores for at least three of the five ecological functions, similar to Sites #8 and #10 in Group D (Table D-9). Forty-two percent of the site's riparian corridors receive at least one primary ecological function score, similar to all other sites in this group except Site #9, which has more primary-scoring areas (Table D-9). The vegetation types within 300 ft of streams are co-dominated by forested and low-structure vegetation, most similar to Site #8 in this group (Table D-4). The largest percentage of land receiving a given primary score is for *Bank stabilization and pollution control*, but *Large wood and channel dynamics* and *Organic material sources* are also important primary functions (Table D-8; see also Table 4 and Appendix 5 for description of ecological functions mapping).

Wildlife habitat resources.
Including Habitats of Concern, 33 percent of the lands in this site fall within the wildlife habitat inventory, ranking it eighth of the 27 resource sites (Table 16). Within model patches, a remarkably high 57 percent fall within the top third of the point range (Table D-10). Of the four criteria in the GIS model, this site tends to score low to moderate in size, moderate to high in

interior (excellent compared to many other sites), moderate in water resources, and high in connectivity (Table D-11). In general, this site's wildlife habitat patches are characterized by a low degree of fragmentation, excellent connectivity, and good water resources. There is a substantial amount of interior habitat in this resource site, making it an excellent area for Neotropical migratory birds and other species requiring interior or relatively undisturbed habitats.

Habitat types in this resource site are dominated by conifer/hardwood forest cover, reflecting the strong size and interior habitat scores discussed above (Table D-15). Wetlands comprise an estimated eight percent of lands. This site contributes over two percent of the region's total wetlands, ranking 13th among the 27 resource sites.

Species of Concern. Four Species of Concern sighting locations fall within the site. Each sighting may include one or more species; if a species occurs more than once in the resource site it is only listed once here. These include the following species:

- Acorn Woodpecker
- Willow Flycatcher
- Elk (listed as sensitive here because it is considered in the Goal 5 rule)
- Great Blue Heron nesting colony

There are very likely many other Species of Concern using this resource site, particularly those relying on forest interior habitats (see Table D-15). Examples of species likely to occur in this site may be found by referencing the species list in Appendix 7 and identifying the species with a double "XX" under the habitat. General species needs and potential reasons for their decline are identified in the *Sensitive Species Accounts* section above. More detailed information on all species' needs can be obtained through Johnson and O'Neil (2001).

Habitats of Concern.
The following Habitats of Concern are partially or wholly within this resource site. Using the Unique ID # (UID), please refer to Appendix 8 for information concerning each Habitat of Concern:

- UID numbers: 49, 55, 56, 57, 58

Resource site data tables: Riparian Corridors

Table D-6. Acres within resource site by jurisdiction.

Jurisdiction	Acres within subwatershed
Beaverton	8.8
Hillsboro	1,670.9
Portland	474.8
Unincorporated Multnomah County	2,308.2
Unincorporated Washington County	2,835.9

Table D-7. Acres in Metro and riparian corridor.

Resource site	Total acres within Metro	Total acres within riparian corridor
Middle Rock Creek-Tualatin River	7,300.2	2,390.8

Table D-8. Number of acres within riparian corridor providing ecological function.

Resource site:	Ecological function	*Primary Value*		*Secondary Value*	
		Acres*	% of Total**	Acres	% of Total
Middle Rock Creek-Tualatin River	Microclimate & shade	432.5	18.1%	978.6	40.9%
	Streamflow moderation & water storage	310.5	13.0%	2,032.4	85.0%
	Bank stabilization & pollution control	945.3	39.5%	253.5	10.6%
	Large wood & channel dynamics	751.4	31.4%	198.3	8.3%
	Organic material sources	636.8	26.6%	157.9	6.6%

*Number of acres scored within the riparian corridor for each function
**Percent of total acres within the riparian corridor

Table D-9. Breakdown of ecological scores.

Resource site	Ecological Score	Acres	% of Total Acres
Middle Rock Creek-Tualatin River	1 to 5	1,382.1	57.8%
	6 to 11	256.3	10.7%
	12 to 17	113.3	4.7%
	18 to 23	86.8	3.6%
	24 to 29	428.5	17.9%
	30	123.9	5.2%
	Total acres	2,390.8	100.0%

Resource site data tables: Wildlife Habitat

Table D-10. Breakdown of total wildlife model patch scores.*

Resource site: Middle Rock Creek-Tualatin River	Number of acres in each wildlife score category									Total wildlife model patch acres in inventory
	1	2	3	4	5	6	7	8	9	
Model score	31.1	140.5	326.1	293.3	96.8	133.6	45.3	1,282.4	0.0	2,349.0
Percent of total	1.3%	6.0%	13.9%	12.5%	4.1%	5.7%	1.9%	54.6%	0.0%	100.0%

*Does not include Habitats of Concern outside of model patches.

Table D-11. Breakdown of total wildlife patch model scores by criteria.*

Resource site: Middle Rock Creek-Tualatin River	Number of acres by score for each model criterion												Total wildlife model patch acres in inventory
	Size[2]			Interior[2]			Water[3]			Connectivity			
	1	2	3	1	2	3	1	2	3	1	2	3	
	1,086.1	638.6	0.0	257.6	638.6	643.8	67.6	1,935.4	280.3	212.5	556.7	1,579.9	2,349.0
Percent of total acres in inventory	46.2%	27.2%	0.0%	11.0%	27.2%	27.4%	2.9%	82.4%	11.9%	9.0%	23.7%	67.3%	na

[1]Does not include Habitats of Concern outside of model patches.
[2]These numbers do not add up to 100.0% because Type 2 patches (low structure vegetation within 300 feet of streams and wetlands) were not ranked for these criteria.
[3]These numbers do not add up to 100% because not all patches contained or were near water resources.

Table D-12. Breakdown of total wildlife model patch area by 2000 Metro photo interpretation landcover and known wetlands.*

Resource site: Middle Rock Creek - Tualatin River	Low structure vegetation within 300 feet of stream		Forested vegetation	Forested wetlands	Grass/shrub wetlands within 300 feet of a stream	Other wetlands	Total wildlife model patch acres in inventory
	Low structure vegetation/ intact topsoil	Non-forest woody vegetation					
Acres	555.0	69.4	1,540.8	99.6	72.1	12.2	2,349.0
Percent of total	23.6%	3.0%	65.6%	4.2%	3.1%	0.5%	100.0%

*Does not include Habitats of Concern outside of model patches.

Table D-13. Total acres of inventoried wildlife habitat by type and total Species of Concern (SOCs).

Resource site: Middle Rock Creek - Tualatin River	Wildlife patches (acres)	HOCs inside Wildlife patches (acres)*	HOCs outside Wildlife patches (including wetlands <2 acres)	Total inventoried wildlife habitat acres	Total SOCs
Acres	2349.0	234.4	19.4	2368.4	4
Percent of total	99.2%	9.9%	0.8%	100.0%	N/A

*Habitats of Concern.

Table D-14. Total area of model patches and Habitats of Concern by 1998 Landsat Landcover Area.

Resource Site: Middle Rock Creek - Tualatin River / Landcover type:	Total area of wildlife model patches	Total area of HOCs outside of modeled patches (including wetlands <2 acres)	Percent of total inventoried habitat
Water	5.35	0.7	0.3%
Barren	135.08	5.3	5.9%
Low structure agriculture	214.50	2.1	9.1%
High structure agriculture	6.72	0.0	0.3%
Deciduous closed canopy	544.74	1.0	23.0%
Mixed closed canopy	635.98	0.8	26.9%
Conifer closed canopy	56.03	0.9	2.4%
Deciduous open canopy	70.35	1.3	3.0%
Mixed open canopy	61.01	0.6	2.6%
Conifer open canopy	18.22	0.2	0.8%
Deciduous scattered canopy	159.86	0.5	6.8%
Mixed scattered canopy	33.62	0.7	1.4%
Conifer scattered canopy	5.91	0.4	0.3%
Closed canopy shrub	74.12	0.5	3.1%
Open canopy shrub	98.93	0.3	4.2%
Scattered canopy shrub	59.78	0.8	2.6%
Meadow/grass	168.69	3.3	7.3%
Not classified	0.15	0.0	0.0%
Total	**2,349.03**	**19.4**	**100.0%**

The table below provides estimates of each type of the habitats described in Metro's Technical Report for Fish and Wildlife Habitat, based on Johnson and O'Neil's (2001) habitat scheme. These numbers are provided for subwatershed comparison purposes and represent estimates of available habitat type. Several data types were used to compile this table, and the data sources vary in their precision. For example, the satellite data sources are less accurate than hand-digitized forest canopy cover. There is also slight overlap between certain habitat types. For example, Riparian Wetlands (RWET) are also partially included in Westside Lowland Coniferous Hardwood/Westside Oak and Douglas-fir (WLCH/WODF) because some wetlands also contain forest, and Open Water (WATR) is not always considered part of habitat patches. Therefore, the sums of these habitat types are slightly different from the "Total wildlife habitat acres in inventory" shown in Table 16. Nonetheless, these numbers provide a generalized means of comparing the quality and quantity of habitat available to wildlife among and between subwatersheds. Note also that the estimates for Westside Grasslands (WEGR) probably represent grasslands that are not native rather than true native grasslands, which are largely extirpated from the metro region.

Table D-15. Wildlife habitat availability[1] based on Johnson & O'Neil's (2001) habitat types and species-habitat associations.

Resource site:	Habitat type						
Middle Rock Creek - Tualatin River	WATR[2]	HWET[3]	RWET[3]	TOTWET[3]	WLCH/ WODF[4]	WEGR	AGPA
Total acres	0.0	84.3	99.6	199.9	1,592.1	331.8	223.3
Percent of total	0.0%	3.6%	4.2%	8.4%	67.2%	14.0%	9.4%

[1]See Table D-14 for land cover types and crosswalk to Johnson and O'Neil's classification scheme.

[2]Note that patch type and data limitations result in an underestimation of open water habitats. For example, medium and small sized stream surfaces are excluded.

[3]Note that HWET and RWET do not represent the full suite of wetlands because some wetlands <2 acres were added in as Habitats of Concern, and some wetlands could not be associated with herbaceous or forested habitats. TOTWET represents the best estimate of all existing wetlands because it includes Habitats of Concern.

[4]Data limitations make it impossible to distinguish between these two habitat types at this time, and no comprehensive oak habitat survey has been conducted for the region. However, known oak habitats are also included in HOCs (see Appendix 10).

SITE #8: Beaverton Creek subwatershed

Named tributaries: Beaverton Creek, Bronson Creek, Cedar Mill Creek, Golf Creek, Johnson Creek, Rock Creek, Wessenger Creek, Willow Creek
Communities within the subwatershed: Beaverton, Hillsboro, Portland, unincorporated Washington County
Total acreage within Metro's boundary: 24,297
Total acres within riparian corridor: 5,822.7

This site contains eight percent of the area comprising Metro's jurisdictional boundary, a relatively substantial amount compared to other Resource Sites (two sites rank higher). Over half of the site (57 percent) is in unincorporated Washington County; 28 percent falls within the City of Beaverton, and four and five percent in the cities of Hillsboro and Portland, respectively. The remaining five percent is in unincorporated Multnomah County (Table D-16).

This site contains 15.3 miles of roads per square mile, placing it in the high end of the third quartile (51-75 percent of maximum) of the range of development compared to all other sites. It is the most developed of the four resource sites in Group D (Table D-2). Zoning is dominated by Zoning is very strongly dominated by single family residential use (Table D-5). More than 6,000 building permits have been issued in this resource site since 1996, more than double that of any other resource site within Metro's boundary (Table D-2).

Riparian resources. Given this site's high development intensity, it is relatively rich with riparian resources; the amount of this site in riparian corridors is 24 percent, comparable to Site #10 in this group (Table 12). The site contributes a substantial amount of the region's riparian corridors, at more than six percent (Table 13).

This resource site has approximately 102 total stream miles, and more than 0.0033 miles of non-piped streams per acre, ranking it 16th among the 27 resource sites (Table 12). Approximately 21 percent of all stream miles are stream links, suggesting a relatively high amount of piping/culverting that is similar to Site #9 (Table D-3). This site has the highest percentage of non-piped streams that are DEQ 303(d) quality limited, at 43 percent (Tables D-2 and D-3). That is not surprising, as research across the country indicates declining stream quality with increasing urbanization (see Metro's Technical Report for Fish and Wildlife Habitat, April 2005). Low to medium gradient streams predominate (Table D-3). Five percent of the site is in the floodplain, with approximately 2-1/2 percent of the land covered by wetland resources (Table D-2). More than a third of the floodplain is developed (the fourth highest level of all resource sites; Table 14), and this probably contributes to decreased stream quality. No anadromous fish are known to be present in this resource site (Table D-2).

Twenty-nine percent of the acreage that falls within the riparian corridor inventory in this site received primary scores for at least three of the five ecological functions, similar to Sites #7 and #10 in Group D (Table D-19). Forty-five percent of the site's riparian corridors receive at least one primary ecological function score, similar to all other sites in this group except Site #9, which has more primary-scoring areas (Table D-19). The vegetation types within 300 ft of streams are co-dominated by forested and low-structure vegetation, most similar to Site #7 in this group (Table D-4). The largest percentage of land receiving a given primary score is for *Bank stabilization and pollution control* and *Large wood and channel dynamics*; however, *Organic* *material sources* is also important primary function (Table D-18; see also Table 4 and Appendix 5 for description of ecological functions mapping).

Wildlife habitat resources.
Including Habitats of Concern, 22 percent of the lands in this site fall within the wildlife habitat inventory, ranking it 19th of the 27 resource sites (Table 16). This low ranking relative to the site's substantial lands within the Metro boundary reflects the high urbanization levels. However, within model patches, 40 percent fall within the top third of the point range (Table D-20). The trends for the four criteria in the GIS model are interesting. All of this site's acreage falls in the lowest size category. For habitat interior, there is a dichotomy in which sites are split between the low and high range, with none in the middle; note that only one site (Site #26) contains a higher proportion of the top category for interior habitat. However, nearly all sites score moderate to high in water resources, and the majority are in the highest connectivity score (water and connectivity are likely related) (Table D-21). In general, this site's resources are characterized by small habitat patches, but these are often placed along streams and thus tend to be well connected. This type of resource site is important for wildlife passage, including movements of migratory birds in the spring and fall.

Habitat types in this resource site are strongly dominated by conifer/hardwood forest cover, but wetlands are also important, comprising approximately 12 percent of this site's lands (Table D-25). The site is important to the regional wetland network, contributing over seven percent and ranking third among the 27 resource sites.

Species of Concern. Thirteen Species of Concern sighting locations fall within the site; this high number is partially due to the fact that numerous surveys have been conducted within the resource site, but also likely due to the valuable aquatic habitats and large amount of land in the Metro boundary. It appears to be a very good area for Red-legged frogs. Each sighting may include one or more species; if a species occurs more than once in the resource site it is only listed once here. These include the following species:

- Red-legged frog
- Band-tailed Pigeon
- Pileated Woodpecker
- Olive-sided Flycatcher
- Willow Flycatcher
- Bufflehead
- Northern Pygmy-owl
- Great Blue Heron nesting colony
- Common Nighthawk
- Western pond turtle

There are very likely many other Species of Concern using this resource site, particularly those relying on forest interior habitats (see Table D-25). Examples of species likely to occur in this site may be found by referencing the species list in Appendix 7 and identifying the species with a double "XX" under the habitat. General species needs and potential reasons for their decline are identified in the *Sensitive Species Accounts* section above. More detailed information on all species' needs can be obtained through Johnson and O'Neil (2001).

Habitats of Concern.
The following Habitats of Concern are partially or wholly within this resource site. Using the Unique ID # (UID), please refer to Appendix 8 for information concerning each Habitat of Concern:

UID numbers: 14, 50, 51, 52, 53, 54, 58, 93, 107

Resource site data tables: Riparian Corridors

Table D-16. Acres within resource site by jurisdiction.

Jurisdiction	Acres within subwatershed
Beaverton	6,902.2
Hillsboro	948.0
Portland	1,301.2
Unincorporated Multnomah County	1,246.4
Unincorporated Washington County	13,899.2

Table D-17. Acres in Metro and riparian corridor.

Resource site	Total acres within Metro	Total acres within riparian corridor
Beaverton Creek	24,297.0	5,788.0

Table D-18. Number of acres within riparian corridor providing ecological function.

Resource site:	Ecological function	*Primary Value*		*Secondary Value*	
		Acres*	% of Total**	Acres	% of Total
Beaverton Creek	Microclimate & shade	1,190.9	20.6%	2,101.8	36.3%
	Streamflow moderation & water storage	1,069.3	18.5%	4,361.5	75.4%
	Bank stabilization & pollution control	2,364.5	40.9%	340.5	5.9%
	Large wood & channel dynamics	2,160.2	37.3%	423.0	7.3%
	Organic material sources	1,670.9	28.9%	306.6	5.3%

*Number of acres scored within the riparian corridor for each function

**Percent of total acres within the riparian corridor

Table D-19. Breakdown of ecological scores.

Resource site	Ecological Score	Acres	% of Total Acres
Beaverton Creek	1 to 5	3,161.9	54.6%
	6 to 11	475.0	8.2%
	12 to 17	450.9	7.8%
	18 to 23	123.2	2.1%
	24 to 29	1,175.7	20.3%
	30	401.3	6.9%
	Total acres	5,788.0	100.0%

Resource site data tables: Wildlife Habitat

Table D-20. Breakdown of total wildlife model patch scores.*

Resource site: Beaverton Creek	Number of acres in each wildlife score category: 1	2	3	4	5	6	7	8	9	Total wildlife model patch acres in inventory
Model score	247.9	425.0	479.4	707.9	516.0	699.8	242.9	1,827.5	0.0	5,146.4
Percent of total	4.8%	8.3%	9.3%	13.8%	10.0%	13.6%	4.7%	35.5%	0.0%	100.0%

*Does not include Habitats of Concern outside of model patches.

Table D-21. Breakdown of total wildlife model patch scores by criteria.*

Resource site:	Number of acres by score for each model criterion												Total wildlife model patch acres in inventory
	Size[2]			Interior[2]			Water[3]			Connectivity			
Beaverton Creek	1	2	3	1	2	3	1	2	3	1	2	3	
Model score	4,381.9	0.0	0.0	1,392.8	0.0	1,827.5	168.9	3,218.0	1,360.2	1,132.9	1,502.8	2,510.7	5,146.4
Percent of total acres in inventory	85.1%	0.0%	0.0%	27.1%	0.0%	35.5%	3.3%	62.5%	26.4%	22.0%	29.2%	48.8%	na

[1]Does not include Habitats of Concern outside of model patches.

[2]These numbers do not add up to 100.0% because Type 2 patches (low structure vegetation within 300 feet of streams and wetlands) were not ranked for these criteria.

[3]These numbers do not add up to 100% because not all patches contained or were near water resources.

Table D-22. Breakdown of total wildlife model patch area by 2000 Metro photo interpretation landcover and known wetlands.*

Resource site: Beaverton Creek	Low structure vegetation within 300 feet of stream: Low structure vegetation/ intact topsoil	Low structure vegetation within 300 feet of stream: Non-forest woody vegetation	Forested vegetation	Forested wetlands	Grass/shrub wetlands within 300 feet of a stream	Other wetlands	Total wildlife model patch acres in inventory
Acres	710.7	53.8	3,856.1	190.5	286.5	48.7	5,146.3
Percent of total	13.8%	1.0%	74.9%	3.7%	5.6%	0.9%	100.0%

*Does not include Habitats of Concern outside of model patches.

Table D-23. Total acres of inventoried wildlife habitat by type and total Species of Concern (SOCs).

Resource site: Beaverton Creek	Wildlife patches (acres)	HOCs inside Wildlife patches (acres)*	HOCs outside Wildlife patches (including wetlands <2 acres)	Total inventoried wildlife habitat acres	Total SOCs
Acres	5146.4	529.0	80.0	5226.4	13
Percent of total	98.5%	10.1%	1.5%	100.0%	N/A

*Habitats of Concern.

Table D-24. Total area of model patches and Habitats of Concern by 1998 Landsat Landcover Area.

Resource Site: Beaverton Creek Landcover type:	Total area of wildlife model patches	Total area of HOCs outside of modeled patches (including wetlands <2 acres)	Percent of total inventoried habitat
Water	12.46	0.3	0.2%
Barren	289.57	24.6	6.0%
Low structure agriculture	107.13	1.4	2.1%
High structure agriculture	27.07	0.0	0.5%
Deciduous closed canopy	964.32	6.4	18.6%
Mixed closed canopy	1,246.04	3.7	23.9%
Conifer closed canopy	667.35	1.1	12.8%
Deciduous open canopy	378.66	11.8	7.5%
Mixed open canopy	257.30	3.6	5.0%
Conifer open canopy	75.65	1.1	1.5%
Deciduous scattered canopy	232.68	7.1	4.6%
Mixed scattered canopy	155.35	2.9	3.0%
Conifer scattered canopy	46.84	0.8	0.9%
Closed canopy shrub	220.71	3.0	4.3%
Open canopy shrub	94.03	2.3	1.8%
Scattered canopy shrub	115.54	3.4	2.3%
Meadow/grass	255.25	6.4	5.0%
Not classified	0.44	0.0	0.0%
Total	**5,146.37**	**80.0**	**100.0%**

The table below provides estimates of each type of the habitats described in Metro's Technical Report for Fish and Wildlife Habitat, based on Johnson and O'Neil's (2001) habitat scheme. These numbers are provided for subwatershed comparison purposes and represent estimates of available habitat type. Several data types were used to compile this table, and the data sources vary in their precision. For example, the satellite data sources are less accurate than hand-digitized forest canopy cover. There is also slight overlap between certain habitat types. For example, Riparian Wetlands (RWET) are also partially included in Westside Lowland Coniferous Hardwood/Westside Oak and Douglas-fir (WLCH/WODF) because some wetlands also contain forest, and Open Water (WATR) is not always considered part of habitat patches. Therefore, the sums of these habitat types are slightly different from the "Total wildlife habitat acres in inventory" shown in Table 16. Nonetheless, these numbers provide a generalized means of comparing the quality and quantity of habitat available to wildlife among and between subwatersheds. Note also that the estimates for Westside Grasslands (WEGR) probably represent grasslands that are not native rather than true native grasslands, which are largely extirpated from the metro region.

Table D-25. Wildlife habitat availability[1] based on Johnson & O'Neil's (2001) habitat types and species-habitat associations.

Resource site:	Habitat type						
Beaverton Creek	WATR[2]	HWET[3]	RWET[3]	TOTWET[3]	WLCH/ WODF[4]	WEGR	AGPA
Total acres	0.0	335.2	190.5	599.8	4,062.8	476.9	135.6
Percent of total	0.0%	6.4%	3.6%	11.5%	77.7%	9.1%	2.6%

[1]See Table D-24 for land cover types and crosswalk to Johnson and O'Neil's classification scheme.

[2]Note that patch type and data limitations result in an underestimation of open water habitats. For example, medium and small sized stream surfaces are excluded.

[3]Note that HWET and RWET do not represent the full suite of wetlands because some wetlands <2 acres were added in as Habitats of Concern, and some wetlands could not be associated with herbaceous or forested habitats. TOTWET represents the best estimate of all existing wetlands because it includes Habitats of Concern.

[4]Data limitations make it impossible to distinguish between these two habitat types at this time, and no comprehensive oak habitat survey has been conducted for the region. However, known oak habitats are also included in HOCs (see Appendix 10).

SITE #9: Lower Rock Creek-Tualatin River subwatershed

Named tributaries: Beaverton Creek, Dawson Creek, Rock Creek, Jackson Slough, Tualatin River
Communities within the subwatershed: Hillsboro, unincorporated Washington County
Total acreage within Metro's boundary: 8,717 (combined Lower Rock Creek-Tualatin River and Middle Tualatin-Davis Creek subwatersheds)
Total acres within riparian corridor: 1,808.6

This site contains three percent of the area comprising Metro's jurisdictional boundary. Most of the site lies within the City of Hillsboro's boundaries (88 percent), with the remaining 12 percent in unincorporated Washington County (Table D-26).

Road density, at 12.6 miles per square mile, is similar to the resource sites in Group C and falls close to the mid-range compared to all other resource sites (Table D-2). Single family residential dominates zoning, but commercial and industrial uses are also important land uses (Table D-5). More than 1,500 building permits have been issued here since 1996 (Table D-2).

Riparian resources. The amount of this site in riparian corridors is 20 percent, comparable to Site #10 in this group (Table 12). The site contributes approximately two percent of the region's riparian corridors (Table 13).

This resource site has approximately 33 total stream miles, and more than 0.0029 miles of non-piped streams per acre (Table 12). Approximately 23 percent of all stream miles are stream links, suggesting a relatively high amount of piping/culverting that is similar to Site #8 (Table D-3). This site has the second-highest percentage of non-piped streams that are DEQ 303(d) quality limited, at 29 percent (Tables D-2 and D-3). Low to medium gradient streams strongly predominate (Table D-3). This site also has the highest percentage of the site in the floodplain of all Group D sites, and approximately 11 percent of the land covered by wetland resources, substantially higher than other Group D sites (Table D-2). Only two percent of the floodplain is developed, the lowest of all 27 resource sites. Approximately five stream miles are known to contain anadromous fish (Table D-2).

Scoring ranges for this site indicate high quality riparian resources. Almost half of the acreage that falls within the riparian corridor inventory in this site received primary scores for at least three of the five ecological functions, and 78 percent of riparian acreage received at least one primary function score (Table D-29). The vegetation types within 300 ft of streams is dominated by low-structure vegetation, but there is also a substantial amount of forest cover (Table D-4). The largest percentage of land receiving a given primary score is similar for three functional criteria: *Large wood and channel dynamics*, *Bank stabilization and pollution control* and *Streamflow moderation and water storage* (reflecting the strong floodplain and wetland components) (Table D-28). *Organic material sources* is also important primary function (Table D-28; see also Table 4 and Appendix 5 for description of ecological functions mapping).

Wildlife habitat resources.
Including Habitats of Concern, 19 percent of the lands in this site fall within the wildlife habitat inventory, ranking it 22nd among the 27 resource sites (Table 16). Within model patches, 41 percent fall within the top third of the point range, similar to Beaverton Creek (Table D-30). Of

the four criteria in the GIS model, this site tends to score low in size and interior (there actually is no acreage above the lowest interior class), high in water resources, and very good connectivity (Table D-31). In general, this site's resources are characterized by small to medium habitat patches that are long and narrow, with excellent water resources and connectivity, reflecting the excellent stream and wetland resources in this site. This type of resource site is important for wildlife passage, including movements of migratory birds in the spring and fall.

Habitat types in this resource site are quite mixed, but wetlands are critically important here. Wetlands comprise 57 percent of the site, and contribute 11 percent of the regional wetland network, ranking second highest among the 27 resource sites. Although wetlands cover the highest percentage of land, forests are nearly as high and grasslands and agriculture also provide significant habitat (Table D-35).

Species of Concern. Six Species of Concern sighting locations fall within the site; the site is important to a variety of species, including waterfowl. Each sighting may include one or more species; if a species occurs more than once in the resource site it is only listed once here. These include the following species:

- Pileated Woodpecker
- Olive-sided Flycatcher
- Willow Flycatcher
- Bald Eagle
- Western Meadowlark
- Bufflehead
- Merlin

There are very likely many other Species of Concern using this resource site, particularly those relying on forest interior habitats (see Table D-35). Examples of species likely to occur in this site may be found by referencing the species list in Appendix 7 and identifying the species with a double "XX" under the habitat. General species needs and potential reasons for their decline are identified in the *Sensitive Species Accounts* section above. More detailed information on all species' needs can be obtained through Johnson and O'Neil (2001).

Habitats of Concern.
The following Habitats of Concern are partially or wholly within this resource site. Using the Unique ID # (UID), please refer to Appendix 8 for information concerning each Habitat of Concern:

UID numbers: 58, 59, 108

Resource site data tables: Riparian Corridors

Table D-26. Acres within resource site by jurisdiction.

Jurisdiction	Acres within subwatershed
Hillsboro	7,640.4
Unincorporated Washington County	1,076.8

Table D-27. Acres in Metro and riparian corridor.

Resource site	Total acres within Metro	Total acres within riparian corridor
Lower Rock Creek-Tualatin River	8,717.3	1,736.4

Table D-28. Number of acres within riparian corridor providing ecological function.

Resource site:	Ecological function	*Primary Value*		*Secondary Value*	
		Acres*	% of Total**	Acres	% of Total
Lower Rock Creek-Tualatin River	Microclimate & shade	482.7	27.8%	190.1	10.9%
	Streamflow moderation & water storage	1,031.5	59.4%	640.7	36.9%
	Bank stabilization & pollution control	1,045.4	60.2%	0.8	0.0%
	Large wood & channel dynamics	1,143.9	65.9%	36.4	2.1%
	Organic material sources	836.1	48.2%	15.3	0.9%

*Number of acres scored within the riparian corridor for each function
**Percent of total acres within the riparian corridor

Table D-29. Breakdown of ecological scores.

Resource site	Ecological Score	Acres	% of Total Acres
Lower Rock Creek-Tualatin River	1 to 5	380.7	21.9%
	6 to 11	163.2	9.4%
	12 to 17	349.1	20.1%
	18 to 23	55.1	3.2%
	24 to 29	428.7	24.7%
	30	359.6	20.7%
	Total acres	1,736.4	100.0%

Resource site data tables: Wildlife Habitat

Table D-30. Breakdown of total wildlife model patch scores.*

Resource site: Lower Rock Creek - Tualatin River	Number of acres in each wildlife score category: 1	2	3	4	5	6	7	8	9	Total wildlife model patch acres in inventory
Model score	52.4	119.3	210.1	96.5	136.8	327.4	319.5	346.1	0.0	1,608.2
Percent of total	3.3%	7.4%	13.1%	6.0%	8.5%	20.4%	19.9%	21.5%	0.0%	100.0%

*Does not include Habitats of Concern outside of model patches.

Table D-31. Breakdown of total wildlife patch model scores by criteria.*

Resource site:	Number of acres by score for each model criterion												Total wildlife model patch acres in inventory
	Size[2]			Interior[2]			Water[3]			Connectivity			
Lower Rock Creek - Tualatin	1	2	3	1	2	3	1	2	3	1	2	3	
River	935.7	346.1	0.0	1,015.3	0.0	0.0	7.8	442.2	1,095.0	239.3	596.6	772.4	1,608.2
Percent of total acres in inventory	58.2%	21.5%	0.0%	63.1%	0.0%	0.0%	0.5%	27.5%	68.1%	14.9%	37.1%	48.0%	na

[1]Does not include Habitats of Concern outside of model patches.

[2]These numbers do not add up to 100.0% because Type 2 patches (low structure vegetation within 300 feet of streams and wetlands) were not ranked for these criteria.

[3]These numbers do not add up to 100% because not all patches contained or were near water resources.

Table D-32. Breakdown of total wildlife model patch area by 2000 Metro photo interpretation landcover and known wetlands.*

Resource site: Lower Rock Creek - Tualatin River	Low structure vegetation within 300 feet of stream: Low structure vegetation/ intact topsoil	Low structure vegetation within 300 feet of stream: Non-forest woody vegetation	Forested vegetation	Forested wetlands	Grass/shrub wetlands within 300 feet of a stream	Other wetlands	Total wildlife model patch acres in inventory
Acres	321.9	4.4	375.1	318.0	346.0	242.8	1,608.2
Percent of total	20.0%	0.3%	23.3%	19.8%	21.5%	15.1%	100.0%

*Does not include Habitats of Concern outside of model patches.

Table D-33. Total acres of inventoried wildlife habitat by type and total Species of Concern (SOCs).

Resource site: Lower Rock Creek - Tualatin River	Wildlife patches (acres)	HOCs inside Wildlife patches (acres)*	HOCs outside Wildlife patches (including wetlands <2 acres)	Total inventoried wildlife habitat acres	Total SOCs
Acres	1608.2	314.7	9.2	1617.4	6
Percent of total	99.4%	19.5%	0.6%	100.0%	N/A

Table D-34. Total area of model patches and Habitats of Concern by 1998 Landsat Landcover Area.

Resource Site: Lower Rock Creek - Tualatin River / Landcover type:	Total area of wildlife model patches	Total area of HOCs outside of modeled patches (including wetlands <2 acres)	Percent of total inventoried habitat
Water	36.55	1.6	2.4%
Barren	188.02	1.0	11.7%
Low structure agriculture	264.71	0.3	16.4%
High structure agriculture	1.90	0.0	0.1%
Deciduous closed canopy	175.64	0.1	10.9%
Mixed closed canopy	167.41	0.2	10.4%
Conifer closed canopy	100.22	0.0	6.2%
Deciduous open canopy	107.94	1.1	6.7%
Mixed open canopy	56.33	0.7	3.5%
Conifer open canopy	18.67	0.4	1.2%
Deciduous scattered canopy	87.96	1.0	5.5%
Mixed scattered canopy	62.13	0.7	3.9%
Conifer scattered canopy	28.07	0.4	1.8%
Closed canopy shrub	71.92	0.3	4.5%
Open canopy shrub	31.69	0.4	2.0%
Scattered canopy shrub	70.45	0.6	4.4%
Meadow/grass	138.61	0.3	8.6%
Not classified	0.00	0.0	0.0%
Total	**1,608.23**	**9.2**	**100.0%**

The table below provides estimates of each type of the habitats described in Metro's Technical Report for Fish and Wildlife Habitat, based on Johnson and O'Neil's (2001) habitat scheme. These numbers are provided for subwatershed comparison purposes and represent estimates of available habitat type. Several data types were used to compile this table, and the data sources vary in their precision. For example, the satellite data sources are less accurate than hand-digitized forest canopy cover. There is also slight overlap between certain habitat types. For example, Riparian Wetlands (RWET) are also partially included in Westside Lowland Coniferous Hardwood/Westside Oak and Douglas-fir (WLCH/WODF) because some wetlands also contain forest, and Open Water (WATR) is not always considered part of habitat patches. Therefore, the sums of these habitat types are slightly different from the "Total wildlife habitat acres in inventory" shown in Table 16. Nonetheless, these numbers provide a generalized means of comparing the quality and quantity of habitat available to wildlife among and between subwatersheds. Note also that the estimates for Westside Grasslands (WEGR) probably represent grasslands that are not native rather than true native grasslands, which are largely extirpated from the metro region.

Table D-35. Wildlife habitat availability[1] based on Johnson & O'Neil's (2001) habitat types and species-habitat associations.

Resource site:	Habitat type						
Lower Rock Creek - Tualatin River	WATR[2]	HWET[3]	RWET[3]	TOTWET[3]	WLCH/ WODF[4]	WEGR	AGPA
Total acres	3.4	588.8	318.0	918.5	809.1	242.0	266.9
Percent of total	0.2%	36.4%	19.7%	56.8%	50.0%	15.0%	16.5%

[1]See Table D-34 for land cover types and crosswalk to Johnson and O'Neil's classification scheme.

[2]Note that patch type and data limitations result in an underestimation of open water habitats. For example, medium and small sized stream surfaces are excluded.

[3]Note that HWET and RWET do not represent the full suite of wetlands because some wetlands <2 acres were added in as Habitats of Concern, and some wetlands could not be associated with herbaceous or forested habitats. TOTWET represents the best estimate of all existing wetlands because it includes Habitats of Concern.

[4]Data limitations make it impossible to distinguish between these two habitat types at this time, and no comprehensive oak habitat survey has been conducted for the region. However, known oak habitats are also included in HOCs (see Appendix 10).

SITE #10: Middle Tualatin River-Gordon Creek subwatershed

Named tributaries: Butternut Creek, Gordon Creek, Lindow Creek, Rock Creek, Tualatin River
Communities within the subwatershed: Beaverton, Hillsboro, unincorporated Washington County
Total acreage within Metro's boundary: 4,347 (combined Middle Tualatin River-Gordon Creek and Lindow Creek subwatersheds)
Total acres within riparian corridor: 940.4

This site contains one percent of the area comprising Metro's jurisdictional boundary. The majority of the site (97 percent) lies in unincorporated Washington County, with the remainder in Beaverton (two percent) and Hillsboro (one percent) (Table D-36).

Despite that most of this resource site is in unincorporated lands, road density falls near the midpoint of the range compared to all other resource sites (12.1 miles per square mile; Table D-2). Reflecting this level of development, zoning is dominated by single family residential use. However, rural zoning is also an important land use type (Table D-5). More than 750 building permits have been issued here since 1996 (Table D-2).

Riparian resources. The amount of this site in riparian corridors is 22 percent, falling between Sites #8 and #9 in this resource group (Table 12). However, the site contributes only about one percent of the region's riparian corridors (Table 13), because a relatively small portion of the resource site falls within Metro's boundary.

This resource site has approximately 16 total stream miles, and 0.0035 miles of non-piped streams per acre, ranking it 12th among the 27 resource sites (Table 12). Only five percent of all stream miles are stream links, suggesting a relatively minor amount of piping/culverting that is most similar to Site #7 (Table D-3). Twenty percent of non-piped stream miles are DEQ 303(d) quality limited (Tables D-2 and D-3). A mixture of stream gradients is found in this resource site (Table D-3). Only two percent of the site is in the floodplain, with one percent of the land covered by wetland resources (Table D-2). Sixteen percent of the floodplain is developed. Less than half a mile of streams in this site are known to harbor anadromous fish (Table D-2).

Twenty-nine percent of the acreage that falls within the riparian corridor inventory in this site received primary scores for at least three of the five ecological functions, similar to Sites #7 and #10 in Group D (Table D-19). Forty-five percent of the site's riparian corridors receive at least one primary ecological function score, similar to all other sites in this group except Site #9, which has more primary-scoring areas (Table D-19). The vegetation types within 300 ft of streams are co-dominated by forested and low-structure vegetation, most similar to Site #7 in this group (Table D-4). The largest percentage of land receiving a given primary score is for *Bank stabilization and pollution control* and *Large wood and channel dynamics*; however, *Organic material sources* is also important primary function (Table D-18; see also Table 4 and Appendix 5 for description of ecological functions mapping).

Wildlife habitat resources.
Including Habitats of Concern, 22 percent of the lands in this site fall within the wildlife habitat inventory, ranking it 18th among the 27 resource sites (Table 16). Within model patches, no acreage falls within the top third of the point range, although nearly 60 percent fall in the middle range (Table D-40). Of the four criteria in the GIS model, all acreage falls in the low size and

habitat interior ranges. Scores for water resources tend to be moderate, while connectivity is spread between the three point categories (Table D-41). In general, this site's resources are characterized by small habitat patches containing no interior habitat, with moderate water resources and varying levels of connectivity.

Conifer and hardwood forest are the dominant habitat types in this resource site, although agricultural lands cover 17 percent of the site's land (Table D-45). Wetlands comprise only four percent of the site, contributing less than one percent of the region's wetlands and ranking 23rd of the 27 resource sites.

Species of Concern. Three Species of Concern sighting locations fall within the site. Each sighting may include one or more species; if a species occurs more than once in the resource site it is only listed once here. These include the following species:

- Pileated Woodpecker
- Band-tailed Pigeon
- Olive-sided Flycatcher

There are very likely other Species of Concern using this resource site, particularly those relying on forested habitats and agricultural lands (see Table D-45). Examples of species likely to occur in this site may be found by referencing the species list in Appendix 7 and identifying the species with a double "XX" under the habitat. General species needs and potential reasons for their decline are identified in the *Sensitive Species Accounts* section above. More detailed information on all species' needs can be obtained through Johnson and O'Neil (2001).

Habitats of Concern.
The following Habitats of Concern are partially or wholly within this resource site. Using the Unique ID # (UID), please refer to Appendix 8 for information concerning each Habitat of Concern:

UID numbers: 107, 108

Resource site data tables: Riparian Corridors

Table D-36. Acres within resource site by jurisdiction.

Jurisdiction	Acres within subwatershed
Beaverton	78.2
Hillsboro	62.2
Unincorporated Washington County	4,206.9

Table D-37. Acres in Metro and riparian corridor.

Resource site	Total acres within Metro	Total acres within riparian corridor
Middle Tualatin River-Gordon Creek	4,347.3	941.5

Table D-38. Number of acres within riparian corridor providing ecological function.

Resource site:	Ecological function	*Primary Value*		*Secondary Value*	
		Acres*	% of Total**	Acres	% of Total
Middle Tualatin River-Gordon Creek	Microclimate & shade	118.7	12.6%	315.6	33.5%
	Streamflow moderation & water storage	88.7	9.4%	756.4	80.3%
	Bank stabilization & pollution control	366.1	38.9%	43.0	4.6%
	Large wood & channel dynamics	304.5	32.3%	58.2	6.2%
	Organic material sources	207.0	22.0%	50.1	5.3%

*Number of acres scored within the riparian corridor for each function
**Percent of total acres within the riparian corridor

Table D-39. Breakdown of ecological scores.

Resource site	Ecological Score	Acres	% of Total Acres
Middle Tualatin River-Gordon Creek	1 to 5	544.8	57.9%
	6 to 11	94.7	10.1%
	12 to 17	96.9	10.3%
	18 to 23	48.7	5.2%
	24 to 29	131.4	14.0%
	30	24.9	2.6%
	Total acres	941.5	100.0%

Resource site data tables: Wildlife Habitat

Table D-40. Breakdown of total wildlife model patch scores.*

Resource site: Middle Tualatin River - Gordon Creek	Number of acres in each wildlife score category									Total wildlife model patch acres in inventory
	1	2	3	4	5	6	7	8	9	
Model score	54.9	129.6	182.7	178.4	208.3	150.4	0.0	0.0	0.0	904.3
Percent of total	6.1%	14.3%	20.2%	19.7%	23.0%	16.6%	0.0%	0.0%	0.0%	100.0%

*Does not include Habitats of Concern outside of model patches.

Table D-41. Breakdown of total wildlife model patch scores by criteria.*

Resource site: Middle Tualatin River - Gordon Creek	Number of acres by score for each model criterion												Total wildlife model patch acres in inventory
	Size[2]			Interior[2]			Water[3]			Connectivity			
	1	2	3	1	2	3	1	2	3	1	2	3	
	569.6	0.0	0.0	395.3	0.0	0.0	103.1	655.9	35.7	215.5	344.6	344.2	904.3
Percent of total acres in inventory	63.0%	0.0%	0.0%	43.7%	0.0%	0.0%	11.4%	72.5%	3.9%	23.8%	38.1%	38.1%	na

[1]Does not include Habitats of Concern outside of model patches.

[2]These numbers do not add up to 100.0% because Type 2 patches (low structure vegetation within 300 feet of streams and wetlands) were not ranked for these criteria.

[3]These numbers do not add up to 100% because not all patches contained or were near water resources.

Table D-42. Breakdown of total wildlife model patch area by 2000 Metro photo interpretation landcover and known wetlands.*

Resource site: Middle Tualatin River - Gordon Creek	Low structure vegetation within 300 feet of stream		Forested vegetation	Forested wetlands	Grass/shrub wetlands within 300 feet of a stream	Other wetlands	Total wildlife model patch acres in inventory
	Low structure vegetation/ intact topsoil	Non-forest woody vegetation					
Acres	313.1	21.6	537.4	19.1	12.0	1.2	904.3
Percent of total	34.6%	2.4%	59.4%	2.1%	1.3%	0.1%	100.0%

*Does not include Habitats of Concern outside of model patches.

Table D-43. Total acres of inventoried wildlife habitat by type and total Species of Concern (SOCs).

Resource site: Middle Tualatin River - Gordon Creek	Wildlife patches (acres)	HOCs inside Wildlife patches (acres)*	HOCs outside Wildlife patches (including wetlands <2 acres)	Total inventoried wildlife habitat acres	Total SOCs
Acres	904.3	214.1	45.1	949.4	2
Percent of total	95.2%	22.5%	4.8%	100.0%	N/A

*Habitats of Concern.

Table D-44. Total area of model patches and Habitats of Concern by 1998 Landsat Landcover Area.

Resource Site: Middle Tualatin River - Gordon Creek / Landcover type:	Total area of wildlife model patches	Total area of HOCs outside of modeled patches (including wetlands <2 acres)	Percent of total inventoried habitat
Water	0.15	0.0	0.0%
Barren	62.00	8.3	7.4%
Low structure agriculture	139.08	21.9	17.0%
High structure agriculture	4.33	0.0	0.5%
Deciduous closed canopy	114.38	0.2	12.1%
Mixed closed canopy	209.37	1.0	22.2%
Conifer closed canopy	80.68	0.0	8.5%
Deciduous open canopy	44.68	1.9	4.9%
Mixed open canopy	58.09	4.0	6.5%
Conifer open canopy	9.80	0.0	1.0%
Deciduous scattered canopy	55.51	0.9	5.9%
Mixed scattered canopy	18.55	0.0	2.0%
Conifer scattered canopy	7.71	0.0	0.8%
Closed canopy shrub	25.88	1.8	2.9%
Open canopy shrub	9.69	1.4	1.2%
Scattered canopy shrub	18.48	3.7	2.3%
Meadow/grass	45.89	0.0	4.8%
Not classified	0.00	0.0	0.0%
Total	**904.28**	**45.1**	**100.0%**

The table below provides estimates of each type of the habitats described in Metro's Technical Report for Fish and Wildlife Habitat, based on Johnson and O'Neil's (2001) habitat scheme. These numbers are provided for subwatershed comparison purposes and represent estimates of available habitat type. Several data types were used to compile this table, and the data sources vary in their precision. For example, the satellite data sources are less accurate than hand-digitized forest canopy cover. There is also slight overlap between certain habitat types. For example, Riparian Wetlands (RWET) are also partially included in Westside Lowland Coniferous Hardwood/Westside Oak and Douglas-fir (WLCH/WODF) because some wetlands also contain forest, and Open Water (WATR) is not always considered part of habitat patches. Therefore, the sums of these habitat types are slightly different from the "Total wildlife habitat acres in inventory" shown in Table 16. Nonetheless, these numbers provide a generalized means of comparing the quality and quantity of habitat available to wildlife among and between subwatersheds. Note also that the estimates for Westside Grasslands (WEGR) probably represent grasslands that are not native rather than true native grasslands, which are largely extirpated from the metro region.

Table D-35. Wildlife habitat availability[1] based on Johnson & O'Neil's (2001) habitat types and species-habitat associations.

Resource site:	Habitat type						
Lower Rock Creek - Tualatin River	WATR[2]	HWET[3]	RWET[3]	TOTWET[3]	WLCH/ WODF[4]	WEGR	AGPA
Total acres	3.4	588.8	318.0	918.5	809.1	242.0	266.9
Percent of total	0.2%	36.4%	19.7%	56.8%	50.0%	15.0%	16.5%

[1]See Table D-34 for land cover types and crosswalk to Johnson and O'Neil's classification scheme.

[2]Note that patch type and data limitations result in an underestimation of open water habitats. For example, medium and small sized stream surfaces are excluded.

[3]Note that HWET and RWET do not represent the full suite of wetlands because some wetlands <2 acres were added in as Habitats of Concern, and some wetlands could not be associated with herbaceous or forested habitats. TOTWET represents the best estimate of all existing wetlands because it includes Habitats of Concern.

[4]Data limitations make it impossible to distinguish between these two habitat types at this time, and no comprehensive oak habitat survey has been conducted for the region. However, known oak habitats are also included in HOCs (see Appendix 10).

E. Lower Tualatin River

General watershed information

Resource sites in the Lower Tualatin River Watershed include:

- Lower Tualatin River-Lake Oswego Canal subwatershed
- Upper and Middle Fanno Creek subwatershed/Summer Creek subwatershed
- Lower Fanno Creek subwatershed
- Rock Creek (So. Washington Co.) subwatershed (combined with Cedar Creek, Chicken Creek, and Lower Tualatin River subwatersheds)

Watershed assessments and plans

Bureau of Planning, City of Portland, 1994. *The Fanno Creek and Tributaries Conservation Plan, January 19, 1994,* City of Portland: Portland, Oregon.

Kurahashi and Associates, Inc, 1997. *Fanno Creek Watershed Management Plan,* Unified Sewage Agency: Hillsboro, Oregon.

Oregon Department of Fish and Wildlife (ODFW) and Unified Sewage Agency (USA), 1995. *Distribution of Fish and Crayfish and Measurement of Available Habitat in the Tualatin River Basin, Final Report of Research,* ODFW: Portland, Oregon and Unified Sewage Agency: Hillsboro, Oregon.

Portland State University and Metropolitan Regional Government, 1995. *Rock Creek Watershed Atlas, Planning with an Awareness of Natural Boundaries, March 1995,* Portland State University and Metro: Portland, Oregon.

Tualatin River Watershed Council, 1999. *Tualatin River Watershed, Action Plan,* Tualatin River Watershed Council: Hillsboro, Oregon.

Tualatin Watershed Council, 2001. *Tualatin River Watershed Atlas,* Tualatin Watershed Council: Hillsboro, Oregon.

Watershed councils and related groups

Fanno Creek, Fans of, PO Box 25835, Portland 97225, 503-499-0412, Daniel Heagerty

Lake Oswego Land Trust, 503-636-2451, Debbie Craig

Rock Creek Environmental Center, 503-690-5402, Bob Mann

Rock Creek Watershed Council, 16747 Timber Road, Vernonia 97064, 503-429-2401, Maggie Belmore

Three Rivers Land Conservancy, PO Box 1116, Lake Oswego 97035, 503-699-9825, Jayne Cronlund

Tualatin Watershed Council, 1080 SW Baseline, Bldg. B, Suite B-2, Hillsboro 97123, (503) 681-0953, FAX (503) 681-9772

Tualatin River National Wildlife Refuge, City of Sherwood, 90 NW Park Street, Sherwood 97140, 503-625-5522, Joan Patterson

Tualatin River Rangers, USA, 155 N First Ave., Hillsboro 97124, 503-640-3516, Linda Kelly

Tualatin Riverkeepers, 16340 SW Beef Bend Road, Sherwood 97140, 503-590-5813, Lauri Mullen

Wetlands, Friends of, 503-253-6247, Alice Blatt

Data descriptions

Table E-1 provides information about the subwatersheds within each watershed, the HUC code, and the acres inside Metro's jurisdictional boundary. Keying in on the resource site number will show how the subwatersheds are aggregated into the resource sites listed above.

All of the resource sites and subwatersheds in Section E fall within the Lower Tualatin River watershed. The Lower Tualatin River/Lake Oswego Canal subwatershed forms its own resource site (Site #11). Similarly, Resource Sites #12, 13 and 14 are formed of only one subwatershed each (Upper and Middle Fanno Creek; Summer Creek; and Lower Fanno Creek, respectively). Site #15 is composed of four subwatersheds – Cedar Creek, Chicken Creek, Rock Creek (south Washington County), and Lower Tualatin River–Lake Oswego Canal.

Tables E-1 and E-2 provide general description about the 5th field and 6th field HUCs. Below these tables are descriptions of the riparian and wildlife habitat resources resource site.

Watershed data tables

Table E-1. Watersheds (5th level HUC), subwatersheds (6th level HUC), and acres within Metro jurisdictional boundary.

Watershed (5th level HUC)	5th field HUC code	Resource site #	Subwatershed (6th level HUC)	6th field HUC code	Acres in Metro
Lower Tualatin River	1709001005	11	Lower Tualatin River - Lake Oswego Canal	170900100501	15,230.9
		12	Upper and Middle Fanno Creek	170900100502	11,183.4
		13	Summer Creek	170900100503	3,769.1
		14	Lower Fanno Creek	170900100504	8,453.8
		15	Cedar Creek	170900100505	1528.42
			Chicken Creek	170900100506	133.5
			Rock Creek (south Washington County)	170900100507	2,102.3
			Lower Tualatin River - Lake Oswego Canal	170900100508	475.1

Table E-2. Resource sites: general information.

General information	Lower Tualatin River - Lake Oswego Canal	Upper and Middle Fanno Creek	Summer Creek	Lower Fanno Creek	Rock Creek (south Washington County)
Miles of DEQ 303(d) listed streams	13.1	12.8	3.9	8.7	4.9
Road density (road miles/square miles in subwatershed)	9.0	17.3	15.0	15.0	10.3
Miles of stream with known anadromous fish presence	8.7	7.1	0.0	8.6	0.6
Acres of hydrologically connected wetlands	359.3	317.2	118.5	237.8	259.8
Total acres of wetlands	369.2	323.8	118.5	238.3	261.5
Acres of floodplains (100 year FEMA + 1996 inundation area)	1,132.0	517.5	61.8	829.0	315.0
Acres of developed floodplains	283.1	107.8	7.0	87.8	22.8
Building permits since 1996 (number)	878.0	1,057.0	1,095.0	1,104.0	1,366.0

Table E-3. Characteristics of stream miles by resource site.

Resource site	Stream miles by channel type		Miles of stream links*	Miles of streams not categorized by channel type	Total stream miles
	Low to medium	*High*			
Lower Tualatin River - Lake Oswego Canal	28.2	6.4	8.4	21.7	64.7
Upper and Middle Fanno Creek	13.3	5.6	7.6	19.7	46.2
Summer Creek	2.3	0.1	2.6	11.7	16.7
Lower Fanno Creek	12.2	0.8	8.6	16.4	38.1
Rock Creek (so. Washington Co.)	6.1	0.0	2.0	4.8	12.9

*Stream links are links between surface streams and may be piped or culverted.

Table E-4. Riparian vegetation by resource site.

Resource site	Vegetation types within 300 feet of a stream (acres)			Forested vegetation >300 feet from a stream
	Low structure vegetation/intact topsoil	Non-forest woody vegetation	Forested vegetation	
Lower Tualatin River - Lake Oswego Canal	1,374.1	35.4	1,790.8	2,251.8
Upper and Middle Fanno Creek	389.6	8.0	949.3	1,208.1
Summer Creek	182.4	16.5	301.8	381.9
Lower Fanno Creek	376.9	10.2	626.7	551.0
Rock Creek (so. Washington Co.)	330.3	13.3	253.8	434.9

Table E-5. Regional zoning by resource site.

Resource site	Acres by zone within each resource site						
	Commercial	Industrial	Multi-family residential	Public/open space	Rural	Single family residential	Mixed use
Lower Tualatin River - Lake Oswego Canal	622.0	1,433.7	224.2	6.2	8,692.0	3,493.8	0.0
Upper and Middle Fanno Creek	967.2	483.5	747.1	231.5	0.0	7,652.2	37.8
Summer Creek	22.2	5.3	424.4	0.0	185.3	2,340.1	237.0
Lower Fanno Creek	909.2	764.6	761.8	65.5	304.2	4,355.4	223.8
Rock Creek (so. Washington Co.)	340.6	732.2	188.9	0.0	947.6	1,540.3	0.0

SITE #11: Lower Tualatin River-Lake Oswego Canal subwatershed

Named streams: Athey Creek, Fields Creek, Lake Oswego Canal, Nyberg Creek, Pecan Creek, Saum Creek, Tualatin River, Wilson Creek
Communities within the subwatershed: Durham, Lake Oswego, Rivergrove, Sherwood, Tigard, Tualatin, West Linn, unincorporated Clackamas County, unincorporated Washington County
Total acreage within Metro's boundary: 15,231
Total acres within riparian corridor: 5,861.2
Other information: One dam with a fishway present and functioning, and a weir pool. Two additional barriers to fish with unknown impact.

This site contains five percent of the area comprising Metro's jurisdictional boundary. It encompasses portions of nine jurisdictions: unincorporated Clackamas County (51 percent), unincorporated Washington County (10 percent), and the cities of Tualatin (25 percent), Lake Oswego (six percent), West Linn (five percent), and one percent or less of the site in the cities of Durham, Rivergrove, Sherwood, and Tigard (Table E-6).

Road density in this site is 9.0 miles per square mile; this is relatively low compared to all other resource sites, falling within the low end of the second quartile (26 to 50 percent of maximum) (Table E-2). Reflecting the relatively undeveloped nature of this resource site, the primary zoning is rural. Single family residential zoning also covers considerable land area in this site (Table E-5). Considering the relatively large amount of this site's land falling within Metro's boundary, the number of building permits issued since 1996 is relatively low at 878 (Table E-2).

Riparian resources. The percentage of this site in riparian corridors is more than 38 percent, substantially higher than the other four Group E sites (Table 12). The site contributes over six percent of the region's riparian corridors; only two sites contribute more (Sites #26 and 27) (Table 13).

This resource site has approximately 30 total stream miles, or 0.0037 miles of non-piped streams per acre (similar to Sites #12, 13 and 14 in Group E) (Tables E-3 and 12); the site ranks tenth among the 27 resource sites in terms of stream density. Approximately 13 percent of all stream miles are stream links. Twenty-three percent of non-piped streams are DEQ 303(d) water-quality limited, the lowest of any site in Group E (Tables E-2 and E-3). The majority of streams in this site are low gradient (Table E-3). Slightly over seven percent of the site is in the floodplain, similar to Site #15 in this group. Approximately three percent of the land is covered by wetland resources (Table E-2). One quarter of the floodplain is developed, most similar to Site #12 in this group and ranking its floodplains fifth most developed among all 27 resource sites (Table 14); Sites #11 and #12 have the most developed floodplains in this group (Table E-2). Anadromous fish are known to be present in nearly nine stream miles (Table E-2).

Twenty-seven percent of the acreage that falls within the riparian corridor inventory in this site received primary scores for at least three of the five ecological functions; this is somewhat lower than other sites in this group (Table E-9). Forty-two percent of the site's riparian corridors receive at least one primary ecological function score (Table E-9). The vegetation types within 300 ft of streams are co-dominated by forested (slightly more) and low-structure vegetation (Table E-4). The largest percentage of land receiving a given primary score is for *Bank stabilization and pollution control* and *Large wood and channel dynamics*, but *Organic material* *sources* is also an important primary functions (Table E-8; see also Table 4 and Appendix 5 for description of ecological functions mapping).

Wildlife habitat resources.
Including Habitats of Concern, 35 percent of the lands in this site fall within the wildlife habitat inventory, ranking it fifth among the 27 resource sites and first among Group E (Table 16). Within model patches, more than 20 percent falls within the top third of the point range, with another 61 percent in the middle range (Table E-10). Of the four criteria in the GIS model, the majority of acreage falls in the low size and habitat interior ranges (Table E-11). However, more than 16 percent falls in the midrange for both criteria, suggesting some fairly large habitat patches that are shaped in such a way as to minimize edge habitat. Wildlife patches in this site have good water resources, with nearly three quarters falling in the midrang and 18 percent in the top score range. Connectivity is excellent, with 65 percent in the top class and another 29 percent in the midrange. In general, this site has strong wildlife habitat resources that tend to be large, well connected, and provide water to wildlife.

Conifer and hardwood forest are the predominant habitat types in this resource site (71 percent), although agricultural lands and grasslands cover another 19 percent (Table E-15). Wetlands are an important wildlife resource here, comprising seven percent of the site. This site contributes more than four percent of the region's wetlands and ranks fourth of the 27 resource sites.

Species of Concern. Three Species of Concern sighting locations fall within the site. Each sighting may include one or more species; if a species occurs more than once in the resource site it is only listed once here. These include the following species:

- Pileated Woodpecker
- Western Bluebird
- Bald Eagle (at least two nests)

There are very likely other Species of Concern using this resource site, particularly those relying on forested habitats and agricultural lands (see Table E-15). Examples of species likely to occur in this site may be found by referencing the species list in Appendix 7 and identifying the species with a double "XX" under the habitat. General species needs and potential reasons for their decline are identified in the *Sensitive Species Accounts* section above. More detailed information on all species' needs can be obtained through Johnson and O'Neil (2001).

Habitats of Concern.
The following Habitats of Concern are partially or wholly within this resource site. Using the Unique ID # (UID), please refer to Appendix 8 for information concerning each Habitat of Concern:

UID numbers: 100, 101, 102, 109, 110, 111, 112, 152

Resource site data tables: Riparian Corridors

Table E-6. Acres within resource site by jurisdiction.

Jurisdiction	Acres within subwatershed
Durham	78.8
Lake Oswego	914.6
Rivergrove	160.3
Sherwood	104.5
Tigard	3.1
Tualatin	3,873.3
West Linn	779.3
Unincorporated Clackamas County	7,822.1
Unincorporated Washington County	1,495.0

Table E-7. Acres in Metro and riparian corridor.

Resource site	Total acres within Metro	Total acres within riparian corridor
Lower Tualatin River - Lake Oswego Canal	15,231.1	5,830.7

Table E-8. Number of acres within riparian corridor providing ecological function.

Resource site:	Ecological function	Primary Value		Secondary Value	
		Acres*	% of Total**	Acres	% of Total
Lower Tualatin River - Lake Oswego Canal	Microclimate & shade	1,089.0	18.7%	2,196.7	37.7%
	Streamflow moderation & water storage	1,045.3	17.9%	4,674.9	80.2%
	Bank stabilization & pollution control	2,100.2	36.0%	286.3	4.9%
	Large wood & channel dynamics	1,970.0	33.8%	491.4	8.4%
	Organic material sources	1,392.9	23.9%	347.9	6.0%

*Number of acres scored within the riparian corridor for each function
**Percent of total acres within the riparian corridor

Table E-9. Breakdown of ecological scores.

Resource site	Ecological Score	Acres	% of Total Acres
Lower Tualatin River - Lake Oswego Canal	1 to 5	3,389.3	58.1%
	6 to 11	501.4	8.6%
	12 to 17	374.1	6.4%
	18 to 23	297.7	5.1%
	24 to 29	886.1	15.2%
	30	382.0	6.6%
	Total acres	5,830.7	100.0%

Resource site data tables: Wildlife Habitat

Table E-10. Breakdown of total wildlife model patch scores.*

Resource site: Lower Tualatin River - Lake Oswego Canal	Number of acres in each wildlife score category									Total wildlife model patch acres in inventory
	1	2	3	4	5	6	7	8	9	
Model score	130.9	145.9	708.5	680.3	448.7	2,140.2	223.3	868.0	0.0	5,345.8
Percent of total	2.4%	2.7%	13.3%	12.7%	8.4%	40.0%	4.2%	16.2%	0.0%	100.0%

*Does not include Habitats of Concern outside of model patches.

Table E-11. Breakdown of total wildlife patch model scores by criteria.*

Resource site: Lower Tualatin River - Lake Oswego Canal	Number of acres by score for each model criterion												Total wildlife model patch acres in inventory
	Size[2]			Interior[2]			Water[3]			Connectivity			
	1	2	3	1	2	3	1	2	3	1	2	3	
	3,358.0	868.0	0.0	2,679.2	868.0	0.0	210.6	3,931.8	942.1	335.0	1,570.4	3,440.5	5,345.8
Percent of total acres in inventory	62.8%	16.2%	0.0%	50.1%	16.2%	0.0%	3.9%	73.5%	17.6%	6.3%	29.4%	64.4%	na

[1]Does not include Habitats of Concern outside of model patches.
[2]These numbers do not add up to 100.0% because Type 2 patches (low structure vegetation within 300 feet of streams and wetlands) were not ranked for these criteria.
[3]These numbers do not add up to 100% because not all patches contained or were near water resources.

Table E-12. Breakdown of total wildlife model patch area by 2000 Metro photo interpretation landcover and known wetlands.*

Resource site: Lower Tualatin River - Lake Oswego Canal	Low structure vegetation within 300 feet of stream		Forested vegetation	Forested wetlands	Grass/shrub wetlands within 300 feet of a stream	Other wetlands	Total wildlife model patch acres in inventory
	Low structure vegetation/ intact topsoil	Non-forest woody vegetation					
Acres	1,095.0	24.8	3,868.3	110.2	195.7	51.8	5,345.8
Percent of total	20.5%	0.5%	72.4%	2.1%	3.7%	1.0%	100.0%

*Does not include Habitats of Concern outside of model patches.

Table E-13. Total acres of inventoried wildlife habitat by type and total Species of Concern (SOCs).

Resource site: Lower Tualatin River - Lake Oswego Canal	Wildlife patches (acres)	HOCs inside Wildlife patches (acres)*	HOCs outside Wildlife patches (including wetlands <2 acres)	Total inventoried wildlife habitat acres	Total SOCs
Acres	5345.8	1019.2	8.6	5354.4	3
Percent of total	99.8%	19.0%	0.2%	100.0%	N/A

*Habitats of Concern.

Table E-14. Total area of model patches and Habitats of Concern by 1998 Landsat Landcover Area.

Resource Site: Lower Tualatin River - Lake Oswego Canal / Landcover type:	Total area of wildlife model patches	Total area of HOCs outside of modeled patches (including wetlands <2 acres)	Percent of total inventoried habitat
Water	23.19	0.0	0.4%
Barren	251.95	1.4	4.7%
Low structure agriculture	595.68	2.1	11.2%
High structure agriculture	28.65	0.0	0.5%
Deciduous closed canopy	1,138.17	0.6	21.3%
Mixed closed canopy	1,394.27	0.4	26.0%
Conifer closed canopy	344.21	0.0	6.4%
Deciduous open canopy	305.56	0.5	5.7%
Mixed open canopy	249.63	1.5	4.7%
Conifer open canopy	68.04	0.2	1.3%
Deciduous scattered canopy	159.55	0.3	3.0%
Mixed scattered canopy	131.43	0.2	2.5%
Conifer scattered canopy	29.00	0.0	0.5%
Closed canopy shrub	229.91	0.1	4.3%
Open canopy shrub	80.29	0.1	1.5%
Scattered canopy shrub	172.79	0.5	3.2%
Meadow/grass	141.81	0.7	2.7%
Not classified	1.66	0.0	0.0%
Total	**5,345.81**	**8.6**	**100.0%**

The table below provides estimates of each type of the habitats described in Metro's Technical Report for Fish and Wildlife Habitat, based on Johnson and O'Neil's (2001) habitat scheme. These numbers are provided for subwatershed comparison purposes and represent estimates of available habitat type. Several data types were used to compile this table, and the data sources vary in their precision. For example, the satellite data sources are less accurate than hand-digitized forest canopy cover. There is also slight overlap between certain habitat types. For example, Riparian Wetlands (RWET) are also partially included in Westside Lowland Coniferous Hardwood/Westside Oak and Douglas-fir (WLCH/WODF) because some wetlands also contain forest, and Open Water (WATR) is not always considered part of habitat patches. Therefore, the sums of these habitat types are slightly different from the "Total wildlife habitat acres in inventory" shown in Table 16. Nonetheless, these numbers provide a generalized means of comparing the quality and quantity of habitat available to wildlife among and between subwatersheds. Note also that the estimates for Westside Grasslands (WEGR) probably represent grasslands that are not native rather than true native grasslands, which are largely extirpated from the metro region.

Table E-15. Wildlife habitat availability[1] based on Johnson & O'Neil's (2001) habitat types and species-habitat associations.

Resource site:	Habitat type						
Lower Tualatin River - Lake Oswego Canal	WATR[2]	HWET[3]	RWET[3]	TOTWET[3]	WLCH/ WODF[4]	WEGR	AGPA
Total acres	167.0	247.5	110.2	369.2	3,823.4	396.3	626.5
Percent of total	3.1%	4.6%	2.1%	6.9%	71.4%	7.4%	11.7%

[1]See Table E-14 for land cover types and crosswalk to Johnson and O'Neil's classification scheme.

[2]Note that patch type and data limitations result in an underestimation of open water habitats. For example, medium and small sized stream surfaces are excluded.

[3]Note that HWET and RWET do not represent the full suite of wetlands because some wetlands <2 acres were added in as Habitats of Concern, and some wetlands could not be associated with herbaceous or forested habitats. TOTWET represents the best estimate of all existing wetlands because it includes Habitats of Concern.

[4]Data limitations make it impossible to distinguish between these two habitat types at this time, and no comprehensive oak habitat survey has been conducted for the region. However, known oak habitats are also included in HOCs (see Appendix 10).

SITE #12: Upper and Middle Fanno Creek subwatershed

Named tributaries: Ash Creek, Fanno Creek, Ivey Creek, Summer Creek, Sylvan Creek
Communities within the subwatershed: Beaverton, Lake Oswego, Portland, Tigard, unincorporated Multnomah County, unincorporated Washington County
Total acreage within Metro's boundary: 11,183
Total acres within riparian corridor: 2,693.5

This site contains four percent of the area comprising Metro's jurisdictional boundary. About 40 percent of the site is in the City of Portland, with the remainder in unincorporated Washington County (23 percent), Beaverton (21 percent), Tigard (12 percent), Multnomah County (four percent), and less than one percent in the City of Lake Oswego (Table E-16).

This site, at 17.3 miles of road per square mile, falls within the top quartile (76 to 100 percent of maximum) of development compared to all other resource sites (Table E-2). Reflecting the relatively urban nature of this site, zoning is strongly dominated by single family residential land use (Table E-5). More than a thousand building permits have been issued in this resource site since 1996 (Table E-2).

Riparian resources. The percentage of this site in riparian corridors is more than 24 percent, close to the proportions in Sites #13, 14 and 15 (Table 12). The site contributes three percent of the region's riparian corridors, the second highest in Group E (Table 13).

This resource site has approximately 46 total stream miles, or 0.0035 miles of non-piped streams per acre (similar to Site #14, and ranking 14th among the 27 resource sites) (Tables E-3 and 12). Approximately 16 percent of all stream miles are stream links, similar to Sites #13 and #15 in this group (Table E-3). Thirty-three percent of non-piped streams are DEQ 303(d) water-quality limited, the second highest in Group E behind Site #15 (Tables E-2 and 12). Five percent of the site is in the floodplain, and two percent of the land is covered by wetland resources (Table E-2). Twenty-one percent of the floodplain is developed, most similar to Site #11 in this group and ranking it seventh most developed among all resource sites (Tables 14 and E-2). Anadromous fish are known to be present in more than seven stream miles (Table E-2).

Nearly a third of the acreage that falls within the riparian corridor inventory in this site received primary scores for at least three of the five ecological functions, similar to Site #12 (Table E-19). Forty-seven percent of the site's riparian corridors receive at least one primary ecological function score, again most similar to Site #12 in this group (Table E-19). The most common vegetation type within 300 ft of streams is forest (Table E-4). The largest percentage of land receiving a given primary score is for *Large wood and channel dynamics* and *Bank stabilization and pollution control* and, but *Organic material sources* is also an important primary function (Table E-18; see also Table 4 and Appendix 5 for description of ecological functions mapping).

Wildlife habitat resources.
Including Habitats of Concern, 23 percent of the lands in this site fall within the wildlife habitat inventory, ranking it 16th among the 27 resource sites and third within Group E (Table 16). Within model patches approximately six percent falls within the top third of the point range, or about a fourth of the proportion within Site #11. However, another 72 percent falls in the middle range (Table E-20). Of the four criteria in the GIS model, the majority of acreage falls in the low

size and habitat interior ranges, with about 40 percent of acreage containing no habitat interior (Table E-21). Wildlife patches in this site have moderate to good water resources, with nearly 40 percent falling in the midrange and another 30 percent in the top score range. Connectivity is moderate, with 53 percent in the midrange and more than 20 percent in the low and high categories. In general, this site can be characterized as having relatively small habitat patches with little forest interior, but reasonably good water resources and connectivity. The site likely provides substantial habitat for native wildlife, with good migratory corridors but limited breeding habitat for Neotropical migratory birds and other wildlife needing interior habitat or less disturbed areas.

Conifer and hardwood forest are the predominant habitat types in this resource site (83 percent) (Table E-25). Wetlands are an even more important wildlife resource here than in Site #11, comprising nearly 13 percent of the site. However, the site's contribution to regional wetland resources is slightly lower than Site #11 because less land falls within the Metro boundary. This site contributes nearly four percent of the region's wetlands and ranks sixth of the 27 resource sites.

Species of Concern. Seven Species of Concern sighting locations fall within the site. Each sighting may include one or more species; if a species occurs more than once in the resource site it is only listed once here. These include the following species:

- Willow Flycatcher
- Northwestern Pond Turtle
- Bald Eagle roost

There are very likely other Species of Concern using this resource site, particularly those relying on forested habitats and wetlands (see Table E-25). There are several Willow Flycatcher and turtle sightings here, suggesting that lowland riparian-wetland complexes may provide very important habitat resources to sensitive wildlife species. Examples of species likely to occur in this site may be found by referencing the species list in Appendix 7 and identifying the species with a double "XX" under the habitat. General species needs and potential reasons for their decline are identified in the *Sensitive Species Accounts* section above. More detailed information on all species' needs can be obtained through Johnson and O'Neil (2001).

Habitats of Concern.
The following Habitats of Concern are partially or wholly within this resource site. Using the Unique ID # (UID), please refer to Appendix 8 for information concerning each Habitat of Concern:

UID numbers: 94, 95, 105

Resource site data tables: Riparian Corridors

Table E-16. Acres within resource site by jurisdiction.

Jurisdiction	Acres within subwatershed
Beaverton	2,318.9
Lake Oswego	9.5
Portland	4,479.2
Tigard	1,310.6
Unincorporated Multnomah County	465.0
Unincorporated Washington County	2,600.4

Table E-17. Acres in Metro and riparian corridor.

Resource site	Total acres within Metro	Total acres within riparian corridor
Upper and Middle Fanno Creek	11,183.5	2,651.7

Table E-18. Number of acres within riparian corridor providing ecological function.

Resource site:	Ecological function	*Primary Value*		*Secondary Value*	
		Acres*	% of Total**	Acres	% of Total
Upper and Middle Fanno Creek	Microclimate & shade	585.4	22.1%	1,116.6	42.1%
	Streamflow moderation & water storage	500.7	18.9%	1,977.8	74.6%
	Bank stabilization & pollution control	1,044.5	39.4%	82.9	3.1%
	Large wood & channel dynamics	1,100.9	41.5%	227.4	8.6%
	Organic material sources	819.4	30.9%	170.4	6.4%

*Number of acres scored within the riparian corridor for each function
**Percent of total acres within the riparian corridor

Table E-19. Breakdown of ecological scores.

Resource site	Ecological Score	Acres	% of Total Acres
Upper and Middle Fanno Creek	1 to 5	1,421.1	53.6%
	6 to 11	195.9	7.4%
	12 to 17	205.1	7.7%
	18 to 23	35.1	1.3%
	24 to 29	632.9	23.9%
	30	161.6	6.1%
	Total acres	2,651.7	100.0%

Resource site data tables: Wildlife Habitat

Table E-20. Breakdown of total wildlife model patch scores.*

Resource site: Upper and Middle Fanno Creek	Number of acres in each wildlife score category: 1	2	3	4	5	6	7	8	9	Total wildlife model patch acres in inventory
Model score	135.4	149.5	267.7	307.5	720.6	782.1	8.4	129.9	0.0	2,501.3
Percent of total	5.4%	6.0%	10.7%	12.3%	28.8%	31.3%	0.3%	5.2%	0.0%	100.0%

*Does not include Habitats of Concern outside of model patches.

Table E-21. Breakdown of total wildlife model patch scores by criteria.*

Resource site:	Number of acres by score for each model criterion												Total wildlife model patch acres in inventory
	Size[2]			Interior[2]			Water[3]			Connectivity			
Upper and Middle Fanno Creek	1	2	3	1	2	3	1	2	3	1	2	3	
	1,865.5	446.3	0.0	1,387.7	0.5	129.4	594.7	987.5	735.8	562.7	1,327.4	611.2	2,501.3
Percent of total acres in inventory	74.6%	17.8%	0.0%	55.5%	0.0%	5.2%	23.8%	39.5%	29.4%	22.5%	53.1%	24.4%	na

[1]Does not include Habitats of Concern outside of model patches.

[2]These numbers do not add up to 100.0% because Type 2 patches (low structure vegetation within 300 feet of streams and wetlands) were not ranked for these criteria.

[3]These numbers do not add up to 100% because not all patches contained or were near water resources.

Table E-22. Breakdown of total wildlife model patch area by 2000 Metro photo interpretation landcover and known wetlands.*

Resource site: Upper and Middle Fanno Creek	Low structure vegetation within 300 feet of stream: Low structure vegetation/ intact topsoil	Non-forest woody vegetation	Forested vegetation	Forested wetlands	Grass/shrub wetlands within 300 feet of a stream	Other wetlands	Total wildlife model patch acres in inventory
Acres	189.5	0.0	1,999.7	98.1	164.8	49.0	2,501.3
Percent of total	7.6%	0.0%	79.9%	3.9%	6.6%	2.0%	100.0%

*Does not include Habitats of Concern outside of model patches.

Table E-23. Total acres of inventoried wildlife habitat by type and total Species of Concern (SOCs).

Resource site: Upper and Middle Fanno Creek	Wildlife patches (acres)	HOCs inside Wildlife patches (acres)*	HOCs outside Wildlife patches (including wetlands <2 acres)	Total inventoried wildlife habitat acres	Total SOCs
Acres	2501.3	200.7	21.0	2522.3	7
Percent of total	99.2%	8.0%	0.8%	100.0%	N/A

*Habitats of Concern.

Table E-24. Total area of model patches and Habitats of Concern by 1998 Landsat Landcover Area.

Resource Site: Upper and Middle Fanno Creek / Landcover type:	Total area of wildlife model patches	Total area of HOCs outside of modeled patches (including wetlands <2 acres)	Percent of total inventoried habitat
Water	3.86	0.0	0.2%
Barren	117.49	7.3	4.9%
Low structure agriculture	0.00	0.0	0.0%
High structure agriculture	0.00	0.0	0.0%
Deciduous closed canopy	433.84	1.7	17.3%
Mixed closed canopy	536.90	0.4	21.3%
Conifer closed canopy	319.75	0.2	12.7%
Deciduous open canopy	303.58	3.3	12.2%
Mixed open canopy	200.26	0.9	8.0%
Conifer open canopy	48.03	0.4	1.9%
Deciduous scattered canopy	120.64	3.3	4.9%
Mixed scattered canopy	86.79	0.7	3.5%
Conifer scattered canopy	20.50	0.1	0.8%
Closed canopy shrub	81.65	0.3	3.2%
Open canopy shrub	52.41	0.7	2.1%
Scattered canopy shrub	43.48	1.1	1.8%
Meadow/grass	132.10	0.6	5.3%
Not classified	0.00	0.0	0.0%
Total	**2,501.27**	**21.0**	**100.0%**

The table below provides estimates of each type of the habitats described in Metro's Technical Report for Fish and Wildlife Habitat, based on Johnson and O'Neil's (2001) habitat scheme. These numbers are provided for subwatershed comparison purposes and represent estimates of available habitat type. Several data types were used to compile this table, and the data sources vary in their precision. For example, the satellite data sources are less accurate than hand-digitized forest canopy cover. There is also slight overlap between certain habitat types. For example, Riparian Wetlands (RWET) are also partially included in Westside Lowland Coniferous Hardwood/Westside Oak and Douglas-fir (WLCH/WODF) because some wetlands also contain forest, and Open Water (WATR) is not always considered part of habitat patches. Therefore, the sums of these habitat types are slightly different from the "Total wildlife habitat acres in inventory" shown in Table 16. Nonetheless, these numbers provide a generalized means of comparing the quality and quantity of habitat available to wildlife among and between subwatersheds. Note also that the estimates for Westside Grasslands (WEGR) probably represent grasslands that are not native rather than true native grasslands, which are largely extirpated from the metro region.

Table E-25. Wildlife habitat availability[1] based on Johnson & O'Neil's (2001) habitat types and species-habitat associations.

Resource site:	Habitat type						
Upper and Middle Fanno Creek	WATR[2]	HWET[3]	RWET[3]	TOTWET[3]	WLCH/ WODF[4]	WEGR	AGPA
Total acres	0.0	213.8	98.1	323.8	2,081.3	230.4	0.0
Percent of total	0.0%	8.5%	3.9%	12.8%	82.5%	9.1%	0.0%

[1]See Table E-24 for land cover types and crosswalk to Johnson and O'Neil's classification scheme.

[2]Note that patch type and data limitations result in an underestimation of open water habitats. For example, medium and small sized stream surfaces are excluded.

[3]Note that HWET and RWET do not represent the full suite of wetlands because some wetlands <2 acres were added in as Habitats of Concern, and some wetlands could not be associated with herbaceous or forested habitats. TOTWET represents the best estimate of all existing wetlands because it includes Habitats of Concern.

[4]Data limitations make it impossible to distinguish between these two habitat types at this time, and no comprehensive oak habitat survey has been conducted for the region. However, known oak habitats are also included in HOCs (see Appendix 10).

SITE #13: Summer Creek subwatershed

Named tributaries: Fanno Creek, Summer Creek
Communities within the subwatershed: Beaverton, Tigard, unincorporated Washington County
Total acreage within Metro's boundary: 3,769.1
Total acres within riparian corridor: 826.5

This site contains one percent of the area comprising Metro's jurisdictional boundary. This site is split nearly equally between Beaverton and Tigard (39 and 41 percent, respectively), with another 20 percent in unincorporated Washington County (Table E-26).

The road density in this site is 15.0 miles per square mile, placing it in the third quartile (51 to 75 percent of maximum) compared to development in all other resource sites (Table E-2). The dominant zoning by far is single family residential (Table E-5). More than a thousand building permits have been issued here since 1996, a high number compared to the acreage within Metro's boundary (Table E-2).

Riparian resources. The percentage of this site in riparian corridors is 23 percent, similar to Sites #12 and #14 in this group (Table 12). The site contributes about one percent of the region's riparian corridors (Table 13).

This resource site has approximately 30 total stream miles, or 0.0037 miles of non-piped streams per acre (similar to Sites #12 and #14 in Group E) (Tables E-3 and 12). The site's stream density ranks ninth among the 27 resource sites. Approximately 16 percent of all stream miles are stream links, as in Sites #12 and #15 (Table E-3). A third of non-piped streams are DEQ 303(d) water-quality limited, similar to Site #14 in Group E (Tables E-2 and 12). Two percent of the site is in floodplain, and wetlands comprise three percent of the lands in this resource site (Table E-2). Eleven percent of the floodplain is developed, similar to Site #14 in this group (Table E-2). Anadromous fish are not known to be present in streams within this site (Table E-2).

Thirty-two percent of the acreage that falls within the riparian corridor inventory in this site received primary scores for at least three of the five ecological functions, similar to Site #12 (Table E-29). Nearly half of the site's riparian corridors receive at least one primary ecological function score (Table E-29). The vegetation type within 300 ft of streams is predominantly forested, also with substantial amounts of low-structure vegetation (Table E-4). The largest percentage of land receiving a given primary score is for *Bank stabilization and pollution control* and *Large wood and channel dynamics,* but *Organic material sources* is also an important primary function (Table E-28; see also Table 4 and Appendix 5 for description of ecological functions mapping).

Wildlife habitat resources.
Including Habitats of Concern, 22 percent of the lands in this site fall within the wildlife habitat inventory, ranking it 17th among the 27 resource sites and fourth within Group E (Table 16). Within model patches less than four percent falls within the top third of the point range, the lowest of the five Group E sites (Table E-30). However, another 72 percent falls in the middle range. Of the four criteria in the GIS model, none of the acreage scored above the lowest class for size or interior ((Table E-31). Wildlife patches in this site have water resources, with this

highest proportion in the midrange but nearly equal percentages for each of the three water classes. Connectivity is moderate, with 43 percent in the midrange and another 29 percent in both the low and high score categories. In general, this site can be characterized as having small habitat patches with little or no forest interior, but reasonably good water resources and connectivity. As with Site #12, this site likely provides substantial habitat for native wildlife, with good migratory corridors but limited breeding habitat for Neotropical migratory birds and other wildlife needing interior habitat or less disturbed areas. A relatively large amount of parklands preserved along Fanno Creek and other tributaries contributes to this site's importance to the region's wildlife.

Habitat types are similar to Site #12. Conifer and hardwood forest are the predominant habitat types in this resource site (80 percent) (Table E-35). Wetlands comprise more than 14 percent of the site, placing it in the middle of the five Group E resource sites. However, the site contributes relatively little (about one and one-half percent of total, ranking 16th of all sites) to regional wetland resources due to the relatively small amount of acreage falling within the Metro boundary.

Species of Concern. There are no known Species of Concern sightings falling within this resource site, although it may provide important habitat resources to sensitive wildlife species. Examples of species likely to occur in this site may be found by referencing the species list in Appendix 7 and identifying the species with a double "XX" under the habitat. General species needs and potential reasons for their decline are identified in the *Sensitive Species Accounts* section above. More detailed information on all species' needs can be obtained through Johnson and O'Neil (2001).

Habitats of Concern.
The following Habitats of Concern are partially or wholly within this resource site. Using the Unique ID # (UID), please refer to Appendix 8 for information concerning each Habitat of Concern:

UID numbers: 96, 97, 107, 168

Resource site data tables: Riparian Corridors

Table E-26. Acres within resource site by jurisdiction.

Jurisdiction	Acres within subwatershed
Beaverton	1,468.9
Tigard	1,533.8
Unincorporated Washington County	766.5

Table E-27. Acres in Metro and riparian corridor.

Resource site	Total acres within Metro	Total acres within riparian corridor
Summer Creek	3,769.1	855.6

Table E-28. Number of acres within riparian corridor providing ecological function.

Resource site:	Ecological function	*Primary Value*		*Secondary Value*	
		Acres*	% of Total**	Acres	% of Total
Summer Creek	Microclimate & shade	203.3	23.8%	339.2	39.6%
	Streamflow moderation & water storage	136.8	16.0%	642.3	75.1%
	Bank stabilization & pollution control	388.5	45.4%	51.1	6.0%
	Large wood & channel dynamics	334.7	39.1%	63.8	7.5%
	Organic material sources	268.4	31.4%	53.3	6.2%

*Number of acres scored within the riparian corridor for each function
**Percent of total acres within the riparian corridor

Table E-29. Breakdown of ecological scores.

Resource site	Ecological Score	Acres	% of Total Acres
Summer Creek	1 to 5	429.7	50.2%
	6 to 11	90.6	10.6%
	12 to 17	63.7	7.4%
	18 to 23	26.9	3.1%
	24 to 29	190.4	22.2%
	30	54.3	6.3%
	Total acres	855.6	100.0%

Resource site data tables: Wildlife Habitat

Table E-30. Breakdown of total wildlife model patch scores.*

Resource site: Summer Creek	Number of acres in each wildlife score category 1	2	3	4	5	6	7	8	9	Total wildlife model patch acres in inventory
Model score	19.6	89.9	89.3	177.1	327.1	85.8	29.8	0.0	0.0	818.6
Percent of total	2.4%	11.0%	10.9%	21.6%	40.0%	10.5%	3.6%	0.0%	0.0%	100.0%

*Does not include Habitats of Concern outside of model patches.

Table E-31. Breakdown of total wildlife patch model scores by criteria.*

Resource site:	Number of acres by score for each model criterion												Total wildlife model patch acres in inventory
	Size[2]			Interior[2]			Water[3]			Connectivity			
Summer Creek	1	2	3	1	2	3	1	2	3	1	2	3	
	704.7	0.0	0.0	492.2	0.0	0.0	208.6	264.8	260.5	234.6	350.0	234.1	818.6
Percent of total acres in inventory	86.1%	0.0%	0.0%	60.1%	0.0%	0.0%	25.5%	32.3%	31.8%	28.7%	42.7%	28.6%	na

[1]Does not include Habitats of Concern outside of model patches.

[2]These numbers do not add up to 100.0% because Type 2 patches (low structure vegetation within 300 feet of streams and wetlands) were not ranked for these criteria.

[3]These numbers do not add up to 100% because not all patches contained or were near water resources.

Table E-32. Breakdown of total wildlife model patch area by 2000 Metro photo interpretation landcover and known wetlands.*

Resource site: Summer Creek	Low structure vegetation within 300 feet of stream: Low structure vegetation/ intact topsoil	Low structure vegetation within 300 feet of stream: Non-forest woody vegetation	Forested vegetation	Forested wetlands	Grass/shrub wetlands within 300 feet of a stream	Other wetlands	Total wildlife model patch acres in inventory
Acres	102.4	11.5	596.2	45.6	53.3	9.6	818.6
Percent of total	12.5%	1.4%	72.8%	5.6%	6.5%	1.2%	100.0%

*Does not include Habitats of Concern outside of model patches.

Table E-33. Total acres of inventoried wildlife habitat by type and total Species of Concern (SOCs).

Resource site: Summer Creek	Wildlife patches (acres)	HOCs inside Wildlife patches (acres)*	HOCs outside Wildlife patches (including wetlands <2 acres)	Total inventoried wildlife habitat acres	Total SOCs
Acres	818.6	91.8	13.7	832.3	0
Percent of total	98.4%	11.0%	1.6%	100.0%	N/A

*Habitats of Concern.

Table E-34. Total area of model patches and Habitats of Concern by 1998 Landsat Landcover Area.

Resource Site: Summer Creek / Landcover type:	Total area of wildlife model patches	Total area of HOCs outside of modeled patches (including wetlands <2 acres)	Percent of total inventoried habitat
Water	3.57	0.0	0.4%
Barren	47.57	2.1	6.0%
Low structure agriculture	10.06	0.0	1.2%
High structure agriculture	0.23	0.0	0.0%
Deciduous closed canopy	137.51	1.0	16.6%
Mixed closed canopy	200.04	0.6	24.1%
Conifer closed canopy	128.04	0.3	15.4%
Deciduous open canopy	59.50	2.4	7.4%
Mixed open canopy	38.83	1.5	4.8%
Conifer open canopy	15.38	0.6	1.9%
Deciduous scattered canopy	39.87	2.2	5.1%
Mixed scattered canopy	25.61	0.6	3.1%
Conifer scattered canopy	14.34	0.3	1.8%
Closed canopy shrub	34.76	0.3	4.2%
Open canopy shrub	15.09	0.4	1.9%
Scattered canopy shrub	19.83	1.2	2.5%
Meadow/grass	28.41	0.2	3.4%
Not classified	0.00	0.0	0.0%
Total	**818.62**	**13.7**	**100.0%**

The table below provides estimates of each type of the habitats described in Metro's Technical Report for Fish and Wildlife Habitat, based on Johnson and O'Neil's (2001) habitat scheme. These numbers are provided for subwatershed comparison purposes and represent estimates of available habitat type. Several data types were used to compile this table, and the data sources vary in their precision. For example, the satellite data sources are less accurate than hand-digitized forest canopy cover. There is also slight overlap between certain habitat types. For example, Riparian Wetlands (RWET) are also partially included in Westside Lowland Coniferous Hardwood/Westside Oak and Douglas-fir (WLCH/WODF) because some wetlands also contain forest, and Open Water (WATR) is not always considered part of habitat patches. Therefore, the sums of these habitat types are slightly different from the "Total wildlife habitat acres in inventory" shown in Table 16. Nonetheless, these numbers provide a generalized means of comparing the quality and quantity of habitat available to wildlife among and between subwatersheds. Note also that the estimates for Westside Grasslands (WEGR) probably represent grasslands that are not native rather than true native grasslands, which are largely extirpated from the metro region.

Table E-35. Wildlife habitat availability[1] based on Johnson & O'Neil's (2001) habitat types and species-habitat associations.

Resource site:	Habitat type						
Summer Creek	WATR[2]	HWET[3]	RWET[3]	TOTWET[3]	WLCH/ WODF[4]	WEGR	AGPA
Total acres	0.0	62.9	45.6	118.5	668.6	65.2	10.3
Percent of total	0.0%	7.6%	5.5%	14.2%	80.3%	7.8%	1.2%

[1]See Table E-34 for land cover types and crosswalk to Johnson and O'Neil's classification scheme.

[2]Note that patch type and data limitations result in an underestimation of open water habitats. For example, medium and small sized stream surfaces are excluded.

[3]Note that HWET and RWET do not represent the full suite of wetlands because some wetlands <2 acres were added in as Habitats of Concern, and some wetlands could not be associated with herbaceous or forested habitats. TOTWET represents the best estimate of all existing wetlands because it includes Habitats of Concern.

[4]Data limitations make it impossible to distinguish between these two habitat types at this time, and no comprehensive oak habitat survey has been conducted for the region. However, known oak habitats are also included in HOCs (see Appendix 10).

SITE #14: Lower Fanno Creek subwatershed

Named tributaries: Ball Creek, Bonita Creek, Carter Creek, Fanno Creek, Tualatin River
Communities within the subwatershed: Durham, King City, Lake Oswego, Portland, Tigard, Tualatin, unincorporated Clackamas County, unincorporated Multnomah County, unincorporated Washington County
Total acreage within Metro's boundary: 8,453.8
Total acres within riparian corridor: 1,907.5

This site contains three percent of the area comprising Metro's jurisdictional boundary. This site encompasses portions of nine different jurisdictions: Tigard (52 percent), unincorporated Washington County (19 percent), Lake Oswego (11 percent), Tualatin (five percent), Lake Oswego (four percent), unincorporated Clackamas County (four percent), King City (three percent), Durham (two percent), and less than one percent in unincorporated Multnomah County (Table E-36).

The estimated development density is similar to Site #13, at 15.0 miles of roads per square mile (Table E-2). Similarly, single family residential land use strongly dominates zoning patterns (Table E-5). However, a similar amount of building permits issued since 1996 (Table E-2) but well more than double the amount of acreage within the Metro boundary suggest that development is occurring more rapidly in Resource Site #13 compared to this site.

Riparian resources. The amount of this site in riparian corridors is 22 percent, the lowest of the five Group E sites but similar to Sites #12 and 13 (Table 12). The site contributes two percent of the region's riparian corridors, placing it within the mid-range of sites within this group (Table 13).

This resource site has approximately 38 total stream miles, or 0.0035 miles of non-piped streams per acre (similar to Site #12, and ranking 13th among all resource sites) (Tables E-3 and 12). Twenty-three percent of all stream miles are stream links, the highest proportion in Group D; this implies that a substantial portion of streams in this resource site have been piped underground or culverted (Table E-3). Thirty percent of non-piped streams are DEQ 303(d) water-quality limited (Tables E-2 and 12). The majority of streams in this site are low gradient (Table E-3). Ten percent of the site is in floodplain, and of that, eleven percent is developed (Table E-2). Three percent of the land in this site is covered by wetlands (Table E-2). Anadromous fish are known to be present in nearly nine stream miles (Table E-2).

The ecological criteria scores for this site indicate high-quality riparian resources. Forty-three percent of the acreage that falls within the riparian corridor inventory in this site received primary scores for at least three of the five ecological functions, the highest of all sites in Group E (Table E-39). More than 65 percent of this site's riparian corridors receive at least one primary ecological function score, also the highest proportion in Group E (Table E-9). The vegetation types within 300 ft of streams is dominated by forest, but there is also a substantial amount of low-structure vegetation near streams (Table E-4). The largest percentage of land receiving a particular primary score is for *Bank stabilization and pollution control* and *Large wood and channel dynamics*. However, *Organic material sources* and *Streamflow moderation and water storage* are also important primary functions (Table E-38; see also Table 4 and Appendix 5 for description of ecological functions mapping).

Wildlife habitat resources.
Including Habitats of Concern, 18 percent of the lands in this site fall within the wildlife habitat inventory, ranking it 24th among the 27 resource sites and last within Group E (Table 16). Within model patches approximately six percent falls within the top third of the point range with another 57 percent in the middle range (Table E-40). Of the four criteria in the GIS model, all of the acreage falls in the low size and habitat interior ranges (Table E-41). However, wildlife patches in this site have very good water resources, with 46 percent falling in the top score category and another 36 percent in the middle category. Connectivity is moderate, with 58 percent in the midrange and the majority of the remainder in the low category. In general, this site can be characterized as having relatively small habitat patches with little forest interior, but reasonably good connectivity and very good water resources. The site likely provides important habitat for native wildlife, with relatively good migratory corridors but limited breeding habitat for Neotropical migratory birds and other wildlife needing interior habitat or less disturbed areas.

Conifer and hardwood forest are the predominant habitat types in this resource site (72 percent), but grasslands may also provide important wildlife habitat (Table E-25). Wetlands comprise more than 15 percent of the site's wildlife habitat, ranking it second among Group E. The site's contribution to regional wetland resources is nearly three percent, and it ranks 11th among the 27 resource sites and fourth among the five Group E resource sites.

Species of Concern. Seven Species of Concern sighting locations fall within the site. Each sighting may include one or more species; if a species occurs more than once in the resource site it is only listed once here. These include the following species:

- Pileated Woodpecker
- Band-tailed Pigeon
- Great Blue Heron rookery

There are very likely other Species of Concern using this resource site, particularly those relying on forested habitats, grasslands and wetlands (see Table E-45). Examples of species likely to occur in this site may be found by referencing the species list in Appendix 7 and identifying the species with a double "XX" under the habitat. General species needs and potential reasons for their decline are identified in the *Sensitive Species Accounts* section above. More detailed information on all species' needs can be obtained through Johnson and O'Neil (2001).

Habitats of Concern.
The following Habitats of Concern are partially or wholly within this resource site. Using the Unique ID # (UID), please refer to Appendix 8 for information concerning each Habitat of Concern:

UID numbers: 98, 99, 100, 106

Resource site data tables: Riparian Corridors

Table E-36. Acres within resource site by jurisdiction.

Jurisdiction	Acres within subwatershed
Durham	191.2
King City	282.0
Lake Oswego	919.2
Portland	347.0
Tigard	4,423.1
Tualatin	413.0
Unincorporated Clackamas County	296.4
Unincorporated Multnomah County	0.0
Unincorporated Washington County	1,581.9

Table E-37. Acres in Metro and riparian corridor.

Resource site	Total acres within Metro	Total acres within riparian corridor
Lower Fanno Creek	8,453.8	1,864.0

Table E-38. Number of acres within riparian corridor providing ecological function.

Resource site:	Ecological function	*Primary Value*		*Secondary Value*	
		Acres*	% of Total**	Acres	% of Total
Lower Fanno Creek	Microclimate & shade	523.0	28.1%	442.1	23.7%
	Streamflow moderation & water storage	790.2	42.4%	933.3	50.1%
	Bank stabilization & pollution control	943.2	50.6%	11.5	0.6%
	Large wood & channel dynamics	1,137.1	61.0%	95.7	5.1%
	Organic material sources	740.6	39.7%	80.4	4.3%

*Number of acres scored within the riparian corridor for each function

**Percent of total acres within the riparian corridor

Table E-39. Breakdown of ecological scores.

Resource site	Ecological Score	Acres	% of Total Acres
Lower Fanno Creek	1 to 5	644.0	34.5%
	6 to 11	118.0	6.3%
	12 to 17	294.8	15.8%
	18 to 23	93.3	5.0%
	24 to 29	423.1	22.7%
	30	290.8	15.6%
	Total acres	1,864.0	100.0%

Resource site data tables: Wildlife Habitat

Table E-40. Breakdown of total wildlife model patch scores.*

Resource site: Lower Fanno Creek	Number of acres in each wildlife score category: 1	2	3	4	5	6	7	8	9	Total wildlife model patch acres in inventory
Model score	121.9	127.4	161.4	331.6	368.9	311.2	87.4	0.0	0.0	1,509.8
Percent of total	8.1%	8.4%	10.7%	22.0%	24.4%	20.6%	5.8%	0.0%	0.0%	100.0%

*Does not include Habitats of Concern outside of model patches.

Table E-41. Breakdown of total wildlife model patch scores by criteria.*

Resource site:	Number of acres by score for each model criterion												Total wildlife model patch acres in inventory
	Size[2]			Interior[2]			Water[3]			Connectivity			
Lower Fanno Creek	1	2	3	1	2	3	1	2	3	1	2	3	
	1,255.2	0.0	0.0	697.7	0.0	0.0	114.2	546.5	689.6	429.6	878.0	202.2	1,509.8
Percent of total acres in inventory	83.1%	0.0%	0.0%	46.2%	0.0%	0.0%	7.6%	36.2%	45.7%	28.5%	58.2%	13.4%	na

[1]Does not include Habitats of Concern outside of model patches.

[2]These numbers do not add up to 100.0% because Type 2 patches (low structure vegetation within 300 feet of streams and wetlands) were not ranked for these criteria.

[3]These numbers do not add up to 100% because not all patches contained or were near water resources.

Table E-42. Breakdown of total wildlife model patch area by 2000 Metro photo interpretation landcover and known wetlands.*

Resource site: Lower Fanno Creek	Low structure vegetation within 300 feet of stream: Low structure vegetation/ intact topsoil	Low structure vegetation within 300 feet of stream: Non-forest woody vegetation	Forested vegetation	Forested wetlands	Grass/shrub wetlands within 300 feet of a stream	Other wetlands	Total wildlife model patch acres in inventory
Acres	245.6	9.1	1,037.3	91.6	64.4	61.9	1,509.8
Percent of total	16.3%	0.6%	68.7%	6.1%	4.3%	4.1%	100.0%

*Does not include Habitats of Concern outside of model patches.

Table E-43. Total acres of inventoried wildlife habitat by type and total Species of Concern (SOCs).

Resource site: Lower Fanno Creek	Wildlife patches (acres)	HOCs inside Wildlife patches (acres)*	HOCs outside Wildlife patches (including wetlands <2 acres)	Total inventoried wildlife habitat acres	Total SOCs
Acres	1509.8	263.5	23.6	1533.4	2
Percent of total	98.5%	17.2%	1.5%	100.0%	N/A

*Habitats of Concern.

Table E-44. Total area of model patches and Habitats of Concern by 1998 Landsat Landcover Area.

Resource Site: Lower Fanno Creek / Landcover type:	Total area of wildlife model patches	Total area of HOCs outside of modeled patches (including wetlands <2 acres)	Percent of total inventoried habitat
Water	12.35	0.0	0.8%
Barren	109.57	4.4	7.4%
Low structure agriculture	31.32	2.7	2.2%
High structure agriculture	0.02	0.0	0.0%
Deciduous closed canopy	236.96	1.5	15.5%
Mixed closed canopy	278.06	0.2	18.1%
Conifer closed canopy	140.22	0.1	9.2%
Deciduous open canopy	150.83	2.1	10.0%
Mixed open canopy	99.39	0.2	6.5%
Conifer open canopy	26.67	0.2	1.8%
Deciduous scattered canopy	81.23	1.3	5.4%
Mixed scattered canopy	54.38	0.8	3.6%
Conifer scattered canopy	23.63	0.0	1.5%
Closed canopy shrub	56.86	0.4	3.7%
Open canopy shrub	37.01	0.9	2.5%
Scattered canopy shrub	43.63	1.2	2.9%
Meadow/grass	127.43	7.7	8.8%
Not classified	0.29	0.0	0.0%
Total	**1,509.84**	**23.6**	**100.0%**

The table below provides estimates of each type of the habitats described in Metro's Technical Report for Fish and Wildlife Habitat, based on Johnson and O'Neil's (2001) habitat scheme. These numbers are provided for subwatershed comparison purposes and represent estimates of available habitat type. Several data types were used to compile this table, and the data sources vary in their precision. For example, the satellite data sources are less accurate than hand-digitized forest canopy cover. There is also slight overlap between certain habitat types. For example, Riparian Wetlands (RWET) are also partially included in Westside Lowland Coniferous Hardwood/Westside Oak and Douglas-fir (WLCH/WODF) because some wetlands also contain forest, and Open Water (WATR) is not always considered part of habitat patches. Therefore, the sums of these habitat types are slightly different from the "Total wildlife habitat acres in inventory" shown in Table 16. Nonetheless, these numbers provide a generalized means of comparing the quality and quantity of habitat available to wildlife among and between subwatersheds. Note also that the estimates for Westside Grasslands (WEGR) probably represent grasslands that are not native rather than true native grasslands, which are largely extirpated from the metro region.

Table E-45. Wildlife habitat availability[1] based on Johnson & O'Neil's (2001) habitat types and species-habitat associations.

Resource site:	Habitat type						
Lower Fanno Creek	WATR[2]	HWET[3]	RWET[3]	TOTWET[3]	WLCH/ WODF[4]	WEGR	AGPA
Total acres	60.7	126.3	91.6	238.3	1,097.7	217.9	34.0
Percent of total	4.0%	8.2%	6.0%	15.5%	71.6%	14.2%	2.2%

[1]See Table E-44 for land cover types and crosswalk to Johnson and O'Neil's classification scheme.

[2]Note that patch type and data limitations result in an underestimation of open water habitats. For example, medium and small sized stream surfaces are excluded.

[3]Note that HWET and RWET do not represent the full suite of wetlands because some wetlands <2 acres were added in as Habitats of Concern, and some wetlands could not be associated with herbaceous or forested habitats. TOTWET represents the best estimate of all existing wetlands because it includes Habitats of Concern.

[4]Data limitations make it impossible to distinguish between these two habitat types at this time, and no comprehensive oak habitat survey has been conducted for the region. However, known oak habitats are also included in HOCs (see Appendix 10).

SITE #15: Rock Creek (South Washington County) subwatershed

Named tributaries: Cedar Creek, Chicken Creek, West Fork Chicken Creek, Goose Creek, Rock Creek
Communities within the subwatershed: Sherwood, Tualatin, unincorporated Washington County
Total acreage within Metro's boundary: 4,239.3 (includes Cedar Creek, Chicken Creek & Lower Tualatin River subwatersheds)
Total acres within riparian corridor: 1,075.1

This site contains one percent of the area comprising Metro's jurisdictional boundary. About 59 percent of the site is in the City of Sherwood, 32 percent in unincorporated Washington County, with the remainder in Tualatin (nine percent) (Table E-46).

The road density in this resource site (10.3 miles per square mile) is relatively low compared to three of four other sites in Group E (Table E-2). Zoning is dominated by single family residential, but rural and industrial land uses are also important in this resource site (Table E-5). The number of building permits issued since 1996 is 1,366 in this site (Table E-2).

Riparian resources. Twenty-six percent of this resource site is within the riparian corridor inventory, second only to Site #11 within Group E (Table 12). The site contributes a little more than one percent of the region's riparian corridors (Table 13).

This resource site has approximately 38 total stream miles, or 0.0035 miles of non-piped streams per acre (similar to Site #12, and ranking 22nd among all resource sites) (Tables E-3 and 12). Twenty-three percent of all stream miles are stream links, the highest proportion in Group D; this implies that a substantial portion of streams in this resource site have been piped underground or culverted (Table E-3). Thirty percent of non-piped streams are DEQ 303(d) water-quality limited (Tables E-2 and 12). The majority of streams in this site are low gradient (Table E-3). Ten percent of the site is in floodplain, and of that, eleven percent is developed (Table E-2). Three percent of the land in this site is covered by wetlands (Table E-2). Anadromous fish are known to be present in nearly nine stream miles (Table E-2).

The ecological criteria scores for this site indicate relatively high-quality riparian resources, second within this group only to Site #14. Thirty-seven percent of the acreage that falls within the riparian corridor inventory in this site received primary scores for at least three of the five ecological functions (Table E-49). Fifty-eight percent of this site's riparian corridors receive at least one primary ecological function score (Table E-49). Vegetation within 300 ft of streams is co-dominated by low structure vegetation and forest (Table E-4). The largest percentage of land receiving a particular primary score is for *Bank stabilization and pollution control* and *Large wood and channel dynamics*. However, *Organic material sources* and *Streamflow moderation and water storage* also contribute important primary functions (Table E-48; see also Table 4 and Appendix 5 for description of ecological functions mapping).

Wildlife habitat resources.
Including Habitats of Concern, more than 25 percent of the lands in this site fall within the wildlife habitat inventory, ranking it 12th among the 27 resource sites and second within Group E (Table 16). Within model patches approximately six percent falls within the top third of the

point range with another 79 percent in the middle range (Table E-50). Of the four criteria in the GIS model, all of the acreage falls in the low size and habitat interior ranges (Table E-51). However, wildlife patches in this site have very good water resources, with 27 percent falling in the top score category and another 64 percent in the middle category. Connectivity is excellent, with 63 percent in the midrange and the majority of the remainder in the midrange category. In general, this site can be characterized as having relatively small habitat patches with little forest interior, but very good water resources and excellent connectivity to other natural areas. The site is probably highly important to animals moving between patches, including Neotropical migratory birds. Aside from the importance of water to wildlife, the strong water resources in this well-connected site likely produce great insect resources for migrating songbirds and nesting native birds and other wildlife.

Conifer and hardwood forest are the predominant habitat types in this resource site (72 percent), but wetlands and grasslands are also highly important (Table E-55). Wetlands comprise more than 24 percent of the site's wildlife habitat, ranking it first among Group E. The site's contribution to regional wetland resources is three percent, and it ranks ninth among the 27 resource sites and third among the five Group E resource sites. However, consider that this site's area falling within the Metro boundary is only 38 percent of that in Site #12, but it contributes close to the same amount to the region's wetland resources.

Species of Concern. One Species of Concern sighting locations fall within the site. Each sighting may include one or more species; if a species occurs more than once in the resource site it is only listed once here. These include the following species:

- Peregrine Falcon

There are very likely other Species of Concern using this resource site, particularly those relying on forested habitats, grasslands and wetlands (see Table E-55). Examples of species likely to occur in this site may be found by referencing the species list in Appendix 7 and identifying the species with a double "XX" under the habitat. General species needs and potential reasons for their decline are identified in the *Sensitive Species Accounts* section above. More detailed information on all species' needs can be obtained through Johnson and O'Neil (2001).

Habitats of Concern.
The following Habitats of Concern are partially or wholly within this resource site. Using the Unique ID # (UID), please refer to Appendix 8 for information concerning each Habitat of Concern:

UID numbers: 106, 107, 154, 155, 156

Resource site data tables: Riparian Corridors

Table E-46. Acres within resource site by jurisdiction.

Jurisdiction	Acres within subwatershed
Sherwood	2,518.8
Tualatin	383.6
Unincorporated Washington County	1,337.0

Table E-47. Acres in Metro and riparian corridor.

Resource site	Total acres within Metro	Total acres within riparian corridor
Rock Creek (so. Washington Co.)	4,239.3	1,102.2

Table E-48. Number of acres within riparian corridor providing ecological function.

Resource site:	Ecological function	*Primary Value*		*Secondary Value*	
		Acres*	% of Total**	Acres	% of Total
Rock Creek (so. Washington County)	Microclimate & shade	277.4	25.2%	282.9	25.7%
	Streamflow moderation & water storage	413.1	37.5%	647.1	58.7%
	Bank stabilization & pollution control	500.8	45.4%	41.3	3.7%
	Large wood & channel dynamics	486.2	44.1%	38.4	3.5%
	Organic material sources	406.2	36.9%	18.1	1.6%

*Number of acres scored within the riparian corridor for each function

**Percent of total acres within the riparian corridor

Table E-49. Breakdown of ecological scores.

Resource site	Ecological Score	Acres	% of Total Acres
Rock Creek (so. Washington County)	1 to 5	466.5	42.3%
	6 to 11	131.9	12.0%
	12 to 17	93.0	8.4%
	18 to 23	23.8	2.2%
	24 to 29	240.5	21.8%
	30	146.5	13.3%
	Total acres	1,102.2	100.0%

Resource site data tables: Wildlife Habitat

Table E-50. Breakdown of total wildlife model patch scores.*

Resource site: Rock Creek (so. Washington County)	Number of acres in each wildlife score category: 1	2	3	4	5	6	7	8	9	Total wildlife model patch acres in inventory
Model score	27.3	8.4	118.3	202.3	38.3	574.6	62.2	0.0	0.0	1,031.5
Percent of total	2.6%	0.8%	11.5%	19.6%	3.7%	55.7%	6.0%	0.0%	0.0%	100.0%

*Does not include Habitats of Concern outside of model patches.

Table E-51. Breakdown of total wildlife model patch scores by criteria.*

Resource site:	Number of acres by score for each model criterion												Total wildlife model patch acres in inventory
	Size[2]			Interior[2]			Water[3]			Connectivity			
Rock Creek (south Washington County)	1	2	3	1	2	3	1	2	3	1	2	3	
	831.6	0.0	0.0	710.2	0.0	0.0	22.1	659.3	276.7	109.4	273.9	648.3	1,031.5
Percent of total acres in inventory	80.6%	0.0%	0.0%	68.8%	0.0%	0.0%	2.1%	63.9%	26.8%	10.6%	26.5%	62.8%	na

[1]Does not include Habitats of Concern outside of model patches.

[2]These numbers do not add up to 100.0% because Type 2 patches (low structure vegetation within 300 feet of streams and wetlands) were not ranked for these criteria.

[3]These numbers do not add up to 100% because not all patches contained or were near water resources.

Table E-52. Breakdown of total wildlife model patch area by 2000 Metro photo interpretation landcover and known wetlands.*

Resource site: Rock Creek (so. Washington Co.)	Low structure vegetation within 300 feet of stream: Low structure vegetation/ intact topsoil	Low structure vegetation within 300 feet of stream: Non-forest woody vegetation	Forested vegetation	Forested wetlands	Grass/shrub wetlands within 300 feet of a stream	Other wetlands	Total wildlife model patch acres in inventory
Acres	187.0	12.9	579.5	94.1	115.5	42.5	1,031.5
Percent of total	18.1%	1.3%	56.2%	9.1%	11.2%	4.1%	100.0%

*Does not include Habitats of Concern outside of model patches.

Table E-53. Total acres of inventoried wildlife habitat by type and total Species of Concern (SOCs).

Resource site: Rock Creek (south Washington Co.)	Wildlife patches (acres)	HOCs inside Wildlife patches (acres)*	HOCs outside Wildlife patches (including wetlands <2 acres)	Total inventoried wildlife habitat acres	Total SOCs
Acres	1031.5	661.0	40.9	1072.5	2
Percent of total	96.2%	61.6%	3.8%	100.0%	N/A

*Habitats of Concern.

Table E-54. Total area of model patches and Habitats of Concern by 1998 Landsat Landcover Area.

Resource Site: Rock Creek (so. Washington Co.) / Landcover type:	Total area of wildlife model patches	Total area of HOCs outside of modeled patches (including wetlands <2 acres)	Percent of total inventoried habitat
Water	0.31	0.0	0.0%
Barren	100.86	10.2	10.4%
Low structure agriculture	66.56	2.2	6.4%
High structure agriculture	3.59	0.0	0.3%
Deciduous closed canopy	92.49	1.6	8.8%
Mixed closed canopy	100.80	0.6	9.5%
Conifer closed canopy	43.38	0.2	4.1%
Deciduous open canopy	51.48	2.4	5.0%
Mixed open canopy	201.02	6.6	19.4%
Conifer open canopy	17.16	0.6	1.7%
Deciduous scattered canopy	35.05	2.0	3.5%
Mixed scattered canopy	20.42	0.9	2.0%
Conifer scattered canopy	3.55	0.2	0.3%
Closed canopy shrub	44.43	1.1	4.2%
Open canopy shrub	36.45	2.3	3.6%
Scattered canopy shrub	102.01	3.4	9.8%
Meadow/grass	111.97	6.5	11.0%
Not classified	0.00	0.0	0.0%
Total	**1,031.53**	**40.9**	**100.0%**

The table below provides estimates of each type of the habitats described in Metro's Technical Report for Fish and Wildlife Habitat, based on Johnson and O'Neil's (2001) habitat scheme. These numbers are provided for subwatershed comparison purposes and represent estimates of available habitat type. Several data types were used to compile this table, and the data sources vary in their precision. For example, the satellite data sources are less accurate than hand-digitized forest canopy cover. There is also slight overlap between certain habitat types. For example, Riparian Wetlands (RWET) are also partially included in Westside Lowland Coniferous Hardwood/Westside Oak and Douglas-fir (WLCH/WODF) because some wetlands also contain forest, and Open Water (WATR) is not always considered part of habitat patches. Therefore, the sums of these habitat types are slightly different from the "Total wildlife habitat acres in inventory" shown in Table 16. Nonetheless, these numbers provide a generalized means of comparing the quality and quantity of habitat available to wildlife among and between subwatersheds. Note also that the estimates for Westside Grasslands (WEGR) probably represent grasslands that are not native rather than true native grasslands, which are largely extirpated from the metro region.

Table E-55. Wildlife habitat availability[1] based on Johnson & O'Neil's (2001) habitat types and species-habitat associations.

Resource site:	Habitat type						
Rock Creek (so. Washington Co.)	WATR[2]	HWET[3]	RWET[3]	TOTWET[3]	WLCH/ WODF[4]	WEGR	AGPA
Total acres	3.4	157.9	94.1	261.5	580.6	262.7	72.3
Percent of total	0.3%	14.7%	8.8%	24.4%	54.1%	24.5%	6.7%

[1]See Table E-54 for land cover types and crosswalk to Johnson and O'Neil's classification scheme.

[2]Note that patch type and data limitations result in an underestimation of open water habitats. For example, medium and small sized stream surfaces are excluded.

[3]Note that HWET and RWET do not represent the full suite of wetlands because some wetlands <2 acres were added in as Habitats of Concern, and some wetlands could not be associated with herbaceous or forested habitats. TOTWET represents the best estimate of all existing wetlands because it includes Habitats of Concern.

[4]Data limitations make it impossible to distinguish between these two habitat types at this time, and no comprehensive oak habitat survey has been conducted for the region. However, known oak habitats are also included in HOCs (see Appendix 10).

F. Lower Clackamas River Watershed

General watershed information

Resource sites in the Lower Clackamas River Watershed include:

- Richardson Creek subwatershed (combined with North Fork Deep Creek subwatershed)
- Rock Creek-Clackamas River subwatershed

Watershed assessments and plans

Clackamas River Basin Council and Ecotrust, 2000. *Rock and Richardson Creek Watershed Assessment, October 2000,* Ecotrust: Portland, Oregon.

Metro. 2000. *Rock and Richardson Creek Landscape and Natural Resource Assessment.* September 2000.

Metropolitan Regional Government, 1995. *Clackamas River Watershed Atlas, September 1995,* Metro: Portland, Oregon.

Portland State University and Metropolitan Regional Government, 1995. *Rock Creek Watershed Atlas, Planning with an Awareness of Natural Boundaries, March 1995,* Portland State University and Metro: Portland, Oregon.

Watershed councils and related groups

- Clackamas River Basin Council, PO Box 1869, Clackamas, 97015-1869, (503) 650-1256
- Clackamas River, Friends of, 9205 SE Clackamas, #142, Clackamas 97015, 503-492-1593, Scott Forrester
- Clackamas River Water, 16770 SE 82nd Drive, Clackamas 97015, 503-722-9241
- Rock Creek Environmental Center, 503-690-5402, Bob Mann
- Rock Creek Watershed Council, 16747 Timber Road, Vernonia 97064, 503-429-2401, Maggie Belmore
- Wetlands, Friends of, 503-253-6247, Alice Blatt
- Johnson Creek Watershed Action Plan. Available online at: http://www.jcwc.org/actionPlan/WAP10.30.03.pdf.

Data descriptions

Table F-1 provides information about the subwatersheds within each watershed, the HUC code, and the acres inside Metro's jurisdictional boundary. Keying in on the resource site number will show how the subwatersheds are aggregated into the resource sites listed above.

All three of the subwatersheds fall within the same 5th field HUC (Lower Clackamas River), but they are divided into two resource sites. Resource Site #16 is comprised of the North Fork Deep Creek and Richardson Creek subwatersheds, for a total of 6,486 acres within the Metro Boundary. Resource is comprised only of its namesake, Rock Creek-Clackamas River, and contains 11,121 acres falling within Metro's jurisdictional boundary.

Tables F-1 and F-2 provide general description about the 5th field and 6th field HUCs. Below these tables are descriptions of the riparian and wildlife habitat resources resource site.

Watershed data tables

Table F-1. Watersheds (5th level HUC), subwatersheds (6th level HUC), and acres within Metro jurisdictional boundary.

Watershed (5th level HUC)	5th field HUC code	Resource site #	Subwatershed (6th level HUC)	6th field HUC code	Acres in Metro
Lower Clackamas River	1709001122	16	North Fork Deep Creek	170900112205	2,644.3
			Richardson Creek	170900112206	3,821.2
		17	Rock Creek - Clackamas River	170900112208	11,120.6

Table F-2. Resource sites: general information.

General information	Richardson Creek	Rock Creek -
Miles of DEQ 303(d) listed streams	0.0	4.0
Road density (road miles/square miles in subwatershed)	5.1	8.1
Miles of stream with known anadromous fish presence	4.4	4.4
Acres of hydrologically connected wetlands	99.4	98.1
Total acres of wetlands	99.5	99.7
Acres of floodplains (100 year FEMA + 1996 inundation area)	0.0	761.9
Acres of developed floodplains	0.0	87.1
Building permits since 1996 (number)	141.0	1,404.0

Table F-3. Characteristics of stream miles by resource site.

Resource site	Stream miles by channel type		Miles of stream links*	Miles of streams not categorized by channel type	Total stream miles
	Low to medium	*High*			
Richardson Creek	0.0	0.8	0.0	29.3	30.1
Rock Creek - Clackamas River	8.0	3.0	5.2	33.3	49.5

*Stream links are links between surface streams and may be piped or culverted.

Table F-4. Riparian vegetation by resource site.

Resource site	Vegetation types within 300 feet of a stream (acres)			Forested vegetation >300 feet from a stream
	Low structure vegetation/intact topsoil	Non-forest woody vegetation	Forested vegetation	
Richardson Creek	1,076.3	57.7	508.4	601.6
Rock Creek - Clackamas River	1,073.3	101.0	1,062.5	1,623.4

Table F-5. Regional zoning by resource site.

Resource site	Acres by zone within each resource site						
	Commercial	Industrial	Multi-family residential	Public/open space	Rural	Single family residential	Mixed use
Richardson Creek	100.7	162.1	0.0	0.0	6,202.7	0.0	0.0
Rock Creek - Clackamas River	266.3	1,705.0	255.9	115.0	6,812.9	1,827.9	105.1

SITE #16: Richardson Creek subwatershed

Named streams: Clackamas River, Elliott Spring, Foster Creek, Goose Creek, Richardson Creek, Dolan Creek, Doane Creek, North Fork Deep Creek, Noyer Creek
Communities within the subwatershed: unincorporated Clackamas County
Total acreage within Metro's boundary: 6,465.5 (includes North Fork Deep Creek subwatershed)
Total acres within riparian corridor: 2,270.7
Other information: Two dams present, unknown impact to fish.

This site contains two percent of the area comprising Metro's jurisdictional boundary. Of this, all falls within unincorporated Clackamas County (Table F-6).

This site is quite undeveloped compared to other sites. The road density, at 5.1 miles per square mile, falls within the lowest quartile (0 to 25 percent of maximum); only Resource Site #1 is lower in road density (Tables A-2 and F-2). This is reflected in the near-complete dominance of rural zoning type (Table F-5). Only 141 building permits have been issued here since 1996 (Table F-2).

Riparian resources. Site #16, similar to the other resource site in Group F, contains a relatively high proportion of riparian resources at 35 percent of its total lands within the Metro Boundary (Table 12). The site contributes almost 2-1/2 percent of the region's riparian corridors (Table 13).

This resource site contains approximately 30.1 total stream miles, none of which are stream links (Table F-3). This suggests minimal piping and culverting. Stream density is 0.0047 miles per acre (Table 12), the second highest of all 27 resource sites. None of the stream miles appear on the DEQ 303(d) water-quality limited list (Table F-2). None of the site is in the floodplain, but the 100 acres of wetlands comprise approximately two percent of this resource site's land (Table F-2). Anadromous fish are known to be present in about four and one-half stream miles (Table F-2).

Twenty-one percent of the acreage that falls within the riparian corridor inventory in this site received primary scores for at least three of the five ecological functions; 40 percent of the site's riparian corridors receive at least one primary ecological function score (Table F-9). Low structure vegetation/intact topsoil is the dominant vegetation cover within 300 ft of streams, in contrast with the other Group F resource site, which also includes substantial forest (Table F-4). The percentage of land receiving a given primary score was dominated by *Bank stabilization and pollution control*, but *Large wood and channel dynamics* also provided a relatively important primary ecological function (Table F-8; see also Table 4 and Appendix 5 for description of ecological functions mapping).

Wildlife habitat resources.
Including Habitats of Concern, more than 34 percent of the lands in this site fall within the wildlife habitat inventory, ranking it sixth among the 27 resource sites (Table 16). Within model patches approximately 21 percent falls within the top third of the point range with another 46 percent in the middle range (Table F-10). Of the four criteria in the GIS model, acreage is split about equally between the lowest and middle size category (Table F-11). A majority of acreage

fell in the lowest category for the interior criterion, but a substantial proportion was also in the middle category. The relatively low total percentages for size and interior (51 percent) suggests that many of the wildlife habitat patches are low structure patches within 300 ft of streams, because these patch types are not scored for size and interior. Thus, low structure vegetation likely provides important connectivity along streams. Water resources were strongly clustered in the middle category, whereas connectivity scored primarily in the high range, with substantial amounts also in the middle category. However, this site rates high for interior habitat relative to most other sites discussed thus far, although the proportion in the other Group F site is even higher. In general, this site can be characterized as having a number of fairly large habitat patches, and many of the larger forested patches contain interior habitat; water resources are very good, and connectivity is excellent. The site is probably highly important to animals moving between patches, including both stopover and breeding territory for Neotropical migratory birds.

Conifer and hardwood forest are the predominant habitat types in this resource site (55 percent), followed by agricultural lands (29 percent) (Table F-15). Wetlands comprise more than four percent of the site's wildlife habitat, proportionally higher than the other Group F site. The site's contribution to regional wetland resources is slightly over one percent, and it ranks 19th among the 27 resource sites.

Species of Concern. One Species of Concern sighting locations fall within the site. Each sighting may include one or more species; if a species occurs more than once in the resource site it is only listed once here. These include the following species:

- Red-legged Frog

There are very likely other Species of Concern using this resource site, particularly those relying on forested habitats, agricultural lands, and low-structure vegetation along streams – such as the Red-legged Frog (see Table F-15). Examples of species likely to occur in this site may be found by referencing the species list in Appendix 7 and identifying the species with a double "XX" under the habitat. General species needs and potential reasons for their decline are identified in the *Sensitive Species Accounts* section above. More detailed information on all species' needs can be obtained through Johnson and O'Neil (2001).

Habitats of Concern.
The following Habitats of Concern are partially or wholly within this resource site. Using the Unique ID # (UID), please refer to Appendix 8 for information concerning each Habitat of Concern:

UID numbers: 139, 140, 141

Resource site data tables: Riparian Corridors

Table F-6. Acres within resource site by jurisdiction.

Jurisdiction	Acres within subwatershed
Unincorporated Clackamas County	6,465.5

Table F-7. Acres in Metro and riparian corridor.

Resource site	Total acres within Metro	Total acres within riparian corridor
Richardson Creek	6,465.5	2,271.8

Table F-8. Number of acres within riparian corridor providing ecological function.

Resource site:	Ecological function	*Primary Value*		*Secondary Value*	
		Acres*	% of Total**	Acres	% of Total
Richardson Creek	Microclimate & shade	289.1	12.7%	674.3	29.7%
	Streamflow moderation & water storage	100.8	4.4%	2,095.9	92.3%
	Bank stabilization & pollution control	834.5	36.7%	129.4	5.7%
	Large wood & channel dynamics	589.5	26.0%	143.2	6.3%
	Organic material sources	479.9	21.1%	125.9	5.5%

*Number of acres scored within the riparian corridor for each function
**Percent of total acres within the riparian corridor

Table F-9. Breakdown of ecological scores.

Resource site	Ecological Score	Acres	% of Total Acres
Richardson Creek	1 to 5	1,372.2	60.4%
	6 to 11	311.1	13.7%
	12 to 17	110.3	4.9%
	18 to 23	192.1	8.5%
	24 to 29	244.4	10.8%
	30	41.7	1.8%
	Total acres	2,271.8	100.0%

Resource site data tables: Wildlife Habitat

Table F-10. Breakdown of total wildlife model patch scores.*

Resource site: Richardson Creek	Number of acres in each wildlife score category									Total wildlife model patch acres in inventory
	1	2	3	4	5	6	7	8	9	
Model score	8.7	84.0	645.2	518.2	91.2	407.6	59.1	394.3	0.0	2,208.1
Percent of total	0.4%	3.8%	29.2%	23.5%	4.1%	18.5%	2.7%	17.9%	0.0%	100.0%

*Does not include Habitats of Concern outside of model patches.

Table F-11. Breakdown of total wildlife patch model scores by criteria.*

Resource site: Richardson Creek	Number of acres by score for each model criterion												Total wildlife model patch acres in inventory
	Size[2]			Interior[2]			Water[3]			Connectivity			
	1	2	3	1	2	3	1	2	3	1	2	3	
	559.0	568.5	0.0	563.9	402.4	0.0	282.6	1,715.8	169.6	101.5	847.4	1,259.2	2,208.1
Percent of total acres in inventory	25.3%	25.7%	0.0%	25.5%	18.2%	0.0%	12.8%	77.7%	7.7%	4.6%	38.4%	57.0%	na

[1]Does not include Habitats of Concern outside of model patches.

[2]These numbers do not add up to 100.0% because Type 2 patches (low structure vegetation within 300 feet of streams and wetlands) were not ranked for these criteria.

[3]These numbers do not add up to 100% because not all patches contained or were near water resources.

Table F-12. Breakdown of total wildlife model patch area by 2000 Metro photo interpretation landcover and known wetlands.*

Resource site: Richardson Creek	Low structure vegetation within 300 feet of stream		Forested vegetation	Forested wetlands	Grass/shrub wetlands within 300 feet of a stream	Other wetlands	Total wildlife model patch acres in inventory
	Low structure vegetation/ intact topsoil	Non-forest woody vegetation					
Acres	1,028.7	51.8	1,042.1	41.2	31.6	12.7	2,208.1
Percent of total	46.6%	2.3%	47.2%	1.9%	1.4%	0.6%	100.0%

*Does not include Habitats of Concern outside of model patches.

Table F-13. Total acres of inventoried wildlife habitat by type and total Species of Concern (SOCs).

Resource site: Richardson Creek	Wildlife patches (acres)	HOCs inside Wildlife patches (acres)*	HOCs outside Wildlife patches (including wetlands <2 acres)	Total inventoried wildlife habitat acres	Total SOCs
Acres	2208.1	436.3	4.5	2212.6	1
Percent of total	99.8%	19.7%	0.2%	100.0%	N/A

*Habitats of Concern.

Table F-14. Total area of model patches and Habitats of Concern by 1998 Landsat Landcover Area.

Resource Site: Richardson Creek / Landcover type:	Total area of wildlife model patches	Total area of HOCs outside of modeled patches (including wetlands <2 acres)	Percent of total inventoried habitat
Water	0.00	0.0	0.0%
Barren	152.93	0.1	6.9%
Low structure agriculture	593.00	3.2	26.9%
High structure agriculture	45.84	0.0	2.1%
Deciduous closed canopy	161.94	0.0	7.3%
Mixed closed canopy	685.99	0.0	31.0%
Conifer closed canopy	66.21	0.0	3.0%
Deciduous open canopy	122.22	0.0	5.5%
Mixed open canopy	99.17	0.0	4.5%
Conifer open canopy	6.42	0.0	0.3%
Deciduous scattered canopy	48.96	1.1	2.3%
Mixed scattered canopy	21.50	0.0	1.0%
Conifer scattered canopy	4.56	0.0	0.2%
Closed canopy shrub	44.68	0.0	2.0%
Open canopy shrub	18.06	0.0	0.8%
Scattered canopy shrub	25.82	0.0	1.2%
Meadow/grass	110.79	0.1	5.0%
Not classified	0.00	0.0	0.0%
Total	**2,208.09**	**4.5**	**100.0%**

The table below provides estimates of each type of the habitats described in Metro's Technical Report for Fish and Wildlife Habitat, based on Johnson and O'Neil's (2001) habitat scheme. These numbers are provided for subwatershed comparison purposes and represent estimates of available habitat type. Several data types were used to compile this table, and the data sources vary in their precision. For example, the satellite data sources are less accurate than hand-digitized forest canopy cover. There is also slight overlap between certain habitat types. For example, Riparian Wetlands (RWET) are also partially included in Westside Lowland Coniferous Hardwood/Westside Oak and Douglas-fir (WLCH/WODF) because some wetlands also contain forest, and Open Water (WATR) is not always considered part of habitat patches. Therefore, the sums of these habitat types are slightly different from the "Total wildlife habitat acres in inventory" shown in Table 16. Nonetheless, these numbers provide a generalized means of comparing the quality and quantity of habitat available to wildlife among and between subwatersheds. Note also that the estimates for Westside Grasslands (WEGR) probably represent grasslands that are not native rather than true native grasslands, which are largely extirpated from the metro region.

Table F-15. Wildlife habitat availability[1] based on Johnson & O'Neil's (2001) habitat types and species-habitat associations.

Richardson Creek	Habitat type						
	WATR[2]	HWET[3]	RWET[3]	TOTWET[3]	WLCH/ WODF[4]	WEGR	AGPA
Total acres	0.0	44.3	41.2	99.5	1,218.0	154.8	642.1
Percent of total	0.0%	2.0%	1.9%	4.5%	55.1%	7.0%	29.0%

[1]See Table F-14 for land cover types and crosswalk to Johnson and O'Neil's classification scheme.

[2]Note that patch type and data limitations result in an underestimation of open water habitats. For example, medium and small sized stream surfaces are excluded.

[3]Note that HWET and RWET do not represent the full suite of wetlands because some wetlands <2 acres were added in as Habitats of Concern, and some wetlands could not be associated with herbaceous or forested habitats. TOTWET represents the best estimate of all existing wetlands because it includes Habitats of Concern.

[4]Data limitations make it impossible to distinguish between these two habitat types at this time, and no comprehensive oak habitat survey has been conducted for the region. However, known oak habitats are also included in HOCs (see Appendix 10).

SITE #17: Rock Creek-Clackamas River subwatershed

Named streams: Clackamas River, Cow Creek, Johnson Creek, Rock Creek, Sieben Drainage Ditch, Tour Creek
Communities within the subwatershed: Gladstone, Happy Valley, Oregon City, unincorporated Clackamas County
Total acreage within Metro's boundary: 11,120.6
Total acres within riparian corridor: 4,172.5
Other information: One barrier to fish passage present with unknown impacts to fish.

This site contains four percent of the area comprising Metro's jurisdictional boundary. Most of the site (79 percent) is in unincorporated Clackamas County, but there are also portions in Oregon City, Happy Valley, and Gladstone (eight, seven, and five percent, respectively) (Table F-16).

The site's road density reflects the relatively undeveloped nature of this site; at 8.1 road miles per square mile, it falls at the top end of the lowest quartile (0 to 25 percent of maximum) compared to all other resource sites (Table F-2). However, compared to Site #16 and reflecting a somewhat increased road density, the zoning shows a rural dominance but also important single family residential and industrial components (Table F-5). About 1,400 building permits have been issued here since 1996 (Table A-2), a relatively low number compared to the amount of land falling within the Metro boundary.

Riparian resources. Site #17, similar to the other resource site in Group F, contains a relatively high proportion of riparian resources at 38 percent of its total lands within the Metro Boundary (Table 12). The site contributes four and one-half percent of the region's riparian corridors; only five of the 27 resource sites contribute more (Table 13).

This resource site contains approximately 50 total stream miles, of which 11 percent are stream links, suggesting a relatively low amount of piping or culverting (Table F-3). Non-piped stream density is 0.0040 miles per acre, somewhat lower than Site #16 (Table 12) but still in the top quarter of all 27 resource sites. Of non-piped streams, nine percent are DEQ 303(d) water-quality limited (Table F-2). Seven percent of the site is in the floodplain, and wetlands comprise less than one percent of this resource site's land (Table F-2). Anadromous fish are known to be present in about four and one-half stream miles.

Higher proportions of this site received primary ecological scores, compared to Site #16. Twenty-six percent of the acreage that falls within the riparian corridor inventory in this site received primary scores for at least three of the five ecological functions; more than 43 percent received at least one primary ecological function score (Table F-19). Vegetation near the stream is co-dominated by forest and low structure vegetation, in contrast with the other Group F resource site, which contains primarily low structure vegetation (Table F-4). The percentage of land receiving a given primary score was co-dominated by *Large wood and channel* dynamics and *Bank stabilization and pollution control* (Table F-18; see also Table 4 and Appendix 5 for description of ecological functions mapping).

Wildlife habitat resources.

Including Habitats of Concern, 34 percent of the lands in this site fall within the wildlife habitat inventory, ranking it seventh among the 27 resource sites, just behind the other Group F resource site (Table 16). Within model patches approximately 31 percent falls within the top third of the point range, ten percent higher than the other resource site in this group. Another 44 percent falls in the middle range (Table F-20). Of the four criteria in the GIS model, the highest proportion of acreage is in the lowest size category, although more than one fourth of this site's land are in the middle size class (Table F-21). Compared to the other resource site in Group F, the percentages for size and interior (71 percent) suggest that approximately 70 percent of wildlife habitat patches within 300 ft of stream are forested, because low-structure patch types are not scored for size and interior (see also Table F-22). A majority of acreage fell in the lowest category for the interior criterion, but a substantial proportion was also in the middle category. Water resources are highest in the middle range followed by the lowest scoring category, whereas connectivity scored primarily in the high range, with substantial amounts also in the middle category. This site rates high for interior habitat relative to most other sites discussed thus far, and has more interior habitat than the other Group F resource site.

In general, this site can be characterized as having large amounts of total and interior habitat; water resources are very good, and connectivity is excellent. The site is probably highly important to animals moving between patches, including both stopover and breeding territory for Neotropical migratory birds. The connectivity with extensive natural areas to the south of this site makes it highly valuable to wildlife, allowing strong possibility of species reintroduction in the event of local extirpations.

Conifer and hardwood forest are the predominant habitat types in this resource site (69 percent) (Table F-25). However, agricultural lands and grasslands comprise another 22 percent. Wetlands cover approximately three percent of the site's wildlife habitat, proportionally lower than the other Group F site. However, at just over one percent the site's contribution to regional wetland resources is about the same as Site #16, ranking 18th among the 27 resource sites.

Species of Concern. One Species of Concern sighting locations fall within the site. Each sighting may include one or more species; if a species occurs more than once in the resource site it is only listed once here. These include the following species:

- Red-legged Frog

There are very likely other Species of Concern using this resource site, particularly those relying on forested habitats and agricultural lands (see Table F-25). Examples of species likely to occur in this site may be found by referencing the species list in Appendix 7 and identifying the species with a double "XX" under the habitat. General species needs and potential reasons for their decline are identified in the *Sensitive Species Accounts* section above. More detailed information on all species' needs can be obtained through Johnson and O'Neil (2001).

Habitats of Concern.

The following Habitats of Concern are partially or wholly within this resource site. Using the Unique ID # (UID), please refer to Appendix 8 for information concerning each Habitat of Concern:

UID numbers: 121, 123, 138

Resource site data tables: Riparian Corridors

Table F-16. Acres within resource site by jurisdiction.

Jurisdiction	Acres within subwatershed
Gladstone	554.4
Happy Valley	829.5
Oregon City	902.9
Unincorporated Clackamas County	8,833.9

Table F-17. Acres in Metro and riparian corridor.

Resource site	Total acres within Metro	Total acres within riparian corridor
Rock Creek - Clackamas River	11,120.7	4,177.9

Table F-18. Number of acres within riparian corridor providing ecological function.

Resource site:	Ecological function	*Primary Value*		*Secondary Value*	
		Acres*	% of Total**	Acres	% of Total
Rock Creek - Clackamas River	Microclimate & shade	722.8	17.3%	1,165.6	27.9%
	Streamflow moderation & water storage	722.8	17.3%	3,339.3	79.9%
	Bank stabilization & pollution control	1,446.5	34.6%	124.0	3.0%
	Large wood & channel dynamics	1,494.1	35.8%	254.9	6.1%
	Organic material sources	952.9	22.8%	231.6	5.5%

*Number of acres scored within the riparian corridor for each function
**Percent of total acres within the riparian corridor

Table F-19. Breakdown of ecological scores.

Resource site	Ecological Score	Acres	% of Total Acres
Rock Creek - Clackamas River	1 to 5	2,372.0	56.8%
	6 to 11	367.9	8.8%
	12 to 17	349.7	8.4%
	18 to 23	280.0	6.7%
	24 to 29	609.5	14.6%
	30	198.8	4.8%
	Total acres	4,177.9	100.0%

Resource site data tables: Wildlife Habitat

Table F-20. Breakdown of total wildlife model patch scores.*

Resource site: Rock Creek - Clackamas River	Number of acres in each wildlife score category									Total wildlife model patch acres in inventory
	1	2	3	4	5	6	7	8	9	
Model score	40.6	227.7	695.4	532.5	529.4	574.0	1,089.5	66.0	0.0	3,755.2
Percent of total	1.1%	6.1%	18.5%	14.2%	14.1%	15.3%	29.0%	1.8%	0.0%	100.0%

*Does not include Habitats of Concern outside of model patches.

Table F-21. Breakdown of total wildlife model patch scores by criteria.*

Resource site: Rock Creek - Clackamas River	Number of acres by score for each model criterion												Total wildlife model patch acres in inventory
	Size[2]			Interior[2]			Water[3]			Connectivity			
	1	2	3	1	2	3	1	2	3	1	2	3	
	1,683.4	1,003.4	0.0	1,335.2	976.8	0.0	1,375.8	1,761.7	429.9	329.2	1,061.9	2,364.0	3,755.2
Percent of total acres in inventory	44.8%	26.7%	0.0%	35.6%	26.0%	0.0%	36.6%	46.9%	11.4%	8.8%	28.3%	63.0%	na

[1]Does not include Habitats of Concern outside of model patches.

[2]These numbers do not add up to 100.0% because Type 2 patches (low structure vegetation within 300 feet of streams and wetlands) were not ranked for these criteria.

[3]These numbers do not add up to 100% because not all patches contained or were near water resources.

Table F-22. Breakdown of total wildlife model patch area by 2000 Metro photo interpretation landcover and known wetlands.*

Resource site: Rock Creek - Clackamas River	Low structure vegetation within 300 feet of stream		Forested vegetation	Forested wetlands	Grass/shrub wetlands within 300 feet of a stream	Other wetlands	Total wildlife model patch acres in inventory
	Low structure vegetation/ intact topsoil	Non-forest woody vegetation					
Acres	972.6	95.8	2,597.0	30.2	31.2	28.4	3,755.2
Percent of total	25.9%	2.6%	69.2%	0.8%	0.8%	0.8%	100.0%

*Does not include Habitats of Concern outside of model patches.

Table F-23. Total acres of inventoried wildlife habitat by type and total Species of Concern (SOCs).

Resource site: Rock Creek - Clackamas River	Wildlife patches (acres)	HOCs inside Wildlife patches (acres)*	HOCs outside Wildlife patches (including wetlands <2 acres)	Total inventoried wildlife habitat acres	Total SOCs
Acres	3755.2	675.9	6.6	3761.7	1
Percent of total	99.8%	18.0%	0.2%	100.0%	N/A

*Habitats of Concern.

Table F-24. Total area of model patches and Habitats of Concern by 1998 Landsat Landcover Area.

Resource Site: Rock Creek - Clackamas River / Landcover type:	Total area of wildlife model patches	Total area of HOCs outside of modeled patches (including wetlands <2 acres)	Percent of total inventoried habitat
Water	54.38	0.0	1.4%
Barren	191.64	1.5	5.1%
Low structure agriculture	478.88	0.6	12.7%
High structure agriculture	35.97	0.0	1.0%
Deciduous closed canopy	713.05	0.3	19.0%
Mixed closed canopy	914.08	0.8	24.3%
Conifer closed canopy	283.57	0.0	7.5%
Deciduous open canopy	220.05	1.1	5.9%
Mixed open canopy	207.61	0.3	5.5%
Conifer open canopy	17.38	0.0	0.5%
Deciduous scattered canopy	127.28	0.5	3.4%
Mixed scattered canopy	59.84	0.0	1.6%
Conifer scattered canopy	30.05	0.0	0.8%
Closed canopy shrub	129.24	0.2	3.4%
Open canopy shrub	56.65	0.2	1.5%
Scattered canopy shrub	66.31	0.3	1.8%
Meadow/grass	168.94	0.7	4.5%
Not classified	0.25	0.0	0.0%
Total	**3,755.17**	**6.6**	**100.0%**

The table below provides estimates of each type of the habitats described in Metro's Technical Report for Fish and Wildlife Habitat, based on Johnson and O'Neil's (2001) habitat scheme. These numbers are provided for subwatershed comparison purposes and represent estimates of available habitat type. Several data types were used to compile this table, and the data sources vary in their precision. For example, the satellite data sources are less accurate than hand-digitized forest canopy cover. There is also slight overlap between certain habitat types. For example, Riparian Wetlands (RWET) are also partially included in Westside Lowland Coniferous Hardwood/Westside Oak and Douglas-fir (WLCH/WODF) because some wetlands also contain forest, and Open Water (WATR) is not always considered part of habitat patches. Therefore, the sums of these habitat types are slightly different from the "Total wildlife habitat acres in inventory" shown in Table 16. Nonetheless, these numbers provide a generalized means of comparing the quality and quantity of habitat available to wildlife among and between subwatersheds. Note also that the estimates for Westside Grasslands (WEGR) probably represent grasslands that are not native rather than true native grasslands, which are largely extirpated from the metro region.

Table F-25. Wildlife habitat availability[1] based on Johnson & O'Neil's (2001) habitat types and species-habitat associations.

Resource site:	Habitat type						
Rock Creek - Clackamas River	WATR[2]	HWET[3]	RWET[3]	TOTWET[3]	WLCH/ WODF[4]	WEGR	AGPA
Total acres	132.6	59.6	30.2	99.7	2,575.9	293.1	515.4
Percent of total	3.5%	1.6%	0.8%	2.7%	68.5%	7.8%	13.7%

[1]See Table F-24 for land cover types and crosswalk to Johnson and O'Neil's classification scheme.

[2]Note that patch type and data limitations result in an underestimation of open water habitats. For example, medium and small sized stream surfaces are excluded.

[3]Note that HWET and RWET do not represent the full suite of wetlands because some wetlands <2 acres were added in as Habitats of Concern, and some wetlands could not be associated with herbaceous or forested habitats. TOTWET represents the best estimate of all existing wetlands because it includes Habitats of Concern.

[4]Data limitations make it impossible to distinguish between these two habitat types at this time, and no comprehensive oak habitat survey has been conducted for the region. However, known oak habitats are also included in HOCs (see Appendix 10).

G. Johnson Creek

General watershed information

Resource sites within the Johnson Creek Watershed include:

- Johnson Creek-Sunshine Creek subwatershed
- Kelley Creek subwatershed
- Middle Johnson Creek subwatershed
- Lower Johnson Creek-Willamette River
- Lake Oswego subwatershed
- Tryon Creek subwatershed
- Johnson Creek-Crystal Springs Creek subwatershed
- Mount Scott Creek subwatershed

Watershed assessments and plans

Bureau of Planning, City of Portland, 1991. *Johnson Creek Basin Protection Plan, July 17, 1991,* City of Portland: Portland, Oregon.

Bureau of Planning, City of Portland, 1993. *The East Buttes, Terraces and Wetlands Conservation Plan, May 26, 1993,* City of Portland: Portland, Oregon.

Bureau of Planning, City of Portland, 1997. *Portland Environmental Handbook,* City of Portland: Portland, Oregon.

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Community and Economic Development Department, City of Gresham, 1988. *Inventory of Significant Natural Resources and Open Spaces,* City of Gresham: Gresham, Oregon.

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Willamette Basin Task Force, Pacific Northwest River Basins Commission, 1969. *The Willamette Basin, Comprehensive Study of Water and Related Land Resources,* Pacific Northwest River Basins Commission: Portland, Oregon.

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Willamette Restoration Initiative, 2001. *Restoring A River of Life, The Willamette Restoration Strategy – Recommendations for the Willamette Basin Supplement to the Oregon Plan for Salmon and Watersheds, February 2001*, Willamette Restoration Initiative: Portland, Oregon.
Woodward-Clyde Consultants, 1995. *Johnson Creek Resources Management Plan*, Woodward-Clyde Consultants: Portland, Oregon.

Watershed councils and related groups

Clackamas River Basin Council, PO Box 1869, Clackamas, 97015-1869, (503) 650-1256
Clackamas River, Friends of, 9205 SE Clackamas, #142, Clackamas 97015, 503-492-1593, Scott Forrester
Clackamas River Water, 16770 SE 82nd Drive, Clackamas 97015, 503-722-9241
Fairview Creek Watershed Group, 2115 SE Morrison St., Portland 97214, (503) 661-7612, FAX (503) 661-5296
Fairview Creek Watershed Council, PO Box 36, Fairview 97024, (503) 231-2270, Shannon Schmitt
Fairview Creek Watershed Conservation Group, PO Box 36, Fairview 97204, 503-669-6000, Gregory Dresden
Johnson Creek Watershed Council, 525 Logus St., Oregon City 97045, (503) 239-3932, FAX (503) 239-3946
Johnson Creek Watershed Council, 8300 SE McLaughlin Blvd, Portland 97282, 503-239-3932, Kim Hatfield
Johnson Creek, Friends of Beaverton's 503-626-4398, Susan Langston
Johnson Creek, Friends of, 503-257-3161, Clifton Lee Powell
Mt. Scott and Kellogg Creeks, Friends of, PO Box 22373, Milwaukie 97269, 503-653-7875, Steve Berliner
Minthorn Springs, Friends of, 3006 SE Washington Street, Milwaukie 97222, 503-659-8509, Mart Hughes
Tryon Creek Watershed Council, 10750 Boones Ferry Rd., Portland 97219, (503) 823-5596
Tryon Creek State Park, Friends of, 11321 SW Terwilliger Blvd, Portland 97219, 503-636-4398, Louise Shorr
Wetlands, Friends of, 503-253-6247, Alice Blatt
Willamette River Restoration Committee, 541-484-9466, Timothy Green

Data descriptions

Table G-1 provides information about the subwatersheds within each watershed, the HUC code, and the acres inside Metro's jurisdictional boundary. In Section G, all subwatersheds also comprise their own resource site, with the same names. All eight of the resource sites fall within the same 5th field HUC (Johnson Creek).

Tables G-1 and G-2 provide general description about the 5th field and 6th field HUCs. Below these tables are descriptions of the riparian and wildlife habitat resources resource site.

Watershed data tables

Table G-1. Watersheds (5th level HUC), subwatersheds (6th level HUC), and acres within Metro jurisdictional boundary.

Watershed (5th level HUC)	5th field HUC code	Resource site #	Subwatershed (6th level HUC)	6th field HUC code	Acres in Metro
Johnson Creek	1709001201	18	Johnson Creek - Sunshine Creek	170990120101	12,372.9
		19	Kelley Creek	170990120102	3,175.6
		20	Middle Johnson Creek	170990120103	8,949.5
		21	Lower Johnson Creek - Willamette River	170990120104	5,950.2
		22	Lake Oswego	170990120105	4,168.7
		23	Tryon Creek	170990120106	4,356.4
		24	Johnson Creek - Crystal Springs Creek	170990120107	7,844.6
		25	Mount Scott Creek	170990120108	11,809.6

Table G-2. Resource sites: general information.

General information	Johnson - Sunshine Creeks	Kelley Creek	Middle Johnson Creek	Lower Johnson Creek	Lake Oswego	Tryon Creek	Johnson - Crystal Springs Creeks	Mount Scott Creek
Miles of DEQ 303(d) listed streams	10.0	0.0	3.6	3.9	2.8	5.2	6.8	2.2
Road density (road miles/square miles in subwatershed)	7.8	5.5	14.7	14.9	15.3	14.6	20.9	14.3
Miles of stream with known anadromous fish presence	9.7	2.3	3.4	4.0	0.4	2.6	8.3	9.2
Acres of hydrologically connected wetlands	111.0	16.0	14.4	38.6	10.2	3.8	39.7	146.1
Total acres of wetlands	111.1	16.0	14.4	38.6	13.1	3.8	46.4	147.0
Acres of floodplains (100 year FEMA + 1996 inundation area)	346.8	34.4	378.9	717.1	590.2	107.7	572.0	706.5
Acres of developed floodplains	11.8	1.2	164.4	74.6	75.8	37.1	295.4	149.6
Building permits since 1996 (number)	622.0	258.0	1,474.0	557.0	417.0	285.0	1,016.0	1,452.0

Table G-3. Characteristics of stream miles by resource site.

Resource site	Stream miles by channel type		Miles of stream links*	Miles of streams not categorized by channel type	Total stream miles
	Low to medium	*High*			
Johnson - Sunshine Creeks	11.9	1.9	3.7	31.3	48.9
Kelley Creek	3.0	0.7	0.2	8.4	12.2
Middle Johnson Creek	4.2	0.6	26.7	5.2	36.7
Lower Johnson Creek - Willamette River	15.5	6.4	7.1	2.5	31.5
Lake Oswego	12.0	1.6	6.1	3.3	23.0
Tryon Creek	1.3	2.4	2.7	17.4	23.8
Johnson - Crystal Springs Creeks	9.2	1.3	20.6	3.8	34.9
Mount Scott Creek	11.1	2.5	16.3	17.4	47.3

*Stream links are links between surface streams and may be piped or culverted.

Table G-4. Riparian vegetation by resource site.

Resource site	Vegetation types within 300 feet of a stream (acres)			Forested vegetation >300 feet from a stream
	Low structure vegetation/intact topsoil	Non-forest woody vegetation	Forested vegetation	
Johnson - Sunshine Creeks	1,201.5	90.5	1,156.8	2,371.5
Kelley Creek	350.1	14.8	339.6	729.7
Middle Johnson Creek	142.2	6.0	408.7	899.8
Lower Johnson Creek - Willamette River	119.3	6.9	691.6	705.0
Lake Oswego	40.6	2.7	376.0	602.0
Tryon Creek	93.7	0.0	949.7	886.2
Johnson - Crystal Springs Creeks	259.4	2.8	227.8	367.8
Mount Scott Creek	447.5	21.0	597.4	1,184.9

Table G-5. Regional zoning by resource site.

Resource site	Acres by zone within each resource site						
	Commercial	Industrial	Multi-family residential	Public/open space	Rural	Single family residential	Mixed use
Johnson - Sunshine Creeks	39.7	306.4	388.4	124.3	7,347.8	3,953.1	213.3
Kelley Creek	7.7	0.0	0.0	2.0	2,569.5	596.5	0.0
Middle Johnson Creek	289.6	348.0	1,415.5	975.1	0.0	5,401.3	517.9
Lower Johnson Creek - Willamette River	254.8	82.9	304.0	164.2	51.5	4,667.3	205.0
Lake Oswego	189.5	0.0	144.6	0.0	85.5	3,260.6	55.4
Tryon Creek	135.7	37.8	137.9	528.6	107.8	3,350.3	58.3
Johnson - Crystal Springs Creeks	223.7	932.1	923.2	679.5	0.0	4,819.3	254.0
Mount Scott Creek	287.6	937.7	555.9	519.3	266.3	7,899.7	1,242.1

SITE #18: Johnson Creek-Sunshine Creek subwatershed

Named streams: Butler Creek, Fairview Creek, Johnson Creek, Kelly Creek, Sunshine Creek
Communities within the subwatershed: Gresham, Portland, unincorporated Clackamas County, unincorporated Multnomah County
Total acreage within Metro's boundary: 12,372.9
Total acres within the riparian corridor: 4,787.5

This site contains four percent of the area comprising Metro's jurisdictional boundary. Forty percent of this site is in unincorporated Clackamas County; 38 percent is in Gresham, 20 percent in unincorporated Multnomah County, and two percent in the City of Portland. About seven percent of the site is in the City of Troutdale, with the remaining two percent in unincorporated Multnomah County (Table G-6).

This site and the next (Site #19) are the two least developed resource sites in Group G (Table G-2). This resource site has a road density of 7.8 miles per square mile, falling in the first quartile (0 to 25 percent of maximum) compared to all other resource sites. Zoning is strongly rural, but single family residential covers nearly half as much acreage (Table G-5), primarily reflecting the portion of the site's land falling with Gresham's boundaries. Over 600 building permits have been issued here since 1996 (Table G-2), but this is a relatively low number compared to the amount of land within Metro's boundary.

Riparian resources. Thirty-nine percent of this site is part of the riparian corridor inventory, the third highest proportion of the eight resource sites in Group G (Table 12). It contributes more than five percent of the region's total riparian resources, the fifth highest amount of all 27 resource sites (Table 13).

This resource site contains 49 total stream miles, and about 0.0037 miles of non-piped streams per acre, ranking it 11th among the 27 resource sites; 3.7 miles, or about eight percent, are stream links and may be piped or culverted (Tables 12 and G-3). About 22 percent of non-piped stream miles are listed by the DEQ as 303(d) quality-limited (Tables G-2 and 12). Anadromous fish are known to be present in approximately 10 stream miles (Table G-2). Three percent of the site is floodplain, and one percent is wetland (Table G-2 and G-3). About 3-1/2 percent of the floodplain is developed, similar to Site #19 in this group.

Approximately 20 percent of this site's acreage within the riparian corridor inventory received primary scores for at least three of the five ecological functions. However, nearly 70 percent the site's riparian resources are limited to secondary functions, similar to Sites #19 and 20 in Group G (Table G-9). The highest percentage of land receiving a primary score was fairly evenly divided between *Large wood and channel dynamics* and *Bank stabilization and pollution control* (Table G-8; see also Table 4 and Appendix 5 for description of ecological functions mapping).

Wildlife habitat resources. Including Habitats of Concern, 39 percent of the lands in this site fall within the wildlife habitat inventory, ranking it fourth among the 27 resource sites (Table 16). Within model patches approximately 24 percent falls within the top third of the point range, the fourth highest proportion of the eight Group G resource sites; another 59 percent falls in the middle range (Table G-10). Of the four criteria in the GIS model, the proportion of acreage is divided nearly equally between the middle and lowest category, at 39 and 36 percent, respectively (Table G-11). The highest percentage for the interior criterion was the lowest score category (46 percent), although another 23 percent fell in the middle category. These total percentages suggest that nearly one fourth of this site's wildlife resources are low-structure vegetation patches within 300 ft of streams, because these patch types are not scored for these two criteria (see also Table G-12). Water resources were highest in the low range (53 percent) followed by the middle scoring category (36 percent), whereas connectivity scored primarily in the high range (74 percent), with substantial amounts also in the middle category. This site rates high for interior habitat relative to many other sites discussed thus far, and ranks fourth among the generally well-connected resource sites within Group G.

In general, this site can be characterized as having large amounts of total and interior habitat; water resources are moderate, but that is influenced by the unusually large amount of upland habitats in addition to riparian resources. Connectivity to other natural areas is excellent. The site is probably highly important to animals moving between patches, including both stopover and breeding territory for Neotropical migratory birds. The connectivity with extensive natural areas in adjacent watersheds makes it highly valuable to wildlife, allowing potential for species reintroduction in the event of local extirpations.

Conifer and hardwood forest are the predominant habitat types in this resource site (76 percent) (Table G-15). Wetlands cover more than two percent of the site's wildlife habitat, proportionally lower than the many of the 27 resource sites but ranking fourth among the eight resource sites in Group G. The site contributes a little over one percent to the region's wetland resources, ranking 17th among the 27 resource sites.

Species of Concern. Nine Species of Concern sighting locations fall within the site. Each sighting may include one or more species; if a species occurs more than once in the resource site it is only listed once here. These include the following species:

- Pileated Woodpecker (numerous sightings, reflecting strong coniferous component)
- Willow Flycatcher
- Bald Eagle nest site

There are very likely other Species of Concern using this resource site, particularly those relying on forested habitats and agricultural lands (see Table G-15). Examples of species likely to occur in this site may be found by referencing the species list in Appendix 7 and identifying the species with a double "XX" under the habitat. General species needs and potential reasons for their decline are identified in the *Sensitive Species Accounts* section above. More detailed information on all species' needs can be obtained through Johnson and O'Neil (2001).

Habitats of Concern.
The following Habitats of Concern are partially or wholly within this resource site. Using the Unique ID # (UID), please refer to Appendix 8 for information concerning each Habitat of Concern:

UID numbers: 12, 133, 136, 137

Resource site data tables: Riparian Corridors

Table G-6. Acres within resource site by jurisdiction.

Jurisdiction	Acres within subwatershed
Gresham	4,730.0
Portland	244.3
Unincorporated Clackamas County	4,928.2
Unincorporated Multnomah County	2,470.4

Table G-7. Acres in Metro and riparian corridor.

Resource site	Total acres within Metro	Total acres within riparian corridor
Johnson - Sunshine Creeks	12,372.9	4,777.5

Table G-8. Number of acres within riparian corridor providing ecological function.

Resource site	Ecological function	*Primary Value*		*Secondary Value*	
		Acres*	% of Total**	Acres	% of Total
Johnson - Sunshine Creeks	Microclimate & shade	751.1	15.7%	1,513.1	31.7%
	Streamflow moderation & water storage	402.3	8.4%	4,282.2	89.6%
	Bank stabilization & pollution control	1,293.2	27.1%	410.2	8.6%
	Large wood & channel dynamics	1,158.2	24.2%	281.7	5.9%
	Organic material sources	929.7	19.5%	233.2	4.9%

*Number of acres scored within the riparian corridor for each function
**Percent of total acres within the riparian corridor

Table G-9. Breakdown of ecological scores.

Resource site	Ecological Score	Acres	% of Total Acres
Johnson - Sunshine Creeks	1 to 5	3,297.1	69.0%
	6 to 11	372.7	7.8%
	12 to 17	169.1	3.5%
	18 to 23	136.9	2.9%
	24 to 29	595.5	12.5%
	30	206.2	4.3%
	Total acres	4,777.5	100.0%

Resource site data tables: Wildlife Habitat

Table G-10. Breakdown of total wildlife model patch scores.*

Resource site: Johnson - Sunshine Creeks	Number of acres in each wildlife score category: 1	2	3	4	5	6	7	8	9	Total wildlife model patch acres in inventory
Model score	27.5	131.8	662.4	703.2	777.9	1,298.3	1,133.7	0.0	0.0	4,734.6
Percent of total	0.6%	2.8%	14.0%	14.9%	16.4%	27.4%	23.9%	0.0%	0.0%	100.0%

*Does not include Habitats of Concern outside of model patches.

Table G-11. Breakdown of total wildlife patch model scores by criteria.*

Resource site:	Number of acres by score for each model criterion												Total wildlife model patch acres in inventory
	Size[2]			Interior[2]			Water[3]			Connectivity			
Johnson - Sunshine Creeks	1	2	3	1	2	3	1	2	3	1	2	3	
	1,699.3	1,835.1	0.0	2,156.7	1,071.7	0.0	2,506.2	1,681.0	382.1	226.6	994.5	3,513.5	4,734.6
Percent of total acres in inventory	35.9%	38.8%	0.0%	45.6%	22.6%	0.0%	52.9%	35.5%	8.1%	4.8%	21.0%	74.2%	na

[1]Does not include Habitats of Concern outside of model patches.

[2]These numbers do not add up to 100.0% because Type 2 patches (low structure vegetation within 300 feet of streams and wetlands) were not ranked for these criteria.

[3]These numbers do not add up to 100% because not all patches contained or were near water resources.

Table G-12. Breakdown of total wildlife model patch area by 2000 Metro photo interpretation landcover and known wetlands.*

Resource site: Johnson - Sunshine Creeks	Low structure vegetation within 300 feet of stream: Low structure vegetation/ intact topsoil	Low structure vegetation within 300 feet of stream: Non-forest woody vegetation	Forested vegetation	Forested wetlands	Grass/shrub wetlands within 300 feet of a stream	Other wetlands	Total wildlife model patch acres in inventory
Acres	1,122.3	77.9	3,430.8	42.5	47.6	13.5	4,734.6
Percent of total	23.7%	1.6%	72.5%	0.9%	1.0%	0.3%	100.0%

*Does not include Habitats of Concern outside of model patches.

Table G-13. Total acres of inventoried wildlife habitat by type and total Species of Concern (SOCs).

Resource site: Johnson - Sunshine Creeks	Wildlife patches (acres)	HOCs inside Wildlife patches (acres)*	HOCs outside Wildlife patches (including wetlands <2 acres)	Total inventoried wildlife habitat acres	Total SOCs
Acres	4734.6	248.7	87.7	4822.3	9
Percent of total	98.2%	5.2%	1.8%	100.0%	N/A

*Habitats of Concern.

Table G-14. Total area of model patches and Habitats of Concern by 1998 Landsat Landcover Area.

Resource Site: Johnson - Sunshine Creeks / Landcover type:	Total area of wildlife model patches	Total area of HOCs outside of modeled patches (including wetlands <2 acres)	Percent of total inventoried habitat
Water	0.76	0.0	0.0%
Barren	152.23	7.5	3.3%
Low structure agriculture	396.96	1.3	8.3%
High structure agriculture	121.05	2.0	2.6%
Deciduous closed canopy	1,423.25	2.2	29.6%
Mixed closed canopy	1,348.09	2.7	28.0%
Conifer closed canopy	303.19	0.7	6.3%
Deciduous open canopy	230.76	1.4	4.8%
Mixed open canopy	118.02	0.8	2.5%
Conifer open canopy	11.92	0.2	0.3%
Deciduous scattered canopy	134.68	1.4	2.8%
Mixed scattered canopy	68.13	0.9	1.4%
Conifer scattered canopy	7.34	0.0	0.2%
Closed canopy shrub	158.54	5.3	3.4%
Open canopy shrub	44.25	3.0	1.0%
Scattered canopy shrub	63.53	10.0	1.5%
Meadow/grass	151.95	48.2	4.2%
Not classified	0.01	0.0	0.0%
Total	**4,734.65**	**87.7**	**100.0%**

The table below provides estimates of each type of the habitats described in Metro's Technical Report for Fish and Wildlife Habitat, based on Johnson and O'Neil's (2001) habitat scheme. These numbers are provided for subwatershed comparison purposes and represent estimates of available habitat type. Several data types were used to compile this table, and the data sources vary in their precision. For example, the satellite data sources are less accurate than hand-digitized forest canopy cover. There is also slight overlap between certain habitat types. For example, Riparian Wetlands (RWET) are also partially included in Westside Lowland Coniferous Hardwood/Westside Oak and Douglas-fir (WLCH/WODF) because some wetlands also contain forest, and Open Water (WATR) is not always considered part of habitat patches. Therefore, the sums of these habitat types are slightly different from the "Total wildlife habitat acres in inventory" shown in Table 16. Nonetheless, these numbers provide a generalized means of comparing the quality and quantity of habitat available to wildlife among and between subwatersheds. Note also that the estimates for Westside Grasslands (WEGR) probably represent grasslands that are not native rather than true native grasslands, which are largely extirpated from the metro region.

Table G-15. Wildlife habitat availability[1] based on Johnson & O'Neil's (2001) habitat types and species-habitat associations.

Resource site:	Habitat type						
Johnson - Sunshine Creeks	WATR[2]	HWET[3]	RWET[3]	TOTWET[3]	WLCH/ WODF[4]	WEGR	AGPA
Total acres	25.3	61.1	42.5	111.1	3,655.7	321.0	521.4
Percent of total	0.5%	1.3%	0.9%	2.3%	75.8%	6.7%	10.8%

[1]See Table G-14 for land cover types and crosswalk to Johnson and O'Neil's classification scheme.

[2]Note that patch type and data limitations result in an underestimation of open water habitats. For example, medium and small sized stream surfaces are excluded.

[3]Note that HWET and RWET do not represent the full suite of wetlands because some wetlands <2 acres were added in as Habitats of Concern, and some wetlands could not be associated with herbaceous or forested habitats. TOTWET represents the best estimate of all existing wetlands because it includes Habitats of Concern.

[4]Data limitations make it impossible to distinguish between these two habitat types at this time, and no comprehensive oak habitat survey has been conducted for the region. However, known oak habitats are also included in HOCs (see Appendix 10).

SITE #19: Kelley Creek subwatershed

Named streams: Kelly Creek, Mitchell Creek
Communities within the subwatershed: Gresham, Happy Valley, Portland, unincorporated Clackamas County, unincorporated Multnomah County
Total acreage within Metro's boundary: 3,175.6
Total acres within the riparian corridor: 1,424.9

This site contains one percent of the area comprising Metro's jurisdictional boundary. Forty-six percent of the site falls within unincorporated Multnomah County; the remainder falls in unincorporated Clackamas County (37 percent), Portland (12 percent), Gresham (four percent), and Happy Valley (two percent) (Table G-16).

This site is the third least developed of all resource sites, with only 5.5 road miles per square mile (Table G-2). It is also the least developed resource site in Group G. The zoning is strongly rural, with some single family residential (Table G-5). About 260 building permits have been issued here since 1996 (Table G-2).

Riparian resources. Forty-five percent of this site is part of the riparian corridor inventory, the second highest proportion of the eight resource sites in Group G (Table 12). However, it contributes only one and one-half percent of the region's total riparian resources due to the relatively small acreage falling within the Metro boundary (Table 13).

This resource site contains 12 total stream miles, and about 0.0038 miles of non-piped streams per acre, ranking it eighth among the 27 resource sites. Two percent of total stream miles are stream links and may be piped or culverted (Tables 12 and G-3). None of the stream miles are DEQ 303(d) listed (Table G-2). Anadromous fish are known to be present in approximately 2 stream miles (Table G-2). One percent of the site is floodplain, and one percent is wetland (Tables G-2 and G-3). About 3-1/2 percent of the floodplain is developed, similar to Site #18 in this group.

Approximately 16 percent of this site's acreage within the riparian corridor inventory received primary scores for at least three of the five ecological functions (Table G-19). However, 74 percent the site's riparian resources are limited to secondary functions, similar to Sites #18 and 20 in Group G. The highest percentage of land receiving a primary score was for *Bank stabilization and pollution control*, followed by *Large wood and channel dynamics* (Table G-18; see also Table 4 and Appendix 5 for description of ecological functions mapping).

Wildlife habitat resources. Including Habitats of Concern, 45 percent of the lands in this site fall within the wildlife habitat inventory, ranking it second among the 27 resource sites and first in Group G (Table 16). Within model patches approximately 43 percent falls within the top third of the point range, the third highest proportion of the eight Group G resource sites; another 38 percent falls in the middle range (Table G-20). Of the four criteria in the GIS model, the highest proportion of acreage is in the middle size score category (43 percent), with another 32 percent in the lowest category (Table G-11). The acreage for the interior criterion was about equally divided between the lowest and middle categories (35 and 34 percent, respectively). These total percentages suggest that approximately 30 percent of this site's wildlife resources are low-structure vegetation patches within 300 ft of streams, because these patch types are not scored for these two criteria (see also Table G-22). Water resources were highest in the medium range (59 percent) followed by the middle scoring category (35 percent), whereas connectivity scored primarily in the high range (76 percent, with another 23 percent in the middle caegory). This site ranks very high for interior habitat relative to many of the 27 resource sites, and ranks third among the generally well-connected resource sites within Group G.

In general, this site can be characterized as having extensive amounts of total habitat, substantial interior habitat, good water resources and outstanding connectivity. Water resources are moderate rather than high due to the unusually large amount of upland habitats in addition to riparian resources. As with other sites with these characteristics, this site is probably highly important to animals moving between patches, including both stopover and breeding territory for Neotropical migratory birds. The connectivity with extensive natural areas in adjacent watersheds makes it highly valuable to wildlife, allowing potential for species reintroduction in the event of local extirpations.

Conifer and hardwood forest are the predominant habitat types in this resource site (76 percent) (Table G-25). Wetlands cover more just over one percent of the site's wildlife habitat, proportionally lower than the many of the 27 resource sites and ranking sixth among the eight resource sites in Group G. The site contributes 0.2 percent to the region's wetland resources, ranking 24th among the 27 resource sites.

Species of Concern. No Species of Concern sighting locations fall within the site. However, there are very likely Species of Concern using this resource site, particularly those relying on forested habitats (see Table G-25). Examples of species likely to occur in this site may be found by referencing the species list in Appendix 7 and identifying the species with a double "XX" under the habitat. General species needs and potential reasons for their decline are identified in the *Sensitive Species Accounts* section above. More detailed information on all species' needs can be obtained through Johnson and O'Neil (2001).

Habitats of Concern.
The following Habitats of Concern are partially or wholly within this resource site. Using the Unique ID # (UID), please refer to Appendix 8 for information concerning each Habitat of Concern:

UID numbers: 123, 138

Resource site data tables: Riparian Corridors

Table G-16. Acres within resource site by jurisdiction.

Jurisdiction	Acres within subwatershed
Gresham	135.9
Happy Valley	47.7
Portland	369.4
Unincorporated Clackamas County	1,177.5
Unincorporated Multhomah County	1,445.1

Table G-17. Acres in Metro and riparian corridor.

Resource site	Total acres within Metro	Total acres within riparian corridor
Kelley Creek	3,175.6	1,423.1

Table G-18. Number of acres within riparian corridor providing ecological function.

Resource site	Ecological function	*Primary Value*		*Secondary Value*	
		Acres*	% of Total**	Acres	% of Total
Kelley Creek	Microclimate & shade	191.5	13.5%	461.8	32.4%
	Streamflow moderation & water storage	49.5	3.5%	1,354.1	95.2%
	Bank stabilization & pollution control	332.3	23.4%	104.9	7.4%
	Large wood & channel dynamics	283.8	19.9%	90.8	6.4%
	Organic material sources	223.9	15.7%	75.3	5.3%

*Number of acres scored within the riparian corridor for each function

**Percent of total acres within the riparian corridor

Table G-19. Breakdown of ecological scores.

Resource site	Ecological Score	Acres	% of Total Acres
Kelley Creek	1 to 5	1,046.1	73.5%
	6 to 11	118.4	8.3%
	12 to 17	33.1	2.3%
	18 to 23	33.9	2.4%
	24 to 29	163.7	11.5%
	30	28.0	2.0%
	Total acres	1,423.1	100.0%

Resource site data tables: Wildlife Habitat

Table G-20. Breakdown of total wildlife model patch scores.*

Resource site: Kelley Creek	Number of acres in each wildlife score category									Total wildlife model patch acres in inventory
	1	2	3	4	5	6	7	8	9	
Model score	13.8	15.3	234.5	127.7	78.0	331.1	609.5	0.0	0.0	1,410.0
Percent of total	1.0%	1.1%	16.6%	9.1%	5.5%	23.5%	43.2%	0.0%	0.0%	100.0%

*Does not include Habitats of Concern outside of model patches.

Table G-21. Breakdown of total wildlife patch model scores by criteria.*

Resource site: Kelley Creek	Number of acres by score for each model criterion												Total wildlife model patch acres in inventory
	Size[2]			Interior[2]			Water[3]			Connectivity			
	1	2	3	1	2	3	1	2	3	1	2	3	
	451.2	609.5	0.0	492.3	476.2	0.0	494.4	832.5	53.9	17.5	318.8	1,073.6	1,410.0
Percent of total acres in inventory	32.0%	43.2%	0.0%	34.9%	33.8%	0.0%	35.1%	59.0%	3.8%	1.2%	22.6%	76.1%	na

[1]Does not include Habitats of Concern outside of model patches.
[2]These numbers do not add up to 100.0% because Type 2 patches (low structure vegetation within 300 feet of streams and wetlands) were not ranked for these criteria.
[3]These numbers do not add up to 100% because not all patches contained or were near water resources.

Table G-22. Breakdown of total wildlife model patch area by 2000 Metro photo interpretation landcover and known wetlands.*

Resource site: Kelley Creek	Low structure vegetation within 300 feet of stream		Forested vegetation	Forested wetlands	Grass/shrub wetlands within 300 feet of a stream	Other wetlands	Total wildlife model patch acres in inventory
	Low structure vegetation/ intact topsoil	Non-forest woody vegetation					
Acres	334.9	14.4	1,046.8	6.1	5.3	2.4	1,410.0
Percent of total	23.8%	1.0%	74.2%	0.4%	0.4%	0.2%	100.0%

*Does not include Habitats of Concern outside of model patches.

Table G-23. Total acres of inventoried wildlife habitat by type and total Species of Concern (SOCs).

Resource site: Kelley Creek	Wildlife patches (acres)	HOCs inside Wildlife patches (acres)*	HOCs outside Wildlife patches (including wetlands <2 acres)	Total inventoried wildlife habitat acres	Total SOCs
Acres	1410.0	330.0	12.1	1422.0	0
Percent of total	99.2%	23.2%	0.8%	100.0%	N/A

*Habitats of Concern.

Table G-24. Total area of model patches and Habitats of Concern by 1998 Landsat Landcover Area.

Resource Site: Kelley Creek Landcover type:	Total area of wildlife model patches	Total area of HOCs outside of modeled patches (including wetlands <2 acres)	Percent of total inventoried habitat
Water	0.00	0.0	0.0%
Barren	32.23	0.1	2.3%
Low structure agriculture	204.41	2.1	14.5%
High structure agriculture	29.83	0.0	2.1%
Deciduous closed canopy	318.76	1.1	22.5%
Mixed closed canopy	588.09	5.6	41.7%
Conifer closed canopy	49.34	0.1	3.5%
Deciduous open canopy	26.03	0.9	1.9%
Mixed open canopy	37.74	0.6	2.7%
Conifer open canopy	6.03	0.5	0.5%
Deciduous scattered canopy	28.52	0.3	2.0%
Mixed scattered canopy	9.89	0.2	0.7%
Conifer scattered canopy	0.17	0.0	0.0%
Closed canopy shrub	32.55	0.3	2.3%
Open canopy shrub	8.10	0.2	0.6%
Scattered canopy shrub	17.28	0.3	1.2%
Meadow/grass	21.01	0.0	1.5%
Not classified	0.00	0.0	0.0%
Total	**1,409.97**	**12.1**	**100.0%**

The table below provides estimates of each type of the habitats described in Metro's Technical Report for Fish and Wildlife Habitat, based on Johnson and O'Neil's (2001) habitat scheme. These numbers are provided for subwatershed comparison purposes and represent estimates of available habitat type. Several data types were used to compile this table, and the data sources vary in their precision. For example, the satellite data sources are less accurate than hand-digitized forest canopy cover. There is also slight overlap between certain habitat types. For example, Riparian Wetlands (RWET) are also partially included in Westside Lowland Coniferous Hardwood/Westside Oak and Douglas-fir (WLCH/WODF) because some wetlands also contain forest, and Open Water (WATR) is not always considered part of habitat patches. Therefore, the sums of these habitat types are slightly different from the "Total wildlife habitat acres in inventory" shown in Table 16. Nonetheless, these numbers provide a generalized means of comparing the quality and quantity of habitat available to wildlife among and between subwatersheds. Note also that the estimates for Westside Grasslands (WEGR) probably represent grasslands that are not native rather than true native grasslands, which are largely extirpated from the metro region.

Table G-25. Wildlife habitat availability[1] based on Johnson & O'Neil's (2001) habitat types and species-habitat associations.

Resource site: Kelley Creek	Habitat type						
	WATR[2]	HWET[3]	RWET[3]	TOTWET[3]	WLCH/ WODF[4]	WEGR	AGPA
Total acres	0.0	7.8	6.1	16.0	1,073.7	46.8	236.3
Percent of total	0.0%	0.5%	0.4%	1.1%	75.5%	3.3%	16.6%

[1]See Table G-24 for land cover types and crosswalk to Johnson and O'Neil's classification scheme.

[2]Note that patch type and data limitations result in an underestimation of open water habitats. For example, medium and small sized stream surfaces are excluded.

[3]Note that HWET and RWET do not represent the full suite of wetlands because some wetlands <2 acres were added in as Habitats of Concern, and some wetlands could not be associated with herbaceous or forested habitats. TOTWET represents the best estimate of all existing wetlands because it includes Habitats of Concern.

[4]Data limitations make it impossible to distinguish between these two habitat types at this time, and no comprehensive oak habitat survey has been conducted for the region. However, known oak habitats are also included in HOCs (see Appendix 10).

SITE #20: Middle Johnson Creek subwatershed

Named streams: Fairview Creek, Johnson Creek
Communities within the subwatershed: Gresham, Happy Valley, Portland**,** unincorporated Clackamas county, unincorporated Multnomah county
Total acreage within Metro's boundary: 8,949.5
Total acres within the riparian corridor: 1,798.9

This site contains three percent of the area comprising Metro's jurisdictional boundary. The majority of the site (82 percent) falls within the City of Portland's boundaries; 16 percent is in Gresham, and one percent or less falls within Happy Valley and unincorporated Clackamas and Multnomah counties (Table G-26).

The road density in this site is 14.7 miles per square mile, falling within the third quartile (51 to 75 percent of maximum) compared to all other resource sites (Table G-2). The zoning is primarily single family residential, but multi-family residential and public space/open lands are also important land uses in this resource site (Table G-5). Nearly 1,500 building permits have been issued here since 1996 (Table A-2).

Riparian resources. Seventeen percent of this site is part of the riparian corridor inventory, ranking it next to last in Group G (Table 12). However, it contributes nearly two percent of the region's total riparian resources (Table 13).

This resource site contains 37 total stream miles, but because most of these (73 percent) are stream links, actual stream density is only 0.0011 miles per acre, ranking it last among all 27 resource sites (Tables 12 and G-3). More than a third of the non-piped stream miles are DEQ 303(d) listed (Table G-2). Anadromous fish are known to be present in approximately 3-1/2 stream miles (Table G-2). Four percent of the site is floodplain, and less than one percent is wetland (Tables G-2 and G-3). Forty-three percent of the floodplain is developed, second only to Site #24 among all 27 resource sites (Table 14).

Approximately 18 percent of this site's acreage within the riparian corridor inventory received primary scores for at least three of the five ecological functions, and more than 32 percent received at least one primary score (Table G-29). Approximately 68 percent of the site's riparian resources are limited to secondary functions. The highest percentage of land receiving a primary score was for *Bank stabilization and pollution control* and *Large wood and channel dynamics* (Table G-28; see also Table 4 and Appendix 5 for description of ecological functions mapping).

Wildlife habitat resources. Including Habitats of Concern, 18 percent of the lands in this site fall within the wildlife habitat inventory, ranking it 23rd among the 27 resource sites and seventh of the eight Group G resource sites (Table 16). Despite the relatively low proportion of wildlife habitat, what is there tends to be high-scoring; within model patches approximately 55 percent falls within the top third of the point range, the second highest proportion of the eight Group G resource sites; another 33 percent falls in the middle range (Table G-30). Of the four criteria in the GIS model, the highest proportion of acreage is in the middle size score category (55 percent), with another 35 percent in the lowest category (Table G-31). The acreage for the interior criterion all fell in the lowest score category (82 percent). This suggests that there are some long, linear habitat patches along streams in this resource site. The high total percentages for these two criteria suggest that most of the habitat resources within 300 ft of streams are forested, because low-structure patch types are not scored for these two criteria (see also Table G-32). In fact, most of the water resources for this site fell within the middle scoring range (68 percent), confirming what can be seen on the map. In keeping with this resource configuration, most of the acreage scored in the high range for connectivity (85 percent). This site ranks fourth high for connectivity relative to all 27 resource sites, and ranks second among the generally well-connected resource sites within Group G.

In general, this site can be characterized as having high quality wildlife habitat despite fairly intense urbanization. While there is little interior habitat the excellent connectivity and large patch sizes situated along waterways provide a very valuable wildlife habitat complex, and contribute important resources to the regional wildlife habitat system. As with other sites with these characteristics, this site is probably highly important to animals moving between patches, including both stopover and breeding territory for Neotropical migratory birds.

As with other Group G sites, conifer and hardwood forest are the predominant habitat types in this resource site (78 percent) (Table G-35). Wetlands cover one percent of the site's wildlife habitat, proportionally lower than the many of the 27 resource sites and ranking seventh among the eight resource sites in Group G. The site contributes 0.2 percent to the region's wetland resources, ranking 25th among the 27 resource sites.

Species of Concern. Four Species of Concern sighting locations fall within the site. Each sighting may include one or more species; if a species occurs more than once in the resource site it is only listed once here. These include the following species:

- Red-legged Frog
- Bald Eagle nest site
- *Rorippa columbiae* (sensitive plant species)
- *Sidalcea nelsoniana* (sensitive plant species)

There are very likely other Species of Concern using this resource site, particularly those relying on forested habitats and agricultural lands (see Table G-35). Examples of species likely to occur in this site may be found by referencing the species list in Appendix 7 and identifying the species with a double "XX" under the habitat. General species needs and potential reasons for their decline are identified in the *Sensitive Species Accounts* section above. More detailed information on all species' needs can be obtained through Johnson and O'Neil (2001).

Habitats of Concern.

The following Habitats of Concern are partially or wholly within this resource site. Using the Unique ID # (UID), please refer to Appendix 8 for information concerning each Habitat of Concern:

UID numbers: 12, 33, 126, 133, 134, 135, 136, 161

Resource site data tables: Riparian Corridors

Table G-26. Acres within resource site by jurisdiction.

Jurisdiction	Acres within subwatershed
Gresham	1,437.2
Happy Valley	78.9
Portland	7,358.3
Unincorporated Clackamas County	58.5
Unincorporated Multhomah County	16.6

Table G-27. Acres in Metro and riparian corridor.

Resource site	Total acres within Metro	Total acres within riparian corridor
Middle Johnson Creek	8,949.7	1,539.2

Table G-28. Number of acres within riparian corridor providing ecological function.

Resource site	Ecological function	*Primary Value*		*Secondary Value*	
		Acres*	% of Total**	Acres	% of Total
Middle Johnson Creek	Microclimate & shade	233.0	15.1%	549.5	35.7%
	Streamflow moderation & water storage	233.2	15.2%	1,281.3	83.2%
	Bank stabilization & pollution control	353.8	23.0%	81.6	5.3%
	Large wood & channel dynamics	431.5	28.0%	116.9	7.6%
	Organic material sources	271.9	17.7%	88.0	5.7%

*Number of acres scored within the riparian corridor for each function
**Percent of total acres within the riparian corridor

Table G-29. Breakdown of ecological scores.

Resource site	Ecological Score	Acres	% of Total Acres
Middle Johnson Creek	1 to 5	1,041.5	67.7%
	6 to 11	92.0	6.0%
	12 to 17	122.3	7.9%
	18 to 23	16.9	1.1%
	24 to 29	196.6	12.8%
	30	70.0	4.5%
	Total acres	1,539.2	100.0%

Resource site data tables: Wildlife Habitat

Table G-30. Breakdown of total wildlife model patch scores.*

Resource site: Middle Johnson Creek	Number of acres in each wildlife score category									Total wildlife model patch acres in inventory
	1	2	3	4	5	6	7	8	9	
Model score	88.2	24.0	52.2	109.8	298.1	38.8	740.5	0.0	0.0	1,351.7
Percent of total	6.5%	1.8%	3.9%	8.1%	22.1%	2.9%	54.8%	0.0%	0.0%	100.0%

*Does not include Habitats of Concern outside of model patches.

Table G-31. Breakdown of total wildlife patch model scores by criteria.*

Resource site: Middle Johnson Creek	Number of acres by score for each model criterion												Total wildlife model patch acres in inventory
	Size[2]			Interior[2]			Water[3]			Connectivity			
	1	2	3	1	2	3	1	2	3	1	2	3	
	478.5	740.5	0.0	1,107.3	0.0	0.0	271.4	920.0	30.2	130.5	72.2	1,149.0	1,351.7
Percent of total acres in inventory	35.4%	54.8%	0.0%	81.9%	0.0%	0.0%	20.1%	68.1%	2.2%	9.7%	5.3%	85.0%	na

[1]Does not include Habitats of Concern outside of model patches.
[2]These numbers do not add up to 100.0% because Type 2 patches (low structure vegetation within 300 feet of streams and wetlands) were not ranked for these criteria.
[3]These numbers do not add up to 100% because not all patches contained or were near water resources.

Table G-32. Breakdown of total wildlife model patch area by 2000 Metro photo interpretation landcover and known wetlands.*

Resource site: Middle Johnson Creek	Low structure vegetation within 300 feet of stream		Forested vegetation	Forested wetlands	Grass/shrub wetlands within 300 feet of a stream	Other wetlands	Total wildlife model patch acres in inventory
	Low structure vegetation/ intact topsoil	Non-forest woody vegetation					
Acres	127.6	5.0	1,208.2	4.6	0.0	6.2	1,351.7
Percent of total	9.4%	0.4%	89.4%	0.3%	0.0%	0.5%	100.0%

*Does not include Habitats of Concern outside of model patches.

Table G-33. Total acres of inventoried wildlife habitat by type and total Species of Concern (SOCs).

Resource site: Middle Johnson Creek	Wildlife patches (acres)	HOCs inside Wildlife patches (acres)*	HOCs outside Wildlife patches (including wetlands <2 acres)	Total inventoried wildlife habitat acres	Total SOCs
Acres	1351.7	425.2	276.4	1628.1	4
Percent of total	83.0%	26.1%	17.0%	100.0%	N/A

*Habitats of Concern.

Table G-34. Total area of model patches and Habitats of Concern by 1998 Landsat Landcover Area.

Resource Site: Middle Johnson Creek / Landcover type:	Total area of wildlife model patches	Total area of HOCs outside of modeled patches (including wetlands <2 acres)	Percent of total inventoried habitat
Water	0.77	0.0	0.0%
Barren	43.96	25.1	4.2%
Low structure agriculture	9.21	0.0	0.6%
High structure agriculture	0.00	0.0	0.0%
Deciduous closed canopy	259.65	8.8	16.5%
Mixed closed canopy	437.62	3.3	27.1%
Conifer closed canopy	337.67	0.2	20.8%
Deciduous open canopy	49.61	9.4	3.6%
Mixed open canopy	36.46	10.7	2.9%
Conifer open canopy	21.15	0.2	1.3%
Deciduous scattered canopy	35.08	11.2	2.8%
Mixed scattered canopy	25.67	10.7	2.2%
Conifer scattered canopy	16.39	0.0	1.0%
Closed canopy shrub	39.64	9.1	3.0%
Open canopy shrub	10.43	7.6	1.1%
Scattered canopy shrub	10.43	26.2	2.2%
Meadow/grass	17.95	154.0	10.6%
Not classified	0.00	0.0	0.0%
Total	**1,351.69**	**276.4**	**100.0%**

The table below provides estimates of each type of the habitats described in Metro's Technical Report for Fish and Wildlife Habitat, based on Johnson and O'Neil's (2001) habitat scheme. These numbers are provided for subwatershed comparison purposes and represent estimates of available habitat type. Several data types were used to compile this table, and the data sources vary in their precision. For example, the satellite data sources are less accurate than hand-digitized forest canopy cover. There is also slight overlap between certain habitat types. For example, Riparian Wetlands (RWET) are also partially included in Westside Lowland Coniferous Hardwood/Westside Oak and Douglas-fir (WLCH/WODF) because some wetlands also contain forest, and Open Water (WATR) is not always considered part of habitat patches. Therefore, the sums of these habitat types are slightly different from the "Total wildlife habitat acres in inventory" shown in Table 16. Nonetheless, these numbers provide a generalized means of comparing the quality and quantity of habitat available to wildlife among and between subwatersheds. Note also that the estimates for Westside Grasslands (WEGR) probably represent grasslands that are not native rather than true native grasslands, which are largely extirpated from the metro region.

Table G-35. Wildlife habitat availability[1] based on Johnson & O'Neil's (2001) habitat types and species-habitat associations.

Resource site:	Habitat type						
Middle Johnson Creek	WATR[2]	HWET[3]	RWET[3]	TOTWET[3]	WLCH/ WODF[4]	WEGR	AGPA
Total acres	12.9	6.3	4.6	14.4	1,273.8	226.5	9.2
Percent of total	0.8%	0.4%	0.3%	0.9%	78.2%	13.9%	0.6%

[1]See Table G-34 for land cover types and crosswalk to Johnson and O'Neil's classification scheme.

[2]Note that patch type and data limitations result in an underestimation of open water habitats. For example, medium and small sized stream surfaces are excluded.

[3]Note that HWET and RWET do not represent the full suite of wetlands because some wetlands <2 acres were added in as Habitats of Concern, and some wetlands could not be associated with herbaceous or forested habitats. TOTWET represents the best estimate of all existing wetlands because it includes Habitats of Concern.

[4]Data limitations make it impossible to distinguish between these two habitat types at this time, and no comprehensive oak habitat survey has been conducted for the region. However, known oak habitats are also included in HOCs (see Appendix 10).

SITE #21: Lower Johnson Creek-Willamette River

Named streams: Clackamas River, Willamette River
Communities within the subwatershed: Gladstone, Lake Oswego, Oregon City, West Linn, unincorporated Clackamas County
Total acreage within Metro's boundary: 5,950.2
Total acres within the riparian corridor: 1,897.1

This site contains two percent of the area comprising Metro's jurisdictional boundary. About 40 percent of the site is in West Linn, 38 percent in unincorporated Clackamas County, and the remainder is in Gladstone (15 percent), Lake Oswego (seven percent) and Oregon City (less than one percent) (Table G-36).

At 14.9 road miles per square mile, this site's road density is similar to several other sites in Group G, placing it in the third quartile (51 to 75% of maximum) compared to all other resource sites (e.g., site #20, 22, 23, and 25) (Table G-2). Zoning is primarily single family residential (Table G-5). About 560 building permits have been issued in this site since 1996 (Table G-2).

Riparian resources. Thirty-two percent of this site is part of the riparian corridor inventory, ranking it in the middle of Group G (Table 12). It contributes two percent of the region's total riparian resources (Table 13).

This resource site contains 32 total stream miles, of which 23 percent are stream links. Non-piped stream density is 0.0041 miles per acre, the fourth highest of all 27 resource sites (Tables 12 and G-3). Sixteen percent of the non-piped stream miles are DEQ 303(d) listed (Table G-2). Anadromous fish are known to be present in approximately four stream miles (Table G-2). Low to medium gradient streams predominate (Table G-3). Twelve percent of the site is floodplain, and one percent is wetland (Tables G-2 and G-3). Approximately 10 percent of the floodplain is developed.

A substantial amount of riparian resources in this site received primary scores. Approximately 44 percent of this site's acreage within the riparian corridor inventory received primary scores for at least three of the five ecological functions, and more than 62 percent received at least one primary score (Table G-39). The highest percentage of land receiving a primary score was for *Large wood and channel dynamics*, followed by *Bank stabilization and pollution control*. *Streamflow moderation and water storage* was also an important primary function in this resource site (Table G-38; see also Table 4 and Appendix 5 for description of ecological functions mapping).

Wildlife habitat resources. Including Habitats of Concern, 25 percent of the lands in this site fall within the wildlife habitat inventory, ranking it 13th among the 27 resource sites and fourth of the eight Group G resource sites (Table 16). Within model patches, no acreage falls within the top third of the point range; however, 74 percent falls in the middle range (Table G-40). Of the four criteria in the GIS model, the highest proportion of acreage is in the middle size score category (55 percent), with another 35 percent in the lowest category (Table G-41). The majority of the mid-range scores fell west of the Willamette River, with less total habitat and more fragmentation east of the river.

The acreage for the size and interior criteria all fell in the lowest score category (94 and 72 percent, respectively). This suggests that there are some long, linear habitat patches in this resource site. The high total percentage for the size criterion suggests that most of the habitat resources within 300 ft of streams are forested, because low-structure patch types are not scored for this criterion (see also Table G-42). Most of the water resources for this site fell within the middle or high scoring range (54 and 27 percent, respectively). This is influenced by the fact that the largest habitat is much longer than it is wide wide, and most of the streams run perpendicular through the patch thus lowering the density of water resources in the site. The overall connectivity scores fell primarily in the middle (47 percent) and high (34 percent) range for the site. The habitat patches west of the Willamette River have excellent connectivity; preserving this connectivity will be essential to maintaining the integrity of habitat here. This patch also contains a narrow corridor of connectivity to Mary S. Young State Park and adjacent patches closer to the Willamette River, and maintaining or enhancing that connector is vital.

As with other Group G sites, conifer and hardwood forest are the predominant habitat types in this resource site (87 percent), but open water, at 23 percent, is a very important habitat resource (Table G-45). Wetlands cover nearly three percent of the site's wildlife habitat, proportionally lower than the many of the 27 resource sites and ranking seventh among the eight resource sites in Group G. The site contributes 0.4 percent to the region's wetland resources, ranking 22nd among the 27 resource sites.

In general, this site can be characterized as having relatively high quality wildlife habitat west of the Willamette River, with less habitat that is generally lower in quality east of the river (due to fragmentation and lack of water resources). On the east side of the river a relatively low proportion of the habitat is protected through parks and public lands, but this pattern is improved to the west, where the low scores in habitat interior are mitigated by strong connectivity and good water resources. The proximity to the river and connectivity make the western portion of this site highly important to wildlife movement and an important migratory resource.

Species of Concern. Four Species of Concern sighting locations fall within the site. Each sighting may include one or more species; if a species occurs more than once in the resource site it is only listed once here. These include the following species:

- Band-tailed Pigeon
- Red-legged Frog
- Great Blue Heron nest colony

There are very likely other Species of Concern using this resource site, particularly those relying on forested habitats and agricultural lands (see Table G-45). Examples of species likely to occur in this site may be found by referencing the species list in Appendix 7 and identifying the species with a double "XX" under the habitat. General species needs and potential reasons for their decline are identified in the *Sensitive Species Accounts* section above. More detailed information on all species' needs can be obtained through Johnson and O'Neil (2001).

Habitats of Concern.
The following Habitats of Concern are partially or wholly within this resource site. Using the Unique ID # (UID), please refer to Appendix 8 for information concerning each Habitat of Concern:

UID numbers: 117, 118, 119, 120, 145

Resource site data tables: Riparian Corridors

Table G-36. Acres within resource site by jurisdiction.

Jurisdiction	Acres within subwatershed
Gladstone	921.0
Lake Oswego	402.3
Oregon City	0.3
West Linn	2,354.6
Unincorporated Clackamas County	2,272.0

Table G-37. Acres in Metro and riparian corridor.

Resource site	Total acres within Metro	Total acres within riparian corridor
Lower Johnson Creek	5,950.3	1,897.0

Table G-38. Number of acres within riparian corridor providing ecological function.

Resource site	Ecological function	*Primary Value*		*Secondary Value*	
		Acres*	% of Total**	Acres	% of Total
Lower Johnson Creek	Microclimate & shade	452.0	23.8%	674.8	35.6%
	Streamflow moderation & water storage	670.6	35.4%	1,134.3	59.8%
	Bank stabilization & pollution control	994.4	52.4%	66.0	3.5%
	Large wood & channel dynamics	1,079.1	56.9%	170.9	9.0%
	Organic material sources	479.7	25.3%	134.9	7.1%

*Number of acres scored within the riparian corridor for each function

**Percent of total acres within the riparian corridor

Table G-39. Breakdown of ecological scores.

Resource site	Ecological Score	Acres	% of Total Acres
Lower Johnson Creek	1 to 5	705.9	37.2%
	6 to 11	161.5	8.5%
	12 to 17	191.9	10.1%
	18 to 23	365.8	19.3%
	24 to 29	326.1	17.2%
	30	145.7	7.7%
	Total acres	1,897.0	100.0%

Resource site data tables: Wildlife Habitat

Table G-40. Breakdown of total wildlife model patch scores.*

Resource site: Lower Johnson Creek	Number of acres in each wildlife score category									Total wildlife model patch acres in inventory
	1	2	3	4	5	6	7	8	9	
Model score	81.7	119.1	174.5	121.1	179.2	781.5	0.0	0.0	0.0	1,457.2
Percent of total	5.6%	8.2%	12.0%	8.3%	12.3%	53.6%	0.0%	0.0%	0.0%	100.0%

*Does not include Habitats of Concern outside of model patches.

Table G-41. Breakdown of total wildlife patch model scores by criteria.*

Resource site: Lower Johnson Creek	Number of acres by score for each model criterion												Total wildlife model patch acres in inventory
	Size[2]			Interior[2]			Water[3]			Connectivity			
	1	2	3	1	2	3	1	2	3	1	2	3	
	1,374.5	0.0	0.0	1,049.9	0.0	0.0	77.2	779.4	392.3	280.5	677.5	499.2	1,457.2
Percent of total acres in inventory	94.3%	0.0%	0.0%	72.1%	0.0%	0.0%	5.3%	53.5%	26.9%	19.2%	46.5%	34.3%	na

[1]Does not include Habitats of Concern outside of model patches.

[2]These numbers do not add up to 100.0% because Type 2 patches (low structure vegetation within 300 feet of streams and wetlands) were not ranked for these criteria.

[3]These numbers do not add up to 100% because not all patches contained or were near water resources.

Table G-42. Breakdown of total wildlife model patch area by 2000 Metro photo interpretation landcover and known wetlands.*

Resource site: Lower Johnson Creek	Low structure vegetation within 300 feet of stream		Forested vegetation	Forested wetlands	Grass/shrub wetlands within 300 feet of a stream	Other wetlands	Total wildlife model patch acres in inventory
	Low structure vegetation/ intact topsoil	Non-forest woody vegetation					
Acres	80.1	2.5	1,339.4	12.8	11.6	10.7	1,457.2
Percent of total	5.5%	0.2%	91.9%	0.9%	0.8%	0.7%	100.0%

*Does not include Habitats of Concern outside of model patches.

Table G-43. Total acres of inventoried wildlife habitat by type and total Species of Concern (SOCs).

Resource site: Lower Johnson Creek	Wildlife patches (acres)	HOCs inside Wildlife patches (acres)*	HOCs outside Wildlife patches (including wetlands <2 acres)	Total inventoried wildlife habitat acres	Total SOCs
Acres	1457.2	247.7	14.0	1471.2	4
Percent of total	99.1%	16.8%	0.9%	100.0%	N/A

*Habitats of Concern.

Table G-44. Total area of model patches and Habitats of Concern by 1998 Landsat Landcover Area.

Resource Site: Lower Johnson Creek / Landcover type:	Total area of wildlife model patches	Total area of HOCs outside of modeled patches (including wetlands <2 acres)	Percent of total inventoried habitat
Water	14.67	9.0	1.6%
Barren	44.55	1.0	3.1%
Low structure agriculture	0.00	0.0	0.0%
High structure agriculture	0.02	0.0	0.0%
Deciduous closed canopy	284.02	0.3	19.3%
Mixed closed canopy	357.25	0.5	24.3%
Conifer closed canopy	220.15	0.0	15.0%
Deciduous open canopy	154.66	0.4	10.5%
Mixed open canopy	102.28	0.5	7.0%
Conifer open canopy	25.25	0.1	1.7%
Deciduous scattered canopy	65.41	0.4	4.5%
Mixed scattered canopy	47.77	0.3	3.3%
Conifer scattered canopy	15.91	0.0	1.1%
Closed canopy shrub	53.58	0.7	3.7%
Open canopy shrub	22.79	0.2	1.6%
Scattered canopy shrub	21.89	0.2	1.5%
Meadow/grass	26.99	0.3	1.9%
Not classified	0.00	0.0	0.0%
Total	**1,457.19**	**14.0**	**100.0%**

The table below provides estimates of each type of the habitats described in Metro's Technical Report for Fish and Wildlife Habitat, based on Johnson and O'Neil's (2001) habitat scheme. These numbers are provided for subwatershed comparison purposes and represent estimates of available habitat type. Several data types were used to compile this table, and the data sources vary in their precision. For example, the satellite data sources are less accurate than hand-digitized forest canopy cover. There is also slight overlap between certain habitat types. For example, Riparian Wetlands (RWET) are also partially included in Westside Lowland Coniferous Hardwood/Westside Oak and Douglas-fir (WLCH/WODF) because some wetlands also contain forest, and Open Water (WATR) is not always considered part of habitat patches. Therefore, the sums of these habitat types are slightly different from the "Total wildlife habitat acres in inventory" shown in Table 16. Nonetheless, these numbers provide a generalized means of comparing the quality and quantity of habitat available to wildlife among and between subwatersheds. Note also that the estimates for Westside Grasslands (WEGR) probably represent grasslands that are not native rather than true native grasslands, which are largely extirpated from the metro region.

Table G-45. Wildlife habitat availability[1] based on Johnson & O'Neil's (2001) habitat types and species-habitat associations.

Resource site:	Habitat type						
Lower Johnson Creek	WATR[2]	HWET[3]	RWET[3]	TOTWET[3]	WLCH/ WODF[4]	WEGR	AGPA
Total acres	341.1	22.3	12.8	38.6	1,275.3	72.4	0.0
Percent of total	23.2%	1.5%	0.9%	2.6%	86.7%	4.9%	0.0%

[1]See Table G-44 for land cover types and crosswalk to Johnson and O'Neil's classification scheme.

[2]Note that patch type and data limitations result in an underestimation of open water habitats. For example, medium and small sized stream surfaces are excluded.

[3]Note that HWET and RWET do not represent the full suite of wetlands because some wetlands <2 acres were added in as Habitats of Concern, and some wetlands could not be associated with herbaceous or forested habitats. TOTWET represents the best estimate of all existing wetlands because it includes Habitats of Concern.

[4]Data limitations make it impossible to distinguish between these two habitat types at this time, and no comprehensive oak habitat survey has been conducted for the region. However, known oak habitats are also included in HOCs (see Appendix 10).

SITE #22: Lake Oswego subwatershed

Named streams: Oswego Creek, Spring Brook Creek, Willamette River
Communities within the subwatershed: Lake Oswego, Portland, unincorporated Clackamas county
Total acreage within Metro's boundary: 4,168.7
Total acres within the riparian corridor: 1,541.7
Other information: One dam with unknown impacts to fish. One other barrier to fish passage present with no known fishway.

This site contains one percent of the area comprising Metro's jurisdictional boundary. Most of the site (94 percent) is in Lake Oswego, with the remainder in unincorporated Clackamas County (five percent) and the City of Portland (one percent) (Table G-46).

Road density in this site is 15.3 miles per square mile, placing it in the third quartile (51 to 75% of maximum) compared to all other resource sites (Table G-2). Single family residential is the dominant zoning pattern (Table G-5). About 420 building permits have been issued here since 1996 (Table G-2).

Riparian resources. Thirty-seven percent of this site is part of the riparian corridor inventory, ranking it in fourth of eight sites in Group G (Table 12). It contributes two percent of the region's total riparian resources (Table 13).

This resource site contains 23 total stream miles, of which 27 percent are stream links, suggesting moderately high amounts of piping and culverting. Non-piped stream density is 0.0041 miles per acre, placing it in the top quarter of all resource sites (Tables 12 and G-3). Low to medium gradient streams predominate (Table G-3). Seventeen percent of the non-piped stream miles are DEQ 303(d) listed (Table G-2). Anadromous fish are known to be present in less than one stream miles (Table G-2). Fourteen percent of the site is floodplain, and less than one percent is wetland (Tables G-2 and G-3). Approximately 13 percent of the floodplain is developed.

A substantial amount of riparian resources in this site received primary scores. Approximately 16 percent of this site's acreage within the riparian corridor inventory received primary scores for at least three of the five ecological functions, but nearly 55 percent received at least one primary score (Table G-49). The highest percentage of land receiving a primary score was for *Large wood and channel dynamics*, followed by *Streamflow moderation and water storage* (not surprising, given Oswego Lake's presence in the site) (Table G-48; see also Table 4 and Appendix 5 for description of ecological functions mapping).

Wildlife habitat resources. Including Habitats of Concern, 24 percent of the lands in this site fall within the wildlife habitat inventory, ranking it 14th among the 27 resource sites and fifth of the eight Group G resource sites (Table 16). Within model patches, less than one percent of the acreage falls within the top third of the point range; however, 78 percent falls in the middle range (Table G-50). Of the four criteria in the GIS model, by far the highest proportion of the acreage falls in the lowest size and interior score category (97 and 75 percent, respectively) (Table G-51). The high proportion of acreage accounted for in the size criterion indicates that nearly all of the lands within 300 ft of streams are forested, because low-structure patch types are not scored for this criterion (see also Table G-52). Most of the water resources for this site fell within the middle or high scoring range (57 and 30 percent, respectively). The overall connectivity scores fell primarily in the high range (42 percent), with decreasing but still important proportions in the medium and low score categories (37 and 21 percent, respectively). The most substantial habitat patch is north of Oswego Lake and includes important areas of connectivity to the lake; preserving this connectivity will be essential to maintaining the integrity of habitat in this site. A smaller patch just south of the Lake is even more well connected to this important open water resource. Portions of each of these patches are protected by parks. Several other significant habitat patches provide important connectivity to adjacent resource sites.

As with other Group G sites, conifer and hardwood forest are the predominant habitat types in this resource site (89 percent). Open water is not fully accounted for in this site at just three percent, but this habitat type is undoubtedly also a very important habitat resource (Table G-55). Wetlands cover slightly more than one percent of the site's wildlife habitat, proportionally lower than the many of the 27 resource sites and ranking sixth among the eight resource sites in Group G. The site contributes 0.2 percent to the region's wetland resources, ranking 26th among the 27 resource sites.

In general, this site can be characterized as having moderate quality wildlife habitat, but with some important habitat patches connected to Oswego Lake and to adjacent watersheds. The proximity to the lake is important to wildlife species utilizing open water habitats. The lake is known to be important to Bald Eagles, Osprey and waterfowl; it contains substantial development along the shorelines, but also substantial habitat. Retention of as much habitat as possible (particularly tree canopy) should accompany further lakeshore development if maintaining wildlife habitat quality is desired. Habitat enhancement near the lake on developed lots and creating connectors between isolated habitat patches would improve habitat quality over existing conditions in this site.

Species of Concern. Proximity to a large water resource such as Oswego Lake is highly valuable to wildlife and provides for distinctive plant communities, and this is reflected by the high number of Species of Concern sighting locations (11) falling within the site. Each sighting may include one or more species; if a species occurs more than once in the resource site it is only listed once here. These include the following species:

- Bald Eagle
- Great Blue Heron nest colony
- *Cimicifuga elata* (plant species)
- *Delphinium leucophaeum* (plant species)
- *Sullivantia oregana* (plant species)

There are very likely other Species of Concern using this resource site, particularly those relying on forested habitats and agricultural lands (see Table G-55). Examples of species likely to occur in this site may be found by referencing the species list in Appendix 7 and identifying the species with a double "XX" under the habitat. General species needs and potential reasons for their decline are identified in the *Sensitive Species Accounts* section above. More detailed information on all species' needs can be obtained through Johnson and O'Neil (2001).

Habitats of Concern.
The following Habitats of Concern are partially or wholly within this resource site. Using the Unique ID # (UID), please refer to Appendix 8 for information concerning each Habitat of Concern:

UID numbers: 111 (barely touches this resource site from the south)

Resource site data tables: Riparian Corridors

Table G-46. Acres within resource site by jurisdiction.

Jurisdiction	Acres within subwatershed
Lake Oswego	3,914.3
Portland	57.8
Unincorporated Clackamas County	196.6

Table G-47. Acres in Metro and riparian corridor.

Resource site	Total acres within Metro	Total acres within riparian corridor
Lake Oswego	4,168.7	1,541.7

Table G-48. Number of acres within riparian corridor providing ecological function.

Resource site	Ecological function	*Primary Value*		*Secondary Value*	
		Acres*	% of Total**	Acres	% of Total
Lake Oswego	Microclimate & shade	268.9	17.4%	579.1	37.6%
	Streamflow moderation & water storage	524.0	34.0%	933.3	60.5%
	Bank stabilization & pollution control	323.0	21.0%	109.8	7.1%
	Large wood & channel dynamics	766.7	49.7%	104.4	6.8%
	Organic material sources	214.6	13.9%	76.7	5.0%

*Number of acres scored within the riparian corridor for each function
**Percent of total acres within the riparian corridor

Table G-49. Breakdown of ecological scores.

Resource site	Ecological Score	Acres	% of Total Acres
Lake Oswego	1 to 5	699.5	45.4%
	6 to 11	101.6	6.6%
	12 to 17	488.8	31.7%
	18 to 23	41.5	2.7%
	24 to 29	158.0	10.2%
	30	52.4	3.4%
	Total acres	1,541.7	100.0%

Resource site data tables: Wildlife Habitat

Table G-50. Breakdown of total wildlife model patch scores.*

Resource site: Lake Oswego	Number of acres in each wildlife score category: 1	2	3	4	5	6	7	8	9	Total wildlife model patch acres in inventory
Model score	42.0	49.7	124.7	61.0	78.3	648.3	0.0	1.3	0.0	1,005.3
Percent of total	4.2%	4.9%	12.4%	6.1%	7.8%	64.5%	0.0%	0.1%	0.0%	100.0%

*Does not include Habitats of Concern outside of model patches.

Table G-51. Breakdown of total wildlife patch model scores by criteria.*

Resource site:	Number of acres by score for each model criterion												Total wildlife model patch acres in inventory
	Size[2]			Interior[2]			Water[3]			Connectivity			
Lake Oswego	1	2	3	1	2	3	1	2	3	1	2	3	
	974.1	1.3	0.0	754.5	1.3	0.0	67.2	570.2	299.8	213.6	372.9	418.8	1,005.3
Percent of total acres in inventory	96.9%	0.1%	0.0%	75.1%	0.1%	0.0%	6.7%	56.7%	29.8%	21.2%	37.1%	41.7%	na

[1]Does not include Habitats of Concern outside of model patches.
[2]These numbers do not add up to 100.0% because Type 2 patches (low structure vegetation within 300 feet of streams and wetlands) were not ranked for these criteria.
[3]These numbers do not add up to 100% because not all patches contained or were near water resources.

Table G-52. Breakdown of total wildlife model patch area by 2000 Metro photo interpretation landcover and known wetlands.*

Resource site: Lake Oswego	Low structure vegetation within 300 feet of stream: Low structure vegetation/ intact topsoil	Low structure vegetation within 300 feet of stream: Non-forest woody vegetation	Forested vegetation	Forested wetlands	Grass/shrub wetlands within 300 feet of a stream	Other wetlands	Total wildlife model patch acres in inventory
Acres	27.2	2.7	965.2	5.3	0.1	4.8	1,005.3
Percent of total	2.7%	0.3%	96.0%	0.5%	0.0%	0.5%	100.0%

*Does not include Habitats of Concern outside of model patches.

Table G-53. Total acres of inventoried wildlife habitat by type and total Species of Concern (SOCs).

Resource site: Lake Oswego	Wildlife patches (acres)	HOCs inside Wildlife patches (acres)*	HOCs outside Wildlife patches (including wetlands <2 acres)	Total inventoried wildlife habitat acres	Total SOCs
Acres	1005.3	0.1	3.0	1008.3	11
Percent of total	99.7%	0.0%	0.3%	100.0%	N/A

*Habitats of Concern.

Table G-54. Total area of model patches and Habitats of Concern by 1998 Landsat Landcover Area.

Resource Site: Lake Oswego Landcover type:	Total area of wildlife model patches	Total area of HOCs outside of modeled patches (including wetlands <2 acres)	Percent of total inventoried habitat
Water	12.52	0.1	1.2%
Barren	29.00	1.1	3.0%
Low structure agriculture	11.67	0.0	1.2%
High structure agriculture	0.09	0.0	0.0%
Deciduous closed canopy	194.29	0.4	19.3%
Mixed closed canopy	243.22	0.3	24.2%
Conifer closed canopy	229.59	0.3	22.8%
Deciduous open canopy	69.77	0.2	6.9%
Mixed open canopy	58.34	0.0	5.8%
Conifer open canopy	21.81	0.0	2.2%
Deciduous scattered canopy	34.34	0.1	3.4%
Mixed scattered canopy	25.13	0.0	2.5%
Conifer scattered canopy	19.39	0.1	1.9%
Closed canopy shrub	26.18	0.0	2.6%
Open canopy shrub	10.64	0.1	1.1%
Scattered canopy shrub	10.09	0.0	1.0%
Meadow/grass	9.19	0.2	0.9%
Not classified	0.00	0.0	0.0%
Total	**1,005.26**	**3.0**	**100.0%**

The table below provides estimates of each type of the habitats described in Metro's Technical Report for Fish and Wildlife Habitat, based on Johnson and O'Neil's (2001) habitat scheme. These numbers are provided for subwatershed comparison purposes and represent estimates of available habitat type. Several data types were used to compile this table, and the data sources vary in their precision. For example, the satellite data sources are less accurate than hand-digitized forest canopy cover. There is also slight overlap between certain habitat types. For example, Riparian Wetlands (RWET) are also partially included in Westside Lowland Coniferous Hardwood/Westside Oak and Douglas-fir (WLCH/WODF) because some wetlands also contain forest, and Open Water (WATR) is not always considered part of habitat patches. Therefore, the sums of these habitat types are slightly different from the "Total wildlife habitat acres in inventory" shown in Table 16. Nonetheless, these numbers provide a generalized means of comparing the quality and quantity of habitat available to wildlife among and between subwatersheds. Note also that the estimates for Westside Grasslands (WEGR) probably represent grasslands that are not native rather than true native grasslands, which are largely extirpated from the metro region.

Table G-55. Wildlife habitat availability[1] based on Johnson & O'Neil's (2001) habitat types and species-habitat associations.

Resource site:	Habitat type						
Lake Oswego	WATR[2]	HWET[3]	RWET[3]	TOTWET[3]	WLCH/ WODF[4]	WEGR	AGPA
Total acres	30.0	4.9	5.3	13.1	897.4	30.3	11.8
Percent of total	3.0%	0.5%	0.5%	1.3%	89.0%	3.0%	1.2%

[1]See Table G-54 for land cover types and crosswalk to Johnson and O'Neil's classification scheme.

[2]Note that patch type and data limitations result in an underestimation of open water habitats. For example, medium and small sized stream surfaces are excluded.

[3]Note that HWET and RWET do not represent the full suite of wetlands because some wetlands <2 acres were added in as Habitats of Concern, and some wetlands could not be associated with herbaceous or forested habitats. TOTWET represents the best estimate of all existing wetlands because it includes Habitats of Concern.

[4]Data limitations make it impossible to distinguish between these two habitat types at this time, and no comprehensive oak habitat survey has been conducted for the region. However, known oak habitats are also included in HOCs (see Appendix 10).

SITE #23: Tryon Creek subwatershed

Named streams: Forest Creek, Tryon Creek, Willamette River
Communities within the subwatershed: Lake Oswego, Portland, unincorporated Clackamas county, unincorporated Multnomah county
Total acreage within Metro's boundary: 4,356.4
Total acres within the riparian corridor: 1,972.8

This site contains one percent of the area comprising Metro's jurisdictional boundary. Sixty-eight percent of the site is in the City of Portland, with another 20 percent in Lake Oswego. The remainder is in unincorporated Clackamas (seven percent) and Multnomah (five percent) counties (Table G-56).

This site's road density of 14.6 miles per square miles places it in the third quartile (51 to 75% of maximum) compared to all other resource sites (Table G-2). Considering the amount of habitat preserved in Tryon Creek State Park and adjacent Marshall Park, combined with the average development intensity falling within the third quartile of all sites, the areas outside of the habitat patches may be considered highly developed. As with the majority of other resource sites in Group G, single family residential is the dominant zoning pattern (Table G-5). However, a relatively low number of building permits (285) have been issued in this site since 1996 (Table G-2).

Riparian resources. More than 45 percent of this site is part of the riparian corridor inventory, second only to Site #1 (Table 12). It contributes two percent of the region's total riparian resources (Table 13).

This resource site contains 24 total stream miles, of which 11 percent are stream links, suggesting relatively low amounts of piping and culverting (Table G-3). Non-piped stream density is 0.0048 miles per acre, the highest in Group G and also the highest of all 27 resource sites (Tables 12 and G-3). However, one quarter of the non-piped stream miles are DEQ 303(d) listed (Table G-2). Anadromous fish are known to be present in nearly three stream miles (Table G-2). Approximately 2-1/2 percent of the site is floodplain, and less than one percent is wetland (Tables G-2 and G-3). Approximately 34 percent of the floodplain is developed, the third highest of all 27 resource sites (Table 14).

Approximately 24 percent of this site's acreage within the riparian corridor inventory received primary scores for at least three of the five ecological functions, and 37 percent received at least one primary score (Table G-59). The highest percentage of land receiving a primary score was divided about equally between *Large wood and channel dynamics* and *Bank stabilization and pollution control* (Table G-58; see also Table 4 and Appendix 5 for description of ecological functions mapping).

Wildlife habitat resources. Including Habitats of Concern, 44 percent of the lands in this site fall within the wildlife habitat inventory, ranking it third among the 27 resource sites and second of the eight Group G resource sites – although it accounts for more habitat within the regional system than the first-ranked site within Group G (2.5 versus 1.9 percent, respectively; Table 16). Within model patches, a remarkable 84 percent of the acreage falls within the top third of the point range (Table G-60). Of the four criteria in the GIS model, by far the highest proportion of the acreage falls in the middle score category for size, interior, and water, while most of the acreage falls in the tope score category for connectivity (84, 84, 91, and 88 percent, respectively) (Table G-61). The high proportion of acreage accounted for in the size criterion indicates that nearly all of the lands within 300 ft of streams are forested, because low-structure patch types are not scored for this criterion (see also Table G-62).

Conifer and hardwood forest strongly predominate habitat types in this resource site (93 percent) (Table G-65). Wetlands cover only 0.2 percent of the site's wildlife habitat, proportionally the lowest of the 27 resource sites. The site contributes little to the region's wetland resources, because wetlands are uncommon in the mid- to high-gradient habitats representative of this resource site.

In general, this highly developed site can be characterized as providing extraordinarily important interior habitat to the region's wildlife, with a substantial proportion protected by parks and public lands. Many Neotropical migratory birds breed in this site and also use it for important stopover habitat, and it abounds with deer, beaver, and other mammal sign. Tryon Creek State Park includes southern connectivity to the Willamette River through a narrow corridor. Many developed areas also contain very important tree cover, providing key connectivity from core areas such as Tryon Creek State Park to peripheral, but very important, habitats at the outer edge of large patches, such as Maricara Nature Park. Some of these areas along streams are steeply sloped and thus receive protection through Title 3. One drawback of this resource site is that it is not well connected with adjacent resource sites (except for Site #26), such as Resource Sites # 12, 14 and 22; increasing connectivity to these sites, primarily along streams, would be a valuable restoration activity. Retaining or improving existing tree canopy in developments connected to the parklands is another important factor that will influence the value of this site's habitat in the future.

Species of Concern. Three Species of Concern sighting locations fall within the site. Each sighting may include one or more species; if a species occurs more than once in the resource site it is only listed once here. These include the following species:

- Pileated Woodpecker
- Willow Flycatcher
- Northern Pygmy Owl

There are very likely other Species of Concern using this resource site, particularly those relying on forested habitats and agricultural lands (see Table G-65). Examples of species likely to occur in this site may be found by referencing the species list in Appendix 7 and identifying the species with a double "XX" under the habitat. General species needs and potential reasons for their decline are identified in the *Sensitive Species Accounts* section above. More detailed information on all species' needs can be obtained through Johnson and O'Neil (2001).

Habitats of Concern.

The following Habitats of Concern are partially or wholly within this resource site. Using the Unique ID # (UID), please refer to Appendix 8 for information concerning each Habitat of Concern:

UID numbers: 114

Resource site data tables: Riparian Corridors

Table G-56. Acres within resource site by jurisdiction.

Jurisdiction	Acres within subwatershed
Lake Oswego	876.9
Portland	2,958.2
Unincorporated Clackamas County	294.8
Unincorporated Multhomah County	226.5

Table G-57. Acres in Metro and riparian corridor.

Resource site	Total acres within Metro	Total acres within riparian corridor
Tryon Creek	4,356.5	1,972.8

Table G-58. Number of acres within riparian corridor providing ecological function.

Resource site	Ecological function	*Primary Value*		*Secondary Value*	
		Acres*	% of Total**	Acres	% of Total
Tryon Creek	Microclimate & shade	454.5	23.0%	1,119.1	56.7%
	Streamflow moderation & water storage	74.4	3.8%	1,850.2	93.8%
	Bank stabilization & pollution control	623.5	31.6%	83.4	4.2%
	Large wood & channel dynamics	651.9	33.0%	289.0	14.6%
	Organic material sources	441.3	22.4%	213.9	10.8%

*Number of acres scored within the riparian corridor for each function
**Percent of total acres within the riparian corridor

Table G-59. Breakdown of ecological scores.

Resource site	Ecological Score	Acres	% of Total Acres
Tryon Creek	1 to 5	1,239.8	62.8%
	6 to 11	162.2	8.2%
	12 to 17	97.0	4.9%
	18 to 23	44.8	2.3%
	24 to 29	389.9	19.8%
	30	39.1	2.0%
	Total acres	1,972.8	100.0%

Resource site data tables: Wildlife Habitat

Table G-60. Breakdown of total wildlife model patch scores.*

Resource site: Tryon Creek	Number of acres in each wildlife score category: 1	2	3	4	5	6	7	8	9	Total wildlife model patch acres in inventory
Model score	23.6	46.3	81.9	86.2	10.4	50.8	0.0	1,597.8	0.0	1,896.9
Percent of total	1.2%	2.4%	4.3%	4.5%	0.5%	2.7%	0.0%	84.2%	0.0%	100.0%

*Does not include Habitats of Concern outside of model patches.

Table G-61. Breakdown of total wildlife patch model scores by criteria.*

Resource site: Tryon Creek	Number of acres by score for each model criterion												Total wildlife model patch acres in inventory
	Size[2]			Interior[2]			Water[3]			Connectivity			
	1	2	3	1	2	3	1	2	3	1	2	3	
	219.1	1,597.8	0.0	67.6	1,597.8	0.0	44.3	1,716.4	74.8	94.3	139.2	1,663.4	1,896.9
Percent of total acres in inventory	11.6%	84.2%	0.0%	3.6%	84.2%	0.0%	2.3%	90.5%	3.9%	5.0%	7.3%	87.7%	na

[1]Does not include Habitats of Concern outside of model patches.

[2]These numbers do not add up to 100.0% because Type 2 patches (low structure vegetation within 300 feet of streams and wetlands) were not ranked for these criteria.

[3]These numbers do not add up to 100% because not all patches contained or were near water resources.

Table G-62. Breakdown of total wildlife model patch area by 2000 Metro photo interpretation landcover and known wetlands.*

Resource site: Tryon Creek	Low structure vegetation within 300 feet of stream: Low structure vegetation/ intact topsoil	Low structure vegetation within 300 feet of stream: Non-forest woody vegetation	Forested vegetation	Forested wetlands	Grass/shrub wetlands within 300 feet of a stream	Other wetlands	Total wildlife model patch acres in inventory
Acres	80.0	0.0	1,814.2	2.1	0.0	0.6	1,896.9
Percent of total	4.2%	0.0%	95.6%	0.1%	0.0%	0.0%	100.0%

*Does not include Habitats of Concern outside of model patches.

Table G-63. Total acres of inventoried wildlife habitat by type and total Species of Concern (SOCs).

Resource site: Tryon Creek	Wildlife patches (acres)	HOCs inside Wildlife patches (acres)*	HOCs outside Wildlife patches (including wetlands <2 acres)	Total inventoried wildlife habitat acres	Total SOCs
Acres	1896.9	646.6	0.6	1897.5	3
Percent of total	100.0%	34.1%	0.0%	100.0%	N/A

*Habitats of Concern.

Table G-64. Total area of model patches and Habitats of Concern by 1998 Landsat Landcover Area.

Resource Site: Tryon Creek / Landcover type:	Total area of wildlife model patches	Total area of HOCs outside of modeled patches (including wetlands <2 acres)	Percent of total inventoried habitat
Water	0.94	0.0	0.0%
Barren	32.05	0.4	1.7%
Low structure agriculture	0.00	0.0	0.0%
High structure agriculture	0.00	0.0	0.0%
Deciduous closed canopy	521.43	0.0	27.5%
Mixed closed canopy	649.81	0.0	34.2%
Conifer closed canopy	281.44	0.0	14.8%
Deciduous open canopy	112.95	0.0	6.0%
Mixed open canopy	79.98	0.0	4.2%
Conifer open canopy	11.48	0.0	0.6%
Deciduous scattered canopy	54.44	0.0	2.9%
Mixed scattered canopy	43.00	0.1	2.3%
Conifer scattered canopy	7.88	0.0	0.4%
Closed canopy shrub	52.16	0.0	2.7%
Open canopy shrub	16.53	0.0	0.9%
Scattered canopy shrub	13.02	0.0	0.7%
Meadow/grass	19.79	0.0	1.0%
Not classified	0.00	0.0	0.0%
Total	**1,896.90**	**0.6**	**100.0%**

The table below provides estimates of each type of the habitats described in Metro's Technical Report for Fish and Wildlife Habitat, based on Johnson and O'Neil's (2001) habitat scheme. These numbers are provided for subwatershed comparison purposes and represent estimates of available habitat type. Several data types were used to compile this table, and the data sources vary in their precision. For example, the satellite data sources are less accurate than hand-digitized forest canopy cover. There is also slight overlap between certain habitat types. For example, Riparian Wetlands (RWET) are also partially included in Westside Lowland Coniferous Hardwood/Westside Oak and Douglas-fir (WLCH/WODF) because some wetlands also contain forest, and Open Water (WATR) is not always considered part of habitat patches. Therefore, the sums of these habitat types are slightly different from the "Total wildlife habitat acres in inventory" shown in Table 16. Nonetheless, these numbers provide a generalized means of comparing the quality and quantity of habitat available to wildlife among and between subwatersheds. Note also that the estimates for Westside Grasslands (WEGR) probably represent grasslands that are not native rather than true native grasslands, which are largely extirpated from the metro region.

Table G-65. Wildlife habitat availability[1] based on Johnson & O'Neil's (2001) habitat types and species-habitat associations.

Resource site:	Habitat type						
Tryon Creek	WATR[2]	HWET[3]	RWET[3]	TOTWET[3]	WLCH/ WODF[4]	WEGR	AGPA
Total acres	28.0	0.6	2.1	3.8	1,762.5	49.3	0.0
Percent of total	1.5%	0.0%	0.1%	0.2%	92.9%	2.6%	0.0%

[1]See Table G-64 for land cover types and crosswalk to Johnson and O'Neil's classification scheme.

[2]Note that patch type and data limitations result in an underestimation of open water habitats. For example, medium and small sized stream surfaces are excluded.

[3]Note that HWET and RWET do not represent the full suite of wetlands because some wetlands <2 acres were added in as Habitats of Concern, and some wetlands could not be associated with herbaceous or forested habitats. TOTWET represents the best estimate of all existing wetlands because it includes Habitats of Concern.

[4]Data limitations make it impossible to distinguish between these two habitat types at this time, and no comprehensive oak habitat survey has been conducted for the region. However, known oak habitats are also included in HOCs (see Appendix 10).

SITE #24: Johnson Creek-Crystal Springs Creek subwatershed

Named streams: Crystal Springs Creek, Johnson Creek, Veterans Creek
Communities within the subwatershed: Happy Valley, Milwaukie, Portland, unincorporated Clackamas county, unincorporated Multnomah county
Total acreage within Metro's boundary: 7,844.6
Total acres within the riparian corridor:1,309.7
Other information: One barrier to fish passage present with unknown impacts.

This site contains three percent of the area comprising Metro's jurisdictional boundary. The majority of the site (63 percent) is in the City of Portland; 16 percent is in Milwaukie, 19 percent in unincorporated Clackamas County, and the remainder is in Happy Valley and unincorporated Multnomah County (about one percent each) (Table G-66).

This site has the highest road density of all resource sites, at 20.9 road miles per square mile (Table G-2). As with other highly urban resource sites, the dominant zoning is single family residential (Table G-5). About 1,000 building permits have been issued in this site since 1996 (Table G-2).

Riparian resources. Fifteen percent of this site is part of the riparian corridor inventory, ranking it last in Group G (Table 12). It contributes a little over one percent of the region's total riparian resources (Table 13).

This resource site contains 35 total stream miles, of which 59 percent are stream links, suggesting very high levels of piping and culverting (Table G-3). As a result, non-piped stream density is 0.0018 miles per acre, ranking it 25^{th} of the 27 resource sites (Tables 12 and G-3). Reflecting the highly urban and modified nature of this resource site, 47 percent of non-piped stream miles are DEQ 303(d) listed (Table G-2). However, anadromous fish are known to be present in more than eight stream miles (Table G-2). Low to medium gradient streams predominate (Table G-3); approximately seven percent of the site is floodplain, and less than one percent is wetland (Tables G-2 and G-3). Approximately 52 percent of the floodplain is developed – the highest level of all 27 resource sites (Table 14).

Approximately 27 percent of this site's acreage within the riparian corridor inventory received primary scores for at least three of the five ecological functions, and 44 percent received at least one primary score (Table G-69). The highest percentage of land receiving a primary score was divided about equally between *Large wood and channel dynamics* and *Bank stabilization and pollution control* (Table G-68; see also Table 4 and Appendix 5 for description of ecological functions mapping). The developed floodplain component of this resource site resulted in high secondary *Streamflow moderation and water storage* percentages.

Wildlife habitat resources. Including Habitats of Concern, 10 percent of the lands in this site fall within the wildlife habitat inventory, ranking it last among the 27 resource sites; this is not surprising considering the site's highly developed nature (Table 16). Within model patches, only one tenth of one percent of the acreage falls within the top third of the point range, with 58 percent in the mid-range and the remainder in the lowest score category (Table G-70). Of the four criteria in the GIS model, virtually all of the acreage falls in the lowest score category for size and interior (Table G-71). The majority of acreage falls in the middle category for waterk although substantial acreage is also in the highest and lowest categories; the connectivity scores fall primarily in the middle and low categories. Together, these factors add up to a fairly sparse, fragmented habitat system that is often typical of highly developed watersheds. The relatively high proportion of acreage accounted for in the size and interior criteria suggest that the majority of the lands within 300 ft of streams are forested, because low-structure patch types are not scored for these criteria (see also Table G-72).

Conifer and hardwood forest are predominant habitat types in this resource site (78 percent), but grasslands, wetlands and open water also contribute important habitat (Table G-75). Wetlands cover six percent of the site's wildlife habitat. The site contributes one-half of one percent to the region's wetland resources, ranking 21st among the 27 resource sites.

In general, this highly developed site can be characterized as providing relatively small amounts of habitat that is generally isolated and fragmented. However, the complex of natural areas comprised of Crystal Springs, Reed College Canyon and Westmoreland Golf Course provides important habitat to the site and is less than half a mile from Oaks Bottom, which has excellent water resources and connects to the Willamette River. Street and backyard trees provide a modest level of connectivity for birds between these natural areas. Johnson Creek and the Springwater Corridor provide key migratory bird stopover habitat; although these areas do not rate highly in the regional wildlife habitat inventory, they are locally very important to wildlife. Several relatively large habitat patches in site's eastern area, including Lincoln Memorial Park and Willamette National Cemetery, provide key habitat in this area and connect to Resource Site #20, following the Johnson Creek complex. Key wildlife habitat improvements in this area might include increasing the forest canopy cover throughout the resource site, including backyard and street trees, but particularly along waterways.

Species of Concern. One Species of Concern sighting location falls within the site. Each sighting may include one or more species; if a species occurs more than once in the resource site it is only listed once here. These include the following species:

- Great Blue Heron nesting colony

There are very likely other Species of Concern using this resource site, particularly those relying on forested habitats and agricultural lands (see Table G-75). Examples of species likely to occur in this site may be found by referencing the species list in Appendix 7 and identifying the species with a double "XX" under the habitat. General species needs and potential reasons for their decline are identified in the *Sensitive Species Accounts* section above. More detailed information on all species' needs can be obtained through Johnson and O'Neil (2001).

Habitats of Concern.
The following Habitats of Concern are partially or wholly within this resource site. Using the Unique ID # (UID), please refer to Appendix 8 for information concerning each Habitat of Concern:

UID numbers: 33, 127, 128, 130, 135

Resource site data tables: Riparian Corridors

Table G-66. Acres within resource site by jurisdiction.

Jurisdiction	Acres within subwatershed
Happy Valley	78.5
Milwaukie	1,273.7
Portland	4,909.3
Unincorporated Clackamas County	1,494.5
Unincorporated Multhomah County	88.7

Table G-67. Acres in Metro and riparian corridor.

Resource site	Total acres within Metro	Total acres within riparian corridor
Johnson - Crystal Springs Creeks	7,844.6	1,176.5

Table G-68. Number of acres within riparian corridor providing ecological function.

Resource site	Ecological function	*Primary Value*		*Secondary Value*	
		Acres*	% of Total**	Acres	% of Total
Johnson - Crystal Springs Creeks	Microclimate & shade	167.7	14.3%	227.0	19.3%
	Streamflow moderation & water storage	306.3	26.0%	802.4	68.2%
	Bank stabilization & pollution control	400.3	34.0%	17.7	1.5%
	Large wood & channel dynamics	460.5	39.1%	47.4	4.0%
	Organic material sources	297.9	25.3%	40.1	3.4%

*Number of acres scored within the riparian corridor for each function
**Percent of total acres within the riparian corridor

Table G-69. Breakdown of ecological scores.

Resource site	Ecological Score	Acres	% of Total Acres
Johnson - Crystal Springs Creeks	1 to 5	653.0	55.5%
	6 to 11	76.7	6.5%
	12 to 17	134.5	11.4%
	18 to 23	28.8	2.4%
	24 to 29	216.8	18.4%
	30	66.7	5.7%
	Total acres	1,176.5	100.0%

Resource site data tables: Wildlife Habitat

Table G-70. Breakdown of total wildlife model patch scores.*

Resource site: Johnson - Crystal Springs Creeks	Number of acres in each wildlife score category									Total wildlife model patch acres in inventory
	1	2	3	4	5	6	7	8	9	
Model score	74.9	157.6	110.1	78.5	334.5	54.1	1.1	0.0	0.0	810.8
Percent of total	9.2%	19.4%	13.6%	9.7%	41.3%	6.7%	0.1%	0.0%	0.0%	100.0%

*Does not include Habitats of Concern outside of model patches.

Table G-71. Breakdown of total wildlife patch model scores by criteria.*

Resource site: Johnson - Crystal Springs Creeks	Number of acres by score for each model criterion												Total wildlife model patch acres in inventory
	Size[2]			Interior[2]			Water[3]			Connectivity			
	1	2	3	1	2	3	1	2	3	1	2	3	
	592.9	0.9	0.0	407.5	0.0	0.0	147.1	371.1	173.2	324.5	344.4	141.9	810.8
Percent of total acres in inventory	73.1%	0.1%	0.0%	50.3%	0.0%	0.0%	18.1%	45.8%	21.4%	40.0%	42.5%	17.5%	na

[1]Does not include Habitats of Concern outside of model patches.

[2]These numbers do not add up to 100.0% because Type 2 patches (low structure vegetation within 300 feet of streams and wetlands) were not ranked for these criteria.

[3]These numbers do not add up to 100% because not all patches contained or were near water resources.

Table G-72. Breakdown of total wildlife model patch area by 2000 Metro photo interpretation landcover and known wetlands.*

Resource site: Johnson - Crystal Springs Creeks	Low structure vegetation within 300 feet of stream		Forested vegetation	Forested wetlands	Grass/shrub wetlands within 300 feet of a stream	Other wetlands	Total wildlife model patch acres in inventory
	Low structure vegetation/ intact topsoil	Non-forest woody vegetation					
Acres	217.0	0.0	551.8	13.4	12.0	16.5	810.8
Percent of total	26.8%	0.0%	68.1%	1.7%	1.5%	2.0%	100.0%

*Does not include Habitats of Concern outside of model patches.

Table G-73. Total acres of inventoried wildlife habitat by type and total Species of Concern (SOCs).

Resource site: Johnson - Crystal Springs Creeks	Wildlife patches (acres)	HOCs inside Wildlife patches (acres)*	HOCs outside Wildlife patches (including wetlands <2 acres)	Total inventoried wildlife habitat acres	Total SOCs
Acres	810.8	91.4	7.7	818.5	1
Percent of total	99.1%	11.2%	0.9%	100.0%	N/A

*Habitats of Concern.

Table G-74. Total area of model patches and Habitats of Concern by 1998 Landsat Landcover Area.

Resource Site: Johnson - Crystal Springs Creeks Landcover type:	Total area of wildlife model patches	Total area of HOCs outside of modeled patches (including wetlands <2 acres)	Percent of total inventoried habitat
Water	10.43	0.1	1.3%
Barren	54.99	0.5	6.8%
Low structure agriculture	0.00	0.0	0.0%
High structure agriculture	0.00	0.0	0.0%
Deciduous closed canopy	142.65	0.8	17.5%
Mixed closed canopy	183.26	0.6	22.5%
Conifer closed canopy	78.44	1.0	9.7%
Deciduous open canopy	86.62	1.1	10.7%
Mixed open canopy	44.09	0.5	5.5%
Conifer open canopy	11.48	0.2	1.4%
Deciduous scattered canopy	45.23	0.5	5.6%
Mixed scattered canopy	27.49	0.2	3.4%
Conifer scattered canopy	10.33	0.1	1.3%
Closed canopy shrub	35.20	0.8	4.4%
Open canopy shrub	19.78	0.7	2.5%
Scattered canopy shrub	17.78	0.3	2.2%
Meadow/grass	43.06	0.2	5.3%
Not classified	0.00	0.0	0.0%
Total	**810.83**	**7.7**	**100.0%**

The table below provide s estimates of each type of the habitats described in Metro's Technical Report for Fish and Wildlife Habitat, based on Johnson and O'Neil's (2001) habitat scheme. These numbers are provided for subwatershed comparison purposes and represent estimates of available habitat type. Several data types were used to compile this table, and the data sources vary in their precision. For example, the satellite data sources are less accurate than hand-digitized forest canopy cover. There is also slight overlap between certain habitat types. For example, Riparian Wetlands (RWET) are also partially included in Westside Lowland Coniferous Hardwood/Westside Oak and Douglas-fir (WLCH/WODF) because some wetlands also contain forest, and Open Water (WATR) is not always considered part of habitat patches. Therefore, the sums of these habitat types are slightly different from the "Total wildlife habitat acres in inventory" shown in Table 16. Nonetheless, these numbers provide a generalized means of comparing the quality and quantity of habitat available to wildlife among and between subwatersheds. Note also that the estimates for Westside Grasslands (WEGR) probably represent grasslands that are not native rather than true native grasslands, which are largely extirpated from the metro region.

Table G-75. Wildlife habitat availability[1] based on Johnson & O'Neil's (2001) habitat types and species-habitat associations.

Resource site:	Habitat type						
Johnson - Crystal Springs Creeks	WATR[2]	HWET[3]	RWET[3]	TOTWET[3]	WLCH/ WODF[4]	WEGR	AGPA
Total acres	24.1	28.5	13.4	46.4	634.7	81.8	0.0
Percent of total	2.9%	3.5%	1.6%	5.7%	77.5%	10.0%	0.0%

[1]See Table G-74 for land cover types and crosswalk to Johnson and O'Neil's classification scheme.

[2]Note that patch type and data limitations result in an underestimation of open water habitats. For example, medium and small sized stream surfaces are excluded.

[3]Note that HWET and RWET do not represent the full suite of wetlands because some wetlands <2 acres were added in as Habitats of Concern, and some wetlands could not be associated with herbaceous or forested habitats. TOTWET represents the best estimate of all existing wetlands because it includes Habitats of Concern.

[4]Data limitations make it impossible to distinguish between these two habitat types at this time, and no comprehensive oak habitat survey has been conducted for the region. However, known oak habitats are also included in HOCs (see Appendix 10).

SITE #25: Mount Scott Creek subwatershed

Named streams: Forest Creek, Johnson Creek, Kellogg Creek, Mount Scott Creek, Phillips Creek, Willamette River
Communities within the subwatershed: Gladstone, Happy Valley, Johnson City, Lake Oswego, Milwaukie, Portland, unincorporated Clackamas county, unincorporated Multnomah county
Total acreage within Metro's boundary: 11,809.6
Total acres within the riparian corridor: 2,665.7
Other information: Three dams present, two with unknown impacts to fish, one with a present and functioning fishway.

This site contains four percent of the area comprising Metro's jurisdictional boundary. Most of the site falls within three jurisdictions: unincorporated Clackamas County (67 percent), Milwaukie (15 percent) and Happy Valley (14 percent). Two percent is in unincorporated Multnomah County, with the remaining jurisdictions – Gladstone, Johnson City, Lake Oswego, and Portland – containing one percent or less of the site (Table G-76).

This site is similar in development intensity to Resource Sites #20-23, with a road density of 14.3 miles per square mile, falling in the third quartile (51 to 75 percent of maximum) compared to all other resource sites (Table G-2). Similar to those sites, single family residential zoning dominates (Table G-5). About 1,450 building permits have been issued here since 1996 (Table G-2).

Riparian resources. Approximately 23 percent of this site is part of the riparian corridor inventory, ranking it sixth of the eight resource sites in Group G (Table 12). However, because the site has a substantial amount of land within the Metro boundary, it contributes a relatively high amount (three percent) of the region's riparian resources relative to all other resource sites (Table 13).

This resource site contains 47 total stream miles, of which 34 percent are stream links, suggesting moderately high levels of piping and culverting (Table G-3). Non-piped stream density is 0.0026 miles per acre; two of the eight sites in Group G contain lower stream densities (Tables 12 and G-3). Slightly more than two percent of non-piped stream miles are DEQ 303(d) listed (Table G-2). Anadromous fish are known to be present in more than nine stream miles (Table G-2). Six percent of the site is floodplain, and one percent is wetland (Table G-2). Twenty-one percent of the floodplain is developed, ranking this site sixth among all 27 resource sites (Table 14).

Nearly a third of this site's acreage within the riparian corridor inventory received primary scores for at least three of the five ecological functions, and 46 percent received at least one primary score (Table G-79). Similar to Site #24, the highest percentage of land receiving a primary score was divided about equally between *Large wood and channel dynamics* and *Bank stabilization and pollution control* (Table G-78; see also Table 4 and Appendix 5 for description of ecological functions mapping). Sixty-eight percent of this site's riparian corridor acreage received secondary scores for *Streamflow moderation and water storage*, and another 29 percent received secondary scores for *Microclimate and shade*.

Wildlife habitat resources. Including Habitats of Concern, 19 percent of the lands in this site fall within the wildlife habitat inventory, ranking it 21st among the 27 resource sites and sixth among the eight Group G sites (Table 16). Within model patches, only four percent of the acreage falls within the top third of the point range, although 68 percent falls in the mid-range (Table G-80). Of the four criteria in the GIS model, most of the acreage falls in the lowest score category for size and interior (Table G-81). Approximately half of the acreage falls in the middle category for water, with another 28 percent in the lowest score category; the connectivity scores fall primarily in the highest and middle categories. The proportion of acreage accounted for in the size and interior criteria suggest that a relatively small but significant amount of lands within 300 ft of streams are unforested, because low-structure patch types are not scored for these criteria (see also Table G-82).

Conifer and hardwood forest are predominant habitat types in this resource site (77 percent), but open water, grasslands and wetlands also contribute important habitat (Table G-85). Wetlands cover seven percent, the highest of the Group G sites. The site contributes two percent to the region's wetland resources, ranking 14th among the 27 resource sites.

In general, this site can be characterized as providing a moderate amount of wildlife habitat, of moderate quality; however, placed within the urbanized context, the existing habitat is very important to wildlife in that area. A majority of the habitat is aggregated into several relatively large patches, with some important interior habitat. Water resources are moderate, but connectivity is good relative to many other sites with similar development intensity. The key wildlife habitat sites are along or adjacent to streams, with relatively little protection through parks or public lands. Important upland habitat is provided by Mt. Talbert, with important migratory bird stopover habitat.

Species of Concern. Four Species of Concern sighting location falls within the site. Each sighting may include one or more species; if a species occurs more than once in the resource site it is only listed once here. These include the following species:

- Western Painted Turtles
- Pileated Woodpecker
- *Cimicifuga elata* (plant species)
- *Sidalcea nelsoniana* (plant species)

There are very likely other Species of Concern using this resource site, particularly those relying on forested habitats and agricultural lands (see Table G-85). Examples of species likely to occur in this site may be found by referencing the species list in Appendix 7 and identifying the species with a double "XX" under the habitat. General species needs and potential reasons for their decline are identified in the *Sensitive Species Accounts* section above. More detailed information on all species' needs can be obtained through Johnson and O'Neil (2001).

Habitats of Concern.
The following Habitats of Concern are partially or wholly within this resource site. Using the Unique ID # (UID), please refer to Appendix 8 for information concerning each Habitat of Concern:

UID numbers: 18, 21, 32, 116, 123, 124, 138, 162, 166

Resource site data tables: Riparian Corridors

Table G-76. Acres within resource site by jurisdiction.

Jurisdiction	Acres within subwatershed
Gladstone	111.7
Happy Valley	1,645.3
Johnson City	43.7
Lake Oswego	9.0
Milwaukie	1,824.6
Portland	12.4
Unincorporated Clackamas County	7,888.3
Unincorporated Multnomah County	274.6

Table G-77. Acres in Metro and riparian corridor.

Resource site	Total acres within Metro	Total acres within riparian corridor
Mount Scott Creek	11,809.8	2,662.6

Table G-78. Number of acres within riparian corridor providing ecological function.

Resource site	Ecological function	*Primary Value*		*Secondary Value*	
		Acres*	% of Total**	Acres	% of Total
Mount Scott Creek	Microclimate & shade	469.5	17.6%	780.3	29.3%
	Streamflow moderation & water storage	684.3	25.7%	1,807.3	67.9%
	Bank stabilization & pollution control	1,050.6	39.5%	103.5	3.9%
	Large wood & channel dynamics	1,031.6	38.7%	125.5	4.7%
	Organic material sources	573.9	21.6%	100.1	3.8%

*Number of acres scored within the riparian corridor for each function
**Percent of total acres within the riparian corridor

Table G-79. Breakdown of ecological scores.

Resource site	Ecological Score	Acres	% of Total Acres
Mount Scott Creek	1 to 5	1,428.8	53.7%
	6 to 11	202.8	7.6%
	12 to 17	217.1	8.2%
	18 to 23	282.8	10.6%
	24 to 29	331.4	12.4%
	30	199.8	7.5%
	Total acres	2,662.6	100.0%

Resource site data tables: Wildlife Habitat

Table G-80. Breakdown of total wildlife model patch scores.*

Resource site: Mount Scott Creek	Number of acres in each wildlife score category: 1	2	3	4	5	6	7	8	9	Total wildlife model patch acres in inventory
Model score	129.8	175.3	287.2	350.4	753.8	366.2	4.6	85.2	0.0	2,152.5
Percent of total	6.0%	8.1%	13.3%	16.3%	35.0%	17.0%	0.2%	4.0%	0.0%	100.0%

*Does not include Habitats of Concern outside of model patches.

Table G-81. Breakdown of total wildlife patch model scores by criteria.*

Resource site:	Number of acres by score for each model criterion												Total wildlife model patch acres in inventory
	Size[2]			Interior[2]			Water[3]			Connectivity			
Mount Scott Creek	1	2	3	1	2	3	1	2	3	1	2	3	
	1,694.6	89.8	0.0	1,208.0	85.2	0.0	600.6	1,064.9	308.9	546.8	697.1	908.5	2,152.5
Percent of total acres in inventory	78.7%	4.2%	0.0%	56.1%	4.0%	0.0%	27.9%	49.5%	14.3%	25.4%	32.4%	42.2%	na

[1]Does not include Habitats of Concern outside of model patches.

[2]These numbers do not add up to 100.0% because Type 2 patches (low structure vegetation within 300 feet of streams and wetlands) were not ranked for these criteria.

[3]These numbers do not add up to 100% because not all patches contained or were near water resources.

Table G-82. Breakdown of total wildlife model patch area by 2000 Metro photo interpretation landcover and known wetlands.*

Resource site: Mount Scott Creek	Low structure vegetation within 300 feet of stream: Low structure vegetation/ intact topsoil	Low structure vegetation within 300 feet of stream: Non-forest woody vegetation	Forested vegetation	Forested wetlands	Grass/shrub wetlands within 300 feet of a stream	Other wetlands	Total wildlife model patch acres in inventory
Acres	353.2	14.9	1,650.5	46.7	40.6	46.7	2,152.5
Percent of total	16.4%	0.7%	76.7%	2.2%	1.9%	2.2%	100.0%

*Does not include Habitats of Concern outside of model patches.

Table G-83. Total acres of inventoried wildlife habitat by type and total Species of Concern (SOCs).

Resource site: Mount Scott Creek	Wildlife patches (acres)	HOCs inside Wildlife patches (acres)*	HOCs outside Wildlife patches (including wetlands <2 acres)	Total inventoried wildlife habitat acres	Total SOCs
Acres	2152.5	544.1	50.5	2203.1	4
Percent of total	97.7%	24.7%	2.3%	100.0%	N/A

*Habitats of Concern.

Table G-84. Total area of model patches and Habitats of Concern by 1998 Landsat Landcover Area.

Resource Site: Mount Scott Creek / Landcover type:	Total area of wildlife model patches	Total area of HOCs outside of modeled patches (including wetlands <2 acres)	Percent of total inventoried habitat
Water	8.28	7.6	0.7%
Barren	142.85	13.6	7.1%
Low structure agriculture	7.44	0.5	0.4%
High structure agriculture	0.00	0.0	0.0%
Deciduous closed canopy	368.33	2.9	16.9%
Mixed closed canopy	517.64	2.8	23.6%
Conifer closed canopy	282.66	0.8	12.9%
Deciduous open canopy	178.18	4.9	8.3%
Mixed open canopy	115.18	1.0	5.3%
Conifer open canopy	29.80	0.0	1.4%
Deciduous scattered canopy	109.53	1.2	5.0%
Mixed scattered canopy	70.02	1.0	3.2%
Conifer scattered canopy	19.29	0.3	0.9%
Closed canopy shrub	92.98	1.9	4.3%
Open canopy shrub	42.69	0.8	2.0%
Scattered canopy shrub	40.63	1.7	1.9%
Meadow/grass	127.05	9.5	6.2%
Not classified	0.00	0.0	0.0%
Total	**2,152.53**	**50.5**	**100.0%**

The table below provide s estimates of each type of the habitats described in Metro's Technical Report for Fish and Wildlife Habitat, based on Johnson and O'Neil's (2001) habitat scheme. These numbers are provided for subwatershed comparison purposes and represent estimates of available habitat type. Several data types were used to compile this table, and the data sources vary in their precision. For example, the satellite data sources are less accurate than hand-digitized forest canopy cover. There is also slight overlap between certain habitat types. For example, Riparian Wetlands (RWET) are also partially included in Westside Lowland Coniferous Hardwood/Westside Oak and Douglas-fir (WLCH/WODF) because some wetlands also contain forest, and Open Water (WATR) is not always considered part of habitat patches. Therefore, the sums of these habitat types are slightly different from the "Total wildlife habitat acres in inventory" shown in Table 16. Nonetheless, these numbers provide a generalized means of comparing the quality and quantity of habitat available to wildlife among and between subwatersheds. Note also that the estimates for Westside Grasslands (WEGR) probably represent grasslands that are not native rather than true native grasslands, which are largely extirpated from the metro region.

Table G-85. Wildlife habitat availability[1] based on Johnson & O'Neil's (2001) habitat types and species-habitat associations.

Resource site:	Habitat type						
Mount Scott Creek	WATR[2]	HWET[3]	RWET[3]	TOTWET[3]	WLCH/ WODF[4]	WEGR	AGPA
Total acres	222.6	87.2	46.7	147.0	1,705.6	222.3	7.9
Percent of total	10.1%	4.0%	2.1%	6.7%	77.4%	10.1%	0.4%

[1]See Table G-84 for land cover types and crosswalk to Johnson and O'Neil's classification scheme.

[2]Note that patch type and data limitations result in an underestimation of open water habitats. For example, medium and small sized stream surfaces are excluded.

[3]Note that HWET and RWET do not represent the full suite of wetlands because some wetlands <2 acres were added in as Habitats of Concern, and some wetlands could not be associated with herbaceous or forested habitats. TOTWET represents the best estimate of all existing wetlands because it includes Habitats of Concern.

[4]Data limitations make it impossible to distinguish between these two habitat types at this time, and no comprehensive oak habitat survey has been conducted for the region. However, known oak habitats are also included in HOCs (see Appendix 10).

H. <u>Scappoose Creek</u>

General watershed information

Resource sites in the Scappoose Creek Watershed include:

- Lower Willamette River subwatersheds
- Columbia Slough and Multnomah Channel subwatersheds (combined)

Watershed assessments and plans

Bureau of Environmental Services, City of Portland, 2001. *Relationships Between Bank Treatment / Nearshore Development and Anadromous / Resident Fish in the Lower Willamette River*, City of Portland: Portland, Oregon.

Bureau of Planning, 1991. City of Portland, *Balch Creek Watershed Protection* Plan, February, 8, 1991, City of Portland: Portland, Oregon.

Bureau of Planning, City of Portland, 1990. *East Columbia Neighborhood Natural Resources Management Plan*, City of Portland: Portland, Oregon.

Bureau of Planning, City of Portland, 1990. *Natural Resources Management Plan for Smith and Bybee Lakes, May 8, 1990,* City of Portland: Portland, Oregon.

Bureau of Planning, City of Portland, 1991. *The Northwest Hills Natural Areas Protection Plan, July 31, 1991,* City of Portland: Portland, Oregon.

Bureau of Planning, City of Portland, 1992. *The Southwest Hills Resource Protection Plan, January 23, 1992,* City of Portland: Portland, Oregon.

Bureau of Planning, City of Portland, 1993. *The East Buttes, Terraces and Wetlands Conservation Plan, May 26, 1993,* City of Portland: Portland, Oregon.

Bureau of Planning, City of Portland, 1994. *Skyline West Conservation Plan, September 21, 1994,* City of Portland: Portland, Oregon.

Bureau of Planning, City of Portland, 1997. *Portland Environmental Handbook*, City of Portland: Portland, Oregon.

Bureau of Planning, City of Portland, 2001. *Portland's Willamette River Atlas*, City of Portland: Portland, Oregon.

Community and Economic Development Department, City of Gresham, 1988. *Inventory of Significant Natural Resources and Open Spaces,* City of Gresham: Gresham, Oregon.

Lev, Esther, 2001. W*ildlife Habitat Inventory for the Willamette River*, Environmental Consulting: Portland, Oregon.

Lower Columbia River Estuary Program, 1999. *Lower Columbia River Estuary Plan, Volumes 1-3,* Lower Columbia River Estuary Program: Portland, Oregon.

Moses, Todd, 1993. *Stream Rehabilitation Concepts, Upper Fairview Creek, Gresham, Oregon,* Watershed Applications: Portland, Oregon.

Portland Parks and Recreation, Bureau of Planning, City of Portland, 1995. *Forest Park, Natural Resources Management Plan*, City of Portland: Portland, Oregon.

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USGS, 1995. *NAWQA Willamette Basin Study,* USGS: Portland, Oregon.

Wells, Scott, 1997. *Columbia Slough Technical Report*, Portland State University: Portland, Oregon.

Willamette Basin Task Force, Pacific Northwest River Basins Commission, 1969. *The Willamette Basin, Comprehensive Study of Water and Related Land Resources,* Pacific Northwest River Basins Commission: Portland, Oregon.

Willamette Basin Task Force, Pacific Northwest River Basins Commission, 1997. *The Willamette Basin, Recommendations to Governor John Kitzhaber*, Willamette River Basin Task Force: Portland, Oregon.

Willamette Restoration Initiative, 2001. *Restoring A River of Life, The Willamette Restoration Strategy Overview, February 2001*, Willamette Restoration Initiative: Portland, Oregon.

Willamette Restoration Initiative, 2001. *Restoring A River of Life, The Willamette Restoration Strategy – Recommendations for the Willamette Basin Supplement to the Oregon Plan for Salmon and Watersheds, February 2001*, Willamette Restoration Initiative: Portland, Oregon.

Watershed councils and related groups

Arnold Creek, Friends of, 4106 SW Vacuna Street, Portland 97219, 503-244-9958, Amanda Fritz

Balch Creek, Friends of, 5240 NW Cornell Road, Portland 97210, 503-297-3613, Eberhard Gloekler

Blue and Fairview Lakes Land Trust, 503667-4547, Jane Graybill

Blue Fairview Lakes , Friends of, 21130 NE Interlachen Lane, Interlachen 97024, (503) 667-4547, Jane Graybill

Citizens Interested in Bull Run, Inc. 503-665-4777, Frank Gearhart

Columbia Children's Arboretum Preservation Committee, 9509 NE 13th Ave., Portland 97211, Martha Johnson

Columbia Slough Watershed Council, 7040 NE 47th Ave., Portland 97218-1212, (503) 281-1132, FAX (503) 281-5187

Columbia Slough Program, City of Portland, Bureau of Environmental Services, 503-823-7268

Fairview Creek Watershed Group, 2115 SE Morrison St., Portland 97214, (503) 661-7612, FAX (503) 661-5296

Fairview Creek Watershed Council, PO Box 36, Fairview 97024, (503) 231-2270, Shannon Schmitt

Fairview Creek Watershed Conservation Group, PO Box 36, Fairview 97204, 503-669-6000, Gregory Dresden

Forest Park, Friends of, PO Box 2413, Portland 97208, 503-223-5449, Lee Kellogg

Lower Columbia WS Council, 12589 Hwy 30, Clatskanie 97016, 503-728-9015, Margaret Magruder

(Multnomah Channel) Friends of Retaining the Channel Environment, 13010 NW Marina Way, Portland 97231, 503-285-6756, Mark Valeske

Oaks Bottom Wildlife Refuge, 7516 SE 21st, Portland 97202, 503-654-8454, Martha Taylor

Oaks Bottom Management Committee, 2115 SE Morrison Street, Ste. 201, Portland 97214, 503-231-2270, Steve Fedje

Sauvie Island Conservancy, 19300 NW Sauvie Island Road, Portland 97231, 503-621-3049, Donna Matrazzo

Skyline Ridge, Citizens for Preservation of, 15400 NW McNamee Road, Portland 97231, 503-621-3564, Chris Foster

Smith and Bybee Lakes, Friends of, PO Box 83862, Portland 97283, 503-240-0233, Jeffrey Kee

West Hills Streams, Friends of, 6039 Knights Bridge Drive, Portland 97219, 503-246-0449, Liz Callison

Wetlands, Friends of, 503-253-6247, Alice Blatt

Willamette River Restoration Committee, 541-484-9466, Timothy Green

Data descriptions

Table H-1 provides information about the subwatersheds within each watershed, the HUC code, and the acres inside Metro's jurisdictional boundary. Keying in on the resource site number will show how the subwatersheds are aggregated into the resource sites listed above.

Both of the Resource Sites in Section H fall within the Scappoose Creek watershed. Resource Site #26 is comprised only of its namesake subwatershed, Lower Willamette River. Resource Site #27 combines the Columbia Slough and Multnomah Channel subwatersheds.

Tables H-1 and H-2 provide general description about the 5th field and 6th field HUCs. Below these tables are descriptions of the riparian and wildlife habitat resources resource site.

Watershed data tables

Table H-1. Watersheds (5th level HUC), subwatersheds (6th level HUC), and acres within Metro jurisdictional boundary.

Watershed (5th level HUC)	5th field HUC code	Resource site #	Subwatershed (6th level HUC)	6th field HUC code	Acres in Metro
Scappoose Creek	1709001202	26	Lower Willamette River	170900120201	32,899.0
		27	Columbia Slough	170900120202	53,571.9
			Multnomah Channel	170900120203	1,037.6

Table H-2. Resource sites: general information.

General information	Lower Willamette	Columbia Slough
Miles of DEQ 303(d) listed streams	13.3	43.3
Road density (road miles/square miles in subwatershed)	20.4	12.0
Miles of stream with known anadromous fish presence	13.3	21.7
Acres of hydrologically connected wetlands	262.2	3,298.1
Total acres of wetlands	262.2	3,329.7
Acres of floodplains (100 year FEMA + 1996 inundation area)	3,409.4	15,814.1
Acres of developed floodplains	317.8	993.8
Building permits since 1996 (number)	2,775.0	3,414.0

Table H-3. Characteristics of stream miles by resource site.

Resource site	Stream miles by channel type		Miles of stream links*	Miles of streams not categorized by channel type	Total stream miles
	Low to medium	*High*			
Lower Willamette River	17.9	27.2	31.9	10.0	87.0
Columbia Slough	81.5	6.7	33.7	23.7	145.5

*Stream links are links between surface streams and may be piped or culverted.

Table H-4. Riparian vegetation by resource site.

Resource site	Vegetation types within 300 feet of a stream (acres)			Forested vegetation >300 feet from a stream
	Low structure vegetation/intact topsoil	Non-forest woody vegetation	Forested vegetation	
Lower Willamette River	248.5	13.2	2,546.3	5,555.5
Columbia Slough	2,385.6	118.5	1,659.6	3,393.5

Table H-5. Regional zoning by resource site.

Resource site	Acres by zone within each resource site						
	Commercial	Industrial	Multi-family residential	Public/open space	Rural	Single family residential	Mixed use
Lower Willamette River	2,282.3	6,606.4	2,618.6	6,618.3	1,543.8	11,655.0	1,536.7
Columbia Slough	2,597.7	18,256.2	2,923.2	7,167.6	8,308.4	13,636.8	1,247.8

SITE #26: Lower Willamette River subwatershed

Named streams: Balch Creek, Doane Creek, Johnson Creek (west side), Marquam Gulch, Saltzman Creek, Willamette River
Communities within the subwatershed: Milwaukie, Portland, unincorporated Clackamas County, unincorporated Multnomah County
Total acreage within Metro's boundary: 32,899
Total acres within riparian corridor: 10,977.2

This site contains 11 percent of the area comprising Metro's jurisdictional boundary, surpassed only by Site #27, Columbia Slough. Ninety-five percent of the site falls within the City of Portland's boundaries; the remainder is in unincorporated Multnomah County (four percent), unincorporated Clackamas County (one percent), and Milwaukie (less than one percent) (Table H-6).

This site is the second most highly developed of all resource sites, based on the road density of 20.4 road miles per square mile (Table H-2). Zoning is dominated by single family residential use, but industrial lands and public/open space also contribute substantial zoning acreages (Table H-5). Nearly 2,800 building permits have been issued here since 1996, although that number is not outstandingly high considering the resource site's contribution to the Metro boundary's land base (Table H-2).

Riparian resources. One-third of this site is part of the riparian corridor inventory (Table 12). Resource Site #26 contributes nearly 12 percent of the region's riparian corridor resources; together with the other Group H resource site, these two sites comprise a full third of the region's riparian inventory (Table 13).

This resource site contains 87 total stream miles, of which 37 percent are stream links, suggesting high levels of piping and culverting (Table H-3). Despite the strong contribution to regional riparian resources, non-piped stream density is only 0.0017 miles per acre; the site ranks second to last of all 27 resource sites in terms of stream density (Tables 12 and H-3). Twenty-four percent of non-piped stream miles are DEQ 303(d) listed (Table H-2). Anadromous fish are known to be present in more than thirteen stream miles (Table H-2). Stream gradients are mixed, but dominated by high gradients (Table H-3); however, ten percent of the site is floodplain, and one percent is wetland (Tables H-2 and H-3). Approximately ten percent of the floodplain is developed, a relatively low proportion given the site's development intensity.

Approximately 34 percent of this site's acreage within the riparian corridor inventory received primary scores for at least three of the five ecological functions, and 44 percent received at least one primary score (Table H-9). The highest percentage of land receiving a primary score was divided about equally between *Large wood and channel dynamics* and *Bank stabilization and pollution control* (Table H-8; see also Table 4 and Appendix 5 for description of ecological functions mapping). However, *Streamflow moderation and water storage* was also an important primary function in this site, and also provided very substantial secondary functions (70 percent of the site's riparian acreage included this secondary function).

Wildlife habitat resources. Including Habitats of Concern, 27 percent of the lands in this site fall within the wildlife habitat inventory, ranking it 11th among the 27 resource sites and first of the two Group H resource sites (Table 16). Within model patches, 78 percent of the acreage falls within the top third of the point range, ranking second among the 27 resource sites, behind Resource Site #23 (Tryon Creek) (Table 17).

Of the four criteria in the GIS model, 87 percent of the acreage falls in the lowest size score category, with another ten percent in the medium category (Table H-11). For habitat interior, the acreage falls primarily in the top category (66 percent), but nearly one quarter also falls within the lowest score category, with little in the middle class. That is because Forest Park comprises a substantial proportion of the habitat in this site, but much of the remainder consists of relatively small, isolated habitat patches east of the Willamette River. This site scores strongly in the middle score category for water (83 percent), but receives excellent scores for connectivity, with 89 percent of all acreage receiving the top score. Again, this is influenced by Forest Park. The total proportion of acreage accounted for in the size and interior criteria suggest that a relatively small amount of lands within 300 ft of streams are unforested, because low-structure patch types are not scored for these criteria (see also Table H-12).

Conifer and hardwood forest strongly predominate the habitat types in this resource site (92 percent), but open water is also an extremely important habitat type here (Table H-15). A relatively extensive series of oak woodlands are present in this site, identified through Habitats of Concern (based on local expert knowledge). Wetlands cover three percent of this site's wildlife habitat, slightly lower than the other Group H site; this number is negatively influenced by the large amount of habitat covered by Forest Park, a fairly steeply sloped area generally lacking in wetlands. This site contributes three percent to the region's wetland resources, ranking 8th among the 27 resource sites.

In general, this site can be characterized as providing a large amount of very high quality wildlife habitat. Forest Park is one of the most highly rated habitat patches in the entire urban region; it provides very extensive interior habitat for nesting Neotropical migrants and area-sensitive species, is likely a source habitat for species repopulation to other patches, and is an elk migratory corridor. A substantial portion of Forest Park and associated areas is also situated in Resource Site #27, to the north of this site. This resource site includes a long segment of the Willamette River, contributing important open water and riverine island habitat important to Bald Eagle, Osprey, waterfowl, shorebirds and migratory birds. This site is uniquely important to the region's wildlife.

Species of Concern. Twenty-three Species of Concern sighting location falls within the site, attesting to the site's importance in the regional wildlife habitat system. Each sighting may include one or more species; if a species occurs more than once in the resource site it is only listed once here. These include the following species:

- Pileated Woodpecker
- Band-tailed Pigeon
- Bald Eagle
- Peregrine Falcon
- Purple Martin
- Painted Turtle
- Western Meadowlark

- Bufflehead
- Dusky Canada Goose
- Merlin
- Western Pond Turtle
- Great Blue Heron nesting colony
- *Fluminicola fuscus* (plant species)
- *Rorippa columbiae* (plant species)

There are very likely other Species of Concern using this resource site, particularly those relying on forested habitats and open water (see Table H-15). Examples of species likely to occur in this site may be found by referencing the species list in Appendix 7 and identifying the species with a double "XX" under the habitat. General species needs and potential reasons for their decline are identified in the *Sensitive Species Accounts* section above. More detailed information on all species' needs can be obtained through Johnson and O'Neil (2001).

Habitats of Concern.
The following Habitats of Concern are partially or wholly within this resource site. Using the Unique ID # (UID), please refer to Appendix 8 for information concerning each Habitat of Concern:

UID numbers: 1, 2, 3, 4, 16, 22, 23, 24, 26, 27, 28, 29, 30, 31, 33, 49, 50, 75, 76, 77, 79, 81, 115, 129, 130, 132, 162, 167

Resource site data tables: Riparian Corridors

Table H-6. Acres within resource site by jurisdiction.

Jurisdiction	Acres within subwatershed
Milwaukie	66.8
Portland	31,240.2
Unincorporated Clackamas County	178.3
Unincorporated Multnomah County	1,413.8

Table H-7. Acres in Metro and riparian corridor.

Resource site	Total acres within Metro	Total acres within riparian corridor
Lower Willamette River	32,899.2	10,940.8

Table H-8. Number of acres within riparian corridor providing ecological function.

Resource site	Ecological function	*Primary Value*		*Secondary Value*	
		Acres*	% of Total**	Acres	% of Total
Lower Willamette River	Microclimate & shade	1,052.5	9.6%	4,345.5	39.7%
	Streamflow moderation & water storage	3,112.4	28.4%	7,693.0	70.3%
	Bank stabilization & pollution control	4,521.4	41.3%	2,430.3	22.2%
	Large wood & channel dynamics	4,453.8	40.7%	877.8	8.0%
	Organic material sources	1,140.5	10.4%	566.1	5.2%

*Number of acres scored within the riparian corridor for each function
**Percent of total acres within the riparian corridor

Table H-9. Breakdown of ecological scores.

Resource site	Ecological Score	Acres	% of Total Acres
Lower Willamette River	1 to 5	6,080.8	55.6%
	6 to 11	460.3	4.2%
	12 to 17	689.8	6.3%
	18 to 23	2,582.0	23.6%
	24 to 29	944.9	8.6%
	30	183.1	1.7%
	Total acres	10,940.8	100.0%

Resource site data tables: Wildlife Habitat

Table H-10. Breakdown of total wildlife model patch scores.*

Resource site: Lower Willamette River	Number of acres in each wildlife score category									Total wildlife model patch acres in inventory
	1	2	3	4	5	6	7	8	9	
Model score	317.5	252.0	126.9	280.4	80.7	800.5	1,044.4	5,576.8	0.0	8,479.1
Percent of total	3.7%	3.0%	1.5%	3.3%	1.0%	9.4%	12.3%	65.8%	0.0%	100.0%

*Does not include Habitats of Concern outside of model patches.

Table H-11. Breakdown of total wildlife patch model scores by criteria.*

Resource site: Lower Willamette River	Number of acres by score for each model criterion												Total wildlife model patch acres in inventory
	Size[2]			Interior[2]			Water[3]			Connectivity			
	1	2	3	1	2	3	1	2	3	1	2	3	
	7,388.6	881.9	0.0	2,067.0	18.1	5,558.6	472.9	7,047.2	500.4	577.9	347.5	7,553.7	8,479.1
Percent of total acres in inventory	87.1%	10.4%	0.0%	24.4%	0.2%	65.6%	5.6%	83.1%	5.9%	6.8%	4.1%	89.1%	na

[1]Does not include Habitats of Concern outside of model patches.

[2]These numbers do not add up to 100.0% because Type 2 patches (low structure vegetation within 300 feet of streams and wetlands) were not ranked for these criteria.

[3]These numbers do not add up to 100% because not all patches contained or were near water resources.

Table H-12. Breakdown of total wildlife model patch area by 2000 Metro photo interpretation landcover and known wetlands.*

Resource site: Lower Willamette River	Low structure vegetation within 300 feet of stream		Forested vegetation	Forested wetlands	Grass/shrub wetlands within 300 feet of a stream	Other wetlands	Total wildlife model patch acres in inventory
	Low structure vegetation/ intact topsoil	Non-forest woody vegetation					
Acres	198.4	10.2	8,008.3	21.1	6.4	234.7	8,479.0
Percent of total	2.3%	0.1%	94.4%	0.2%	0.1%	2.8%	100.0%

*Does not include Habitats of Concern outside of model patches.

Table H-13. Total acres of inventoried wildlife habitat by type and total Species of Concern (SOCs).

Resource site: Lower Willamette River	Wildlife patches (acres)	HOCs inside Wildlife patches (acres)*	HOCs outside Wildlife patches (including wetlands <2 acres)	Total inventoried wildlife habitat acres	Total SOCs
Acres	8479.1	5369.6	282.9	8761.9	23
Percent of total	96.8%	61.3%	3.2%	100.0%	N/A

*Habitats of Concern.

Table H-14. Total area of model patches and Habitats of Concern by 1998 Landsat Landcover Area.

Resource Site: Lower Willamette River / Landcover type:	Total area of wildlife model patches	Total area of HOCs outside of modeled patches (including wetlands <2 acres)	Percent of total inventoried habitat
Water	220.27	17.1	2.7%
Barren	122.75	19.4	1.6%
Low structure agriculture	2.38	0.0	0.0%
High structure agriculture	0.00	0.0	0.0%
Deciduous closed canopy	2,106.15	56.4	24.7%
Mixed closed canopy	3,075.12	44.2	35.6%
Conifer closed canopy	1,725.21	16.3	19.9%
Deciduous open canopy	289.60	26.6	3.6%
Mixed open canopy	222.09	11.0	2.7%
Conifer open canopy	55.45	2.4	0.7%
Deciduous scattered canopy	201.47	20.2	2.5%
Mixed scattered canopy	116.33	11.7	1.5%
Conifer scattered canopy	37.48	2.8	0.5%
Closed canopy shrub	149.95	21.2	2.0%
Open canopy shrub	50.24	8.6	0.7%
Scattered canopy shrub	42.34	8.7	0.6%
Meadow/grass	61.32	16.4	0.9%
Not classified	0.93	0.0	0.0%
Total	**8,479.09**	**282.9**	**100.0%**

The table below provides estimates of each type of the habitats described in Metro's Technical Report for Fish and Wildlife Habitat, based on Johnson and O'Neil's (2001) habitat scheme. These numbers are provided for subwatershed comparison purposes and represent estimates of available habitat type. Several data types were used to compile this table, and the data sources vary in their precision. For example, the satellite data sources are less accurate than hand-digitized forest canopy cover. There is also slight overlap between certain habitat types. For example, Riparian Wetlands (RWET) are also partially included in Westside Lowland Coniferous Hardwood/Westside Oak and Douglas-fir (WLCH/WODF) because some wetlands also contain forest, and Open Water (WATR) is not always considered part of habitat patches. Therefore, the sums of these habitat types are slightly different from the "Total wildlife habitat acres in inventory" shown in Table 16. Nonetheless, these numbers provide a generalized means of comparing the quality and quantity of habitat available to wildlife among and between subwatersheds. Note also that the estimates for Westside Grasslands (WEGR) probably represent grasslands that are not native rather than true native grasslands, which are largely extirpated from the metro region.

Table H-15. Wildlife habitat availability[1] based on Johnson & O'Neil's (2001) habitat types and species-habitat associations.

Resource site:	Habitat type						
Lower Willamette River	WATR[2]	HWET[3]	RWET[3]	TOTWET[3]	WLCH/ WODF[4]	WEGR	AGPA
Total acres	2,497.9	241.1	21.1	262.2	8,020.4	187.6	2.4
Percent of total	28.5%	2.8%	0.2%	3.0%	91.5%	2.1%	0.0%

[1]See Table H-14 for land cover types and crosswalk to Johnson and O'Neil's classification scheme.

[2]Note that patch type and data limitations result in an underestimation of open water habitats. For example, medium and small sized stream surfaces are excluded.

[3]Note that HWET and RWET do not represent the full suite of wetlands because some wetlands <2 acres were added in as Habitats of Concern, and some wetlands could not be associated with herbaceous or forested habitats. TOTWET represents the best estimate of all existing wetlands because it includes Habitats of Concern.

[4]Data limitations make it impossible to distinguish between these two habitat types at this time, and no comprehensive oak habitat survey has been conducted for the region. However, known oak habitats are also included in HOCs (see Appendix 10).

SITE #27: Columbia Slough subwatershed

Named streams: Arata Creek, Columbia River, Columbia Slough, Fairview Creek, Miller Creek, Multnomah Channel, Willamette River
Communities within the subwatershed: Fairview, Gresham, Maywood Park, Portland, Troutdale, Wood Village, unincorporated Multnomah County
Total acreage within Metro's boundary: 54,610 (combined Columbia Slough and Multnomah Channel)
Total acres within riparian corridor: 20,569.2

This site contains 18 percent of the area comprising Metro's jurisdictional boundary, the highest amount of any of the resource sites. Most of the site (71 percent) falls within the City of Portland's boundaries, but there are also portions in unincorporated Multnomah County (13 percent), Gresham (eight percent), Fairview (four percent), Troutdale (two percent), and one percent or less in Maywood Park and Wood Village (Table H-16).

Compared to the other site in Group H, this site is relatively undeveloped. Road density is 12.0 miles per square mile, placing this site within the second quartile (26 to 50 percent of maximum) compared to all other resource sites (Table H-2). Zoning is mixed in this resource site, but industrial is the most significant land base contributor, followed by substantial acreage zoned for single family residential, as well as rural and public/open space (Table H-5). More than 3,400 building permits have been issued here since 1996 (Table H-2).

Riparian resources. Thirty-seven percent of this site is part of the riparian corridor inventory (Table 12). This site contributes 22 percent of the region's riparian resources, far more than any other resource site in the Metro boundary (Table 13).

This resource site contains 87 total stream miles, of which 37 percent are stream links, suggesting high levels of piping and culverting (Table H-3). Despite the strong contribution to regional riparian resources, non-piped stream density is only 0.0020 miles per acre, ranking it 24th of the 27 resource sites. Nearly 40 percent of non-piped stream miles are DEQ 303(d) listed (Table H-2); however, this site is known to provide very important fish habitat, with anadromous fish known to be present in nearly 22 stream miles (Table H-2). Streams are predominantly low gradient, as indicated by the high proportion of floodplains, at 29 percent; six percent of the floodplains are developed. Six percent of the site's lands are also wetlands, contributing to off-channel fish-rearing habitat and other highly valuable aquatic resources (Table H-3).

Reflecting the strong riparian component of this resource site, approximately 56 percent of its acreage within the riparian corridor inventory received primary scores for at least three of the five ecological functions, and a remarkable 83 percent received at least one primary score (Table H-19). The highest percentage of land receiving a primary score was divided about equally between *Large wood and channel dynamics* and *Streamflow moderation and water storage*, each covering more than three-quarters of the inventory. However, *Bank stabilization and pollution control* also provided primary function to 60 percent of the site's riparian inventory (Table H-18; see also Table 4 and Appendix 5 for description of ecological functions mapping). Secondary functions in this site are relatively minimal because so much of the land is covered by primary ecological functions.

Wildlife habitat resources. Including Habitats of Concern, 21 percent of the lands in this site fall within the wildlife habitat inventory, ranking it 20th among the 27 resource sites and second of the two Group H resource sites (Table 16). Within model patches, 46 percent of the acreage falls within the top third of the point range, ranking sixth among the 27 resource sites and second to Site #27 in Group H (Table 17).

Of the four criteria in the GIS model, 59 percent of the acreage falls in the lowest size score category, with another ten percent in the medium category (Table H-21). For habitat interior, the acreage falls primarily in the lowest score category (36 percent), but portions fall within the middle and high ranges as well (20 and 12 percent, respectively). This site scores very well for water resources, with approximately equal proportions in the middle and high ranges (48 and 44 percent, respectively). The scores are also very good for connectivity, with 57 percent in the highest class and another 29 percent in the middle class. The total proportion of acreage accounted for in the size and interior criteria suggest that a modest amount of lands (approximately 20 percent) within 300 ft of streams are unforested, because low-structure patch types are not scored for these criteria (see also Table H-22).

Open water is a critically important habitat type in this resource site, covering an estimated 65 percent of wildlife habitat, substantially more than any of the other resource sites (Table H-25). Conifer and hardwood forest strongly predominate the habitat types in this resource site (92 percent), but open water is also an extremely important habitat type here (Table H-25). A relatively extensive series of oak woodlands are present in this site, identified through Habitats of Concern (based on local expert knowledge). Wetlands cover three percent of this site's wildlife habitat, slightly lower than the other Group H site; this number is negatively influenced by the large amount of habitat covered by Forest Park, a fairly steeply sloped area generally lacking in wetlands. This site contributes three percent to the region's wetland resources, ranking 8th among the 27 resource sites.

In general, this site can be characterized as providing a large amount of very high quality wildlife habitat. Forest Park is one of the most highly rated habitat patches in the entire urban region; it provides very extensive interior habitat for nesting Neotropical migrants and area-sensitive species, is likely a source habitat for species repopulation to other patches, and is an elk migratory corridor. A substantial portion of Forest Park and associated areas is also situated in Resource Site #27, to the north of this site. This resource site includes a long segment of the Willamette River, contributing important open water and riverine island habitat important to Bald Eagle, Osprey, waterfowl, shorebirds and migratory birds. This site is uniquely important to the region's wildlife.

Species of Concern. Twenty-three Species of Concern sighting location falls within the site, attesting to the site's importance in the regional wildlife habitat system. Each sighting may include one or more species; if a species occurs more than once in the resource site it is only listed once here. These include the following species:

- Pileated Woodpecker
- Band-tailed Pigeon
- Bald Eagle
- Peregrine Falcon
- Purple Martin

- Painted Turtle
- Western Meadowlark
- Bufflehead
- Dusky Canada Goose
- Merlin
- Western Pond Turtle
- Great Blue Heron nesting colony
- *Fluminicola fuscus* (plant species)
- *Rorippa columbiae* (plant species)

There are very likely other Species of Concern using this resource site, particularly those relying on forested habitats and open water (see Table H-15). Examples of species likely to occur in this site may be found by referencing the species list in Appendix 7 and identifying the species with a double "XX" under the habitat. General species needs and potential reasons for their decline are identified in the *Sensitive Species Accounts* section above. More detailed information on all species' needs can be obtained through Johnson and O'Neil (2001).

Species of Concern. Attesting to this site's importance to regional wildlife, 34 Species of Concern sighting location falls within the site. Each sighting may include one or more species; if a species occurs more than once in the resource site it is only listed once here. These include the following species:

- Western Painted Turtle
- Bald Eagle
- Oregon Vesper Sparrow
- Purple Martin
- Pacific Fisher
- Pileated Woodpecker
- Streaked Horned Lark
- Band-tailed Pigeon
- Bufflehead
- Western Pond Turtle
- Red-legged Frog
- Elk
- Northern Pygmy Owl
- Merlin
- Common Nighthawk
- Peregrine Falcon
- Western Meadowlark
- Great Blue Heron nesting colony
- *Cimicifuga elata* (plant species)

There are very likely other Species of Concern using this resource site, particularly those relying on forested habitats and agricultural lands (see Table H-25). Examples of species likely to occur in this site may be found by referencing the species list in Appendix 7 and identifying the species with a double "XX" under the habitat. General species needs and potential reasons for their decline are identified in the *Sensitive Species Accounts* section above. More detailed information on all species' needs can be obtained through Johnson and O'Neil (2001).

Habitats of Concern.

The following Habitats of Concern are partially or wholly within this resource site. Using the Unique ID # (UID), please refer to Appendix 8 for information concerning each Habitat of Concern:

UID numbers: 6, 8, 9, 15, 17, 20, 25, 34, 35, 48, 49, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 76, 78, 81, 84, 85, 86, 88, 89, 162, 164

Resource site data tables: Riparian Corridors

Table H-16. Acres within resource site by jurisdiction.

Jurisdiction	Acres within subwatershed
Fairview	2,263.1
Gresham	4,188.9
Maywood Park	107.5
Portland	38,966.3
Troutdale	1,219.7
Wood Village	604.7
Unincorporated Multnomah County	7,258.6

Table H-17. Acres in Metro and riparian corridor.

Resource site	Total acres within Metro	Total acres within riparian corridor
Columbia Slough	54,610.0	20,129.8

Table H-18. Number of acres within riparian corridor providing ecological function.

Resource site	Ecological function	*Primary Value*		*Secondary Value*	
		Acres*	% of Total**	Acres	% of Total
Columbia Slough	Microclimate & shade	2,414.6	12.0%	1,582.3	7.9%
	Streamflow moderation & water storage	15,303.8	76.0%	4,570.4	22.7%
	Bank stabilization & pollution control	12,037.5	59.8%	791.6	3.9%
	Large wood & channel dynamics	15,864.7	78.8%	293.3	1.5%
	Organic material sources	3,541.1	17.6%	191.8	1.0%

*Number of acres scored within the riparian corridor for each function
**Percent of total acres within the riparian corridor

Table H-19. Breakdown of ecological scores.

Resource site	Ecological Score	Acres	% of Total Acres
Columbia Slough	1 to 5	3,442.9	17.1%
	6 to 11	747.1	3.7%
	12 to 17	4,716.2	23.4%
	18 to 23	7,860.0	39.0%
	24 to 29	1,416.1	7.0%
	30	1,947.5	9.7%
	Total acres	20,129.8	100.0%

Resource site data tables: Wildlife Habitat

Table H-20. Breakdown of total wildlife model patch scores.*

Resource site: Columbia Slough	Number of acres in each wildlife score category: 1	2	3	4	5	6	7	8	9	Total wildlife model patch acres in inventory
Model score	262.1	713.2	1,254.2	978.9	577.5	1,441.6	1,270.8	1,786.3	1,331.3	9,615.9
Percent of total	2.7%	7.4%	13.0%	10.2%	6.0%	15.0%	13.2%	18.6%	13.8%	100.0%

*Does not include Habitats of Concern outside of model patches.

Table H-21. Breakdown of total wildlife patch model scores by criteria.*

Resource site: Columbia Slough	Number of acres by score for each model criterion												Total wildlife model patch acres in inventory
	Size[2]			Interior[2]			Water[3]			Connectivity			
	1	2	3	1	2	3	1	2	3	1	2	3	
	5,654.5	1,929.1	0.0	3,431.4	1,929.1	1,188.5	175.1	4,585.3	4,199.8	1,340.4	2,792.4	5,483.1	9,615.9
Percent of total acres in inventory	58.8%	20.1%	0.0%	35.7%	20.1%	12.4%	1.8%	47.7%	43.7%	13.9%	29.0%	57.0%	na

[1]Does not include Habitats of Concern outside of model patches.

[2]These numbers do not add up to 100.0% because Type 2 patches (low structure vegetation within 300 feet of streams and wetlands) were not ranked for these criteria.

[3]These numbers do not add up to 100% because not all patches contained or were near water resources.

Table H-22. Breakdown of total wildlife model patch area by 2000 Metro photo interpretation landcover and known wetlands.*

Resource site: Columbia Slough	Low structure vegetation within 300 feet of stream: Low structure vegetation/ intact topsoil	Low structure vegetation within 300 feet of stream: Non-forest woody vegetation	Forested vegetation	Forested wetlands	Grass/shrub wetlands within 300 feet of a stream	Other wetlands	Total wildlife model patch acres in inventory
Acres	1,965.3	67.0	4,334.2	504.7	359.8	2,384.9	9,615.8
Percent of total	20.4%	0.7%	45.1%	5.2%	3.7%	24.8%	100.0%

*Does not include Habitats of Concern outside of model patches.

Table H-23. Total acres of inventoried wildlife habitat by type and total Species of Concern (SOCs).

Resource site: Columbia Slough	Wildlife patches (acres)	HOCs inside Wildlife patches (acres)*	HOCs outside Wildlife patches (including wetlands <2 acres)	Total inventoried wildlife habitat acres	Total SOCs
Acres	9615.9	6380.7	2083.8	11699.7	34
Percent of total	82.2%	54.5%	17.8%	100.0%	N/A

*Habitats of Concern.

Table H-24. Total area of model patches and Habitats of Concern by 1998 Landsat Landcover Area.

Resource Site: Columbia Slough Landcover type:	Total area of wildlife model patches	Total area of HOCs outside of modeled patches (including wetlands <2 acres)	Percent of total inventoried habitat
Water	1,262.32	160.6	12.2%
Barren	1,087.46	678.1	15.1%
Low structure agriculture	114.51	20.0	1.1%
High structure agriculture	0.29	0.0	0.0%
Deciduous closed canopy	1,469.96	140.3	13.8%
Mixed closed canopy	1,297.42	59.8	11.6%
Conifer closed canopy	883.55	53.1	8.0%
Deciduous open canopy	444.31	72.2	4.4%
Mixed open canopy	206.99	18.6	1.9%
Conifer open canopy	71.39	8.2	0.7%
Deciduous scattered canopy	392.87	62.1	3.9%
Mixed scattered canopy	254.22	38.6	2.5%
Conifer scattered canopy	119.79	29.0	1.3%
Closed canopy shrub	284.14	71.0	3.0%
Open canopy shrub	169.54	48.0	1.9%
Scattered canopy shrub	255.46	46.0	2.6%
Meadow/grass	1,301.60	578.1	16.1%
Not classified	0.06	0.1	0.0%
Total	**9,615.88**	**2083.8**	**100.0%**

The table below provides estimates of each type of the habitats described in Metro's Technical Report for Fish and Wildlife Habitat, based on Johnson and O'Neil's (2001) habitat scheme. These numbers are provided for subwatershed comparison purposes and represent estimates of available habitat type. Several data types were used to compile this table, and the data sources vary in their precision. For example, the satellite data sources are less accurate than hand-digitized forest canopy cover. There is also slight overlap between certain habitat types. For example, Riparian Wetlands (RWET) are also partially included in Westside Lowland Coniferous Hardwood/Westside Oak and Douglas-fir (WLCH/WODF) because some wetlands also contain forest, and Open Water (WATR) is not always considered part of habitat patches. Therefore, the sums of these habitat types are slightly different from the "Total wildlife habitat acres in inventory" shown in Table 16. Nonetheless, these numbers provide a generalized means of comparing the quality and quantity of habitat available to wildlife among and between subwatersheds. Note also that the estimates for Westside Grasslands (WEGR) probably represent grasslands that are not native rather than true native grasslands, which are largely extirpated from the metro region.

Table H-25. Wildlife habitat availability[1] based on Johnson & O'Neil's (2001) habitat types and species-habitat associations.

Resource site:	Habitat type						
Columbia Slough	WATR[2]	HWET[3]	RWET[3]	TOTWET[3]	WLCH/ WODF[4]	WEGR	AGPA
Total acres	7,548.7	2,744.7	504.7	3,329.7	5,622.4	2,398.7	134.8
Percent of total	64.5%	23.5%	4.3%	28.5%	48.1%	20.5%	1.2%

[1]See Table H-24 for land cover types and crosswalk to Johnson and O'Neil's classification scheme.

[2]Note that patch type and data limitations result in an underestimation of open water habitats. For example, medium and small sized stream surfaces are excluded.

[3]Note that HWET and RWET do not represent the full suite of wetlands because some wetlands <2 acres were added in as Habitats of Concern, and some wetlands could not be associated with herbaceous or forested habitats. TOTWET represents the best estimate of all existing wetlands because it includes Habitats of Concern.

[4]Data limitations make it impossible to distinguish between these two habitat types at this time, and no comprehensive oak habitat survey has been conducted for the region. However, known oak habitats are also included in HOCs (see Appendix 10).

Adequacy of information

The second step of the Goal 5 inventory process is to determine if the information collected for the inventory is adequate. According to the Goal 5 rule, the information about a particular Goal 5 resource site shall be deemed adequate if it provides the location, quantity and quality of the resource. A discussion of these three aspects of Metro's Goal 5 inventory follows.

Location

Location information shall include a description or map of the resource area for each site (OAR 660-023-0030(3)(a)). Although this information must be sufficient to determine whether a resource exists on a particular site, the precise location of the resource need not be determined at this stage in the inventory process.[12]

Information about location is sufficient if the local government develops a map that shows that a resource exists on a particular site. Riparian corridors and wildlife habitat have been mapped for the entire area within Metro's jurisdiction. The data for all 27 resource sites is summarized for ease of comparison in Tables 12-17 following this section. Metro's riparian corridor and wildlife habitat inventory maps depict the resource sites to the tax lot level. The inventory also describes the acres of each jurisdiction that fall within a resource site. Resource sites are based on subwatersheds using the Hydrologic Unit Code (HUC) system, as identified by the Natural Resources Conservation Service (NRCS).

The methodologies used to develop the riparian corridor inventory maps were described previously in the *Metro's Goal 5 Inventory Methodology* section of this document. Local jurisdictions, property owners, and other interested parties have extensively reviewed the inventory map. Map corrections have been made and continue to be made to more accurately depict location of the resource.

Quantity

Concerning quantity, Goal 5 requires local governments to estimate the relative abundance or scarcity of the resource (OAR 660-023-0030(c)).

Metro's stream modeling has indicated that the region has lost approximately 400 miles of streams (about 30 percent of the original) (Metro 1997). In addition, 213 miles are listed by the Department of Environmental Quality as water-quality limited (DEQ 1996). Eleven percent of the Metro region's natural areas were lost between 1989-1999, with accompanying adverse effects on watershed hydrology and wildlife habitat (Metro Parks and Greenspaces). The portion of the Willamette River running through the metro region is influenced not only by intensity of urbanization within its own watersheds, but also by cumulative effects from land use and

[12] Prior to amendment, OAR 660-016-0000(2) required a determination of site specific resource location, which included a description or map of the resource site's boundaries and the impact area, if different. For non-site specific resources, determination was to be as specific as possible. *Id*. However, OAR 660-023-0030(3)(a) does not distinguish between site specific and non-site specific resources. Rather, the new rule requires information about location to include a description or map of the resource and to be sufficient enough to conclude whether a resource exists on a particular site. *Id*.

activities upstream. Habitat loss, alteration, and significant increases in the amount of impervious land cover characterize the Metro region.

Information about quantity is adequate if it shows the relative abundance or scarcity of the resource. The number of streams, riparian corridors and upland vegetation lost that historically provided fish and wildlife habitat and the accompanying impacts of urbanization indicate that the riparian corridors and wildlife habitat remaining in this region are correspondingly important. Relative to what once existed, riparian corridor and wildlife habitat resources that were once abundant are now scarce.

The declining quantity and condition of riparian corridor resource is impacting the ability of native fish and wildlife to survive in this region. Thirteen salmonid runs are listed as Threatened or Endangered under the federal Endangered Species Act, and two of these are also listed by the state as Threatened or Endangered. Another run is listed as Endangered only at the state level. Out of the entire genus, only resident rainbow trout are not considered to be at risk. Salmonids are important as an indicator of watershed and riparian corridor health. In addition, 55 other vertebrate species are on the Sensitive Species list, relating directly to habitat loss and alteration in the metro region over time.

Metro's riparian corridor inventory identifies the location of riparian corridors and quantifies the acres within the riparian corridor and the number of stream miles by resource site, as shown in Table 12 below. Based on this inventory there is a total of 93,035 acres within the riparian corridor in the region and 855 miles of streams. In addition, there are approximately 8,524 acres of hydrologically connected wetlands and 35,008 acres of floodplains in the region.

Metro's wildlife habitat inventory identifies the location of wildlife habitat and quantifies the acres within wildlife habitat patches, as shown in Table 16 below. Based on this inventory there is a total of 75,200 acres within the wildlife habitat inventory, including modeled patches (71,359 acres) and Habitats of Concern (3,842 additional acres).

Quality

Quality information shall indicate a resource site's value relative to other known examples of the same resource (OAR 660-023-0030(3)(b)). Although regional comparison of resources is preferred, quality comparisons may be made for resource sites within the jurisdiction, if no other local examples exist (Id). Local governments shall consider any determinations about resource quality provided in available state or federal inventories.

Information about quality is adequate if it indicates "a resource site's value relative to other known examples of the same resource." Riparian corridors occur wherever there is a river, lake, stream or wetland. Wildlife habitat occurs where there are features including forest canopy, wetlands, streams and other water features, important low-structure vegetation areas, and areas that are functionally important such as wildlife passage corridors or migratory stopover areas; these are typically 2-acre patches or larger.

It is important to distinguish "condition" of the resource area from the Goal 5 rule requirement to consider a "site's relative value." The condition of riparian corridors and wildlife habitat in the Metro region varies based on past and present development impacts that may have disturbed the soil, vegetation and terrestrial ecosystem adjacent to streams and wetlands. However, the present condition of the resource does not diminish its value relative to other identified resources. Metro's inventory includes an assessment of ecological function and habitat quality as well as providing specific data on the condition of riparian corridors and wildlife by resource site.

Riparian corridors. Metro's riparian corridor inventory approach considers the ecological functions of the riparian corridor and maps the landscape features providing that function. Areas are given a primary or secondary ecological function score based on widths identified in the scientific literature (see previous discussion of inventory methodology for more information). Metro conducted an extensive scientific literature review that describes the qualities necessary to have a healthy ecosystem for watersheds and riparian corridors (Metro 2002). The ecological function approach to the inventory takes the science and applies it in a practical way to map riparian corridors. This approach provides a tool to identify the resource and to consider relative ecological function within a resource site and across the region.

One comparison that may be made is to consider the amount of the region's total acres of riparian corridor that is found in each resource site. Table 13 below shows the acres of each site within the riparian corridor and the percent of the region's riparian corridors by resource site. Some sites containing a small percentage of the region's riparian corridors may have been more heavily impacted by urban development over the past 200 years than those with a higher percentage. Other sites in headwater areas – typically in the higher elevations – do not naturally contain large quantities of wetlands or floodplains (Table 14). Some sites that provide a high percentage of the region's riparian corridors may contain large areas of floodplains and wetlands. In some sites, substantial floodplain development has occurred. These data allow for adequate comparison of sites across the region.

Another method of comparing the ecological function provided by riparian corridors in resource sites across the region is to look at the ecological function score. Table 15 shows the percent of the riparian corridor receiving scores in five categories. Each site has the potential to receive a score of up to 30 (five primary scores – a primary receives a score of 6) and a minimum of one (a secondary receives a score of one). As can be seen in the table, Site 9: Lower Rock Creek-Tualatin River contains the highest percentage (21%) of area receiving a primary score for all five functions, while several sites contain riparian corridors in which only two percent of the area received a score of 30. Sites that contain high percentages of the riparian corridor that received a score of one through five (secondary scores) most likely contain large forest, agricultural and floodplain areas. Site 19: Kelly Creek includes the largest portion of the riparian corridor receiving a low score (74%) while Site #27: Columbia Slough includes the smallest portion at 17 percent.

Wildlife habitat. Metro's wildlife habitat approach considers the configuration of wildlife habitat within a regional context and maps the landscape features contributing to a high-quality system of regional wildlife habitat. Habitat patches are scored based on size, shape (interior habitat), connectivity to water, and connectivity to other natural areas, based on the information gained through the literature reviewed in Metro's Technical Report for Fish and Wildlife Habitat (Metro 2002). This approach provides a straightforward way to apply science to existing habitats based on GIS resources, as modified by adaptive management received via field studies. It allows valid comparison of the relative value of habitat patches, both within resource sites and across the entire region.

Similar to the riparian corridors inventory, one comparison that may be made is to consider the amount of the region's total acres of wildlife habitat that is found in each resource site. Table 16 below shows the acres of each site within the wildlife habitat inventory and the percent of the region's habitat by resource site. Referring back to Table 8 in Metro's Technical Report for Fish and Wildlife Habitat, every major watershed has experienced substantial loss of closed canopy forest from historic levels; however, some have lost more than others. Some sites containing a small percentage of wildlife habitat may have been more heavily impacted by urban development over the past 200 years than those with a higher percentages. These numbers may reflect overall habitat loss – as with the highly developed Johnson Creek/Crystal Springs site – or conversion to agriculture or other land uses, as in the McKay Creek subwatershed (Table 16). These data allow for adequate comparison of sites across the region.

Another method of comparing the relative value or quality of wildlife habitat in resource sites across the region is to look at the wildlife model score. Table 17 shows the percent of the wildlife habitat receiving scores, from a range of one (low-scoring) to nine. Site #23 (Tryon Creek) contains the highest percentage (84%) of area receiving wildlife scores in the top third of the scoring range, while sites such as #21 (Lower Johnson Creek – Willamette River) and #10 (Middle Tualatin River – Gordon Creek) rank 26th and 27th among the resource sites, respectively. The sites on the lower end of the point scale typically contain more fragmented wildlife habitat resources and a lesser amount of forest canopy cover compared to higher-scoring sites.

In addition to the riparian corridor and wildlife habitat data described above, Metro's inventory includes information on the condition of riparian corridors by resource site. The *Site Analysis* section provides a summary of each data item. The inventory includes regionally consistent data for:

- Miles of DEQ 303(d) listed streams,
- Road density (road miles/square miles in subwatershed),
- Miles of stream with known anadromous fish presence,
- Acres of hydrologically connected wetlands,
- Acres of floodplains (100-year FEMA + 1996 inundation area),
- Building permits since 1996 (number),
- Characteristics of stream miles by resource site, and riparian vegetation by resource site.

Table 12. Quantity of riparian corridor resources in Metro region by resource site.

Resource site#	Resource site name	Total acres in Metro's Boundary	Total acres in riparian corridor	Percent of site in riparian corridor	Non-piped stream miles in resource site
1	Lower Sandy River-Columbia River	5,712.3	3,498.3	61.2%	23.6
2	Beaver Creek-Sandy River	10,336.6	3,666.8	35.5%	34.7
3	Willamette River-Boeckman Creek	7,616.8	2,248.1	29.5%	22.2
4	Willamette River-Lower Tualatin River	11,403.7	4,172.2	36.6%	35.5
5	Council Creek	5,708.2	1,142.4	20.0%	15.8
6	McKay Creek	3,842.7	635.8	16.5%	8.3
7	Middle Rock Creek-Tualatin River	7,300.2	2,390.8	32.7%	27.8
8	Beaverton Creek	24,297.0	5,788.0	23.8%	81.1
9	Lower Rock Creek-Tualatin River	8,717.3	1,736.4	19.9%	25.1
10	Middle Tualatin River-Gordon Creek	4,347.3	941.5	21.7%	15.3
11	Lower Tualatin River-Lake Oswego Canal	15,231.1	5,830.7	38.3%	56.3
12	Upper and Middle Fanno Creek	11,183.5	2,651.7	23.7%	38.6
13	Summer Creek	3,769.1	855.6	22.7%	14.1
14	Lower Fanno Creek	8,453.8	1,864.0	22.0%	29.4
15	Rock Creek (south Washington Co.)	4,239.3	1,102.2	26.0%	10.9
16	Richardson Creek	6,465.5	2,271.8	35.1%	30.1
17	Rock Creek-Clackamas River	11,120.7	4,177.9	37.6%	44.3
18	Johnson Creek-Sunshine Creek	12,372.9	4,777.5	38.6%	45.2
19	Kelley Creek	3,175.6	1,423.1	44.8%	12.1
20	Middle Johnson Creek	8,949.7	1,539.2	17.2%	10.0
21	Lower Johnson Creek-Willamette River	5,950.3	1,897.0	31.9%	24.5
22	Lake Oswego	4,168.7	1,541.7	37.0%	16.9
23	Tryon Creek	4,356.5	1,972.8	45.3%	21.1
24	Johnson Creek-Crystal Springs	7,844.6	1,176.5	15.0%	14.3
25	Mount Scott Creek	11,809.8	2,662.6	22.5%	31.0
26	Lower Willamette River	32,899.2	10,940.8	33.3%	55.1
27	Columbia Slough	54,610.0	20,129.8	36.9%	111.8
Total		**295,882.5**	**93,035.4**	**na**	**854.9**

Table 13. Percent of the region's riparian corridors by resource site.

Resource site#	Resource site name	Acres of resource site in riparian corridor	Percent of region's riparian corridors in resource site
1	Lower Sandy River-Columbia River	3,498.3	3.8%
2	Beaver Creek-Sandy River	3,666.8	3.9%
3	Willamette River-Boeckman Creek	2,248.1	2.4%
4	Willamette River-Lower Tualatin River	4,172.2	4.5%
5	Council Creek	1,142.4	1.2%
6	McKay Creek	635.8	0.7%
7	Middle Rock Creek-Tualatin River	2,390.8	2.6%
8	Beaverton Creek	5,788.0	6.2%
9	Lower Rock Creek-Tualatin River	1,736.4	1.9%
10	Middle Tualatin River-Gordon Creek	941.5	1.0%
11	Lower Tualatin River-Lake Oswego Canal	5,830.7	6.3%
12	Upper and Middle Fanno Creek	2,651.7	2.9%
13	Summer Creek	855.6	0.9%
14	Lower Fanno Creek	1,864.0	2.0%
15	Rock Creek (south Washington Co.)	1,102.2	1.2%
16	Richardson Creek	2,271.8	2.4%
17	Rock Creek-Clackamas River	4,177.9	4.5%
18	Johnson Creek-Sunshine Creek	4,777.5	5.1%
19	Kelley Creek	1,423.1	1.5%
20	Middle Johnson Creek	1,539.2	1.7%
21	Lower Johnson Creek-Willamette River	1,897.0	2.0%
22	Lake Oswego	1,541.7	1.7%
23	Tryon Creek	1,972.8	2.1%
24	Johnson Creek-Crystal Springs	1,176.5	1.3%
25	Mount Scott Creek	2,662.6	2.9%
26	Lower Willamette River	10,940.8	11.8%
27	Columbia Slough	20,129.8	21.6%
Total		**93,035.4**	**100.0%**

Table 14. Percent developed floodplain by resource site.

Resource site#	Resource site name	Floodplain Acres	Developed Floodplain Acres	Percent Developed Floodplain
1	Lower Sandy River-Columbia River	1,563.8	40.8	2.6%
2	Beaver Creek-Sandy River	2,173.0	59.6	2.7%
3	Willamette River-Boeckman Creek	411.2	32.8	8.0%
4	Willamette River-Lower Tualatin River	1,172.3	229.4	19.6%
5	Council Creek	626.0	24.2	3.9%
6	McKay Creek	344.9	26.4	7.7%
7	Middle Rock Creek-Tualatin River	239.2	8.2	3.4%
8	Beaverton Creek	1,246.1	421.9	33.9%
9	Lower Rock Creek-Tualatin River	854.3	16.6	1.9%
10	Middle Tualatin River-Gordon Creek	83.7	13.5	16.1%
11	Lower Tualatin River-Lake Oswego Canal	1,132.0	283.1	25.0%
12	Upper and Middle Fanno Creek	517.5	107.8	20.8%
13	Summer Creek	61.8	7.0	11.3%
14	Lower Fanno Creek	829.0	87.8	10.6%
15	Rock Creek (south Washington Co.)	315.0	22.8	7.2%
16	Richardson Creek	0.0	0.0	0.0%
17	Rock Creek-Clackamas River	761.9	87.1	11.4%
18	Johnson Creek-Sunshine Creek	346.8	11.8	3.4%
19	Kelley Creek	34.4	1.2	3.5%
20	Middle Johnson Creek	378.9	164.4	43.4%
21	Lower Johnson Creek-Willamette River	717.1	74.6	10.4%
22	Lake Oswego	590.2	75.8	12.8%
23	Tryon Creek	107.7	37.1	34.4%
24	Johnson Creek-Crystal Springs	572.0	295.4	51.6%
25	Mount Scott Creek	706.5	149.6	21.2%
26	Lower Willamette River	3,409.4	317.8	9.3%
27	Columbia Slough	15,814.1	993.8	6.3%
Total		**35,008.9**	**3,590.3**	**10.3%**

Table 15. Percent of riparian corridor by ecological function score by resource site (excludes Habitats of Concern outside of model patches).

Resource site#	Resource site name	Ecological function score					
		1 to 5	6 to 11	12 to 17	18 to 23	24 to 29	30
1	Lower Sandy River-Columbia River	37.4%	7.2%	16.0%	19.6%	11.1%	8.8%
2	Beaver Creek-Sandy River	24.7%	5.1%	12.1%	34.4%	13.2%	10.5%
3	Willamette River-Boeckman Creek	47.1%	12.8%	8.7%	9.0%	14.3%	8.1%
4	Willamette River-Lower Tualatin River	54.7%	7.0%	7.6%	15.8%	9.8%	5.1%
5	Council Creek	27.1%	9.3%	26.1%	4.7%	24.1%	8.7%
6	McKay Creek	28.7%	8.8%	18.9%	3.1%	23.8%	16.7%
7	Middle Rock Creek-Tualatin River	57.8%	10.7%	4.7%	3.6%	17.9%	5.2%
8	Beaverton Creek	54.6%	8.2%	7.8%	2.1%	20.3%	6.9%
9	Lower Rock Creek-Tualatin River	21.9%	9.4%	20.1%	3.2%	24.7%	20.7%
10	Middle Tualatin River-Gordon Creek	57.9%	10.1%	10.3%	5.2%	14.0%	2.6%
11	Lower Tualatin River-Lake Oswego Canal	58.1%	8.6%	6.4%	5.1%	15.2%	6.6%
12	Upper and Middle Fanno Creek	53.6%	7.4%	7.7%	1.3%	23.9%	6.1%
13	Summer Creek	50.2%	10.6%	7.4%	3.1%	22.2%	6.3%
14	Lower Fanno Creek	34.5%	6.3%	15.8%	5.0%	22.7%	15.6%
15	Rock Creek (south Washington Co.)	42.3%	12.0%	8.4%	2.2%	21.8%	13.3%
16	Richardson Creek	60.4%	13.7%	4.9%	8.5%	10.8%	1.8%
17	Rock Creek-Clackamas River	56.8%	8.8%	8.4%	6.7%	14.6%	4.8%
18	Johnson Creek-Sunshine Creek	69.0%	7.8%	3.5%	2.9%	12.5%	4.3%
19	Kelley Creek	73.5%	8.3%	2.3%	2.4%	11.5%	2.0%
20	Middle Johnson Creek	67.7%	6.0%	7.9%	1.1%	12.8%	4.5%
21	Lower Johnson Creek-Willamette River	37.2%	8.5%	10.1%	19.3%	17.2%	7.7%
22	Lake Oswego	45.4%	6.6%	31.7%	2.7%	10.2%	3.4%
23	Tryon Creek	62.8%	8.2%	4.9%	2.3%	19.8%	2.0%
24	Johnson Creek-Crystal Springs	55.5%	6.5%	11.4%	2.4%	18.4%	5.7%
25	Mount Scott Creek	53.7%	7.6%	8.2%	10.6%	12.4%	7.5%
26	Lower Willamette River	55.6%	4.2%	6.3%	23.6%	8.6%	1.7%
27	Columbia Slough	17.1%	3.7%	23.4%	39.0%	7.0%	9.7%
Totals		**44.3%**	**6.9%**	**12.1%**	**16.7%**	**13.1%**	**6.9%**

Table 16. Quantity of wildlife habitat resources in Metro region by resource site.

Resource site#	Resource site name	Total acres in Metro's Boundary	Total acres in wildlife patches	% of site in wildlife patches	Total acres HOCs inside patches	% of site in HOCs inside patches	Total acres HOCs outside patches	% of site in HOCs outside patches	Total acres of inventoried wildlife habitat	% of region's inventoried wildlife habitat in resource site
1	Lower Sandy River-Columbia River	5,712.3	2,490.4	43.6%	1,894.2	33.2%	392.6	6.9%	2,883.1	3.8%
2	Beaver Creek-Sandy River	10,336.6	2,118.3	20.5%	943.7	9.1%	317.3	3.1%	2,435.6	3.2%
3	Willamette River-Boeckman Creek	7,616.8	2,041.0	26.8%	273.7	3.6%	20.0	0.3%	2,061.0	2.7%
4	Willamette River-Lower Tualatin River	11,403.7	3,232.5	28.3%	767.8	6.7%	7.7	0.1%	3,240.3	4.3%
5	Council Creek	5,708.2	901.4	15.8%	230.4	4.0%	11.1	0.2%	912.5	1.2%
6	McKay Creek	3,842.7	482.7	12.6%	74.6	1.9%	1.6	0.0%	484.4	0.6%
7	Middle Rock Creek-Tualatin River	7,300.2	2,349.0	32.2%	234.4	3.2%	19.4	0.3%	2,368.4	3.1%
8	Beaverton Creek	24,297.0	5,146.4	21.2%	529.0	2.2%	80.0	0.3%	5,226.4	6.9%
9	Lower Rock Creek-Tualatin River	8,717.3	1,608.2	18.4%	314.7	3.6%	9.2	0.1%	1,617.4	2.2%
10	Middle Tualatin River-Gordon Creek	4,347.3	904.3	20.8%	214.1	4.9%	45.1	1.0%	949.4	1.3%
11	Lower Tualatin River-Lake Oswego Canal	15,231.1	5,345.8	35.1%	1,019.2	6.7%	8.6	0.1%	5,354.4	7.1%
12	Upper and Middle Fanno Creek	11,183.5	2,501.3	22.4%	200.7	1.8%	21.0	0.2%	2,522.3	3.4%
13	Summer Creek	3,769.1	818.6	21.7%	91.8	2.4%	13.7	0.4%	832.3	1.1%
14	Lower Fanno Creek	8,453.8	1,509.8	17.9%	263.5	3.1%	23.6	0.3%	1,533.4	2.0%
15	Rock Creek (south Washington Co.)	4,239.3	1,031.5	24.3%	661.0	15.6%	40.9	1.0%	1,072.5	1.4%
16	Richardson Creek	6,465.5	2,208.1	34.2%	436.3	6.7%	4.5	0.1%	2,212.6	2.9%
17	Rock Creek-Clackamas River	11,120.7	3,755.2	33.8%	675.9	6.1%	6.6	0.1%	3,761.7	5.0%
18	Johnson Creek-Sunshine Creek	12,372.9	4,734.6	38.3%	248.7	2.0%	87.7	0.7%	4,822.3	6.4%
19	Kelley Creek	3,175.6	1,410.0	44.4%	330.0	10.4%	12.1	0.4%	1,422.0	1.9%
20	Middle Johnson Creek	8,949.7	1,351.7	15.1%	425.2	4.8%	276.4	3.1%	1,628.1	2.2%
21	Lower Johnson Creek-Willamette River	5,950.3	1,457.2	24.5%	247.7	4.2%	14.0	0.2%	1,471.2	2.0%
22	Lake Oswego	4,168.7	1,005.3	24.1%	0.1	0.0%	3.0	0.1%	1,008.3	1.3%
23	Tryon Creek	4,356.5	1,896.9	43.5%	646.6	14.8%	0.6	0.0%	1,897.5	2.5%
24	Johnson Creek-Crystal Springs	7,844.6	810.8	10.3%	91.4	1.2%	7.7	0.1%	818.5	1.1%
25	Mount Scott Creek	11,809.8	2,152.5	18.2%	544.1	4.6%	50.5	0.4%	2,203.1	2.9%
26	Lower Willamette River	32,899.2	8,479.1	25.8%	5,369.6	16.3%	282.9	0.9%	8,761.9	11.7%
27	Columbia Slough	54,610.0	9,615.9	17.6%	6,380.7	11.7%	2,083.8	3.8%	11,699.7	15.6%
Total		**295,882.5**	**71,358.7**	**24.1%**	**23,108.9**	**7.8%**	**3,841.7**	**1.3%**	**75,200.3**	**100.0%**

Table 17. Percent of wildlife patch by wildlife model score and resource site (excludes Habitats of Concern).

Resource site#	Resource site name	Wildlife Model Score								
		1	2	3	4	5	6	7	8	9
1	Lower Sandy River-Columbia River	0.1%	0.4%	7.8%	15.6%	6.1%	5.4%	64.6%	0.0%	0.0%
2	Beaver Creek-Sandy River	0.6%	5.9%	24.5%	14.3%	15.9%	23.7%	15.2%	0.0%	0.0%
3	Willamette River-Boeckman Creek	1.8%	6.3%	17.7%	13.8%	20.4%	15.7%	13.6%	10.7%	0.0%
4	Willamette River-Lower Tualatin River	1.3%	7.3%	11.9%	5.9%	11.5%	53.7%	0.9%	7.4%	0.0%
5	Council Creek	2.6%	6.2%	35.0%	10.3%	15.9%	12.7%	17.1%	0.0%	0.0%
6	McKay Creek	4.2%	11.2%	31.7%	14.1%	8.4%	20.2%	4.5%	5.8%	0.0%
7	Middle Rock Creek-Tualatin River	1.3%	6.0%	13.9%	12.5%	4.1%	5.7%	1.9%	54.6%	0.0%
8	Beaverton Creek	4.8%	8.3%	9.3%	13.8%	10.0%	13.6%	4.7%	35.5%	0.0%
9	Lower Rock Creek-Tualatin River	3.3%	7.4%	13.1%	6.0%	8.5%	20.4%	19.9%	21.5%	0.0%
10	Middle Tualatin River-Gordon Creek	6.1%	14.3%	20.2%	19.7%	23.0%	16.6%	0.0%	0.0%	0.0%
11	Lower Tualatin River-Lake Oswego Canal	2.4%	2.7%	13.3%	12.7%	8.4%	40.0%	4.2%	16.2%	0.0%
12	Upper and Middle Fanno Creek	5.4%	6.0%	10.7%	12.3%	28.8%	31.3%	0.3%	5.2%	0.0%
13	Summer Creek	2.4%	11.0%	10.9%	21.6%	40.0%	10.5%	3.6%	0.0%	0.0%
14	Lower Fanno Creek	8.1%	8.4%	10.7%	22.0%	24.4%	20.6%	5.8%	0.0%	0.0%
15	Rock Creek (south Washington Co.)	2.6%	0.8%	11.5%	19.6%	3.7%	55.7%	6.0%	0.0%	0.0%
16	Richardson Creek	0.4%	3.8%	29.2%	23.5%	4.1%	18.5%	2.7%	17.9%	0.0%
17	Rock Creek-Clackamas River	1.1%	6.1%	18.5%	14.2%	14.1%	15.3%	29.0%	1.8%	0.0%
18	Johnson Creek-Sunshine Creek	0.6%	2.8%	14.0%	14.9%	16.4%	27.4%	23.9%	0.0%	0.0%
19	Kelley Creek	1.0%	1.1%	16.6%	9.1%	5.5%	23.5%	43.2%	0.0%	0.0%
20	Middle Johnson Creek	6.5%	1.8%	3.9%	8.1%	22.1%	2.9%	54.8%	0.0%	0.0%
21	Lower Johnson Creek-Willamette River	5.6%	8.2%	12.0%	8.3%	12.3%	53.6%	0.0%	0.0%	0.0%
22	Lake Oswego	4.2%	4.9%	12.4%	6.1%	7.8%	64.5%	0.0%	0.1%	0.0%
23	Tryon Creek	1.2%	2.4%	4.3%	4.5%	0.5%	2.7%	0.0%	84.2%	0.0%
24	Johnson Creek-Crystal Springs	9.2%	19.4%	13.6%	9.7%	41.3%	6.7%	0.1%	0.0%	0.0%
25	Mount Scott Creek	6.0%	8.1%	13.3%	16.3%	35.0%	17.0%	0.2%	4.0%	0.0%
26	Lower Willamette River	3.7%	3.0%	1.5%	3.3%	1.0%	9.4%	12.3%	65.8%	0.0%
27	Columbia Slough	2.7%	7.4%	13.0%	10.2%	6.0%	15.0%	13.2%	18.6%	13.8%
Totals		**2.9%**	**5.5%**	**12.5%**	**11.6%**	**11.4%**	**20.9%**	**13.2%**	**20.2%**	**1.9%**

Summary

The discussion above describes how Metro's Goal 5 inventories for riparian corridors and wildlife habitat meet the requirements of the Goal 5 rule by including regionally consistent information on the location, quantity and quality of resources in the region; fieldwork adds credibility to the inventory methods. Based on this, Metro's inventory is determined to be adequate for purposes of making a significance decision.

Determining regionally significant resources

Goal 5 legal requirements

If the information gathered about a resource site is considered adequate, the Goal 5 process then calls for a determination of whether a resource site is "significant." Significance is determined based upon the location, quantity and quality of the resource. Some of the criteria for determining significance are found in the rules governing specific Goal 5 resources. Local governments also may rely on "any additional criteria adopted by the local government" (OAR 660-023-0030(4)(c)). This represents a broad delegation of authority from the Land Conservation and Development Commission (LCDC) to local governments to add criteria to determine the significance of resource sites.

Identifying significant riparian resources

All of the areas mapped as providing function to the riparian corridor are ecologically significant. As discussed thoroughly in Metro's Technical Report for Fish and Wildlife Habitat, April 2005, activities throughout the entire watershed impact the health of the riparian corridor and the streams, thus affecting the quality of the habitat for fish and wildlife. The biological integrity of the riparian corridor depends, in part, on the width and condition of the riparian area, which dictates stream functions and ultimately the type of plant and animal species that can live in and around streams. Based on the previously described functional approach and consistent with Goal 5 TAC recommendations, Metro staff proposed defining the riparian corridor for purposes of the Goal 5 inventory as any site that receives a primary or secondary ecological function score[13].

A landscape perspective of riparian corridors as contiguous, interconnected, and dynamic systems within a nested array of watersheds is critical in determining the significance of a specific riparian corridor. Metro's Technical Report for Fish and Wildlife Habitat identifies and discusses the ecosystem functions of riparian corridors. It emphasizes the value of the connectivity of the linear stream system across the landscape and the width of the riparian corridor as essential components for providing the properly functioning habitat for fish and wildlife. Each riparian corridor is important to enable a properly functioning network of streams and rivers to support fish and wildlife in the Metro region.

[13] The riparian corridor is defined based on five functions: microclimate and shade; streamflow moderation and water storage; bank stabilization, sediment and pollution control; large wood and channel dynamics; and organic material sources.

Scientific basis

To the maximum extent possible, all perennial, intermittent and ephemeral streams should be protected from surrounding land use activities by a buffer (May 2000). The effectiveness of a riparian corridor protection program depends on the percentage of stream miles that are protected; the more miles protected, the more effective a program will be (Wenger 1999). As stated by Fischer et al. (2000): “Continuous buffers are more effective at moderating stream temperatures, reducing gaps in protection from non-point source pollution, and providing better habitat and movement corridors for wildlife.”

Several functions important for fish and wildlife are influenced by the entire system of streams. For instance, nearly half of the large woody debris found in low gradient streams is delivered from upstream sources (Pollock and Kennard 1998). Studies have also found that the temperature of streams is influenced not only by the condition of adjacent forest but also by upland forest conditions and upstream conditions (Pollock and Kennard 1998). The hydrologic regime of a stream at any given point is directly related to development patterns and activities in all hydrologically connected upstream drainages (Wigmosta et al. 1994; Booth 2000).

The entire stream network functions as a system, thus removing the connection between intermittent and perennial streams may have detrimental consequences to the physical and biological components of stream ecosystems, particularly in the long term (FEMAT 1993). Naiman et al. (1992) stated that intermittent streams are an important, often overlooked, component of aquatic ecosystems.

Riparian buffers are especially important along the small headwater streams that typically make up the majority of stream miles in any basin (Osborne and Kovacic 1993; Binford and Bucheneau 1993; Hubbard and Lowrance 1994; Lowrance et al. 1997; May et al. 1997a; Fischer et al. 2000). These smaller streams have more interaction with the land and riparian vegetation plays an integral role in reducing sediment and other pollutants, maintaining temperature regimes, and providing large woody debris and other organic inputs (FEMAT 1993). Riparian buffers along larger streams have less of an impact on water quality, however they often are longer and wider thus providing better wildlife habitat (Fischer et al. 2000).

In urban areas the functions of the aquatic ecosystem are altered, as described in the previous section. Increased urbanization causes an increase in negative inputs such as contaminants, sediments and stormwater flow, and also reduces the amount of large woody debris and other organic inputs required for the survival of aquatic life (Booth et al. 1997; Todd 2000). Johnson and Ryba (1992) stated that “ a large buffer in an area of high-intensity land use…is more essential than in low-intensity land use areas.” FEMAT (1993) recommends 91 m (300 ft) on each side of fish bearing streams in a forested landscape, as well as protecting permanently flowing non-fish bearing streams; constructed ponds, reservoirs, and all wetlands greater than one acre; all lakes and natural ponds; and seasonal or intermittent streams, smaller wetlands, and unstable areas to a lesser extent. The protection of all of these areas is crucial to maintaining habitat for aquatic and riparian-associated wildlife. In an urban area, with the greater impacts associated with urbanization, a protection scheme of less than that recommended by FEMAT in the forested landscape may not be sufficient to fully provide fish and wildlife habitat.

Identifying regionally significant riparian resources

The Goal 5 rule includes language specific to Metro that allows the protection of regional resources. The rule states that a "regional resource is a site containing a significant Goal 5 resource…" (OAR 660-23-080 (1)(b)). The regional resources must be identified on a map adopted by Metro ordinance. This language implies that Metro has considerable leeway in defining a regional resource. Title 3 Section 5 states that Metro will protect "regionally significant resources." Therefore, Metro is considering "regionally significant resources" and "regional resources" to be synonymous. Metro's Regional Framework Plan also calls for protection of "regionally significant parks, natural areas, open spaces, trails and greenways" in Section 3.2.

There are many alternative methodologies that could be selected to identify "regionally significant resources." In October 2000 the Metropolitan Policy Advisory Committee (MPAC), a body that consists of elected officials representing the cities and counties within the Metro region, adopted a Vision Statement that included a vision, goal, and objectives. The language in the Vision Statement reflects the many regional, state, and federal policies that have guided Metro in developing a strategy for protecting fish and wildlife habitat. The vision and goal as described in the document are:

> ***Vision:*** Our region places a high priority on the protection of its streams, wetlands and floodplains to maintain access to nature; sustain and enhance native fish and wildlife species and their habitats; mitigate high storm flows and maintain adequate summer flows; provide clean water; and create communities that fully integrate the built and natural environment. As ribbons of green, stream and river corridors maintain connections with adjacent upland habitats, form an interconnected mosaic of urban forest and other fish and wildlife habitat, and contribute significantly to our region's livability. The RUGGOs state that the region should "Manage watersheds to protect and ensure to the maximum extent practicable the integrity of streams, wetlands and floodplains, and their multiple biological, physical, and social values," as well as that "A region-wide system of linked significant wildlife habitats should be developed. This system should be preserved, restored where appropriate, and managed to maintain the region's biodiversity."
>
> ***Goal:*** The overall goal is to conserve, protect and restore a continuous ecologically viable streamside corridor system, from the streams' headwaters to their confluence with others streams and rivers, and with their floodplains in a manner that is integrated with the surrounding urban landscape. This system will be achieved through conservation, protection and appropriate restoration of streamside corridors through time.

Table 18 below shows several alternatives for identifying regionally significant riparian corridors, a brief discussion of each alternative, and an assessment of how well each alternative meets the criteria for identifying regionally significant resources (below). These options were considered by staff, various advisory committees, the executive officer, and the Council, in that order. Staff recommended retaining all areas receiving one or more primary functions as regionally significant. However, after much discussion the Metropolitan Technical Advisory Committee (MTAC) recommended retaining everything on the map as regionally significant. The discussion below, regarding the assessment of criteria for identifying regionally significant riparian corridors, follows the thought process providing the basis for Metro's decision.

1. **Science-based** means that the option is compatible with the information presented in Metro's Technical Report for Fish and Wildlife Habitat, and that it is likely to provide some level of protection for each of the five identified Ecological Functional Values addressed in Metro's GIS model.

2. **Watershed approach** implies that the option provides resource protection with the minimum spatial unit considered being a watershed. This is consistent with Metro's Regional Urban Growth Goals and Objectives (RUGGOs) Objective 12 and Metro's Regional Framework Plan (RFP) section 4.13, dealing with watershed management and regional water quality, and is an important component of master planning because conditions in one part of the watershed may be influenced by activities in all other parts of the watershed.
3. **Protects hydrology** within this context suggests that an option will help protect existing hydrologic function from further human-induced alteration. In urbanized watersheds, altered hydrology is a fundamental pathway to ecological and biological degradation. However, it is important to recognize that hydrology in many of the region's watersheds is already substantially altered, and restoration of more natural hydrological regimes will require programs that address the fundamental impacts on hydrology, such as impervious surfaces and piping of stormwater runoff directly to streams.
4. **Promotes connectivity**: Connectivity refers to how tributaries are connected to larger rivers, how groundwater interacts with surface water, how water moves among streams, wetlands and floodplains, and how fish and wildlife move among watershed components (aquatic and terrestrial). The ecological health of a watershed (and its wildlife) depends in part on the connectivity between and among streams and other water resources, as well as the riparian area, over space and time. Well-connected streams and riparian buffers serve as movement corridors for wildlife and plants, allowing re-population of extirpated species, gene flow over space, and dispersal and migration corridors. Metro's Vision Statement reiterates our commitment to regional connectivity: "As ribbons of green, stream and river corridors maintain connections with adjacent upland habitats, form an interconnected mosaic of urban forest and other fish and wildlife habitat, and contribute significantly to our region's livability."
5. **Multispecies benefits** implies protection of vertebrate and invertebrate biological diversity (not just fish). This is consistent with Metro's RUGGOs stating that the region should "Manage watersheds to protect and ensure to the maximum extent practicable the integrity of streams, wetlands and floodplains, and their multiple biological, physical, and social values." To protect the region's biodiversity, options with multispecies benefits provide a more holistic ecological approach, and may help prevent future Endangered Species Act listings of other species.
6. **Restoration potential**: alternatives addressing this criterion will address certain areas within and near the riparian corridor that may be currently degraded, but are important to wildlife and hydrology and could be restored to increase ecological function. While not required by Goal 5, restoration of such areas is consistent with Metro's RUGGOs and Vision Statement and would likely result in higher levels of ecological function, increase the potential for ESA compliance, and decrease the potential for future ESA listings.
7. **Meets Goal 5 requirements:** alternatives likely to be in compliance with the rules outlined in the Goal 5 rule.
8. **Meets the goals in the Vision Statement:** alternatives that support the goals outlined in Metro's Vision Statement.
9. **Likely to address ESA requirement:** alternatives that are likely to be consistent with National Marine Fisheries Services' matrix of Pathways and Indicators and what is necessary to protect critical fish habitat.

Each alternative in Table 18 is evaluated based on how well it meets all nine of the above criteria for identifying regionally significant resources. Metro staff applied the information in Metro's

Technical Report for Fish and Wildlife Habitat and best professional judgment in evaluating each alternative against the criteria.

Table 18. Alternatives for determining regionally significant riparian corridors.

Alternatives for determining regional significance	Discussion	Criteria for identifying regionally significant resources								
		Science-based	Watershed approach	Protects hydrology	Promotes connectivity	Multispecies benefits	Restoration potential	Meets state Goal 5 requirements	Meets the goals in the Vision Statement	Likely to address ESA requirements
1. Identifying all areas within Metro's defined riparian corridor as significant regional resources.	A wealth of scientific literature describes the important functions and values of riparian corridors for fish and wildlife habitat. Federal, State, local and Metro policy also identifies the importance of riparian corridors, while public opinion indicates high value placed on streams as well. Protecting riparian corridors is an important part of a salmonid recovery strategy for the Metro region, in response to the ESA listings. While not every riparian corridor in the region contains a salmon-bearing stream, this does not negate the importance of every riparian corridor in the larger picture of salmonid fish populations and habitat for other fish and wildlife species. While some riparian corridors may currently be degraded, the resource still may be deemed significant due to its restoration and enhancement potential. This option provides the most potential for protecting and restoring fish and wildlife habitat in the Metro region.	4	4	4	4	4	4	4	4	4
2. Identifying all areas receiving an ecological function score of 3 or more within Metro's defined riparian corridor as significant regional resources.	This alternative would reduce the amount of land that would fall within the area identified as being a regional resource by omitting areas receiving secondary scores for either the water storage or microclimate functions. Forest patches receive a secondary score for microclimate between 101-780 feet from a stream and for water storage until there is a break in the patch.	4	4	?	?	4	4	4	4	4
3. Identifying all areas receiving an ecological function score of 6 or more within Metro's defined riparian corridor as significant regional resources.	All of the sites receiving an ecological function score provide an important contribution to fish and wildlife habitat. However, the areas receiving primary ecological function scores are the most critical to maintain and restore healthy streams and riparian corridors. Most of the widths delineating primary ecological functions are based on a minimum corridor width identified in the science. As long as vegetation is present, this alternative results in a 150-ft corridor without the presence of steep slopes, which extend it to 200 ft. The minimum corridor width is 50 ft. Based on Metro's Technical Review for Goal 5, this alternative depicts the minimum area likely to provide the basis for a scientifically sound decision.	4	4	?	?	4	?	4	4	4
4. Identifying all areas receiving an ecological function score of 12 or more within Metro's defined riparian corridor as significant regional resources.	This alternative would identify all sites that receive two or more primary ecological function scores as regional resources. The result of this alternative would be a 100-ft corridor (with vegetation present) up to 150 ft with steep slopes, or a 50-ft default for bank stabilization and channel migration. While this alternative may meet state Goal 5 requirements, it is not likely to meet the Council adopted Vision Statement or federal ESA requirements. This option fails to adequately safeguard the full suite of riparian functions necessary to protect fish and wildlife habitat and water quality, such as Ecological Functional Values that often extend spatially beyond the limits outlined here (e.g., Microclimate and Shade, Streamflow Moderation and Water Storage). Ecologically important but degraded areas (e.g., unvegetated but undeveloped areas that could be restored) would be excluded.	4	4	?	?	4	?	4		

Alternatives for determining regional significance	Discussion	Criteria for identifying regionally significant resources								
		Science-based	Watershed approach	Protects hydrology	Promotes connectivity	Multispecies benefits	Restoration potential	Meets state Goal 5 requirements	Meets the goals in the Vision Statement	Likely to address ESA requirements
5. Identifying only the riparian corridors on fish-bearing streams as regional resources.	This option only addresses the symptoms of ecological degradation (endangered species), not the causes, and is narrowly focused on fish. The data and maps depicting fish-bearing streams are inadequate for the Metro region and therefore using this criterion could exclude many miles of fish-bearing streams, resulting in inconsistent resource protection. It also excludes streams that could bear fish if structural blockages were altered or removed, as well as non-fish-bearing streams that add cold water, large wood, and nutrients that feed into fish-bearing streams. This option is unlikely to adequately protect any of the identified Ecological Functional Values on a regional basis.	4					?	4		
6. Identifying only the riparian corridors with high quality habitat as regional resources.	There is no comprehensive database or map of riparian corridor habitat quality for the Metro region. Riparian corridor habitat assessments have been conducted for only selected watersheds around the region. In addition, "high quality" is a judgement call. This project does not exclusively focus on the quality of the riparian corridor habitat because its goals are to protect, restore and conserve riparian corridors regardless of their current condition. If this option were chosen, it would result in identifying a limited and potentially inadequate number of riparian corridor miles as regional resources, and would not adequately protect the identified Ecological Functional Values on a regional basis.					4		4		
7. Identifying only the riparian corridors with designated threatened, endangered or sensitive fish and wildlife species present as regional resources.	This option only addresses the symptoms of ecological degradation (endangered species), not the causes, and is narrowly focused on species that are already at risk. The goal described in the Vision Statement is to protect, conserve and restore riparian corridors for all fish and wildlife species that use these corridors for food, shelter, protection and as travel corridors in the Metro region. Lack of comprehensive, consistently collected data would result in inconsistent and inadequate resource protection under this option. This project has used a multi-species approach in order to ensure that the greatest numbers of species are protected. If this option were chosen, it would fail to protect the identified Ecological Functional Values in the region.					4		4		
8. Identifying only the riparian corridors currently protected by cities and counties as significant regional resources.	Metro's analysis of Goal 5 fish and wildlife habitat protection programs in the region revealed that Goal 5 protection varies significantly from high levels of protection to little or no protection. Current individual Goal 5 programs do not add up to a regionally consistent or comprehensive protection program for riparian corridor fish and wildlife habitat. If this option were chosen, it would not result in adequate protection of the identified Ecological Functional Values at the regional level.				?	4	?	4		

Based on the policies included in the Vision Statement and Goal 5 TAC recommendations, Metro used the ecological functions approach to identify regionally significant resources. As described previously, this approach combines GIS mapping technology, scientific recommendations, and fieldwork for an inventory that encompasses the entire Metro region. The approach provides adequate information on the location, quantity, and quality of the riparian corridor resources in the region. On the basis of all of the information considered, based on the criteria describe above and on advice Metro received from its advisory committees, Metro designates all of the identified riparian inventory as regionally significant.

Identifying significant wildlife habitat resources

All of the areas mapped as providing wildlife habitat are biologically significant. As discussed in Metro's Technical Report for Fish and Wildlife Habitat, wildlife habitat loss has been pervasive in our region and has resulted in widespread fragmentation and degradation of remaining habitats. Several habitat types and numerous wildlife species are formally recognized to be at-risk by natural resources agencies in our region.

Important guidelines in developing a conservation plan for wildlife habitat are: large habitat patches are better than small patches; small patches of unique habitat are worth saving; connectivity to other patches is important; and connectivity and/or proximity to water resources is valuable. These factors help determine habitat quality, thus they play key roles in what species can utilize habitat patches and persist over the long term in our region.

A substantial portion of existing wildlife habitat in the region was excluded from Metro's wildlife habitat inventory at the outset. For example, our inventory focused on patches with closed forest canopy, with low-structure vegetation only appearing in the inventory if it is within 300 feet of a waterway. The inventory also set a minimum patch size of 2 acres (except for wetlands). Thus, upland forested patches that were not in closed canopy conditions were excluded, as were most low-structure patches further than 300 feet from water sources and most patches smaller than 2 acres. Taking this into account and considering the substantial losses of natural cover over time, each habitat patch in the inventory may be important to enable a properly functioning habitat network to support the long-term persistence of wildlife in the Metro region.

A landscape perspective of wildlife habitats as contiguous, interconnected, and dynamic systems within a nested array of watersheds is critical in determining the significance of a specific habitat patch. Metro's Technical Report for Fish and Wildlife Habitat identifies and discusses the ecosystem functions of wildlife habitats. It emphasizes the value of connectivity across the landscape as an essential component for providing properly functioning habitat for wildlife. Based on the previously described inventory approach and consistent with Goal 5 TAC recommendations, Metro staff proposed defining wildlife habitat for purposes of the Goal 5 inventory as any site that receives a score of one or more on the wildlife habitat GIS model scoring system (described in Table 7 on page 26 of this report), or any site that has been mapped as a Habitat of Concern.

Scientific basis

Urban environments have similar ecological problems worldwide, including habitat loss, fragmentation, damage and simplification (instream and terrestrial); introduced species; and human disturbance (see Metro's Technical Report for Fish and Wildlife Habitat, Impacts of Urbanization section). Native vegetation plays a critical role in a watershed, particularly the longitudinal and lateral connectivity of the riparian corridor but also within specific upland habitat types such as oak. Downed wood and snags (or large woody debris), frequently found in natural ecosystems but often lacking in disturbed environments, are crucial in providing high quality habitat in both aquatic and terrestrial ecosystems; many at-risk species in our region depend on large wood to meet their life-history needs.

The characteristics that Metro has incorporated into its wildlife habitat inventory are designed to conserve the features known to be most critical to a healthy regional system of wildlife habitats. The importance of these characteristics are reviewed in Metro's Technical Report for Fish and Wildlife Habitat, April 2005 .

For example, large habitat patches typically contain more large wood, fewer nonnative plants and animals, and better three-dimensional structure than smaller patches. Patch shape also influences these factors. Between-patch connectivity along streams provides both water and passage to wildlife, allowing post-breeding dispersal and natural reintroduction of locally extirpated species. The wildlife habitat inventory represents a regional "backbone" of habitats that have the potential to support healthy, productive and diverse wildlife populations as the region's human population increases over time. This habitat system's value could be further increased by building additional connectivity and improving native conditions through carefully planned habitat restoration; our regional approach to evaluating wildlife habitats provides an excellent opportunity to identify key restoration sites based that may disproportionately, positively influence conditions for wildlife.

Identifying regionally significant wildlife habitat resources

The Goal 5 rule includes language specific to Metro that allows the protection of regional resources. The rule states that a "regional resource is a site containing a significant Goal 5 resource…" (OAR 660-23-080 (1)(b)). The regional resources must be identified on a map adopted by Metro ordinance. This language implies that Metro has considerable leeway in defining a regional resource. Title 3 Section 5 states that Metro will protect "regionally significant resources." Based on habitat loss over time, it could validly be argued that all habitats identified in the inventory are regionally significant and contribute to the vitality of the region's wildlife. However, smaller, more isolated habitat patches lacking in water resources generally provide less value to wildlife than larger, well-connected patches with water; fieldwork confirms what the scientific literature tells us.

There are many alternative methodologies that could be selected to identify "regionally significant resources." Metro's goals in identifying regionally significant wildlife habitats are to meet the vision, goals and objectives in the Vision Statement endorsed by MPAC (described in the regional significance section for riparian corridors, above) and to comply with the Goal 5 rule. The Regional Significance decision should aim for "A region-wide system of linked significant wildlife habitats should be developed. This system should be preserved, restored where appropriate, and managed to maintain the region's biodiversity." (Vision Statement)

Table 19 below shows several alternatives for identifying regionally significant riparian corridors, a brief discussion of each alternative, and an assessment of how well each alternative meets the criteria for identifying regionally significant resources (below). These options were considered by staff, various advisory committees, the executive officer, and the Council, in that order.

Each alternative in Table 19 below is evaluated based on how well it meets all five of the criteria for identifying regionally significant wildlife habitat resources. Metro staff applied the information in Metro's Technical Report for Fish and Wildlife Habitat and best professional judgement in evaluating each alternative against the criteria.

1. **Meets Goal 5 requirements:** alternatives likely to be in compliance with the rules outlined in the Goal 5 rule.
2. **Meets the goals in the Vision Statement:** alternatives that support the goals outlined in Metro's Vision Statement.

3. **Supports the goals in ODFW's Wildlife Diversity Plan:** Options meeting this criterion should directly support a goal, priority, or strategy stated in ODFW's Wildlife Diversity Plan (ODFW 1993). The Goal 5 rule states that when gathering information regarding wildlife habitat under the standard inventory process in OAR 660-23-030(2), local governments shall obtain current habitat inventory from ODFW and other state and federal agencies. Because such habitat information is limited, Metro has also incorporated ODFW's wildlife diversity goals for the state into the Goal 5 inventory process. The stated goal of ODFW's Wildlife Diversity Plan is: "To maintain Oregon's wildlife diversity by protecting and enhancing populations and habitats of native wildlife at self-sustaining levels throughout natural geographic ranges." The Plan also recognizes that habitat is most often the key to maintaining wildlife populations, and that a multi-species, ecosystem-based approach to research and management should be used whenever possible. Metro's vertebrate species list (Appendix 7) identifies wildlife species that are native to this region (e.g., species whose natural geographic ranges fall within the metro area). Options with a high level of agreement with this criterion should: (1) be science-based, (2) consider at least a watershed approach, and (3) pay particular attention to the protection of at-risk habitats and species (including groups of at-risk species such as Neotropical migratory birds), as manifested in the Habitats of Concern and through patch size and connectivity issues.
4. **Consistent with Metro's Technical Report for Fish and Wildlife Habitat** means that the option is compatible with the information presented in Metro's Goal 5 Technical Review (scientific literature review), and that it is likely to qualitatively differentiate habitat patches based on each of the four identified habitat characteristics addressed in Metro's GIS model (patch size, shape, connectivity to other patches, and water resources).
5. **Ecosystem approach:** ODFW's Wildlife Diversity Plan recognizes that a multi-species, ecosystem-based approach to research and management should be used whenever possible, stating that:

   > …Maintaining wildlife diversity means maintaining the full array of native species and populations of those species. To this end, the Plan calls for a multi-species, ecosystem-based approach whenever possible…An ecosystem approach to wildlife management represents (in its broadest sense) a philosophy of natural resource management that emphasizes sustaining ecological values and functions while deriving socially-defined benefits. Ecosystem management considers all natural components, both biological and physical, rather than focusing on single species or groups of species. (ODFW 1993)

   ODFW does not provide a spatially explicit definition of ecosystem, but states that ecosystem management assumes that by preserving adequate amounts, quality and connectivity of habitat, all wildlife species will be maintained. The metro region is largely contained within ODFW's recognized Western Interior Valleys physiographic province, and forms a cohesive ecosystem unit via the influences of the greater Portland region's urbanization patterns, which exert varying (but predictable) degrees of human influence along the urban-rural gradient. Alternatives supporting this criterion should consider the region's wildlife habitats as a cohesive, interrelated system.
6. **Promotes sensitive species/habitat conservation:** the Goal 5 rule states that when gathering information regarding wildlife habitat under the standard inventory process in OAR 660-23-030(2), local governments shall obtain current habitat inventory from ODFW and other state and federal agencies, including at least the following:

- Threatened, endangered, and sensitive wildlife species habitat information;
- Sensitive bird site inventories; and
- Wildlife species of concern and/or habitats of concern identified and mapped by ODFW…

Sensitive, or at-risk, species and habitats are also identified as priorities by ODFW. Note that neither ODFW nor any other agency has systematically mapped species or habitats of concern specifically for the metro region. Partial information is available from a variety of sources, and Metro used such data to incorporate site-specific sensitive species information into the Habitats of Concern layer (for example, know native turtle nesting and crossing areas). Although site-specific species information is limited, many sensitive species are habitat specialists relying on sensitive habitats, such as riparian or grasslands; regional loss of these habitats contributes to these sensitive species' decline. The Habitats of Concern layer includes all of the sensitive habitat information that Metro has received (verified using aerial photos and GIS data) and that meet our definition of Habitats of Concern (based on ODFW, USFWS, Partners in Flight, and the Oregon Biodiversity Project), including: priority conservation habitats (based on ODFW, USFWS, the Oregon Biodiversity Project, and the Oregon/Washington chapter of Partners in Flight); riverine islands and deltas; and patches providing unique or critical wildlife functions, such as migration corridors and stopover habitat, inter-patch connectors, and biologically or geologically unique areas habitat vital for a sensitive species. Alternatives supporting this criterion should include the full known extent of the Habitats of Concern layer.

7. **Maintains existing connectivity:** Metro's RUGGOs state that, "A region-wide system of linked significant wildlife habitats should be developed. This system should be preserved, restored where appropriate, and managed to maintain the region's biodiversity." Connectivity in the wildlife habitat context refers to how well fish and wildlife can move among watershed components (aquatic and terrestrial). The ecological health of a watershed and its wildlife depends in part on the connectivity between and among streams and other water resources, as well as the riparian area and upland habitats, over space and time. Well-connected streams, riparian buffers, and upland patches serve as movement corridors for wildlife and plants, allowing re-population of extirpated species, gene flow over space, and migration and dispersal corridors. Within Metro's wildlife habitat inventory, many patches providing important connectivity corridors are not forested, but consist of low-structure vegetation, including agricultural lands; in addition to connectivity, these habitats are very important to wildlife species dependent on non-forested habitats, such as grassland bird and mammal species. Alternatives resulting in significant reduction of existing connectivity, such as substantial omission of low-structure connector patches or options failing to consider connectivity, would not meet this criterion (and would also reduce the amount of available grassland and shrub habitat in the inventory).
8. **Maximizes restoration potential:** alternatives addressing this criterion will address certain areas that may be currently degraded, but are important to wildlife and could be restored to increase wildlife habitat functions and value. The more lower-scoring areas included as regionally significant, the more restoration potential exists in a regional wildlife habitat plan, in terms of improving both habitat quality and connectivity. For example, low-structure vegetation within 300' of streams, or small "stepping-stone" upland habitats providing important inter-patch connectivity for birds, could be enhanced with native plants or improved with connectivity in mind. While not required by Goal 5, restoration of such areas is consistent with Metro's RUGGOs and Vision Statement as well as ODFW's Wildlife Diversity Plan, and would likely result in higher levels of ecological function, increase the potential for retaining sensitive species, and decrease the potential for future ESA listings. Alternatives supporting this criterion would be more inclusive of smaller connector patches, regardless of their current condition.

Table 19. Options for determining regionally significant wildlife habitats.

Options for determining regional significance	Discussion	Criteria for identifying regionally significant resources							
		Meets Goal 5 requirements	Meets the goals in the Vision Statement	Supports the goals in ODFW's Wildlife Diversity Plan	Consistent with Metro's Technical Report for Fish and Wildlife Habitat	Ecosystem approach	Promotes sensitive species/habitat conservation	Maintains existing connectivity	Maximizes restoration potential
1. Identify all areas within Metro's wildlife habitat inventory as significant regional resources, including all Habitats of Concern (HOCs).	Considerable research documents the importance of habitat patch size and shape, water resources, and habitat connectivity to wildlife, and Metro's 2001 fieldwork validates the importance of these habitat characteristics in our area. Federal and state wildlife agencies and conservation organizations document significant and continuing losses of the proposed wildlife HOCs, and consistently consider these habitats to be at risk in our area. A habitat network that includes all of the above characteristics is most likely to enhance sensitive species persistence and biological diversity. Risk to the resource: this option provides the most potential to protect and restore the region's wildlife habitat by including all identified wildlife habitat including the smallest forest patches and low structure (non-forest) vegetation within 300 feet of water as regionally significant. The only risk to wildlife habitat resources is to habitat not included in the current inventory.	4	4	4	4	4	4	4	4
2. Identify all areas within Metro's wildlife habitat inventory scoring 2 or greater plus HOCs as significant regional resources.	Same as Option 1, except that all habitat patches with a score of 1 would be omitted (approximately 2,070 acres); these patches tend to be in developed settings and may or may not be near other, similar patches. Sizes range: 2 to 20+ acres. Risk to the resource: the most important wildlife functions for these smaller patches are migratory bird stopover habitat, locally important wildlife habitat, and building blocks with which to retain existing and enhance future connectivity through carefully planned restoration or creation of proximal patches.	4	4	4	4	4	4	4	4
3. Identify all areas within Metro's wildlife habitat inventory scoring 3 or greater plus HOCs as significant regional resources.	Risk to the resources: same as Option 2, except that all habitat patches with a score of 1 and 2 would be omitted (approximately 6,012 acres). Patches omitted include larger patches compared to option 2 (up to 100+ acres) and some patches with excellent water resources. For example, a narrow 106-acre patch nearly 4 miles long, comprising the riparian vegetation along the Willamette River/Multnomah Channel shoreline across from Smith and Bybee Lakes, would be omitted. This option would likely reduce existing connectivity; reduce potential for restoration of connectivity because important "stepping stones" would be lost; reduce existing connectivity of habitat patches to water; and result in the omission some important riparian habitats. Increased chance of adversely affecting sensitive species.	4	?	?	4	4	4	?	

Options for determining regional significance	Discussion	Criteria for identifying regionally significant resources							
		Meets Goal 5 requirements	Meets the goals in the Vision Statement	Supports the goals in ODFW's Wildlife Diversity Plan	Consistent with Metro's Technical Report for Fish and Wildlife Habitat	Ecosystem approach	Promotes sensitive species/habitat conservation	Maintains existing connectivity	Maximizes restoration potential
4. Identify all areas within Metro's wildlife habitat inventory scoring 4 or greater plus HOCs as significant regional resources.	<u>Risk to the resource</u>: same as Option 3 except that all patches with a score of 1,2, and 3 would be omitted (approximately 14,933 acres). Compared to Option 3, this option doubles the acreage of wildlife habitat omitted. Patches omitted include larger patches and substantially larger amounts low-structure vegetation within 300' of water sources compared to Option 3. In addition, some larger habitat upland patches would be omitted compared to Option 3. For example, a 227-acre low-structure patch along a long stream segment would be omitted. These patches are important connectors and provide grassland habitat. Areas with scarce habitat, such as southeast and northeast Portland, would likely be strongly influenced because a significant percentage of their remaining habitat patches could be excluded from the inventory. This option could also have a strong negative influence on the connectivity of the region's wildlife habitat system and is unlikely to provide a regional wildlife habitat system that meets Metro's and ODFW's stated wildlife habitat goals.	4	**?**	**?**	4	**?**	4		
5. Identify only wildlife habitat patches that are already in the existing riparian corridor inventory plus all HOCs.	This option would retain the wildlife score structure, but would consider habitats to be regionally significant only if they fall within the Council-approved riparian corridor inventory except for HOCs. All HOCs would be retained as regionally significant, whether in the riparian inventory or not. Over 90% of wildlife habitats fall within the riparian corridor inventory. <u>Risk to the resource</u>: one result of this option would be omission of habitats in areas generally lacking in water and habitat resources, such as developed areas in northeast and southeast Portland. The forested portions of certain butte tops would be omitted because they do not meet the definition of Habitats of Concern; however, these patches provide important breeding and migratory stopover habitat to songbirds, including Neotropical migrants.	4	4	**?**	**?**	**?**	4	**?**	4

Options for determining regional significance	Discussion	Criteria for identifying regionally significant resources								
		Meets Goal 5 requirements	Meets the goals in the Vision Statement	Supports the goals in ODFW's Wildlife Diversity Plan	Consistent with Metro's Technical Report for Fish and Wildlife Habitat	Ecosystem approach	Promotes sensitive species/habitat conservation	Maintains existing connectivity	Maximizes restoration potential
6. Identify only wildlife habitat patches with known sightings of designated threatened, endangered or sensitive wildlife species as regional resources.	*The Safe Harbor provision in the Goal 5 rule states that local governments may determine that significant wildlife habitat is only those sites where one or more of the following conditions exist: "(a) the habitat has been documented to perform a life support function for a wildlife species listed by the federal government as a threatened or endangered species or by the state of Oregon as a threatened, endangered, or sensitive species; (b) the habitat has document occurrences of more than incidental use by a species described in subsection (a) of this section; (c) the habitat has been documented as a sensitive bird nesting, roosting, or watering resource site for osprey or great blue herons…; (d) the habitat has been documented to be essential to achieving policies or population objectives specified in a wildlife species management plan adopted by the Oregon Fish and Wildlife Commission pursuant to ORS Chapter 496; or (e) the area is identified and mapped by ODFW as habitat for a wildlife species of concern and/or as a habitat of concern…"* Risk to the resource: this option only addresses the symptoms of ecological degradation (at-risk species), not the causes, such as habitat loss and fragmentation. Further, although Metro has collected available information of over 300 sensitive species sightings, there is no comprehensive, consistently collected database or survey of sensitive species in the Metro region, nor does the existing data distinguish between incidental and "more than incidental" use. This option would likely result in inconsistent, and probably inadequate, resource protection; it could fail to protect many important habitat patches solely due to lack of survey data, and would fail to address large-scale patterns of habitat connectivity and fragmentation. This option is not likely to promote biodiversity or the long-term persistence of sensitive species and habitats in the region, nor would it meet the goals in the Vision Statement.	4					?		

Based on the policies included in the Vision Statement and Goal 5 TAC recommendations, Metro used the multi-tiered approach to identify regionally significant wildlife habitat resources. As described previously, this approach combines GIS mapping technology, scientific recommendations, and fieldwork for an inventory that encompasses the entire Metro region. The approach provides adequate information on the location, quantity, and quality of the riparian corridor resources in the region. . On the basis of all of the information considered, based on the criteria describe above and on advice Metro received from its advisory committees, Metro designates all wildlife resources that received a score of two or greater, plus all habitats of concern, as regionally significant.

Conclusion

This document contains a detailed description of Metro's Goal 5 inventory approach, methodology, and site analyses for riparian corridors and wildlife habitat. Metro's analysis of how its inventory meets the requirements of the Goal 5 rule by including regionally consistent information on the location, quantity and quality of riparian corridor resources in the region is also covered. Based on this documentation, Metro's inventory has been determined to be adequate for purposes of making a significance decision.

A landscape perspective of both riparian corridors and wildlife habitat as contiguous, interconnected, and dynamic systems within a nested array of watersheds is critical in determining the significance of a specific riparian or wildlife resource. Although the two types of resource may be examined separately, they are closely related, as the substantial overlap between the two inventories indicates. Fish rely on streams, but fish are also a type of wildlife; in turn, terrestrial wildlife relies on healthy riparian areas to meet daily survival needs. Metro's Technical Report for Fish and Wildlife Habitat identifies and discusses the ecosystem functions of riparian corridors and the elements that are important to wildlife habitat. It emphasizes the importance of the connectivity of the linear stream system across the landscape, width of the riparian corridor, and configuration of wildlife habitat patches as essential components for providing the properly functioning habitat for fish and wildlife. Riparian areas and wildlife habitat should be considered within the context of the subwatershed, watershed, and regional system. Metro's inventory provides the means to do just that.

Metro's review of the scientific literature, combined with a survey of historic and present conditions and the current negative trend of wildlife and water resources, argue for a strong conservation effort. Each riparian corridor is important to enable a properly functioning network of streams and rivers to support fish and wildlife in the Metro region. Each patch of remaining habitat is important to the region's wildlife, and the removal of any habitat patch should be considered carefully if thoughtful wildlife habitat conservation is to be a regional goal. Such consideration will be undertaken in the next step of the Goal 5 Process, the ESEE analysis (Environmental, Social, Economic and Energy consequences of allowing, limiting, or prohibiting development).

The biological integrity of the riparian corridor depends, in part, on the width and condition of the riparian area, and these factors help dictate stream functions and ultimately the type of plant and animal species that can live in and around streams. Based on the ecological function approach and consistent with Goal 5 TAC and other technical advisory committee recommendations, Executive Officer Mike Burton proposed defining ***significant riparian corridors*** for purposes of the Goal 5 inventory as any site that receives a primary or secondary ecological function score. This recommendation was forwarded to Metro Council, who voted to accept this definition of regional significance in Resolution No. 01-3141C on December 13, 2001 (Appendix 3).

The biological integrity of the region's wildlife habitat depends, in part, on the size, shape, and connectivity of habitat patches, in addition to the availability of water resources. Combined with habitat type, these factors help dictate wildlife habitat quality and ultimately the type of plant and animal species that can live in the region. The Habitats of Concern data layer incorporates sensitive species information inasmuch as is possible, through identification of at-risk habitat types with which declining species are associated, and identification of known areas critical to the life-history requirements of sensitive species. Based on the multi-tiered approach to mapping wildlife habitat and consistent with Goal 5 TAC recommendations, Executive Office Mike Burton has proposed defining ***significant wildlife habitat*** for purposes of the Goal 5 inventory as any site that receives a score of one or more, or any site that has been identified as a Habitat of Concern. This recommendation was forwarded to Metro Council, who voted, in Resolution No. 02-3177A on August 8, 2002, to identify all sites that received a score of two or more, or that had been identified as Habitats of Concern, as regionally significant.

The inclusion of a property in the riparian corridor inventory, wildlife habitat inventory, or both does not mean that landowners will be forced to abandon the property or that future development will be prohibited. This document represents only the inventory – that is, what has been identified as part of the Goal 5 riparian or wildlife resource. The ESEE analysis will be followed by a program to conserve, protect, and restore the region's natural resources. Taken together, the inventory, ESEE, and program steps in the Goal 5 process are designed to help ensure an equitable, unbiased decision process that will provide guidance to local jurisdictions in how to protect and improve the ecological integrity of the region's natural resources. Involvement of the public and local jurisdictions has been and will continue to be a vital part of this process.

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ATTACHMENT 1 TO EXHIBIT F
ORDINANCE NO. 05-1077C

INVENTORY REPORT APPENDICES

The appendices to the Inventory Report are available for review in the Metro Council's files or from the Metro Planning Department, 600 N.E. Grand Ave., Portland, OR 97232.

ATTACHMENT 1

Appendix 1

General GIS methodology and variable descriptions.

General Methodology for Collecting and Summarizing Data

Data for the resource inventory site analysis was collected and created from internal and external sources. Tables 1A, 1B, 2A, 2B, and 2C of Appendix A describe the data used for this report and its original source. The external data was either downloaded from the original source's website or mailed directory to Metro from their GIS departments. For instance, the most current data for the distribution of many types of salmon was collected from ODFW. The date and URL of the data is included on the former mentioned tables. In addition, meta data was collected for each of the external data sources and included as a part of Appendix A.

Internal data was collected from various departments and the Intramet network drive. In addition, some data was created and used for this report. For instance, the Forest Canopy coverage was delineated at a scale of 1:4800 using 2000 aerial photos and generalized criteria by the Metro Data Resource Center. This included land covered by forest canopy in patches generally larger than one acre in size. For more information see Appendix A – Table 1A. This table also includes the date of the most recent update of the data. Meta data for the internal Metro data are located on the Intramet website.

The data was summarized for each 6th field HUC by intersecting the original data with the HUC boundaries and summing the total acres, number or miles for each HUC by a specific type or category within each data set. For instance, the distribution of spring chinook (a GIS coverage with 1:100,000 stream reaches where the salmon are distributed) coverage was intersected or overlayed (line in polygon operation) with the 6th field HUCs. This returned a coverage that was cliped by the HUC boundaries and a database with a 6th field HUC identifier for each record or stream line or arc. This coverage was then clipped by the Metro boundary. A summary table was created from this data listing the summation of the number of stream miles of spring chinook distribution for each 6th field HUC within the Metro boundary. Each of these summary tables were appended together to create a raw datatable of resource information by 6th field HUC within the Metro boundary (see Table 4 of Appendix D).

Geographic Areas of Interest

Geographic areas of interest include:

Geographic, Database and Variable Nomenclature

File Naming Conventions

All temporary or final files will be named by geographic code and abbreviated topic. The geographic code can be found table #1 below. See the Example of a completed name below:

Example:

(Geographic code) + (topic code) + (file extension)

"ms"+"001" + ".Dbf"

ms001.dbf

Table Naming Conventions

Tables in a relational database will follow the same geographic + topical convention used above wherever possible. See the example below:

Example:

(Geographic code) + (topic code)

"ms"+ "001"

ms001

<u>Item / Variable Naming Conventions</u>

Individual variables or items will be named by geographic code + topic code + element code. Geographic codes are organized in table 1 below. Topic and element codes are organized and defined in table 2 below. Table 2 has been organized by each variables description in an outline form. Please see the example below for a better description:

Example:

(geographic code)+(topic code)+(element code)

"mw"+"001"+"001"

mw001001

In the case of the example above the variable code would signify the topic "hydrologic unit description" (topic code = "001") and the element "area" (element code = "001"). The data is constrained to the portions of the watersheds (10 digit) that are inside the metro boundary (geographic code = "mw").

Table 1: Geographic Codes

Geographic Code / Table Code	Description
SB	All or Portions of the Six Sub-Basin Level (8 digit) Units that fall within the Study Area. There are 6 of these.
SW	All Watershed level (10 digit) units that fall within the Study Area. There are 12 of these areas.
SS	All Sub-Watershed level units (12 digit) that fall within the Study area. There are 82 of these.
MB	Portions of the Six Sub-Basin Level (8 digit) Units that fall within the Study Area and are Inside the Metro Service District Boundary. There are 6 of these.
MW	All Watershed level units (10 digit) that fall within the Study area and are inside the Metro Service District Boundary. There are 12 of these.
MS	All Sub-Watershed level units (12 digit) that fall within the Study area and are inside the Metro Service District Boundary. There are 41 of these.
MR	Sites boundaries are derived from sub-watershed units that are inside the Metro Service District Boundary. Some smaller units were combined. There are 27 of these.

Data Dictionary

Table 2: Topic and Element Codes

Topic Code	Element Code		
001		**A.**	**Hydrologic Unit Description (001001 – 001007)**
	001	1.	Area
	002	2.	Total Surface Area
		3.	Elevation
	003		a. Minimum
	004		b. Maximum
	005		c. Range
	006		c. Mean
	007		d. Standard Deviation
002		**B.**	**Hydrography - Streams Rivers & Lakes (002001 – 002007)**
		1.	Total Stream Length
	001		a. Low to medium channel type (floodplain streams)
	002		b. High channel type
	003		c. Stream links (piped streams)
	004		d. All Others
	005	2.	Total Water Area For Major Streams
	006	3.	Total Water Area For Hydrologically connected Lakes & other Water Bodies
	007	4.	Total Area for Non-Hydrologically connected Lakes and other Water Bodies Bodies
003		**C.**	**Wetlands, Floodplains and Hydric Soils (003001 – 003005)**
	001	1.	Total Hydrologically Connected Wetland Area
	002	2.	Total Floodplain Area
	003	3.	Total Hydric soils area
	004	4.	Total area for non-hydrologically connected wetlands
	005	5.	Total developed floodplain area
004		**D.**	**Land Cover and Vegetation (004001 – 004026)**
		1.	Total 1998 Landsat Landcover Area
	001		a. Water
	002		b. Barren
	003		c. Low structure agriculture
	004		d. High structure agriculture
	005		e. Deciduous closed canopy
	006		f. Mixed closed canopy forest
	007		g. Conifer closed canopy forest
	008		h. Deciduous open canopy forest
	009		i. Mixed open canopy forest
	010		j. Conifer open canopy forest
	011		k. Deciduous scattered canopy forest
	012		l. Mixed scattered canopy forest
	013		m. Conifer scattered canopy forest
	014		n. Closed canopy shrub
	015		o. Open canopy shrub
	016		p. Scattered canopy shrub
	017		q. Meadow/grass
	018		r. Not classified
		2.	Total 1998 Landsat Percent Canopy Closure Area
	019		a. 0-25% Forest Canopy Closure
	020		b. 26-50% Forest Canopy Closure
	021		c. 51-75 % Forest Canopy Closure

022 d. 76-100% Forest Canopy Closure

3. Total 2000 Metro Photo Interpretation Landcover Area
023 a. Low structure vegetation or intact topsoil within 300 feet of surface stream
024 b. Non-Forested woody vegetation within 300 feet of a surface stream
025 c. Forested vegetation within 300 feet of a surface stream
026 d. Forested vegetation greater than 300 feet from a surface stream.

005 **E. Hypsography (005001 – 005004)**
1. Total area by percent slope
001 a. Slopes form 7% to 14%
002 b. Slopes from 15% to 24%
003 c. Slopes of 25% or more
004 2. Total area within steeply sloped ravines

006 **F. Fish Presence By Species (006001 - 006026)**
1. Stream length believed to currently contain Coho Salmon Runs
001 a. 100k Level Streams
002 b. Tributaries
2. Stream length believed to currently contain Spring Chinook Runs
003 a. 100k Level Streams
004 b. Tributaries
3. Stream length Believed to currently contain Summer Chinook Runs
005 a. 100k Level Streams
006 b. Tributaries
4. Stream length Believed to currently contain Fall Chinook Runs
007 a. 100k Level Streams
008 b. Tributaries
5. Stream length Believed to currently contain Sockeye Runs
009 a. 100k Level Streams
010 b. Tributaries
6. Stream Length Believed to Currently Contain Chum Runs
011 a. 100k Level Streams
012 b. Tributaries
7. Stream length Believed to currently contain Summer Steelhead Runs
013 a. 100k Level Streams
014 b. Tributaries
8. Stream length Believed to currently contain Winter Steelhead Runs
015 a. 100k Level Streams
016 b. Tributaries
9. Stream length Believed to currently contain Cutthroat Trout
017 a. 100k Level Streams
018 b. Tributaries
10. Stream length Believed to currently contain Bull Trout
019 a. 100k Level Streams
020 b. Tributaries
11. Stream Length believed to currently bear any Anadramous Species
021 a. 100k Level Streams
022 b. Tributaries
12. Stream Length believed to currently contain sturgeon
023 a. 100k Level Streams
024 b. Tributaries
13. Stream Length believed to currently or historically bear any fish species
025 a. 100k Level Streams
026 b. Tributaries

007 **G. Riparian Model Scoring (007001-007016)**
1. Total area Receiving Value for Microclimate and Shade
001 a. Primary 6 points

002 b. Secondary 1 point

2. Total area Receiving Value for Stream flow Mod. & Water storage

003 a. Primary 6 points

004 b. Secondary 1 point

3. Total area Receiving Value for Bank Stabilization and Pollution Control

005 a. Primary 6 points

006 b. Secondary 1 point

4. Total area Receiving Value for Large Wood and Channel Dynamics

007 a. Primary 6 points

008 b. Secondary 1 point

5. Total area Receiving Value for Organic Material Sources

009 a. Primary 6 points

010 b. Secondary 1 point

6. Total Area Receiving Riparian Score

011 a. Scored 1 to 5

012 b. Scored 6 to 11

013 c. Scored 12 to 17

014 d. Scored 18 to 23

015 e. Scored 24 to 29

016 f. Scored 30

008 **H. Human Disturbance Factors (008001-008086)**

1. Stream Crossings

001 a. Culverted Road Crossings

002 b. Unculverted Road Crossings

003 2. Total Road length

004 3. Total area considered developed for planning purposes

005 4. Total Area Inside UGB

006 5. Building permits issued for new structures since 1996

6. Stream Length listed as water quality limited (303d) for fecal, E Coli

007 a. 100k Level Streams

008 b. Tributaries

7. Stream Length listed as water quality limited (303d) for total dissolved gasses

009 a. 100k Level Streams

010 b. Tributaries

8. Stream Length listed as water quality limited (303d) for turbidity

011 a. 100k Level Streams

012 b. Tributaries

9. Stream Length listed as water quality limited (303d) for PH

013 a. 100k Level Streams

014 b. Tributaries

10. Stream Length listed as water quality limited (303d) for toxins

015 a. 100k Level Streams

016 b. Tributaries

11. Stream Length listed as water quality limited (303d) for sediments

017 a. 100k Level Streams

018 b. Tributaries

12. Stream Length listed as water quality limited (303d) for dissolved oxygen

019 a. 100k Level Streams

020 b. Tributaries

13. Stream Length listed as water quality limited (303d) for biological criteria

021 a. 100k Level Streams

022 b. Tributaries

14. Stream Length listed as water quality limited (303d) for nutrients

023 a. 100k Level Streams

024 b. Tributaries

15. Stream Length listed as water quality limited (303d) for aquatic growth

025 a. 100k Level Streams
026 b. Tributaries
16. Stream Length listed as water quality limited (303d) for flow modification
027 a. 100k Level Streams
028 b. Tributaries
17. Stream Length listed as water quality limited (303d) for habitat modification
029 a. 100k Level Streams
030 b. Tributaries
18. Stream Length listed as water quality limited (303d) for temperature
031 a. 100k Level Streams
032 b. Tributaries
19. Total Stream Length listed as water quality limited (303d) for any factor
033 a. 100k Level Streams
034 b. Tributaries
035 20. Number of Oregon Water Quality Index Data Collection Points
036 21. Number of Clean Water Services RSAT Data Collection Points
037 22. Total stream length surveyed as part of ODFW Aquatic Inventory Project.
23. Total Area by Current Generalized Zoning Class
038 a. Industrial
039 b. Commercial
040 c. Multi-Family Residential
041 d. Public / Open Space
042 e. Rural
043 f. Single Family Residential
044 g. Mixed Use
24. Total area by 2040 Design types
045 a. Central City
046 b. Regional Centers
047 c. Town Centers
048 d. Inner Neighborhoods
049 e. Outer Neighborhoods
050 f. Employment Areas
051 g. Industrial Areas
052 h. Corridors
053 i. Station Core
054 j. Station Areas
055 k. Main Streets
25. Total Area by local Planning Jurisdiction
056 a. Unincorporated Clackamas County
057 b. Unincorporated Multnomah County
058 c. Unincorporated Washington County
059 e. City of Beaverton
060 f. City of Cornelius
061 g. City of Durham
062 h. City of Fairview
063 i. City of Forest Grove
064 j. City of Gladstone
065 k. City of Gresham
066 l. City of Happy Valley
067 m. City of Hillsboro
068 n. City of Johnson City
069 o. City of King City
070 p. City of Lake Oswego
071 q. City of Maywood Park
072 r. City of Milwaukee
073 s. City of Oregon City

074 t. City of Portland
075 u. Rivergrove
076 v. City of Sherwood
077 w. City of Tigard
078 x. City of Troutdale
079 y. City of Tualatin
080 z. City of West Lyn
081 aa. City of Wilsonville
082 bb. Wood Village

24. cntd Total area by 2040 Design types

083 l. Water
084 m. Open spaces
085 n. Parks

1. cntd Stream Crossings

086 c. Culverts bad for fish passage

009 **I. Wildlife Patches (009001-009024)**

1. Total area of patches by 2000 Metro Photo Interpretation Landcover and Known Wetlands

001 a. Forests
002 b. Shrub/Scrubs
003 c. Grasslands
004 d. Forested Wetlands
005 e. Grass/shrub Wetlands
006 e. Other Wetlands

2. Total area of patches by 1998 Landsat Landcover Area

007 a. Water
008 b. Barren
009 c. Low structore agriculture
010 d. High structure agriculture
011 e. Deciduous closed canopy
012 f. Mixed closed canopy forest
013 g. Conifer closed canopy forest
014 h. Deciduous open canopy forest
015 i. Mixed open canopy forest
016 j. Conifer open canopy forest
017 k. Deciduous scattered canopy forest
018 l. Mixed scattered canopy forest
019 m. Conifer scattered canopy forest
020 n. Closed canopy shrub
021 o. Open canopy shrub
022 p. Scattered canopy shrub
023 q. Meadow/grass
024 r. Not classified

010 **J. Sensitive Species of Concern (SOCs) and Habitats of Concern (HOCs) (010001-010021)**

001 1. Total number of SOCs

2. Total area of HOCs (including small wetlands < 2 acres)

002 a. Inside Patches
003 b. Outside Patches

3. Total area of outside HOCs (including small wetlands < 2 acres) by Landsat Landcover Area

004 a. Water
005 b. Barren
006 c. Low structore agriculture

007 d. High structure agriculture
008 e. Deciduous closed canopy
009 f. Mixed closed canopy forest
010 g. Conifer closed canopy forest
011 h. Deciduous open canopy forest
012 i. Mixed open canopy forest
013 j. Conifer open canopy forest
014 k. Deciduous scattered canopy forest
015 l. Mixed scattered canopy forest
016 m. Conifer scattered canopy forest
017 n. Closed canopy shrub
018 o. Open canopy shrub
019 p. Scattered canopy shrub
020 q. Meadow/grass
021 r. Not classified

011 K. Wildlife Model Scoring (011001-011021)

1. Total area for cummulative wildlife score
001 a. For a score of 9 points
002 b. For a score of 8 points
003 c. For a score of 7 points
004 d. For a score of 6 points
005 e. For a score of 5 points
006 f. For a score of 4 points
007 g. For a score of 3 points
008 h. For a score of 2 points
009 i. For a score of 1 point

2. Total area by score for overall patch size
010 a. For a score of 3 points
011 b. For a score of 2 points
012 c. For a score of 1 point

3. Total area by score for edge to interior
013 a. For a score of 3 points
014 b. For a score of 2 points
015 c. For a score of 1 point

4. Total area by score for proximity to water
016 a. For a score of 3 points
017 b. For a score of 2 points
018 c. For a score of 1 point

5. Total area by score for poximity to other patches
019 a. For a score of 3 points
020 b. For a score of 2 points
021 c. For a score of 1 point

TABLE 3 – Item Descriptions for Site and Watershed Data

CODE	ELEMENT	DESCRIPTION	UNITS	Data Used from Table 1 in Appendix D
MR001- Hydrologic Unit Description - (MR001001- MR001007)				
MR001001	Area	Total 2 dimensional area for each watershed calculated through GIS methods using Regional 12 digit hydrologic unit data.	Acres	METRO RES, METRO MET
MR001002	Total surface area	Total drainage area corrected by vertical relief. Calculated using GIS methodology and a digital elevation model.	Acres	METRO RES, METRO DEM, METRO MET
MR001003	Minimum elevation	The lowest elevation measured in the watershed.	Feet	METRO RES, METRO DEM, METRO MET
MR001004	Maximum elevation	The Highest elevation measured in the watershed.	Feet	METRO RES, METRO DEM, METRO MET
MR001005	Range of elevation	The difference between the highest and lowest measured elevations within the watershed.	Feet	METRO RES, METRO DEM, METRO MET
MR001006	Mean elevation	The mean elevation derived by finding the central tendency for all measured elevations within the watershed using a digital elevation model.	Feet	METRO RES, METRO DEM, METRO MET
MR001007	Standard deviation of elevation	The standard deviation or variance for all measured elevations from the mean elevation in variable MR001006. Calculated using GIS methodology and a digital elevation model.	Feet	METRO RES, METRO DEM, METRO MET
MR002 – Hydrography – Streams, Rivers, & Lakes (MR002001 – MR002008)				
MR002001	Total stream length in low to medium channel type floodplain streams	Miles of streams within the watershed that have Oregon watershed enhancement board Geomorphic characteristics for low to medium gradient streams.	Miles	METRO RES, METRO CHT, METRO STR, METRO MET
MR002002	Total stream length in high channel type streams	Miles of streams within the watershed that have Oregon watershed enhancement board Geomorphic characteristics for high gradient streams.	Miles	METRO RES, METRO CHT, METRO STR, METRO MET
MR002003	Total stream lengths of stream links	Miles of streams that run under the ground through pipes.	Miles	METRO RES, METRO CHT, METRO STR, METRO MET
MR002004	Total length of all other types of streams	Miles of streams that are depicted but not classified.	Miles	METRO RES, METRO CHT, METRO STR, METRO MET
MR002005	Total water area for major streams	The water area for major rivers and streams. Includes Willamette and Columbia water areas.	Acres	METRO RES, METRO OWT, METRO MET
MR002006	Total water area for hydrologically connected lakes and other water bodies	Total square acres of major lakes and other water bodies within the metro boundary summarized by Site. Water bodies are considered hydrologically connected if their boundaries begin within ¼ mile of a riparian corridor.	Acres	METRO RES, METRO OWT, METRO MET
MR002007	Total area for non-hydrologically connected lakes and other water bodies	Total square acres of major lakes and other water bodies within the metro boundary summarized by Site. Water bodies are considered non-hydrologically connected if their boundaries occur outside of ¼ mile of a riparian corridor.	Acres	METRO RES, METRO OWT, METRO MET
MR003 – Wetlands, Floodplains and Hydric Soils - (MR003001 – MR003003)				
MR003001	Total hydrologically connected wetland area	Total square acres of natural wetlands within the metro boundary summarized by Site. Wetlands mapped by the National Wetland Inventory and later updated as a part of the Title 3 water quality process. Additionally modified to incorporate information from local government review and local wetland inventories. For more information, see Appendix G – Methodology for incorporation of	Acres	METRO RES, METRO WET, METRO STR, METRO MET

The DRC metadata viewer is located on Metro's Intranet website (intramet), under Departments, DRC, MetaData Viewer. External metadata can be found in a Binder in Metro's Long-Range Planning Department.

CODE	ELEMENT	DESCRIPTION	UNITS	Data Used from Table 1 in Appendix D
		Local Wetlands Inventory into Metro Wetlands layer. Wetlands are considered hydrologically connected if the wetland boundary begins within ¼ mile of a riparian corridor.		
MR003002	Total floodplain area	Total square acres of floodplain within the metro boundary summarized by Site. Floodplains (FEMA 1996) are areas covered by the 100-year floodplain mapped for the Federal Emergency Management Administration and/or areas mapped as inundated during the 1996 flood event by the Army Corps of Engineers, excluding ponded areas as noted by local governments.	Acres	METRO RES, METRO FLD, METRO MET
MR003003	Total hydric soils area	Total square acres of Hydric Soils within the metro boundary summarized by Site. Hydric Soils are from Natural Resource Conservation Service (NRCS) soils mapping. The hydric layer is derived from NRCS soil mapping and allows easy mapping of the hydric soil information.	Acres	METRO RES, METRO SOI, METRO MET
MR003004	Total area for non-hydrologically connected wetlands	Total square acres of natural wetlands within the metro boundary summarized by Site.. Wetlands mapped by the National Wetland Inventory and later updated as a part of the Title 3 water quality process. Additionally modified to incorporate information from local government review and local wetland inventories. For more information, see Appendix G – Methodology for incorporation of Local Wetlands Inventory into Metro Wetlands layer. Wetlands are considered non-hydrologically connected if the wetland boundary begins outside of ¼ mile of a riparian corridor.	Acres	METRO RES, METRO WET, METRO STR, METRO MET
MR003005	Total area for developed floodplains	Total square acres of developed floodplains within Metro jurisdiction, summarized by Site. "Developed Floodplains" are developed lands polygons within the floodplain where no digitized forest canopy, wetlands, open water, golf courses, parks or open spaces polygons occur. For more information, see Appendix F – Methodology for identifying developed floodplains.	Acres	METRO RES, METRO DFLD, METRO MET
MR004 Land Cover and Vegetation (MR004001 – MR004025)				
MR004001	Total 1998 Landsat Landcover area of water	Total square acres of water (from the 1998 Landsat landcover classification) within Metro, summarized by Site.	Acres	METRO RES, METRO MET, METRO LC98
MR004002	Total 1998 Landsat Landcover area of barren land	Total square acres of barren land (from the 1998 Landsat landcover classification) within Metro, summarized by Site.	Acres	METRO RES, METRO MET, METRO LC98
MR004003	Total 1998 Landsat Landcover area of low structure agriculture	Total square acres of low structure agriculture (from the 1998 Landsat landcover classification) within Metro, summarized by Site.	Acres	METRO RES, METRO MET, METRO LC98
MR004004	Total 1998 Landsat Landcover area of high structure agriculture	Total square acres of high structure agriculture (from the 1998 Landsat landcover classification) within Metro, summarized by Site.	Acres	METRO RES, METRO MET, METRO LC98
MR004005	Total 1998 Landsat Landcover area of deciduous closed canopy	Total square acres of deciduous closed canopy (from the 1998 Landsat landcover classification) within Metro, summarized by Site.	Acres	METRO RES, METRO MET, METRO LC98
MR004006	Total 1998 Landsat Landcover area of mixed closed canopy	Total square acres of mixed closed canopy (from the 1998 Landsat landcover classification) within Metro, summarized by Site.	Acres	METRO RES, METRO MET, METRO LC98

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CODE	ELEMENT	DESCRIPTION	UNITS	Data Used from Table 1 in Appendix D
MR004007	Total 1998 Landsat Landcover area of conifer closed canopy forest	Total square acres of conifer closed canopy (from the 1998 Landsat landcover classification) within Metro, summarized by Site.	Acres	METRO RES, METRO MET, METRO LC98
MR004008	Total 1998 Landsat Landcover area of deciduous open canopy forest	Total square acres of deciduous open canopy forest (from the 1998 Landsat landcover classification) within Metro, summarized by Site.	Acres	METRO RES, METRO MET, METRO LC98
MR004009	Total 1998 Landsat Landcover area of mixed open canopy forest	Total square acres of mixed open canopy forest (from the 1998 Landsat landcover classification) within Metro, summarized by Site.	Acres	METRO RES, METRO MET, METRO LC98
MR004010	Total 1998 Landsat Landcover area of conifer open canopy forest	Total square acres of conifer open canopy forest (from the 1998 Landsat landcover classification) within Metro, summarized by Site.	Acres	METRO RES, METRO MET, METRO LC98
MR004011	Total 1998 Landsat Landcover area of deciduous scattered canopy forest	Total square acres of deciduous scattered canopy forest (from the 1998 Landsat landcover classification) within Metro, summarized by Site.	Acres	METRO RES, METRO MET, METRO LC98
MR004012	Total 1998 Landsat Landcover area of mixed scattered canopy forest	Total square acres of mixed scattered canopy forest (from the 1998 Landsat landcover classification) within Metro, summarized by Site.	Acres	METRO RES, METRO MET, METRO LC98
MR004013	Total 1998 Landsat Landcover area of conifer scattered canopy forest	Total square acres of conifer scattered canopy forest (from the 1998 Landsat landcover classification) within Metro, summarized by Site.	Acres	METRO RES, METRO MET, METRO LC98
MR004014	Total 1998 Landsat Landcover area of closed canopy shrub	Total square acres of closed canopy shrub (from the 1998 Landsat landcover classification) within Metro, summarized by Site.	Acres	METRO RES, METRO MET, METRO LC98
MR004015	Total 1998 Landsat Landcover area of open canopy shrub	Total square acres of open canopy shrub (from the 1998 Landsat landcover classification) within Metro, summarized by Site.	Acres	METRO RES, METRO MET, METRO LC98
MR004016	Total 1998 Landsat Landcover area of scattered canopy shrub	Total square acres of scattered canopy shrub (from the 1998 Landsat landcover classification) within Metro, summarized by Site.	Acres	METRO RES, METRO MET, METRO LC98
MR004017	Total 1998 Landsat Landcover area of meadow/grass	Total square acres of meadow/grass (from the 1998 Landsat landcover classification) within Metro, summarized by Site.	Acres	METRO RES, METRO MET, METRO LC98
MR004018	Total 1998 Landsat Landcover area of not classified	Total square acres of non-classified land (from the 1998 Landsat landcover classification) within Metro, summarized by Site.	Acres	METRO RES, METRO MET, METRO LC98
MR004019	Total 1998 Landsat percent canopy closure area of 0-25% forest canopy closure	Total square acres of 0-25% forest canopy closure area (from the 1998 Landsat landcover classification) within Metro, summarized by Site.	Acres	METRO RES, METRO MET, METRO VC98
MR004020	Total 1998 Landsat percent canopy closure area of 26-50% forest canopy closure	Total square acres of 26%-50% forest canopy closure area (from the 1998 Landsat landcover classification) within Metro, summarized by Site.	Acres	METRO RES, METRO MET, METRO VC98
MR004021	Total 1998 Landsat percent canopy closure area of 51-75% forest canopy closure	Total square acres of 51%-75% forest canopy closure area (from the 1998 Landsat landcover classification) within Metro, summarized by Site.	Acres	METRO RES, METRO MET, METRO VC98
MR004022	Total 1998 Landsat percent canopy closure area of 76-100% forest canopy closure	Total square acres of 76%-100% forest canopy closure area (from the 1998 Landsat landcover classification) within Metro, summarized by Site.	Acres	METRO RES, METRO MET, METRO VC98

The DRC metadata viewer is located on Metro's Intranet website (intramet), under Departments, DRC, MetaData Viewer. External metadata can be found in a Binder in Metro's Long-Range Planning Department.

CODE	ELEMENT	DESCRIPTION	UNITS	Data Used from Table 1 in Appendix D
MR004023	Total 2000 Metro Photo Interpretation landcover area of low structure vegetation or intact topsoil within 300 feet of surface stream	Total square acres of low structure vegetation within 300 feet of a surface stream (found through a stream buffer overlay analysis) within the metro boundary summarized by Site. Land cover classes generally larger than one acre in size. Delineated at a scale of 1:4800 using 2000 aerial photos and generalized criteria by the Metro Data Resource Center.	Acres	METRO RES, METRO MET, METRO VEG, METRO STR
MR004024	Total 2000 Metro Photo Interpretation landcover area non-forested woody vegetation within 300 feet of a surface stream	Total square acres of non-forested woody vegetation within 300 feet of a surface stream (found through a stream buffer overlay analysis) within the metro boundary summarized by Site. Land cover classes generally larger than one acre in size. Delineated at a scale of 1:4800 using 2000 aerial photos and generalized criteria by the Metro Data Resource Center.	Acres	METRO RES, METRO MET, METRO VEG, METRO STR
MR004025	Total 2000 Metro Photo Interpretation landcover area of forested vegetation within 300 feet of a surface stream	Total square acres of forested vegetation within 300 feet of a surface stream (found through a stream buffer overlay analysis) within the metro boundary summarized by Site. Land cover classes generally larger than one acre in size. Delineated at a scale of 1:4800 using 2000 aerial photos and generalized criteria by the Metro Data Resource Center.	Acres	METRO RES, METRO MET, METRO VEG, METRO STR
MR004026	Total 2000 Metro Photo Interpretation landcover area of forested vegetation greater than 300 feet from a surface stream	Total square acres of forested vegetation in areas greater than 300 feet from a surface stream (found through a stream buffer overlay analysis) within the metro boundary summarized by Site. Land cover classes generally larger than one acre in size. Delineated at a scale of 1:4800 using 2000 aerial photos and generalized criteria by the Metro Data Resource Center.	Acres	METRO RES, METRO MET, METRO VEG, METRO STR
MR005 – Hypsography (MR005001 – MR005004)				
MR005001	Total area by percent slope of slopes form 7% to 14%	Slopes of 7-14% derived from the USGS DEMs, summarized by Site.	Acres	METRO RES, METRO MET, METRO RAV, USGS DEM
MR005002	Total area by percent slope of slopes from 15% to 24%	Slopes of greater than 15-25% derived from the USGS DEMs, summarized by Site.	Acres	METRO RES, METRO MET, METRO RAV, USGS DEM
MR005003	Total area by percent slope of slopes of 25% or more	Slopes of greater than 25% derived from the USGS DEMs, summarized by Site.	Acres	METRO RES, METRO MET, METRO RAV, USGS DEM
MR005004	Total area within steeply sloped ravines	Steep slopes of greater than 25% within 175 feet of streams and extending to the first effective break in slope derived from the USGS DEMs, summarized by Site.	Acres	METRO RES, METRO MET, METRO RAV, USGS DEM
MR006 – Fish Presence by Species (MR006001 – MR006026)				
MR006001	Stream length believed to currently contain Coho Salmon Runs - 100k Level Streams	Total linear length in miles of 100K streams with areas of Coho salmon habitat within the metro boundary summarized by Site. These areas of "currently" suitable habitat are believed to be utilized by wild, natural, and/or hatchery fish populations. The term "currently" is defined as within the past five reproductive cycles.	Miles	ODFW DCO
MR006002	Stream length believed to currently contain Coho Salmon Runs - Tributaries	ODFW has not completed the 1:24,000K fish distribution coverages yet.	Miles	ODFW
MR006003	Stream length believed to currently contain Spring Chinook Runs - 100k Level Streams	Total linear length in miles of 100K streams with areas of SPRING CHINOOK habitat within the metro boundary summarized by Site. These areas of "currently" suitable habitat are believed to be utilized by wild, natural, and/or hatchery fish populations. The term "currently" is defined as within the past five reproductive cycles.	Miles	ODFW DCI2

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CODE	ELEMENT	DESCRIPTION	UNITS	Data Used from Table 1 in Appendix D
MR006004	Stream length believed to currently contain Spring Chinook Runs – Tributaries	ODFW has not completed the 1:24,000K fish distribution coverages yet.	Miles	ODFW
MR006005	Stream length believed to currently contain Summer Chinook Runs - 100k Level Streams	Total linear length in miles of 100K streams with areas of SUMMER CHINOOK habitat within the metro boundary summarized by Site. These areas of "currently" suitable habitat are believed to be utilized by wild, natural, and/or hatchery fish populations. The term "currently" is defined as within the past five reproductive cycles.	Miles	PSMFC DXX
MR006006	Stream length believed to currently contain Summer Chinook Runs – Tributaries	PSMFC / ODFW has not completed the 1:24,000K fish distribution coverages yet.	Miles	PSMFC
MR006007	Stream length believed to currently contain Fall Chinook Runs - 100k Level Streams	Total linear length in miles of 100K streams with areas of FALL CHINOOK habitat within the metro boundary summarized by Site. These areas of "currently" suitable habitat are believed to be utilized by wild, natural, and/or hatchery fish populations. The term "currently" is defined as within the past five reproductive cycles.	Miles	ODFW DCI1
MR006008	Stream length believed to currently contain Fall Chinook Runs – Tributaries	ODFW has not completed the 1:24,000K fish distribution coverages yet.	Miles	ODFW
MR006009	Stream length believed to currently contain Sockeye Runs - 100k Level Streams	Total linear length in miles of 100K streams with areas of SOCKEYE habitat within the metro boundary summarized by Site. These areas of "currently" suitable habitat are believed to be utilized by wild, natural, and/or hatchery fish populations. The term "currently" is defined as within the past five reproductive cycles.	Miles	PSMFC DSN
MR006010	Stream length believed to currently contain Sockeye Runs – Tributaries	PSMFC / ODFW has not completed the 1:24,000K fish distribution coverages yet.	Miles	PSMFC
MR006011	Stream length believed to currently contain Chum Runs – 100k Level Streams	Total linear length in miles of 100K streams with areas of CHUM habitat within the metro boundary summarized by Site. These areas of "currently" suitable habitat are believed to be utilized by wild, natural, and/or hatchery fish populations. The term "currently" is defined as within the past five reproductive cycles.	Miles	ODFW DCH
MR006012	Stream length believed to currently contain Chum Runs – Tributaries	ODFW has not completed the 1:24,000K fish distribution coverages yet.	Miles	ODFW
MR006013	Stream length believed to currently contain Summer Steelhead Runs - 100k Level Streams	Total linear length in miles of 100K streams with areas of SUMMER STEELHEAD habitat within the metro boundary summarized by Site. These areas of "currently" suitable habitat are believed to be utilized by wild, natural, and/or hatchery fish populations. The term "currently" is defined as within the past five reproductive cycles.	Miles	ODFW DSS
MR006014	Stream length believed to currently contain Summer Steelhead Runs – Tributaries	ODFW has not completed the 1:24,000K fish distribution coverages yet.	Miles	ODFW
MR006015	Stream length believed to currently contain Winter Steelhead Runs - 100k Level Streams	Total linear length in miles of 100K streams with areas of WINTER STEELHEAD habitat within the metro boundary summarized by Site. These areas of "currently" suitable habitat are believed to be utilized by wild, natural, and/or hatchery fish populations. The term "currently" is defined as within the past five reproductive cycles.	Miles	ODFW DSW

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CODE	ELEMENT	DESCRIPTION	UNITS	Data Used from Table 1 in Appendix D
MR006016	Stream length believed to currently contain Winter Steelhead Runs – Tributaries	ODFW has not completed the 1:24,000K fish distribution coverages yet.	Miles	ODFW
MR006017	Stream length believed to currently contain Lahontan Cutthroat Trout Runs - 100k Level Streams	Total linear length in miles of 100K streams with areas of CUTTHROAT habitat within the metro boundary summarized by Site. These areas of "currently" suitable habitat are believed to be utilized by wild, natural, and/or hatchery fish populations. The term "currently" is defined as within the past five reproductive cycles.	Miles	ODFW DCT
MR006018	Stream length believed to currently contain Lahontan Cutthroat Trout Runs – Tributaries	ODFW has not completed the 1:24,000K fish distribution coverages yet.	Miles	ODFW
MR006019	Stream length believed to currently contain Bull trout Runs – 100k Level Streams	Total linear length in miles of 100K streams with areas of BULL TROUT habitat within the metro boundary summarized by Site. These areas of "currently" suitable habitat are believed to be utilized by wild, natural, and/or hatchery fish populations. The term "currently" is defined as within the past five reproductive cycles.	Miles	ODFW BTD
MR006020	Stream length believed to currently contain Bull trout Runs – Tributaries	ODFW has not completed the 1:24,000K fish distribution coverages yet.	Miles	ODFW
MR006021	Stream length believed to currently contain all anadromous species Runs – 100k Level Streams	Total linear length in miles of 100K streams with areas of ALL anadromous FISH habitat within the metro boundary summarized by Site. These areas of "currently" suitable habitat are believed to be utilized by wild, natural, and/or hatchery fish populations. The term "currently" is defined as within the past five reproductive cycles.	Miles	PSMFC DAF
MR006022	Stream length believed to currently contain all anadromous species Runs – Tributaries	PSMFC / ODFW has not completed the 1:24,000K fish distribution coverages yet.	Miles	PSMFC
MR006023	Stream length believed to currently contain White Sturgeon Runs - 100k Level Streams	Total linear length in miles of 100K streams with areas of STURGEON habitat within the metro boundary summarized by Site. These areas of "currently" suitable habitat are believed to be utilized by wild, natural, and/or hatchery fish populations. The term "currently" is defined as within the past five reproductive cycles.	Miles	PSMFC DWS
MR006024	Stream length believed to currently contain White Sturgeon Runs – Tributaries	PSMFC / ODFW has not completed the 1:24,000K fish distribution coverages yet.	Miles	PSMFC
MR006025	Stream length believed to currently or historically bear any fish species - 100k Level Streams	Data was not available as of June 2002.	Miles	PORT HISSAL
MR006026	Stream length believed to or historically bear any fish species – Tributaries	Data was not available as of June 2002.	Miles	PORT
MR007 – Riparian Model Scoring (MR007001 – MR00716)				

The DRC metadata viewer is located on Metro's Intranet website (intramet), under Departments, DRC, MetaData Viewer. External metadata can be found in a Binder in Metro's Long-Range Planning Department.

CODE	ELEMENT	DESCRIPTION	UNITS	Data Used from Table 1 in Appendix D
MR007001	Total area receiving value for Microclimate and Shade – Primary 6 points	Total square acres of a forest or woody vegetation landcover type within 100 feet of a surface stream; a hydrologically connected wetland (begins within ¼ mile of a stream); or an area subject to flooding – summarized by Site. For more information see Appendix J – Riparian model criteria.	Acres	METRO RES, METRO MET, METRO RMR
MR007002	Total area receiving value for Microclimate and Shade – Secondary 1 point	Total square acres of a forest or woody vegetation landcover type that is contiguous to the primary area (100 feet) and extends outward to 780 feet. For more information see Appendix J - Riparian model criteria.	Acres	METRO RES, METRO MET, METRO RMR
MR007003	Total area receiving value for Stream flow Mod. & Water storage -Primary 6 points	Total square acres of a wetland or other water body with a hydrologic connection to a surface stream (begins within ¼ mile of a stream); OR an area subject to flooding except developed floodplains – summarized by Site. For more information see Appendix J - Riparian model criteria.	Acres	METRO RES, METRO MET, METRO RWS
MR007004	Total area receiving value for Stream flow Mod. & Water storage -Secondary 1 point	Total square acres of a forest, woody vegetation, or low structure vegetation/undeveloped soils landcover type within 300 feet of a surface stream; OR a forest landcover type that is contiguous to the riparian corridor (starts within 300 feet but extends beyond); OR developed floodplains – summarized by Site. For more information see Appendix J - Riparian model criteria.	Acres	METRO RES, METRO MET, METRO RWS
MR007005	Total area receiving value for Bank Stabilization and Pollution Control -Primary 6 points	Total square acres of a landscape feature within 50 feet of a surface stream and is not a forest, woody vegetation, or low structure vegetation/undeveloped soils landcover type; OR a forest, woody vegetation, or low structure vegetation/undeveloped soils landcover type within 100 feet of a surface stream; OR a forest, woody vegetation, or low structure vegetation/undeveloped soils landcover type within 100-200 feet of a surface stream, if the slope is greater than 25%; OR a forest, woody vegetation, or low structure vegetation/undeveloped soils landcover type within 100 feet of a hydrologically connected wetland; a forest, woody vegetation, or low structure vegetation/undeveloped soils landcover type within an area subject to flooding– summarized by Site. For more information see Appendix J - Riparian model criteria.	Acres	METRO RES, METRO MET, METRO RBS
MR007006	Total area receiving value for Bank Stabilization and Pollution Control -Secondary 1 point	Total square acres of a forest, woody vegetation, or low structure vegetation/undeveloped soils landcover type on a slope greater than 25% that starts within 175 feet of a surface stream reach and runs to the first effective break in slope– summarized by Site. For more information see Appendix J - Riparian model criteria.	Acres	METRO RES, METRO MET, METRO RBS
MR007007	Total area receiving value for Large Wood and Channel Dynamics -Primary 6 points	Total area of a forest landcover type within 150 feet of a surface stream or a hydrologically connected wetland; OR within an area subject to flooding except developed floodplains; OR within 50 feet of a surface stream– summarized by Site. For more information see Appendix J - Riparian model criteria.	Acres	METRO RES, METRO MET, METRO RLW
MR007008	Total area receiving value for Large Wood and Channel Dynamics –Secondary 1 point	Total square acres of a forest landcover type within 150 to 262 feet of a surface stream– summarized by Site. For more information see Appendix J - Riparian model criteria.	Acres	METRO RES, METRO MET, METRO RLW

The DRC metadata viewer is located on Metro's Intranet website (intramet), under Departments, DRC, MetaData Viewer. External metadata can be found in a Binder in Metro's Long-Range Planning Department.

CODE	ELEMENT	DESCRIPTION	UNITS	Data Used from Table 1 in Appendix D
MR007009	Total area receiving value for Organic Material Sources - Primary 6 points	Total square acres of a forest or woody vegetation landcover type within 100 feet of a surface stream or a hydrologically connected wetland; OR low structure vegetation/undeveloped soils landcover type within 50 feet of a surface stream or a hydrologically connected wetland; OR a forest, woody vegetation, or low structure vegetation/undeveloped topsoil landcover type within an area subject to flooding– summarized by Site. For more information see Appendix J - Riparian model criteria.	Acres	METRO RES, METRO MET, METRO ROM
MR007010	Total area receiving value for Organic Material Sources - Secondary 1 point	Total square acres of a forest or woody vegetation landcover type within 100 to 170 feet of a surface stream– summarized by Site. For more information see Appendix J - Riparian model criteria.	Acres	METRO RES, METRO MET, METRO ROM
MR007011	Total area receiving Riparian Score - 1 to 5	Total square acres of landscape features (scored in MR007001-MR007010) receiving a cumulative score of 1-5 points. For more information see Appendix J - Riparian model criteria.	Acres	METRO RES, METRO MET, METRO RIP
MR007012	Total area receiving Riparian Score - 6 to 11	Total square acres of landscape features (scored in MR007001-MR007010) receiving a cumulative score of 6-11 points. For more information see Appendix J - Riparian model criteria.	Acres	METRO RES, METRO MET, METRO RIP
MR007013	Total area receiving Riparian Score - 12 to 17	Total square acres of landscape features (scored in MR007001-MR007010) receiving a cumulative score of 12-17 points. For more information see Appendix J - Riparian model criteria.	Acres	METRO RES, METRO MET, METRO RIP
MR007014	Total area receiving Riparian Score - 18 to 23	Total square acres of landscape features (scored in MR007001-MR007010) receiving a cumulative score of 18-23 points. For more information see Appendix J - Riparian model criteria.	Acres	METRO RES, METRO MET, METRO RIP
MR007015	Total area receiving Riparian Score - 24 to 29	Total square acres of landscape features (scored in MR007001-MR007010) receiving a cumulative score of 24-29 points. For more information see Appendix J - Riparian model criteria.	Acres	METRO RES, METRO MET, METRO RIP
MR007016	Total area receiving Riparian Score – 30	Total square acres of landscape features (scored in MR007001-MR007010) receiving a cumulative score of 30 points. For more information see Appendix J - Riparian model criteria.	Acres	METRO RES, METRO MET, METRO RIP
MR008 – Human Disturbance Factors (MR008001 – MR008086)				
MR008001	Culverted road stream crossings	Total number of culverted road crossings in each Site within the metro boundary. For the Metro survey potential culverts were initially located by intersecting the RLIS Lite street shapefile with Metro's new stream cover. The potential culverts were all field checked by Victor Vrell who had done the earlier surveys on the County, ODOT and Portland or Gresham roads. He rated culverts according to ODFW standards.	Count - Number	METRO RES, METRO MET, METRO CUL
MR008002	Unculverted (bridges) road stream crossings	Total number of unculverted road crossings (bridges) in each Site within the metro boundary. For the Metro survey potential culverts were initially located by intersecting the RLIS Lite street shapefile with Metro's new stream cover. The potential culverts were all field checked by Victor Vrell who had done the earlier surveys on the County, ODOT and Portland or Gresham roads. He rated culverts according to ODFW standards.	Count - Number	METRO RES, METRO MET, METRO CUL

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CODE	ELEMENT	DESCRIPTION	UNITS	Data Used from Table 1 in Appendix D
MR008003	Total road length	Total linear length in miles of the regional street network within the metro boundary summarized by Site. Streets are categorized by type for cartographic purposes. These streets and address range information are used by 911 centers for dispatch information. Since the accuracy of this information is important for emergency dispatch, they provide updates on a regular basis. Virtually every street in the region is on this map.	Miles	METRO RES, METRO MET, METRO MRD
MR008004	Total area considered developed for planning purposes	Total square acres of METRO'S developed land for planning purposes within the metro boundary summarized by Site. METRO's developed land is the "reverse" of METRO's undeveloped lands layer. In other words, any land (or water) which is not undeveloped is show on the developed layer. * Metro's Vacant Land Definitions Every tax lot is determined to be vacant, partially vacant, or developed. * Vacant tax lots are those that have no building, improvements or identifiable land use. * Developed lots must have improvements and specific land uses. For example, a paved parking lot is developed but an unpaved lot where trucks are parked is vacant. * Lots under site development show building activity, but development is incomplete and they are considered vacant. * If a developed tax lot has 1/2 acre (20,000-sq. ft.) or greater portion that is vacant, the lot is considered to be partially vacant and partially developed. The vacant portion is added to the vacant land database. * Parks and open spaces are treated as developed. * During the assessment of each tax lot, no consideration is given to constrained land, suitability for building, or to redevelopment potential.	Acres	METRO RES, METRO MET, METRO DEV
MR008005	Total area Inside UGB	Total square acres of the urban growth boundary inside each Site within the metro boundary. The urban growth boundary separates urban and urbanize land from rural land. State law requires that a 20-year supply of urbanizable land be included inside its borders at all times.	Acres	METRO RES, METRO MET, METRO UGB
MR008006	Building permits issued for new structures since 1996	Total number of building permits for new structures since 1996 in each Site within the metro boundary. The building permits layer contains permits issued for new construction since July 1996 that geocoded to Metro's taxlot or street network coverages. Permits were geocoded to successive databases and each attempt resulted in less precision. Data inconsistencies within the permits have resulted in some manual geocoding to the most likely taxlot.	Count - Number	METRO RES, METRO MET, METRO BUL
MR008007	Stream length listed as water quality limited (303d) for fecal, E Coli- 100k Level Streams	Total linear length in miles of fecal, E Coli water quality limited (303d) streams within the metro boundary summarized by Site. The 1998 303D Streams Layer is a GIS representation of Oregon's 1998 List of Water Quality Limited Waterbodies. The source for the streams was from the 1:100,000-scale Pacific Northwest River Reach data layer developed by the United States Geological Survey and other Federal and State agencies.	Miles	METRO RES, METRO MET, DEQ 303
MR008008	Stream length listed as water quality limited (303d) for fecal, E Coli- Tributaries	DEQ only has the 1:100,000K 303D streams available in GIS format at this time.	Miles	DEQ

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CODE	ELEMENT	DESCRIPTION	UNITS	Data Used from Table 1 in Appendix D
MR008009	Stream length listed as water quality limited (303d) for total dissolved gas- 100k Level Streams	Total linear length in miles of total dissolved gas water quality limited (303d) streams within the metro boundary summarized by Site. The 1998 303D Streams Layer is a GIS representation of Oregon's 1998 List of Water Quality Limited Waterbodies. The source for the streams was from the 1:100,000-scale Pacific Northwest River Reach data layer developed by the United States Geological Survey and other Federal and State agencies.	Miles	METRO RES, METRO MET, DEQ 303
MR008010	Stream length listed as water quality limited (303d) for total dissolved gasses- Tributaries	DEQ only has the 1:100,000K 303D streams available in GIS format at this time.	Miles	DEQ
MR008011	Stream length listed as water quality limited (303d) for turbidity- 100k Level Streams	Total linear length in miles of turbidity water quality limited (303d) streams within the metro boundary summarized by Site. The 1998 303D Streams Layer is a GIS representation of Oregon's 1998 List of Water Quality Limited Waterbodies. The source for the streams was from the 1:100,000-scale Pacific Northwest River Reach data layer developed by the United States Geological Survey and other Federal and State agencies.	Miles	METRO RES, METRO MET, DEQ 303
MR008012	Stream length listed as water quality limited (303d) for turbidity- Tributaries	DEQ only has the 1:100,000K 303D streams available in GIS format at this time.	Miles	DEQ
MR008013	Stream length listed as water quality limited (303d) for PH- 100k Level Streams	Total linear length in miles of Ph water quality limited (303d) streams within the metro boundary summarized by Site. The 1998 303D Streams Layer is a GIS representation of Oregon's 1998 List of Water Quality Limited Waterbodies. The source for the streams was from the 1:100,000-scale Pacific Northwest River Reach data layer developed by the United States Geological Survey and other Federal and State agencies.	Miles	METRO RES, METRO MET, DEQ 303
MR008014	Stream length listed as water quality limited (303d) for PH- Tributaries	DEQ only has the 1:100,000K 303D streams available in GIS format at this time.	Miles	DEQ
MR008015	Stream length listed as water quality limited (303d) for toxins- 100k Level Streams	Total linear length in miles of toxin(s) water quality limited (303d) streams within the metro boundary summarized by Site. The 1998 303D Streams Layer is a GIS representation of Oregon's 1998 List of Water Quality Limited Waterbodies. The source for the streams was from the 1:100,000-scale Pacific Northwest River Reach data layer developed by the United States Geological Survey and other Federal and State agencies.	Miles	METRO RES, METRO MET, DEQ 303
MR008016	Stream length listed as water quality limited (303d) for toxins- Tributaries	DEQ only has the 1:100,000K 303D streams available in GIS format at this time.	Miles	DEQ
MR008017	Stream length listed as water quality limited (303d) for sediments- 100k Level Streams	Total linear length in miles of sediment water quality limited (303d) streams within the metro boundary summarized by Site. The 1998 303D Streams Layer is a GIS representation of Oregon's 1998 List of Water Quality Limited Waterbodies. The source for the streams was from the 1:100,000-scale Pacific Northwest River Reach data layer developed by the United States Geological Survey and other Federal and State agencies.	Miles	METRO RES, METRO MET, DEQ 303
MR008018	Stream length listed as water quality limited (303d) for sediments- Tributaries	DEQ only has the 1:100,000K 303D streams available in GIS format at this time.	Miles	DEQ

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CODE	ELEMENT	DESCRIPTION	UNITS	Data Used from Table 1 in Appendix D
MR008019	Stream length listed as water quality limited (303d) for dissolved oxygen- 100k Level Streams	Total linear length in miles of dissolved oxygen water quality limited (303d) streams within the metro boundary summarized by Site. The 1998 303D Streams Layer is a GIS representation of Oregon's 1998 List of Water Quality Limited Waterbodies. The source for the streams was from the 1:100,000-scale Pacific Northwest River Reach data layer developed by the United States Geological Survey and other Federal and State agencies.	Miles	METRO RES, METRO MET, DEQ 303
MR008020	Stream length listed as water quality limited (303d) for dissolved oxygen- Tributaries	DEQ only has the 1:100,000K 303D streams available in GIS format at this time.	Miles	DEQ
MR008021	Stream length listed as water quality limited (303d) for biological criteria- 100k Level Streams	Total linear length in miles of biological criteria water quality limited (303d) streams within the metro boundary summarized by Site. The 1998 303D Streams Layer is a GIS representation of Oregon's 1998 List of Water Quality Limited Waterbodies. The source for the streams was from the 1:100,000-scale Pacific Northwest River Reach data layer developed by the United States Geological Survey and other Federal and State agencies.	Miles	METRO RES, METRO MET, DEQ 303
MR008022	Stream length listed as water quality limited (303d) for biological criteria- Tributaries	DEQ only has the 1:100,000K 303D streams available in GIS format at this time.	Miles	DEQ
MR008023	Stream length listed as water quality limited (303d) for nutrients- 100k Level Streams	Total linear length in miles of nutrient(s) water quality limited (303d) streams within the metro boundary summarized by Site. The 1998 303D Streams Layer is a GIS representation of Oregon's 1998 List of Water Quality Limited Waterbodies. The source for the streams was from the 1:100,000-scale Pacific Northwest River Reach data layer developed by the United States Geological Survey and other Federal and State agencies.	Miles	METRO RES, METRO MET, DEQ 303
MR008024	Stream length listed as water quality limited (303d) for nutrients- Tributaries	DEQ only has the 1:100,000K 303D streams available in GIS format at this time.	Miles	DEQ
MR008025	Stream length listed as water quality limited (303d) for aquatic growth- 100k Level Streams	Total linear length in miles of nuisance aquatic growth water quality limited (303d) streams within the metro boundary summarized by Site. The 1998 303D Streams Layer is a GIS representation of Oregon's 1998 List of Water Quality Limited Waterbodies. The source for the streams was from the 1:100,000-scale Pacific Northwest River Reach data layer developed by the United States Geological Survey and other Federal and State agencies.	Miles	METRO RES, METRO MET, DEQ 303
MR008026	Stream length listed as water quality limited (303d) for aquatic growth- Tributaries	DEQ only has the 1:100,000K 303D streams available in GIS format at this time.	Miles	DEQ
MR008027	Stream length listed as water quality limited (303d) for flow modification- 100k Level Streams	Total linear length in miles of flow modification water quality limited (303d) streams within the metro boundary summarized by Site. The 1998 303D Streams Layer is a GIS representation of Oregon's 1998 List of Water Quality Limited Waterbodies. The source for the streams was from the 1:100,000-scale Pacific Northwest River Reach data layer developed by the United States Geological Survey and other Federal and State agencies.	Miles	METRO RES, METRO MET, DEQ 303
MR008028	Stream length listed as water quality limited (303d) for flow modification- Tributaries	DEQ only has the 1:100,000K 303D streams available in GIS format at this time.	Miles	DEQ

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CODE	ELEMENT	DESCRIPTION	UNITS	Data Used from Table 1 in Appendix D
MR008029	Stream length listed as water quality limited (303d) for habitat modification- 100k Level Streams	Total linear length in miles of habitat modification water quality limited (303d) streams within the metro boundary summarized by Site. The 1998 303D Streams Layer is a GIS representation of Oregon's 1998 List of Water Quality Limited Waterbodies. The source for the streams was from the 1:100,000-scale Pacific Northwest River Reach data layer developed by the United States Geological Survey and other Federal and State agencies.	Miles	METRO RES, METRO MET, DEQ 303
MR008030	Stream length listed as water quality limited (303d) for habitat modification- Tributaries	DEQ only has the 1:100,000K 303D streams available in GIS format at this time.	Miles	DEQ
MR008031	Stream length listed as water quality limited (303d) for temperature- 100k Level Streams	Total linear length in miles of temperature water quality limited (303d) streams within the metro boundary summarized by Site. The 1998 303D Streams Layer is a GIS representation of Oregon's 1998 List of Water Quality Limited Waterbodies. The source for the streams was from the 1:100,000-scale Pacific Northwest River Reach data layer developed by the United States Geological Survey and other Federal and State agencies.	Miles	METRO RES, METRO MET, DEQ 303
MR008032	Stream length listed as water quality limited (303d) for temperature- Tributaries	DEQ only has the 1:100,000K 303D streams available in GIS format at this time.	Miles	DEQ
MR008033	Stream length listed as water quality limited (303d) for any factor – 100k Level Streams	Total linear length in miles of all water quality limited (303d) streams within the metro boundary summarized by Site. The 1998 303D Streams Layer is a GIS representation of Oregon's 1998 List of Water Quality Limited Waterbodies. The source for the streams was from the 1:100,000-scale Pacific Northwest River Reach data layer developed by the United States Geological Survey and other Federal and State agencies.	Miles	METRO RES, METRO MET, DEQ 303
MR008034	Stream length listed as water quality limited (303d) for any factor – Tributaries	DEQ only has the 1:100,000K 303D streams available in GIS format at this time.	Miles	DEQ
MR008035	Number of Oregon Water Quality Index data collection points	Total number of Oregon Water Quality Index data collection points in each Site within the metro boundary. The Oregon Water Quality Index (OWQI) analyzes a defined set of water quality parameters and produces a score describing general water quality. The water quality parameters included in the OWQI are temperature, dissolved oxygen (percent saturation and concentration), biochemical oxygen demand, pH, total solids, ammonia and nitrate nitrogen, total phosphorous, and fecal coliform. OWQI scores range from 10 (worst case) to 100 (ideal water quality). The Department of Environmental Quality Laboratory maintains a large network of ambient water quality monitoring sites. Monitoring sites are representative of Oregon streams, including pristine waters and highly impacted waters.	Count - Number	METRO RES, METRO MET, DEQ OWI
MR008036	Number of Clean Water Services RSAT data collection points	Total number of RSAT data collection points in each Site within the metro boundary. Clean Water Services has been collecting water quality and riparian ecological data at many sampling sites within the Tualatin Basin.	Count - Number	METRO RES, METRO MET, CWS RSA

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CODE	ELEMENT	DESCRIPTION	UNITS	Data Used from Table 1 in Appendix D
MR008037	Total stream length surveyed as part of ODFW Aquatic Inventory Project.	Total linear length in miles of streams surveyed as part of ODFW Aquatic Inventory Project within the metro boundary summarized by Site. The Oregon Department of Fish & Wildlife has been actively acquiring stream habitat inventory information for the purpose of habitat assessment since 1990. This information is collected during the summer months by stream survey crews using methods described in Moore et al. (1997). The field data focuses on channel and valley morphology (stream and reach data), riparian characteristics and condition (reach data), and in-stream habitat (habitat unit data).	Miles	METRO RES, METRO MET, ODFW AIP
MR008038	Total Area by Current Generalized Zoning Class - Industrial	Total square acres of generalized zoning class INDUSTRIAL within the metro boundary summarized by Site. Zoning designation boundaries from local zoning ordinances. This layer has been reviewed by each jurisdiction and corrections were made by Metro where advised. The field used to summarize this data was Zonegen_cl which contains seven generalized classifications into which the zoning is generalized.	Acres	METRO RES, METRO MET, METRO ZON
MR008039	Total Area by Current Generalized Zoning Class - Commercial	Total square acres of generalized zoning class COMMERCIAL within the metro boundary summarized by Site. Zoning designation boundaries from local zoning ordinances. This layer has been reviewed by each jurisdiction and corrections were made by Metro where advised. The field used to summarize this data was Zonegen_cl which contains seven generalized classifications into which the zoning is generalized.	Acres	METRO RES, METRO MET, METRO ZON
MR008040	Total Area by Current Generalized Zoning Class - Multi-Family Residential	Total square acres of generalized zoning class MULTI-FAMILY within the metro boundary summarized by Site. Zoning designation boundaries from local zoning ordinances. This layer has been reviewed by each jurisdiction and corrections were made by Metro where advised. The field used to summarize this data was Zonegen_cl which contains seven generalized classifications into which the zoning is generalized.	Acres	METRO RES, METRO MET, METRO ZON
MR008041	Total Area by Current Generalized Zoning Class - Public / Open Space	Total square acres of generalized zoning class PUBLIC / OPEN SPACE within the metro boundary summarized by Site. Zoning designation boundaries from local zoning ordinances. This layer has been reviewed by each jurisdiction and corrections were made by Metro where advised. The field used to summarize this data was Zonegen_cl which contains seven generalized classifications into which the zoning is generalized.	Acres	METRO RES, METRO MET, METRO ZON
MR008042	Total Area by Current Generalized Zoning Class - Rural	Total square acres of generalized zoning class RURAL within the metro boundary summarized by Site. Zoning designation boundaries from local zoning ordinances. This layer has been reviewed by each jurisdiction and corrections were made by Metro where advised. The field used to summarize this data was Zonegen_cl which contains seven generalized classifications into which the zoning is generalized.	Acres	METRO RES, METRO MET, METRO ZON

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CODE	ELEMENT	DESCRIPTION	UNITS	Data Used from Table 1 in Appendix D
MR008043	Total Area by Current Generalized Zoning Class - Single Family Residential	Total square acres of generalized zoning class SINGLE FAMILY RESIDENTIAL within the metro boundary summarized by Site. Zoning designation boundaries from local zoning ordinances. This layer has been reviewed by each jurisdiction and corrections were made by Metro where advised. The field used to summarize this data was Zonegen_cl which contains seven generalized classifications into which the zoning is generalized.	Acres	METRO RES, METRO MET, METRO ZON
MR008044	Total Area by Current Generalized Zoning Class - Mixed Use	Total square acres of generalized zoning class MIXED USE within the metro boundary summarized by Site. Zoning designation boundaries from local zoning ordinances. This layer has been reviewed by each jurisdiction and corrections were made by Metro where advised. The field used to summarize this data was Zonegen_cl which contains seven generalized classifications into which the zoning is generalized.	Acres	METRO RES, METRO MET, METRO ZON
MR008045	Total area by 2040 Design types - Central City	Total square acres of 2040 design type – central city within the metro boundary summarized by Site.	Acres	METRO RES, METRO MET, METRO DES
MR008046	Total area by 2040 Design types - Regional Centers	Total square acres of 2040 design type – regional center within the metro boundary summarized by Site.	Acres	METRO RES, METRO MET, METRO DES
MR008047	Total area by 2040 Design types - Town Centers	Total square acres of 2040 design type – town centers within the metro boundary summarized by Site.	Acres	METRO RES, METRO MET, METRO DES
MR008048	Total area by 2040 Design types - Inner Neighborhoods	Total square acres of 2040 design type – inner neighborhoods within the metro boundary summarized by Site.	Acres	METRO RES, METRO MET, METRO DES
MR008049	Total area by 2040 Design types - Outer Neighborhoods	Total square acres of 2040 design type – outer neighborhoods within the metro boundary summarized by Site.	Acres	METRO RES, METRO MET, METRO DES
MR008050	Total area by 2040 Design types - Employment Areas	Total square acres of 2040 design type – employment areas within the metro boundary summarized by Site.	Acres	METRO RES, METRO MET, METRO DES
MR008051	Total area by 2040 Design types - Industrial Areas	Total square acres of 2040 design type – industrial areas within the metro boundary summarized by Site.	Acres	METRO RES, METRO MET, METRO DES
MR008052	Total area by 2040 Design types - Corridors	Total square acres of 2040 design type – corridors within the metro boundary summarized by Site.	Acres	METRO RES, METRO MET, METRO DES
MR008053	Total area by 2040 Design types - Station Core	Total square acres of 2040 design type – station core within the metro boundary summarized by Site.	Acres	METRO RES, METRO MET, METRO DES
MR008054	Total area by 2040 Design types - Station Areas	Total square acres of 2040 design type – station area within the metro boundary summarized by Site.	Acres	METRO RES, METRO MET, METRO DES
MR008055	Total area by 2040 Design types - Main Streets	Total square acres of 2040 design type – main streets within the metro boundary summarized by Site.	Acres	METRO RES, METRO MET, METRO DES
MR008056	Total Area by local Planning Jurisdiction - Unincorporated Clackamas County	Total square acres of the local planning jurisdiction – Unincorporated Clackamas County within the metro boundary summarized by Site. Total County area – Total City Area = Unincorporated County area.	Acres	METRO RES, METRO MET, METRO COU
MR008057	Total Area by local Planning Jurisdiction - Unincorporated Multnomah County	Total square acres of the local planning jurisdiction – Unincorporated Multnomah County within the metro boundary summarized by Site. Total County area – Total City Area = Unincorporated County area.	Acres	METRO RES, METRO MET, METRO COU
MR008058	Total Area by local Planning Jurisdiction - Unincorporated Washington County	Total square acres of the local planning jurisdiction – Unincorporated Washington County within the metro boundary summarized by Site. Total County area – Total City Area = Unincorporated County area.	Acres	METRO RES, METRO MET, METRO COU
MR008059	Total Area by local Planning Jurisdiction - City of Beaverton	Total square acres of the local planning jurisdiction - City of Beaverton within the metro boundary summarized by Site.	Acres	METRO RES, METRO MET, METRO CTY

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CODE	ELEMENT	DESCRIPTION	UNITS	Data Used from Table 1 in Appendix D
MR008060	Total Area by local Planning Jurisdiction - City of Cornelius	Total square acres of the local planning jurisdiction - City of Cornelius within the metro boundary summarized by Site.	Acres	METRO RES, METRO MET, METRO CTY
MR008061	Total Area by local Planning Jurisdiction - City of Durham	Total square acres of the local planning jurisdiction - City of Cornelius within the metro boundary summarized by Site.	Acres	METRO RES, METRO MET, METRO CTY
MR008062	Total Area by local Planning Jurisdiction - City of Fairview	Total square acres of the local planning jurisdiction - City of Fairview within the metro boundary summarized by Site.	Acres	METRO RES, METRO MET, METRO CTY
MR008063	Total Area by local Planning Jurisdiction - City of Forest Grove	Total square acres of the local planning jurisdiction - City of Forest Grove within the metro boundary summarized by Site.	Acres	METRO RES, METRO MET, METRO CTY
MR008064	Total Area by local Planning Jurisdiction - City of Gladstone	Total square acres of the local planning jurisdiction - City of Gladstone within the metro boundary summarized by Site.	Acres	METRO RES, METRO MET, METRO CTY
MR008065	Total Area by local Planning Jurisdiction - City of Gresham	Total square acres of the local planning jurisdiction - City of Gresham within the metro boundary summarized by Site.	Acres	METRO RES, METRO MET, METRO CTY
MR008066	Total Area by local Planning Jurisdiction - City of Happy Valley	Total square acres of the local planning jurisdiction - City of Happy Valley within the metro boundary summarized by Site.	Acres	METRO RES, METRO MET, METRO CTY
MR008067	Total Area by local Planning Jurisdiction - City of Hillsboro	Total square acres of the local planning jurisdiction - City of Hillsboro within the metro boundary summarized by Site.	Acres	METRO RES, METRO MET, METRO CTY
MR008068	Total Area by local Planning Jurisdiction - City of Johnson City	Total square acres of the local planning jurisdiction - City of Johnson City within the metro boundary summarized by Site.	Acres	METRO RES, METRO MET, METRO CTY
MR008069	Total Area by local Planning Jurisdiction - City of King City	Total square acres of the local planning jurisdiction - City of King City within the metro boundary summarized by Site.	Acres	METRO RES, METRO MET, METRO CTY
MR008070	Total Area by local Planning Jurisdiction - City of Lake Oswego	Total square acres of the local planning jurisdiction - City of Lake Oswego within the metro boundary summarized by Site.	Acres	METRO RES, METRO MET, METRO CTY
MR008071	Total Area by local Planning Jurisdiction - City of Maywood Park	Total square acres of the local planning jurisdiction - City of Maywood Park within the metro boundary summarized by Site.	Acres	METRO RES, METRO MET, METRO CTY
MR008072	Total Area by local Planning Jurisdiction - City of Milwaukee	Total square acres of the local planning jurisdiction - City of Milwaukie within the metro boundary summarized by Site.	Acres	METRO RES, METRO MET, METRO CTY
MR008073	Total Area by local Planning Jurisdiction - City of Oregon City	Total square acres of the local planning jurisdiction - City of Oregon City within the metro boundary summarized by Site.	Acres	METRO RES, METRO MET, METRO CTY
MR008074	Total Area by local Planning Jurisdiction - City of Portland	Total square acres of the local planning jurisdiction - City of Portland within the metro boundary summarized by Site.	Acres	METRO RES, METRO MET, METRO CTY
MR008075	Total Area by local Planning Jurisdiction - Rivergrove	Total square acres of the local planning jurisdiction – Rivergrove within the metro boundary summarized by Site.	Acres	METRO RES, METRO MET, METRO CTY
MR008076	Total Area by local Planning Jurisdiction - City of Sherwood	Total square acres of the local planning jurisdiction - City of Sherwood within the metro boundary summarized by Site.	Acres	METRO RES, METRO MET, METRO CTY
MR008077	Total Area by local Planning Jurisdiction - City of Tigard	Total square acres of the local planning jurisdiction - City of Tigard within the metro boundary summarized by Site.	Acres	METRO RES, METRO MET, METRO CTY
MR008078	Total Area by local Planning Jurisdiction - City of Troutdale	Total square acres of the local planning jurisdiction - City of Troutdale within the metro boundary summarized by Site.	Acres	METRO RES, METRO MET, METRO CTY
MR008079	Total Area by local Planning Jurisdiction - City of Tualatin	Total square acres of the local planning jurisdiction - City of Tualatin within the metro boundary summarized by Site.	Acres	METRO RES, METRO MET, METRO CTY
MR008080	Total Area by local Planning Jurisdiction - City of West Linn	Total square acres of the local planning jurisdiction - City of West Linn within the metro boundary summarized by Site.	Acres	METRO RES, METRO MET, METRO CTY
MR008081	Total Area by local Planning Jurisdiction - City of Wilsonville	Total square acres of the local planning jurisdiction - City of Wilsonville within the metro boundary summarized by Site.	Acres	METRO RES, METRO MET, METRO CTY

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CODE	ELEMENT	DESCRIPTION	UNITS	Data Used from Table 1 in Appendix D
MR008082	Total Area by local Planning Jurisdiction - Wood Village	Total square acres of the local planning jurisdiction – Wood Village within the metro boundary summarized by Site.	Acres	METRO RES, METRO MET, METRO CTY
MR008083	Total area by 2040 Design types – water	Total square acres of 2040 design type – water within the metro boundary summarized by Site.	Acres	METRO RES, METRO MET, METRO DES
MR008084	Total area by 2040 Design types – open spaces	Total square acres of 2040 design type – open spaces within the metro boundary summarized by Site.	Acres	METRO RES, METRO MET, METRO DES
MR008085	Total area by 2040 Design types – parks	Total square acres of 2040 design type – parks within the metro boundary summarized by Site.	Acres	METRO RES, METRO MET, METRO DES
MR008086	Surveyed culverted road crossing designated as bad for fish passage by the ODFW standards.	Total number of culverted road crossing designated as bad for fish passage in each Site within the metro boundary. For the Metro survey potential culverts were initially located by intersecting the RLIS Lite street shapefile with Metro's new stream cover. The potential culverts were all field checked by Victor Vrell who had done the earlier surveys on the County, ODOT and Portland or Gresham roads. He rated culverts according to ODFW standards. His ratings are recorded in the "Rating" field of the survey spreadsheet (Metro.xls). Ratings used by the Metro surveyor BAD - Surveyor rated culvert as bad for fish passage by ODFW standards	Count - Number	METRO RES, METRO MET, METRO CUL
MR009 – Wildlife Patches (MR009001 – MR009024)				
MR009001	Total forest landcover (2000 Metro Photo Interpretation) within wildlife patches	Total square acres of forested woody vegetation within wildlife patches in the metro boundary summarized by Site. Land cover classes generally larger than one acre in size. Delineated at a scale of 1:4800 using 2000 aerial photos and generalized criteria by the Metro Data Resource Center.	Acres	METRO RES, METRO MET, METRO VEG, METRO WM
MR009002	Total shrub/scrubs landcover (2000 Metro Photo Interpretation) within wildlife patches	Total square acres of non-forested woody vegetation (shrub/scrub) (digitized within 300 feet of a surface stream) within wildlife patches in the metro boundary summarized by Site. Land cover classes generally larger than one acre in size. Delineated at a scale of 1:4800 using 2000 aerial photos and generalized criteria by the Metro Data Resource Center.	Acres	METRO RES, METRO MET, METRO VEG, METRO WM, METRO STR
MR009003	Total grasslands landcover (2000 Metro Photo Interpretation) within wildlife patches	Total square acres of grassland vegetation (digitized within 300 feet of a surface stream) within wildlife patches in the metro boundary summarized by Site. Land cover classes generally larger than one acre in size. Delineated at a scale of 1:4800 using 2000 aerial photos and generalized criteria by the Metro Data Resource Center.	Acres	METRO RES, METRO MET, METRO VEG, METRO WM, METRO STR
MR009004	Total forested wetlands landcover (2000 Metro Photo Interpretation and wetland area MR003001 and MR003004) within wildlife patches	Total square acres of forested woody vegetation in wetlands and inside wildlife patches in the metro boundary summarized by Site. Land cover classes generally larger than one acre in size. Delineated at a scale of 1:4800 using 2000 aerial photos and generalized criteria by the Metro Data Resource Center. Wetlands mapped by the National Wetland Inventory and later updated as a part of the Title 3 water quality process. Additionally modified to incorporate information from local government review and local wetland inventories. For more information, see Appendix G – Methodology for incorporation of Local Wetlands Inventory into Metro Wetlands layer.	Acres	METRO RES, METRO MET, METRO VEG, METRO WM, METRO WET

The DRC metadata viewer is located on Metro's Intranet website (intramet), under Departments, DRC, MetaData Viewer. External metadata can be found in a Binder in Metro's Long-Range Planning Department.

CODE	ELEMENT	DESCRIPTION	UNITS	Data Used from Table 1 in Appendix D
MR009005	Total grass/shrub wetlands landcover (2000 Metro Photo Interpretation and wetland area MR003001 and MR003004) within wildlife patches	Total square acres of grass/shrub vegetation (digitized within 300 feet of a surface stream) in wetlands inside wildlife patches in the metro boundary summarized by Site. Land cover classes generally larger than one acre in size. Delineated at a scale of 1:4800 using 2000 aerial photos and generalized criteria by the Metro Data Resource Center. Wetlands mapped by the National Wetland Inventory and later updated as a part of the Title 3 water quality process. Additionally modified to incorporate information from local government review and local wetland inventories. For more information, see Appendix G – Methodology for incorporation of Local Wetlands Inventory into Metro Wetlands layer.	Acres	METRO RES, METRO MET, METRO VEG, METRO WM, METRO STR, METRO WET
MR009006	Total other wetlands landcover (2000 Metro Photo Interpretation and wetland area MR003001 and MR003004) within wildlife patches	Total square acres of non-classified wetlands within wildlife patches in the metro boundary summarized by Site. Land cover classes generally larger than one acre in size. Delineated at a scale of 1:4800 using 2000 aerial photos and generalized criteria by the Metro Data Resource Center. Wetlands mapped by the National Wetland Inventory and later updated as a part of the Title 3 water quality process. Additionally modified to incorporate information from local government review and local wetland inventories.	Acres	METRO RES, METRO MET, METRO VEG, METRO WM, METRO WET
MR009007	Total 1998 Landsat Landcover area of water within wildlife patches	Total square acres of water (from the 1998 Landsat landcover classification) within Metro and in wildlife patches, summarized by Site.	Acres	METRO RES, METRO MET, METRO LC98, METRO WM
MR009008	Total 1998 Landsat Landcover area of barren land within wildlife patches	Total square acres of barren land (from the 1998 Landsat landcover classification) within Metro and in wildlife patches, summarized by Site.	Acres	METRO RES, METRO MET, METRO LC98, METRO WM
MR009009	Total 1998 Landsat Landcover area of low structure agriculture within wildlife patches	Total square acres of low structure agriculture (from the 1998 Landsat landcover classification) within Metro and in wildlife patches, summarized by Site.	Acres	METRO RES, METRO MET, METRO LC98, METRO WM
MR009010	Total 1998 Landsat Landcover area of high structure agriculture within wildlife patches	Total square acres of high structure agriculture (from the 1998 Landsat landcover classification) within Metro and in wildlife patches, summarized by Site.	Acres	METRO RES, METRO MET, METRO LC98, METRO WM
MR009011	Total 1998 Landsat Landcover area of deciduous closed canopy within wildlife patches	Total square acres of deciduous closed canopy (from the 1998 Landsat landcover classification) within Metro and in wildlife patches, summarized by Site.	Acres	METRO RES, METRO MET, METRO LC98, METRO WM
MR009012	Total 1998 Landsat Landcover area of mixed closed canopy	Total square acres of mixed closed canopy (from the 1998 Landsat landcover classification) within Metro and in wildlife patches, summarized by Site.	Acres	METRO RES, METRO MET, METRO LC98, METRO WM
MR009013	Total 1998 Landsat Landcover area of conifer closed canopy forest within wildlife patches	Total square acres of conifer closed canopy (from the 1998 Landsat landcover classification) within Metro and in wildlife patches, summarized by Site.	Acres	METRO RES, METRO MET, METRO LC98, METRO WM
MR009014	Total 1998 Landsat Landcover area of deciduous open canopy forest within wildlife patches	Total square acres of deciduous open canopy forest (from the 1998 Landsat landcover classification) within Metro and in wildlife patches, summarized by Site.	Acres	METRO RES, METRO MET, METRO LC98, METRO WM

The DRC metadata viewer is located on Metro's Intranet website (intramet), under Departments, DRC, MetaData Viewer. External metadata can be found in a Binder in Metro's Long-Range Planning Department.

CODE	ELEMENT	DESCRIPTION	UNITS	Data Used from Table 1 in Appendix D
MR009015	Total 1998 Landsat Landcover area of mixed open canopy forest within wildlife patches	Total square acres of mixed open canopy forest (from the 1998 Landsat landcover classification) within Metro and in wildlife patches, summarized by Site.	Acres	METRO RES, METRO MET, METRO LC98, METRO WM
MR009016	Total 1998 Landsat Landcover area of conifer open canopy forest within wildlife patches	Total square acres of conifer open canopy forest (from the 1998 Landsat landcover classification) within Metro and in wildlife patches, summarized by Site.	Acres	METRO RES, METRO MET, METRO LC98, METRO WM
MR009017	Total 1998 Landsat Landcover area of deciduous scattered canopy forest within wildlife patches	Total square acres of deciduous scattered canopy forest (from the 1998 Landsat landcover classification) within Metro and in wildlife patches, summarized by Site.	Acres	METRO RES, METRO MET, METRO LC98, METRO WM
MR009018	Total 1998 Landsat Landcover area of mixed scattered canopy forest within wildlife patches	Total square acres of mixed scattered canopy forest (from the 1998 Landsat landcover classification) within Metro and in wildlife patches, summarized by Site.	Acres	METRO RES, METRO MET, METRO LC98, METRO WM
MR009019	Total 1998 Landsat Landcover area of conifer scattered canopy forest within wildlife patches	Total square acres of conifer scattered canopy forest (from the 1998 Landsat landcover classification) within Metro and in wildlife patches, summarized by Site.	Acres	METRO RES, METRO MET, METRO LC98, METRO WM
MR009020	Total 1998 Landsat Landcover area of closed canopy shrub	Total square acres of closed canopy shrub (from the 1998 Landsat landcover classification) within Metro and in wildlife patches, summarized by Site.	Acres	METRO RES, METRO MET, METRO LC98, METRO WM
MR009021	Total 1998 Landsat Landcover area of open canopy shrub within wildlife patches	Total square acres of open canopy shrub (from the 1998 Landsat landcover classification) within Metro and in wildlife patches, summarized by Site.	Acres	METRO RES, METRO MET, METRO LC98, METRO WM
MR009022	Total 1998 Landsat Landcover area of scattered canopy shrub within wildlife patches	Total square acres of scattered canopy shrub (from the 1998 Landsat landcover classification) within Metro and in wildlife patches, summarized by Site.	Acres	METRO RES, METRO MET, METRO LC98, METRO WM
MR009023	Total 1998 Landsat Landcover area of meadow/grass within wildlife patches	Total square acres of meadow/grass (from the 1998 Landsat landcover classification) within Metro and in wildlife patches, summarized by Site.	Acres	METRO RES, METRO MET, METRO LC98, METRO WM
MR009024	Total 1998 Landsat Landcover area of not classified within wildlife patches	Total square acres of non-classified land (from the 1998 Landsat landcover classification) within Metro and in wildlife patches, summarized by Site.	Acres	METRO RES, METRO MET, METRO LC98, METRO WM
MR010 – Sensitive Species of Concern (SOCs) and Habitats of Concern (HOCs) (010001-010021)				

The DRC metadata viewer is located on Metro's Intranet website (intramet), under Departments, DRC, MetaData Viewer. External metadata can be found in a Binder in Metro's Long-Range Planning Department.

CODE	ELEMENT	DESCRIPTION	UNITS	Data Used from Table 1 in Appendix D
MR010001	Total number of SOCs	Total Species of Concern within Metro, summarized by Site. For more information, see Appendix I – Current species and SOCs list. The sensitive species list contains: Vertebrate species that currently exist within the Metro region that are listed as threatened, endangered or species of concern for at least a portion of the year and could be found in the region through diligent search by a knowledgeable person. Vagrant species (those that do not typically occur every year) are not included on this list. The species list is based on the opinion of more than two dozen local wildlife experts. The Oregon Natural Heritage Program (ORNHP), Endangered Species Act (ESA), and Oregon Department of Fish and Wildlife (ODFW) status categories were obtained from ORNHP's February, 2001 *Rare, Threatened and Endangered Plants and Animals of Oregon* publication. Habitat associations were obtained from Johnson and O'Neil's new book, *Wildlife Habitats and Relationships in Oregon and Washington.* The taxonomic standards for common and scientific names for birds is based on the American Ornithological Union Check-list.	Count	METRO RES, METRO MET, METRO SOC
MR010002	Total area of HOCs (including small wetlands < 2 acres) inside of wildlife patches	Total square acres of habitats of concern inside of wildlife patches within Metro, summarized by Site. For more information, see Appendix H – Habitats of Concern Master List. **A habitat of concern** is a unique or unusually important wildlife habitat area. They are identified based on site-specific information provided by local wildlife or habitat experts. Habitats of concern can be smaller than 2 acres, and will be included in the inventory if falling into one or more of the following categories: 1. Any patch specifically identified as a Priority Conservation Habitat by ODFW, USFWS, or other agencies or local wildlife experts. Priority conservation habitats are Oregon white oak savannas and woodlands, native prairie grasslands, wetlands, and bottomland hardwood forests. 2. Any patch of natural land cover identified by ODFW, USFWS, or other agencies or local wildlife experts as a riverine island or delta important to wildlife. 3. Specifically delineated habitat areas that provide life-history requirements of sensitive, threatened or endangered wildlife species or Great Blue Heron rookeries (for example, nesting habitat for an existing population of native turtles); habitats that support at-risk plants; or habitats that provide unusually important wildlife functions, such as major wildlife crossings/pathways or a key migratory pathway, such as an elk migratory corridor.	Acres	METRO RES, METRO MET, METRO HOC, METRO WM, METRO WET

The DRC metadata viewer is located on Metro's Intranet website (intramet), under Departments, DRC, MetaData Viewer. External metadata can be found in a Binder in Metro's Long-Range Planning Department.

CODE	ELEMENT	DESCRIPTION	UNITS	Data Used from Table 1 in Appendix D
MR010003	Total area of HOCs (including small wetlands < 2 acres) outside of wildlife patches	Total square acres of habitats of concern outside of wildlife patches within Metro, summarized by Site. For more information, see Appendix H – Habitats of Concern Master List. **A habitat of concern** is a unique or unusually important wildlife habitat area. They are identified based on site-specific information provided by local wildlife or habitat experts. Habitats of concern can be smaller than 2 acres, and will be included in the inventory if falling into one or more of the following categories: 1. Any patch specifically identified as a Priority Conservation Habitat by ODFW, USFWS, or other agencies or local wildlife experts. Priority conservation habitats are Oregon white oak savannas and woodlands, native prairie grasslands, wetlands, and bottomland hardwood forests. 2. Any patch of natural land cover identified by ODFW, USFWS, or other agencies or local wildlife experts as a riverine island or delta important to wildlife. 3. Specifically delineated habitat areas that provide life-history requirements of sensitive, threatened or endangered wildlife species or Great Blue Heron rookeries (for example, nesting habitat for an existing population of native turtles); habitats that support at-risk plants; or habitats that provide unusually important wildlife functions, such as major wildlife crossings/pathways or a key migratory pathway, such as an elk migratory corridor.	Acres	METRO RES, METRO MET, METRO HOC, METRO WM, METRO WET
MR010004	Total 1998 Landsat Landcover area of water within outside HOCs (MR010003)	Total square acres of water (from the 1998 Landsat landcover classification) within Metro and in outside HOCs, summarized by Site.	Acres	METRO RES, METRO MET, METRO HOC, METRO WM, METRO WET, METRO LC98
MR010005	Total 1998 Landsat Landcover area of barren land within outside HOCs (MR010003)	Total square acres of barren land (from the 1998 Landsat landcover classification) within Metro and in outside HOCs, summarized by Site.	Acres	METRO RES, METRO MET, METRO HOC, METRO WM, METRO WET, METRO LC98
MR010006	Total 1998 Landsat Landcover area of low structure agriculture within outside HOCs (MR010003)	Total square acres of low structure agriculture (from the 1998 Landsat landcover classification) within Metro and in outside HOCs, summarized by Site.	Acres	METRO RES, METRO MET, METRO HOC, METRO WM, METRO WET, METRO LC98
MR010007	Total 1998 Landsat Landcover area of high structure agriculture within outside HOCs (MR010003)	Total square acres of high structure agriculture (from the 1998 Landsat landcover classification) within Metro and in outside HOCs, summarized by Site.	Acres	METRO RES, METRO MET, METRO HOC, METRO WM, METRO WET, METRO LC98
MR010008	Total 1998 Landsat Landcover area of deciduous closed canopy within outside HOCs (MR010003)	Total square acres of deciduous closed canopy (from the 1998 Landsat landcover classification) within Metro and in outside HOCs, summarized by Site.	Acres	METRO RES, METRO MET, METRO HOC, METRO WM, METRO WET, METRO LC98
MR010009	Total 1998 Landsat Landcover area of mixed closed canopy within outside HOCs (MR010003)	Total square acres of mixed closed canopy (from the 1998 Landsat landcover classification) within Metro and in outside HOCs, summarized by Site.	Acres	METRO RES, METRO MET, METRO HOC, METRO WM, METRO WET, METRO LC98
MR010010	Total 1998 Landsat Landcover area of conifer closed canopy forest within outside HOCs (MR010003)	Total square acres of conifer closed canopy (from the 1998 Landsat landcover classification) within Metro and in outside HOCs, summarized by Site.	Acres	METRO RES, METRO MET, METRO HOC, METRO WM, METRO WET, METRO LC98

The DRC metadata viewer is located on Metro's Intranet website (intramet), under Departments, DRC, MetaData Viewer. External metadata can be found in a Binder in Metro's Long-Range Planning Department.

CODE	ELEMENT	DESCRIPTION	UNITS	Data Used from Table 1 in Appendix D
MR010011	Total 1998 Landsat Landcover area of deciduous open canopy forest within outside HOCs (MR010003)	Total square acres of deciduous open canopy forest (from the 1998 Landsat landcover classification) within Metro and in outside HOCs, summarized by Site.	Acres	METRO RES, METRO MET, METRO HOC, METRO WM, METRO WET, METRO LC98
MR010012	Total 1998 Landsat Landcover area of mixed open canopy forest within outside HOCs (MR010003)	Total square acres of mixed open canopy forest (from the 1998 Landsat landcover classification) within Metro and in outside HOCs, summarized by Site.	Acres	METRO RES, METRO MET, METRO HOC, METRO WM, METRO WET, METRO LC98
MR010013	Total 1998 Landsat Landcover area of conifer open canopy forest within outside HOCs (MR010003)	Total square acres of conifer open canopy forest (from the 1998 Landsat landcover classification) within Metro and in outside HOCs, summarized by Site.	Acres	METRO RES, METRO MET, METRO HOC, METRO WM, METRO WET, METRO LC98
MR010014	Total 1998 Landsat Landcover area of deciduous scattered canopy forest within outside HOCs (MR010003)	Total square acres of deciduous scattered canopy forest (from the 1998 Landsat landcover classification) within Metro and in outside HOCs, summarized by Site.	Acres	METRO RES, METRO MET, METRO HOC, METRO WM, METRO WET, METRO LC98
MR010015	Total 1998 Landsat Landcover area of mixed scattered canopy forest within outside HOCs (MR010003)	Total square acres of mixed scattered canopy forest (from the 1998 Landsat landcover classification) within Metro and in outside HOCs, summarized by Site.	Acres	METRO RES, METRO MET, METRO HOC, METRO WM, METRO WET, METRO LC98
MR010016	Total 1998 Landsat Landcover area of conifer scattered canopy forest within outside HOCs (MR010003)	Total square acres of conifer scattered canopy forest (from the 1998 Landsat landcover classification) within Metro and in outside HOCs, summarized by Site.	Acres	METRO RES, METRO MET, METRO HOC, METRO WM, METRO WET, METRO LC98
MR010017	Total 1998 Landsat Landcover area of closed canopy shrub within outside HOCs (MR010003)	Total square acres of closed canopy shrub (from the 1998 Landsat landcover classification) within Metro and in outside HOCs, summarized by Site.	Acres	METRO RES, METRO MET, METRO HOC, METRO WM, METRO WET, METRO LC98
MR010018	Total 1998 Landsat Landcover area of open canopy shrub within outside HOCs (MR010003)	Total square acres of open canopy shrub (from the 1998 Landsat landcover classification) within Metro and in outside HOCs, summarized by Site.	Acres	METRO RES, METRO MET, METRO HOC, METRO WM, METRO WET, METRO LC98
MR010019	Total 1998 Landsat Landcover area of scattered canopy shrub within outside HOCs (MR010003)	Total square acres of scattered canopy shrub (from the 1998 Landsat landcover classification) within Metro and in outside HOCs, summarized by Site.	Acres	METRO RES, METRO MET, METRO HOC, METRO WM, METRO WET, METRO LC98
MR010020	Total 1998 Landsat Landcover area of meadow/grass within outside HOCs (MR010003)	Total square acres of meadow/grass (from the 1998 Landsat landcover classification) within Metro and in outside HOCs, summarized by Site.	Acres	METRO RES, METRO MET, METRO HOC, METRO WM, METRO WET, METRO LC98
MR010021	Total 1998 Landsat Landcover area of not classified within outside HOCs (MR010003)	Total square acres of non-classified land (from the 1998 Landsat landcover classification) within Metro and in outside HOCs, summarized by Site.	Acres	METRO RES, METRO MET, METRO HOC, METRO WM, METRO WET, METRO LC98
MR011 – Wildlife Model Scoring (011001-011021)				

The DRC metadata viewer is located on Metro's Intranet website (intramet), under Departments, DRC, MetaData Viewer. External metadata can be found in a Binder in Metro's Long-Range Planning Department.

CODE	ELEMENT	DESCRIPTION	UNITS	Data Used from Table 1 in Appendix D
MR011001	Total wildlife patch area for a cumulative wildlife model score of 9 points.	Total wildlife patch area receiving a wildlife model score of 9 points, summarized by Site –wildlife model components are described under MR011010-021. (Patch type definitions: Type 1 patches are defined as any forest landcover, forested wetland, or non-forested wetland with a total combined size greater than 2 acres. Where different cover types are contiguous they are considered to be part of a single larger patch. Type 2 patches are defined as any shrubland/scrubland or grassland/open soils landcover in a tract greater than 2 acres, within 300 feet off a surface stream.) For more information, see Appendix K – Wildlife model criteria.	Acres	METRO RES, METRO MET, METRO WM
MR011002	Total wildlife patch area for a cumulative wildlife model score of 8 points.	Total wildlife patch area receiving a wildlife model score of 8 points, summarized by Site –wildlife model components are described under MR011010-021. (Patch type definitions: Type 1 patches are defined as any forest landcover, forested wetland, or non-forested wetland with a total combined size greater than 2 acres. Where different cover types are contiguous they are considered to be part of a single larger patch. Type 2 patches are defined as any shrubland/scrubland or grassland/open soils landcover in a tract greater than 2 acres, within 300 feet off a surface stream.) For more information, see Appendix K – Wildlife model criteria.	Acres	METRO RES, METRO MET, METRO WM
MR011003	Total wildlife patch area for a cumulative wildlife model score of 7 points.	Total wildlife patch area receiving a wildlife model score of 7 points, summarized by Site –wildlife model components are described under MR011010-021. (Patch type definitions: Type 1 patches are defined as any forest landcover, forested wetland, or non-forested wetland with a total combined size greater than 2 acres. Where different cover types are contiguous they are considered to be part of a single larger patch. Type 2 patches are defined as any shrubland/scrubland or grassland/open soils landcover in a tract greater than 2 acres, within 300 feet off a surface stream.) For more information, see Appendix K – Wildlife model criteria.	Acres	METRO RES, METRO MET, METRO WM
MR011004	Total wildlife patch area for a cumulative wildlife model score of 6 points.	Total wildlife patch area receiving a wildlife model score of 6 points, summarized by Site –wildlife model components are described under MR011010-021. (Patch type definitions: Type 1 patches are defined as any forest landcover, forested wetland, or non-forested wetland with a total combined size greater than 2 acres. Where different cover types are contiguous they are considered to be part of a single larger patch. Type 2 patches are defined as any shrubland/scrubland or grassland/open soils landcover in a tract greater than 2 acres, within 300 feet off a surface stream.) For more information, see Appendix K – Wildlife model criteria.	Acres	METRO RES, METRO MET, METRO WM
MR011005	Total wildlife patch area for a cumulative wildlife model score of 5 points.	Total wildlife patch area receiving a wildlife model score of 5 points, summarized by Site –wildlife model components are described under MR011010-021. (Patch type definitions: Type 1 patches are defined as any forest landcover, forested wetland, or non-forested wetland with a total combined size greater than 2 acres. Where different cover types are contiguous they are considered to be part of a single larger patch. Type 2 patches are defined as any shrubland/scrubland or grassland/open soils landcover in a tract greater than 2 acres, within 300 feet off a surface stream.) For more information, see Appendix K – Wildlife model criteria.	Acres	METRO RES, METRO MET, METRO WM

The DRC metadata viewer is located on Metro's Intranet website (intramet), under Departments, DRC, MetaData Viewer. External metadata can be found in a Binder in Metro's Long-Range Planning Department.

CODE	ELEMENT	DESCRIPTION	UNITS	Data Used from Table 1 in Appendix D
MR011006	Total wildlife patch area for a cumulative wildlife model score of 4 points.	Total wildlife patch area receiving a wildlife model score of 4 points, summarized by Site –wildlife model components are described under MR011010-021. (Patch type definitions: Type 1 patches are defined as any forest landcover, forested wetland, or non-forested wetland with a total combined size greater than 2 acres. Where different cover types are contiguous they are considered to be part of a single larger patch. Type 2 patches are defined as any shrubland/scrubland or grassland/open soils landcover in a tract greater than 2 acres, within 300 feet off a surface stream.) For more information, see Appendix K – Wildlife model criteria.	Acres	METRO RES, METRO MET, METRO WM
MR011007	Total wildlife patch area for a cumulative wildlife model score of 3 points.	Total wildlife patch area receiving a wildlife model score of 3 points, summarized by Site –wildlife model components are described under MR011010-021. (Patch type definitions: Type 1 patches are defined as any forest landcover, forested wetland, or non-forested wetland with a total combined size greater than 2 acres. Where different cover types are contiguous they are considered to be part of a single larger patch. Type 2 patches are defined as any shrubland/scrubland or grassland/open soils landcover in a tract greater than 2 acres, within 300 feet off a surface stream.) For more information, see Appendix K – Wildlife model criteria.	Acres	METRO RES, METRO MET, METRO WM
MR011008	Total wildlife patch area for a cumulative wildlife model score of 2 points.	Total wildlife patch area receiving a wildlife model score of 2 points, summarized by Site –wildlife model components are described under MR011010-021. (Patch type definitions: Type 1 patches are defined as any forest landcover, forested wetland, or non-forested wetland with a total combined size greater than 2 acres. Where different cover types are contiguous they are considered to be part of a single larger patch. Type 2 patches are defined as any shrubland/scrubland or grassland/open soils landcover in a tract greater than 2 acres, within 300 feet off a surface stream.) For more information, see Appendix K – Wildlife model criteria.	Acres	METRO RES, METRO MET, METRO WM
MR011009	Total wildlife patch area for a cumulative wildlife model score of 1 point.	Total wildlife patch area receiving a wildlife model score of 1 point, summarized by Site –wildlife model components are described under MR011010-021. (Patch type definitions: Type 1 patches are defined as any forest landcover, forested wetland, or non-forested wetland with a total combined size greater than 2 acres. Where different cover types are contiguous they are considered to be part of a single larger patch. Type 2 patches are defined as any shrubland/scrubland or grassland/open soils landcover in a tract greater than 2 acres, within 300 feet off a surface stream.) For more information, see Appendix K – Wildlife model criteria.	Acres	METRO RES, METRO MET, METRO WM
MR011010	Total wildlife patch area with a score of 3 points for overall patch size	Total square acres of wildlife patch area, scoring 3 points for patch size within Metro, summarized by Site. For more information, see Appendix K – Wildlife model criteria. The size value for a patch is calculated by: 1. Calculating the area in acres for all type 1 patches using a GIS system. Assigning all type 1 patches a value of 1 to 3 based on their distribution within three classes derived by finding natural breaks using a GIS system.	Acres	METRO RES, METRO MET, METRO WMSIZ

The DRC metadata viewer is located on Metro's Intranet website (intramet), under Departments, DRC, MetaData Viewer. External metadata can be found in a Binder in Metro's Long-Range Planning Department.

CODE	ELEMENT	DESCRIPTION	UNITS	Data Used from Table 1 in Appendix D
MR011011	Total wildlife patch area with a score of 2 points for overall patch size	Total square acres of wildlife patch area, scoring 2 points for patch size within Metro, summarized by Site. For more information, see Appendix K – Wildlife model criteria. The size value for a patch is calculated by: 1. Calculating the area in acres for all type 1 patches using a GIS system. Assigning all type 1 patches a value of 1 to 3 based on their distribution within three classes derived by finding natural breaks using a GIS system.	Acres	METRO RES, METRO MET, METRO WMSIZ
MR011012	Total wildlife patch area with a score of 1 points for overall patch size	Total square acres of wildlife patch area, scoring 1 point for patch size within Metro, summarized by Site. For more information, see Appendix K – Wildlife model criteria. The size value for a patch is calculated by: 1. Calculating the area in acres for all type 1 patches using a GIS system. Assigning all type 1 patches a value of 1 to 3 based on their distribution within three classes derived by finding natural breaks using a GIS system.	Acres	METRO RES, METRO MET, METRO WMSIZ
MR011013	Total wildlife patch area with a score of 3 points for edge to interior	Total square acres of wildlife patch area, scoring 3 points for edge to interior within Metro, summarized by Site. For more information, see Appendix K – Wildlife model criteria. The interior value for a patch is calculated by: 1. Defining an interior zone for all type 1 patches by using a GIS system to draw internal buffers of 200 feet for each. 2. Calculating the interior zone area (if any) in acres for all type 1 patches using a GIS system. Assigning all type 1 patches an interior value of 1 to 3 based on their distribution within three classes derived by finding natural breaks using a GIS system.	Acres	METRO RES, METRO MET, METRO WMINT
MR011014	Total wildlife patch area with a score of 2 points for edge to interior	Total square acres of wildlife patch area, scoring 2 points for edge to interior within Metro, summarized by Site. For more information, see Appendix K – Wildlife model criteria. The interior value for a patch is calculated by: 1. Defining an interior zone for all type 1 patches by using a GIS system to draw internal buffers of 200 feet for each. 2. Calculating the interior zone area (if any) in acres for all type 1 patches using a GIS system. Assigning all type 1 patches an interior value of 1 to 3 based on their distribution within three classes derived by finding natural breaks using a GIS system.	Acres	METRO RES, METRO MET, METRO WMINT
MR011015	Total wildlife patch area with a score of 1 point for edge to interior	Total square acres of wildlife patch area, scoring 1 point for edge to interior within Metro, summarized by Site. For more information, see Appendix K – Wildlife model criteria. The interior value for a patch is calculated by: 1. Defining an interior zone for all type 1 patches.by using a GIS system to draw internal buffers of 200 feet for each. 2. Calculating the interior zone area (if any) in acres for all type 1 patches using a GIS system. Assigning all type 1 patches an interior value of 1 to 3 based on their distribution within three classes derived by finding natural breaks using a GIS system.	Acres	METRO RES, METRO MET, METRO WMINT

CODE	ELEMENT	DESCRIPTION	UNITS	Data Used from Table 1 in Appendix D
MR011016	Total wildlife patch area with a score of 3 points for proximity to water	Total square acres of wildlife patch area, scoring 3 points for proximity to water within Metro, summarized by Site. For more information, see Appendix K – Wildlife model criteria. The connectivity to water value for a patch is calculated by: 1. Calculating the area of all type 1 and 2 patches that is less than 300 feet from of a source of water using a GIS system. 2. Deriving the "connectivity to water" ratio of each type 1 patch. This is done by dividing the patch area inside 320 feet by the patch area greater than 300feet away from a stream. (Inside 300 / outside 300 = "connectivity to water" ratio) 3. Deriving the "adjusted connectivity to water" ratio of each type 2 patch. The area inside 300 feet is divided by two to create an adjusted total. The adjusted amount is divided by the patch area greater than 300 feet away from a stream. ((Inside 300 / 2) / outside 300 = "adjusted connectivity to water" ratio) 4. Assigning all type 1 and 2 patches a connectivity to water value of 1 to 3 based on the distribution of their ratios within three classes derived by finding natural breaks using a GIS system.	Acres	METRO RES, METRO MET, METRO WMH20
MR011017	Total wildlife patch area with a score of 2 points for proximity to water	Total square acres of wildlife patch area, scoring 2 points for proximity to water within Metro, summarized by Site. For more information, see Appendix K – Wildlife model criteria. The connectivity to water value for a patch is calculated by: 1. Calculating the area of all type 1 and 2 patches that is less than 300 feet from of a source of water using a GIS system. 2. Deriving the "connectivity to water" ratio of each type 1 patch. This is done by dividing the patch area inside 320 feet by the patch area greater than 300feet away from a stream. (Inside 300 / outside 300 = "connectivity to water" ratio) 3. Deriving the "adjusted connectivity to water" ratio of each type 2 patch. The area inside 300 feet is divided by two to create an adjusted total. The adjusted amount is divided by the patch area greater than 300 feet away from a stream. ((Inside 300 / 2) / outside 300 = "adjusted connectivity to water" ratio) 4. Assigning all type 1 and 2 patches a connectivity to water value of 1 to 3 based on the distribution of their ratios within three classes derived by finding natural breaks using a GIS system.	Acres	METRO RES, METRO MET, METRO WMH20

CODE	ELEMENT	DESCRIPTION	UNITS	Data Used from Table 1 in Appendix D
MR011018	Total wildlife patch area with a score of 1 point for proximity to water	Total square acres of wildlife patch area, scoring 1 point for proximity to water within Metro, summarized by Site. For more information, see Appendix K – Wildlife model criteria. The connectivity to water value for a patch is calculated by: 1. Calculating the area of all type 1 and 2 patches that is less than 300 feet from of a source of water using a GIS system. 2. Deriving the "connectivity to water" ratio of each type 1 patch. This is done by dividing the patch area inside 320 feet by the patch area greater than 300feet away from a stream. (Inside 300 / outside 300 = "connectivity to water" ratio) 3. Deriving the "adjusted connectivity to water" ratio of each type 2 patch. The area inside 300 feet is divided by two to create an adjusted total. The adjusted amount is divided by the patch area greater than 300 feet away from a stream. ((Inside 300 / 2) / outside 300 = "adjusted connectivity to water" ratio) 4. Assigning all type 1 and 2 patches a connectivity to water value of 1 to 3 based on the distribution of their ratios within three classes derived by finding natural breaks using a GIS system.	Acres	METRO RES, METRO MET, METRO WMH20
MR011019	Total wildlife patch area with a score of 3 points for proximity to other patches	Total square acres of wildlife patch area, scoring 3 points for proximity to other patches within Metro, summarized by Site. For more information, see Appendix K – Wildlife model criteria. The Connectivity/Proximity value for a patch is calculated as follows: 1. Perform a nearest neighbor operation GIS operation that measures the average distance from each type 1 and 2 patch to other patches within ¼ mile of their perimeters. 2. Assigning all type 1 and 2 patches a connectivity/proximity value of 1 to 3 based on their distribution within three classes derived by finding natural breaks using a GIS system. *General fragmentation also affects the overall score to a lesser degree. The more fragmented a patch the lower the score.	Acres	METRO RES, METRO MET, METRO WMPRX
MR011020	Total wildlife patch area with a score of 2 points for proximity to other patches	Total square acres of wildlife patch area, scoring 2 points for proximity to other patches within Metro, summarized by Site. For more information, see Appendix K – Wildlife model criteria. The Connectivity/Proximity value for a patch is calculated as follows: 1. Perform a nearest neighbor operation GIS operation that measures the average distance from each type 1 and 2 patch to other patches within ¼ mile of their perimeters. 2. Assigning all type 1 and 2 patches a connectivity/proximity value of 1 to 3 based on their distribution within three classes derived by finding natural breaks using a GIS system. General fragmentation also affects the overall score to a lesser degree. The more fragmented a patch the lower the score.	Acres	METRO RES, METRO MET, METRO WMPRX

CODE	ELEMENT	DESCRIPTION	UNITS	Data Used from Table 1 in Appendix D
MR011021	Total wildlife patch area with a score of 1 point for proximity to other patches	Total square acres of wildlife patch area, scoring 1 point for proximity to other patches within Metro, summarized by Site. For more information, see Appendix K – Wildlife model criteria. The Connectivity/Proximity value for a patch is calculated as follows: 1. Perform a nearest neighbor operation GIS operation that measures the average distance from each type 1 and 2 patch to other patches within ¼ mile of their perimeters. 2. Assigning all type 1 and 2 patches a connectivity/proximity value of 1 to 3 based on their distribution within three classes derived by finding natural breaks using a GIS system. General fragmentation also affects the overall score to a lesser degree. The more fragmented a patch the lower the score.	Acres	METRO RES, METRO MET, METRO WMPRX

The DRC metadata viewer is located on Metro's Intranet website (intramet), under Departments, DRC, MetaData Viewer. External metadata can be found in a Binder in Metro's Long-Range Planning Department.

Appendix 2

Methodology for incorporating Local Wetlands Inventories into GIS wetlands coverage.

M E M O R A N D U M

METRO

TO: Paul Ketchum and Justin Houk
FROM: Lynnae Sutton
DATE: 06/25/2002
SUBJECT: Methodology to incorporate LWIs

METHODOLOGY TO INCORPORATE LOCAL WETLAND INVENTORIES INTO METRO'S WETLAND ANALYSIS LAYER

Metro's Wetland layer includes wetlands mapped in the National Wetland Inventory and later updated as a part of the Title 3 water quality process. Additionally, it was modified to incorporate information from local government review and local wetland inventories, becoming the Metro Wetland Analysis Layer used in the Riparian Corridor and Wildlife Habitat Models for the Goal 5 Inventory Process. To include Local Wetland Inventories (LWIs) the following steps were followed:

1. All wetlands provided in each LWI were included in Metro's wetland coverage.
2. If a wetland fell outside of their jurisdiction and overlapped on one of Metro's wetlands, the Metro wetland would be deleted and the new wetland would be included.
3. If a wetland fell outside of their jurisdiction and did not overlap with one of Metro's wetlands, the new wetland would also be included.
4. Within the jurisdiction, all of Metro's wetlands would be erased and replaced with the LWI polygons. An assumption was made that the LWI is more accurate then Metro's original wetland coverage.
5. If a jurisdiction sent a study polygon (a polygon containing the area that was surveyed) this is the boundary that was used for erasing data from Metro's original wetland coverage and including the LWI. Again, an assumption was made that the LWI is more accurate then Metro's original wetland coverage.

Appendix 3

Resolutions relating to inventory approval.

BEFORE THE METRO COUNCIL

FOR THE PURPOSE OF DIRECTING STAFF TO APPLY FUNCTIONAL, SCIENCE BASED CRITERIA IDENTIFYING POSSIBLE FISH AND WILDLIFE HABITAT ON REGION-WIDE MAPS AND REPORTING BACK TO THE NATURAL RESOURCE COMMITTEE FOR ITS REVIEW	)	RESOLUTION NO 01-3087A Introduced by Mike Burton, Executive Officer

WHEREAS, the Regional Framework Plan and Urban Growth Management Functional Plan ("UGMFP") state that Metro will undertake a program for protection of fish and wildlife habitat; and

WHEREAS, the Title 3, Section 5 of the UGMFP sets forth actions that the Metro Council anticipated that Metro would take in identifying, considering and protecting regionally significant fish and wildlife habitat conservation areas; and

WHEREAS, this resolution represents a preliminary step in identifying criteria to address the direction of the UGMFP by determining significant resources for riparian corridors and wildlife consistent with State Goal 5; and

WHEREAS, the Regional Framework Plan and Metro's Regional Urban Growth Goals and Objectives identify watersheds as the appropriate scale for Metro to consider in identifying fish and wildlife habitats; and

WHEREAS, on May 9, 2001, the Metro Natural Resource Committee directed staff to prepare draft functional, science-based criteria for identifying significant resources pertaining to riparian corridors and wildlife habitat consistent with State Goal 5; and

WHEREAS, Staff presented to the Natural Resource Committee on June 6, 2001 draft criteria for identifying possible riparian corridor and wildlife resources based on six functions derived from a review of scientific literature; and

WHEREAS, staff also presented to the Natural Resource Committee on June 6, 2001, three pilot areas were mapped applying these criteria to limited landscapes within the region; and

WHEREAS, the Goal 5 Technical Advisory Committee, the Metro Technical Advisory Committee (MTAC), Metro Policy Advisory Committee (MPAC) and the Water Resources Policy Advisory Committee (WRPAC) have seen the presentation of these criteria and pilot maps and have completed recommendations and forwarded their recommendations to the Metro; and

WHEREAS, the Natural Resources Committee has solicited public comment, provided public notice and held a public meeting for the purpose of hearing public comments and recommendations; NOW, THEREFORE,

BE IT RESOLVED;

1. That the Metro Council hereby directs staff to use the criteria as described in Exhibit A and apply these to map possible riparian corridor and wildlife habitat areas throughout the region.
2. That the Metro Council directs staff to complete the development of criteria to include uplands wildlife habitat with the riparian corridor criteria described in Exhibit A and to map these areas region-wide.
3. That the Metro Council directs staff to complete work items 1 and 2 above and present these data and maps to the Metro Natural Resource Committee in September, 2001 or as soon thereafter when such data and maps are available.

4. That the Metro Council may alter both the criteria and application of the mapping of these criteria prior to adoption of significant resources related to riparian corridors and wildlife habitat areas, after public comment and review.
5. That the Metro Council will invite broad public review of these data and maps prior to any Metro Council action.
6. That the Metro Council's direction to staff in this resolution is not a final action designating significant resources for riparian corridors and wildlife habitat areas or a final action to protect those areas once designated.

ADOPTED by the Metro Council this 26th day of July 2001.

APPROUVÉ APPROVED METRO COUNCIL CONSEIL MÉTROPOLITAINE METRO

David Bragdon, Presiding Officer

Approved as to Form:

FOR Daniel B. Cooper, General Counsel

DRAFT 7/17/2001

Exhibit A

Metro Goal 5 Fish and Wildlife Habitat
Functional Values and Landscape Features for Identifying Significant Riparian Corridors

MICROCLIMATE AND SHADE			
How does the function help fish and wildlife?	Contributing landscape features	Criteria for mapping the landscape features	
		Primary functional value	Secondary functional value
Undisturbed riparian corridors have a unique microclimate. • This allows for increased plant diversity, and thus a variety of food and cover opportunities for fish and wildlife. • Riparian corridors have reduced summertime temperatures, higher humidity levels, and provide protection from wind in the winter, which benefits wildlife. Riparian vegetation provides shade. • Shade moderates the amount of light reaching the stream and thus helps to reduce water temperature. • Water temperature is one of the most important factors influencing salmon and other aquatic species: they depend on cold, clean water. • Riparian vegetation is most effective in providing shade and moderating stream temperature on smaller streams. *(See pages 5-6; 11; ; 15-25; 38-39; and 42 in the April 2001 draft of the Aquatic and Riparian Habitat chapter in Metro's Science Literature Review.)*	<u>Stands of trees and other vegetated areas</u> → Range of widths recommended to maintain the function identified in the scientific literature: Shade: 39-250 ft[1] Microclimate:75-780 ft	The landscape feature has PRIMARY functional value if it is: <u>a forest or woody vegetation landcover type</u> within **100 feet**[2] of: a surface stream; a hydrologically connected wetland[3]; or an area subject to flooding (includes the 1996 flood inundation and FEMA 100-year floodplain).	
	<u>Stands of trees and other vegetated areas</u> → As indicated above, the range of widths for microclimate is 75-780 ft. The outer range is given a secondary value for microclimate function.		The landscape feature has **SECONDARY** functional value if it is: <u>a forest or woody vegetation landcover type</u> within **100 to 780** feet of: a surface stream; a hydrologically connected wetland; or an area subject to flooding (includes the 1996 flood inundation and FEMA 100-year floodplain) and is not a primary feature.

[1] All distances are for one side of a stream or other water feature as measured from the top of bank, and should be applied to each side of the water feature.
[2] 100 feet is the most commonly cited width identified in the scientific literature as necessary for shade, and close to the minimum necessary for maintaining riparian microclimate.
[3] "Hydrologically-connected wetlands" are wetlands located partially or wholly within ¼ mile of a surface stream or flood area.

STREAMFLOW MODERATION AND WATER STORAGE

How does the function help fish and wildlife?	Contributing landscape features	Criteria for mapping the landscape features: Primary functional value	Criteria for mapping the landscape features: Secondary functional value
The riparian corridor may contain wetlands, soils and vegetation that allow groundwater recharge and discharge, help to store rainwater, prevent flooding, and provide sources of stream flow during dry parts of the year. • Wetlands may occur adjacent to stream channels and within the floodplain of the riparian corridor. Wetlands comprise a very small proportion of the landscape and yet host a significant number of specialized plant and animal species. • Wetlands are important storage areas for flow, particularly during dry seasons, when they become a source of water to the stream. • The hyporheic zone allows groundwater to mix with stream water, which changes chemical properties of the water, cools water temperature, and stimulates biological activity. • Riparian forests and other vegetation act as a sponge to hold water, slow stormwater runoff, and maintain stable flow in streams (base flow). • Un-compacted topsoil rich in organic materials can hold water and slow stormwater runoff. *(See pages 2-4; 7; 15-25 in the April 2001 draft of the Aquatic and Riparian Habitat chapter in Metro's Science Literature Review.)*	Wetlands and floodplains The scientific literature has indicated that all riparian associated wetlands and floodplains if protected, provide streamflow moderation and water storage.	The landscape feature has **PRIMARY** functional value if it is: a wetland or other water body[4] with a hydrologic connection to a surface stream. **OR** an area subject to flooding (includes the 1996 flood inundation and FEMA 100-year floodplain)	
	Forests, other vegetative cover and undeveloped soils Increased levels of impervious surfaces interrupt the hydrologic cycle, alter stream structure, and degrade the chemical profile of the water that flows through streams. These changes affect fish and wildlife in various ways, and are cumulative within watersheds. Forests Riparian and upland vegetation helps moderate streamflow by intercepting, absorbing and facilitating storage of rainfall. Water stored in groundwater is slowly released over time.		The landscape feature has **SECONDARY** functional value if it is: a forest, woody vegetation, or low structure vegetation/undeveloped soils landcover type within 300 feet[5] of a surface stream. **OR** a forest landcover type that is contiguous to the riparian corridor (starts within 300 feet[6] but extends beyond)

[4] "Other water body" could include lakes, ponds, reservoirs, or manmade water feature that is not a water quality facility or farm pond.
[5] All upland forests, vegetation, and undeveloped soils help to moderate streamflow and store water. Staff used 300 feet here because some data layers for landcover types do not extend past 300 feet from a stream.
[6] Forest landcover is the only type that extends beyond 300 feet in the Metro database and thus excludes other types.

Bank Stabilization, Sediment and Pollution Control			
How does the function help fish and wildlife?	**Contributing landscape features**	**Criteria for mapping the landscape features**	
		Primary functional value	**Secondary functional value**
Riparian vegetation provides bank stabilization and sediment control. Wetlands or vegetated floodplains also help to remove sediment, excess nutrients, and chemical pollutants. • Sediment in streams originates from streambank erosion, from within the channel, from upland activities, and from natural disturbances. • Sediment occurs naturally in any stream, but changes in the amount and size of the sediment can have negative impacts on fish and other aquatic wildlife, as well as water quality. • Riparian vegetation helps trap pollutants that are attached to sediment particles. • Riparian vegetation helps to moderate streamflow by intercepting, absorbing, and storing rainfall. • Maintaining low structure vegetation and uncompacted topsoil rich in organic materials allows stormwater to infiltrate into the ground rather than flow over the surface (reduced surface erosion & filters pollutants). (Uncompacted topsoil does not include dirt roads, parking lots, etc.) *(See pages 6-7; 15-25; 39-40 in the April 2001 draft of the Aquatic and Riparian Habitat chapter in Metro's Science Literature Review.)*	<u>Default to maintain basic functions</u> → This 50-foot band is specifically to prevent channelization and ensure future bank stability and prevent bank erosion through allowing vegetation to propagate on stream banks. <u>Forest and other vegetation</u> → Range of widths recommended to maintain the function identified in the scientific literature: • Bank stabilization: ½ site potential tree height to 170 ft • Sediment control: 10 ft (sand) – 400 ft (clay) • Pollutant removal: 13-141 ft <u>Steep slopes</u> → The scientific literature indicates that vegetated steep slopes adjacent to all streams provide bank stabilization, sediment and pollution control. <u>Wetlands and floodplains</u> → The scientific literature has indicated that all riparian associated wetlands and floodplains play a critical role in sediment and pollution control.	The landscape feature has PRIMARY functional value if it is: <u>within **50 feet**</u> of a surface stream and is not a forest, woody vegetation, or low structure vegetation/undeveloped soils landcover type. OR <u>a forest, woody vegetation, or low structure vegetation/undeveloped soils landcover type</u> within **100 feet**[7] of a surface stream. OR a forest, woody vegetation, or low structure vegetation/undeveloped soils landcover type within **100-200 feet** of a surface stream <u>if the slope is greater than 25%.</u> OR a forest, woody vegetation, or low structure vegetation/undeveloped soils landcover type within **100 feet** of a <u>hydrologically connected wetland</u> (title 3 wetland); or a forest, woody vegetation, or low structure vegetation/ undeveloped soils landcover type[8] within <u>an area subject to flooding</u> (includes the 1996 flood inundation and FEMA 100-year floodplain).	
	<u>Steep slopes</u> → The scientific literature indicates that for slopes over 25 percent the buffer should be measured from the break in slope to reduce sediment loading from mass wasting events.		The landscape feature has **SECONDARY** functional value if it is: <u>a forest, woody vegetation, or low structure vegetation/undeveloped soils landcover type located on a slope greater than 25%,</u> that starts within 175 feet[9] of a surface stream reach and runs to the first effective break in slope.

[7] The Metro science paper indicates 100 feet as a suitable average distance for vegetation contributing to filtering.
[8] The woody vegetation and low structure vegetation/undeveloped soils landcover types are mapped to 300 feet, the forest landcover type is mapped to the edge of the floodplain.
[9] 175 feet was chosen due to the method used for mapping riverine slopes.

<table>
<tr><th colspan="4">LARGE WOOD AND CHANNEL DYNAMICS</th></tr>
<tr><th rowspan="2">How does the function help fish and wildlife?</th><th rowspan="2">Contributing landscape features</th><th colspan="2">Criteria for mapping the landscape features</th></tr>
<tr><th>Primary functional value</th><th>Secondary functional value</th></tr>
<tr><td rowspan="2">Large woody debris (LWD), such as branches, logs, uprooted trees, and root wads, is a key component of aquatic habitats in the Pacific Northwest. LWD enters streams either directly from the adjacent riparian area, from upland hillslopes through windthrow or debris avalanches, or from upstream sources.

• LWD helps form important habitat for fish such as pools, riffles, eddies, side channels, meanders, and instream cover (overhanging vegetation). Stream complexity is critical for salmon because at various life stages they require different types of habitat.
• LWD also controls the routing of water and sediment, dissipates stream energy, protects streambanks, stabilizes streambeds, helps retain organic matter, and acts as a surface for biological activity.

Over time, streams move back and forth across the valley floor; this area is called the channel migration zone. Most streams have a channel migration zone, except when the channel is constrained by narrow valleys or ravines or altered by human development.

• This area is frequently defined by the 100-year floodplain, and defines where aquatic or wetland habitat could exist in the future.
• Flood events of varying size and frequency play a vital role in maintaining a diversity of riparian plant species and aquatic habitat.
• Biological productivity is enhanced in the floodplains because sediment and nutrients are deposited during the advance and retreat of floodwaters.

(See pages 9-10; 15-25; 40; and 41 in the April 2001 draft of the Aquatic and Riparian Habitat chapter in Metro's Science Literature Review.)</td>
<td><u>Forest</u> →
Range of widths recommended to maintain the function identified in the scientific literature:
• Large woody debris: one site potential tree height; 150-262 ft

<u>Floodplains</u> →
The scientific literature demonstrates that frequently flooded areas should be maintained to allow for the channel migration zone.

<u>Default to maintain basic functions</u>[10] →
The channel migration zone is basically defined by the floodplain, but where there is no mapped floodplain a default of 50 feet was selected to allow for the channel migration zone.</td>
<td>The landscape feature has PRIMARY functional value if it is:

<u>a forest landcover type</u> within 150 feet of a surface stream, or <u>a hydrologically connected wetland</u>.

OR

within an <u>area subject to flooding</u> (includes the 1996 flood inundation and FEMA 100-year floodplain).

OR

<u>within 50 feet</u> of a surface stream.</td>
<td></td></tr>
<tr><td><u>Forest</u>
As indicated above, the range of widths for large woody debris is 150-262 feet. The outer range is given a secondary value for large wood contribution.</td>
<td>→</td>
<td>The landscape feature has SECONDARY functional value if it is:

<u>a forest landcover type</u> within 150 to 262 feet of a surface stream.</td></tr>
</table>

[10] Application of the <u>default to maintain basic functions</u> will be limited to low and moderate gradient channel types.

ORGANIC MATERIAL SOURCES

<table>
<tr><th rowspan="2">How does the function help fish and wildlife?</th><th rowspan="2">Contributing landscape features</th><th colspan="2">Criteria for mapping the landscape features</th></tr>
<tr><th>Primary functional value</th><th>Secondary functional value</th></tr>
<tr><td rowspan="2">Riparian vegetation provides a majority of the energy and hydrocarbons in aquatic food webs.

• Leaves, fruit, cones, insects, and other organic matter fall directly into the stream channel from the riparian area, or move by wind, erosion, or as dissolved materials in groundwater.
• In smaller streams, most of the organic matter used by aquatic communities comes from the adjacent forest, while in larger streams and rivers organic matter may come from aquatic plants and upstream sources.
• Fallen insects from riparian vegetation can make up 40-50% of the diet of trout and juvenile salmon during the summer months.

(See pages 8; 15-25; and 40 in the April 2001 draft of the Aquatic and Riparian Habitat chapter in Metro's Science Literature Review.)</td><td><u>Vegetation</u> →
Range of widths recommended to maintain the function identified in the scientific literature:
• Small woody debris: 100 ft
• Organic litterfall: ½ site potential tree height; 100-170 ft

<u>Floodplains</u> →
Organic material can enter the aquatic environment when the stream floods and carries away organic material from a vegetated area.</td><td>The landscape feature has PRIMARY functional value if it is:

<u>a forest or woody vegetation landcover type</u> within 100 feet of a surface stream, or a hydrologically connected wetland.

OR

a forest or woody vegetation landcover type within <u>an area subject to flooding</u> (includes the 1996 flood inundation and FEMA 100-year floodplain)</td><td></td></tr>
<tr><td><u>Vegetation</u> →
As indicated above, the range of widths for organic material sources is 100-170 feet. The outer range is given a secondary value for organic material source contribution.</td><td>→</td><td>The landscape feature has SECONDARY functional value if it is:

<u>a forest or woody vegetation landcover type</u> within 100 to 170 feet of a surface stream.</td></tr>
</table>

RIPARIAN WILDLIFE HAB[illegible]T AND CONNECTIVITY

How does the function help fish and wildlife?	Contributing landscape features	Criteria for mapping the landscape features: Primary functional value	Criteria for mapping the landscape features: Secondary functional value
Wildlife are attracted to riparian areas because of the abundance of food sources, cover, and proximity of drinking water. • Natural riparian areas provide a complex and highly productive food web. • Riparian vegetation in the form of grasses, shrubs, trees and other plants provides wildlife habitat for reproduction, nesting, roosting, foraging and protection from the weather and from competitive and predatory species. • Structural complexity exists when there is a diversity of plant species, multiple canopy layers, and snags and downed woody material. Much of the biodiversity found in riparian areas depends on this structural complexity. • Riparian corridors, due to their linear shape, enable wildlife movement between habitat patches. • In the summer, the specialized microclimate in riparian corridors creates diverse habitat characteristics desirable to many species, such as amphibians. • Most wildlife species (92% of non-fish wildlife in this region) utilize riparian areas at some point in their life history for water, food, and shelter. Since riparian areas frequently serve as corridors through the urbanized landscape, they also provide movement and dispersal routes. *(See pages 10; 15-25; 41-42 in the April 2001 draft of the Aquatic and Riparian Habitat chapter in Metro's Science Literature Review.)*	<u>Forest and vegetative cover</u> → Range of widths recommended to maintain the function identified in the scientific literature: • Edge effect: 20 ft (noise) -2,000 ft (minimize predation) • Terrestrial LWD and structural complexity: 1 site potential tree height outside a buffer to 650 ft • Movement corridors: 328 ft • Specific wildlife needs: 100 ft (e.g. frogs & salamanders) – 656 ft (Rufous-sided towhee breeding populations) <u>Floodplains</u> → The entire width of the floodplain provides essential spawning and rearing habitat for fish and important year round habitat for birds, turtles, beavers, muskrats and other wildlife.	The landscape feature has **PRIMARY** functional value if it is: <u>a forest, woody vegetation, or low structure vegetation/undeveloped soils landcover type</u> within **328 feet**[11] of a surface stream, or a hydrologically connected wetland[12]. OR a forest, woody vegetation, or low structure vegetation/undeveloped soils landcover type <u>within an area subject to flooding</u> (includes the 1996 flood inundation and FEMA 100-year floodplain)[13].	
	<u>Forest cover</u> → All forest cover between 328 and 2,000 feet is given secondary functional value based on the needs of wildlife identified above.		The landscape feature has **SECONDARY** functional value if it is: <u>a forest landcover type</u> within **328 to 2,000 feet** of a surface stream, or a hydrologically connected wetland.

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[11] Staff recommends 328 feet, the width identified for wildlife movement corridors in the scientific literature, as the most appropriate minimum width for wildlife habitat.
[12] Data on woody vegetation is limited to within 300 feet of a stream, therefore wetlands outside of this boundary would only receive a primary functional value for the forest landcover type within 328 feet.
[13] The woody vegetation (non-forest woody vegetation types such as shrubs) and low structure vegetation/undeveloped soils landcover types are mapped to 300 feet, the forest landcover type is mapped to the edge of the floodplain.

PRELIMINARY DRAFT

An Approach for Rating the Ecological Functions and Identifying Significant Riparian Corridors

Determining resource significance requires the application of ecological functional values to landscape features and the subsequent rating of those features. The table on the following page is an example of an evaluation tool that assigns a numerical score to riparian corridors based on the ecological functions (benefits provided by resources for fish and wildlife) occurring at any given site. It is a science-based framework for identifying significant riparian corridors from a regional perspective.

The following steps must be taken in determining regional resource significance:

1. **Delineating Resource Features (Goal 5 Inventory).** Using year 2000 aerial photos and other data sources, landscape features such as stands of trees, woody vegetation, meadows, wetlands, steep slopes and flood areas are delineated along the region's streams and rivers. This information, collected as part of Metro's Geographic Information System (GIS), can be displayed on maps to graphically illustrate the condition of riparian corridors across the landscape. (This step provides some information about location, quality and quantity of the resources, more information will be included in Metro's Final Goal 5 Inventory Analysis. Step 2 provides additional data on quality).

2. **Assigning Functional Values (Attachment A).** After delineation, the resource features are given either a primary functional value or a secondary functional value based on the importance of the feature relative to the function (benefit) it provides for fish and wildlife. The importance of the feature is determined by applying criteria derived from, and substantiated by, the scientific literature review. The features are then mapped.

3. **Rating Landscape Features (table on following page).** A rating system allows landscape features to be evaluated for the ecological functions they are currently providing. Landscape features that make a critical contribution get a primary value; others get a secondary value. A numerical score can be assigned to each of the primary and secondary functional values for a given landscape feature (for example: 6 points to each primary functional value and 1 point to each secondary functional value). The scores would be additive for any given landscape features and reflect a relative scale of current ecological function.

4. **Determining Significant Riparian Corridors.** A threshold score must be identified for determining resource significance. A rating table, as described in Step 3, is one method that could be used. A determination of significance could range from including all mapped areas receiving any rating value to a subset of those areas. ***The Metro Council would determine the significance threshold.***

5. **Classifying Significant Riparian Corridors.** After determining resource significance, all significant resource sites could be classified and given a letter ranking. This ranking would indicate relative significance for use in the economic, social, environment and energy (ESEE) analysis. For example, if using the letters A, B, and C, Class A resource sites might receive a higher score in the environment portion of the analysis than Class C sites.

Example: Numerical scoring for ecological functions of landscape features

Primary functional value		Secondary functional value		Numeric score
6		0		36
5		1		31
5		0		30
4		2		26
4		1		25
4		0		24
3		3		21
3		2		20
3		1		19
3		0		18
2		4		16
2		3		15
2	AND	2	EQUALS	14
2		1		13
2		0		12
1		5		11
1		4		10
1		3		9
1		2		8
1		1		7
1		0		6
0		6		6
0		5		5
0		4		4
0		3		3
0		2		2
0		1		1

Notes:
1. There are 6 primary functions and 6 secondary functions.
2. In this example, each primary function is assigned 6 points and each secondary function is assigned 1 point.

Range of recommended buffer widths

While studies result in a variety of recommended buffer widths for the riparian area, all recommend some level of protection for this important resource for fish and wildlife. If riparian buffers of sufficient width are maintained along streams in the urban area they can provide good quality habitat within an altered landscape (Knutson and Naef 1997). Table 5 below summarizes the range of riparian area widths recommended in the scientific literature to protect fish and wildlife habitat. In an urban area restoration is likely to play an important role in addition to protection of habitat that is currently in good condition (May 2000).

Table 5: Range of riparian area widths for fish and wildlife habitat

AQUATIC HABITAT			
Function		Reference	Minimum width (each side of stream)
Temperature regulation and shade	Shade	FEMAT 1993	100 ft
	Shade	Castelle et al. 1994	50-100 ft
	Shade	Spence et al. 1996	98 ft
	Shade	May 2000	98 ft
	Shade	Osborne and Kovacic 1993	33-98 ft
	Shade/reduce solar radiation	Brosofske et al. 1997	250 ft
	Control temperature by shading	Johnson and Ryba 1992	39-141 ft
Bank stabilization and sediment control	Bank stabilization	Spence et al. 1996	170 ft
	Sediment removal and erosion control	May 2000	98 ft
	Ephemeral streams	Clinnick et al. 1985	66 ft
	Bank stabilization	FEMAT 1993	½ SPTH
	Sediment control	Erman et al. 1977	100 ft
	Sediment control	Moring 1982	98 ft
	Sediment removal	Johnson and Ryba 1992	10 ft (sand) – 400 ft (clay)
	High mass wasting area	Cederholm 1994	125 ft
Pollutant removal	Nitrogen	Wenger 1999	50-100 ft
	General pollutant removal	May 2000	98 ft
	Filter metals and nutrients	Castelle et al. 1994	100 ft
	Pesticides	Wenger 1999	>49 ft
	Nutrient removal	Johnson and Ryba 1992*	13 – 141 ft
Large woody debris and organic litter	Large woody debris	FEMAT 1993	1 SPTH
	Large woody debris	Spence et al. 1996	1 SPTH
	Large woody debris	Wenger 1999	1 SPTH
	Large woody debris	May 2000*	262 ft
	Large woody debris	McDade et al. 1990	150 ft
	Small woody debris	Pollock and Kennard 1998	100 ft
	Organic litterfall	FEMAT 1993	½ SPTH
	Organic litterfall	Erman et al. 1977	100 ft
	Organic litterfall	Spence et al. 1996	170 ft
Aquatic wildlife	Cutthroat trout	Hickman and Raleigh 1982	98 ft
	Brook trout	Raleigh 1982	98 ft
	Chinook salmon	Raleigh et al. 1986	98 ft
	Rainbow trout	Raleigh et al. 1984	98 ft
	Cutthroat trout, rainbow trout and steelhead	Knutson and Naef 1997	50 – 200 ft
	Maintenance of benthic communities (aquatic insects)	Erman et al. 1977	100 ft
	Shannon index of macroinvertebrate diversity.	Gregory et al. 1987	100 ft
	Trout and salmon influence zone (Western Washington)	Castelle et al. 1992	200 ft

TERRESTRIAL HABITAT

	Function	Reference	Minimum width (each side of stream)
Wildlife needs	Willow flycatcher nesting	Knutson and Naef 1997	123 ft
	Frogs and salamanders	NRCS 1995	100 ft
	Full complement of herpetofauna	Rudolph and Dickson 1990	>100 ft
	Belted Kingfisher roosts	USFWS HEP Model	100 – 200 ft
	Deer	NRCS 1995	200 ft
	Smaller mammals	Allen 1983	214 – 297 ft
	Birds	Jones et al. 1988	246 – 656 ft
	Beaver	NRCS 1995	300 ft
	Minimum distance needed to support area-sensitive neotropical migratory birds	Hodges and Krementz 1996	328 ft
	Western pond turtle nests	Knutson and Naef 1997	330 ft
	Pileated woodpecker	Castelle et al. 1992	450 ft
	Bald eagle nest, roost, perch Nesting ducks, heron rookery and sandhill cranes	Castelle et al. 1992	600 ft
	Pileated woodpecker nesting	Small 1982	328 ft
	Mule deer fawning	Knutson and Naef 1997	600 ft
	Rufous-sided towhee breeding populations	Knutson and Naef 1997	656 ft
	Fish and Wildlife	FEMAT 1993	Two-site potential tree heights; 300 ft
	General wildlife habitat	May 2000	328 ft
Edge effect	Interior bird species	Tassone 1981	164 ft
	Neotropical migrants	Keller et al. 1993	328 ft
	Effect of increased predation	Wilcove et al. 1986	2,000 ft
	Noise reduction of a mature evergreen buffer	Harris 1985	20 ft
	Reduce commercial noise	Groffman et al. 1990	100 ft
LWD and structural complexity	Snags and downed wood	FEMAT 1993	1 SPTH outside the buffer
	Width necessary to minimize non-native vegetation	Hennings 2001	650 ft
Movement corridors	Travel corridor for red fox and marten	Small 1982	328 ft
	Minimum to allow for interior habitat species movement	Environment Canada 1998	328 ft
Microclimate	Maintain microclimate	May 2000	328 ft
	Prevent wind damage	Pollock and Kennard 1998	75 ft
	Approximate natural conditions	Brosofske et al. 1997	250 ft
	Maintain microclimate	Knutson and Naef 1997	200-525 ft
	Maintain humidity and soil temperature	Chen et al. 1995	98 – 787 ft
	Maintain microclimate	FEMAT 1993	3 SPTH

Acronyms:

SPTH: site potential tree height
NMFS: National Marine Fisheries Service
NRCS: National Resource Conservation Service
USFWS: U.S. Fish and Wildlife Service
FEMAT: Forest Ecosystem Management Assessment Team

BEFORE THE METRO COUNCIL

FOR THE PURPOSE OF ADOPTING A DRAFT MAP OF REGIONALLY SIGNIFICANT FISH HABITAT PURSUANT TO RESOLUTION NO. 01-3141C	) RESOLUTION NO. 02-3176)) Introduced by Metro Council Natural) Resources Committee

WHEREAS, the Regional Framework Plan and Urban Growth Management Functional Plan state that Metro will undertake a program for protection of fish and wildlife habitat; and

WHEREAS, on July 17, 2001, in Resolution No. 01-3087A, Metro Council approved a draft matrix of ecological functional criteria to be used to map potential riparian corridor resources in the Metro region; and

WHEREAS, on December 13, 2001, in Resolution No. 01-3141C, Metro Council identified criteria that define regionally significant riparian corridors and applied those criteria to adequate information Metro gathered on the location, quantity and quality of riparian corridors in the Metro region; and

WHEREAS, as part of that resolution, Metro Council amended the matrix of ecological functional mapping criteria as follows:

- For microclimate and shade the secondary functional value is retained to include all forest or woody vegetation that is beyond 100 feet but within 780 feet;
- For stream flow moderation and water storage, developed floodplains should not be included as a primary function, rather, they should be included as a secondary function;
- For large wood and channel dynamics the secondary functional value should be revised to read "Forest within 150 to 262 feet of a stream;
- For the organic materials functional, the primary function be revised to read "Forest or woody vegetation within 100 feet of a stream or wetland; or within a flood area, or vegetation or undisturbed soils within 50 feet of a stream or wetland;" and

WHEREAS, in connection with Resolution No. 01-3141C Metro Council directed staff to provide data and analysis on:

- The location of developed floodplains.
- How the stream network mapping might be extended to capture all "waters of the state" as defined by ORS 196.800(14).
- Ecological functional criteria necessary to map wildlife habitat in the Metro region; and

WHEREAS, Metro Council directed staff to produce a map reflecting Metro Council's regionally significant riparian corridor decision for Metro Council review prior to identifying conflicting uses in the ESEE analysis; and

WHEREAS, Metro Council will consider the criteria and mapping of regionally significant wildlife habitat in a separate resolution; and

WHEREAS, at Metro Council Natural Resource Committee's February 27, 2002 meeting, staff presented a map of known streams entitled "Metro Stream Network Comparison" that might qualify as "waters of the state" and that are not currently part of the stream network to which Metro has applied the ecological functional mapping criteria for riparian corridors; and

WHEREAS, Metro Council Natural Resource Committee found that information on such streams is not consistent throughout the region, and that Metro Council had not considered riparian corridors along streams draining less than 50 acres to generally to be regionally significant. However, Metro Council Natural Resources Committee recommended that these streams be considered by local governments in their local Goal 5 processes; and

WHEREAS, at the March 6, 2002, Metro Council Natural Resources Committee meeting, staff presented data and analysis in a memo dated February 7, 2002, to identify the location of development within floodplains; and

WHEREAS, several options were identified for locating lands in developed floodplains and staff presented four options for locating these lands. Metro Council Natural Resources Committee recommended Option 3 which integrates existing Metro databases for floodplains, undeveloped lands, developed lands, forest canopy and grassland land cover types, open water, wetlands, and parks and open space to identify the locations of development within floodplains; and

WHEREAS, a draft inventory map of regionally significant riparian corridors that reflect Metro Council's decision in Resolution No. 01-3141C and the Metro Council Natural Resources Committee's direction on the mapping of development within floodplains is attached as Exhibit A; now, therefore

BE IT RESOLVED:

1. That the data contained within the Metro databases, and the integration of those databases as described in the February 7, 2002 memo from Justin Houk and Lynnea Sutton to Andy Cotugno provide adequate information to refine the location, quality and quantity of regionally significant riparian corridors as identified by the Metro Council in Resolution No. 01-3141C.

2. The Metro Council adopts the draft map in Exhibit A as the inventory of regionally significant riparian corridors. The draft map shall be the basis for conducting the economic, social, environmental and energy consequences analysis required by the Goal 5 administrative rule.

3. The Metro Council reserves the opportunity to minimally or substantially alter the draft map prior to adoption of a final map of regionally significant fish and wildlife habitat areas and Program to Achieve Goal 5, after public comment and review.

4. The Metro Council's actions in this resolution are not final actions designating regionally significant fish and wildlife habitat areas or a final action to protect those areas through a Program to Achieve Goal 5.

ADOPTED by the Metro Council this 8th day of August 2002.

Susan McLain Dep. Presiding Officer

Carl Hosticka, Presiding Officer

Approved as to Form:

Daniel B. Cooper, General Counsel

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BEFORE THE METRO COUNCIL

FOR THE PURPOSE OF ESTABLISHING CRITERIA TO DEFINE AND IDENTIFY REGIONALLY SIGNIFICANT WILDLIFE HABITAT AND ADOPTING A DRAFT MAP OF REGIONALLY SIGNIFICANT WILDLIFE HABITAT AREAS	))))))	RESOLUTION NO. 02-3177A Introduced by Councilor Susan McLain, Chair, Natural Resources Committee

WHEREAS, the Regional Framework Plan and Urban Growth Management Functional Plan (Functional Plan) state that Metro will undertake a program for protection of fish and wildlife habitat; and

WHEREAS, the Title 3, Section 5 of the Functional Plan sets forth actions anticipated by Metro Council that Metro would take in identifying, considering, and protecting regionally significant fish and wildlife habitat conservation areas; and

WHEREAS, Metro is applying the State Goal 5 administrative rule as the framework for identifying regionally significant fish and wildlife habitat areas; and

WHEREAS, Metro Council has determined that OAR 660-023-0090 (riparian corridors) and OAR 660-023-0110 (wildlife habitat) are the relevant State Goal 5 resources for Metro Council consideration of regional fish and wildlife habitat to be consistent with State Goal 5; and

WHEREAS, on December 13, 2001, Metro Council adopted Resolution No. 01-3141C for the purpose of establishing criteria to define and identify regionally significant fish habitat; and

WHEREAS, in public hearings before Metro Council Natural Resources Committee and in recommendations from the Metro Policy Advisory Committee (MPAC), Metro Technical Advisory Committee (MTAC), Metro Goal 5 Technical Advisory Committee (Goal 5 TAC) and the Water Resources Policy Advisory Committee (WRPAC) Metro Council was urged to complete the analysis of potential regionally significant wildlife habitat and combine that information with the mapping of regionally significant riparian corridors; and

WHEREAS, in Resolution No. 01-3141C, Metro Council directed staff to complete additional work necessary to inventory and map regional wildlife habitat and present that information to Metro Council in early 2002; and

WHEREAS, in response to Metro Council's direction, staff compiled a decision package similar to the package provided for Metro Council's consideration of regionally significant riparian corridors. That package included the following products:

- An analysis of existing Goal 5 data, reports and regulations from cities and counties. This information is contained in a November 20, 2001 memo from the Office of General Counsel on local Goal 5 data, reports and regulations and additional information concerning fish and wildlife habitat areas gathered and exchanged with local governments and agencies.
- A methodology and criteria for identifying wildlife habitat and maps applying those criteria to the region.

- A map(s), based on the regionwide wildlife habitat maps, identifying Goal 5 resource sites and Goal 5 "wildlife habitat" within those resource sites to serve as the basis for identifying regionally significant wildlife habitat.
- An inventory narrative including information on the location, quantity and quality of the potential resource sites identified on the map.
- A map(s) of potential significant resource sites containing wildlife habitat.
- A summary of recommended criteria for identifying and defining regionally significant wildlife habitat.
- A map(s) of potential resource sites containing wildlife habitat, which could be adopted as "regional resources" under the Goal 5 administrative rule. The map of resource sites is the map identified as Exhibit B of Resolution No. 01-3141C; and

WHEREAS, staff presented draft criteria to Metro Council Natural Resources Committee in February 2002 for identifying Goal 5 wildlife habitat based on information contained in "Metro's Scientific Literature Review for Goal 5;" and

WHEREAS, the Metro Council Natural Resources Committee held numerous public hearings and accepted public comment on the topic of regionally significant wildlife habitat including hearings on June 26, July 3, July 17, and July 31, 2002; and

WHEREAS, on June 7, 2002, the Goal 5 Technical Advisory Committee recommended that the June 4, 2002 draft of the Wildlife Habitat Criteria Matrix be adopted with the following modifications: 1) for each criterion, include references back to the Goal 5 Technical Report that directs the reader to the underlying science as documented in Metro's *Technical Report for Goal 5* dated January, 2002.; 2) for the "Connectivity and Proximity to Water Resources" criterion, the average distance of a patch from water sources such as streams, lakes and wetlands *within 320 feet of the patch* should be changed to *within 300 feet of the patch* (it is already mapped using the latter); and 3) for the "Habitats of Concern and Habitats for Unique and Sensitive Species" criterion, Metro should include information on the wetlands inventory layer addressing how it incorporated local wetlands inventory information. The Goal 5 TAC recommended that all inventoried wildlife habitat receiving a score of 2 through 9 including all Habitats of Concern should be identified as regionally significant wildlife habitat; and

WHEREAS, at their June 10 meeting, the Water Resources Policy Advisory Committee recommended that Metro accept the revised inventory of regionally significant riparian corridors and adopt Resolution No. 02-3176.; and that Metro accept the June 4, 2002 version of the Wildlife Habitat Criteria Matrix and the April 17, 2002 decision draft map as the inventory of significant wildlife habitat. At their July 15, 2002 meeting, the Water Resource Policy Advisory Committee recommended that Metro designate all wildlife habitat areas receiving a score of 1 through 9 including Habitat of Concern as regionally significant; and

WHEREAS, at their July 17, 2002 meeting, the Metro Technical Advisory Committee recommended adoption of the draft wildlife habitat criteria dated June 4, 2002; with the same modifications recommended by the Goal 5 TAC as listed above. In addition, they included the recommendation that in cases where Habitats of Concern have been designated solely on the basis of documented species use of a given area, biological survey data should be required as a minimum, for documentation; and

WHEREAS, at the July 24, 2002 meeting, the Metro Policy Advisory Committee recommended that the Metro Council adopt the recommendations as indicated in the Metro Technical Advisory Committee recommendation, including adoption of the draft Wildlife Habitat inventory map for those areas receiving a score of 2 through 9 including Habitats of Concern; and

WHEREAS, areas with a score of 1 in exhibit B, while not regionally significant Goal 5 resources as individual sites, are significant resource sites, and in the aggregate have multiple values that provide important elements of wildlife habitat, stormwater protection, urban forestry canopy and livability; now, therefore,

BE IT RESOLVED:

1. That Metro Council finds that the information in Exhibit A, including *Metro's Riparian Corridor and Wildlife Habitat Inventories*, dated July 2002, and *Metro's Scientific Literature Review for Goal 5*, dated January 2002, contain adequate information to determine the location, quantity and quality of wildlife habitat resources in the Metro region.

2. That Metro Council finds that sufficient data has been gathered and examined concerning local Goal 5 data, reports and regulations to comply with Title 3, Section 5(C)(2) of the Functional Plan.

3. That the Metro Council is relying on the same Goal 5 resource sites identified in Resolution No. 01-3141C as resource sites that contain Goal 5 wildlife habitat resources.

4. Metro Council accepts the Metro Council Natural Resources Committee, WRPAC, Goal 5 TAC, MTAC and MPAC recommendations that the resources shown on Exhibit B are significant "wildlife habitat" resources.

5. That Metro Council interprets the term "regionally significant" wildlife habitat as that term is used in Title 3 of the Functional Plan to be those Goal 5 wildlife habitat resources that qualify as "regional resources" under the Goal 5 administrative rule.

6. That the Metro Council adopts the criteria in Exhibit C, revised as recommended by the Metro Policy Advisory Committee cited above as criteria that define regionally significant wildlife habitat. A resource need not meet every criteria to be considered regionally significant.

7. That Metro Council has applied the criteria identified in Exhibit C to the information in Exhibits A and B to define regionally significant wildlife habitat as all areas scoring 2 through 9 including Habitats of Concern as identified in Exhibit D. The Metro Council recommends that areas scoring 1 be considered by local governments in their local Goal 5 process.

8. That staff is directed to produce a combined map reflecting Metro Council's regionally significant riparian corridor decision in Resolution No. 01-3141C and its decision on regionally significant wildlife habitat.

9. That the map of regionally significant riparian corridors and wildlife habitat that staff has been directed to produce will be a draft map which will be the basis for conducting subsequent steps in the Goal 5 process including the economic, social, environmental and energy consequences analysis and the Program to Achieve Goal 5.

10. Metro Council reserves the opportunity to minimally or substantially alter the draft map prior to adoption of a final map of regionally significant fish and wildlife habitat areas and Program to Achieve Goal 5, after public comment and review.

11. The draft map of regionally significant wildlife habitat will be subject to correction for accuracy until the Council reaches a final decision including the ESEE analysis and program choices which is anticipated in 2003. The Council directs the staff to review all new requests for map corrections during the ESEE and program steps of the regional fish and wildlife project, making changes where documentation of the presence or absence of a physical feature is demonstrated. In addition, staff is directed to develop a post adoption map correction process that may be adopted as an amendment to the Urban Growth Management Functional Plan.

12. The Metro Council's actions in this resolution are not final actions designating regionally significant fish and wildlife habitat areas or a final action to protect those areas through a Program to Achieve Goal 5.

ADOPTED by the Metro Council this 8th day of AUGUST 2002.

Susan McLain

Carl Hosticka, Presiding Officer

Dep. Presiding Officer

Approved as to Form:

Daniel B. Cooper, General Counsel

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OMA/KDH/kvw (08/09/02)

Appendix 4

Data list and reference to location of metadata.

TABLE 1 - METRO INTERNAL GIS DATA LIST

SOURCE	CODE	THEME NAME	DESCRIPTION	DATE	META-DATA	ASSIGNED VARIABLES in Appendix E
Clean Water Services, DSL	RSA	RSAT Sampling points and data point data 1:24,000	Clean Water Service has been collecting water quality and riparian ecological data at many sampling sites within the Tualatin Basin. http://www.usa-cleanwater.org/ShowPage.aspN/AID={2CB75766-8290-4521-BABB-B39170E77613} Choose Appendix D	2001	No	Partial, MR008036
Oregon Department of Env. Quality-DEQ	OWI	Oregon Water Quality Index Data point data 1:24,000	Oregon Water Quality Index Sampling Points and Data from 1999 Water Quality Annual Report. http://www.deq.state.or.us/lab/WQM/WQI/wqimain.htm	1999	Yes, On file with Metro Planning Department	Partial, MR008035
Division of State Lands-DSL	ESH	Essential Salmon Habitat 1:100,000K	2001 Essential Salmon Habitat layer. This layer was created from the 100k hydro data that is at the Oregon Geospatial Data Clearinghouse's web site. Thus the meta data is virtually the same. We do not list species of fish here in this layer, rather we simply depict presence / absence. The location for the vectors were obtained and agreed upon from DSL and ODFW personnel. This layer is projected into the Oregon Statewide standard - Oregon Lambert Projection, NAD83, GRS1980, 3.28084(units). Essential Salmon Habitat is considered by the biologist as those water bodies that are deemed spawning and rearing. This means the coverage does not include migratory routes, like the main stem of the Columbia. http://statelands.dsl.state.or.us/	2001	No	N/A
METRO	BUL	Building Permits	Building permits collected since 1996.	1996	Yes, Found under Building Permits in the DRC metadata viewer	MR008006
METRO	CHT	Channel habitat Types	Information on the geomorphic characteristic of distinct stream reaches in the metro area. Derived using Oregon Watershed Enhancement standards. Incorporates information on stream channel gradient and confinement.	1998	No, Contact Metro Planning Department	MR002001-MR002004
METRO	COU	County Boundaries	Jurisdictional Boundaries for Washington, Multnomah, and Clackamas Counties.	2001 most recent update	Yes, Found under county boundaries in the DRC metadata viewer.	MR008056-MR008058
METRO	CTY	City Boundaries	Jurisdictional Boundaries for cities within Metro jurisdiction.	2001 most recent update	Yes, Found under city boundaries in the DRC metadata viewer.	MR008059-MR008082
METRO	CUL	Culverts	Stream crossings by roads and other transportation facilities. Prepared by Metro Transportation Department, 2000 using road network, stream network, and field inspections.	1998	No, Contact Metro Transportation Department	MR008001, MR008002, MR008086
METRO	DEM	Regional Digital Elevation Model	USGS 1:24000 - 10 meter digital elevation data compiled for the fifth field watersheds in the Metro Area.	2001	No, Contact Metro Planning Department	MR001002-MR001007
METRO	DEV	Developed Lands	METRO's developed land layer is the "reverse" of METRO's undeveloped lands layer. In other words, any land (or water) which is not undeveloped is show on the developed layer. * Metro's Vacant Land Definitions Every tax lot is determined to be vacant, partially vacant, or developed. * Vacant tax lots are those that have no building, improvements or identifiable land use. * Developed lots must have improvements and specific land uses. For	2001	Yes, Found under Developed land in the DRC metadata viewer.	MR008004

The DRC metadata viewer is located on Metro's Intranet website (intramet), under Departments, DRC, MetaData Viewer. External metadata can be found in a Binder in Metro's Long-Range Planning Department.

SOURCE	CODE	THEME NAME	DESCRIPTION	DATE	META-DATA	ASSIGNED VARIABLES in Appendix E
			example, a paved parking lot is developed but an unpaved lot where trucks are parked is vacant. * Lots under site development show building activity, but development is incomplete and they are considered vacant. * If a developed tax lot has 1/2 acre (20,000-sq. ft.) or greater portion that is vacant, the lot is considered to be partially vacant and partially developed. The vacant portion is added to the vacant land database. * Parks and open spaces are treated as developed. * During the assessment of each tax lot, no consideration is given to constrained land, suitability for building, or to redevelopment potential.			
METRO	DES	Regional Land Use Design types	Regional Land use design types from the Region 2040 plan.	N/A	Yes, Found under design types in the DRC metadata viewer	MR008045-MR008055
METRO	FLD	Flood Areas (FEMA/1996)	Areas covered by the 100-year floodplain mapped for the Federal Emergency Management Administration and/or areas mapped as inundated during the 1996 flood event by the Army Corps of Engineers, excluding ponded areas as noted by local governments. The layer includes minor edits to incorporate local information received through the Title 3 map review process and subsequent public review.	1992 orig. 2001 most recent update	Yes, found under Flood Plains in the DRC metadata viewer	MR003002
METRO	DFLD	Developed floodplains	"Developed Floodplains" are developed lands polygons within the floodplain where no digitized forest canopy, wetlands, open water, golf courses, parks or open spaces polygons occur.	2002	Yes, refer to Appendix F this document	MR003005
METRO	HU12	Regional 12 digit hydrologic units	6th field hydrologic units for the metro area. Derived in an automated fashion through GIS using National Resource Conservation Service Standards.	2001	Yes, found under Hydrologic Units in DRC metadata viewer	N/A
METRO	MET	Metro Boundary	Metro Jurisdictional Boundary	1980 orig. 2001 most recent update	Yes, Found under Metro Boundary in the DRC Metadata Viewer	N/A
METRO	MRD	Metro Street Network	Regional highways, streets, and roads	2001 most recent update	Yes, Found under streets in the DRC Metadata Viewer	MR008003
METRO	OWT	Open Water	Open water surface areas of lakes, ponds, and some rivers from the USGS 7½-minute quadrangle map data, from Metro stream modeling data of topography and as modified by review by cities and counties in the region	1988 orig. 2001 most recent update	Yes, found under Streams lines in the DRC metadata viewer	MR002008
METRO	RAV	Steeply Sloped Ravines	Slopes greater than 25 percent beginning within 200 horizontal feet of the stream centerline or bank where mapped and extending to the first effective break in slope. Derived using the slope calculation method within the Arc-Info software program, 7½-minute USGS topographic map data, and manual interpretation.	1998 orig. 2001 most recent update	No, Contact Metro Planning Department	MR005001-004
METRO	RBS	Riparian Bank stabilization, Sediment and Pollution control	Areas contributing to the Riparian Bank stabilization, Sediment and Pollution control function in the riparian scoring matrix found in Metro Council Resolution No. 01-3141B. Areas are rated as primary (6 points) or secondary (1 point) depending on there relative contribution.	2001	No, Contact Metro Planning Department or read appendix J of this report	MR007005-MR007006
METRO	RES	Metro Goal 5 Resource Sites	Hydrologically based resource management areas within the Metro Jurisdiction. Developed from the metro boundary, the 6th field hydrologic units using additional criteria (see appendix C)	2001	No, Contact Metro Planning Department or read Appendix B of this report	All
METRO	RIP	Riparian	Represents resource features receiving values for one or more of the	2001	No, Contact Metro	MR007011-

The DRC metadata viewer is located on Metro's Intranet website (intramet), under Departments, DRC, MetaData Viewer. External metadata can be found in a Binder in Metro's Long-Range Planning Department.

SOURCE	CODE	THEME NAME	DESCRIPTION	DATE	META-DATA	ASSIGNED VARIABLES in Appendix E
		Functional Values Layer	five ecological functions appearing in the riparian scoring matrix. The matrix is included in Metro's Resolution No. 01-3141B. These layers were derived using the Goal 5 inventory features and the riparian scoring matrix. There is a layer for each individual function and a layer depicting cumulative score for all features.		Planning Department or read Appendix J of this report	MR007016
METRO	RLW	Riparian Large Wood and Channel Dynamics	Riparian Bank stabilization, Sediment and Pollution control in the riparian scoring matrix found in Metro Council Resolution No. 01-3141B. Areas are rated as primary (6 points) or secondary (1 point) depending on there relative contribution.	2001	No, Contact Metro Planning Department or read Appendix J of this report	MR007007-MR007008
METRO	RMR	Riparian Microclimate and shade	Areas contributing to the microclimate and shade function in the riparian scoring matrix found in Metro Council Resolution No. 01-3141B. Areas are rated as primary (6 points) or secondary (1 point) depending on there relative contribution.	2001	No, Contact Metro Planning Department or read Appendix J of this report	MR007001-MR007002
METRO	ROM	Riparian Organic Material Sources	Areas contributing to the organic material sources function in the riparian scoring matrix found in Metro Council Resolution No. 01-3141B. Areas are rated as primary (6 points) or secondary (1 point) depending on there relative contribution.	2001	No, Contact Metro Planning Department or read Appendix J of this report	MR007009-MR007010
METRO	RWS	Riparian Stream flow Moderation & Water Storage	Areas contributing to the stream flow Moderation & Water Storage function in the riparian scoring matrix found in Metro Council Resolution No. 01-3141B. Areas are rated as primary (6 points) or secondary (1 point) depending on there relative contribution.	2001	No, Contact Metro Planning Department or read Appendix J of this report	MR007003-MR007004
METRO	SOI	Regional Soils	USDA soils data compiled for Washington, Multnomah, and Clackamas Counties.	1996	Yes, Found under soils in the DRC Metadata Viewer	MR003003
METRO	STR	Stream Centerlines	Central channels or central braids of streams included on Metro's stream network. The network is composed of streams appearing on USGS digital line graph data, supplemented by stream model and edited for accuracy using air photos by Data Resource Center. The network includes minor edits to incorporate local information received through the Title 3 map review process and subsequent public reviews.	1988 orig. 2001 most recent update	Yes, found under Streams lines in the DRC metadata viewer	MR002001-MR002007
METRO	UGB	Metro UGB	The Urban Growth Boundary administrated by metro	1980 orig. 2001 most recent	Yes, Found under Metro UGB in the DRC Metadata Viewer	N/A
METRO	VC98	Satellite Vegetation Canopy Closure	Landsat TM Satellite derived canopy closure data, 1998. Data at 25 x 25 meters (80 x 80 feet) pixel. Data organized into 5 classed based on percent canopy closure.	1998	Yes, Found under Vegetation cover, 1998 in the DRC Metadata viewer	MR004019-MR004022
METRO	LC98	Satellite Landcover	Landsat TM Satellite derived landcover, 1998. Data at 25 x 25 meters (80 x 80 feet) pixel. Data organized into 17 classes.	1998	Yes, Found under Landcover, 1998 in the DRC Metadata viewer	MR004001-MR004018
METRO	VEG	Vegetation Landcover	Land covered by forest canopy, woody vegetation, and open soils /low structure vegetation in patches generally larger than one acre in size. Delineated at a scale of 1:4800 using 2000 aerial photos and generalized criteria by the Metro Data Resource Center. Forest canopy was created for the entire metro area. Woody vegetation and open soils / low structure vegetation was created within 300 feet of all Metro area surface streams.	2000 orig. 2001 most recent update	Yes, found under Vegetation coverage 2000, canopy cover. in the DRC metadata viewer	MR004023-MR004026
METRO	WET	Wetlands	Wetlands mapped by the National Wetland Inventory and later updated as a part of the Title 3 water quality process. Additionally modified to incorporate information from local government review and local wetland	1998 orig. 2001 most recent	Yes, found under Wetlands poly in the DRC metadata viewer	MR003001, MR003004

The DRC metadata viewer is located on Metro's Intranet website (intramet), under Departments, DRC, MetaData Viewer. External metadata can be found in a Binder in Metro's Long-Range Planning Department.

SOURCE	CODE	THEME NAME	DESCRIPTION	DATE	META-DATA	ASSIGNED VARIABLES in Appendix E
			inventories. Wetlands are considered hydrologically connected if the wetland boundary begins within ¼ mile of a riparian corridor	update		
METRO	ZON	Generalized Regional Zoning	Local jurisdictional zoning reclassified into more general regional zoning classes.	2001 most recent update	Yes, found under zoning in the DRC metadata viewer	MR008038-MR008044
METRO	HOC	Habitats of Concern	**A habitat of concern** is a unique or unusually important wildlife habitat area (polygon data). They are identified based on site-specific information provided by local wildlife or habitat experts. Habitats of concern can be smaller than 2 acres, and will be included in the inventory if falling into one or more of the following categories: 1. Any patch specifically identified as a Priority Conservation Habitat by ODFW, USFWS, or other agencies or local wildlife experts. Priority conservation habitats are Oregon white oak savannas and woodlands, native prairie grasslands, wetlands, and bottomland hardwood forests. 2. Any patch of natural land cover identified by ODFW, USFWS, or other agencies or local wildlife experts as a riverine island or delta important to wildlife. Specifically delineated habitat areas that provide life-history requirements of sensitive, threatened or endangered wildlife species or Great Blue Heron rookeries (for example, nesting habitat for an existing population of native turtles); habitats that support at-risk plants; or habitats that provide unusually important wildlife functions, such as major wildlife crossings/pathways or a key migratory pathway, such as an elk migratory corridor.	2002	No, Contact Metro Planning Department or read Appendix H – Habitats of Concern Master List	MR010002-MR010021
METRO	SOC	Species of Concern	The sensitive species list / point data contains: Vertebrate species that currently exist within the Metro region that are listed as threatened, endangered or species of concern for at least a portion of the year and could be found in the region through diligent search by a knowledgeable person. Vagrant species (those that do not typically occur every year) are not included on this list. The species list is based on the opinion of more than two dozen local wildlife experts. The Oregon Natural Heritage Program (ORNHP), Endangered Species Act (ESA), and Oregon Department of Fish and Wildlife (ODFW) status categories were obtained from ORNHP's February, 2001 *Rare, Threatened and Endangered Plants and Animals of Oregon* publication. Habitat associations were obtained from Johnson and O'Neil's new book, *Wildlife Habitats and Relationships in Oregon and Washington*. The taxonomic standards for common and scientific names for birds is based on the American Ornithological Union Check-list.	2002	No, Contact Metro Planning Department or read Appendix I – Current Species and Species of Concern list	MR010001
METRO	WM	Wildlife patch model – cumulative score	Wildlife patches scored by the wildlife model score. The wildlife model criteria include overall patch size, a measure of the patch's edge to interior, and a patch's proximity to water and other patches. Patches are composed of two types. These include: Type 1 patches are defined as any forest landcover, forested wetland, or non-forested wetland with a total combined size greater than 2 acres. Where different cover types are contiguous they are considered to be part of a single larger patch.	2002	No, Contact Metro Planning Department or read Appendix K – Wildlife Model Criteria	MR009001-MR009024 & MR011001-MR011021

The DRC metadata viewer is located on Metro's Intranet website (intramet), under Departments, DRC, MetaData Viewer. External metadata can be found in a Binder in Metro's Long-Range Planning Department.

SOURCE	CODE	THEME NAME	DESCRIPTION	DATE	META-DATA	ASSIGNED VARIABLES in Appendix E
			Type 2 patches are defined as any shrubland/scrubland or grassland/open soils landcover in a tract greater than 2 acres, within 300 feet off a surface stream.)			
METRO	WMSIZ	Total wildlife patch area for overall patch size	The size value for a wildlife patch is calculated by: 1. Calculating the area in acres for all type 1 patches using a GIS system. Assigning all type 1 patches a value of 1 to 3 based on their distribution within three classes derived by finding natural breaks using a GIS system.	2002	No, Contact Metro Planning Department or read Appendix K – Wildlife Model Criteria	MR011010-MR011012
METRO	WMINT	Total wildlife patch area for edge to interior	The interior value for a wildlife patch is calculated by: 1. Defining an interior zone for all type 1 patches by using a GIS system to draw internal buffers of 200 feet for each. 2. Calculating the interior zone area (if any) in acres for all type 1 patches using a GIS system. Assigning all type 1 patches an interior value of 1 to 3 based on their distribution within three classes derived by finding natural breaks using a GIS system.	2002	No, Contact Metro Planning Department or read Appendix K – Wildlife Model Criteria	MR011013-MR011015
METRO	WMH20	Total wildlife patch area for proximity to water	The connectivity to water value for a wildlife patch is calculated by: 1. Calculating the area of all type 1 and 2 patches that is less than 300 feet from of a source of water using a GIS system. 2. Deriving the "connectivity to water" ratio of each type 1 patch. This is done by dividing the patch area inside 320 feet by the patch area greater than 300feet away from a stream. (Inside 300 / outside 300 = "connectivity to water" ratio) 3. Deriving the "adjusted connectivity to water" ratio of each type 2 patch. The area inside 300 feet is divided by two to create an adjusted total. The adjusted amount is divided by the patch area greater than 300 feet away from a stream. ((Inside 300 / 2) / outside 300 = "adjusted connectivity to water" ratio) Assigning all type 1 and 2 patches a connectivity to water value of 1 to 3 based on the distribution of their ratios within three classes derived by finding natural breaks using a GIS system.	2002	No, Contact Metro Planning Department or read Appendix K – Wildlife Model Criteria	MR011016-MR011018
METRO	WMPRX	Total wildlife patch area for proximity to other patches	The Connectivity/Proximity value for a wildlife patch is calculated as follows: 1. Perform a nearest neighbor operation GIS operation that measures the average distance from each type 1 and 2 patch to other patches within ¼ mile of their perimeters. 2. Assigning all type 1 and 2 patches a connectivity/proximity value of 1 to 3 based on their distribution within three classes derived by finding natural breaks using a GIS system. *General fragmentation also affects the overall score to a lesser degree. The more fragmented a patch the lower the score.	2002	No, Contact Metro Planning Department or read Appendix K – Wildlife Model Criteria	MR011019-MR011021
City of Portland-PORT	HISSAL	Historical to current fish species distribution 1:100,000K	Data not available as of June 2002.	--	--	MR006025
Oregon Department of Fish and	BTD	Bull Trout distribution 1:100,000K	Display current and historic (pre-1990) distribution of bull trout in Oregon (and in adjacent states where metapopulations overlap); for use with the 1997 statewide status report on bull trout, conservation strategies, and	2001	Yes, On file with Metro Planning Department	MR006019

The DRC metadata viewer is located on Metro's Intranet website (intramet), under Departments, DRC, MetaData Viewer. External metadata can be found in a Binder in Metro's Long-Range Planning Department.

SOURCE	CODE	THEME NAME	DESCRIPTION	DATE	META-DATA	ASSIGNED VARIABLES in Appendix E
Wildlife-ODFW			for general distribution. ftp://rainbow.dfw.state.or.us/pub/gis/k100/meta/BUTGIS2001.html			
ODFW	DCH	Chum distribution 1:100,000K	Areas of suitable habitat currently believed to be utilized by wild, natural, and/or hatchery fish populations. The term "currently" is defined as within the past five reproductive cycles. This information is based on the best professional judgement of ODFW staff biologists and in some cases, that of staff from other natural resource agencies within Oregon. ftp://rainbow.dfw.state.or.us/pub/gis/k100/meta/chum.htm	2001	Yes, On file with Metro Planning Department	MR006011
ODFW	DCI1	Fall Chinook distribution 1:100,000K	Areas of suitable habitat currently believed to be utilized by wild, natural, and/or hatchery fish populations. The term "currently" is defined as within the past five reproductive cycles. This information is based on the best professional judgement of ODFW staff biologists and in some cases, that of staff from other natural resource agencies within Oregon. ftp://rainbow.dfw.state.or.us/pub/gis/k100/meta/ch_fall.htm	2001	Yes, On file with Metro Planning Department	MR006007
ODFW	DCI2	Spring chinook distribution 1:100,000K	Areas of suitable habitat currently believed to be utilized by wild, natural, and/or hatchery fish populations. The term "currently" is defined as within the past five reproductive cycles. This information is based on the best professional judgement of ODFW staff biologists and in some cases, that of staff from other natural resource agencies within Oregon. ftp://rainbow.dfw.state.or.us/pub/gis/k100/meta/ch_spring.htm	2001	Yes, On file with Metro Planning Department	MR006003
ODFW	DCO	Coho distribution 1:100,000K	Areas of suitable habitat currently believed to be utilized by wild, natural, and/or hatchery fish populations. The term "currently" is defined as within the past five reproductive cycles. This information is based on the best professional judgement of ODFW staff biologists and in some cases, that of staff from other natural resource agencies within Oregon. ftp://rainbow.dfw.state.or.us/pub/gis/k100/meta/coho.htm	2001	Yes, On file with Metro Planning Department	MR006001
ODFW	DCT	Lahontan cutthroat distribution 1:100,000K	Areas of suitable habitat currently believed to be utilized by wild, natural, and/or hatchery fish populations. The term "currently" is defined as within the past five reproductive cycles. This information is based on the best professional judgement of ODFW staff biologists and in some cases, that of staff from other natural resource agencies within Oregon. ftp://rainbow.dfw.state.or.us/pub/gis/k100/meta/lcttmetadata.html	2001	Yes, On file with Metro Planning Department	MR006017
ODFW	DSS	Summer steelhead distribution 1:100,000K	Areas of suitable habitat currently believed to be utilized by wild, natural, and/or hatchery fish populations. The term "currently" is defined as within the past five reproductive cycles. This information is based on the best professional judgment of ODFW staff biologists and in some cases, that of staff from other natural resource agencies within Oregon. ftp://rainbow.dfw.state.or.us/pub/gis/k100/meta/st_summer.htm	2001	Yes, On file with Metro Planning Department	MR006013
ODFW	DSW	Winter steelhead distribution 1:100,000K	Areas of suitable habitat currently believed to be utilized by wild, natural, and/or hatchery fish populations. The term "currently" is defined as within the past five reproductive cycles. This information is based on the best professional judgment of ODFW staff biologists and in some cases, that of staff from other natural resource agencies within Oregon. ftp://rainbow.dfw.state.or.us/pub/gis/k100/meta/st_winter.htm	2001	Yes, On file with Metro Planning Department	MR006015
ODFW	OFH	Oregon fish hatcheries	A simple point coverage to locate fish propagation facilities within the state of Oregon. Facilities are differentiated by function as well as whether or not they are ODFW operated. ftp://rainbow.dfw.state.or.us/pub/gis/other/meta/hatch-v1.html	2000	Yes, On file with Metro Planning Department	No
ODFW	WVB	Willamette Valley/North-	This dataset contains both passable and impassable barriers to anadromous salmonid migration for the Willamette Valley and the	2000	Yes, On file with Metro Planning Department	No

The DRC metadata viewer is located on Metro's Intranet website (intramet), under Departments, DRC, MetaData Viewer. External metadata can be found in a Binder in Metro's Long-Range Planning Department.

SOURCE	CODE	THEME NAME	DESCRIPTION	DATE	META-DATA	ASSIGNED VARIABLES in Appendix E
		coast barriers point data 1:24,000	Northcoast of Oregon. Dams are found in a separate dataset. ftp://rainbow.dfw.state.or.us/pub/gis/other/meta/wvncbars.html			
ODFW	WVD	Willamette Valley/North-coast dams point data 1:24,000	This dataset contains locations of dams. Dams that are both passable and impassable to salmonid migration are included. This dataset only includes dams for the Willamette Valley and the Northcoast of Oregon. This dataset can be used to identify geographic locations of dams that may impede or block the migration of anadromous salmonids. ftp://rainbow.dfw.state.or.us/pub/gis/other/meta/wvncdaMR.html	2000	Yes, On file with Metro Planning Department	No
DEQ	303	303D 1998 Listed Streams and Lakes 1:100,000K	Water Quality Limited Stream - 303(d) List http://www.streamnet.org/online-data/303d.html	1998	Yes, On file with Metro Planning Department	Yes, MR008007-MR008034
ODFW	AIP	Aquatic Inventories Project, Habitat and Reach Data Coverages, 1:100,000K	The Oregon Department of Fish & Wildlife has been actively acquiring stream habitat inventory information for the purpose of habitat assessment since 1990. This information is collected during the summer months by stream survey crews using methods described in Moore et al. (1997). The field data focuses on channel and valley morphology (stream and reach data), riparian characteristics and condition (reach data), and in-stream habitat (habitat unit data). http://osu.orst.edu/Dept/ODFW/freshwater/inventory/pdffiles/metaweb.pdf	2001	Yes, On file with Metro Planning Department	Partial, MR008036
Pacific States Marine Fisheries Commission, Environmental Protection Agency-PSMFC/EPA (STREAM-NET)	DAF	All NW anadromous fish distribution 1:100,000K	This dataset is a record of the distribution of salmon and steelhead, based upon the best professional judgment of local fish biologists, as of year 2001 in the Pacific Northwest Region (Oregon, Washington, and Idaho). This data was collected by biologists at the state fish & wildlife agencies of Washington (WDFW), Oregon (ODFW) and Idaho (IDFG). ftp://ftp.streamnet.org/pub/streamnet/gisdata/MetaAnad.htm	2001	Yes, On file with Metro Planning Department	MR006021
PSMFC/EPA (STREAM-NET)	DPS	NW Pink salmon distribution 1:100,000K	This dataset is a record of fish distribution and activity of Pink Salmon, based upon the best professional judgment of local fish biologists, as of year 2000 in the Pacific Northwest Region (Oregon, Washington, and Idaho). This data was collected by biologists at the state fish & wildlife agency of Washington (WDFW) Data was then compiled by the following StreamNet staff into paper maps or event tables at the state level. ftp://ftp.streamnet.org/pub/streamnet/gisdata/MetaPink.htm	2001	Yes, On file with Metro Planning Department	N/A
PSMFC/EPA (STREAM-NET)	DSN	NW sockeye salmon distribution 1:100,000K	This dataset is a record of fish distribution and activity of Sockeye Salmon, based upon the best professional judgment of local fish biologists, as of year 2000 in the Pacific Northwest Region (Oregon, Washington, and Idaho). This data was collected by biologists at the state fish & wildlife agencies of Washington (WDFW), and Idaho (IDFG). Data was then compiled by the following StreamNet staff into paper maps or event tables at the state level. ftp://ftp.streamnet.org/pub/streamnet/gisdata/MetaSock.htm	2001	Yes, On file with Metro Planning Department	MR006009
PSMFC/EPA (STREAM-NET)	DWS	NW White Sturgeon distribution 1:100,000K	This dataset is a record of fish distribution and activity of White Sturgeon, based upon the best professional judgment of local fish biologists, as of year 2000 in the Pacific Northwest Region (Oregon, Washington, and Idaho). This data was collected by biologists at the	2001	Yes, On file with Metro Planning Department	MR006023

The DRC metadata viewer is located on Metro's Intranet website (intramet), under Departments, DRC, MetaData Viewer. External metadata can be found in a Binder in Metro's Long-Range Planning Department.

SOURCE	CODE	THEME NAME	DESCRIPTION	DATE	META-DATA	ASSIGNED VARIABLES in Appendix E
			state fish & wildlife agencies of Washington (WDFW), Oregon (ODFW) and Idaho (IDFG). Data was then compiled by the following StreamNet staff into paper maps or event tables at the state level. ftp://ftp.streamnet.org/pub/streamnet/gisdata/MetaWhSturg.htm			
PSMFC/EPA (STREAM-NET)	DXX	Summer Chinook distribution 1:100,000K	This dataset is a record of fish distribution and activity of Summer Chinook Salmon, based upon the best professional judgment of local fish biologists, as of year 2001 in the Pacific Northwest Region (Oregon, Washington, and Idaho). This data was collected by biologists at the state fish & wildlife agencies of Washington (WDFW), Oregon (ODFW) and Idaho (IDFG). Data was then compiled by the following StreamNet staff into paper maps or event tables at the state level. ftp://ftp.streamnet.org/pub/streamnet/gisdata/MetaSuChin.htm	2001	Yes, On file with Metro Planning Department	MR006005

The DRC metadata viewer is located on Metro's Intranet website (intramet), under Departments, DRC, MetaData Viewer. External metadata can be found in a Binder in Metro's Long-Range Planning Department.

TABLE 2A - GIS AND LOCATIONAL DATA CONSULTED FOR SUMMARIES

SOURCE	THEME NAME	DESCRIPTION	DATE	META-DATA
USGS	Willamette Valley Natural Wetlands and Riparian Vegetation, 1:24,000 and Metadata	NATIVE WETLAND, RIPARIAN, AND UPLAND PLANT COMMUNITIES AND THEIR BIOTA IN THE WILLAMETTE VALLEY, OREGON by Jonathan H. Titus, John A. Christy, Dick VanderSchaaf, James S. Kagan, and Edward R. Alverson, Oregon Natural Heritage Program, The Nature Conservancy As part of the Willamette Basin Geographic Initiative Program, the Environmental Protection Agency (EPA) funded The Nature Conservancy of Oregon to inventory, classify, and map native wetland and riparian plant communities and their threatened biota in the Willamette Valley. ftp://ftp.sscgis.state.or.us/pub/data/regional/shpfiles/wvnatwet.html	1998	Yes
Oregon Department of Water Resources (WRD)	Dams regulated by the WRD, 1:24,000 and Metadata	Depict the approximate location of dams in the state of Oregon that the State has statutory authority over. These are dams that are greater than or equal to 10-feet in height and store greater than or equal to 9.2-acre-feet of water behind them. ftp://ftp.sscgis.state.or.us/pub/data/statewide/k24/ordams.htm	1998	Yes
USGS	Ground water pollution 1:2,000,000	USGS delineated ground water pollution, 1:2,000,000 http://www.gis.state.or.us/data/alphalist.html	?	No
U.S. Department of Agriculture, Natural Resources Conservation Service (NRCS)	USDA NRCS Certified Ssurgo Soil Surveys 1:24,000	Certified SSURGO Soil data from the NRCS (not available for the entire state) 1:24,000 This data set is a digital soil survey and generally is the most detailed level of soil geographic data developed by the National Cooperative Soil Survey. The information was prepared by digitizing maps, by compiling information onto a planimetric correct base and digitizing, or by revising digitized maps using remotely sensed and other information. ftp://ftp.sscgis.state.or.us/pub/data/regional/ssurgo/surgo.txt	1998	Yes
ODFW	Willamette Valley Vegetation, 1:24,000	Oregon Department of Fish and Wildlife in collaboration with NW Region Habitat Conservation Section Ecological Analysis Center. Clair Klock, Steve Smith, Tom O'Neil, Rebecca Goggans, Charley Barrett Vegetation/Land cover identified in data: Urban - all city and industrial area, Forested Urban - forested area with increased housing density, Water - rivers, lakes and ponds, Black Hawthorn, Hedgerows and Brushy Fields, Cottonwood, Willow, Reed Canary grass, Cattail – Bulrush, Hairgrass Prairie, Ash - Cottonwood - bottomland Pasture Mosaic, Oak - Douglas Fir - > 50% Oak, Douglas Fir - Oak - < 50% Oak, Oak - Madrone or Douglas Fir - Madrone - any % of Madrone, Maple-Alder-Fir, Douglas Fir or any conifer, Gravel and Sand - usually along rivers, Unclassified Forest - forested areas in the foothills of the Cascade and Coast Range, Annual Row Corps, Annual Grass, Perennial Grass, Orchards, Vineyards, Berries, Christmas trees, Nursery Stock, Parks. Data does not include Portland Metropolitan area. ftp://rainbow.dfw.state.or.us/pub/gis/k24/meta/wv-veg.html	1999	Yes
ODFW	Bull trout gene conservation groups, 1:100,000	Display current and historic (pre-1990) distribution of bull trout in Oregon (and in adjacent states where metapopulations overlap); for use with the 1997 statewide status report on bull trout, conservation strategies, and for general distribution. ftp://rainbow.dfw.state.or.us/pub/gis/k100/meta/BUTGIS2001.html	1999	Yes
ODFW	Bull trout sitings as points, 1:100,000 and metadata	A point coverage (Bullpoint01) showing bull trout sighting information is also available at the ftp site. It is a partial record of a variety of surveys and miscellaneous observations of bull trout. ftp://rainbow.dfw.state.or.us/pub/gis/k100/meta/BUTGIS2001.html	2001	Yes

The DRC metadata viewer is located on Metro's Intranet website (intramet), under Departments, DRC, MetaData Viewer. External metadata can be found in a Binder in Metro's Long-Range Planning Department.

SOURCE	THEME NAME	DESCRIPTION	DATE	META-DATA
Pacific Northwest Ecosystem Research Consortium (ERC)	ERC procedures, and associated databases, used for evaluating the suitability of Willamette habitats for wildlife species, 30m cell resolution.	(1) Habitat change modeling (White et al. 1997, 1999; Hulse et al. in press; Santelmann et al. in press) and (2) application of a spatially explicit life history simulator, PATCH (a Program to Assist in Tracking Critical Habitat [Schumaker 1998]). Habitat change modeling calculates the proportional changes in the total quantity of suitable habitat (sum of the suitability score times the area for each habitat class) for various groups of species between two points in time. PATCH considers both the quantity of habitat and its distribution and connectivity within the landscape in evaluating wildlife population responses. Outputs from PATCH include estimates of population abundance and maps of population distribution and source-sink areas. Land use/land cover classes defined in the basin wide maps developed by the PNW-ERC (available at http://www.orst.edu/dept/pnw-erc) based principally on Thematic Mapper ™ imagery. The requirement for a consistent analysis over an area as large as the Willamette River Basin (30,000 sq. km) limits the types of data available to characterize habitat. The approach and data are not intended and not suitable for decisions regarding individual sites. However, they are appropriate for describing overall patterns within the Willamette Basin and assessment of basin wide and watershed-scale changes in wildlife responses over time. As the spatial extent of an analysis increases, the resolution of the analysis by necessity becomes coarser. The benefits of management decisions, and supporting analyses, at multiple, linked spatial scales have been widely recognized (e.g., FEMAT 1993, Bormann et al. 1994). These projects focus on the large watershed to basin scale. Habitat relationships were identified for 279 vertebrate species that currently breed or historically occurred in the Willamette River Basin: 19 amphibians, 15 reptiles, 164 birds, and 81 mammals. http://www.fsl.orst.edu/pnwerc/wrb/futures/evaluation/terr_wildlife/datasets.html	1999	Yes
ERC	Historic vegetation and metadata	Historic vegetation (1850) partially covering the Willamette Valley. http://www.fsl.orst.edu/pnwerc/wrb/access.html	1999	No
ERC	LULC 1990 projected at 10 year increments through 2050 with 30m cell resolution and metadata.	Land Use / Land Cover circa 1990 is a gridded representation of the landscape of the Willamette River Basin around 1990. Each 30 m cell describes a land cover or a land use. The former includes forest age and type, agricultural crops, and water features. The latter includes roads, railways, urban residential use (defined by four categories of household density), commercial and industrial uses, and rural structures. Multiple data sources were drawn from in order to construct this grid, and a priority scheme invoked to uniquely define each cell. This grid represents the initial conditions upon which possible future scenarios of development within the WRB are based. The WRB Plan Trend 2050 future represents a straight-line projection of recent trends in mainstream zoning and land use to the year 2050. To the extent that long range plans indicate an intention of development and management trends, they are incorporated into the plan trend future. Forestry (Northwest Forest Plan) and urban land uses (Metro 2040) provide examples of management and future growth plans which are incorporated into this scenario. In the Plan Trend scenario, forestry and agriculture land uses cover the largest area in the WRB. Urban land uses have grown in areal extent relative to 1990 conditions with population growth	1999	Yes

The DRC metadata viewer is located on Metro's Intranet website (intramet), under Departments, DRC, MetaData Viewer. External metadata can be found in a Binder in Metro's Long-Range Planning Department.

SOURCE	THEME NAME	DESCRIPTION	DATE	META-DATA
		accommodated by density increases in the Portland metropolitan area and the other large cities. http://www.fsl.orst.edu/pnwerc/wrb/metadata/ec90.html, http://www.fsl.orst.edu/pnwerc/wrb/metadata/pt00v06.html, http://www.fsl.orst.edu/pnwerc/wrb/metadata/pt10v06.html through http://www.fsl.orst.edu/pnwerc/wrb/metadata/pt50v06.html		
CWS	RSAT sampling sites and data with no metadata, 1:24,000K.	Clean Water Service has collected water quality and riparian ecological data at many sampling sites within the Tualatin Basin. http://www.usa-cleanwater.org/ShowPage.asp?ID={2CB75766-8290-4521-BABB-B39170E77613} Choose Appendix D	2001	No

TABLE 2B - ADDITIONAL REFERENCE GIS AND LOCATIONAL DATA

SOURCE	THEME NAME	DESCRIPTION	DATE	META-DATA
DEQ	Approved Landfills and Thermal Treatment Facilities for Petroleum-Contaminated Soils (PCS) as of September 1998	The data lists locations that have been given DEQ approval as of September 1998 to receive petroleum-contaminated soils. The fields include facility name, tons per year limit, contact information. http://www.deq.state.or.us/wmc/tank/pcsfacilities.htm	1998	Yes
DEQ	Environmental Cleanup Site Information (ECSI) Database as of July 2001	ECSI, an acronym for **Environmental Cleanup Site Information,** is an electronic database that the Oregon Department of Environmental Quality (DEQ) has used since 1989 to track sites with known or suspected hazardous substance contamination. Each ECSI entry contains basic data such as site name and location. For most sites, ECSI also indicates how and when the site became contaminated, qualitative risks the contamination may pose to human health or the environment, investigative and cleanup actions that have occurred, and prioritized further actions, if any, that are required. At many sites, ECSI documents contaminants found in soil, surface water, sediments, and groundwater, with associated concentrations and sampling dates. ECSI categorizes current site status as either: 1) under investigation; 2) on the Confirmed Release List (CRL) or Inventory of Facilities Needing Further Action (Inventory); or 3) cleaned up to DEQ standards (No Further Action, or NFA). http://www.deq.state.or.us/wmc/cleanup/ecsiq&a.htm	2001	Yes
DEQ	Potential Brownfield Sites in Oregon From DEQ's ECSI and UST Cleanup Databases as of June 2000	During the last several years, there has been growing interest, both locally and nationally, in "Brownfields." The U. S. Environmental Protection Agency (EPA) defines Brownfields as "abandoned, idled, or under-used industrial and commercial facilities where expansion or redevelopment is complicated by real or perceived environmental contamination." In a broader sense, Brownfields may be any property where actual **or suspected** contamination impairs the property value. In order to assist individuals in identifying Brownfields in Oregon, we have produced a list of possible Brownfields. The list includes all database sites except: 1) those at which DEQ has determined cleanup to be complete; 2) those undergoing active cleanup with DEQ oversight; and (3) underground storage tank sites to which DEQ has issued an operating permit. We have also excluded heating oil tank releases, as most of these occur at individual residences. Using these criteria, just under 2,850 sites have been selected from the total database population of about 8,800. http://www.deq.state.or.us/wmc/cleanup/bfintro.htm	2000	Yes
DEQ	UST Cleanup Site Database August 2001	The UST Cleanup List is a listing of all sites with reported releases of petroleum products from regulated underground storage tanks (USTs),	2001	Yes

The DRC metadata viewer is located on Metro's Intranet website (intramet), under Departments, DRC, MetaData Viewer. External metadata can be found in a Binder in Metro's Long-Range Planning Department.

SOURCE	THEME NAME	DESCRIPTION	DATE	META-DATA
		unregulated USTs, and home heating oil tanks. http://www.deq.state.or.us/wmc/tank/lustlist.htm		
DEQ	On-line Laboratory Analytical Storage and Retrieval Database	Water Quality monitoring data is in the Laboratory Analytical Storage and Retrieval (LASAR) database. Continuous monitoring data are not included. Database is updated regularly. The following data are included: (For additional water quality data visit EPA's STORET database site.) ξ Bacteriological ξ Biological ξ Fungicide ξ Habitat ξ Herbicide ξ Inorganic ξ Metals ξ Organic ξ Pesticide ξ Physical ξ Radiological http://www.deq.state.or.us/wq/lasar/LasarHome.htm	2001	Yes
DEQ	DEQ Wastewater Permits On-line Database as of November 2001	The Wastewater Permits Database has been put online to allow the public to search DEQ's Source Information System (SIS) database for information on NPDES[1] and WPCF[2] permits. It contains records from DEQ's Source Information System current through 12/3/2001. Includes domestic, industrial and general (storm water permits). [1]NPDES is the acronym for National Pollutant Discharge Elimination System permits. These are permits required by the federal Clean Water Act and issued by DEQ pursuant to a delegation agreement with the US Environmental Protection Agency. NPDES permits generally cover all discharges to waters of the United States (surface water). [2]WPCF is the acronym for Water Pollution Control Facility permits. These permits are required by state statute and issued by DEQ. WPCF permits generally cover all discharges not covered by an NPDES permit, including discharges to groundwater. http://www.deq.state.or.us/wq/SISData/FacilityHome.asp	2001	Yes
ODFW	Oregon Gap vegetation, 1:100,000 and Metadata	The development of the 1998 OR-GAP vegetation coverage was done as an update to the pilot GAP analysis project and first generation land cover map in 1992. The following are some of the classification types: ***FOREST AND WOODLAND COVER TYPES :*** *Sitka Spruce-W. Hemlock Maritime Forest, Mountain Hemlock Montane Forest, True Fir-Hemlock Montane Forest, Shasta Red Fir-Mountain Hemlock Forest, Whitebark-Lodgepole Pine Montane Forest, Douglas Fir/White Oak Forest, Oregon White Oak Forest, etc…* ***SHRUBLAND AND GRASSLAND TYPES:*** *Mountain Mahogany Shrubland, Sagebrush Steppe, etc…* ***NON-NATIVE OR MINIMAL VEGETATIVE COVER:*** *Urban, Agriculture, etc…* ***RIPARIAN AND HERBACEOUS WETLAND TYPES:*** *Wet Meadow, Palustrine Forest, etc…* http://rainbow.dfw.state.or.us/data.html	1998	Yes
Oregon Natural Heritage Program (ONHP)	Ecoregions, 1:250,000 and Metadata	**Level III and IV Ecoregion Descriptions for Oregon** 11/29/00 -- Sandra A. Bryce and Alan J. Woods http://www.gis.state.or.us/data/alphalist.html choose Ecoregions	2000	Yes

The DRC metadata viewer is located on Metro's Intranet website (intramet), under Departments, DRC, MetaData Viewer. External metadata can be found in a Binder in Metro's Long-Range Planning Department.

SOURCE	THEME NAME	DESCRIPTION	DATE	META-DATA
ODFW	Wildlife management units (no metadata	ODFW wildlife management units http://rainbow.dfw.state.or.us/data.html	1999	No
PSMFC/EPA	Adult fish returns data for the Pacific Northwest (1:100,000) and metadata	This dataset is a record of anadromous fish adult return counts and estimates which were completed in the Pacific Northwest. ftp://ftp.streamnet.org/pub/streamnet/gisdata/MetaAdReturns.txt	2000	Yes
PSMFC/EPA	Pacific NW Water Quality sampling data for streams and lakes (GIS and SQL database) and metadata (last updated 10/26/00).	This data set is a record of water quality data collected for various stream sites in the Pacific Northwest. The data was originally compiled from a variety of sources for the EPA (Environmental Protection Agency) by PSMFC (Pacific States Marine Fisheries Commission) for the National Nutrient Criteria Program. All of the data met the following criteria: * Chemical analysis performed by a qualified laboratory * Not being previously archived in STORET * Samples taken from streams * Sampling sites with enough location information to be tied to a specific stream location * Water chemistry data containing at least one parameter for Nitrogen or Phosphorus ftp://ftp.streamnet.org/pub/streamnet/gisdata/MetaWQStreams.htm	2000	Yes
ERC	Demographic, hydrologic, physiographic, base grids and land use/land cover spatial dataset for the Willamette Valley. ERC	Digital maps and supporting material used in developing future scenarios (LULC 2050) for the Willamette River Basin (physiographic, culture, etc). They are in ArcInfo format organized into six categories called Theme Groups. These maps provide the starting point for development of the maps in the Possible Futures section. http://www.fsl.orst.edu/pnwerc/wrb/access.html	1999	Yes
EPA	Toxic Release Inventory 1985-1999	The Toxics Release Inventory (TRI), published by the U.S. EPA, is a valuable source of information regarding toxic chemicals that are being used, manufactured, treated, transported, or released into the environment. Two statutes, Section 313 of the Emergency Planning and Community Right-To-Know Act (EPCRA) and section 6607 of the Pollution Prevention Act (PPA), mandate that a publicly accessible toxic chemical database be developed and maintained by US EPA. This database, known as the Toxics Release Inventory (TRI), contains information concerning waste management activities and the release of toxic chemicals by facilities that manufacture, process, or otherwise use said materials. Using this information, citizens, businesses, and governments can work together to protect the quality of their land, air and water. http://www.epa.gov/tri/general.htm	1999	Yes
EPA	BASINS Version 3. EPA	The U.S. Environmental Protection Agency's water programs and their counterparts in states and pollution control agencies are increasingly emphasizing watershed and water quality-based assessment and integrated analysis of point and nonpoint sources. Better Assessment Science Integrating point and Nonpoint Sources **(BASINS)** is a system developed to meet the needs of such agencies. It integrates a geographic information system (GIS), national watershed and meteorological data, and state-of-the-art environmental assessment and modeling tools into one convenient package. The heart of BASINS is its suite of interrelated components essential for performing watershed and water quality analysis. Includes LULC and other GIS coverages and water quality data. http://www.epa.gov/ost/basins/basinsv3.htm and http://www.epa.gov/ost/basins/metadata.htm	2001	Yes

The DRC metadata viewer is located on Metro's Intranet website (intramet), under Departments, DRC, MetaData Viewer. External metadata can be found in a Binder in Metro's Long-Range Planning Department.

Appendix 5

Riparian corridors and wildlife habitat GIS model criteria matrices.

FINAL 12/13/2001
Exhibit A, Appendix A   Resolution 01-3141C

<u>Metro Goal 5 Fish and Wildlife Habitat</u>
Ecological Functional Values and Landscape Features

<table>
<tr><th colspan="4">MICROCLIMATE AND SHADE</th></tr>
<tr><th rowspan="2">How does the function help fish and wildlife?</th><th rowspan="2">Contributing landscape features</th><th colspan="2">Criteria for mapping the landscape features</th></tr>
<tr><th>Primary functional value</th><th>Secondary functional value</th></tr>
<tr><td rowspan="2">Undisturbed riparian corridors have a unique microclimate.
• This allows for increased plant diversity, and thus a variety of food and cover opportunities for fish and wildlife.
• Riparian corridors have reduced summertime temperatures, higher humidity levels, and provide protection from wind in the winter, which benefits wildlife.

Riparian vegetation provides shade.
• Shade moderates the amount of light reaching the stream and thus helps to reduce water temperature.
• Water temperature is one of the most important factors influencing salmon and other aquatic species: they depend on cold, clean water.
• Riparian vegetation is most effective in providing shade and moderating stream temperature on smaller streams.

(See pages 5-6; 11; 15-25; 38-39; and 42 in the April 2001 draft of the Aquatic and Riparian Habitat chapter in Metro's Science Literature Review.)</td><td><u>Stands of trees and other vegetated areas</u> →
Range of widths recommended to maintain the function identified in the scientific literature:
Shade: 39-250 ft[1]
Microclimate:75-780 ft</td><td>The landscape feature has PRIMARY functional value if it is:

<u>a forest or woody vegetation landcover type</u> within 100 feet[2] of: a surface stream; a hydrologically connected wetland[3]; or an area subject to flooding (includes the 1996 flood inundation and FEMA 100-year floodplain).</td><td></td></tr>
<tr><td><u>Stands of trees and other vegetated areas</u> →
As indicated above, the range of widths for microclimate is 75-780 ft. The outer range is given a secondary value for microclimate function.</td><td></td><td>The landscape feature has SECONDARY functional value if it is:

<u>a forest or woody vegetation landcover type</u> that is beyond 100 feet but within 780 feet.</td></tr>
</table>

[1] All distances are for one side of a stream or other water feature as measured from the top of bank, and should be applied to each side of the water feature.
[2] 100 feet is the most commonly cited width identified in the scientific literature as necessary for shade, and close to the minimum necessary for maintaining riparian microclimate.
[3] "Hydrologically-connected wetlands" are wetlands located partially or wholly within ¼ mile of a surface stream or flood area.

Streamflow Moderation and Water Storage

How does the function help fish and wildlife?	Contributing landscape features	Criteria for mapping the landscape features: Primary functional value	Criteria for mapping the landscape features: Secondary functional value
The riparian corridor may contain wetlands, soils and vegetation that allow groundwater recharge and discharge, help to store rainwater, prevent flooding, and provide sources of stream flow during dry parts of the year. • Wetlands may occur adjacent to stream channels and within the floodplain of the riparian corridor. Wetlands comprise a very small proportion of the landscape and yet host a significant number of specialized plant and animal species. • Wetlands are important storage areas for flow, particularly during dry seasons, when they become a source of water to the stream. • The hyporheic zone allows groundwater to mix with stream water, which changes chemical properties of the water, cools water temperature, and stimulates biological activity. • Riparian forests and other vegetation act as a sponge to hold water, slow stormwater runoff, and maintain stable flow in streams (base flow). • Un-compacted topsoil rich in organic materials can hold water and slow stormwater runoff. *(See pages 2-4; 7; 15-25 in the April 2001 draft of the Aquatic and Riparian Habitat chapter in Metro's Science Literature Review.)*	Wetlands and floodplains The scientific literature has indicated that all riparian associated wetlands and floodplains if protected, provide streamflow moderation and water storage.	The landscape feature has **PRIMARY** functional value if it is: a wetland or other water body[4] with a hydrologic connection to a surface stream. **OR** an area subject to flooding except developed floodplains[5] (includes the 1996 flood inundation and FEMA 100-year floodplain)	
	Forests, other vegetative cover and undeveloped soils Increased levels of impervious surfaces interrupt the hydrologic cycle, alter stream structure, and degrade the chemical profile of the water that flows through streams. These changes affect fish and wildlife in various ways, and are cumulative within watersheds. Forests Riparian and upland vegetation helps moderate streamflow by intercepting, absorbing and facilitating storage of rainfall. Water stored in groundwater is slowly released over time.		The landscape feature has **SECONDARY** functional value if it is: a forest, woody vegetation, or low structure vegetation/undeveloped soils landcover type within **300 feet**[6] of a surface stream. **OR** a forest landcover type that is contiguous to the riparian corridor (starts within **300 feet**[7] but extends beyond) **OR** developed floodplains

[4] "Other water body" could include lakes, ponds, reservoirs, or manmade water feature that is not a water quality facility or farm pond.
[5] Criteria will be devised to map the location of developed floodplains.
[6] All upland forests, vegetation, and undeveloped soils help to moderate streamflow and store water. Staff used 300 feet here because some data layers for landcover types do not extend past 300 feet from a stream.
[7] Forest lan[illegible]er is the only type that extends beyond 300 feet in the Metro database a[illegible]us excludes other types.

BANK STABILIZATION, SEDIMENT AND POLLUTION CONTROL

How does the function help fish and wildlife?	Contributing landscape features	Criteria for mapping the landscape features: Primary functional value	Criteria for mapping the landscape features: Secondary functional value
Riparian vegetation provides bank stabilization and sediment control. Wetlands or vegetated floodplains also help to remove sediment, excess nutrients, and chemical pollutants. • Sediment in streams originates from streambank erosion, from within the channel, from upland activities, and from natural disturbances. • Sediment occurs naturally in any stream, but changes in the amount and size of the sediment can have negative impacts on fish and other aquatic wildlife, as well as water quality. • Riparian vegetation helps trap pollutants that are attached to sediment particles. • Riparian vegetation helps to moderate streamflow by intercepting, absorbing, and storing rainfall. • Maintaining low structure vegetation and uncompacted topsoil rich in organic materials allows stormwater to infiltrate into the ground rather than flow over the surface (reduced surface erosion & filters pollutants). (Uncompacted topsoil does not include dirt roads, parking lots, etc.) *(See pages 6-7; 15-25; 39-40 in the April 2001 draft of the Aquatic and Riparian Habitat chapter in Metro's Science Literature Review.)*	<u>Default to maintain basic functions</u> → This 50-foot band is specifically to prevent channelization and ensure future bank stability and prevent bank erosion through allowing vegetation to propagate on stream banks.	The landscape feature has PRIMARY functional value if it is: <u>within **50 feet**</u> of a surface stream and is not a forest, woody vegetation, or low structure vegetation/undeveloped soils landcover type. **OR**	
	<u>Forest and other vegetation</u> → Range of widths recommended to maintain the function identified in the scientific literature: • Bank stabilization: ½ site potential tree height to 170 ft • Sediment control: 10 ft (sand) – 400 ft (clay) • Pollutant removal: 13-141 ft	<u>a forest, woody vegetation, or low structure vegetation/undeveloped soils landcover type</u> within **100 feet**[8] of a surface stream. **OR**	
	<u>Steep slopes</u> → The scientific literature indicates that vegetated steep slopes adjacent to all streams provide bank stabilization, sediment and pollution control.	a forest, woody vegetation, or low structure vegetation/undeveloped soils landcover type within **100-200 feet** of a surface stream <u>if the slope is greater than 25%.</u> **OR**	
	<u>Wetlands and floodplains</u> → The scientific literature has indicated that all riparian associated wetlands and floodplains play a critical role in sediment and pollution control.	a forest, woody vegetation, or low structure vegetation/undeveloped soils landcover type within **100 feet** of a <u>hydrologically connected wetland</u> (title 3 wetland); or a forest, woody vegetation, or low structure vegetation/undeveloped soils landcover type[9] within <u>an area subject to flooding</u> (includes the 1996 flood inundation and FEMA 100-year floodplain).	
	<u>Steep slopes</u> → The scientific literature indicates that for slopes over 25 percent the buffer should be measured from the break in slope to reduce sediment loading from mass wasting events.		The landscape feature has **SECONDARY** functional value if it is: <u>a forest, woody vegetation, or low structure vegetation/undeveloped soils landcover type located on a slope greater than 25%,</u> that starts within 175 feet[10] of a surface stream reach and runs to the first effective break in slope.

[8] The Metro science paper indicates 100 feet as a suitable average distance for vegetation contributing to filtering.
[9] The woody vegetation and low structure vegetation/undeveloped soils landcover types are mapped to 300 feet, the forest landcover type is mapped to the edge of the floodplain.
[10] 175 feet was chosen due to the method used for mapping riverine slopes.

LARGE WOOD AND CHANNEL DYNAMICS

How does the function help fish and wildlife?	Contributing landscape features	Criteria for mapping the landscape features: Primary functional value	Criteria for mapping the landscape features: Secondary functional value
Large woody debris (LWD), such as branches, logs, uprooted trees, and root wads, is a key component of aquatic habitats in the Pacific Northwest. LWD enters streams either directly from the adjacent riparian area, from upland hillslopes through windthrow or debris avalanches, or from upstream sources. • LWD helps form important habitat for fish such as pools, riffles, eddies, side channels, meanders, and instream cover (overhanging vegetation). Stream complexity is critical for salmon because at various life stages they require different types of habitat. • LWD also controls the routing of water and sediment, dissipates stream energy, protects streambanks, stabilizes streambeds, helps retain organic matter, and acts as a surface for biological activity. Over time, streams move back and forth across the valley floor; this area is called the channel migration zone. Most streams have a channel migration zone, except when the channel is constrained by narrow valleys or ravines or altered by human development. • This area is frequently defined by the 100-year floodplain, and defines where aquatic or wetland habitat could exist in the future. • Flood events of varying size and frequency play a vital role in maintaining a diversity of riparian plant species and aquatic habitat. • Biological productivity is enhanced in the floodplains because sediment and nutrients are deposited during the advance and retreat of floodwaters. *(See pages 9-10; 15-25; 40; and 41 in the April 2001 draft of the Aquatic and Riparian Habitat chapter in Metro's Science Literature Review.)*	Forest → Range of widths recommended to maintain the function identified in the scientific literature: • Large woody debris: one site potential tree height; 150-262 ft Floodplains → The scientific literature demonstrates that frequently flooded areas should be maintained to allow for the channel migration zone. Default to maintain basic functions[11] → The channel migration zone is basically defined by the floodplain, but where there is no mapped floodplain a default of 50 feet was selected to allow for the channel migration zone.	The landscape feature has **PRIMARY** functional value if it is: a forest landcover type within **150 feet** of a surface stream, or a hydrologically connected wetland. **OR** within an area subject to flooding except developed floodplains (includes the 1996 flood inundation and FEMA 100-year floodplain). **OR** within 50 feet of a surface stream.	
	Forest → As indicated above, the range of widths for large woody debris is 150-262 feet. The outer range is given a secondary value for large wood contribution.	→	The landscape feature has **SECONDARY** functional value if it is: a forest landcover type within **150 to 262 feet** of a surface stream.

[11] Application of the default to maintain basic functions will be limited to low and moderate gradient channel types.

Organic Material Sources			
How does the function help fish and wildlife?	**Contributing landscape features**	**Criteria for mapping the landscape features**	
		Primary functional value	**Secondary functional value**
Riparian vegetation provides a majority of the energy and hydrocarbons in aquatic food webs. • Leaves, fruit, cones, insects, and other organic matter fall directly into the stream channel from the riparian area, or move by wind, erosion, or as dissolved materials in groundwater. • In smaller streams, most of the organic matter used by aquatic communities comes from the adjacent forest, while in larger streams and rivers organic matter may come from aquatic plants and upstream sources. • Fallen insects from riparian vegetation can make up 40-50% of the diet of trout and juvenile salmon during the summer months. *(See pages 8; 15-25; and 40 in the April 2001 draft of the Aquatic and Riparian Habitat chapter in Metro's Science Literature Review.)*	<u>Vegetation</u> → Range of widths recommended to maintain the function identified in the scientific literature: • Small woody debris: 100 ft • Organic litterfall: ½ site potential tree height; 100-170 ft <u>Floodplains</u> → Organic material can enter the aquatic environment when the stream floods and carries away organic material from a vegetated area.	The landscape feature has **PRIMARY** functional value if it is: <u>a forest or woody vegetation landcover type</u> within **100 feet** of a surface stream, or a hydrologically connected wetland. **OR** <u>a low structure vegetation/undeveloped topsoil landcover type</u> within **50 feet** of a surface stream or a hydrologically connected wetland. **OR** a forest, woody vegetation, or low structure vegetation/undeveloped topsoil landcover type within <u>an area subject to flooding</u> (includes the 1996 flood inundation and FEMA 100-year floodplain)	
	<u>Vegetation</u> → As indicated above, the range of widths for organic material sources is 100-170 feet. The outer range is given a secondary value for organic material source contribution.		The landscape feature has **SECONDARY** functional value if it is: <u>a forest or woody vegetation landcover type</u> within **100 to 170 feet** of a surface stream.

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April 2005 Wildlife Habitat Criteria Matrix

LARGE PATCHES ARE BETTER THAN SMALL PATCHES		
How does the function benefit fish and wildlife?	**Mapping assumption**	**Criteria and Value**
Several studies have been conducted that indicate a larger habitat patch is better for the survival of many native species. • A study on the predation on Neotropical migratory songbirds in the northeastern U.S. found an increased amount of predation in smaller forest patches. • A study of native small mammal populations found that species diversity increased with patch size. The habitat patches that did not contain native small mammals were in general smaller fragments. • Local studies show that large habitat patches have higher proportions of native plants and birds than small patches. Larger patches frequently retain more of the functions and values provided by native habitat. For example, many forest interior bird species are dependent on insects for food and a study in Ontario found that invertebrate biomass was 10 to 36 times higher in large forest patches than small forest patches. Long-term trends in wildlife populations are directly related to the area of habitat available – the larger the patch, the longer a population can sustain itself. Some species require a certain amount of territory for foraging and breeding purposes. Other species are limited in population by the amount of resources available within a patch, thus the larger the patch the larger the population. Larger animals typically require a larger amount of land just to support their body mass. For example, a deer forages on a much larger range than a mouse.	*Overall Patch Size* Assumption: the larger the patch the greater the value for wildlife habitat.	The size value for a patch is calculated by: 1. Calculating the area in acres for all type 1 patches[1] using a GIS system. 2. Assigning all type 1 patches a value of 1 to 3 based on their distribution within three classes derived by finding natural breaks using a GIS system[2].

[1] Type 1 patches are defined as any forest landcover, forested wetland, or nonforested wetland with a total combined size greater than 2 acres. Where different cover types are contiguous they are considered to be part of a single larger patch. Type 2 patches are defined as any shrubland/scrubland or grassland/open soils landcover in a tract greater than 2 acres, within 300 feet off a surface stream.

[2] The Jenkins method for finding natural breaks was used. This method creates classes based on natural groupings of data values. Features are divided into classes whose boundaries are set where there are relatively big jumps in the data values.

MAXIMIZE INTERIOR HABITAT (MINIMIZE EDGE HABITAT)		
How does the function benefit fish and wildlife?	**Mapping assumption**	**Criteria and value**
Edge habitat occurs where one habitat type, such as a forest, meets a meadow, stream, road, or other natural or artificial habitat type. While edge habitats frequently contain a high number of species, many sensitive species that need interior habitat are unable to survive in edge areas. • The size of a patch, as well as the relationship with surrounding habitats, relate directly to the edge effects on wildlife populations. • Species richness and diversity is typically higher in edge habitats, but the number of habitat specialists, or species that require a particular type of habitat for survival, tends to decrease. These are the species most vulnerable to negative effects of urbanization. • Patch size and shape both impact the amount of edge habitat – a large square has less edge habitat and more interior habitat than a long, thinly shaped habitat. • Urbanization typically increases habitat fragmentation, providing more edge habitat and reducing the amount of original habitat. The edge effect can penetrate far into the interior habitat necessary for certain species. • Some studies have shown that certain impacts such as invasion by exotic plants and predation can penetrate up to 1,640 feet (500 meters) into the forest. • Studies have found that the abundance of interior habitat bird species was reduced within 656-1,640 feet (200 to 500 meters) of an edge. • Local studies have found that non-native plants and birds are substantially reduced beyond 200 feet (61 meters) of an edge. • A study in southern Ontario found that ovenbirds, an interior habitat species, select nest sites more than 820 feet (250 meters) from the forest edge, a distance that is not possible in a small habitat fragment. *(See the Upland Habitat section of Metro's Scientific Literature Review for Goal 5).*	*Interior Area Size* Assumption: a patch with more interior habitat has a higher value for wildlife habitat because it reduces competition from nonnative and generalist species, provides better food and cover, and increases avian nest success for native species.	The interior value for a patch is calculated by: 1. Defining an interior zone for all type 1 patches[1] by using a GIS system to draw internal buffers of 200 feet for each. 2. Calculating the interior zone area (if any) in acres for all type 1 patches using a GIS system. 3. Assigning all type 1 patches an interior value of 1 to 3 based on their distribution within three classes derived by finding natural breaks using a GIS system[2].

[1] Type 1 patches are defined as any forest landcover, forested wetland, or nonforested wetland with a total combined size greater than 2 acres. Where different cover types are contiguous they are considered to be part of a single larger patch. Type 2 patches are defined as any shrubland/scrubland or grassland/open soils landcover in a tract greater than 2 acres, within 300 feet off a surface stream.

[2] The Jenks [illegible]d for finding natural breaks was used. This method creates classes based on nat[illegible] groupings of data values. Features are divided into classes whose boundaries are [illegible] where there are relatively big j[illegible]s in the data values.

CONNECTIVITY AND PROXIMITY TO WATER RESOURCES IS IMPORTANT		
How does the function benefit fish and wildlife?	**Mapping assumption**	**Criteria and value**
Corridors play an important role in urban areas to provide opportunity for migration and movement, including between upland and riparian habitats. • Habitat patches near water resources have increased diversity of wildlife • Most wildlife species use riparian areas for some aspect of their life history • In the Metro region, nearly half of all native vertebrate species depend on riparian habitats, with 93 percent using riparian areas for breeding or feeding • Riparian corridors frequently serve as travel routes, especially in urban areas, and have the greatest potential for an interconnected wildlife system providing food, water and travel routes	<u>Proximity to water</u> Assumption: patches that are closer to sources of water have higher wildlife performance than areas further from water sources. Upland patches with connectivity to the riparian area are more valuable than disconnected upland patches.	The connectivity to water value for a patch is calculated by: 1. Calculating the area of all type 1 and 2 patches[1] that is less than 300 feet from of a source of water[2] using a GIS system. 2. Deriving the "connectivity to water" ratio of each type 1 patch. This is done by dividing the patch area inside 320 feet by the patch area greater than 300feet away from a stream. (Inside 300 / outside 300 = "connectivity to water" ratio) 3. Deriving the "adjusted connectivity to water" ratio of each type 2 patch. The area inside 300 feet is divided by two to create an adjusted total. The adjusted amount is divided by the patch area greater than 300 feet away from a stream. ((Inside 300 / 2) / outside 300 = "adjusted connectivity to water" ratio) 4. Assigning all type 1 and 2 patches a connectivity to water value of 1 to 3 based on the distribution of their ratios[3] within three classes derived by finding natural breaks using a GIS system[4].

[1] Type 1 patches are defined as any forest landcover, forested wetland, or nonforested wetland with a total combined size greater than 2 acres. Where different cover types are contiguous they are considered to be part of a single larger patch. Type 2 patches are defined as any shrubland/scrubland or grassland/open soils landcover in a tract greater than 2 acres, within 300 feet off a surface stream.

[2] A source of water is defined as any surface river or stream, wetland, or other water body.

[3] Ratios and adjusted ratios are combined for the final scoring.

[4] The Jenkins method for finding natural breaks was used. This method creates classes based on natural groupings of data values. Features are divided into classes whose boundaries are set where there are relatively big jumps in the data values.

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CONNECTIVITY AND PROXIMITY TO OTHER PATCHES IS IMPORTANT		
How does the function benefit fish and wildlife?	**Mapping assumption**	**Criteria and Ranking**
Connectivity is important for wildlife for several reasons. Wildlife populations that are connected to each other are more likely to survive over the long term than an isolated. Many species must migrate seasonally to meet basic needs for food, shelter and breeding, and connections between habitat patches allow this migration to occur. Animal movement frequency decreases in direct relation to the distance between habitat patches, and is called the *distance effect*. • Increased habitat fragmentation impacts the ability of wildlife to disperse between habitat patches. • Dispersal of animals between patches helps to preserve populations by protecting against catastrophes and preventing genetic decline due to inbreeding. • However, the distance between habitat fragments need not be great before it begins to have an impact if a species is unable to move through the matrix of modified habitat. • Some species may be able to use small habitat patches that are individually too small by composing a home range made up of multiple habitat fragments. • Other species may survive within the urban matrix if they have a series of relatively small patches that are connected by movement corridors.	<u>*Proximity to other Patches*</u> Assumption: the closer a patch is to other disaggregated patches the greater the value for wildlife habitat.	The Connectivity/Proximity value for a patch is calculated as follows: 1. Perform a nearest neighbor operation GIS operation that measures the average distance from each type 1 and 2 patch[1] to other patches within ¼ mile of their perimeters.* 2. Assigning all type 1 and 2 patches a connectivity/proximity value of 1 to 3 based on their distribution within three classes derived by finding natural breaks using a GIS system[2]. *General fragmentation also affects the overall score to a lesser degree. The more fragmented a patch the lower the score.

[1] Type 1 patches are defined as any forest landcover, forested wetland, or nonforested wetland with a total combined size greater than 2 acres. Where different cover types are contiguous they are considered to be part of a single larger patch. Type 2 patches are defined as any shrubland/scrubland or grassland/open soils landcover in a tract greater than 2 acres, within 300 feet off a surface stream.

[2] The Jenkin[illegible]hod for finding natural breaks was used. This method creates classes based on n[illegible] groupings of data values. Features are divided into classes whose boundaries ar[illegible] where there are relatively [illegible]jumps in the data values.

HABITATS OF CONCERN AND HABITATS FOR UNIQUE AND SENSITIVE SPECIES		
How does the function benefit fish and wildlife?	**Mapping assumption**	**Criteria**
The Goal 5 Rule for Wildlife Habitat 660-23-110 (2) states that: "...local governments shall obtain current habitat inventory information from ODFW and other state and federal agencies. These inventories shall include at least the following: (a) Threatened, endangered, and sensitive wildlife species habitat information; (b) Sensitive bird site inventories; and (c) Wildlife species of concern and/or habitats of concern identified and mapped by ODFW..." To augment the modeling process Metro has obtained data from ODFW, USFWS and other local experts on sensitive, endangered and threatened species and the presence and importance of specific habitat types and patches. These are habitats of concern, described as follows:	<u>Sensitive habitats and sensitive species</u> Assumption: Habitats of concern and areas vital to sensitive, threatened, or endangered animal or plant communities are an important component of a regional wildlife inventory.	A habitat of concern is a unique or unusually important wildlife habitat area. They are identified based on site-specific information provided by local wildlife or habitat experts. Habitats of concern can be smaller than 2 acres, and will be included in the inventory if falling into one or more of the following categories:
• **Priority conservation habitats.** ODFW identifies grasslands, deciduous oak and riparian forests, aquatic habitats, and urban natural area corridors as the top four Willamette Valley habitats at risk. The Oregon Biodiversity Project, in which ODFW and USFWS are partners, identifies native prairie grasslands, oak habitats, wetlands, and bottomland hardwood forest as conservation priorities in the Willamette Valley. The Oregon-Washington chapter of Partners in Flight (ODFW and USFWS are partners) considers grassland-savanna, oak woodland, and riparian forests to be priority conservation habitats. From these sources we conclude that native oak habitats, native grasslands, wetlands, and bottomland hardwood forests are priority conservation habitats. Less than one percent of historic Willamette Valley native oak and grassland habitats still exists. Over 70 percent of the bottomland hardwood forests have been lost. In the Willamette Valley, various sources document wetland losses between 40-57 percent of original, with continuing losses of more than 500 wetland acres per year.		Any patch specifically identified as a Priority Conservation Habitat by ODFW, USFWS, or other agencies or local wildlife experts. Priority conservation habitats are Oregon white oak savannas and woodlands, native prairie grasslands, wetlands, and bottomland hardwood forests.
• **Riverine islands and deltas.** Riverine islands and deltas provide unique habitat for shorebirds, waterfowl, nesting terns and gulls, and other wildlife through enriched food resources, sand and mudflats, and protection from predators and disturbance. Macroinvertebrate communities are denser and more diverse around river islands and deltas. Bald eagles winter, breed, and forage on islands in our area. Channel complexity and large wood, which are linked to island formation, have been substantially reduced from historic levels.		Any patch of natural land cover identified by ODFW, USFWS, or other agencies or local wildlife experts as a riverine island or delta important to wildlife.
• **Patches providing unique or critical wildlife functions.** Patches providing unique or critical wildlife functions should be considered on a site-by-site basis for their importance in the inventory.. Such habitats include migration corridors or stopover areas such as grassy hilltops, inter-patch connectors, biologically or geologically unique areas such as rocky outcrops or talus slopes important to many herptiles and bats. Habitat vital for a sensitive species or habitats that support at-risk plants fall into this category.		Specifically delineated habitat areas that provide life-history requirements of sensitive, threatened or endangered wildlife species or Great Blue Heron rookeries (for example, nesting habitat for an existing population of native turtles); habitats that support at-risk plants; or habitats that provide unusually important wildlife functions, such as major wildlife crossings/pathways or a key migratory pathway, such as an elk migratory corridor.

Appendix 6

Methodology for identifying developed floodplains.

M E M O R A N D U M

METRO

TO: Andy Cotugno
FROM: Justin Houk and Lynnae Sutton
DATE: 02/07/2002
SUBJECT: Modeling Developed Floodplain

MODELING DEVELOPED FLOODPLAIN

Council Resolution 3141C (Regionally Significant Fish Habitat) directs staff to produce a GIS dataset to identify developed areas within floodplains. To determine if Metro's existing data could be used to model this dataset, a "Developed Floodplains" coverage was created and evaluated using the following methodology and data.

DATA USED IN DEVELOPED FLOODPLAIN MODEL

Table 1 lists the data used in creating the "Developed Floodplains" layer. It is important to note the minimum mapping units, assumptions and rules by which each dataset was developed, since these items are incorporated into the "Developed Floodplains" layer. For instance, a taxlot is either developed, partially developed or undeveloped. Developed lots must have improvements and specific land uses. For example, a paved parking lot is developed but an unpaved lot where trucks are parked is vacant. If a developed tax lot has a 1/2 acre (20,000-sq. ft.) or greater portion that is vacant, the lot is considered to be partially vacant and partially developed. The vacant portion is added to the vacant or undeveloped land database. These are some of the rules used in the production of vacant lands each year. Developed lands then are the "reverse" of the undeveloped lands layer. In other words, any land (or water) which is not undeveloped is shown on the developed layer.

Table 1 – Data used in "Developed Floodplains Model"

DATASET	DESCRIPTION
Floodplains	Flood of 1996 and 100 Year Flood Plain as delineated by the Federal Emergency Management Association (FEMA). Digitized by the Portland Office of the Army Corps of Engineers. Updated with local input.
Undeveloped lands	The undeveloped land layer represents lands appearing unimproved on aerial photography, without regard to developability and accessibility. *On partially developed parcels, only undeveloped areas 1/2 acre or larger are included.* The layer is digitized on an annual basis. Metro's vacant land definitions: Every tax lot is determined to be vacant, partially vacant, or developed. • Vacant tax lots are those that have no building, improvements or identifiable land use. • Developed lots must have improvements and specific land uses. For example, a paved parking lot is developed but an

	unpaved lot where trucks are parked is vacant. • Lots under site development show building activity, but development is incomplete and they are considered vacant. • If a developed tax lot has 1/2 acre (20,000-sq. ft.) or greater portion that is vacant, the lot is considered to be partially vacant and partially developed. The vacant portion is added to the vacant land database. • Parks and open spaces are treated as developed. During the assessment of each tax lot, no consideration is given to constrained land, suitability for building, or to redevelopment potential.
Developed lands	This layer is the "reverse" of the undeveloped lands layer. In other words, any land (or water) which is not undeveloped is show on the developed layer.
Land cover including: Forest canopy throughout metropolitan region, grassland and shrub/scrub land within 300 feet of a stream.	Forest canopy was digitized from the 2000 aerial photographs. *The tree stands were only digitized if they were at least two acres in size. Gaps between forest stands were only digitized if they were at least 1 acre in size.* Grassland and shrub/scrub land were digitized within 300 feet of a stream.
Open water	River and other water body outlines.
Wetlands	This layer is the National Wetland Inventory (NWI) with revisions made by local governments in the tri-county region. These revisions were coordinated by Metro's Growth Management department. NWI digital data files are records of wetlands location and classification as defined by the U.S. Fish & Wildlife Service. This dataset contains ground planimetric coordinates of wetlands, line, and area features and wetlands attributes.
Parks and open space	Public and private parks and open space. (updated quarterly)

DEVELOPED FLOODPLAIN MODEL METHODOLOGY

The following steps were used in creating the "Developed Floodplains" coverage:

- Floodplains and developed lands were intersected, extracting developed land polygons which fell within the floodplains, creating a preliminary developed floodplains layer.
- Parks and openspaces were considered undeveloped for this model. Those within the floodplain were intersected with the developed floodplains layer. Then developed floodplains that were also designated as a park or openspace were removed from the layer.
- Forest canopy and shrub/scrub/grassland (within 300 feet of a stream) polygons within the floodplain were intersected with the developed floodplains layer. Then, developed floodplains that were also designated as these vegetation land cover types were removed from the layer.
- Wetland polygons within the floodplain were intersected with the developed floodplains layer. Then, developed floodplains that were also designated as a wetland were removed from the layer.
- Open water polygons within the floodplain were intersected with the developed floodplains layer. Then, developed floodplains that were also designated as open water were removed from the layer.

Hence, "Developed Floodplains" are developed lands polygons within the floodplain where no digitized forest canopy, wetlands, open water or parks and open spaces polygons occur.

METHODS OF EVALUATING MODEL

In order to evaluate the model, developed floodplain polygons[1] were chosen at random from throughout the metropolitan region. They were visually evaluated for quality by overlaying them onto the 2000 aerial photographs. Each polygon was qualitatively rated as Very Good (4), Good (3) – containing some minor problems, Fair (2) – containing more problems, and Poor (1) – not delineated correctly. There were a total of 51 sample polygons evaluated. In addition, comments on the problems within the dataset were recorded along with the qualitative rating. Appendix A – contains the results from this analysis.

DISCUSSION OF RESULTS

Of the 51 sampled polygons, 20 were rated as poor (1) or fair (2) (i.e., problems with correct delineation of developed floodplains). This represents about 39% of the sample. Hence, 61% of the sample are rated as very good (3) or good (4). All of the polygons that were rated as poor were along open water and actually contained open water, beach, vegetation or sand bars, areas that should not be considered developed. This poor rating is most likely due to the fact that taxlots are digitized to the "low water" mark. These represented about 16% of the sample. To potentially fix a large portion of this problem, major river bank map corrections could be completed so that the river banks did not coincide with the low water mark or taxlot boundary.

Polygons rated as very good were found in developed areas within the floodplain. These represented about 47% of the sample. Developed floodplain polygons rated as good constituted about 16% of the sample. Most of these polygons contained some undeveloped acreage, generally less than an acre in size, or were in close proximity to an undeveloped floodplain polygon containing some developed acreage.

The largest problems were in the polygons rated as fair. These constituted about 21% of the sample and contained similar problems as the "good" polygons. However, the area that was incorrectly identified as

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[1] A polygon is a two-dimensional feature representing an area such as a state or county.

either developed or undeveloped was generally large compared to the areas within the "good" category. For instance, a large developed floodplain polygon contained a 2 acre grassland.

There were three polygons which represented some unique problems within the datasets. In one example, about 60% of a golf course lawn was categorized as developed due to improvements, while 40% of it was categorized as undeveloped. To alleviate this problem, delineated golf courses could be designated as undeveloped. In another example, when wetland polygons were removed from the developed floodplains, an incorrect wetland delineation caused a building and road patch to be identified as undeveloped. Map corrections, such as including local wetland inventories, may alleviate some of these problems. And finally, when the parks were removed from the developed floodplain, parking lots were then designated as part of the undeveloped floodplain because they were within a park boundary. Parks are hard to categorize because they may contain large undeveloped or developed areas, depending on the type of park. These three examples represent less then one percent of the total sample.

It is important to remember that these categories were subjective. Hence, someone else could have looked at the same sample polygons and placed some of those designated as poor in the fair category and visa versa.

Assuming that most of the polygons were designated correctly and finding a way to filter out those rated as poor, 79% of the sample could be considered acceptable, leaving 21% considered questionable. If one assumes at least a 5% error level in the categorization of the polygons, 74% to 84% of the polygons could be considered acceptable, leaving 16% to 26% considered questionable. If the polygons designated as poor were left in the sample, only 63% could be considered acceptable with 37% categorized as unacceptable.

CONCLUSIONS AND OPTIONS

There are several options available in the production of a GIS dataset identifying developed areas within floodplains. Table 2 lists several options and potential pros and cons associated with each of these decisions.

Table 2 – Developed Floodplain Options

DEVELOPED FLOODPLAIN OPTION	PROS	CONS
Option 1 - Digitize all impervious areas within the floodplain, based on specific rules.	• A rule-base could be developed to establish known reasons why specific polygons are designated as impervious (developed) within the floodplain and why others are not, resulting in less gray area within the polygon designations. • A more precise coverage of "Developed Floodplains" would be available with this option.	• Impervious polygons within the floodplains would have to be digitized each year, as the undeveloped polygons are digitized each year. • A large portion of staff time and resources would have to be committed to this project... about 400-500 hours annually.
Option 2 – Use the modeled "Developed Floodplains" and evaluate each polygon for correctness, re-digitizing those with common problems (including all of a road instead of just a portion of it).	• A more precise coverage of "Developed Floodplains" would be available with this option.	• A large portion of staff time and resources would have to be committed to this project... about 300-400 hours annually.

Option 3 -- Use the modeled "Developed Floodplains".	• Developed floodplains are already identified with this option. No additional staff time required in the production of a "Developed Floodplain" GIS data coverage.	• There may be more map corrections with this option then with the first two options.
Option 4 – Create a more conservative version of modeled developed floodplains by overlaying the developed areas and floodplains.	• There would be less gray area in terms of the definition of modeled developed floodplains.	• A large portion of undeveloped areas would be considered developed.

Option 3 is considered the recommended option in the production of a "Developed Floodplains" GIS dataset. An additional model standard could be considered to mark golf courses as undeveloped. In addition, if the former mentioned river bank and local wetland inventory map corrections were completed, it may increase the "correctness" of the modeled developed floodplains to approximately 80%. Option 4 would create a more conservative version of modeled developed floodplains. However, large portions of undeveloped areas may be considered as developed.

Appendix 7

Vertebrate species list for the Metro region.

Metro Region Species List:
Purpose and Limitations

June 19, 2001

The purpose of Metro's Species List is threefold:

1. To identify fish and wildlife species that occur in the Metro region.
2. To identify the relative importance of various types of habitat to fish and wildlife species.
3. To provide a biologically meaningful way in which to describe the biodiversity of the Metro region.

THE LIST IS NOT A STATEMENT OF POLICY. In keeping with Metro's Streamside CPR Vision Statement, the focus of the list is on native fish and wildlife species whose historic ranges include the metropolitan area and whose habitats are or can be provided for in urban habitats. Urban habitats may never be conducive to significant populations of some species, such as black bear and cougar. Further analysis and Metro Council deliberation will help determine (to the extent possible) the type, amount, and location of fish and wildlife habitats that should be protected and/or restored. For example, landowner incentives will be developed for conservation purposes.

This list contains:

1. All known native vertebrate species that currently exist within the Metro region (the final version will include a map of area involved) for at least a portion of the year and could be found in the region through diligent search by a knowledgeable person. Vagrant species (those that do not typically occur every year) are not included on this list.
2. Extirpated (locally extinct) native vertebrate species known to have inhabited the region in the past.
3. Nonnative vertebrate species with established breeding populations in the region.

The species list is based on the opinion of more than two dozen local wildlife experts. The Oregon Natural Heritage Program (ORNHP), Endangered Species Act (ESA), and Oregon Department of Fish and Wildlife (ODFW) status categories were obtained from ORNHP's February, 2001 *Rare, Threatened and Endangered Plants and Animals of Oregon* publication. Habitat associations were obtained from Johnson and O'Neil's new book, *Wildlife Habitats and Relationships in Oregon and Washington*. The taxonomic standards for common and scientific names for birds is based on the American Ornithological Union Check-list. We are also developing a separate aquatic and terrestrial invertebrate list, but this will not be as comprehensive in scope as the vertebrate species list.

Upon completion, these lists will be available to the public through Metro's website. For questions or comments regarding this list, please contact Paul Ketcham (ketcham@metro.dst.or.us, phone 503/797-1726).

Metro Region Species List:
Key to Notations

* Indicates species that are non-native (also known as alien or introduced) to Metro region.

( ) Parentheses indicate a species that was historically present but was extirpated from the Metro region within approximately the last century.

1 **Code** (type of animal)
A = Amphibians
B = Birds
F = Fish
M = Mammals
R = Reptiles

2 **Migratory Status** (indicates trend for the majority of a given species in the Metro region):
A = Anadromous (fish; lives in the ocean, spawns in fresh water)
C = Catadromous (fish; lives in fresh water, spawns in the ocean)
M = Migrates through area without stopping for long time periods
N = Neotropical migratory species (birds; majority of individuals breeding in the Metro region migrate south of U.S./Mexico border for winter)
R = Permanent resident (lives in the area year-round)
S = Short-distance migrant (from elevational to regional migration, e.g., across several states)
W = Winters in the Metro region

3 **Federal Status** is based on current Endangered Species Act listings. **E** = Endangered, **T** = Threatened. Endangered taxa are those which are in danger of becoming extinct within the foreseeable future throughout all or a significant portion of their range. Threatened taxa are those likely to become endangered within the foreseeable future.
LE = Listed Endangered. Taxa listed by the U.S. Fish and Wildlife Service (USFWS) or the National Marine Fisheries Service (NMFS) as Endangered under the Endangered Species Act (ESA), or by the Departments of Agriculture (ODA) and Fish and Wildlife (ODFW) of the state of Oregon under the Endangered Species Act of 1987 (OESA).
LT = Listed Threatened. Taxa listed by the USFWS, NMFS, ODA, or ODFW as Threatened.
PE = Proposed Endangered. Taxa proposed by the USFWS or NMFS to be listed as Endangered under the ESA or by ODFW or ODA under the OESA.
PT = Proposed Threatened. Taxa proposed by the USFWS or NMFS to be listed as Threatened under the ESA or by ODFW or ODA under the OESA.
C = Candidate taxa for which NMFS or USFWS have sufficient information to support a proposal to list under the ESA, or which is a candidate for listing by the ODA under the OESA.
SoC = Species of Concern. Former C2 candidates which need additional information in order to propose as Threatened or Endangered under the ESA. These are species which USFWS is reviewing for consideration as Candidates for listing under the ESA.

4 **ODFW Status** (state status) is based on current Oregon Department of Fish and Wildlife "Oregon Sensitive Species List," 2001. See Federal Status (above) for definitions of LT and LE.
SC (Critical) = Species for which listing as threatened or endangered is pending; or those for which listing as threatened or endangered may be appropriate if immediate conservation actions are not taken. Also considered critical are some peripheral species which are at risk throughout their range, and some disjunct populations.
SV (Vulnerable) = Species for which listing as threatened or endangered is not believed to be imminent and can be avoided through continued or expanded use of adequate protective measures and monitoring. In some cases the population is sustainable, and protective measures

Appendix 1. Species list and habitat associations for species normally occurring within the Metro region. Study area is the Metro jurisdictional boundary plus 1 mile buffer.

Code[1]	Common Name	Genus/Species	Migratory Status[2]	Federal Status[3]	ODFW Status[4]	ORNHP Rank[5]	ORNHP List[6]	Riparian Assn.[7]	Habitat Type[8]							
									WATR	HWET	RWET	WLCH	WODF	WEGR	AGPA	URBN
F	River Lamprey	*Lampetra ayresi*	A	SoC	None	G4/S4	4	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F	Western Brook Lamprey	*Lampetra richardsoni*	A	None	None	None	None	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F	Pacific Lamprey	*Lampetra tridentata*	A	SoC	SV	G5/S3	2	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F	White Sturgeon	*Acipenser transmontanus*	A	None	None	None	None	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F*	American Shad*	*Alosa sapidissima*	A	N/A - alien	N/A - alien	N/A - alien	None	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F	Chiselmouth	*Acrocheilus alutaceus*	R	None	None	None	N/A - alien	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F*	Goldfish*	*Carassius auratus*	R	N/A - alien	N/A - alien	N/A - alien	None	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F*	Common Carp*	*Cyprinus carpio*	R	N/A - alien	N/A - alien	N/A - alien	N/A - alien	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F	Peamouth Chub	*Mylocheilus caurinus*	R	None	None	None	N/A - alien	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
(F)	(Oregon Chub - extirpated from Metro area)	*Oregonichthys crameri*	R	LE	SC	G2/S2	None	(XX)	(XX)	(XX)	N/A	N/A	N/A	N/A	N/A	N/A
F	Northern Pikeminnow (Squawfish)	*Ptychocheilus oregonensis*	R	None	None	None	1	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F	Longnose Dace	*Rhynichthys cataractae*	R	None	None	None	None	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F	Leopard Dace	*Rhynichthys falcatus*	R	None	None	None	None	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F	Speckled Dace	*Rhynichthys osculus*	R	None	None	None	None	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F	Redside Shiner	*Richardsonius balteatus*	R	None	None	None	None	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F	Largescale Sucker	*Catostomus macrocheilus*	R	None	None	None	None	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F*	Brown Bullhead*	*Ameiurus nebulosus*	R	N/A - alien	N/A - alien	N/A - alien	N/A - alien	XX	XX	XX	N/A	N/A	N/A	N/A	N/A	N/A
F	Eulachon (Columbia River Smelt)	*Thaleichthys pacificus*	A	None	None	None	None	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F	Coastal Cutthroat Trout, SW WA/Col. R. ESU	*Oncorhynchus clarki clarki*	A	PT	SC	G4T2Q/S2	2	XX	XX	X	N/A	N/A	N/A	N/A	N/A	N/A
F	Coastal Cutthroat Trout, Upper Will. R. ESU	*Oncorhynchus clarki clarki*	A	SoC	None	G4T?Q/S3?	4	XX	XX	X	N/A	N/A	N/A	N/A	N/A	N/A
F	Chum Salmon, Columbia River ESU	*Oncorhynchus keta*	A	LT	SC	G5T2Q/S2	1	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F	Coho Salmon, Oregon Coast ESU	*Oncorhynchus kisutch*	A	LT	SC	G4T2Q/S2	1	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F	Coho Salmon, Lower Columbia R./Southwest Washington ESU	*Oncorhynchus kisutch*	A	C	LE	G4T2Q/S2	1	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F	Rainbow Trout (resident populations)	*Oncorhynchus mykiss*	R	None	None	None	None	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F	Steelhead (anadromous Rainbow Trout), Oregon Coast ESU	*Oncorhynchus mykiss*	A	C	SV	G5T2T3Q/S2S3	1	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F	Steelhead, Lower Columbia River ESU	*Oncorhynchus mykiss*	A	LT	SC	G5T2Q/S2	1	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F	Steelhead, Upper Willamette River ESU, winter run	*Oncorhynchus mykiss*	A	LT	SC	G5T2Q/S2	1	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F	Steelhead, Middle Columbia River ESU	*Oncorhynchus mykiss*	A	LT	SC/SV	G5T2Q/S2	1	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F	Steelhead, Snake River Basin ESU	*Oncorhynchus mykiss*	A	LT	SV	G5T2T3Q/S2S3	1	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F	Steelhead, Upper Columbia River ESU	*Oncorhynchus mykiss*	A	LE	None	G5T2Q/SU	None	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F	Sockeye Salmon, Snake River ESU	*Oncorhynchus nerka*	A	LE	None	G5T1Q/SX	1 - ex	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F	Chinook Salmon, Lower Columbia R. ESU	*Oncorhynchus tshawytscha*	A	LT	SC	G5T2Q/S2	1	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F	Chinook Salmon, Upper Will. R spring run	*Oncorhynchus tshawytscha*	A	LT	None	G5T2Q/S2	1	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F	Chinook Salmon, Snake River Fall-run ESU	*Oncorhynchus tshawytscha*	A	LT	LT	G5T1Q/S1	1	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F	Chinook Salmon, Snake River Spr/Sum.run	*Oncorhynchus tshawytscha*	A	LT	LT	G5T1Q/S1	1	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F	Chinook Salmon, Upper Col. R. Spring-run	*Oncorhynchus tshawytscha*	A	LE	None	G5T1Q/SU	None	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F	Mountain Whitefish	*Prosopium williamsoni*	R	None	None	None	None	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F	Sand Roller	*Percopsis transmontanus*	R	None	None	None	None	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F*	Mosquitofish*	*Gambusia affinis*	R	N/A - alien	N/A - alien	N/A - alien	N/A - alien	XX	XX	XX	N/A	N/A	N/A	N/A	N/A	N/A
F	Three-spined Stickleback	*Gasterosteus aculeatus*	R	None	None	None	None	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F	Prickly Sculpin	*Cottus asper*	R	None	None	None	None	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F	Reticulate Sculpin	*Cottus perplexus*	R	None	None	None	None	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F*	Green Sunfish*	*Lepomis cyanellus*	R	N/A - alien	N/A - alien	N/A - alien	N/A - alien	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F*	Pumpkinseed Sunfish*	*Lepomis gibbosus*	R	N/A - alien	N/A - alien	N/A - alien	N/A - alien	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A

Code[1]	Common Name	Genus/Species	Migratory Status[2]	Federal Status[3]	ODFW Status[4]	ORNHP Rank[5]	ORNHP List[6]	Riparian Assn.[7]	Habitat Type[8]								
									WATR	HWET	RWET	WLCH	WODF	WEGR	AGPA	URBN
F*	Warmouth*	*Lepomis gulosus*	R	N/A - alien	N/A - alien	N/A - alien	N/A - alien	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F*	Bluegill*	*Lepomis macrochirus*	R	N/A - alien	N/A - alien	N/A - alien	N/A - alien	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F*	Smallmouth Bass*	*Micropterus dolomieu*	R	N/A - alien	N/A - alien	N/A - alien	N/A - alien	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F*	Largemouth Bass*	*Micropterus salmoides*	R	N/A - alien	N/A - alien	N/A - alien	N/A - alien	XX	XX	X	N/A	N/A	N/A	N/A	N/A	N/A
F*	White Crappie*	*Pomoxis annularis*	R	N/A - alien	N/A - alien	N/A - alien	N/A - alien	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F*	Black Crappie*	*Pomoxis nigromaculatus*	R	N/A - alien	N/A - alien	N/A - alien	N/A - alien	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F*	Yellow Perch*	*Perca flavescens*	R	N/A - alien	N/A - alien	N/A - alien	N/A - alien	XX	XX	X	N/A	N/A	N/A	N/A	N/A	N/A
F*	Walleye*	*Stizostedion vitreum vitreum*	R	N/A - alien	N/A - alien	N/A - alien	N/A - alien	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F	Starry Flounder	*Platichthys stellatus*	R	None	None	None	None	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
A	Northwestern Salamander	*Ambystoma gracile*	R	None	None	None	None	XX	XX	XX	XX	X	X	X	X	X
A	Long-toed Salamander	*Ambystoma macrodactylum*	R	None	None	None	None	XX	XX	XX	XX	X	X	X	X	X
A	Pacific Giant Salamander	*Dicamptodon tenebrosus*	R	None	None	None	None	XX			XX	X	X	X		X
A	Cope's Giant Salamander	*Dicamptodon copei*	R	None	SU	G3/S2	2	XX	X		XX	X				
A	Columbia Torrent Salamander	*Rhyacotriton kezeri*	R	None	SC	G3/S3	2	XX			XX	X				
A	Cascade Torrent Salamander	*Rhyacotriton cascadae*	R	None	SV	G3/S3	2	XX			XX	X				
A	Rough-skinned Newt	*Taricha granulosa*	R	None	None	None	None	XX	XX	XX	XX	X	X	X	X	X
A	Dunn's Salamander	*Plethodon dunni*	R	None	None	None	None	X			X	X	X			X
A	Western Red-backed Salamander	*Plethodon vehiculum*	R	None	None	None	None	X			X	X	X			X
A	Ensatina	*Ensatina eschscholtzii*	R	None	None	None	None	X			X	XX	X	X	X	X
A	Clouded Salamander	*Aneides ferreus*	R	None	SU	G3/S3	3					X	X		X	X
A	Oregon Slender Salamander	*Batrachoseps wrighti*	R	SoC	SU	G4/S3	1	X			X	X				
A	Western Toad	*Bufo boreas*	R	None	SV	G4/S4	4	XX	XX	XX	XX	X	X	X	X	X
A	Tailed Frog	*Ascaphus truei*	R	SoC	SV	G4/S3	2	XX			XX	X				
A	Pacific Chorus Frog (tree frog)	*Hyla regilla*	R	None	None	None	None	XX	XX	XX	XX	X	X	X	X	X
A	Northern Red-legged Frog	*Rana aurora aurora*	R	SoC	SV/SU	G4T4/S3	2	XX	XX	XX	XX	XX	X	X	X	X
(A)	(Oregon Spotted Frog - extirpated)	*Rana pretiosa*	R	C	SC	G2G3/S2	1	(XX)	(XX)	(XX)	(XX)	(X)	(X)	(X)	(X)	
A*	Bullfrog*	*Rana catesbeiana*	R	N/A - alien	N/A - alien	N/A - alien	N/A - alien	XX	XX	XX	XX	X	X	X	X	X
R*	Common Snapping Turtle*	*Chelydra serpentina*	R	N/A - alien	N/A - alien	N/A - alien	N/A - alien	XX	XX	XX	X				X	X
R	Painted Turtle	*Chrysemys picta*	R	None	SC	G5/S2	2	XX	XX	XX	X		X		X	X
R	Northwestern Pond Turtle	*Clemmys marmorata marmorata*	R	SoC	SC	G3T3/S2	1	XX	XX	XX	XX	X	XX	X	X	X
R*	Red-eared Slider*	*Trachemys scripta elegans*	R	N/A - alien	N/A - alien	N/A - alien	N/A - alien	XX	XX	XX	X				X	X
R	Northern Alligator Lizard	*Elgaria coerulea*	R	None	None	None	None	X			X	X	X	X		X
R	Southern Alligator Lizard	*Elgaria multicarinata*	R	None	None	None	None	X			X	X	X	X	X	X
R	Western Fence Lizard	*Sceloporus occidentalis*	R	None	None	None	None					X	X	X	X	X
R	Western Skink	*Eumeces skiltonianus*	R	None	None	None	None					X	X	X	X	X
R	Rubber Boa	*Charina bottae*	R	None	None	None	None	X			X	X		X	X	X
R	Racer	*Coluber constrictor*	R	None	None	None	None						X	X	X	X
R	Sharptail Snake	*Contia tenuis*	R	None	SV	G5/S3	4	X			X	X	X	X	X	X
R	Ringneck Snake	*Diadophis punctatus*	R	None	None	None	None	X			X	X	X	X	X	X
R	Gopher Snake	*Pituophis catenifer*	R	None	None	None	None						X	X	X	X
R	Western Terrestrial Garter Snake	*Thamnophis elegans*	R	None	None	None	None	X		X	X		X	X	X	X
R	Northwestern Garter Snake	*Thamnophis ordinoides*	R	None	None	None	None	X			X	X	X	X	X	X
R	Common Garter Snake	*Thamnophis sirtalis*	R	None	None	None	None	XX		XX	XX	X	X	X	X	X
B	Red-throated Loon	*Gavia stellata*	W / M	None	None	None	None	XX			XX					

Code[1]	Common Name	Genus/Species	Migratory Status[2]	Federal Status[3]	ODFW Status[4]	ORNHP Rank[5]	ORNHP List[6]	Riparian Assn.[7]	Habitat Type[8]								
									WATR	HWET	RWET	WLCH	WODF	WEGR	AGPA	URBN	
B	Pacific Loon	*Gavia pacifica*	W / M	None	None	None	None	XX			XX						
B	Common Loon	*Gavia immer*	W / M	None	None	None	None	XX	X	XX							
B	Pied-billed Grebe	*Podilymbus podiceps*	S / N	None	None	None	None	XX	X	XX	X						
B	Horned Grebe	*Podiceps auritus*	W / M	None	SP	G5/S2B, S5N	2	XX	XX	XX							
B	Eared Grebe	*Podiceps nigricollis*	W	None	None	None	None	XX	XX	XX							
B	Western Grebe	*Aechmophorus occidentalis*	W	None	None	None	None	XX	XX	XX							
B	Clark's Grebe	*Aechmophorus clarkii*	W / M	None	None	None	None	XX	XX	XX							
B	Doubled-crested Cormorant	*Phalacrocorax auritus*	R / S	None	None	None	None	XX	XX	X	X					X	
B	American Bittern	*Botaurus lentiginosus*	S / N	None	None	None	None	XX		XX					X		
B	Great Blue Heron	*Ardea herodias*	R	None	None	None	None	XX	XX	XX	XX	X	X	X	XX	X	
B	Great Egret	*Ardea alba*	W / M	None	None	None	None	XX	XX	XX	XX	X	X	X	X	X	
B	Green Heron	*Butorides virescens*	N / S	None	None	None	None	XX	X	XX	XX						
B	Black-crowned Night Heron	*Nycticorax nycticorax*	S	None	None	None	None	XX	XX	XX	X						
(B)	(California Condor - extirpated)	*(Gymnogyps californianus)*	R	LE	None	G1SX	1-ex	(X)			(X)			(X)			
B	Turkey Vulture	*Cathartes aura*	N	None	None	None	None	X		X	X	X	X	X	X	X	
B	Greater White-fronted Goose	*Anser albifrons*	W / M	None	None	None	None	XX	XX	XX					XX		
B	Snow Goose	*Chen caerulescens*	W / M	None	None	None	None	XX	XX	XX					XX		
B	Ross's Goose	*Chen rossii*	W / M	None	None	None	None	XX	XX	XX					XX		
B	Canada Goose	*Branta canadensis*	VARIABLE	None	None	None	None	XX	XX	XX	X				XX		
B	Dusky Canada Goose	*Branta canadensis occidentalis*	W / M	None	None	G5T2T3/ S2N	4	XX	XX	XX	X				XX		
B	Aleutian Canada Goose (wintering)	*Branta canadensis leucopareia*	W / M	LT	LE	G5T3/S2N	1	XX	XX	XX	X				XX		
B	Trumpeter Swan	*Cygnus buccinator*	W / M	None	None	None	None	XX	XX	XX					XX		
B	Tundra Swan	*Cygnus columbianus*	W / M	None	None	None	None	XX	XX	XX					XX		
B	Wood Duck	*Aix sponsa*	S	None	None	None	None	XX	XX	X	XX	X			X		
B	Gadwall	*Anas strepera*	W / M	None	None	None	None	XX	XX	XX				X	X		
B	Mallard	*Anas platyrhynchos*	R	None	None	None	None	XX	X	XX	XX				X	X	
B	Eurasian Wigeon	*Anas penelope*	W / M	None	None	None	None	XX	XX	X					X		
B	American Wigeon	*Anas americana*	W / M	None	None	None	None	XX	X	XX	X				XX		
B	Blue-winged Teal	*Anas discors*	W / M	None	None	None	None	XX	X	XX				X	XX		
B	Cinnamon Teal	*Anas cyanoptera*	N	None	None	None	None	XX	X	XX				X	XX		
B	Northern Shoveler	*Anas clypeata*	W / M	None	None	None	None	XX	XX	XX				X	X		
B	Northern Pintail	*Anas acuta*	W / M	None	None	None	None	XX	XX	XX					X		
B	Green-winged Teal	*Anas crecca*	S	None	None	None	None	XX	X	XX	X			X	X		
B	Canvasback	*Aythya valisineria*	W / M	None	None	None	None	XX	XX	XX							
B	Redhead	*Aythya americana*	W / M	None	None	None	None	XX	XX	XX							
B	Ring-necked Duck	*Aythya collaris*	W / M	None	None	None	None	XX	X	X	XX						
B	Greater Scaup	*Aythya marila*	W / M	None	None	None	None	XX	XX								
B	Lesser Scaup	*Aythya affinis*	W / M	None	None	None	None	XX	XX	XX							
B	Surf Scoter	*Melanitta perspicillata*	W / M	None	None	None	None	X	X								
B	Harlequin Duck	*Histrionicus histrionicus*	W / M	SoC	SU	G4/S2B, S3N	2	XX	XX		XX						
B	Bufflehead	*Bucephala albeola*	W / M	None	SU	G5/S2B,S5N	4	XX	XX	XX	X						
B	Common Goldeneye	*Bucephala clangula*	M	None	None	None	None	XX	XX	X							
B	Barrow's [illegible]leneye	*Bucephala islandica*	W / M	None	SU	G5/S3B,S3N	4	XX	XX	X							

Code[1]	Common Name	Genus/Species	Migratory Status[2]	Federal Status[3]	ODFW Status[4]	ORNHP Rank[5]	ORNHP List[6]	Riparian Assn.[7]	Habitat Type[8]							
									WATR	HWET	RWET	WLCH	WODF	WEGR	AGPA	URBN
B	Hooded Merganser	*Lophodytes cucullatus*	W / M	None	None	None	None	XX	XX	X	XX	XX				
B	Common Merganser	*Mergus merganser*	W / M	None	None	None	None	XX	XX		XX	XX				
B	Red-breasted Merganser	*Mergus serrator*	W / M	None	None	None	None	X	X							
B	Ruddy Duck	*Oxyura jamaicensis*	W / M	None	None	None	None	XX	XX	XX						
B	Osprey	*Pandion haliaetus*	N	None	None	None	None	XX	XX		X	X	X		X	X
B	White-tailed Kite (appears to be undergoing range expansion)	*Elanus leucurus*	W / M	None	None	G5/S1B, S3N	2	X			X	X		X	XX	
B	Bald Eagle[a]	*Haliaeetus leucocephalus*	S	LT[a]	LT	G4/S3B, S4N	2	XX	XX	X	X	X	X	X	X	X
B	Northern Harrier	*Circus cyaneus*	N	None	None	None	None	X		X	X			X	X	X
B	Sharp-shinned Hawk	*Accipiter striatus*	N	None	None	None	None	X		X		X	X	X	X	X
B	Cooper's Hawk	*Accipiter cooperii*	S	None	None	None	None	X		X	X	X	X	X	X	X
B	Northern Goshawk	*Accipiter gentilis*	W / M	SoC	SC	G5/S3	2	X		X	X	X	X			
B	Red-shouldered Hawk (appears to be undergoing range expansion)	*Buteo lineatus*	?	None	None	None	None	X			X	X			X	
B	Red-tailed Hawk	*Buteo jamaicensis*	S / N	None	None	None	None	X		X	X	X	X	X	XX	X
B	Rough-legged Hawk	*Buteo lagopus*	W / M	None	None	None	None	X		X	X	X	X	X	X	X
B	American Kestrel	*Falco sparverius*	S	None	None	None	None	X		X	X	X	X	X	X	X
B	Merlin	*Falco columbarius*	W / M	None	None	G5/S1B	2	X	X	X	X	X	X	X	X	X
B	American Peregrine Falcon	*Falco peregrinus anatum*	N	None	LE	G4T3/S1B	2	X	X	X	X	X	X	X	X	X
B*	Ring-necked Pheasant*	*Phasianus colchicus*	R	N/A - alien	N/A - alien	N/A - alien	N/A - alien	X		X	X	X	X	XX	XX	X
B	Ruffed Grouse	*Bonasa umbellus*	R	None	None	None	None	XX			XX	XX	X		X	
B	Blue Grouse	*Dendragapus obscurus*	R	None	None	None	None	X			X	XX	X			
B*	Wild Turkey*	*Meleagris gallopavo*	R	N/A - alien	N/A - alien	N/A - alien	N/A - alien	X			X	X	X	X	X	X
(B)	(Mountain Quail - extirpated)	*Oreortyx pictus*	R / S	SoC	SU	G5/S4?	4	(X)			(X)	(X)	(X)		(X)	(X)
B	California Quail	*Callipepla californica*	R	None	None	None	None	X		X	X	X	X	X	X	X
B	Virginia Rail	*Rallus limicola*	R / S	None	None	None	None	XX		XX					X	
B	Sora	*Porzana carolina*	S / N	None	None	None	None	XX		XX					X	
B	American Coot	*Fulica americana*	R / S	None	None	None	None	XX	XX	XX					X	X
B	Lesser Sandhill Crane	*Grus canadensis*	W / M	None	None	None	None	XX		XX					XX	
B	Black-bellied Plover	*Pluvialis squatarola*	M	None	None	None	None	X	X						XX	
B	American Golden-plover	*Pluvialis dominica*	W / M	None	None	None	None	X	X						XX	
B	Semipalmated Plover	*Charadrius semipalmatus*	M	None	None	None	None	XX	XX						X	
B	Killdeer	*Charadrius vociferus*	S / N	None	None	None	None	X		X	X	X	X	X	XX	X
B	Greater Yellowlegs	*Tringa melanoleuca*	W / M	None	None	None	None	XX	XX	XX	X			X	X	
B	Lesser Yellowlegs	*Tringa flavipes*	W / M	None	None	None	None	XX	XX	XX	X			X	X	
B	Solitary Sandpiper	*Tringa solitaria*	W / M	None	None	None	None	XX	XX	XX	XX			X	X	
B	Spotted Sandpiper	*Actitis macularia*	N	None	None	None	None	XX	X	X	XX				X	
B	Semipalmated Sandpiper	*Calidris pusilla*	W / M	None	None	None	None	XX	XX							
B	Western Sandpiper	*Calidris mauri*	W / M	None	None	None	None	XX	XX	XX					X	
B	Least Sandpiper	*Calidris minutilla*	W / M	None	None	None	None	XX	X	XX					X	
B	Baird's Sandpiper	*Calidris bairdii*	W / M	None	None	None	None	XX	X	XX					X	
B	Pectoral Sandpiper	*Calidris melanotos*	W / M	None	None	None	None	XX	X	XX					X	
B	Dunlin	*Calidris alpina*	W / M	None	None	None	None	XX	XX	XX					XX	

Code[1]	Common Name	Genus/Species	Migratory Status[2]	Federal Status[3]	ODFW Status[4]	ORNHP Rank[5]	ORNHP List[6]	Riparian Assn.[7]	Habitat Type[8]							
									WATR	HWET	RWET	WLCH	WODF	WEGR	AGPA	URBN
B	Short-billed Dowitcher	*Limnodromus griseus*	W / M	None	None	None	None	X		X					X	
B	Long-billed Dowitcher	*Limnodromus scolopaceus*	W / M	None	None	None	None	XX	X	XX					XX	
B	Common Snipe	*Gallinago gallinago*	S / N	None	None	None	None	XX		XX				X	XX	
B	Wilson's Phalarope	*Phalaropus tricolor*	W / M	None	None	None	None	XX	X	X						
B	Red-necked Phalarope	*Phalaropus lobatus*	W / M	None	None	None	None	X	X							
B	Bonaparte's Gull	*Larus philadelphia*	M / W	None	None	None	None	XX	X						X	X
B	Mew Gull	*Larus canus*	W / M	None	None	None	None	XX	XX						X	X
B	Ring-billed Gull	*Larus delawarensis*	W / M	None	None	None	None	XX	XX	X					X	X
B	California Gull	*Larus californicus*	S	None	None	None	None	XX	XX	X					X	X
B	Herring Gull	*Larus agentatus*	W / M	None	None	None	None	XX	XX	X					X	X
B	Thayer's Gull	*Larus thayeri*	W / M	None	None	None	None	XX	XX	X					X	X
B	Western Gull	*Larus occidentalis*	R / S	None	None	None	None	X	X							XX
B	Glaucous Gull	*Larus hyperboreus*	W / M	None	None	None	None	XX	XX	X						X
B	Glaucous-winged Gull	*Larus glaucescens*	W / M	None	None	None	None	XX	X							XX
B	Caspian Tern	*Sterna caspia*	N	None	None	None	None	XX	XX	XX						
B	Forster's Tern	*Sterna forsteri*	M	None	None	None	None	XX	XX	XX						
B	Common Tern	*Sterna hirundo*	W / M	None	None	None	None	X	X							
B*	Rock Dove*	*Columba livia*	R	N/A - alien	N/A - alien	N/A - alien	N/A - alien							X	XX	XX
B	Band-tailed Pigeon	*Columba fasciata*	S	SoC	None	G5/S4	4	XX			XX	XX	XX		X	X
B	Mourning Dove	*Zenaida macroura*	S	None	None	None	None	XX			XX	X	X	X	XX	X
B	Barn Owl	*Tyto alba*	R / S	None	None	None	None	X		X	X		X	X	XX	X
B	Western Screech-Owl	*Otus kennicottii*	R	None	None	None	None	X		X	X	X	X		X	X
B	Great Horned Owl	*Bubo virginianus*	R	None	None	None	None	X		X	X	X	X	X	X	X
B	Northern Pygmy-Owl	*Glaucidium gnoma*	R	None	SC	G5/S4?	4	X		X	X	XX	X		X	X
(B)	(Northern Spotted Owl - extirpated from Metro region)	*(Strix occidentalis caurina)*	(S)	LT	LT	G3T3S3	1					(XX)	(X)			
B	Barred Owl	*Strix varia*	R	None	None	None	None	X			X	XX	X			X
B	Long-eared Owl	*Asio otus*	W / M	None	None	None	None	X		X		X	X	X	X	
B	Short-eared Owl	*Asio flammeus*	W / M	None	None	None	None	XX		XX				X	XX	
B	Northern Saw-whet Owl	*Aegolius acadicus*	R / S	None	None	None	None	X			X	XX	XX		X	X
B	Common Nighthawk (nearly extirpated)	*Chordeiles minor*	N	None	SC	G5/S5	4	X	X	X	X	X	X	X	X	X
B	Vaux's Swift	*Chaetura vauxi*	N	None	None	None	None	XX	XX	X	X	X	X	X		X
B	Anna's Hummingbird	*Calypte anna*	R	None	None	None	None	X			X	XX	X			X
B	Rufous Hummingbird	*Selasphorus rufus*	N	None	None	None	None	X		X	X	X	X	X	X	X
B	Belted Kingfisher	*Ceryle alcyon*	S	None	None	None	None	XX	XX		XX					
B	Lewis's Woodpecker (extirpated as breeding species)	*Melanerpes lewis*	W / M	SoC	SC	G5/S3B, S3N	4	X			X		XX	X	X	X
B	Acorn Woodpecker	*Melanerpes formicivorus*	R	SoC	None	G5/S3?	4						XX	X		X
B	Red-breasted Sapsucker	*Sphyrapicus ruber*	S	None	None	None	None	X			X	X	X	X	X	X
B	Downy Woodpecker	*Picoides pubescens*	R	None	None	None	None	XX			XX	X	X		X	X
B	Hairy Woodpecker	*Picoides villosus*	R	None	None	None	None	X			X	X	X	X	X	X
B	Northern Flicker	*Colaptes auratus*	R	None	None	None	None	X			X	X	X	X	X	X
B	Pileated Woodpecker	*Dryocopus pileatus*	R	None	SV	G5/S4?	4	X			X	X	X		X	X

Code	Common Name	Genus/Species	Migratory Status[2]	Federal Status[3]	ODFW Status[4]	ORNHP Rank[5]	ORNHP List[6]	Riparian Assn.[7]	Habitat Type[8]							
									WATR	HWET	RWET	WLCH	WODF	WEGR	AGPA	URBN
B*	Monk Parakeet*	*Myiopsitta monachus*	R	N/A - alien	N/A - alien	N/A - alien	N/A - alien	XX			XX		X		X	XX
(B)	(Yellow-billed Cuckoo; extirpated)	*Coccyzus americanus*	N	SoC	SC	G5/S1B	2	(XX)			(XX)					
B	Olive-sided Flycatcher	*Contopus cooperi (= borealis)*	N	SoC	SV	G5/S4	4	X			X	XX				
B	Western Wood-Pewee	*Contopus sordidulus*	N	None	None	None	None	X			X	X	X		X	X
B	Willow Flycatcher (western OR race)	*Empidonax traillii brewsteri*	N	None	SV	G5TU/S1B	4	XX			XX	X	X		X	X
B	Hammond's Flycatcher	*Empidonax hammondii*	N	None	None	None	None					X	X			
B	Dusky Flycatcher	*Empidonax oberholseri*	M	None	None	None	None	X			X	X	X			
B	Pacific-slope Flycatcher	*Empidonax dificilus*	N	None	None	None	None	X			X	XX	X			
B	Say's Phoebe	*Sayornis saya*	N	None	None	None	None							X	X	X
B	Western Kingbird	*Tyrannus verticalis*	N	None	None	None	None						X	X	X	X
B	Northern Shrike	*Lanius excubitor*	W / M	None	None	None	None	X		X				X	XX	
B	Cassin's Vireo	*Vireo cassinii*	N	None	None	None	None					X	XX			X
B	Hutton's Vireo	*Vireo huttoni*	R / S	None	None	None	None	X			X	X	XX		X	X
B	Warbling Vireo	*Vireo gilvus*	N	None	None	None	None	XX			XX	XX	X		X	X
B	Red-eyed Vireo	*Vireo olivaceus*	N	None	None	None	None	XX			XX	X				
B	Steller's Jay	*Cyanocitta stelleri*	R	None	None	None	None	X			X	X	X		X	X
B	Western Scrub-Jay	*Aphelocoma californica*	R	None	None	None	None	X			X	X	XX	X	X	X
B	Gray Jay	*Perisoreus canadensis*	R	None	None	None	None	X			X	X	X			X
B	American Crow	*Corvus brachyrhynchos*	R	None	None	None	None	X		X	X	X	X	X	XX	XX
B	Common Raven	*Corvus corax*	R	None	None	None	None	X		X	X	X	X	X	X	X
B	Streaked Horned Lark	*Eremophila alpestris strigata*	S	SoC	SC	G5T2/S2?	2							XX	X	X
B	Purple Martin	*Progne subis*	N	SoC	SC	G5/S3B	2	XX	XX	X	X	X	X	X		X
B	Tree Swallow	*Tachycineta bicolor*	N	None	None	None	None	XX	XX	XX	XX	X	X	X	X	X
B	Violet-green Swallow	*Tachycineta thalassina*	N	None	None	None	None	X	X	X	X	X	X	X	X	X
B	Northern Rough-winged Swallow	*Stelgidopteryx serripennis*	N	None	None	None	None	XX	XX	XX	XX	X	X	X	X	X
B	Cliff Swallow	*Petrochelidon pyrrhonota*	N	None	None	None	None	XX	XX	X	XX	X	X	X	X	X
B	Barn Swallow	*Hirundo rustica*	N	None	None	None	None	XX	XX	XX	XX	X	X	X	XX	X
B	Black-capped Chickadee	*Poecile atricapilla*	R	None	None	None	None	X		X	X	X	X	X	X	X
B	Mountain Chickadee	*Poecile gambeli*	W / M	None	None	None	None	X			X	X	X			X
B	Chestnut-backed Chickadee	*Poecile rufescens*	R	None	None	None	None	X			X	X	X		X	X
B	Bushtit	*Psaltriparus minimus*	R	None	None	None	None	X			X	X	X		X	X
B	Red-breasted Nuthatch	*Sitta canadensis*	R	None	None	None	None	X			X	X	X		X	X
B	White-breasted Nuthatch	*Sitta carolinensis*	R	None	None	None	None	X			X		X	X	X	X
B	Brown Creeper	*Certhia americana*	R	None	None	None	None	X			X	X	X	X	X	X
B	Bewick's Wren	*Thryomanes bewickii*	R	None	None	None	None	X		X	X	X	X		X	X
B	House Wren	*Troglodytes aedon*	N	None	None	None	None	X			X	X	X	X	X	X
B	Winter Wren	*Troglodytes troglodytes*	R	None	None	None	None	X			X	X	X			X
B	Marsh Wren	*Cistothorus palustris*	N	None	None	None	None	XX		XX						
B	American Dipper	*Cinclus mexicanus*	R / S	None	None	None	None	XX	XX	X	XX					
B	Golden-crowned Kinglet	*Regulus satrapa*	R	None	None	None	None	X			X	XX	X			X
B	Ruby-crowned Kinglet	*Regulus calendula*	W / M	None	None	None	None	X		X	X	X	X	X	X	X
B	Western Bluebird	*Sialia mexicana*	S	None	SV	G5/S4B, S4N	4					XX	XX	X	X	X
B	Townsend's Solitaire	*Myadestes townsendi*	W / M	None	None	None	None	X			X	X	X		X	X

Code[1]	Common Name	Genus/Species	Migratory Status[2]	Federal Status[3]	ODFW Status[4]	ORNHP Rank[5]	ORNHP List[6]	Riparian Assn.[7]	Habitat Type[8]							
									WATR	HWET	RWET	WLCH	WODF	WEGR	AGPA	URBN
B	Swainson's Thrush	*Catharus ustulatus*	N	None	None	None	None	X			X	X	X		X	X
B	Hermit Thrush	*Catharus guttatus*	S	None	None	None	None	X			X	X	X		X	X
B	American Robin	*Turdus migratorius*	S	None	None	None	None	X		X	X	X	X	X	X	X
B	Varied Thrush	*Ixoreus naevius*	W / M	None	None	None	None					XX	X		X	X
B*	European Starling*	*Sturnus vulgaris*	R / S	N/A - alien	N/A - alien	N/A - alien	N/A - alien	XX		X	XX	X	X	X	X	XX
B	American Pipit	*Anthus rubescens*	W / M	None	None	None	None	X		X				X	XX	
B	Cedar Waxwing	*Bombycilla cedrorum*	S	None	None	None	None	X		X	X	X	X		X	X
B	Orange-crowned Warbler	*Vermivora celata*	N	None	None	None	None	X			X	X	X	X	X	X
B	Nashville Warbler	*Vermivora ruficapilla*	N	None	None	None	None	X			X	X	X		X	
B	Yellow Warbler	*Dendroica petechia*	N	None	None	None	None	XX			XX					
B	Yellow-rumped Warbler	*Dendroica coronata*	S	None	None	None	None	X		X	X	X	X		X	X
B	Black-throated Gray Warbler	*Dendroica nigrescens*	N	None	None	None	None	XX			XX	XX	XX		X	X
B	Townsend's Warbler	*Dendroica townsendi*	S / N	None	None	None	None	X			X	X	X		X	X
B	Hermit Warbler	*Dendroica occidentalis*	N	None	None	None	None	X			X	XX	X			
B	MacGillivray's Warbler	*Oporornis tolmiei*	N	None	None	None	None	X			X	X	X		X	
B	Common Yellowthroat	*Geothlypis trichas*	N	None	None	None	None	XX		XX	XX	X	X	X		X
B	Wilson's Warbler	*Wilsonia pusilla*	N	None	None	None	None	XX			XX	XX	X		X	X
B	Yellow-breasted Chat	*Icteria virens*	N	SoC	SC	G5/S4?	4	XX			XX	X	X		X	
B	Western Tanager	*Piranga ludoviciana*	N	None	None	None	None	X			X	XX	XX			X
B	Spotted Towhee	*Pipilo maculatus*	R	None	None	None	None	X			X	X	XX		X	X
B	Chipping Sparrow	*Spizella passerina*	N	None	None	None	None	X			X	X	X	X	X	X
B	Oregon Vesper Sparrow	*Pooecetes gramineus affinis*	S / N	SoC	SC	G5T3/S2B, S2N	2							XX	XX	
B	Savannah Sparrow	*Passerculus sandwichensis*	S / N	None	None	None	None	X		X	X			XX	XX	X
B	Fox Sparrow	*Passerella iliaca*	W / M	None	None	None	None	X			X	X	X		X	X
B	Song Sparrow	*Melospiza melodia*	R	None	None	None	None	X		X	X	X	X	X	X	X
B	Lincoln's Sparrow	*Melospiza lincolnii*	S / N	None	None	None	None	XX		XX	XX	X			X	
B	Swamp Sparrow	*Melospiza georgiana*	W / M	None	None	None	None	XX		XX	XX				X	
B	White-throated Sparrow	*Zonotrichia albicollis*	W / M	None	None	None	None								X	X
B	Harris's Sparrow	*Zonotrichia querula*	W / M	None	None	None	None								X	X
B	White-crowned Sparrow	*Zonotrichia leucophrys*	S	None	None	None	None	X		X	X	X	X	X	X	X
B	Golden-crowned Sparrow	*Zonotrichia atricapilla*	R	None	None	None	None	X		X	X	X	X	X	X	X
B	Dark-eyed Junco	*Junco hyemalis*	S	None	None	None	None	X			X	X	X		X	X
B	Black-headed Grosbeak	*Pheucticus melanocephalus*	N	None	None	None	None	X			X	X	X		X	X
B	Lazuli Bunting	*Passerina amoena*	N	None	None	None	None	X			X	X	X	X	XX	X
B	Red-winged Blackbird	*Agelaius phoeniceus*	S	None	None	None	None	XX		XX	X			X	X	X
B	Tricolored Blackbird	*Agelaius tricolor*	S	SoC	SP	G3/S2B	2	XX		XX					X	
B	Western Meadowlark (extirpated as breeding species)	*Sturnella neglecta*	W / M	None	SC	G5/S5	4	X		X				XX	XX	
B	Yellow-headed Blackbird	*Xanthocephalus xanthocephalus*	N	None	None	None	None	XX		XX					X	
B	Brewer's Blackbird	*Euphagus cyanocephalus*	S	None	None	None	None	X		X	X		X	X	XX	X
B	Brown-headed Cowbird	*Molothrus ater*	S / N	None	None	None	None	X		X	X	X	X	X	XX	X
B	Bullock's Oriole	*Icterus bullockii*	N	None	None	None	None	XX			XX		XX		X	X

Code[1]	Common Name	Genus/Species	Migratory Status[2]	Federal Status[3]	ODFW Status[4]	ORNHP Rank[5]	ORNHP List[6]	Riparian Assn.[7]	Habitat Type[8]							
									WATR	HWET	RWET	WLCH	WODF	WEGR	AGPA	URBN
B	Purple Finch	*Carpodacus purpureus*	S	None	None	None	None	XX			XX	X	XX		X	X
B	House Finch	*Carpodacus mexicanus*	R	None	None	None	None	X		X	X	X	X	X	XX	XX
B	Red Crossbill	*Loxia curvirostra*	R / S	None	None	None	None	X			X	X	X			X
B	Pine Siskin	*Carduelis pinus*	S	None	None	None	None	X		X	X	X	X		X	X
B	Lesser Goldfinch	*Carduelis psaltria*	S	None	None	None	None	XX			XX	X	XX	X	X	X
B	American Goldfinch	*Carduelis tristis*	S	None	None	None	None	X		X	X	X	X	X	X	X
B	Evening Grosbeak	*Coccothraustes vespertinus*	W / M	None	None	None	None	X			X	X	X			X
B*	House Sparrow*	*Passer domesticus*	R	N/A - alien	N/A - alien	N/A - alien	N/A - alien								XX	XX
M*	Virginia Opossum*	*Didelphis virginiana*	R	N/A - alien	N/A - alien	N/A - alien	N/A - alien	X			X	X	X	X	XX	XX
M	Vagrant Shrew	*Sorex vagrans*	R	None	None	None	None	X		X	X	X	X	X	X	X
M	Pacific Water Shrew	*Sorex bendirii*	R	None	None	None	None	XX		X	XX	X	X			
M	Water Shrew	*Sorex palustris*	R	None	None	None	None	XX			XX	X				
M	Trowbridge's Shrew	*Sorex trowbridgii*	R	None	None	None	None	X			X	XX	X		X	X
M	Shrew-mole	*Neurotrichus gibbsii*	R	None	None	None	None	X		X	X	XX	X		X	X
M	Townsend's Mole	*Scapanus townsendii*	R	None	None	None	None	X		X	X	X	X	X	X	X
M	Coast Mole	*Scapanus orarius*	R	None	None	None	None	X			X	XX	X	X	X	X
M	Yuma Myotis	*Myotis yumanensis*	R / S	SoC	None	G5/S3	4	XX	XX	XX	XX	X	X	X	X	X
M	Little Brown Myotis	*Myotis lucifugus*	R / S	None	None	None	None	X	X	X	X	X	X	X	X	X
M	Long-legged Myotis	*Myotis volans*	R / S	SoC	SU	G5/S3	4	X	X	X	X	XX	X	X	X	X
M	Fringed Myotis	*Myotis thysanodes*	R / S	SoC	SV	G4G5/S2?	2	X	X	X	X	X	X		X	X
M	Long-eared Myotis	*Myotis evotis*	R / S	SoC	SU	G5/S3	4	X	X	X	X	X	X	X	X	X
M	Silver-haired Bat	*Lasionycteris noctivagans*	L	SoC	SU	G5/S4?	4	X	X	X	X	XX	X	X	X	X
M	Big Brown Bat	*Eptesicus fuscus*	R / S	None	None	None	None	X	X	X	X	X	XX	X	XX	XX
M	Hoary Bat	*Lasiuris cinereus*	L	None	None	G5/S4?	4	X	X	X	X	X	X	X	X	X
M	Pacific Western Big-eared Bat	*Corynorhinus townsendii townsendii*	R / S	SoC	SC	G4T3T4/S2?	2	XX	XX	X	X	X	X	X	X	X
M	Brush Rabbit	*Sylvilagus bachmani*	R	None	None	None	None	X			X	X	X	X	X	X
M*	Eastern Cottontail*	*Sylvilagus floridanus*	R	N/A - alien	N/A - alien	N/A - alien	N/A - alien	X			X				X	X
M	Mountain Beaver	*Aplodontia rufa*	R	None	None	None	None	XX			XX	XX				
M	Townsend's Chipmunk	*Tamias townsendii*	R	None	None	None	None	X			X	XX	X			X
M	California Ground Squirrel	*Spermophilus beecheyi*	R	None	None	None	None					X	X	X	X	X
M*	Eastern Fox Squirrel*	*Sciurus niger*	R	N/A - alien	N/A - alien	N/A - alien	N/A - alien							XX	XX	XX
M*	Eastern Gray Squirrel*	*Sciurus carolinensis*	R	N/A - alien	N/A - alien	N/A - alien	N/A - alien						XX		X	XX
M	Western Gray Squirrel	*Sciurus griseus*	R	None	SU	G5/S4?	3					X	XX		X	X
M	Douglas' Squirrel	*Tamiasciurus douglasii*	R	None	None	None	None		XX	XX	X					
M	Northern Flying Squirrel	*Glaucomys sabrinus*	R	None	None	None	None	X			X	XX	XX			X
(M)	(Western pocket gopher)	*(Thomomys mazama)*	(R)	None	None	None	None					(XX)	(XX)	(X)	(X)	(X)
M	Camas Pocket Gopher	*Thomomys bulbivorus*	R	SoC	None	G3G4/S3 S4	3							XX	XX	X
M	American Beaver	*Castor canadensis*	R	None	None	None	None	XX	XX	XX	XX	X	X		X	X
M	Deer Mouse	*Peromyscus maniculatus*	R	None	None	None	None	XX		XX	XX	XX	XX	XX	XX	XX
M	Bushy-tailed Woodrat	*Neotoma cinerea*	R	None	None	None	None	X			X	XX	XX		XX	X
M	Western Red-backed Vole	*Clethrionomys californicus*	R	None	None	None	None	X			X	X				
M	Heather Vole	*Phenacomys intermedius*	R	None	None	None	None	X			X		X			
M	White-foo[illegible] Vole	*Arborimus (= Phenacomys) albipes*	R	SoC	SU	G3G4/S3	4	XX			XX	XX				

Code[1]	Common Name	Genus/Species	Migratory Status[2]	Federal Status[3]	ODFW Status[4]	ORNHP Rank[5]	ORNHP List[6]	Riparian Assn.[7]	Habitat Type[8] WATR	HWET	RWET	WLCH	WODF	WEGR	AGPA	URBN
M	Red Tree Vole	*Arborimus (= Phenacomys) longicaudus*	R	SoC	None	G3G4/S3S4	3	X			X	XX	XX			
M	Gray-tailed Vole	*Microtus canicaudus*	R	None	None	None	None							XX	XX	
M	Townsend's Vole	*Microtus townsendii*	R	None	None	None	None	XX		XX	X	X	X	X	X	
M	Long-tailed Vole	*Microtus longicaudus*	R	None	None	None	None	XX		XX	XX	X	X	X	X	
M	Creeping Vole	*Microtus oregoni*	R	None	None	None	None	X			X	X	X	X	X	X
M	Water Vole	*Microtus richardsoni*	R	None	None	None	None	X			X	X				
M	Common Muskrat	*Ondatra zibethicus*	R	None	None	None	None	XX	XX	XX	XX				X	X
M*	Black Rat*	*Rattus rattus*	R	N/A - alien	N/A - alien	N/A - alien	N/A - alien								X	XX
M*	Norway Rat*	*Rattus norvegicus*	R	N/A - alien	N/A - alien	N/A - alien	N/A - alien								X	XX
M*	House Mouse*	*Mus musculus*	R	N/A - alien	N/A - alien	N/A - alien	N/A - alien								XX	XX
M	Pacific Jumping Mouse	*Zapus trinotatus*	R	None	None	None	None	XX		X	XX	X	X		X	
M	Common Porcupine	*Erethizon dorsatum*	R	None	None	None	None	XX		X	XX	XX	XX		X	X
M*	Nutria*	*Myocastor coypus*	R	N/A - alien	N/A - alien	N/A - alien	N/A - alien	XX	XX	XX	XX				X	X
M	Coyote	*Canis latrans*	R	None	None	None	None	X		X	X	X	X	X	X	X
M	Red Fox	*Vulpes vulpes*	R	None	None	None	None	X			X	X	X	XX	X	X
M	Gray Fox	*Urocyon cinereoargenteus*	R	None	None	None	None	X			X	XX	X	X	X	
(M)	(Gray Wolf - extirpated)	*(Canis lupus)*	S	None	None	None	None	(X)			(X)	(X)	(X)	(X)		
M	Black Bear	*Ursus americanus*	S	None	None	None	None	X		X	X	X	X	X	X	X
(M)	(Grizzly Bear)	*(Ursus arctos)*	(R)	LT	None	G4/SX	2-ex	(X)			(X)	(X)		(X)		
M	Common Raccoon	*Procyon lotor*	R	None	None	None	None	XX	X	XX	XX	X	X	X	XX	XX
M	Ermine	*Mustela erminea*	R	None	None	None	None	X			X	X	X	X	X	
M	Long-tailed Weasel	*Mustela frenata*	R	None	None	None	None	X		X	X	X	X	X	X	X
M	Mink	*Mustela vison*	R	None	None	None	None	XX	XX	XX	XX	X	X	X	X	X
M	Striped Skunk	*Mephitis mephitis*	R	None	None	None	None	X		X	X	X	X	X	X	X
M	Western Spotted Skunk	*Spilogale gracilis*	R	None	None	None	None	X			X	X	X	X	X	X
M	Northern River Otter	*Lontra canadensis*	R	None	None	None	None	XX	XX	XX	XX					X
M	Mountain Lion (Cougar)	*Puma concolor*	S	None	None	None	None	X		X	X	X	X		X	X
M	Bobcat	*Lynx rufus*	S	None	None	None	None	X		X	X	X	X	X	X	X
M*	Domestic Cat (feral)*	*Felis domesticus*	R	N/A - alien	N/A - alien	N/A - alien	N/A - alien	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
M	California Sea Lion	*Zalophus californianus*	S	None	None	None	None	XX	XX							
M	Roosevelt Elk	*Cervus elaphus roosevelti*	S	None	None	None	None	X		X	X	X	X	X	X	X
(M)	(Columbian White-tailed Deer)	*(Odocoileus virginiana leucurus)*	(R)	LE	SV	G5T2QS2	1	(X)		(X)	(X)	(X)	(XX)	(X)	(X)	(X)
M	Mule Deer	*Odocoileus hemionus*	R	None	None	None	None	X		X	X	X	X	X	X	X

[a] Bald eagle is currently proposed for de-listing at the federal level.
I:\gm\long_range_planning\Goal 5\Goal 5 report revision\Science Review\Current Chapters & appxs\Appx 1 Species list - Verts.doc

Appendix 8

Habitats of Concern master list.

DRAFT

Habitats of Concern Master List

UNIQUE ID (UID)	HABITAT COMMENTS	SOURCE(S)	PRIORITY CONSERVATION HABITAT CODE*	RIVERINE ISLAND OR DELTA*	UNIQUE OR CRITICAL WILDLIFE FUNCTIONS*
1	Oak woodland	Barb Grover, City of Portland	O		
2	Oak woodland	Barb Grover, City of Portland	O		
3	Oak woodland	Barb Grover, City of Portland	O		
4	Oak woodland	Barb Grover, City of Portland	O		
6	Remnant native wetland; Columbia Slough wetlands/cottonwood forest, 4-corners. Portland Columbia South Shore NR management plan	Lynn Sharp, URS; Mike Houck, Audubon Society of Portland	W, B		
8	Smith & Bybee critical connector to the river.	Elaine Stewart, Metro; Barb Grover, City of Portland; Mike Houck, Audubon Society of Portland			C
9	Dredge spoils to the north - critical SOC breeding area.	Elaine Stewart, Metro; Mike Houck, Audubon Society of Portland			S
9	Smith and Bybee Lakes/wetlands. Identified as waterfowl and shorebird habitat on *US Army Corps Regional Urban Wildlife Habitat Maps, Portland-Vancouver Metropolitan Area Water Resources Study, October 1978*. This is the largest contiguous wetland habitat remaining in the Columbia Slough watershed. Includes an area for sensitive species passage on the Leadbetter Peninsula.	Mike Houck, Audubon Society of Portland; Elaine Stewart, Metro.	W, B		M
9	St. Johns Landfill. Critical area for sensitive species.	Mike Houck, Audubon Society of Portland	(G)		S; G
9	Columbia Slough and adjacent wetland/riparian areas. Houck has seen 18 beaver in their burrows along this reach of the Columbia Slough. Several sensitive species; Bald Eagle, Osprey, Great Blue Heron all use trees along the slough as perch trees, and some for nesting. Red-tailed Hawk nests. River otter are frequently seen in the reach between Kelley Point Park and St. Johns Landfill. Houck heard a Yellow-billed Cuckoo here in the early 1980's.	Mike Houck, Audubon Society of Portland	W, B		M, P
12	Powell Butte grassy areas. Important migratory stopover habitat; grasslands and forest. See *Wild in the City, A Guide to Portland's Natural Areas.*	Bob Altman, American Bird Conservancy; Barb Grover, City of Portland; Mike Houck, Audubon Society of Portland			M, G
14	Jenkins Woods. Mixed oak/ash/Ponderosa pine forest; important connector to Tualatin Hills Nature Park. Some bottomland hardwood as well. This was one of Mike Houck's highest rated wildlife habitats in 1986 Beaverton Goal 5 inventory. It was, unfortunately and inappropriately in his opinion, listed as "other" important habitat and, therefore, received no protection at that time. It is an important remnant of ponderosa pine, Oregon white oak, and Oregon ash habitat with wetlands scattered throughout the forest matrix. It is listed as a candidate natural area on *US Army Corps Regional Urban Wildlife Habitat Maps, Portland-Vancouver Metropolitan Area Water Resources Study, October 1978.*	Lynn Sharp, URS; Mike Houck, Audubon Society of Portland	O, W, B		C
15	Oak palisades	Barb Grover, City of Portland	O		
16	Oak palisades	Barb Grover, City of Portland	O		
18	Mt. Talbert mixed forest w/oak and riparian; see also UID #124. For more information see Metro Regional Parks and Greenspaces target area information.	Bob Altman, American Bird Conservancy; Lynn Sharp, URS	O, B		M
19	Sandy River Delta; wetlands, riparian bottomland hardwood. Identified as Unique Area on *US Army Corps Regional Urban Wildlife Habitat Maps, Portland-Vancouver Metropolitan Area Water Resources Study, October 1978.*	Curt Zonick, Metro; Bob Altman, American Bird Conservancy; Mike Houck, Audubon Society of Portland	W, B	D	M
20	Government Island: This Port and Metro owned complex is important waterfowl and riparian habitat. Lemon Island and Sand Island (downstream) were listed as Unique Areas on *US Army Corps Regional Urban Wildlife Habitat Maps, Portland-Vancouver Metropolitan Area Water Resources Study, October 1978.*	Bob Altman, American Bird Conservancy; Mike Houck, Audubon Society of Portland	W, B	I	M
21	Elk Rock	Barb Grover, City of Portland	W, B	I	M
22	Oaks Bottom wetlands and mudflats area. See *Wild in the City, A Guide to Portland's Natural Areas.*	Barb Grover, City of Portland; Mike Houck, Audubon Society of Portland	W, B		M
23	Oak palisades/bottomland hardwood.	Barb Grover, City of Portland	O		
24	Oak palisades	Barb Grover, City of Portland	O		
25	Oak habitat nr Newberry Rd.	Barb Grover, City of Portland	O		
26	Oak habitat nr Saltzman Rd	Barb Grover, City of Portland	O		
27	Oak habitat nr Cornell Rd.	Barb Grover, City of Portland	O		
28	Oak habitat nr Marquam/Sam Jcksn	Barb Grover, City of Portland	O		
29	Important Columbia Willow / mudflat; foraging habitat for migratory and resident shorebirds.	Barb Grover, City of Portland			M; U; P
30	Mudflats along Marine Powers Park; foraging habitat for migratory and resident shorebirds.	Barb Grover, City of Portland			M; U
31	Mudflats at end of Swan Lagoon; foraging habitat for migratory and resident shorebirds.	Barb Grover, City of Portland			M; U
32	North Clackamas District Park: Wetland does not show up on our inventory but it is there. Unusually fine specimen of remnant native wetland. Wetland classes are taught there. See *Wild in the City, A Guide to Portland's Natural Areas.*	Lynn Sharp, URS; Mike Houck, Audubon Society of Portland	B, W		
33	Kelly Butte: important migratory area and stopover habitat; sensitive plant species population. More natural than Mt. Tabor habitat. Important botanical site as well.	Barb Grover, Portland; T. McGuire, Adolfson; Mike Houck, Audubon Society of Portland			M, G (PARTIAL), P
34	West Hayden Island. This is one of the most significant stands of black cottonwood/Oregon ash riparian habitat left on the lower Columbia River. Identified as the most significant wildlife habitat in the Columbia Slough Watershed area in Portland's Goal 5 process. Also identified as Special Riparian Forest/Wetlands on *US Army Corps Regional Urban Wildlife Habitat Maps, Portland-Vancouver Metropolitan Area Water Resources Study, October 1978*. Osprey nesting area; important migratory stopover habitat.	Mike Houck, Audubon Society of Portland	B, W	I	M
35	Kelley Point Park. Large cottonwood forest, important shallow water habitat. Caspian Terns in summer. Migratory stopover habitat.	Mike Houck, Audubon Society of Portland	B, W		M

UNIQUE ID (UID)	HABITAT COMMENTS	SOURCE(S)	PRIORITY CONSERVATION HABITAT CODE*	RIVERINE ISLAND OR DELTA*	UNIQUE OR CRITICAL WILDLIFE FUNCTIONS*
38	Fernhill Wetlands. Major floodplains. The entire floodplain on both sides of Fernhill Road constitutes highly significant wetland and riparian habitat. Sensitive species use the habitat for critical life-history phases, including areas north of the Tualatin River and around the Fernhill Wetland complex (Clean Water Services sewage ponds). Bald Eagle, Great Blue Heron perching areas. This area is described in detail in *Wild in the City, A Guide to Portland's Natural Areas* and the Tualatin Riverkeepers' book, *Exploring the Tualatin River Basin*. Listed as Natural Area candidate site on *U.S. Army Corps Regional Urban Wildlife Habitat Maps, Portland-Vancouver Metropolitan Area Water Resources Study, October 1978.*	Mike Houck, Audubon Society of Portland	B, W		M
39	Pacific University campus and downtown Forest Grove Oaks. The oak trees in and around downtown Forest Grove harbor what is now believed to be the only extant colony of a sensitive species in the northern Willamette Valley; believed to be the northern extent of this species' range.	Mike Houck, Audubon Society of Portland	O		S
40	Jackson Bottom Wetland Complex (fields and riparian area west of Hwy 219). These fields are important waterfowl habitat during winter months. Tundra Swans and a variety of waterfowl congregate here during high water months. Bald Eagles perch in the trees. This is ecologically linked to the Jackson Bottom Wetland Preserve to the west of Hwy 219. This area is described in detail in *Wild in the City, a Guide to Portland's Natural Areas* and the Tualatin Riverkeepers' book, *Exploring the Tualatin River Basin.*	Mike Houck, Audubon Society of Portland	B, W		M, C, U
41	Tualatin Floodplain (Cornelius): The oxbows, wetlands, and riparian habitat along this reach of the Tualatin River is the most significant wildlife area in Cornelius. The riparian zone was identified as Special Riparian Forest/Wetlands and the floodplains to the south of the Tualatin were identified as Waterfowl and shorebird habitat on the *US Army Corps Regional Urban Wildlife Habitat Maps, Portland-Vancouver Metropolitan Area Water Resources Study, October 1978*.	Mike Houck, Audubon Society of Portland	B, W		M, U
43	Riparian area between Hillsboro/Cornelius - this entire riparian area is listed as Special Riparian Forest/Wetlands on *US Army Corps Regional Urban Wildlife Habitat Maps, Portland-Vancouver Metropolitan Area Water Resources Study, October 1978.*	Mike Houck, Audubon Society of Portland	B, W		
44	Riparian area, NE Cornelius - this entire riparian area is listed as Special Riparian Forest/Wetlands on *US Army Corps Regional Urban Wildlife Habitat Maps, Portland-Vancouver Metropolitan Area Water Resources Study, October 1978.*	Mike Houck, Audubon Society of Portland	B, W		
45	Riparian area near Cornelius - this entire riparian area is listed as Special Riparian Forest/Wetlands on *US Army Corps Regional Urban Wildlife Habitat Maps, Portland-Vancouver Metropolitan Area Water Resources Study, October 1978.*	Mike Houck, Audubon Society of Portland	B, W		
46	Riparian area SW of Hillsboro - this entire riparian area is listed as Special Riparian Forest/Wetlands on *US Army Corps Regional Urban Wildlife Habitat Maps, Portland-Vancouver Metropolitan Area Water Resources Study, October 1978.*	Mike Houck, Audubon Society of Portland	B, W		
47	Riparian area SW of Hillsboro - this entire riparian area is listed as Special Riparian Forest/Wetlands on *US Army Corps Regional Urban Wildlife Habitat Maps, Portland-Vancouver Metropolitan Area Water Resources Study, October 1978.*	Mike Houck, Audubon Society of Portland	B, W		
48	Wapato Wetlands, Columbia Slough - Most extensive stand of native wapato in the metro region	Mike Houck, Audubon Society of Portland	B, W		P
49	Forest Park. Elk migration corridor; very important interior habitat for area-sensitive species, especially Neotropical migratory songbirds; migratory corridor from outlying areas, source of repopulation if species become extirpated inside Metro boundary. Largest habitat patch in the urban region.	Mike Houck, Audubon Society of Portland	B		E, M
50	Balch Creek. Elk migration corridor; important connectivity with Forest Park; interior habitat for Neotropical migratory songbirds. Also important headwaters area. Roost area for sensitive species.	Mike Houck, Audubon Society of Portland	B		E, M
51	Cedar Mill Creek wetlands and forest: This was one of the most significant sites on Mike Houck's 1984 Washington County Goal 5 inventory. Large population of Wood Ducks use open water bodies here.	Mike Houck, Audubon Society of Portland	B, W		C
52	Pepper Tree Wetlands - Owned in part by Tualatin Hills Park and Recreation District, this shrub-scrub wetland area was a significant wildlife site identified on Mike Houck's 1984 Washington County Goal 5 inventory.	Mike Houck, Audubon Society of Portland	B, W		
53	Commonwealth Lake wetland - The channelized portion of Cedar Mill Creek immediately adjacent (north) to Commonwealth Lake is an important winter waterfowl habitat. Houck has seen several hundred to as many as 1,500 waterfowl (Green-winged Teal, American and Eurasian Wigeon, Mallards, and Pintail, Canada Geese) use these wetlands and adjacent grass habitat around the lake.	Mike Houck, Audubon Society of Portland	W		M
54	Tualatin Hills Nature Park - THPRD-owned forest at confluence of Cedar Mill and Beaverton Creeks. Its value as fish and wildlife habitat is well-established, with several sensitive species being found in the interior forest adjacent to Cedar Mill Creek in 1984 (M. Houck) and numerous individuals of a sensitive species found in 2001 (L. Hennings). Listed as a Candidate Natural Area on *US Army Corps Regional Urban Wildlife Habitat Maps, Portland-Vancouver Metropolitan Area Water Resources Study, October 1978.*	Mike Houck, Audubon Society of Portland	B, W		M
55	Important wetland/connector listed on *US Army Corps Regional Urban Wildlife Habitat Maps, Portland-Vancouver Metropolitan Area Water Resources Study, October 1978.*	Mike Houck, Audubon Society of Portland	B, W		C
56	Important wetland/connector listed on *US Army Corps Regional Urban Wildlife Habitat Maps, Portland-Vancouver Metropolitan Area Water Resources Study, October 1978.*	Mike Houck, Audubon Society of Portland	B, W		C, M
57	Important wetland/connector; listed as Special Riparian Forest/Wetland on *US Army Corps Regional Urban Wildlife Habitat Maps, Portland-Vancouver Metropolitan Area Water Resources Study, October 1978.*	Mike Houck, Audubon Society of Portland	B, W		M, C
58	Important wetland/connector; listed as Special Riparian Forest/Wetland on *US Army Corps Regional Urban Wildlife Habitat Maps, Portland-Vancouver Metropolitan Area Water Resources Study, October 1978.*	Mike Houck, Audubon Society of Portland	B, W		M, C
59	Jackson Bottom Wetlands preserve; see notes on UID #40; linkage to wetland areas to the west. Important waterfowl area.	Mike Houck, Audubon Society of Portland	B, W		M, C
60	Important wetland/connector; listed on *US Army Corps Regional Urban Wildlife Habitat Maps, Portland-Vancouver Metropolitan Area Water Resources Study, October 1978.*	Mike Houck, Audubon Society of Portland	B, W		M, C
61	Harborton Forest & Wetlands: This is a significant riparian forest and wetland complex at the confluence of the Multnomah Channel and Willamette River. This site was identified as significant on the 1986 Willamette River Greenway Mike Houck did for the City of Portland. This entire riparian area is listed as Special Riparian Forest/Wetlands on *US Army Corps Regional Urban Wildlife Habitat Maps, Portland-Vancouver Metropolitan Area Water Resources Study, October 1978.*	Mike Houck, Audubon Society of Portland	B, W		

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62	"Big four-corners area", Columbia Slough wetlands and cottonwood forest: identified as one of the most important remaining wildlife areas in Portland's Columbia South Shore Natural Resource Management Plan.	Mike Houck, Audubon Society of Portland; Lynn Sharp, URS	B, W		M
63	Important waterfowl and riparian habitat.	Mike Houck, Audubon Society of Portland	B, W	I	
64	"Little four-corners area", Columbia Slough: An important open water, wetland and riparian area, highly rated in Columbia Slough Shore Natural Resource Management Plan.	Mike Houck, Audubon Society of Portland	B, W		
65	Johnson Lake: Largest and most natural open water body on upper Columbia Slough, highly rated in Columbia Slough Shore Natural Resource Management Plan. Heavily used by wintering waterfowl (Ring-necked Duck, Gadwall, American Wigeon, Bufflehead, Lesser Scaup, Wood Duck, Canvasback, and Pied-billed Grebes; Double-crested Cormorant). Adjacent cottonwood forest important remnant riparian habitat.	Mike Houck, Audubon Society of Portland	B, W		M
66	Whitaker Ponds: important for fish and wildlife and widely used for environmental education.	Mike Houck, Audubon Society of Portland	B, W		U
67	Buffalo Slough, Columbia Slough - very important winter waterfowl area.	Mike Houck, Audubon Society of Portland	B, W		M
68	Subaru Wetlands/Broadmoor Golf Course Wetlands: At the time it was inventoried for Portland's Goal 5, Columbia Slough Shore Natural Resource Management Plan. This wetland was aliments totally dominated by native shrub-scrub vegetation, making it one of the few wetlands in the region not dominated by invasive reed canarygrass.	Mike Houck, Audubon Society of Portland	B, W		
69	Peninsula Canal: sensitive species habitat area; important wildlife viewing area; heavy use by waterfowl during winter months.	Mike Houck, Audubon Society of Portland	W		C; M
70	Tomahawk Island: Great Blue Heron rookery; small remnant cottonwood forest. Large quarry to the west of this cottonwood stand is highly important potential restoration site (does not appear on map).	Mike Houck, Audubon Society of Portland	B	I	M
71	Children's Arboretum/Brandwein Wetland Restoration Site: While relatively small, this remnant native wetland and forest complex is highly significant wildlife area in this reach of the watershed.	Mike Houck, Audubon Society of Portland	B, W		
72	Bridgeton Slough riparian/wetlands, sensitive species area; although degraded, this reach of the Bridgeton Slough continues to harbor a sensitive species that is rare to the area and a few years ago, also contained a nesting colony of another sensitive species. Good potential pond turtle habitat, as well.	Mike Houck, Audubon Society of Portland	B, W		S
73	Vanport Wetlands (formerly Radio Tower Wetlands): An important 80-acre remnant wetland. Port of Portland is currently undertaking major restoration effort at these wetlands.	Mike Houck, Audubon Society of Portland	B (PARTIAL), W		
74	Heron Lakes Golf Course wetlands: Great Blue Heron nesting colony; currently undergoing extensive revegetation, this large wetland complex extends from North Force Boulevard to the railroad berm. Thirty Great Blue Heron nests are currently in the remnant at the wetland's northeast corner. Great Horned Owls and Red-tailed Hawks also nest here. Sensitive species roost in winter months. An important wildlife viewing area as well.	Mike Houck, Audubon Society of Portland	B, W		S
75	Oak habitat	Mike Houck, Audubon Society of Portland; Barb Grover, City of Portland	O		
75	Waud and Willamette Bluff oak/pine forest: Unique mix of ponderosa pine/Oregon white oak/Pacific madrone forest with poison oak understory.	Mike Houck, Audubon Society of Portland, Audubon Society of Portland	O		
76	Oak habitat	Mike Houck, Audubon Society of Portland; Barb Grover, City of Portland	O		
77	Oak habitat and small but significant Swan Island wapato wetland; per Houck, small wetland in the Swan Island lagoon, immediately adjacent to the boat ramp; he identified this small emergent wetland that lies between moored ships and small riparian strip in 1986 Willamette Greenway inventory.	Mike Houck, Audubon Society of Portland; Barb Grover, City of Portland	O, W		P
78	Columbia Slough	Mike Houck, Audubon Society of Portland	B, W		M, C
79	Willamette Cove Greenspace: This is one of the few relatively "natural" riparian areas on this side of the Willamette, downstream of Ross Island. It is publicly owned and has excellent restoration potential, once toxic waste issues are addressed on adjacent McCormick Baxter site. Important oak and riparian habitats.	Mike Houck, Audubon Society of Portland	O, B		
81	Mt. Tabor: While this is a managed forest canopy , it is an important site for Neotropical migrants and an important wildlife viewing area.	Mike Houck, Audubon Society of Portland			M, G
84	McGuire Island: Identified as Unique Area on *US Army Corps Regional Urban Wildlife Habitat Maps, Portland-Vancouver Metropolitan Area Water Resources Study, October 1978.*	Mike Houck, Audubon Society of Portland	B	I	M
85	Columbia Slough Wetland Mitigation Site: Wetlands extend from NE 181st to near Fairview Lake, along both sides of the Columbia Slough.	Mike Houck, Audubon Society of Portland	B, W		
86	Fairview Creek quarry ponds, forest and wetlands	Mike Houck, Audubon Society of Portland	B, W		C
88	Columbia River riparian forest: Identified as Special Riparian Forest/Wetlands on *US Army Corps Regional Urban Wildlife Habitat Maps, Portland-Vancouver Metropolitan Area Water Resources Study, October 1978.*	Mike Houck, Audubon Society of Portland	B, W		M
89	Company Lake/Sundial Beach and riparian forest: Identified as Unique Area on *US Army Corps Regional Urban Wildlife Habitat Maps, Portland-Vancouver Metropolitan Area Water Resources Study, October 1978.*	Mike Houck, Audubon Society of Portland	B, W		D
90	Gary, Flag, and Chatham Islands: Identified as Unique Area on *US Army Corps Regional Urban Wildlife Habitat Maps, Portland-Vancouver Metropolitan Area Water Resources Study, October 1978.*	Mike Houck, Audubon Society of Portland	B	I	M
91	Beaver Creek Greenway: Important remnant riparian zone in Troutdale and Gresham. Important migratory corridor.	Mike Houck, Audubon Society of Portland	B, W		C, M
92	Sandy River Gorge: Identified as Special Riparian Forest/Wetlands; Unique Natural Area, Anadromous fish migration and spawning area on *US Army Corps Regional Urban Wildlife Habitat Maps, Portland-Vancouver Metropolitan Area Water Resources Study, October 1978.* Includes all riparian habitat along river.	Mike Houck, Audubon Society of Portland	B, W		M, C

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93	Hart-Lowami Woods and Vale Park riparian area/wetland area: see *Wild in the City, A Guide to Portland's Natural Areas*. Per Julie Reilly (THPRD), Vale Park is a recent addition to the old Vale Park; site runs from Hart Road south to Gleneden Dr., east of 155th. Although part of the site adjacent to Hart and 155th is an open grassy site, it is wet prairie. Many good native plants growing here, including a wide variety of sedges and rushes, young Oregon ash trees, and checker-mallow.	Mike Houck, Audubon Society of Portland; Julie Reilly, THPRD	B, W		M
94	Oregon Episcopal School Wetlands: see *Wild in The City, A Guide to Portland's Natural Areas.*	Mike Houck, Audubon Society of Portland	B, W		C, M
95	Creekside Marsh and Fanno Creek Greenway Park: see *Wild in the City, a Guide to Portland's Natural Areas.* Per Julie Reilly, THPRD: This is open wet prairie, unmowed, with good habitat for meadowlark and other birds, small mammals and coyote. Unique grassland habitat.	Mike Houck, Audubon Society of Portland	B, W		U
96	Summer Creek Tributary: The small stream that runs parallel to SE Teal Blvd. harbors a large population of a sensitive amphibian species several years ago. Note that a map correction resulted in the removal of the area north of Teal Boulevard (see Mayor Rob Drake's letter of July 29, 2002).	Mike Houck, Audubon Society of Portland	B		C, M
97	Summer Lake Park / Reflections at Summer Creek: This reach of Summer Creek, a tributary to Fanno Creek, is significant fish and wildlife habitat. See *Wild in the City, A Guide to Portland's Natural Areas.*	Mike Houck, Audubon Society of Portland	B, W		
98	Fanno Creek Greenway, Tigard: See *Wild in the City, A Guide to Portland's Natural Areas.*	Mike Houck, Audubon Society of Portland	B, W		M
99	Cook Park and Tualatin River Floodplain: See *Wild in The City, A Guide to Portland's Natural Areas.*	Mike Houck, Audubon Society of Portland	B, W		
100	Durham City Park; Fanno Creek Greenway: See *Wild in The City, A Guide to Portland's Natural Areas*. Important Neotropical migratory bird breeding and migrating area (Hennings 1999).	Mike Houck, Audubon Society of Portland	B, W		C, M
101	Hedges Creek Marsh: According to The Wetlands Conservancy: Once a year-round stream, is now only seasonal because of new construction within the basin. Fifty years ago you could catch trout in Hedges Creek. The marsh, about two miles long, is located in downtown Tualatin and is bounded almost entirely by industrial and commercial development. In spite of this, the marsh continues to attract a wide variety of wildlife.	Mike Houck, Audubon Society of Portland	B, W		
105	Allen Boulevard, Fanno Creek Riparian Area: Important bottomland hardwood and migratory corridor, breeding habitat for Neotropical birds.	Mike Houck, Audubon Society of Portland	B, W		C, M
106	Tualatin River National Wildlife Refuge - see *Wild in the City, A Guide to Portland's Natural Areas.* Important waterfowl, shorebirds, wetlands area. Important low-structure habitat for grassland/wetlands breeding and migrating birds.	Mike Houck, Audubon Society of Portland	B, W		M, C
107	Cooper Mountain: Metro Regional Parks and Greenspaces owns a significant portion of Cooper Mountain, precisely because it has high upland wildlife habitat value. Several headwater streams also present. The open oak and Pacific madrone habitat is unique in the region. Very high bird diversity (Hennings 1999), with several breeding sensitive bird species. Important Neotropical migratory bird habitat, both breeding and stopover. High habitat diversity. Alligator lizards.	Mike Houck, Audubon Society of Portland	O, R		M, G
108	South Hillsboro / Tualatin River Floodplain: a very critical connectivity corridor for migration and travel routes. Connectivity to Jackson Slough. Numerous, extensive wetlands and bottomland. Excellent wildlife habitat.	Mike Houck, Audubon Society of Portland	B, W		C, M
109	Nyberg Creek riparian area and wetlands.	Mike Houck, Audubon Society of Portland	B, W		
110	Saum Creek Greenway and Wetlands: Current student restoration efforts by Arbor School of Arts & Sciences of Tualatin, project entitled "Woods and Streams" which with the help of the students will restore 2.5 acres of deciduous/riparian forest and the associated Saum Creek Greenway. Macroinvertebrate and water quality sample area for SWRP (Student Watershed Research Project).	Mike Houck, Audubon Society of Portland	B, W		C
111	Bryant Woods Park and Canal Acres Parks. Important migratory corridor and Neotropical migratory songbird breeding habitat. Some VERY large diameter cottonwoods and Douglas-fir (Hennings 1999). See *Wild in the City, A Guide to Portland's Natural Areas*; and Lake Oswego Parks information.	Mike Houck, Audubon Society of Portland	B, W		M, C
112	Wilson Creek Watershed: See Three Rivers Land Conservancy data: "The Wilson Creek Natural Area is one of Three Rivers Land Conservancy's most exciting projects. The Conservancy has an opportunity to purchase 50 acres of land along the mainstem of Wilson Creek, a tributary of the lower Tualatin River located in unincorporated Clackamas County. Our vision for the Wilson Creek corridor is to protect a large enough acreage of high quality habitat to serve as an anchor for wildlife along the lower Tualatin River. We also envision linking this piece of land into a system of hiking trails open to the public." Important riparian, wetlands, bottomland forest.	Mike Houck, Audubon Society of Portland	B		C
114	Tryon Creek Watershed: See Metro Regional Parks and Greenspace target area information; *Wild in The City, A Guide to Portland's Natural Areas*; and Portland Bureau of Environmental Services watershed plan. Important riparian, bottomland hardwood forest, wetlands; excellent interior habitat for nesting area-sensitive species; critical connectivity for Neotropical migratory birds; several sensitive species sightings.	Mike Houck, Audubon Society of Portland	B, W		M, C
115	Riverview Cemetery: Important riparian and bottomland forest; excellent connectivity with Willamette River.	Mike Houck, Audubon Society of Portland	B		M
116	Elk Rock Island and Spring Park: See *Wild in the City, A Guide to Portland's Natural Areas.* Includes important mudflats for migratory and resident shorebird foraging.	Mike Houck, Audubon Society of Portland	B, W	I	M
117	Rock Island; important island/migratory habitat.	Mike Houck, Audubon Society of Portland	B, W	I	M
118	Mary S. Young Park and Cedar Island: See *Wild in the City, A Guide to Portland's Natural Areas.* Key connectivity to major river.	Mike Houck, Audubon Society of Portland	B	I	M
119	Goat Island: includes Great Blue Heron rookery.	Mike Houck, Audubon Society of Portland	B	I	M, S
120	Glenecho Marsh - important shrub-scrub riparian wetland complex.	Mike Houck, Audubon Society of Portland	B, W		
121	Clackamas River riparian area and greenway: Important connectivity corridor. Significant bottomland hardwood and wetlands, but connectivity and proximity to Clackamas River is a key function here. See Metro Greenspaces target area information.	Mike Houck, Audubon Society of Portland	B, W		C, M
123	Rock Creek (See Metro's Clackamas River Atlas). Critical connectivity to Clackamas River. Some bottomland forest and wetlands. Important movement corridor and migratory area.	Mike Houck, Audubon Society of Portland	B, W		C, M

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Habitats of Concern Master List

UNIQUE ID (UID)	HABITAT COMMENTS	SOURCE(S)	PRIORITY CONSERVATION HABITAT CODE*	RIVERINE ISLAND OR DELTA*	UNIQUE OR CRITICAL WILDLIFE FUNCTIONS*
124	Mt. Talbert mixed forest w/oak, some riparian. See Metro Regional Parks and Greenspaces target area information. See also UID #18.	Bob Altman, American Bird Conservancy; Lynn Sharp, URS; Mike Houck, Audubon Society of Portland.	O, B, W		M
126	Beggar's Tick Marsh: See *Wild in the City, A Guide to Portland's Natural Areas*	Mike Houck, Audubon Society of Portland	W		P, U
127	Tideman Johnson Park, Johnson Creek Riparian Area: see *Wild in the City, A Guide to Portland's Natural Areas.*	Mike Houck, Audubon Society of Portland	B, W		C, M
128	Reed College Canyon: Important Neotropical migratory bird habitat and migration area. Extensive wetlands with important upland connectivity. Education area. See *Wild in the City: A Guide to Portland's Natural Areas.*	Mike Houck, Audubon Society of Portland	B, W		M, C
129	Macadam Bay Club, Willamette Butterfly Park and Willamette Park: See *Wild in the City, A Guide to Portland's Natural Areas.*	Mike Houck, Audubon Society of Portland	B, W		M
130	Oaks Bottom Wildlife Refuge. Excellent wildlife area; heron rookeries. See *Wild in the City, A Guide to Portland's Natural Areas.*	Barb Grover, City of Portland; Mike Houck, Audubon Society of Portland.	B, W, O		
132	Ross Island complex: The only relatively natural island complex (Ross, Hardtack, East, and Toe) remaining in the Portland harbor. Its juxtaposition to Holgate Channel and Oaks Bottom Wildlife Refuge makes this an extremely valuable fish and wildlife resource in the central city. Sensitive species nest here regularly; Great Blue Heron colonies have had up to 55 nests here (recently the rookery relocated to East Island); Osprey nested here; river otter, beaver seen here as well. See *Wild in the City, A Guide to Portland's Natural Areas.*	Mike Houck, Audubon Society of Portland	B	I	M
133	Powell Butte Nature Park: Important bird migratory stopover habitat. Also important connectivity with highly ranked model patches to the south. See also UID #12 and *Wild in the City, A Guide to Portland's Natural Areas.* Nesting Lazuli Buntings and other relatively rare species.	Mike Houck, Audubon Society of Portland			M
134	Zenger Farms Wetlands: See *Wild in the City, A Guide to Portland's Natural Areas.*	Mike Houck, Audubon Society of Portland	W		
135	Brookside Wetlands: Active education area for grades 1-12, David Douglas HS and others; valuable breeding habitat for wetland-associated species; increases connectivity for migrating wildlife along Johnson Creek.	Mike Houck, Audubon Society of Portland	W		C, M
136	Grant Butte / Fairview Creek Wetlands: Grassy hilltop, wetlands, good habitat heterogeneity; important migratory stopover habitat, important to Neotropical migrants.	Mike Houck, Audubon Society of Portland	W		G, M
137	Johnson Creek Riparian Area: Excellent riparian wildlife habitat encompassing several tributaries and a good section of Johnson Creek.	Mike Houck, Audubon Society of Portland	B, W		C, M
139	Richardson Creek. Critical connectivity area to extensive habitats south of jurisdictional boundary. (Also very important headwaters area). Does contain some bottomland hardwood, but connectivity is key. Potential wildlife repopulation source when local extirpations occur. See Metro Clackamas River Atlas.	Mike Houck, Audubon Society of Portland	B		C, M
140	Noyer Creek - See Metro Clackamas River Atlas. Very important connectivity to North Fork Deep Creek. Important corridor for source of repopulation from large wildlife areas to the south of the Metro boundary, in the event that local extirpations occur.	Mike Houck, Audubon Society of Portland	B		
141	North Fork, Deep Creek. Provides vital connectivity to extensive natural areas outside of jurisdictional boundary. Some riparian and bottomland hardwood. Potential wildlife repopulation sources when extirpation occurs.	Mike Houck, Audubon Society of Portland	B		C, M
143	Beaver Creek; important connectivity and extremely valuable wildlife habitat.	Mike Houck, Audubon Society of Portland	B		C, M
145	Camassia Nature Preserve (The Nature Conservancy) and Wilderness Park (West Linn). Hennings 2001 has bird data, habitat information. Excellent and unique habitat including mixed oak woodlands, extensive "stands" of licorice fern (indicator of decaying dead wood), highly unusual site. Adjacency to a school makes it an excellent educational and recreational resource for the area's children.	Mike Houck, Audubon Society of Portland	O		P; U
148	Canemah Bluff: Oak-madrone; rocky outcrops important to herptiles and bats. Shares bird list with UID #149. See Metro Parks and Greenspaces data for their acquisition priorities.	Mike Houck, Audubon Society of Portland	O		U, M
149	Willamette Narrows Islands: Big Rock and Little Rock Islands: see Metro Regional Parks and Greenspaces information; see *Wild in the City, A Guide to Portland's Natural Areas*; The Nature Conservancy owns Little Rock Island.	Mike Houck, Audubon Society of Portland		I	M
150	Willamette Narrows Uplands - See Metro Regional Parks and Greenspaces information. Excellent mixed oak habitat with unusual wetland types, rocky outcrops, a wonderful bird list from Spring 2002 (Hennings). Critically important connectivity with the Willamette River.	Mike Houck, Audubon Society of Portland	O		M; U
152	Tonquin Wetland, Forest, Geologic Area. Wetlands, mixed hardwood with some native oak; unique geologic area, important to herptiles. Identified in Houck's 1984 Washington County Goal 5 inventory as highly significant. Habitat heterogeneity supports many wildlife species.	Mike Houck, Audubon Society of Portland; Jim Morgan, Metro	B, W, O		U
153	Coffee Creek (Seely Ditch) / Coffee Lake Corridor - good wildlife habitat and very important connector to Tualatin River National Wildlife Refuge. Important migratory corridor.	Mike Houck, Audubon Society of Portland; Jim Morgan, Metro	B, W		M, C
154	Chicken Creek / Tualatin River National Wildlife Refuge headwaters area. Important riparian, bottomland hardwood, wetlands; avian migratory corridor and important wildlife movement area.	Mike Houck, Audubon Society of Portland	B, W		M, C
155	Cedar Creek headwaters: Important complex of riparian tributaries, providing extensive connectivity, habitat and migratory pathways.	Mike Houck, Audubon Society of Portland	B, W		M
156	Rock Creek Corridor/Tualatin River National Wildlife Refuge: Identified as highly significant site on Mike Houck's 1984 Washington County Goal 5 inventory. Important wildlife migratory corridor.	Mike Houck, Audubon Society of Portland	B, W		M, C
161	Wetland: herbaceous/shrub-scrub wetland/riparian area important to wildlife.	Mike Houck, Audubon Society of Portland	W		
162	Oak palisades	Barb Grover, City of Portland	O		

DRAFT

Habitats of Concern Master List

UNIQUE ID (UID)	HABITAT COMMENTS	SOURCE(S)	PRIORITY CONSERVATION HABITAT CODE*	RIVERINE ISLAND OR DELTA*	UNIQUE OR CRITICAL WILDLIFE FUNCTIONS*
163	Wetland - important native plant community. NOTE: THIS SITE WAS SUBMITTED BUT APPEARS TO BE INADVERTENTLY LEFT OFF OF MAP - TO BE ADDED BACK ON. Location: 1S107BB01300 east of 185th, south of 184th Ct (deadends), north of Sandra, and Ewen Street runs north of the site from 185th around and near the east side of it in a semi-circle. Owned by Washington Co. Housing Authority. It is an old farm, with a very unique wetland-ash complex with very few invasives. It did not appear on the City's LWI inventory and is therefore not an adopted significant Goal 5 resource. Very small, total parcel is 1.42 acres and the wetland is approximately 1/4 of that. Confirmed via field work (V. Smith).	Veronica Smith, City of Beaverton	B, W		
164	Cottonwood bottomland hardwood	Jim Morgan, Metro	B		
165	Cottonwood/ash bottomland hardwood	Jim Morgan, Metro	B		
166	Oregon White Oak community	Jim Morgan, Metro	O		
167	Cottonwood bottomland hardwood	Jim Morgan, Metro	B		
168	Davids Windsor Park - herbaceous wetland, seasonal inundation is more extensive than that shown on Metro's inventory. Important wildlife area. This park is south of Scholls Ferry in the far "dip" of Beaverton city limits, north of Barrows Road. Most of the area is dense scrub-shrub and some forest, with an ephemeral stream in the north that becomes an intermittent stream towards the south. Good sensitive species habitat.	Julie Reilly, Tualatin Hills Park and Recreation District	W		

*Code descriptions: O = native oak; W = wetland; B = bottomland hardwood; I = riverine island; D = river delta area; M = important migratory stopover habitat; C = important connector or corridor; S = area critical to sensitive species life history (or Great Blue Heron rookery), on more than an incidental basis; E = important elk migratory corridor; G = grassy hilltop important to migrants and grassland-associated species; P = contains sensitive or unique plant populations; U = site with unique or critical wildlife functions.

Appendix 9

Technical description of Wildlife Habitat Assessment methodology.

Wildlife Habitat Assessment Narrative Sheet
Portland Metro Region

Observer Name(s): ____________________ **Date and time:** ____________________

Site ID: ______________ **Site Name:** ______________________________

1. Weather

Wind:__________ Precipitation: None Mist Lt rain Med rain Hard rain Other Snow

Percent cloud cover: 0% 33% 66% 100% Temperature: ________

2. Physical parameters

Site dimensions and acreage (calcutlate using GIS; attach map for each site):

General topography (flat, rolling, ravine, bluff, etc.): ______________________________

Table 1: Water features within the surveyed area (ponds, lakes, streams, wetlands, etc.; fill in table):

Type	Number, size or extent	Condition (describe)	Isolated or connected to stream? (wetlands)	Vegetation? (list)

Major structures, roads, playgrounds, parking lots, etc.:

____

____

____

3. Vegetation

Table 2: Vegetation type(s), dominant species in each vegetation layer (herbaceous, shrub, tree canopy), and approximate percentages of each habitat type (use Johnson and O'Neil's 2001 scheme):

Habitat Type	WATR	HWET	RWET	WLCH	WODF	WEGR	FIELD	AGPA	URBN
Approx. % cover									
Dominant herb species									
Dominant shrub species (< 5 m)									
Dominant canopy spp (> 5 m)									

Table 3: General estimate of percent tree and shrub cover:

% Cover	<5%	5-25%	26-50%	51-75%	76-100%
Herb					
Shrub					
Canopy					

Table 4: Snag abundance and size (relative to size of habitat patch):

General abundance	Absent	Low	Medium	High
Small dbh (< 10")				
Medium dbh (10-24")				
Large dbh (>24")				

Comment on general health and vitality of habitat. Is there new vegetative recruitment? Different aged trees? ______________________________

____

____

Flora: If there is a particular species of plant present that is sensitive or unique in some way, list it here. Include unusually significant findings such as large clumps of ninebark, red-osier dogwood, very large trees, etc. If Oregon White Oak or other species of interest is present but not dominant its presence and relative abundance should be documented. ______________________________

____

____

Rarity of habitat type: List the presence and extent of rare habitats such as oak/madrone, native grasslands (basically absent, but include non-reed canarygrass grasslands that look good), and bottomland hardwood forest (should be cottonwoods present).

____

____

____

4. Wildlife

Species observed (herps, fish, birds, mammals) or known to be present (include wildlife sign, such as rubs, scrapes, tracks and droppings, woodpecker sign, etc.): ______________________________

____

____

____

5. Human disturbance

List human uses and use by domestic animals:

____

____

List proximity to residential/developed areas, and type of nearby developments/land use (may be done from aerial photos in office if not visible in the field): ______________________________

____

Use aerial photos to assess interspersion with other natural areas (done in the office, not in the field).

6. Current restoration efforts and restoration potential:

Comment on evidence of restoration and enhancement efforts currently on the site (include notes on apparent success or failure):____

Comment on enhancement and/or maintenance that would improve habitat. Be sure to link this information closely to the "Enhanced Score" category on the scoring sheet.

Remove non-native plants: type__________________ prevalence __________________
Upland (non-streambank) plantings are needed (describe): ____________________________
Streambank plantings are needed (describe): ____________________________________
Slope stabilization:____
Trash or other cleanup (describe): ____
Other (describe): ____
Other (describe): ____

7. Additional comments:

General description of other habitat features (food sources, bird feeders, roosting, perching, nesting, etc.):

Other unique or outstanding features:____

Other notes and comments:____

8. Aerial photograph "to do's:"

Delineate the habitat surveyed (all sites)
Confirm or correct wetlands, if possible (use an encircled check - √; add new ones not on map)
Correct stream lines when possible
Mark significant patches of reed canarygrass, Himalayan blackberry, other invasives
Mark important rare habitat patches
Mark important single features (very large trees, etc.)
Label habitat types (Johnson and O'Neil scheme)
Label possible restoration sites (when not apparent from invasive delineations)

WILDLIFE HABITAT ASSESSMENT SCORING SHEET

Portland Metro Region

Observer(s): ______________ Date: ____________ Photos? No____ Yes____Roll & Exp#__________

Site ID: ________ Site name__________________________ Thomas Guide #______________

Directions to site entry and extent of area surveyed:_______________________________

____

____

	Component	Range of Values	Score Existing	Score Enhanced	Comments
WATER	Seasonality and Quantity	None 0 / Moderate 4 / Good 8			
WATER	Channel morphology, complexity, alteration	Poor 0 / Moderate 3 / Good 6			
WATER	Proximity to cover	None 0 / Near 4 / Adjacent 8			
WATER	Diversity (streams, ponds, wetlands)	Zero 0 / One 4 / Two 6 / Three+ 8			
FOOD	Variety	Low 0 / Medium 4 / High 8			
FOOD	Quantity	Low 0 / Medium 4 / High 8			
FOOD	Seasonality	Low 0 / Limited 4 / Yr-round 8			
COVER	Structural diversity	Low 0 / Medium 4 / High 8			
COVER	Variety and seasonality	Low 0 / Medium 4 / High 8			
COVER	Nesting and denning sites	Low 0 / Medium 2 / High 4			
HUMAN DISTURB.	Habitat modification, structures, etc.	High 0 / Medium 4 / Low 8			
HUMAN DISTURB.	Direct human disturb. (trails, road noise, pets)	High 0 / Medium 3 / Low 6			
UNIQUE FEATURES	Wildlife	Not diverse 0 / Somewhat 2 / Very 4			
UNIQUE FEATURES	Flora	Not unique 0 / Somewhat 2 / Very 4			Do not score in field.
UNIQUE FEATURES	Rarity of habitat type	Not rare 0 / Somewhat 3 / Very 4			Do not score in field.
IMPORTANT HABITAT FEATURES	Interspersion with other habitats	Low 0 / Medium 3 / High 6			Done in office using aerial photos. Do not score in field.
IMPORTANT HABITAT FEATURES	Downed wood, old stumps, snags	Low 0 / Medium 4 / High 8			
IMPORTANT HABITAT FEATURES	% nonnative herbs	100% 0 / 80% 1 / 50% 2 / 10% 3 / 0% 4			
IMPORTANT HABITAT FEATURES	% nonnative shrubs	100% 0 / 75% 1 / 50% 2 / 25% 3 / 10% 4 / 5% 5 / 0 6			
IMPORTANT HABITAT FEATURES	% nonnative canopy	>10% 0 / 5% 2 / 3% 3 / 0 6			
	TOTAL SCORE:		Existing	Enhanced	

METRO 2001
WILDLIFE HABITAT ASSESSMENT METHODOLOGY

The following Wildlife Habitat Assessment (WHA) data collection and numerical rating system is a modification of one that was originally developed for site-specific use in the City of Beaverton in 1983 as part of their statewide planning Goal 5 update (we define a "site" as a contiguous habitat patch surrounded by other land use types). The original methodology was designed by a technical advisory team consisting of staff from the City of Beaverton, Portland Audubon Society, U.S. Environmental Protection Agency, U.S. Army Corps of Engineers, U.S. Fish and Wildlife Service, Oregon Department of Fish and Wildlife, and the Wetlands Conservancy. Since that time, it has been used in Washington County, Gresham and in the entire Portland metropolitan region, including the Willamette Greenway, as well as Eugene and other areas statewide. Selecting a widely used protocol is advantageous because it potentially allows for comparison and repeatability of data over space and time. The methodology in its current form was modified based on input from Jennifer Thompson (U.S. Fish and Wildlife Service), Holly Michael (Oregon Department of Fish and Wildlife), and Tom McGuire (formerly City of Portland, currently with Adolfson and Associates) and Barb Grover (City of Portland). We thank them for their technical assistance.

Each time this methodology has been used, it has been slightly modified and refined to address the specific needs of local jurisdictions and the Oregon Department of Land, Conservation, and Development (DLCD). For example, Metro has added data columns for the presence of downed wood and nonnative plants, two major urban habitat issues; in addition, we have altered the Water Quality category to reflect channel and bank morphology and stability rather than basing it on water quality, which we are currently not equipped to measure in the field.

The WHA is inherently biased towards vegetative types with woody structure. This is one of the drawbacks of using a generalized methodology for assessing multiple habitat types – habitats that are potentially of great importance, such as native grasslands and oak-madrone, may receive low ratings due to natural lack of structural diversity. Yet many habitat specialists rely on these habitats. For this reason, Metro emphasizes the importance of delineating such rare, important habitats in a separate step during the planning process, rather than relying solely on a generalized methodology such as the WHA. This method is one tool among many that should be utilized in thoughtful wildlife habitat planning.

The following is a discussion of that methodology as it was applied by Metro in the Portland metropolitan region. The methodology involves identifying and evaluating parameters that make sites good or potentially good wildlife habitat areas. There are two parts to the methodology:

1. A narrative description of the site.
2. A numerical rating of various wildlife habitat parameters.

NARRATIVE DESCRIPTION
A narrative description of the site and survey conditions, including weather, topography, vegetation, wildlife habitat features, human use and habitat enhancement potential, are completed at each site using a standard inventory form (see attached form called *Wildlife Habitat Assessment Narrative Sheet*).

NUMERICAL RATING
The numerical rating system (see attached form called *Wildlife Habitat Assessment Scoring Sheet*) reviews each site in terms of its potential for wildlife. The system is based on the fact that all wildlife has three basic requirements for survival: food, water and cover.

Each site is to be evaluated in terms of relative quantity, quality, diversity and seasonality of the components that appear at the site. Also considered are human disturbance, the proximity to other aquatic and upland areas, unique or rare features, and wildlife, flora and habitat types. Note that the "Score Existing" and "Score Enhanced" refer to existing conditions versus the site's potential if successful restoration efforts were implemented; these potential restoration activities should be documented in the narrative description under "Restoration Potential."

This rating system was meant to assess the relative values of aquatic and upland habitats. It was not intended to provide a comprehensive analysis of each site. Information derived from the rating sheets should be used in tandem with the narrative descriptions. However, if performed during the same year by the same well-trained field crew, the WHA scoring methodology allows for general comparisons of wildlife habitat quality between a wide variety of habitat types. This consideration and time required in the field are the primary advantages of using a qualitative methodology such as the WHA over a quantitative one.

DESCRIPTION OF VARIABLES

Photos — List photo roll and exposure numbers, or whether digital camera was used (if digital camera used, first photo should identify site so as not to confuse exposures). If no photos are taken, state so.

Site ID — A space is provided for the observer to label each site with an individual identification number or code. These codes will be predetermined.

Site Name — Name of park(s), property owner, or address of site.

Thomas Guide — Map page and grid number so anyone can find their way to the site.

Directions — Directions to the site and entry point. Give directions from nearest major road. Indicate the boundaries of the extent of the site surveyed (you may mark this on the map if preferred).

The table on the Scoring Sheet consists of 20 components that are evaluated for each site. The 20 components are divided into six general categories:

1. Water
2. Food
3. Cover
4. Human disturbance
5. Unique features
6. Important habitat features

Consistency of scoring can only be accomplished through extensive group training at the same sites, in combination with periodic "calibration" sessions in which the group reassembles and ensures that scoring is consistent among individuals. In most cases, scoring should be based on the degree to which the site is in a natural vs. unnatural/disturbed condition and to account for variety of native habitat types and natural conditions.

Note that any whole number within the point range for each category may be used; for example, if the range of choices is 0, 4 or 8, an observer could assign any whole number between 0 and 8. This will help prevent the observer from having to make arbitrary judgment calls if a criterion appears to fall between categories.

Water

Four aspects of water characteristics on a site are included on the rating form: seasonality and quantity; channel morphology, complexity and alteration; proximity to cover; and diversity (e.g. ephemeral and perennial streams, ponds and wetlands). All of these factors play an important role in the site's significance to wildlife.

It is important to note that the relative value of these aspects compared to most other components (food, cover, human disturbance and unique features) was higher. The reason for this weighting of the relative value of the water component was that wetlands and riparian habitats are disproportionately important to wildlife. Therefore, it is possible that a site with good water resources but lesser values under other categories would rank higher than an upland site with better food and cover values.

Seasonality and quantity: This aspect refers to the amount of water available on site and its seasonality. Year-round water is extremely important to most wildlife species, particularly in an urban setting where habitat fragmentation may isolate habitat patches from other water sources. For example, this could include a perennial stream where there is evidence of associated ephemeral (seasonal) wetlands (indicated by vegetation) and/or dry side channels (indicating presence of ephemeral streams). Ephemeral streams and wetlands provide important habitat to fish and amphibians that is different from perennial sources. A site with a perennial stream but no evidence of other water sources such as those described above should receive a score of 6 or 7, weighted by the size of the stream and its relative importance to the patch. For example, if the habitat patch is very large but only has one small stream present, certain non-mobile groups such as amphibians would have a hard time getting to the stream from the outer edges of the patch, thus this site would receive a 6 instead of 7. A site with only seasonal or ephemeral sources would receive a 4. A site without any apparent water resources should receive a zero in this category.

Channel morphology, complexity, and alteration: Metro changed this criterion (formerly "quality") because we did not feel that stagnant or seasonally flushed water could accurately reflect water quality without more technical measurements. Furthermore, we were unlikely to be able to ascertain the flushing frequency of such water sources. Thus we selected a criterion that is particularly important to instream and other aquatic habitat because it reflects alterations in the hydrologic regime. However, we have weighted this criterion somewhat lower than the other three aquatic criteria because the simple presence of water is critically important to so many terrestrial species, and the WHA is generally geared towards terrestrial wildlife habitat.

Streams with altered hydrologic regimes are unable to support the same quantity and quality of instream wildlife. For example, urban streams often become "flashy" – that is, during a storm event water levels both rise and drop more quickly than in undisturbed conditions. This causes bank erosion and other effects, changing the channel form and composition of the substrate. One result is that aquatic invertebrate communities are typically simplified, presumably resulting in reduced food resources for both instream (fish and aquatic amphibians) and terrestrial vertebrates (birds, some small mammals, and terrestrial amphibians). Water quality is also typically lower in these sites due to sedimentation and toxins that enter the stream from impervious surfaces and storm drains. High-scoring sites should show little evidence of degradation; signs of stream degradation include channel incision and containment (i.e., not allowed to meander), evidence of erosion (rootlets, undercutting, toppling woody vegetation, bare soil) along the banks, and heavy sedimentation within the streambed. Other factors, such as oil sheen, sewerage smell, pipes and culverts, or excessive trash in and near the stream, may also downgrade this criterion. Healthy streams should contain a good supply of large wood.

Ponds and wetlands may also show evidence of human-induced alterations. For example, some constructed wetlands may not perform functions adequately imitating those found in natural wetlands, and some human-made ponds may be armored, dammed or otherwise altered. Levees and dikes are another form of modification. Some wetlands may appear to have been drained and/or filled. Such water resources are probably not as valuable to wildlife as "natural" ponds and wetlands, and should receive a somewhat lower score under this criterion. Other factors similar to those mentioned above (e.g., unstable banks, oil sheen, etc.) also generally apply to these water sources.

Proximity to cover: Wildlife will use water more if it is close to vegetative cover. This allows escape from predators and protection from weather extremes. The closer and more dense the cover, the more important the water source to many species. Dense cover immediately adjacent to a water source gave the site a value of 8, nearby cover a value of 4, and no cover a value of 0.

Diversity: A site with a mixture of wetland, stream and open pond or lake has higher wildlife value than a site with only one of these features. Lowest scores have no water present at the site (score = 0); sites with only one water source receive 4 points; sites with > 1 water source (two different types of streams [ephemeral and perennial], a stream and a pond, pond and wetland, etc.) receive a score of 8. Sites receiving the highest scores should have more than one type of water available, with at least one perennial (available year-round) source.

FOOD

Food is a basic requirement for any organism. Wildlife species cannot survive in one area for any appreciable period of time without food. The greater the variety and quantity of food, the greater the potential for serving the needs of more wildlife species. The three aspects included under food are variety, quantity, and seasonality. Metro altered these criteria slightly (formerly variety, quantity and seasonality, and proximity to cover) because most food resources *are* cover.

Variety: The variety of food on a site was rated from 8 (high) to 0 (low). We recognize that any intact food web includes plant matter, insects, and other animals; however, we focus here on plants because that is what can be readily assessed using this methodology. The presence of insects and other wildlife depends largely on water and plant resources, thus non-plant food resources are covered to some degree under other categories. A site with little or no "food plant" species – for example, a site dominated by reed canarygrass or Scot's broom - receives a score of zero, whereas a site with limited food such as one dominated by Himalayan blackberry receives a score of 2-4 (depending on whether it is a native species, which would score higher), and a site with several food species may receive a score of 4-8. Native flowering plants are also a food source, but should not count into the scoring as much as fruits, nuts and berries.

Quantity: This aspect measures the amount of food and its availability. Sites having large quantities of food available received a value of 8, and sites with little or no food available received a value of 0. To receive the maximum score, food plants should be primarily native. For example, sites limited primarily to blackberry patches could receive a score of 2, whereas similar quantities of a native source would receive a 3. Keep in mind the 3-dimensional nature of food availability.

Seasonality: This aspect measures the year-round availability of food. Sites which provide food year-round received a value of 8, and those sites providing limited food seasonally received a value of 4. Sites with food available in only one season received a score of 2. This has to do with the timing of fruiting or seed setting. For example, spring plants include Indian plum, salmonberry, ferns, fungi, and flowering plants (including maples). Summer plants include red-osier dogwood, salmonberry, thimbleberry, strawberry, Oregon ash, red alder, blackberries and cherries. Fall plants include salal, Oregon grape, hawthorn, rose hips, ocean spray, Douglas' spirea, blackberries, Oregon ash, red alder and oaks. Wintertime food sources might include hazelnut and other nuts, oak, snowberry, and conifers; highest scoring sites should include such food resources.

COVER

The aspects of cover included here (structural diversity, variety and seasonality, and nesting and denning sites) attempt to describe the physical environment of the site from a number of perspectives that are important to wildlife.

Structural Diversity: What is looked for in this category is the vertical stratification of the vegetation on a site. That is, is there only one layer of vegetative cover (e.g., lawn or one layer of shrub, such as Himalayan blackberry) or are there two, three or more layers. The most diverse structural system in our area would be multi-layered, with a ground layer of herbaceous vegetation (sedges, grasses, ferns, herbaceous plants, etc.), a second layer consisting of shrubs (Himalayan blackberry, snowberry, Oregon grape, etc.), perhaps another layer of taller shrubs (red or blue elderberry, Indian plum, red osier dogwood, vine-maple, ninebark), a short tree layer (Pacific or red-osier dogwood, hazelnut, saplings of taller species), and finally the tall canopy layer (Douglas-fir, Western hemlock, big-leaf maple, black cottonwood, Oregon ash, Oregon white oak, etc.). The highest scoring sites should have a range of age and size classes. The more layers present, the greater the surface area for feeding, traveling and breeding available to a wider diversity of wildlife species. In general, woody vegetation (tree and shrub cover) are more important than herbaceous cover in the types of habitat we are surveying. However, certain plants such as sword fern also provide invaluable cover to low-dwelling creatures. Values range from 8 for high structural diversity to 0 for low or no structural diversity.

Variety and seasonality: This reflects the variety and year-round availability of plants within each vegetative layer. Variety of cover is important from cover, feeding and reproductive standpoints. The greater the variety of cover, and the longer it is available to wildlife through the year (e.g., conifers and sword ferns provide better winter cover), the more important the habitat. For example, a forested wetland with a mixture of rushes, sedges, spirea and willows will be a much more important wildlife habitat area than a wetland with a monoculture of reed canary-grass. Variety values range from 8 for high variety to 0 for no or low variety. Reed canarygrass monocultures should receive a 1, mowed lawns a 0.

Nesting and denning sites: This criterion refers to structures such as snags, cavities, stumps, large downed wood, vegetative cover, clumps of mistletoe, large trees, logs, undercut banks, brush piles, root wads, bird and bat boxes, old unused buildings, and reptile/amphibian hybernacula such as rocky outcrops and rock piles. Sites with a variety of nesting and denning sites may receive up to four points.

The third part of the form includes values in addition to food, water and cover. The components examined include human disturbance, unique features and important habitat features.

HUMAN DISTURBANCE

Disturbance is examined from two perspectives – modifications to the physical habitat and actual on- or near-site audible or visible disturbances. The previous (non-Metro) version dealt more with natural disturbances; while we recognize that natural disturbances are very important agents of influence on wildlife communities, the natural disturbance regime in urban areas (e.g. fire, landslides, flooding) is often suppressed or highly modified by human activities. In addition, it is a judgment call as to whether such natural disturbances are beneficial or detrimental to wildlife. Thus Metro altered these criteria to clarify their meaning and reflect more human-related disturbances, and also increased their range of values to reflect the importance of human disturbance to wildlife and habitat in the urban setting. When scoring these and other criteria, keep in mind the extent of disturbance relative to habitat patch size.

Habitat modification, structures, etc: This category was used to assign a higher value to those sites with little physical modification and to reflect the fact that the removal or disturbance of physical components (food, water, cover) is detrimental to wildlife. The presence of structures, human trails, roads and paved areas, houses, playgrounds, sewer and stormwater manholes, outfalls or pipes, homeless camps, trash piles, etc. alter natural habitat. Significantly modified habitats such as lawns also fall within this category. Houses and buildings intrude light into habitats at night and are also usually sources of further disturbances. Some species seem to be human-avoiders; for example, larger habitat patches with no roads, trails, etc. in the patch's interior may provide very important "interior habitat" for some disturbance-sensitive species such as Neotropical migratory songbirds. In general, the more physical alterations to a habitat patch, the more altered the wildlife community is likely to become. For example, a moderately wide habitat patch (75-100 m) with some lawn and houses adjacent to the patch but some ($\geq$ 25%) intact natural forest and/or other natural habitats, might receive a 4. A large patch with a major trail or several minor trails, but little other disturbance, would receive a 5 or 6, whereas a smaller patch with the same amount of trails and disturbance might receive from 2-4, depending on the amount of disturbance relative to the habitat patch size.

<u>Direct human disturbance (people on trails and elsewhere, voices, road noise, pets, etc):</u> Even if an area is highly disturbed from a physical perspective, it may receive little human use. Human and human-related (domestic animal) disturbances can be very detrimental to wildlife. This criterion deals specifically with humans (on foot or in vehicles) and their pets, and refers to human-associated disturbances that can be directly seen, heard, or otherwise detected. Examples include road noise, voices, music, construction and industrial noise, lawnmowers, dogs barking, or humans, dogs or cats seen. It is recognized that time and date will influence this criterion; for example, a park visited on the weekend or after school hours may have more humans and pets around. However, that is something we cannot address here without more time and money, thus we can only estimate these influences based on what we see and hear. To compensate for this flaw we assigned a somewhat lower range of scores for this criterion (0-6 rather than 0-8 for the Physical Disturbance category). A site with multiple human (or pet) related disturbances such as road noise, barking, presence of or sounds from humans (voices, chainsaws, music, etc.) receives a low score, whereas a site where none of these influences are heard or seen receives a 6.

WILDLIFE

Because this is a qualitative rather than quantitative survey method, there are some problems with this criterion, such as: differences in observer expertise, differences in wildlife detectability due to weather, changes in wildlife communities over seasons, and non-standardized amounts of time spent at various sites. As a result, Metro does not at this time intend to use the resulting criterion score in the final analysis phase. However, we would still like your professional opinion of each site's score.

Note that Metro has altered this component, which previously relied specifically on the presence of so-called "sensitive species" (those that are identified through an at-risk categorization in state or federal lists). If sensitive species were used, then sites with none detected but with very good habitat would be effectively downgraded, and that is not our intent here. In addition, in-depth searches would need to be conducted in order to locate and identify any of the large number of sensitive species that could be found in the urban region, and that is beyond the scope of this project. Another means of estimating sensitive species presence is to use the Oregon Natural Heritage Program (ONHP) data, but that is too coarse-grained for our use at this time. However, scores based on ONHP data (as well as any sensitive species actually detected onsite) could be added in the office at a later date as the data improves. Thus Metro has altered this score to more reflect wildlife diversity, and relative rarity *in the urban region.* Metro also moved two subcategories, flora and unique habitat types, to the narrative description, because (1) we are not scoring these subcategories and (2) a better written description of unique and valuable features can be made.

<u>Wildlife:</u> Many sites in the urban region will not receive the highest possible score in this category, reflecting the general depletion of certain large mammals and loss of habitat specialists, as well as habitat loss and alteration. For wildlife, the highest-scoring sites might have large mammals such as elk, bear, cougar, bobcat, etc. present, and this is likely only in sites such as Forest Park or perhaps Oxbow (and would be hard to document with our level of effort). Alternatively, a site with a diverse array of native wildlife species such as beaver, muskrat, otter, Neotropical migratory songbirds, and other species may receive the highest score. The presence or signs of presence of any "Sensitive Species" (see Metro's species list) would automatically bump a site up to the highest score in this category. Bald Eagles provide one example.

Known habitat specialists or animals that are relatively rare in the urban region, such as presence or sign of Pileated or Hairy Woodpeckers, oak specialists such as White-breasted Nuthatch, Acorn Woodpeckers, Western gray squirrel (also a sensitive species), unusual reptiles, mammals or amphibians, or what appears to be a very good mix of native wildlife species could increase the score in this category up to the maximum even if no sensitive species were found to be present. If only common wildlife were apparent except for Pileated Woodpecker sign, the site should receive a 1 or 2. A site with high abundance of nonnative species such as European Starlings but few other species beyond the commonplace should receive a 0. Presence of a heron rookery would increase a site's score to 4 because of its importance to a large number of water-dependent birds. Bats are of particular interest in the urban setting, thus bridges and structures should be quickly checked for crevices ≥ ½".

IMPORTANT HABITAT FEATURES

Interspersion with other habitats: Habitats are important to one another in the sense that a number of different habitat types and habitat patches adjacent to one another can provide an overall diversity of vegetative cover, food, and often water, as well as the potential for wildlife to move between patches. Therefore, an isolated site surrounded by pavement, buildings, bare ground, etc. would receive a lower interspersion value than if the site were surrounded by other habitat types, such as wetlands (emergent, forested, shrub), upland forests, shrubby areas or meadows. Sites receiving the highest scores would have other habitat patches nearby, and some of those habitat patches would be different habitat types than the site. The interspersion ranges from 6 for high interspersion to 0 for low interspersion.

Downed wood, old stumps and snags: The scientific literature indicates that downed wood is a fundamentally important habitat element for terrestrial insects, amphibians and small mammals. Downed wood also provides critical refugia for instream wildlife (addressed in "Channel morphology"), and ultimately derives from terrestrial sources. Snags are included here because they are future sources of downed wood, therefore indicate the continued presence of downed wood over time. Although there is some overlap with the "Nesting and denning sites" category within Cover, the importance of large downed wood justifies snag inclusion here. Sites with little or no downed wood, old stumps or snags receive a score of 0, sites with a moderate amount of such features receive a 4, and sites with relatively high amounts of woody sources receive an 8.

Percent nonnative plants: Nonnative insects, birds and other animals are generally associated with nonnative plants, whereas native animals generally prefer native plants. Nonnative organisms are a major threat to biological diversity, particularly in urban ecosystems. Edge habitats tend to contain more nonnative plants than interior habitats, thus it is important to mentally average the overall percent nonnative cover across edge and interior habitats. Nonnative plants could also have been included in the Habitat Modification criterion under Human Disturbance; we chose to place nonnatives under Important Habitat Features because they have the potential to influence several other categories (e.g., food, cover, unique features).

We have assigned different scores to each vegetation layer, recognizing that all layers are important, but some more so than others. The herb layer, with short generation times, is usually the first to "go nonnative," and is not as important to wildlife in general as the shrub layer. The shrub and canopy layers provide critical nesting habitat, cover, and food to native insects, birds and other wildlife in our region, thus these two layers are assigned greater potential point values than the herb layer. For each layer, the lowest score reflects a strong nonnative component (e.g., ≥ 25% overall nonnative), whereas the highest score reflects primarily native plant cover (e.g., >95% natives).

TOTAL SCORE

This can be done in the office. Each site received a total score by adding up the points on the WHA Scoring Sheet.

Appendix 10

Information on HUCs, including definitions and HUC standards.

Description of context and role of hydrologic units

Hydrologic unit boundaries, for the most part, define the areal extent of surface water drainage to a point. During the late 1970's the Natural Resources Conservation Service (NRCS), formerly the Soil Conservation Service, initiated a national program to further subdivide HUC's into smaller watersheds for water resources planning. A 3-digit extension was added to the 8-digit I.D. By the early 1980's this 11-digit HU mapping was completed for most of the U.S. By the late 1980's and early 1990's the advent of GIS made the mapping of digital HU boundaries feasible. A national standard (NI-170-304-superceeded by National Interagency Guidelines) established procedures and specifications for delineating and mapping hydrologic units (HU's). These guidelines help ensure accurate and consistent HU boundaries nationwide and the digital database is usable with other natural resource digital data layers in a GIS.

The goal of this initiative is to provide a hydrologically correct, seamless and consistent national Geographic Information System (GIS) database at a scale of 1:24,000, that has been extensively reviewed and matches the USGS topographical 7.5 minute quads. The new levels are called watershed (5th level, 10-digit) and subwatershed (6th level, 12-digit). The watershed level is typically 40,000 to 250,000 acres and subwatershed level is typically 10,000 to 40,000 acres with some as small as 3,000 acres.

Useful Definitions:

Basin:

The third level (6-digit) of the hydrologic unit hierarchy. Basins are nested within or are sometimes equivalent to sub-regions. Basins were formerly named "accounting units."

Hydrologic Unit Code Definition:

The numerical identifier of a specific hydrologic unit consisting of a 2 digit sequence for each specific level within the delineation hierarchy.

Hydrologic Unit Definition:

A hydrologic unit is a drainage area delineated to nest in a multi-level, hierarchical drainage system. Its boundaries are defined by hydrographic and topographic criteria that delineates an area of land upstream from a specific point on a river, stream or similar surface waters. A hydrologic unit can accept surface water directly from upstream drainage areas, and indirectly from associated surface areas such as remnant, non-contributing and diversions to form a drainage area with single or multiple outlet points. Hydrologic units are only synonymous with classic watershed when their boundaries include all the source area contributing surface water to a single defined outlet point.

Sub-basin:

Subdivisions of basins. The sub-basin is the fourth level (8-digit) of the hydrologic unit hierarchy. Sub-basins were formerly named "cataloging unit". The average size is about 450,000 acres.

Subwatershed:

Subdivisions within watersheds. Subwatershed is the sixth level (12-digit) in the hydrologic unit hierarchy. Subwatersheds generally range in size from 10,000 to 40,000 acres.

Watershed:

Subdivisions within a sub-basin. The 5th level (10-digit) in the hydrologic unit hierarchy. Watersheds range in size from 40,000 to 250,000 acres.

(Definition Sources: National Resource Conservation Service)
(Sub-basin data source: U.S. Forest Service, Northwest Ecosystem Office)

Outline of Ecotrust Work

Using the Federal Standards for Delineation of Hydrologic Unit Boundaries, Ecotrust developed an interactive program to deliniate 6th and 7th field HUC boundaries within the Metropolitan Region. The mapping deliniation is done by using ArcInfo GIS incorporating DEM's, DRG's, and a variety of internal METRO geospatial data. The deliniation program first determines the boundaries of a HUC by analyzing hydrographic and topographic features that delineates an area of land upstream from a specific point on a river, stream or similar surface waters. The program initially determines these points and then creates the boundaries automatically (using the criteria from the national standards). It allows the user to accept the boundaries or interactively edit the boundaries. It is important to note that the hydrologic units are only synonymous with classic watershed when their boundaries include all the source area contributing surface water to a single defined outlet point.

Outline of Final Products and Future Steps

From the work done by Ecotrust, we have a set of 6th field HUC boundaries that we used for analysis within our resouce inventory summaries. The 6th field HUCS were delineated and named according to the NRCS standards. These sub-watersheds fit within the 5th field HUCs developed by the Regional Ecosystem office of the US Forest Service. These in turn fit within the 4th field HUCS developed by the NRCS.

In addition, we also have a set of 7th field HUCS from the work done by Ecotrust. These may require some editing prior to their use for analysis purposes.

Additional future work may include comparison of our 6th and 7th field HUCS with the 6th and 7th field HUCS currently under development at the Regional Water Resources Office of the USGS in Portland, Oregon.

Maps

1. Color map of labeled sub-basin (4th field HUCs) within METRO boundary.
2. Color map of 5th and 6th field HUCs within METRO boundary.

USDA

United States Department of Agriculture

Natural Resources Conservation Service

National 5th and 6th Level Hydrologic Unit Database

Draft Interagency National Guideline and State Coordinators

Federal Standards for Delineation of Hydrologic Unit Boundaries - 12/6/01 (MSWord Document) Latest Official Version

HU State Coordinators

Overview

Hydrologic unit boundaries define the areal extent of surface water drainage to a point. The goal of this initiative is to provide a hydrologically correct, seamless and consistent national Geographic Information System (GIS) database at a scale of 1:24,000, that has been extensively reviewed and matches the USGS topographical 7.5 minute quads. The new levels are called **watershed (5th level, 10-digit)**and **subwatershed (6th level, 12-digit)**. The watershed level is typically 40,000 to 250,000 acres and subwatershed level is typically 10,000 to 40,000 acres with some as small as 3,000 acres. An estimated 22,000 watersheds and 160,000 subwatersheds will be mapped to the 5th and 6th level. The GIS coverages will be available by the Internet to any person, including federal, state, local government agencies, researchers, private companies, utilities, environmental groups, and concerned citizens. The database will assist in planning and describing water use and related land use activities.

During the 1970's the US Geological Survey (USGS) developed a hierarchical hydrologic unit code (HUC) for the United States. This system divides the country into 21 Regions, 222 Subregions, 352 Accounting Units, and 2,149 Cataloging units based on surface hydrologic features. The smallest USGS unit (8-digit HUC) is approximately 448,000 acres. During the late 1970's the Natural Resources Conservation Service (NRCS), formerly the Soil Conservation Service, initiated a national program to further subdivide HUC's into smaller watersheds for water resources planning. A 3-digit extension was added to the 8-digit I.D. By the early 1980's this 11-digit HU mapping was completed for most of the U.S. During the 1980's several NRCS state offices starting mapping watersheds into subwatersheds by adding 2 or 3-digits to the 11-digit HUC. By the late 1980's and early 1990's the advent of GIS made the mapping of digital HU boundaries feasible. At this time, the NRCS decided to delineate and map the entire U.S. to the 11 and 14-digit level.

The mapping would be done by the use of GIS incorporating DEM's, DRG's, and a variety of geospatial data and techniques. A national standard (NI-170-304-superceeded by National Interagency Guidelines) established procedures and specifications for delineating and mapping hydrologic units (HU's). These guidelines help ensure accurate and consistent HU boundaries nationwide and the digital database is usable with other natural resource digital data layers in a GIS. The national standard was issued in 1992; since then, it has continued to be updated. The 1995 version is available as NI 170-304 along with a summary of updates made since June 1995. This effort to delineate and digitize the HU's is coordinated by each NRCS state office in coordination with other federal, state, and local agencies, and others interested in the effort. NCGC is providing coordination, verification, and certification (Power Point Slides) of state datasets, as well as integrating the state coverages into one national HU dataset. A list of state contacts for the effort is available.

Over the last several years many federal and state agencies have realized current 8-digit hydrologic unit (HU) maps are unsatisfactory for many purposes, because of inadequate bases or scales. Because of this, the NRCS has continued to work with other federal and state agencies and with the Subcommittee on Spatial Water Data Federal Geographic Data Committee (FGDC) to establish a Federal interagency standard covering mapping and delineation of hydrologic units that would be suitable for all agencies. In cooperation with the FGDC and the Advisory Committee on Water Information (ACWI), a new interagency guideline has been written. During December of 2000, this document was presented to the FGDC for their review. **This document has superseded NI 170-304 as the official standard for delineation of 5th and 6th level hydrologic units.** Over the last couple of years, a series of workshops have been held to promote this interagency effort and to resolve subwatershed delineation issues.

HU Users and Applications

RLIS
REGIONAL LAND INFORMATION SYSTEM

Regional Hydrologic Unit Sub-Basins

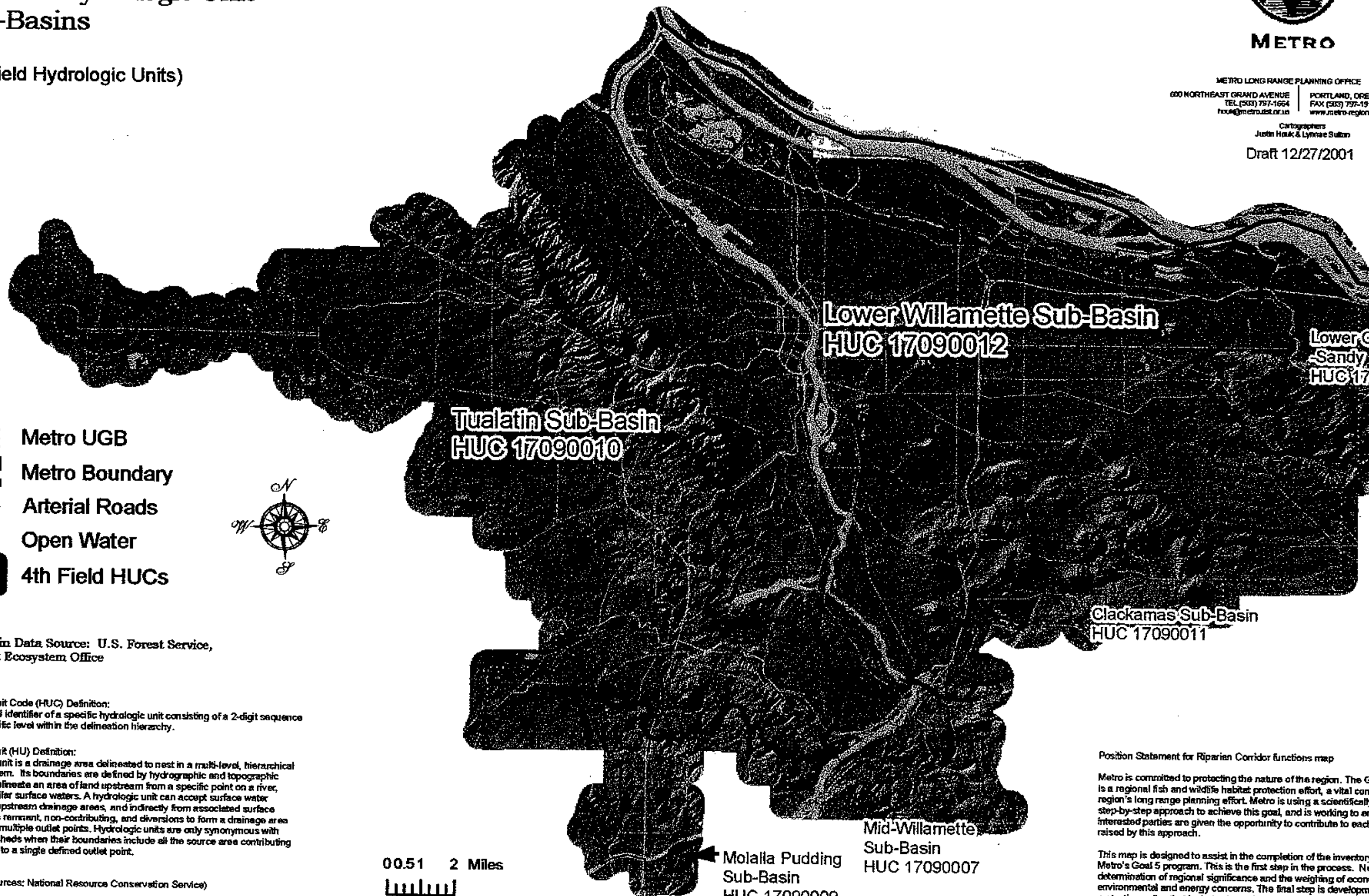
(4th Field Hydrologic Units)

METRO

METRO LONG RANGE PLANNING OFFICE
600 NORTHEAST GRAND AVENUE | PORTLAND, OREGON 97232-2736
TEL (503) 797-1664 | FAX (503) 797-1911
houk@metro.dst.or.us | www.metro-region.org

Cartographers
Justin Houk & Lynnae Sutton

Draft 12/27/2001



- Metro UGB
- Metro Boundary
- Arterial Roads
- Open Water
- 4th Field HUCs

Sub - Basin Data Source: U.S. Forest Service, Northwest Ecosystem Office

Hydrologic Unit Code (HUC) Definition:
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Hydrologic Unit (HU) Definition:
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(Definition Sources: National Resource Conservation Service)

Position Statement for Riparian Corridor functions map

Metro is committed to protecting the nature of the region. The Goal 5 program is a regional fish and wildlife habitat protection effort, a vital component of the region's long range planning effort. Metro is using a scientifically-based, step-by-step approach to achieve this goal, and is working to ensure that all interested parties are given the opportunity to contribute to each policy decision raised by this approach.

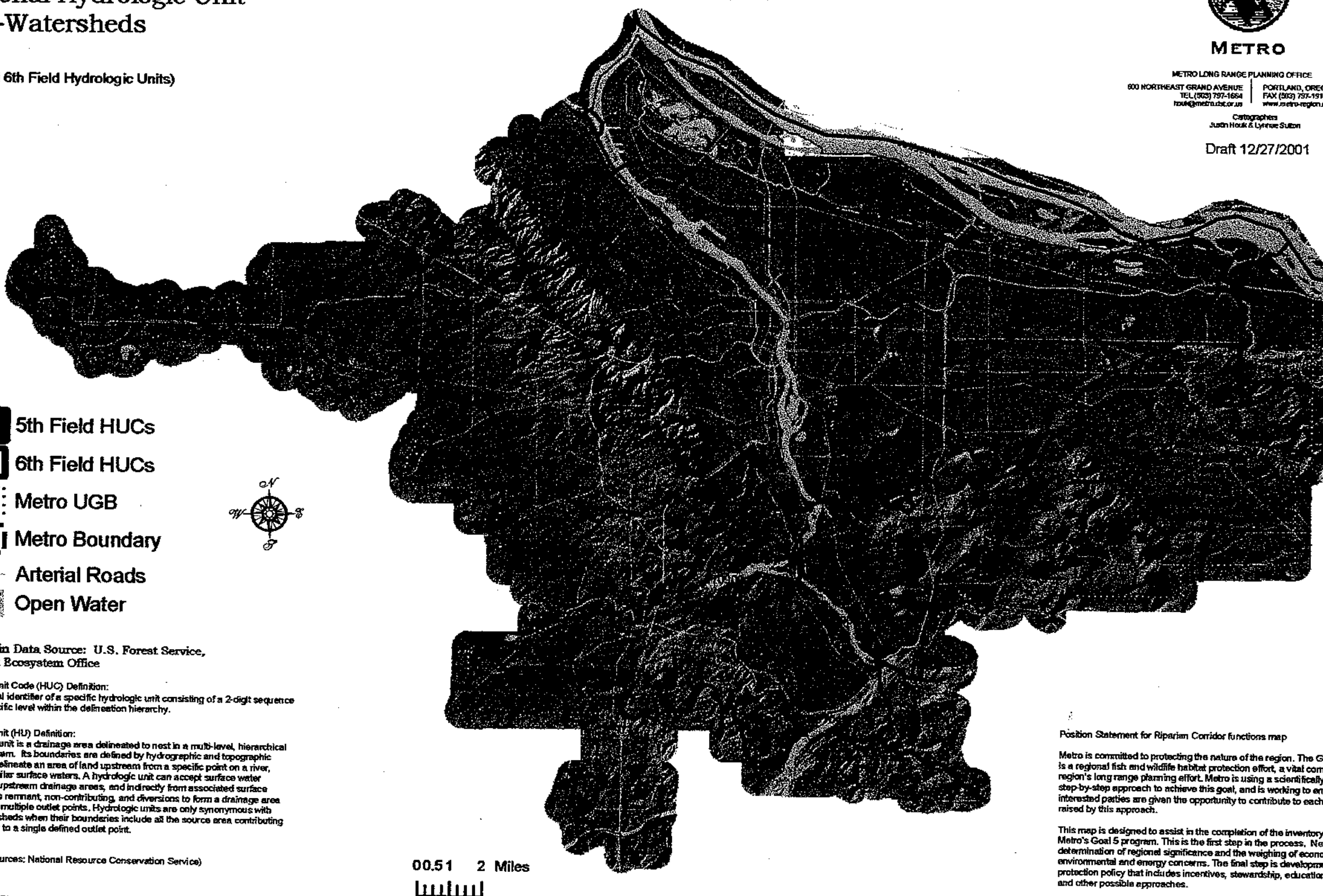
This map is designed to assist in the completion of the inventory phase of the Metro's Goal 5 program. This is the first step in the process. Next will be the determination of regional significance and the weighing of economic, social, environmental and energy concerns. The final step is development of a protection policy that includes incentives, stewardship, education, regulation and other possible approaches.

C:\111data\111gisworkspace\mxd\8X11-Basin-122001-4thbasins2.mxd

REGIONAL LAND INFORMATION SYSTEM

Regional Hydrologic Unit Sub-Watersheds

(5th and 6th Field Hydrologic Units)



5th Field HUCs
6th Field HUCs
Metro UGB
Metro Boundary
Arterial Roads
Open Water

Sub - Basin Data Source: U.S. Forest Service, Northwest Ecosystem Office

Hydrologic Unit Code (HUC) Definition:
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(Definition Sources: National Resource Conservation Service)

METRO

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Cartographers
Justin Houk & Lynnae Sutton

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NRCS HU Power Point

State URLs and Technical Information (MSWord Document)

HU_QA_QC_Review_Checklist (MSWord Document)

HU 5th and 6th Level Fact Sheet (MSWord Document)

Geospatial Data and aml's for HU Delineation

- Geospatial Data Gateway (Provides one-stop shopping for natural resources or environmental data anytime, from anywhere, to anyone.)
- huclevel.aml (An ArcEdit aml which will assign proper huc_level attributes to every arc in a coverage)
- huc_levelqc.aml (An ArcEdit aml which will check proper hu_level attribute values)
- within.ave (ArcView Avenue script from Bureau of Land Management for HU delineation)
- Reo_ws1.avx (ArcView extension from Bureau of Land Management for HU delineation)
- dshuccalc.aml (An ArcEdit aml which calculates the downstream 10-digit HU from the dslist)
- dslist.aml (An ArcEdit aml which writes a 10-digit HU downstream list)
- huc_codesqc.aml (An ArcEdit aml that verifies the HUC_8, HUC_10, and HUC_12 codes against each other)

National Geospatial Links

- National Hydrography Dataset (NHD)
- National Elevation Dataset (NED)
- National Elevation Dataset-Hydrologic Derivatives (NED-H)
- Geographic Names Information System (GNIS)

Summaries and Power Point Presentations from the Year 2000 Workshops

- HU USFS
- HUC NOAA
- Western States Summary
- Mid-Atlantic States Summary
- North Central States Summary
- Arizona HU Delineation Techniques
- Watershed Boundary Dataset Pilot Project Overview

FGDC Metadata Links

- HU FGDC Metadata Template
- http://www.sdvc.uwyo.edu/clearinghouse/metainfo.html
- http://geology.usgs.gov/tools/metadata/tools/doc/ctc/

Subwatershed, 6th Level:
Hydrologic Unit Boundary Status by State
Hydrologic Unit Boundary Data - Subwatershed Status by 8-digit HUDatabase Access
U.S. Virgin Islands and Puerto Rico
Alaska
Hawaii

For Hydrologic Unit Information, contact Kenny Legleiter: klegleit@ftw.nrcs.usda.gov

http://www.ftw.nrcs.usda.gov/huc_data.html

Appendix 11

Bibliographies on water quality reports.

USGS REPORTS (*indicates digital copy, **indicates hard copy, ***indicates online copy, <no digital abstract) See: http://oregon.usgs.gov/pubs_dir/online_list.html

1- Columbia/Lower Willamette
2- Tualatin
3- Clackamas
4- Sandy
5- Willamette Basin (1-4)
6- Statewide

TOX - TOXICS
WQ - WATER QUALITY
HAB - HABITAT
HYDO - HYDROLOGY

1, TOX, *WRIR 99-4051. Investigation of the Distribution of Organochlorine and Polycyclic Aromatic Hydrocarbon Compounds in the Lower Columbia River Using Semipermeable-Membrane Devices, by Kathleen A. McCarthy and Robert W. Gale.

1, WQ, * WRIR 95-4294. Water Quality of the Lower Columbia River Basin: Analysis of Current and Historical Water-Quality Data through 1994, by G.J. Fuhrer, D.Q. Tanner, J.L. Morace, S.W. McKenzie, K.A. Skach

1, WQ, *WRIR 95-4196. Sediment Oxygen Demand in the Lower Willamette River, Oregon, 1994, by James M. Caldwell and Micelis C. Doyle.

1, WQ, *WRIR 96-662a. Total Dissolved Gas, Barometric Pressure, and Water Temperature Data, Lower Columbia River, Oregon and Washington, 1996, by Dwight Q. Tanner, Howard E. Harrison, and Stuart W. McKenzie.

2, HYDRO, **, < OFR 96-173. Water-quality, streamflow, and meteorological data for the Tualatin River Basin, Oregon, 1991-1993, by M.C. Doyle and J.M. Caldwell. 1996.

2, TOX, **, *WRIR 99-4107. Selected Elements and Organic Chemicals in Bed Sediment and Fish Tissue of the Tualatin River Basin, Oregon, 1992-96, by Bernadine A. Bonn.

2, TOX, WQ, **, *WRIR 00-4062. Phosphorus and E. coli in the Fanno and Bronson Creek subbasins of the Tualatin River Basin, Oregon, during summer low-flow conditions, 1996 by Kathleen A.

2, WQ, **, ***WRIR 97-4103. Sediment Oxygen Demand in the Tualatin River Basin, Oregon, 1992-96, by Stewart A. Rounds and Micelis C. Doyle.

2, WQ, **, *WRIR 01-4041. Modeling Water Quality in the Tualatin River, Oregon, 1991-1997, by Stewart A. Rounds and Tamara M. Wood.

2, WQ, **, *WRIR 97-4071. Relations of Tualatin River Water Temperatures to Natural and Human-Caused Factors, by John C. Risley.

2, WQ, *WRIR 00-4071. Effects of Hypothetical Management Scenarios on Simulated Water Temperatures in the Tualatin River, Oregon, 1998, by John C. Risley.

2, WQ, HYDRO, **, *OFR 96-315. Water-Temperature, Specific-Conductance, and Meteorological Data for the Tualatin River Basin, Oregon, 1994-95, by John C. Risley and Micelis C. Doyle

5, HAB, *WRIR 97-4023. Summary of Information on Aquatic Biota and their Habitats in the Willamette Basin, Oregon, Through 1995, by Bob Altman, Colleen M. Henson, and Ian R. Waite.

5, HYDRO, **, *WRIR 95-4078. Stream velocity and dispersion characteristics determined by dye-trace studies on selected stream reaches in the Willamette River Basin, Oregon, by Karl K. Lee.

5, HYDRO, **, *WRIR 95-4284. Precipitation-Runoff and Streamflow-Routing Models for the Willamette River Basin, Oregon, by Antonius Laenen and John C. Risley.

5, HYDRO, **, *WRIR 97-4082-A. Environmental Setting of the Willamette Basin, Oregon, by Mark A. Uhrich and Dennis A. Wentz.
5, HYDRO, *WRIR 96-4111. Ground-Water Pumpage in the Willamette Lowland Regional Aquifer System, Oregon and Washington, 1990 by Charles A. Collins and Tyson M. Broad.

5, TOX, **, *WRIR 97-4082-D. Dioxins and furans in bed sediment and fish tissue of the Willamette Basin, Oregon, 1992-95, by Bernadine A. Bonn.

5, TOX, **, *WRIR 97-4268. Distribution of Dissolved Pesticides and Other Water Quality Constituents in Small Streams, and their Relation to Land Use, in the Willamette River Basin, Oregon, 1996, by Chauncey W. Anderson, Tamara M. Wood, and Jennifer L. Morace.

5, TOX, **, *WRIR 98-4205. Arsenic in Ground Water of the Willamette Basin, Oregon, by Stephen R. Hinkle and Danial J. Polette.

5, TOX, **,*WRIR 96-4234. Occurrence of Selected Trace Elements and Organic Compounds and Their Relation to Land Use in The Willamette River Basin, Oregon, 1992-94, by Chauncey W. Anderson, Frank A. Rinella, and Stewart A. Rounds.

5, TOX, *WRIR 01-4065. Herbicide Use in the Management of Roadside Vegetation, Western Oregon, 1999-2000: Effects on the Water Quality of Nearby Streams by Tamara M. Wood.

5, WQ, **, *WRIR 97-4082-C. Seasonal and Spatial Variability of Nutrients and Pesticides in Streams of the Willamette Basin, Oregon, 1993-95, by Frank A. Rinella and Mary L. Janet.

5, WQ, **, *WRIR 99-4036. Ground-Water and Water-Chemistry Data for the Williamette Basin, Oregon by Leonard L. Orzol, Karl C. Wozniak, Tiffany R. Meissner, and Douglas B. Lee.

5, WQ, *CIRC 1161. Water quality in the Willamette Basin, Oregon, 1991-95, by Dennis A. Wentz, Bernadine A. Bonn, Kurt D. Carpenter, Stephen R. Hinkle, Mary L. Janet, Frank A. Rinella, Mark A. Uhrich, Ian R. Waite, Antonius Laenen, and Kenneth E. Bencala.

5, WQ, *WRIR 97-4082-B. Quality of Shallow Ground Water in Alluvial Aquifers of the Willamette Basin, Oregon, 1993-95, by Stephen R. Hinkle.

5, WQ, TOX, **, * OFR 95-373 Analytical data from Phases I and II of the Willamette River Basin Water Quality Study, Oregon, 1992-94, by Howard E. Harrison, Chauncey W. Anderson, Frank A. Rinella, Timothy M. Gasser, and Ted R. Pogue, Jr.

6, HYDRO, ***WSP 2425. Oregon Wetland Resources, by Luther C. Kjelstrom and John S. Williams. Oregon chapter in U.S.Geological Survey, National water summary on wetland resources.

6, HYDRO, **, < OR-00-1. Water Resources Data Oregon, Water Year 2000. U.S. Department of the Interior, U.S. Geological Survey. 2000.
McCarthy.

DEQ REPORTS (*indicates digital copy, **indicates hard copy, ***indicates online copy) See http://www.deq.state.or.us/wq/

1- Columbia/Lower Willamette
2- Tualatin
3- Clackamas
4- Sandy
5- Willamette Basin
6- Statewide

TOX - TOXICS
WQ - WATER QUALITY
HAB – HABITAT / LAND QUALITY
HYDO - HYDROLOGY

1, TOX, **Oregon Department of Environmental Quality (DEQ). 1999. *Portland Harbor Sediment Management Plan- Table of Contents.* DEQ: Portland, Oregon. URL: www.deq.state.or.us/nwr/portlandharbor/phsmp/contents.htm. Downloaded: 10/25/01.

1, TOX, **Oregon Department of Environmental Quality (DEQ). 1999. *Portland Harbor Sediment Management Plan- APPENDIX F, Site Discovery Results to Date.* DEQ: Portland, Oregon. URL: www.deq.state.or.us/nwr/portlandharbor/phsmp/. Downloaded: 10/25/01.

1,2,3,4 WQ, *DEQ. 2001. *Total Maximum Daily Load Documents.* DEQ: Portland, Oregon. URL: http://www.deq.state.or.us/wq/TMDLs/TMDLs.htm Downloaded: 10/29/01.

1,2,3,4, WQ, **Cude, Curtis. 2001. *Oregon Water Quality Index Report for Lower Willamette, Sandy and Lower Columbia Basins, Water Years 1986-1995.* DEQ: Portland, Oregon. URL: http://www.deq.state.or.us/lab/wqm/wqi/lowwill/lowilly5.htm. Downloaded: 10/25/01.

6, HAB, **DEQ, 2001. *Environmental Cleanup Site Information (ECSI) Database Guide.* DEQ: Portland, Oregon. URL: http://www.deq.state.or.us/wmc/cleanup/ecsiq&a.htm Downloaded: 10/29/01. Summary: ECSI, an acronym for Environmental Cleanup Site Information, is an electronic database that the Oregon Department of Environmental Quality has used since 1989 to track sites with known or suspected hazardous substance contamination. ECSI, which assigns unique identification numbers to individual sites, summarizes information about sites and their investigative/ remedial status, as well as Cleanup Program recommendations for further action. Each entry contains basic data such as site name and location. It also contains data on how and when the site became contaminated, qualitative risks and contamination may pose to human health or the environment, investigative and cleanup actions that have occurred. ECSI categorizes current site status as either: 1) under investigation, 2) on the confirmed release list or inventory of facilities needing further action inventory; 3) cleaned up to DEQ standards (NFA, no further action).

6, HAB, **DEQ, 2001. *Potential Brownfield Sites in Oregon From DEQ's ECSI and UST Cleanup Databases Guide.* DEQ: Portland, Oregon. URL: http://www.deq.state.or.us/wmc/cleanup/bfintro.htm Downloaded: 10/29/01. Summary: Brownfields are defined as "abandoned, idled, or under-used industrial and commercial facilities where expansion or redevelopment is complicated by real or perceived environmental contamination. In a broader sense, Brownfields may be any property where actual or suspected contamination impairs the property value. In order to assist individuals in identifying Brownfields in Oregon, we have produced a list of possible Brownfields. The list includes all database sites except: 1) those at which DEQ has determined cleanup to be complete; 2) those undergoing active cleanup with DEQ oversight; and (3) underground storage tank sites to which DEQ has issued an operating permit.

6, HAB, **DEQ, 2001. *UST Cleanup Site Database Guide.* DEQ: Portland, Oregon. URL: http://www.deq.state.or.us/wmc/tank/lustlist.htm Downloaded: 10/29/01. Summary: The UST Cleanup List is a listing of all sites with reported releases of petroleum products from regulated underground storage tanks (USTs), unregulated USTs, and home heating oil tanks.

6, WQ, **Cude, Curtis. 2001. *Interpretation and Communication of Water Quality Data Using the Oregon Water Quality Index.* DEQ: Portland, Oregon. URL: http://www.deq.state.or.us/lab/wqm/wqi/. Downloaded: 10/25/01.
6, WQ, **Cude, Curtis. 2001. *Oregon Water Quality Index Methodology.* DEQ: Portland, Oregon. URL: http://www.deq.state.or.us/lab/wqm/wqi/. Downloaded: 10/25/01.

6, WQ, **Cude, Curtis. 2001. *Oregon Water Quality Index Summary Report. Water Years 1990-1999.* DEQ: Portland, Oregon. URL: http://www.deq.state.or.us/lab/wqm/wqi/. Downloaded: 10/25/01. Summary: Ranks water quality index data for streams throughout the state, including several within the metropolitan area. Identifies streams with a significant increase in water quality and streams with minimum seasonal index averages with excellent, good, fair, poor and very poor. Also, identifies the trend at each of the sample site and it's magnitude.

6, WQ, **Cude, Curtis. 2001. *Specific Examples of Trend Analysis Using the Oregon Water Quality Index.* DEQ: Portland, Oregon. URL: http://www.deq.state.or.us/lab/wqm/wqi/. Downloaded: 10/25/01.

6, WQ, **DEQ. 2001. *On-line Laboratory Analytical Storage and Retrieval Database Guide.* DEQ: Portland, Oregon. Summary: Guide to describing types of data available for each parameter (bacteriological, biological, fungicide, habitat, herbicide, inorganic, metals, organic, pesticide, physical and raidological). For instance, under bacteriological the database contains information about coliform, total, E. Coli, Enterococcus, etc... URL: http://www.deq.state.or.us/wq/lasar/LasarHome.htm Downloaded: 10/29/01.

6, WQ, *DEQ. 2001. *Nonpoint Source Pollution FY 2000 Annual Report.* DEQ: Portland, Oregon. URL: http://www.deq.state.or.us/wq/nonpoint/nonpoint.htm Downloaded: 10/29/01. Summary: The annual report is the primary mechanism by which EPA evaluates whether or not the State has made satisfactory progress in implementing the approved milestones of tis updataed NPS management plan.
Summary: Digital PDF TMDL documents describing each basin, basin climate, water quality, and TMDLs per basin. There are reports for Columbia/Snake basin on total dissolved gas and temperature and dioxin discharges. There are Columbia Slough Information and TMDL documents. There is a Sandy River Watershed Information document. In addition, there are Tualatin Sub-Basin Information and TMDL documents.

6, WQ, TOX, ***DEQ. 2001. *DEQ Wastewater Permits On-line Database Guide.* DEQ: Portland, Oregon. Summary: The Wastewater Permits Database has been put online to allow the public to search DEQ's Source Information System (SIS) database for information on NPDES[1] and WPCF[2] permits. It contains records from DEQ's Source Information System current through 11/1/2001. You can create a csv file from the database to import into a GIS. URL: http://www.deq.state.or.us/wq/SISData/FacilityHome.asp

DEQ

GIS DATA / DATABASES *=not arrived yet, expecting to receive a copy for metro, **=metro has received copy of data, ***=on-line database, ****=hardcopy data

6, HAB, ****DEQ, 2001. *Approved Landfills and Thermal Treatment Facilities for Petroleum-Contaminated Soils (PCS).* DEQ: Portland, Oregon. URL: http://www.deq.state.or.us/wmc/tank/pcsfacilities.htm Downloaded: 10/29/01. Summary: Hardcopy list of approved landfills and thermal treatment facilities for petroleum-contaminated soils (PCS).

6, HAB, **DEQ, 2001. *Environmental Cleanup Site Information (ECSI) Database.* DEQ: Portland, Oregon. URL: http://www.deq.state.or.us/wmc/cleanup/ecsiq&a.htm Downloaded: 10/29/01. Summary: ECSI, an acronym for Environmental Cleanup Site Information, is an electronic database that the Oregon Department of Environmental Quality has used since 1989 to track sites with known or suspected hazardous substance contamination. ECSI, which assigns unique identification numbers to individual sites, summarizes information about sites and their investigative/ remedial status, as well as Cleanup Program recommendations for further action. Each entry contains basic data such as site name and location. It also contains data on how and when the site became contaminated, qualitative risks and contamination may pose to human health or the environment, investigative and cleanup actions that have occurred. ECSI categorizes current site status as either: 1) under investigation, 2) on the confirmed release list or inventory of facilities needing further action inventory; 3) cleaned up to DEQ standards (NFA, no further action).

6, HAB, **DEQ, 2001. *Potential Brownfield Sites in Oregon From DEQ's ECSI and UST Cleanup Databases.* DEQ: Portland, Oregon. URL: http://www.deq.state.or.us/wmc/cleanup/bfintro.htm Downloaded: 10/29/01. Summary: Brownfields are defined as "abandoned, idled, or under-used industrial and commercial facilities where expansion or redevelopment is complicated by real or perceived environmental contamination. In a broader sense, Brownfields may be any property where actual or suspected contamination impairs the property value. In order to assist individuals in identifying Brownfields in Oregon, we have produced a list of possible Brownfields. The list includes all database sites except: 1) those at which DEQ has determined cleanup to be complete; 2) those undergoing active cleanup with DEQ oversight; and (3) underground storage tank sites to which DEQ has issued an operating permit.

6, HAB, **DEQ, 2001. *UST Cleanup Site Database.* DEQ: Portland, Oregon. URL: http://www.deq.state.or.us/wmc/tank/lustlist.htm Downloaded: 10/29/01. Summary: The UST Cleanup List is a listing of all sites with reported releases of petroleum products from regulated underground storage tanks (USTs), unregulated USTs, and home heating oil tanks.

6, WQ, ***DEQ. 2001. *On-line Laboratory Analytical Storage and Retrieval Database.* DEQ: Portland, Oregon. Summary: On-line database to retrieve water quality monitoring data – for continuous data see the Water quality index sampling database. Some of the data included in the database are: bacteriological, biological, fungicide, habitat, herbicide, inorganic, metals, organic, pesticide, physical and raidological. URL: http://www.deq.state.or.us/wq/lasar/LasarHome.htm

6, WQ, **DEQ, 1994-98. *303d 1994-96 and 1998 listed streams and lakes gis database.* DEQ: Portland, Oregon.

6, WQ, **Cude, Curtis. 2001. *Oregon Water Quality Index Sampling Points and Data.* DEQ: Portland, Oregon. Summary: GIS point data for WQI sampling points and table information included.

6, WQ, TOX, ***DEQ. 2001. *DEQ Wastewater Permits On-line Database.* DEQ: Portland, Oregon. Summary: The Wastewater Permits Database has been put online to allow the public to search DEQ's Source Information System (SIS) database for information on NPDES[1] and WPCF[2] permits. It contains records from DEQ's Source Information System current through 11/1/2001. You can create a csv file from the database to import into a GIS. URL: http://www.deq.state.or.us/wq/SISData/FacilityHome.asp

EXTERNAL GIS DATA BY SOURCE

CLEAN WATER SERVICES (CWS)

2, HAB, Clean Water Services (CWS). 2001. RSAT sampling sites and data with no metadata. CWS: Hillsboro, Oregon. Summary: IBI sampling sites and associated data. . http://www.usa-cleanwater.org/ShowPage.asp?ID={2CB75766-8290-4521-BABB-B39170E77613} Choose Appendix D. Table 2 #45

DEQ

6, HAB, DEQ, 1998. *Approved Landfills and Thermal Treatment Facilities for Petroleum-Contaminated Soils (PCS) as of September 1998.* DEQ: Portland, Oregon. URL: http://www.deq.state.or.us/wmc/tank/pcsfacilities.htm Downloaded: 10/29/01. Summary: Hardcopy list of approved landfills and thermal treatment facilities for petroleum-contaminated soils (PCS). Table 2 #46

6, HAB, DEQ, 2001. *Environmental Cleanup Site Information (ECSI) Database as of July 2001.* DEQ: Portland, Oregon. URL: http://www.deq.state.or.us/wmc/cleanup/ecsiq&a.htm Downloaded: 10/29/01. Summary: ECSI, an acronym for Environmental Cleanup Site Information, is an electronic database that the Oregon Department of Environmental Quality has used since 1989 to track sites with known or suspected hazardous substance contamination. ECSI, which assigns unique identification numbers to individual sites, summarizes information about sites and their investigative/ remedial status, as well as Cleanup Program recommendations for further action. Each entry contains basic data such as site name and location. It also contains data on how and when the site became contaminated, qualitative risks and contamination may pose to human health or the environment, investigative and cleanup actions that have occurred. ECSI categorizes current site status as either: 1) under investigation, 2) on the confirmed release list or inventory of facilities needing further action inventory; 3) cleaned up to DEQ standards (NFA, no further action). Table 2 #47

6, HAB, DEQ, 2000. *Potential Brownfield Sites in Oregon From DEQ's ECSI and UST Cleanup Databases as of June 2000.* DEQ: Portland, Oregon. URL: http://www.deq.state.or.us/wmc/cleanup/bfintro.htm Downloaded: 10/29/01. Summary: Brownfields are defined as "abandoned, idled, or under-used industrial and commercial facilities where expansion or redevelopment is complicated by real or perceived environmental contamination. In a broader sense, Brownfields may be any property where actual or suspected contamination impairs the property value. In order to assist individuals in identifying Brownfields in Oregon, we have produced a list of possible Brownfields. The list includes all database sites except: 1) those at which DEQ has determined cleanup to be complete; 2) those undergoing active cleanup with DEQ oversight; and (3) underground storage tank sites to which DEQ has issued an operating permit. Table 2 #48

6, HAB, DEQ, 2001. *UST Cleanup Site Database August 2001.* DEQ: Portland, Oregon. URL: http://www.deq.state.or.us/wmc/tank/lustlist.htm Downloaded: 10/29/01. Summary: The UST Cleanup List is a listing of all sites with reported releases of petroleum products from regulated underground storage tanks (USTs), unregulated USTs, and home heating oil tanks. Table 2 #49

6, WQ, DEQ. 2001. *On-line Laboratory Analytical Storage and Retrieval Database.* DEQ: Portland, Oregon. Summary: On-line database to retrieve water quality monitoring data – for continuous data see the Water quality index sampling database. Some of the data included in the database are: bacteriological, biological, fungicide, habitat, herbicide, inorganic, metals, organic, pesticide, physical and raidological. URL: http://www.deq.state.or.us/wq/lasar/LasarHome.htm Table 2 #50

6, WQ, DEQ, 1994-98. *303d 1994-96 and 1998 listed streams and lakes gis database.* DEQ: Portland, Oregon. http://www.deq.state.or.us/lab/WQM/WQI/wqimain.htm Table 2 #14

6, WQ, Cude, Curtis. 1999. *Oregon Water Quality Index Sampling Points and Data from 1999 Water Quality Annual Report.* DEQ: Portland, Oregon. Summary: GIS point data for WQI sampling points and table information included. http://www.streamnet.org/online-data/303d.html Table 2 #15

6, WQ, TOX, DEQ. 2001. *DEQ Wastewater Permits On-line Database as of November 2001.* DEQ: Portland, Oregon. Summary: The Wastewater Permits Database has been put online to allow the public to search DEQ's Source Information System (SIS) database for information on NPDES[1] and WPCF[2] permits. It contains records from DEQ's Source Information System current through 11/1/2001. You can create a csv file from the database to import into a GIS. URL: http://www.deq.state.or.us/wq/SISData/FacilityHome.asp Table 2 #51

DIVISION OF STATE LANDS (DSL)

2, HAB, Division of State Lands (DSL). 2001. Essential salmon habitats on 100K streams (not including migritory routes) with no metadata. DSL: Salem, Oregon. Summary: Essential salmon habitat is based on 100K stream network and does not include any of the migritory routes. For example, it does not include the mainstem of the Columbia as it is a migritory routes. This was created with collaboration with ODFW scientists. http://statelands.dsl.state.or.us/ Table 2 #34

EPA

6, TOX, EPA. 1999. *Toxic Release Inventory 1985-1999.* EPA: Seattle, Washington. URL: http://www.epa.gov/tri/
Summary: The Toxics Release Inventory (TRI), published by the U.S. EPA, is a valuable source of information regarding toxic chemicals that are being used, manufactured, treated, transported, or released into the environment. Two statutes, Section 313 of the Emergency Planning and Community Right-To-Know Act (EPCRA) and section 6607 of the Pollution Prevention Act (PPA), mandate that a publicly accessible toxic chemical database be developed and maintained by US EPA. This database, known as the Toxics Release Inventory (TRI), contains information concerning waste management activities and the release of toxic chemicals by facilities that manufacture, process, or otherwise use said materials. Using this information, citizens, businesses, and governments can work together to protect the quality of their land, air and water. http://www.epa.gov/tri/general.htm Table 2 #58

6, WQ, TOX, HYDRO, EPA. 2001. BASINS Version 3. EPA: Washinton D.C. URL: http://www.epa.gov/ost/basins/
Summary: The U.S. Environmental Protection Agency's water programs and their counterparts in states and pollution control agencies are increasingly emphasizing watershed and water quality-based assessment and integrated analysis of point and nonpoint sources. Better Assessment Science Integrating point and Nonpoint Sources **(BASINS)** is a system developed to meet the needs of such agencies. It integrates a geographic information system (GIS), national watershed and meteorologic data, and state-of-the-art environmental assessment and modeling tools into one convenient package.

Originally released in September 1996, BASINS addresses three objectives: (1) to facilitate examination of environmental information, (2) to provide an integrated watershed and modeling framework, and (3) to support analysis of point and nonpoint source management alternatives. http://www.epa.gov/ost/basins/basinsv3.htm and http://www.epa.gov/ost/basins/metadata.htm Table 2 #59

BASINS supports the development of total maximum daily loads (TMDLs), which require a watershed-based approach that integrates both point and nonpoint sources. It can support the analysis of a variety of pollutants at multiple scales, using tools that range from simple to sophisticated.

Overcoming the lack of integration, limited coordination, and time-intensive execution typical of more traditional assessment tools, BASINS makes watershed and water quality studies easier by bringing key data and analytical components together "under one roof."

Beside BASINS' primary role in creating TMDL analysis, it has been useful in identifying impaired surface waters from point and nonpoint pollution, wet weather combined sewer overflows (CSO), storm water management issues, and drinking water source protection. BASINS also has been used in urban/rural landuse evaluations, animal feeding operations, and habitat management practices. Another unexpected use of BASINS is providing schools and educational institutions with a quick, free resource of GIS and surface water data for the United States.

The heart of BASINS is its suite of interrelated components essential for performing watershed and water quality analysis. These components are grouped into several categories:

1. nationally derived environmental and GIS databases (the 48 continuous states and the District of Columbia);
2. assessment tools (TARGET, ASSESS, and DATA MINING) for evaluating water quality and point source loadings at a large or small scales;
3. utilities including local data import and management of local water quality observation data;
4. two watershed delineation tools;
5. utilities for classifying elevation (DEM), landuse, soils, and water quality data;
6. an in-stream water quality model (QUAL2E);
7. a simplified GIS based nonpoint source annual loading model (PLOAD);
8. two watershed loading and transport models (HSPF and SWAT);
9. a postprocessor (GenScn) of model data and scenario generator to visualize, analyze, and compare results from HSPF and SWAT; and
10. many mapping, graphing, and reporting formats for documentation.

SPATIALLY DISTRIBUTED DATA

ξ land use/land cover
ξ urbanized areas
ξ populated place locations
ξ reach file verion 1 (RF1)
ξ reach file version 3 (RF3)
ξ soils (STATSGO)
ξ elevation (DEM)
ξ major roads
ξ USGS hydrologic unit boundaries
ξ Drinking water supply sites
ξ Dam sites

- ξ EPA regional boundaries
- ξ State boundaries
- ξ County boundaries
- ξ Federal and Indian Lands
- ξ Ecoregions

ENVIRONMENTAL MONITORING DATA

- ξ WQ monitoring station summaries
- ξ WQ observation data
- ξ Bacteria monitoring station summaries
- ξ Weather station sites
- ξ USGS gaging stations
- ξ Fish consumption advisories
- ξ Nation sediment inventory (NSI)
- ξ Shellfish classified areas
- ξ Clean water needs survey

POINT SOUCE DATA

- ξ Industrial facilities discharge (IFD) sites
- ξ BASINS 3 Permit Compliance System (PCS) sites and loadings
- ξ BASINS 2 Permit Compliance System (PCS) sites and loadings
- ξ Toxic Release Inventory Sites
- ξ CERCLIS-Superfund National Priority List (NPL) Sites
- ξ Resource Conservation and Recovery Information system sites
- ξ Mineral Industry Locations

ODFW

1,2,3,4, HAB, ODFW. 2001. *Aquatic Inventories Project, Habitat and Reach Data Coverages and metadata.* ODFW: Portland, Oregon. http://osu.orst.edu/Dept/ODFW/freshwater/inventory/pdffiles/metaweb.pdf Table 2 #17

5, HAB, ODFW. 1999. *Willamette Valley Vegetation, 1:24,000 and Metadata.* ODFW: Portland, Oregon. ftp://rainbow.dfw.state.or.us/pub/gis/k24/meta/wv-veg.html Table 2 #39

5, HAB, ODFW. 2000. *Willamette Valley/Northcoast barriers and metadata.* ODFW: Portland, Oregon. ftp://rainbow.dfw.state.or.us/pub/gis/other/meta/wvncbars.html Talbe 2 #18

5, HYDRO, ODFW. 2000. *Willamette Valley/Northcoast dams and metadata.* ODFW: Portland, Oregon. ftp://rainbow.dfw.state.or.us/pub/gis/other/meta/wvncdams.html Table 2 #19

6, HAB, ODFW. 2001. *Bull trout distribution, 1:100,000 and metadata.* ODFW: Portland, Oregon. ftp://rainbow.dfw.state.or.us/pub/gis/k100/meta/BUTGIS2001.html Table 2 # 21

6, HAB, ODFW. 1999. *Bull trout gene conservation groups, 1:100,000.* ODFW: Portland, Oregon. ftp://rainbow.dfw.state.or.us/pub/gis/k100/meta/BUTGIS2001.html Table 2 #40

6, HAB, ODFW. 2001. *Bull trout sitings as points, 1:100,000 and metadata.* ODFW: Portland, Oregon. ftp://rainbow.dfw.state.or.us/pub/gis/k100/meta/BUTGIS2001.html Table 2 #41

6, HAB, ODFW. 2001. *Chum distribution, 1:100,000 and metadata.* ODFW: Portland, Oregon. ftp://rainbow.dfw.state.or.us/pub/gis/k100/meta/chum.htm Table 2 #22

6, HAB, ODFW. 2001. *Coho distribution, 1:100,000 and metadata.* ODFW: Portland, Oregon. ftp://rainbow.dfw.state.or.us/pub/gis/k100/meta/coho.htm Table 2 #23

6, HAB, ODFW. 2001. *Fall chinook distribution, 1:100,000 and metadata.* ODFW: Portland, Oregon. ftp://rainbow.dfw.state.or.us/pub/gis/k100/meta/ch_fall.htm Table 2 #24

6, HAB, ODFW. 1999. *Lahontan cutthroat distribution, 1:100,000 and metadata.* ODFW: Portland, Oregon. ftp://rainbow.dfw.state.or.us/pub/gis/k100/meta/lcttmetadata.html Table 2 #25

6, HAB, ODFW. 2000. *Oregon fish hatcheries and metadata.* ODFW: Portland, Oregon. ftp://rainbow.dfw.state.or.us/pub/gis/other/meta/hatch-v1.html Table 2 #20

6, HAB, ODFW. 2001. *Spring chinook distribution, 1:100,000 and metadata.* ODFW: Portland, Oregon. ftp://rainbow.dfw.state.or.us/pub/gis/k100/meta/ch_spring.htm Table 2 #26

6, HAB, ODFW. 2001. *Summer steelhead distribution, 1:100,000 and metadata.* ODFW: Portland, Oregon. ftp://rainbow.dfw.state.or.us/pub/gis/k100/meta/st_summer.htm Table 2 #27

6, HAB, ODFW. 1999. *Wildlife management units (no metadata).* ODFW: Portland, Oregon. ftp://rainbow.dfw.state.or.us/pub/gis/k100/meta/st_winter.htm Table 2 #28

6, HAB, ODFW. 2001. *Winter steelhead distribution, 1:100,000 and metadata.* ODFW: Portland, Oregon. http://rainbow.dfw.state.or.us/data.html Table 2 #54

OREGON GEOSPATIAL DATA CLEARINGHOUSE

5, HAB, USGS. 1996. *Willamette Valley Natual Wetlands, 1:24,000 and Metadata.* USGS: Portland, Oregon. ftp://ftp.sscgis.state.or.us/pub/data/regional/shpfiles/wvnatwet.html Table 2 #35

6, HAB, IDFW. 1998. *Oregon Gap vegetation, 1:100,000 and Metadata.* IDFW: Boise, Oregon. http://rainbow.dfw.state.or.us/data.html Table 2 #52

6, HAB, Oregon Natural Heritage Program (ONHP). 2000. *Ecoregions, 1:250,000 and Metadata.* ONHP: Portland, Oregon. http://www.gis.state.or.us/data/alphalist.html choose EcoRegions. Table 2 #53

6, HYDRO, Oregon Water Resources Department (WRD). 1998. *Dams regulated by the WRD, 1:24,000 and Metadata.* WRD: Salem, Oregon. ftp://ftp.sscgis.state.or.us/pub/data/statewide/k24/ordams.htm Table 2 #36

6, WQ, USGS. No Date Given. *Ground water pollution (no metadata).* USGS: Portland, Oregon. http://www.gis.state.or.us/data/alphalist.html Table 2 #37

6, HAB, NRCS. 1998. *USDA NRCS Certified Ssurgo Soil Surveys.* NRCS: Portland, Oregon. ftp://ftp.sscgis.state.or.us/pub/data/regional/ssurgo/surgo.txt Table 2 #38

PSMFC/EPA DATA (STREAM-NET)

6, HAB, Stream-net. 2000. *Adult fish returns data for the Pacific Northwest (1:100,000) and metadata* (last updated 9/26/00). PSMFC/EPA: Portland, Oregon. Summary: Data includes redd counts, peak counts, spawning, estimates of spawning population and spawner/recruit estimates. ftp://ftp.streamnet.org/pub/streamnet/gisdata/MetaAdReturns.txt Table 2 #55

6, HAB, Stream-net. 2001. *All NW anadromous fish (salmon&steelhead) distribution, 1:100,000 and metadata* (last updated 4/02/01). PSMFC/EPA: Portland, Oregon. ftp://ftp.streamnet.org/pub/streamnet/gisdata/MetaAnad.htm Table 2 #29

6, HAB, Stream-net. 2001. *Current NW pink salmon, 1:100,000 and metadata* (last updated 3/29/01). PSMFC/EPA: Portland, Oregon. ftp://ftp.streamnet.org/pub/streamnet/gisdata/MetaPink.htm Table 2 #30

6, HAB, Stream-net. 2001. *Current NW sockeye salmon distribution, 1:100,000 and metadata* (last updated 3/29/01). PSMFC/EPA: Portland, Oregon. ftp://ftp.streamnet.org/pub/streamnet/gisdata/MetaSock.htm Table 2 #31

6, HAB, Stream-net. 2000. *Current NW white sturgeon distribution, 1:100,000 and metadata* (last updated 3/29/01). PSMFC/EPA: Portland, Oregon. ftp://ftp.streamnet.org/pub/streamnet/gisdata/MetaWhSturg.htm Table 2 #32

6, HAB, Stream-net. 2001. *Current summer chinook salmon distribution, 1:100,000 and metadata* (last updated 3/29/01). PSMFC/EPA: Portland, Oregon. ftp://ftp.streamnet.org/pub/streamnet/gisdata/MetaSuChin.htm Table 2 #33

6, WQ, Stream-net. 2000. *Pacific NW Water Quality sampling data for streams and lakes (GIS and SQL database) and metadata* (last updated 10/26/00). PSMFC/EPA: Portland, Oregon. Summary: Database includes data from approximately 411 sampling sites within the northwest. The water quality data includes many parameters, such as alk, ca, chl, color, cond, depth, do, dphos, fc, nh3, ph, etc...
ftp://ftp.streamnet.org/pub/streamnet/gisdata/MetaWQStreams.htm Table 2 #56

PACIFIC NORTHWEST ECOSYSTEM RESEARCH CONSORTIUM (ERC)

5, HAB, ERC. 1999. *ERC procedures, and associated databases, used for evaluating the suitability of Willamette habitats for wildlife species.* ERC: Eugene, Oregon. Summary: Files include: spreadsheet files for birds, herpes and mammals habitat scores, rules and geography and Metadata (wrb.species.zip). http://www.fsl.orst.edu/pnwerc/wrb/futures/evaluation/terr_wildlife/datasets.html Table 2 #42

5, HAB, ERC. 1999. *1850 Historic vegetation and metadata.* ERC: Eugene, Oregon. http://www.fsl.orst.edu/pnwerc/wrb/access.html Table 2 #43

5, HAB, ERC. 1999. *LULC 1990 projected at 10 year increments through 2050 with 30m cell resolution and metadata.* ERC: Eugene, Oregon. http://www.fsl.orst.edu/pnwerc/wrb/metadata/ec90.html, http://www.fsl.orst.edu/pnwerc/wrb/metadata/pt00v06.html, http://www.fsl.orst.edu/pnwerc/wrb/metadata/pt10v06.html through http://www.fsl.orst.edu/pnwerc/wrb/metadata/pt50v06.html Table 2 #44

5, HAB, ERC, 1999. *Demographic, hydrologic, physiographic, base grids and land use/land cover spatial dataset for the Willamette Valley.* ERC: Eugene, Oregon. http://www.fsl.orst.edu/pnwerc/wrb/access.html Table 2 #57

EXHIBIT F—ORDINANCE NO. 05-1077C

ATTACHMENT 2.

METRO'S TECHNICAL REPORT FOR FISH AND WILDLIFE HABITAT

This report is available for review in the Metro Council's files or on Metro's website: **http://www.metro-region.org/nature**. In addition, copies may be requested from the Metro Planning Department, 600 N.E. Grand Ave., Portland, OR 97232, or by calling 503-797-1555.

EXHIBIT F—ORDINANCE NO. 05-1077C
Attachment 2

Metro's Technical Report for Fish and Wildlife Habitat

April 2005

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List of tables

List of appendices (attached at end of document)

INTRODUCTION

This chapter provides a summary of recent scientific literature and studies relevant to the protection of fish and wildlife habitat. The purpose of this technical report is to provide a sound scientific foundation for public policy related to the management of fish and wildlife habitat in the region.

Metro's Regional Urban Growth Goals and Objectives (RUGGOs; Metro 1995) state that the region should "Manage watersheds to protect and ensure to the maximum extent practicable the integrity of streams, wetlands and floodplains, and their multiple biological, physical, and social values," as well as that "A region-wide system of linked significant wildlife habitats should be developed. This system should be preserved, restored where appropriate, and managed to maintain the region's **biodiversity**." Based on the direction outlined in this policy, Metro is taking a watershed approach in the characterization of the best available science relating to fish and wildlife habitat.

A key goal of this technical report is to provide accessible information to help elected officials, planners, and the general public understand the needs of fish and wildlife, the effects of urbanization on these species, and the biological processes that support them. There are many ways to define "urban" (e.g., May et al. 1997a; Johnson and O'Neil 2001 [see Urban and Mixed Environs in upland habitat descriptions]; McIntyre et al. 2001), often described by the percent imperviousness or human population measures. However, researchers recognize that there is a gradient of urbanization and any classifications within this gradient are arbitrary. Thus for the purposes of this report we define urban as those areas with high human population density, a definition that includes areas that are generally known as "suburban." The technical report will also provide the basis for specific planning activities such as the *inventory* and assessment of watersheds and the riparian corridors and upland habitats that comprise them, identify environmental parameters for the *ESEE analysis*, and guide *program* development.

The main questions guiding this technical report include:
1) What are the key ecological attributes that characterize a healthy watershed?
2) What are the function and values of fish and wildlife habitat and how can they be retained?
3) What are the species of fish and wildlife that characterize the biodiversity of our region?
4) What are the impacts of urbanization on healthy watershed function and fish and wildlife habitat?
5) What is restoration and how is it best approached in an urban context?

The process we used to conduct the technical report is as follows:
- a literature search of major scientific journals and the internet, as well as consulting other literature reviews conducted within the Metro region and the Pacific Northwest,
- consultation with experts on specific issues such as species lists, habitat classification systems, and impacts of urbanization,
- review by Metro's Goal 5 Technical Advisory Committee, and
- peer review by outside entities

This technical report supports a holistic view of watershed function that emphasizes the interconnectedness of the system, including the relationship of riparian corridors with upland habitats and connectivity. This technical report is organized into the following main sections:

- **Watershed perspective**
- **Aquatic and riparian habitat**
- **Upland habitat**
- **Impacts of urbanization**
- **Restoration in an urban environment**

WATERSHED PERSPECTIVE

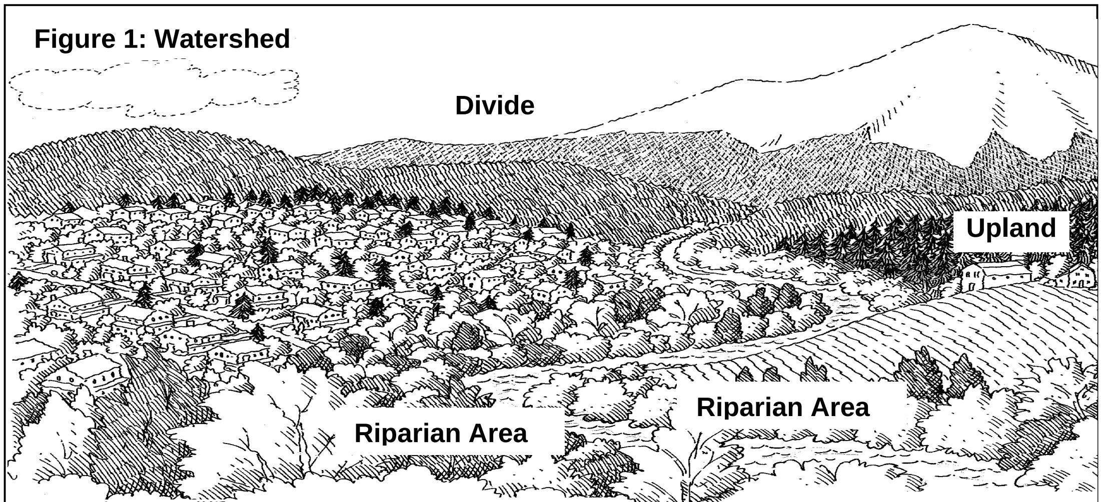
What is a watershed?

An aerial view of the Metro region reveals a network of rivers and streams draining from upland slopes to downstream river valleys. Every tributary, stream or river lies within its own watershed. A **watershed** (or drainage basin) is any area of land from which water, sediment, and organic and dissolved materials drain to a common point, such as a stream, river, pond, lake, or an ocean. According to the Pacific Rivers Council (1993):

> Watersheds are ecosystems composed of a mosaic of different land or terrestrial "patches" that are connected by (drained by) a network of streams. In turn, the flowing water environment is composed of a mosaic of habitats in which materials and energy are transferred and therefore connected through biologically diverse food webs.

Watersheds are hierarchical – small ones nest within larger ones. For example, when two small streams join, their combined drainage areas make up a larger watershed. Each mid-sized watershed contributes, in turn, to a larger watershed. Watersheds can be as large as all the land draining into the Columbia River or as small as 20 acres draining to a pond. Watersheds are separated by a ridge or mountain divide. In natural settings, patterns of drainage are determined by climate, tectonic movements, geomorphic processes and the nature and formation of the rock through which streams erode.

Figure 1: Watershed



Source: Adapted from The Wetlands Conservancy 1995

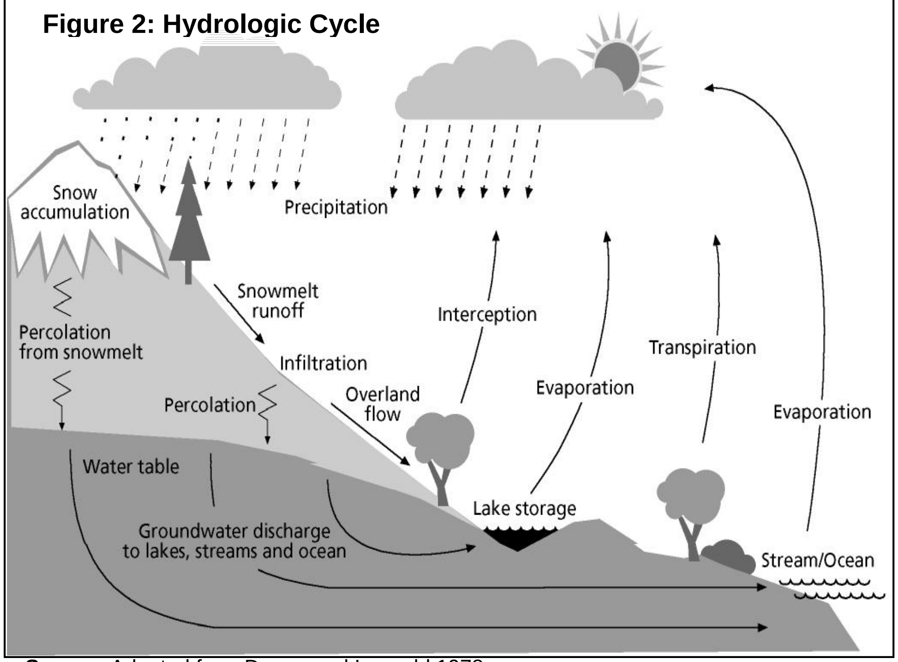
A common set of terms has been developed by the U.S. Geological Survey (USGS) to describe the hierarchical nature of watersheds, known as hydrologic unit cataloging (HUC). Beginning with the term "region," as the largest order of watershed, the terms "sub-region," "basin," "sub-basin," "watershed" and "sub-watershed" are used to described the relative sizes of drainages within geographic areas (Oregon Professional Network 1999). Under the HUC system, the Metro area is located in the Lower Columbia River and the Willamette River basins. The Tualatin and Clackamas rivers are examples of sub-basins in the region, and Johnson Creek is an example of a watershed. The HUC system is described in more detail in the inventory section.

In this report, the term "watershed" is used in a broad sense, rather than describing a drainage areas of a particular size.

The major components of a watershed include the drainage network of tributaries, streams and rivers and their flow regimes, the associated **riparian vegetation, wetlands** and **floodplains** (the **riparian area**), **groundwater**, the **hyporheic zone** (the interface between groundwater and stream water), features within stream channels (e.g., bedrock, sediment, organic debris), and **upland** areas. The ecological health of a watershed depends on the health and connectivity between these components over space and time (Naiman et al. 1992). Connectivity refers to how tributaries are connected to larger rivers, how groundwater interacts with surface water, how water moves among streams, wetlands and floodplains, and how fish and wildlife move among watershed components.

Hydrologic cycle

Figure 2: Hydrologic Cycle



Source: Adapted from Dunne and Leopold 1978

Water is a crucial element that sustains life. It is the major vehicle through which **biotic** (living) and **abiotic** (non-living) materials are transferred from higher to lower land and eventually to the sea. Water moves through and across the landscape by means of surface and underground pathways or channels. Much of the water in channels moves downstream and joins to form larger stream or river systems. Hence, water is a key factor in the occurrence and distribution of organisms and the formation of **aquatic** and **terrestrial** habitat. Rivers and streams contain a small fraction of the world's fresh water, yet they perform a critical role in the continuous water cycle.

The **hydrologic cycle** (Figure 2) provides a useful framework for understanding the continuous cycling of water from the atmosphere to the earth and oceans and back again. The main processes of the hydrologic cycle involve **precipitation**, **evaporation** and **transpiration**. Precipitation, primarily in the form of rain and snow, transfers water from the atmosphere to the earth. A substantial portion of precipitation returns directly to the atmosphere through evaporation and transpiration. During rainstorms, vegetation and other natural (e.g., leaf litter, humus) and manmade surfaces (e.g., flat rooftops, parking lots) intercept and store a portion of rainwater. Some of this intercepted water evaporates during or immediately after the storm before infiltrating into the ground or being absorbed by plants. In addition, water evaporates from the streams, rivers and lakes, from the surface of the ground, and from moisture held in soil. Plants lose water to the atmosphere through a process called transpiration, during which an exchange of gases necessary for photosynthesis occurs. Transpired water originates from water that is taken in by the plant's roots (Montgomery 1986; Allan 1995; Federal Interagency Stream Restoration Working Group [FISRWG] 1998; Watershed Professional Network 1999). The loss of water due to the combined processes of evaporation and transpiration is referred to **evapotranspiration.**

Precipitation that reaches the ground takes several pathways to reach a stream channel or groundwater, and each affects the timing, quantity and quality of streamflow. The pathway followed is influenced by climate, vegetation, topography, geology, land use and soil characteristics (Allan 1995; Poff et al. 1997). Rainfall can be absorbed by soil up to a maximum rate, or **infiltration capacity**. Porous soils, such as coarse-textured sandy soils, usually have high infiltration capacity, whereas tightly packed, clayey soils have low infiltration capacity. When rainfall exceeds the infiltration capacity of the soil, **stormflow** (runoff) moves downslope as **overland flow**. Stormflow usually reaches the channel in a short time frame. Under normal conditions, relatively little runoff occurs in undisturbed regions that have porous soils and natural vegetative cover. In urban settings where paved and impermeable surfaces abound, substantial overland flow may occur (Allan 1995; FISRWG 1998).

Once water enters the soil it moves downward to the groundwater table where it is slowly discharged to the stream over a long period of time. The **baseflow** (or dry-weather flow) of a river is derived primarily from this groundwater. Shallow, **subsurface flow** occurs when there is a relatively impermeable layer underneath permeable topsoil. Water accumulates in this layer and moves downhill, reaching streams through their banks. This movement is faster than groundwater flow but slower than overland flow. **Saturated overland flow** occurs when the water table rises to the ground surface, usually during a large rainstorm, causing groundwater to break out of the saturated soil and to travel as overland flow (Allan 1995; Poff et al. 1997; FISRWG 1998; Watershed Professional Network 1999).

Billions of gallons of water move through the hydrologic cycle each year. Some of this water is temporarily diverted for human use or stored for extended periods of time (even tens of thousands of years), but it eventually makes its way back into the global water cycle. From the longer perspective of geological history, it is still viewed as moving continually through the hydrologic cycle (Montgomery 1986).

Stream corridor – a three-dimensional view

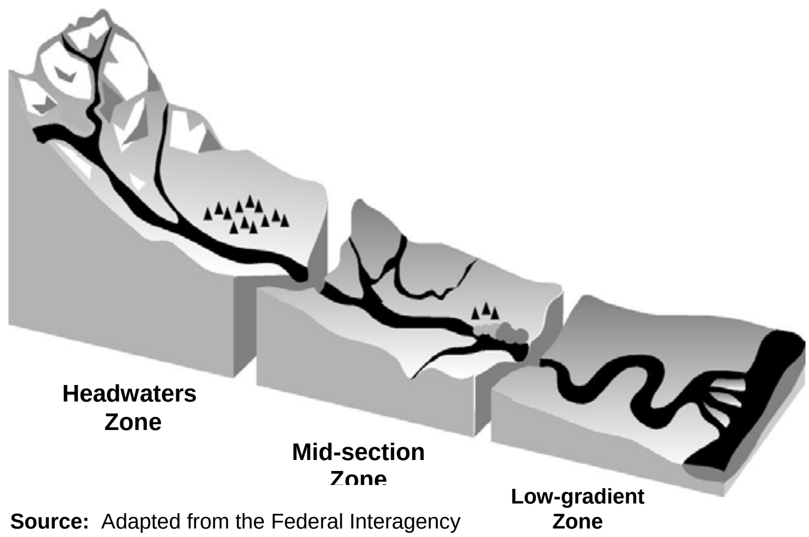
A stream corridor (or riparian corridor) includes the stream channel, the streamside (riparian) vegetation on both sides of the stream, associated wetlands, floodplains as well as other features (see ***Aquatic and Riparian Habitat*** section). Stream and river systems involve three-dimensional processes that connect the longitudinal (upstream-downstream), lateral (floodplains-upland) and vertical (hyporheic-stream channel) system components, all which vary both in space and through time (Naiman et al. 1992; Pacific Rivers Council 1993; Stanford and Ward 1993; FISRWG 1998).

Longitudinal (upstream-downstream)

Watersheds can be divided into three longitudinal zones that correspond to the structural progression that streams commonly exhibit as water flows from headwaters to the mouth (Figure 3). Changes occur in channel size and form; discharge (volume and velocity of water); sediment load, transport, and deposition; nutrients; habitats; and life forms as water flows and materials move downstream from the headwaters zone (FISRWG 1998; Mitchell 1999).

In this region, the **headwaters** zone is generally steeply sloped. Headwater streams carve deep, straight, V-shaped valleys and carry sediment and other materials downstream. The **mid-section** zone receives some of the sediment and other materials from upstream, but transfers much of it downstream. Slopes are typically gentler and the stream or river begins to meander. Narrow and discontinuous floodplains along the channel are temporary storage sites for sediments in long-term transport down the stream corridor. The **low-gradient zone** is where the greatest sediment deposition occurs. Sediments in this zone are smaller than in headwaters and mid-section zones and deposits are sorted by size. Slopes have worn down to low angles. Rivers meander in broad, flat valley floors, working and reworking the floodplain sediments in a dynamic balance of discharge and transport (FISRWG 1998; Mitchell 1999).

Figure 3: Longitudinal view (upstream-downstream)



Source: Adapted from the Federal Interagency Stream Restoration Working Group 1998

Longitudinal changes from the headwaters to the mouth of river ecosystems have been generalized in a conceptual model known as the **River Continuum Concept** (Vannote et al. 1980). Connections between the watershed, floodplain, and stream systems are identified by the model, as well as how biological communities develop and change from the headwaters to the mouth. A limitation to the River Continuum Concept is that it was developed on small streams (Junk et al. 1989).

Lateral (floodplains-upland)

Stream corridors usually exhibit three major components when viewed laterally (across the corridor): the stream channel, the floodplain and the transitional upland fringe (FISRWG 1998). The floodplain, which is an area on one or both sides of a stream channel that is periodically inundated by floodwaters, provides temporary storage for floodwaters and sediment produced by the watershed. Floodplains may be nonexistent or very narrow in steep headwater zones, yet quite expansive in low-gradient zones, where the floor of the stream valley is relatively flat. The transitional upland area serves as the edge or zone of change between the floodplain and the surrounding landscape, and is distinct from the surrounding uplands by its greater connection to the floodplain and stream (FISRWG 1998). Figure 4 in the ***Aquatic and Riparian Habitat*** section illustrates a cross-sectional view of a stream corridor (or riparian corridor). The transitional upland fringe corresponds to the "zone of influence" in Figure 4.

The **Flood-pulse Concept** describes the lateral interaction of streams with their floodplains. This concept is applicable primarily in unaltered large rivers systems with floodplains. It demonstrates how the predictable advance and retreat of floodwaters in the floodplain nourishes it with sediments, enhancing biological productivity and providing important habitat for insects, amphibians, reptiles and fish spawning (Junk et al. 1989; Bayley 1995; FISRWG 1998).

Vertical (hyporheic-stream channel)

An entire ecosystem, undiscovered until only a few decades ago, exists beneath and along the river. This is the hyporheic zone, or the zone of interchange between the stream and groundwater (see Figure 4 in the ***Aquatic and Riparian Habitat*** section). The hyporheic zone is most extensive in low-gradient streams, where wide riverbeds are underlain and surrounded by river rocks and gravel, allowing water to seep below the streambed and allowing exchange of water between the river and the sediment of the floodplain (Stanford and Ward 1993; Triska et al. 1993; Fernald et al. 2000).

Properties of both groundwater and channel water are blended in the hyporheic zone, significantly changing the water's chemical composition and stimulating biological activity (Stanford and Ward 1988; Naiman et al. 2000). The jumbled mix of stones and soil provide a wide range of microhabitats that vary in nutrient and oxygen content. A host of specialized insects and microorganisms take advantage of these living quarters, some never emerging to see the light of day. Important biological activities (such as **denitrification**, or the removal of excess nitrogen) take place in the hyporheic zone, mediated by these specialists. In addition, new evidence suggests that salmon in the Columbia River key in on hyporheic flow to select their spawning habitats because the flow replenishes oxygen, carries away waste, and moderates stream temperatures (Brinckman 2000). Thus, the hyporheic zone plays an important role in aquatic **food webs** by moderating nutrients, including providing insect food to instream wildlife.

Preserving the connection between the components of a stream or river system (i.e., upstream-downstream; floodplains-upland; hyporheic-stream channel) is vital to achieving or maintaining ecologically healthy watersheds (Naiman et al. 1992). The next section explores key attributes of healthy watersheds and the complex array of processes that occur within in them.

Physical, chemical, biological processes in healthy watersheds

The key processes contributing to watershed health are the delivery and routing of water, sediment and woody debris. The resulting stream characteristics are the best indicators of watershed vitality (Naiman et al. 1992). The health of a watershed and the characteristics of streams and rivers are influenced by the geology, topography, climate, natural disturbance regime, land use, soil and vegetation.

Some of the key attributes of watershed health in the Pacific Northwest include (Bisson et al. 1997; Naiman et al 1992; Poff et al. 1997; Hollenbach and Ory 1999):

- Uplands dominated by native forest cover
- Continuous stream corridors with healthy, fully functioning riparian zones
- Floodplains connected with river channels
- Unaltered hydrologic regimes
- Undisturbed hyporheic zones
- Natural input rates of sediment, organic matter, and nutrients that support healthy, productive and diverse fish and wildlife populations
- Lateral, longitudinal and vertical connections between system components
- Natural rates of landscape disturbances

This section provides an overview of the key physical, chemical, and biological processes occurring throughout watersheds that determine stream characteristics and, ultimately, the overall health of a watershed.

Note that a "healthy watershed" does not necessarily equate to pristine conditions. For example, urbanized areas are unlikely to return to pristine conditions within the time frames that matter to people because they are heavily modified and subject to continual human and natural disturbances. Realistically, there is a *gradient* of "healthy" conditions in which the range of possibilities are driven to a large degree by disturbance regime and the system's resiliency to those disturbances. Within this context some (perhaps as yet unknown) modified level of ecological function can be maintained or restored, even in urban areas. Stanford and Ward (1996) comment, "Although restoration to aboriginal state is not expected, nor necessarily desired, recovering some large portion of the lost capacity to sustain native biodiversity and bioproduction is possible by management for processes that maintain normative habitat conditions." Consideration of the key processes in a watershed – including disturbance regime – and the resiliency of the natural system involved can help guide watershed management (Resh et al. 1988; Petraitis et al. 1989).

Physical processes

Diverse stream and floodplain characteristics and plant communities are created by the interaction of the geology, hydrology, climate and **geomorphic** processes, and inputs of organic and inorganic material from hillsides and vegetation within a watershed (Gregory et al. 1991; Naiman et al. 1992; Spence et al. 1996; Rot et al. 2000). The following sections examine how hydrologic patterns influence streamflow, and how streamflow, the physical processes of erosion, sediment transfer, and deposition, and the input of organic and inorganic material form stream channels and create habitat.

Hydrologic pattern and streamflow

The hydrologic cycle, as described earlier, is the continuous cycling of water from the atmosphere to the earth and back again. Hydrologic pattern refers specifically to the type of precipitation, quantity of flow, seasonal water storage, and surface-subsurface water exchanges.

Local and regional streamflow reflects the variability of the hydrologic pattern (Naiman et al. 1992; Poff et al. 1997). Hydrologic connectivity is the water-mediated transfer of matter, energy, and/or organisms within or between elements of the hydrologic cycle; disruptions in hydrologic connectivity may have severe ecological consequences (Pringle 2001).

Precipitation (i.e., rain or snow) is the ultimate source of all streamflow. The intensity, timing and duration of a storm event influence, in part, how quickly water reaches the stream. The variability of climate and land use and their influence on vegetation, soil cover and condition also affect how quickly precipitation reaches streams. Poff et al. (1997) describe the importance of streamflow quantity and timing:

> Streamflow quantity and timing are critical components of water supply, water quality, and the ecological integrity of river systems (Poff and Ward 1989). Indeed streamflow, which is strongly correlated with many critical physiochemical characteristics of rivers, such as water temperature, channel **geomorphology**, and habitat diversity, can be considered a "master variable" that limits the distribution and abundance of riverine species.

Streamflow has two basic components: stormflow and baseflow (see *Hydrologic Cycle* section). Based on the timing and balance of stormflow and baseflow, three categories of streams are recognized: **perennial**, **intermittent** and **ephemeral** streams. Perennial streams flow year round, even during periods of no rainfall. Groundwater is a source of much of the water in the channel. Intermittent streams flow only during certain times of the year, but usually more than 30 days per year. Ephemeral streams flow only during or immediately after periods of rainfall, usually less than 30 days per year (FISRWG 1998).

The size and shape of a channel is determined by three variables: **discharge**, the volume of water moving down a channel per unit of time; **gradient**, the slope of the channel; and **sediment load**, the amount and size of sediment being transported. When one factor changes, the others adjust. Adjustment is reflected in seasonal changes in the slope of the water surface, the degree of **sinuosity** (curvature) of a stream, discharge, and sediment load (FISRWG 1998; Mitchell 2000).

A wide range of flow characteristics is key in the formation and maintenance of a variety of habitat features. The next section describes the geomorphic processes along a stream corridor that form drainage patterns, channels, floodplains, and other watershed and stream corridor features.

Physical habitat forming processes in stream channels

The primary geomorphic processes that operate throughout a watershed are **erosion**, **sediment** (soil particles) transport and sediment deposition (Naiman et al. 1993, FISRWG 1998). The hydrologic pattern within a watershed drives the geomorphic processes. The type of precipitation or disturbance, timing, frequency and magnitude of the event; runoff processes (surface and subsurface flow); gravity; wind; ice; chemical reactions; and vegetation influence the yield and rate of sediment delivery to streams. Stream channels are formed, sustained, and changed by the water, sediment and organic material they carry (Spence et al. 1991; Naiman et al. 1992; FISRWG 1998; Moses and Morris 2001).

Erosion and **sedimentation** occur naturally in a watershed and provide the sources and surfaces necessary for habitat formation for aquatic and terrestrial wildlife species (Naiman et al. 1992). A **disturbance**, be it natural or human-induced, is any significant change in the supply or routing of water, sediment, or woody debris that causes a measurable difference in channel structure and biological community. Natural disturbances such as floods, fire, landslides, plant diseases and insect outbreaks are an integral part of watershed dynamics. These events often result in significant structural changes to the stream channel and biological communities, both in the near term and over time. A natural disturbance, such as a landslide, may destroy aquatic and terrestrial organisms. However, such an event often revitalizes an area by depositing organic material, uncovering buried organic debris, and increasing sunlight by opening forest canopies. These areas often evolve into biologically productive sites over time (Gregory et al. 1991; Naiman et al. 1992).

Although some erosion occurs naturally, many urbanized watersheds experience a higher rate of soil erosion than that of undisturbed landscapes (Pacific Rivers Council 1996). Human disturbance, such as land-use practices associated with urbanization, agriculture, livestock grazing and timber harvest, contribute to this higher rate of soil erosion by altering the natural drainage basin. Many of these alterations have resulted in significant consequences such as landslides, flooding, channel erosion and destruction of aquatic habitat. For a full discussion of the impacts of urbanization, see the ***Aquatic and Riparian Habitat*** section.

Erosion begins with the detachment of soil particles from upland areas, from the streambank, and from within the stream channel. Erosion produces sediment that moves in suspension from its site of origin by air, water, or gravity. Eroded particles, regardless of size, are subject to being transported and deposited downstream. Sediment particles can range in size from fine clay to boulders. Small particles are transported more easily and may be suspended in the water column (suspended or wash load) or in solution. Larger particles move downstream by saltation, or sliding, rolling or skipping along the streambed as bedload. Often only high flow events can move the largest particles downstream. Sediments drop out of water or stop moving when streamflow slows, losing power (i.e., slope and discharge) to move them (FISRWG 1998; Mitchell 1999).

As sediment, **large woody debris** (LWD) and other organic and inorganic materials are transported and deposited throughout a watershed, channel characteristics and aquatic and terrestrial habitats are formed. Large woody debris is important because it influences the routing and storage of water and sediments, as well as the development of channel bottom topography, including the formation and distribution of pools (Beschta 1979; Booth et al. 1997). Large woody debris is also an important source of aquatic cover and acts as a surface for biological activity by aquatic organisms (Gregory et al. 1991; Naiman et al. 1992). In addition, LWD helps dissipate energy generated from streamflow, slowing erosion and sediment transport rate and retaining organic debris, making it available to organisms living there (Naiman et al. 1992). Large woody debris is discussed in more detail in the ***Aquatic and Riparian Habitat*** section.

The structure and form of the channel changes as it moves from the headwaters to the mid-section and low-gradient zones as described below.

Habitat forming processes in headwater zones

In the Pacific Northwest, the majority of rivers draining into the Pacific Ocean originate in steep, mountainous terrain (Naiman et al. 1992). According to Wenger (1999), headwater streams make up the majority of stream miles in any watershed basin, and most streamflow originates from headwaters (Harr 1976). These streams are typically steep (eight degrees or more), flow in narrow bedrock channels with steep valley sides, and exhibit low to moderate sinuosity (Harr 1976; Naiman et al. 1992). They are naturally prone to catastrophic disturbances such as landslides and debris flows. These events can significantly alter the channel and destroy existing aquatic and terrestrial habitat and organisms. However, headwater streams and the surrounding landscape often are revitalized by these events and evolve into biologically productive areas (Naiman et al. 1992).

Headwater streams are vital to the hydrological, biological and geological processes within the watershed (Harr 1976; Pacific Rivers Council 1996; Meyer et al. 2001). For example, headwater streams typically:

- substantially increase water retention capacity in a watershed, resulting in downstream protection from flooding and channel damage
- retain sediments that would otherwise be deposited downstream
- contain substantial amounts of LWD that store sediments and provide habitat structure and sites for critical metabolic activity
- establish the basic chemical composition of unpolluted streams draining a landscape
- are the sites of most active uptake and retention of nutrients
- provide important thermal refuges for fish and other wildlife
- provide unique habitats for numerous species

  Adapted from Meyer et al. 2001

Large woody debris delivered to headwater streams often becomes wedged in the narrow channel. Rapids and waterfalls are common within this zone. Accumulated wood and large boulders create obstructions that form a stair-stepped profile, effectively lowering overall gradient and dissipating energy. This results in less erosion to the streambed and banks, more sediment storage in the channel, and slower downstream movement of organic debris. Headwater streams are occasionally flushed of accumulated sediment and organic debris when natural disturbances such as debris flows occur (Swanson et al. 1982a,b; Gregory et al. 1991; Naiman et al. 1992).

Habitat forming processes in mid-section zones

Mid-section streams are typically larger than headwater streams. They are moderately steep (one to six degree slopes) in narrow valley floors. These streams receive some of the sediment, LWD and other organic material from the headwater zone, as well as from adjacent uplands, but tend to transport sediment rather than storing it for long periods (Naiman et al. 1992). Streambed materials range from gravel to boulders with large woody debris jams that create alternating **pools** and **riffles** (FISRWG 1998). Mid-section streams are usually narrow enough to accumulate large woody debris across the stream (Naiman et al. 1992). The valley within mid-section zones broadens, creating minor floodplains. Streams begin to bend, or **meander** and are typically a single channel, except where woody debris jams and other deposits create streamflow diversions. **Terraces**, **overflow channels** and **oxbow lakes** are limited because channels tend to contain flood flows. When flooding occurs, however, the duration is shorter than in low-gradient streams and rivers. Wetlands commonly form at the base of hillsides where runoff accumulates in saturated soils (Naiman et al. 1992).

Habitat forming processes in low-gradient zones

Increased sediment deposition and greater water volume occur in low-gradient zones (FISRWG 1998). Channels widen and become deeper. Complexity increases both in structure and in the plant communities that occupy the floodplain (Hughes 1997). The fine sediment particles stored in the floodplain in low-gradient zones easily erode, which favors the development of meandering floodplain channels and the creation of alternating pools and riffles, oxbows, sandbars, backwaters, undercut banks, braided channels, and floodplain pools. High water tables are also noted (Johnson and Ryba 1992; Naiman et al. 1992; Cohen 1997). Wetlands are often present along cutoff meanders and oxbow lakes. Large woody debris is scattered in large rivers but often accumulates at river bends or the upstream portion of islands and sandbars.

Flooding in these areas is not restricted to storm events. Lesser magnitude floods occur because of the dynamic accumulation of sediment, beaver dams and debris jams (Naiman et al. 1992). The floodplain provides temporary storage for floodwaters and sediment as well as some long-term storage of groundwater in deep sediments and wetlands. Floodplains expand and contract depending on the season, climate, precipitation, soil characteristics and local topography. Natural disturbances other than flooding may have limited influences on low-gradient streams because the floodplains are isolated from surrounding hillslopes (Naiman et al. 1992).

Episodic disturbances of the floodplain sediments by the meandering river create pockets of young, broadleafed and annual plants, which are nutrient rich and attractive to both wildlife and insects. The presence of large organic debris in floodplain channels affects local flow velocities, creating local zones of scour and deposition, varied channel topography and corresponding habitats (Mitchell, pers. comm. 2001).

Chemical and biological processes

The quantity, timing and variability of streamflow are important components of a healthy watershed, as described earlier. However, an appropriate flow regime does not guarantee a healthy ecosystem if the water quality is degraded. Sediment load (suspended sediment in water) temperature, and chemical composition of water play important roles in water quality and thus the characteristics of aquatic and terrestrial plant and animal communities. This section provides a brief overview of various chemical and biological components within a watershed, such as water quality, vegetation, carbon, nitrogen and phosphorus, aquatic insects and nutrient cycling.

Water quality

Water quality is a fundamental component of ecologically healthy watersheds. Water interacts with everything it touches. Flowing water carries a variety of materials, including:

- Suspended sediment
- Heat
- Dissolved gases (oxygen, carbon dioxide and nitrogen)
- Dissolved nutrients (various forms of nitrogen, phosphorus and carbon)

- Dissolved major ions and trace metals (e.g., calcium, silicate, sulfate, copper, zinc, lead, etc.)
- Suspended and dissolved organic matter (e.g. leaves, algae, LWD, etc.)
- Suspended inorganic matter (elements such as aluminum, iron, silicon, calcium, potassium, magnesium, sodium and phosphorus)
  (Naiman et al. 1992; FISRWG 1998)

Other important parameters relating to water quality include alkalinity, acidity and buffering capacity (buffering causes water to resist changes in pH), potential toxicants (wastes, insecticides, herbicides) and organic nutrients (forms of dissolved organic carbon) (Naiman et al. 1992). An overview is presented in this section of a few key elements of water quality: sediment, temperature and dissolved oxygen.

Sediment

As discussed in the previous section, the transport and deposition of sediment throughout a watershed are key channel and habitat forming processes. However, changes in sediment load and particle size can have negative impacts on water quality and aquatic habitat. Water quality is reduced when excessive amounts of fine sediment such as silt and clay particles enter the stream and become suspended in the water column, causing water to become cloudy, or turbid. In addition, some nutrients and toxic chemicals attach to soil particles on land and enter the water where the pollutants either settle with the sediment or become soluble in water (FISRWG 1998). See ***Aquatic and Riparian Habitat***, *Impacts of Urbanization* for detailed discussion.

Temperature

Water temperature is an important indicator of a watershed's vitality because of its controlling influence on the metabolism, development and activity of aquatic organisms (Naiman et al. 1992). Cold, well-oxygenated water is needed by many aquatic species. Shifting temperatures may have profound effects on aquatic species (e.g., salmon, trout, invertebrates) that can tolerate only a limited range of temperatures. Water temperature is influenced by many factors including groundwater and surface water flow, riparian vegetation (height and canopy density), incoming solar radiation, elevation, climate, stream size, water velocity and depth and **turbidity**.

Temperature changes as water flows downstream. Small streams in forested headwater zones typically have cooler water and stable temperatures because riparian canopy blocks incoming solar radiation. According to Naiman et al. (1992), these streams typically receive one to three percent of total available solar radiation. Mid-section zones typically receive 10 to 20 percent of total available solar radiation because of the gaps that appear in the riparian canopy. Daily temperatures fluctuate between 2-6° C; seasonal variation can be 5-20° C (Naiman et al. 1992). Low-gradient zones generally have wide gaps in riparian canopy but temperature fluctuation is not as great as mid-section streams. This is because larger rivers tend to be deeper and more turbid, restricting the amount of light penetrating through water (Naiman et al. 1992).

Dissolved Oxygen

Dissolved oxygen (DO) is a basic requirement for most aquatic species. Some species require high concentrations of DO (e.g., salmon and trout), while others can survive at lower levels (e.g., carp). Oxygen gas readily dissolves in water, which absorbs it directly from the atmosphere. In addition, aquatic plants release oxygen to the water as a byproduct of photosynthesis. Increased temperatures and **salinity** reduce the amount of oxygen the water can hold. Undisturbed streams generally contain an abundant supply of DO. Dissolved oxygen levels depend in part on the internal mixing and turbulence of water and instream characteristics such as waterfalls and rapids (FISRWG 1998).

Oxygen depletion occurs when oxygen-demanding waste (e.g., sewage, industrial waste, etc.) enters the stream. Oxygen-demanding waste loads are described by a parameter known as **biochemical oxygen demand** (BOD), a measure of the amount of oxygen required to break down organic matter. The more organic matter there is in a stream, the higher the BOD. Excessive aquatic plant growth, due to an overload of nutrients such as nitrates and phosphates, can also lead to oxygen depletion. This development is known as **eutrophication**. As plants die off and decompose, they become part of the organic matter load, increasing BOD (Montgomery 1986; FISRWG 1998).

Vegetation

Vegetation plays a critical role in healthy watersheds. Plant communities are dynamic. Soils, nutrients, and woody debris move from one area to another through precipitation and erosion, leaching, wind, natural and human disturbances, and a variety of other means. Eventually, gravity assists some of these materials down to the riparian zone.

Plant communities in riparian areas help determine what, how much, and when materials from upland areas enter the stream ecosystem. For example, a wide, mature riparian forest will capture many soils and sediments, nutrients, and woody debris, adding richness and complexity to soil and plant communities near the water and protecting water from excessive nutrient or soil inputs (Lowrance et al. 1986; Lowrance et al. 1988; Wenger 1999). A fine balance exists between having enough and having too much of these inputs to the stream. Riparian areas, and consequently the structure, functions and processes occurring within and around the stream, are fundamentally altered when significant upland and riparian vegetation is removed.

The River Continuum Concept generalizes the changes that occur in vegetation from the headwaters to the mouth (Vannote et al. 1980). In headwater streams, where forest canopy overhangs and shades the narrow channel, little sunlight is available to plants and algae within the stream, and most nutrients enter the stream from terrestrial sources. Such externally-derived nutrients are termed **allochthonous**, and consist primarily of large wood and leaf litter (Kauffman et al. 2001). Mid-section zone organisms rely more heavily on internally-derived nutrients (**autochthonous**), such as instream algae and plants (more sunlight is available) and fecal matter. However, small particles of pre-processed nutrients from upstream are also available; therefore, mid-reach streams tend to balance inputs from both external and internal sources. Low-gradient streams flow more slowly, receive abundant sunlight, and acquire nutrients from upstream sources, encouraging instream (autochthonous) plant production (Vannote et al. 1980; FISRWG 1998).

Carbon, nitrogen and phosphorus

Carbon, nitrogen and phosphorus are chemicals that play key roles in aquatic food webs (Meyer et al. 1988; Stanford and Ward 1993). Plants, like all life forms, need carbon because carbon forms the backbone of living molecules. Plants obtain and store carbon from carbon dioxide in the air. Animals obtain carbon from organic matter. Carbon becomes available to insects, fish and other wildlife as plants die, drop leaves, lose branches, or leach nutrients via water flow. Such nutrients are generally referred to as "organic matter" (Allan 1995). As the primary carbon source, riparian vegetation strongly influences carbon inputs to the stream.

When organic matter from the land enters water, it may be consumed or decomposed by insects and microorganisms, physically broken into smaller particles through abrasion, or leached and released into the water. These processes vary among vegetation types. For example, hardwood forests have a more seasonal component to nutrient inputs and leaves decompose relatively quickly, whereas coniferous inputs are more constant with relatively slow decomposition rates due to the waxy leaf surface (Gregory et al. 1991). Seasonal patterns of organic inputs help determine biological community composition.

Nitrogen and phosphorus are vital plant nutrients, although excessive inputs to the stream can lead to uncontrolled plant and algae growth (Allan 1995). Natural sources of nitrogen and phosphorus include plant decomposition and rock erosion. Nitrogen-fixing plants such as alder may also obtain atmospheric nitrogen (Pinay et al. 1993). Nitrogen is readily water soluble, while phosphorus is typically carried to the stream attached to soil particles. These differences in transport to the stream, combined with local geology (mineral leaching and erosion) and riparian vegetation, influence the amounts of nitrogen and phosphorus entering aquatic ecosystems.

Aquatic insects

Aquatic insects and microorganisms convert nutrients and organic matter into forms useable by other organisms. As described above, the importance of plants as instream nutrient sources changes between headwater, mid-section, and low-gradient zones. Aquatic insect communities are arranged accordingly, as theorized by the River Continuum Concept described earlier in this chapter (Vannote et al. 1980). For example, headwater insects specialize in breaking down coarse organic matter. In mid-section zones, most insects collect organic matter or graze on plants and **diatoms**. In low-gradient zones, coarse organic matter is relatively rare but fine organic matter is available from plants, decomposing insects, and sediments. Insects in these reaches tend to be collectors. In each zone, predatory insects comprise a relatively small, but important, component of aquatic insect communities. Throughout this downstream continuum, insects play an important role in converting and supplying nutrients to other instream organisms. Many fish species, including **salmonids**, rely on aquatic insects as their primary food resource (Spence et al. 1996).

Nutrient cycling

As discussed above, a variety of plant and animal materials serve as sources of carbon and nutrients within watersheds. Despite the fact that streamwater flows in one direction (downhill), carbon and nutrients are involved in a continuous cycle, known as **nutrient cycling:**

> …Nutrient cycling describes the passage of an atom or element from a phase where it exists as dissolved available nutrient, through its incorporation into living tissue and passage through perhaps several links in the food chain, to its eventual release by excretion and decomposition and re-entry into the pool of dissolved available nutrients (Allan 1995).

Thus through a complex and variable set of processes relying on sunlight, land, water, plants and animals, essential nutrients are retained in aquatic ecosystems for use by other organisms. The presence, quantity and quality of riparian vegetation are vitally important to this dynamic web of life.

Summary

Many people think of rivers simply as water flowing through a channel. Streams and rivers are not stand-alone units. Every tributary, stream or river lies within its own watershed. A watershed (or drainage basin) is any area of land from which water, sediment, and organic and dissolved materials drain to a common point, such as a stream, river, pond, lake, or an ocean. Watersheds are complex ecosystems that are comprised of a drainage network of tributaries, streams and rivers, floodplains, upland and riparian vegetation, groundwater, the hyporheic zone, and features within stream channels. The ecological health of a watershed and its value for fish and wildlife depends on preserving the connectivity between these components over space and time (Naiman et al. 1992). This highlights why scientists recommend investigating, managing and restoring aquatic and terrestrial systems using a watershed perspective (Forman and Godron 1986; Karr 1991; Pacific Rivers Council 1993; Federal Ecosystem Management Assessment Team [FEMAT] 1993; Karr and Chu 1999; Watershed Professional Network 1999; Naiman et al. 2000).

AQUATIC AND RIPARIAN HABITAT

Introduction

Natural riparian corridors provide valuable habitat for fish and wildlife. For example, in the Metro region, 93 percent of all (non-fish) wildlife species regularly use water-associated habitats, and 45 percent are closely associated with these habitats (Metro's Species List). Riparian corridors are exceptionally productive ecosystems. The interaction between rivers and streams and their adjacent riparian and upland areas provides for a unique and diverse ecological system consisting of:

> …nonliving parts such as groundwater, rocks, and soil; ground cover, understory, and canopy plants; and animals such as insects, reptiles, birds, and mammals. Organisms and nutrients are moving back and forth between aquatic and upland areas, water levels are fluctuating, the channel is shifting laterally, and the riparian vegetation is many-layered. This complex, dynamic environment sustains a large variety of species, life history patterns, and nutrient cycles (Constantz 1998).

This chapter examines the unique characteristics present in riparian corridors that account for the diversity of plant and animal species found there and covers the following topics:

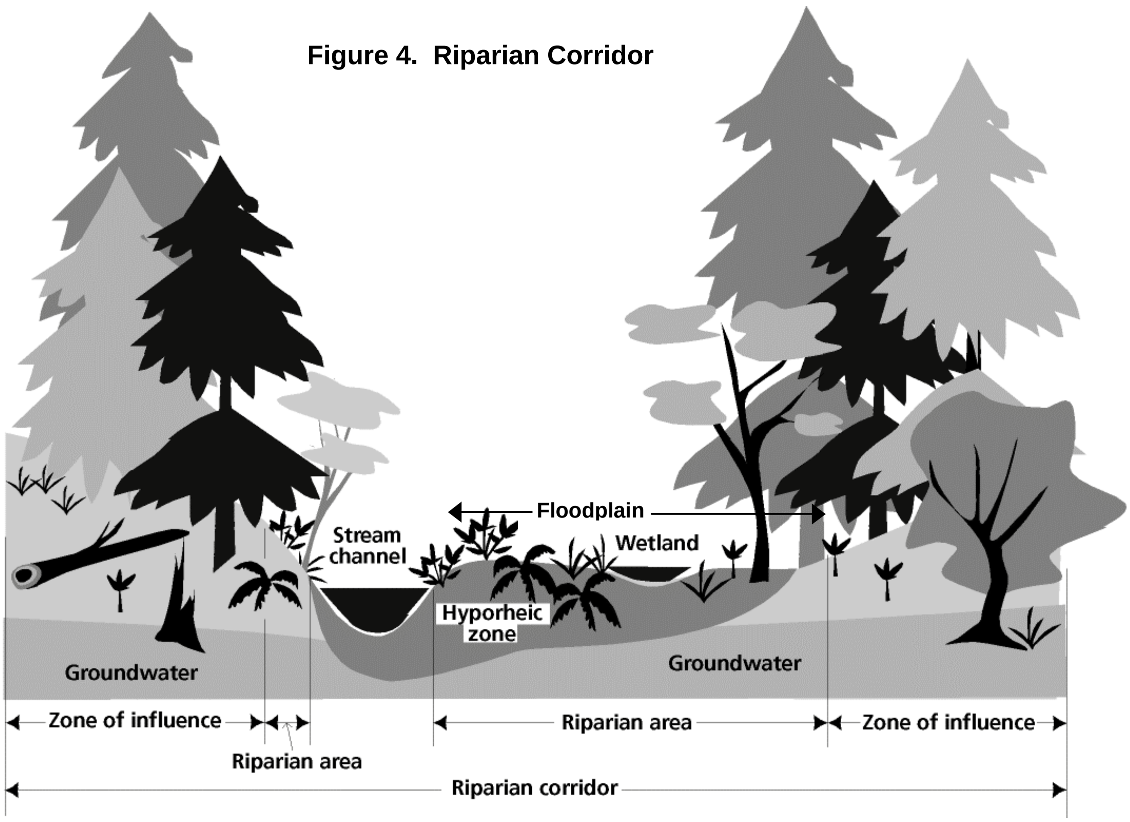
- Definition of a riparian corridor
- Ecological functions of riparian corridors
- Riparian habitat types and species associations
- Impacts of urbanization
- Wildlife use of urban riparian corridors
- Riparian area width

Riparian corridors

The term "riparian" is derived from the Latin word "riparius" meaning "of or belonging to the bank of a river" (Naiman and Decamps 1997). Riparian area refers to the land and vegetation adjacent to waterbodies such as streams, rivers, wetlands and lakes that are influenced by perennial or intermittent water. Riparian areas are dynamic biological and physical systems that act as the interface between terrestrial (land) and aquatic (water) ecosystems (Gregory et al. 1991; Naiman and Decamps 1997). The term **riparian corridor**, as used in this report, includes the stream or river; the riparian vegetation; off-channel habitat such as wetlands, side channels, and the floodplain; the hyporheic zone; and the **zone of influence**, as shown in Figure 4 on the following page.

The spatial extent or width of the riparian area is difficult to delineate. Naiman and Decamps (1997) describe the riparian area as encompassing "the stream channel between the low and high water marks and that portion of the terrestrial landscape from the high water mark toward the upland where vegetation may be influenced by elevated water tables or flooding and the ability of the soils to hold water." Gregory et al. (1991) further describes riparian areas as "three-dimensional zones of direct interaction between terrestrial and aquatic ecosystems," the boundaries of which "extend outward to the limits of flooding and upward into the canopy of streamside vegetation."

Figure 4. Riparian Corridor



The riparian area may contain stream-associated wetlands. Wetlands may occur adjacent to stream channels and within the floodplain of the riparian corridor. They are defined by hydrology, **hydric soils**, and vegetation that depend on frequent and recurrent shallow inundation or saturation at, or near, the soil surface. Swamps, marshes, bogs and similar areas are generally considered wetlands (FEMAT 1993; FISRWG 1998; Kauffman et al. 2001). Plant communities of wetland habitats are dominated by species adapted to survive and grow under periods of anaerobic (absence of oxygen) soil conditions (FEMAT 1993).

Because wetlands may occur within riparian areas, the scientific literature often treats wetlands and riparian areas as synonymous to simplify discussion (FEMAT 1993). This report uses that same approach in its discussion of the ecological functions of riparian corridors for fish and wildlife habitat. However, wetlands are recognized for their highly valuable and productive habitats in *Riparian Habitat Types and Species Associations*, below. Other important wetland and riparian functions such as water storage, sediment trapping, flood damage reduction, water quality improvement/pollution control and groundwater recharge are examined in Metro's (1997b) **Policy Analysis and Scientific Literature Review for Title 3**.

The riparian area includes the entire extent of the floodplain, an integral part of the riparian corridor in low-gradient streams and rivers. A floodplain is defined as the area adjacent to the stream or river channel that becomes inundated with overbank flows during storm events. According to Bayley (1995), the floodplain is "that part of the river-floodplain ecosystem that is regularly flooded and dried, and it represents a type of wetland." Well-developed, complex floodplains are characteristic in large river systems where there are long periods of seasonal flooding, oxbow lakes, wetlands, a diverse forest community and moist soils (Gregory et al. 1991; Naiman et al. 1992; Spence et al. 1996; Poff et al. 1997).

Flood events of different size and frequency play a vital role in maintaining a **diversity** of riparian plant species and aquatic habitat (Junk et al. 1989; Swanson et al. 1998). Biological productivity is enhanced in floodplains because sediment and nutrients are deposited during the advance and retreat of floodwaters (Bayley 1995). Small floods transport fine sediments downstream and laterally, and help create spawning habitat for fish. Intermediate and large floods create opportunities for organic material input, including LWD, and allow for the nourishment and establishment of plant species (Poff et al. 1997).

Most streams have a channel migration zone (CMZ) in reaches where the channel is not constrained by narrow valleys or ravines (e.g., steep headwater channels) (May 2000). Over time, streams move back and forth across the valley floor in a process called lateral migration (FISRWG 1998). The CMZ is the lateral extent of likely channel movement over the past 100-year period (May 2000), or where aquatic or wetland habitat could possibly exist at some time in the future (Pollock and Kennard 1998). The 100-year flood is often used for purposes of delineating the extent of the floodplain (May 2000), although the CMZ includes lower terraces and hillslopes adjacent to the floodplain where the stream is likely to meander (Pollock and Kennard 1998).

The hyporheic zone is another critical component of the riparian corridor. It is the saturated sediment underneath a stream or river channel and below the riparian area where groundwater and channel water mix. Properties of both groundwater and channel water are blended in the hyporheic zone, significantly changing the chemical composition and stimulating biological activity (Stanford and Ward 1988; Naiman et al. 2000).

Beyond the riparian area is the "zone of influence" – the transition area between the riparian area and the upland forest where vegetation is not directly influenced by hydrologic conditions (Naiman et al. 1992; Gregory et al. 1991). Vegetation in this zone still influences the stream by providing shade, microclimate, fine or large woody materials, nutrients, organic and inorganic debris, terrestrial insects, and habitat for riparian-associated wildlife. The extent of the zone of influence depends on stream size and geomorphology. For example, a small headwater stream in a steeply sloped area is influenced by upland vegetation beyond the riparian area that contributes organic material through overland flow and direct leaf-fall. Large streams, on the other hand, are more influenced by the riparian vegetation in the immediate riparian area and inputs from upstream than by upland vegetation (Naiman et al. 1992). The zone of influence may be considered part of the riparian area (Gregory et al. 1991; Naiman et al. 1992; Naiman and Decamps 1997; Knutson and Naef 1997).

Riparian vegetation refers specifically to plant communities occurring within the riparian area that are adapted to wet conditions and are distinct from upland communities (Knutson and Naef 1997). Riparian areas are composed of a mixture of herbs and grasses, shrubs, deciduous trees, and coniferous stands of various ages. Younger vegetation occurs immediately adjacent to the stream channel and commonly consists of deciduous shrubs and trees. Generally, older plant communities such as alder, cottonwood and willow are found in floodplains farther from the channel (Gregory et al. 1991). The distribution, structure and composition of riparian plant communities are largely determined by (derived from: Thomas et al. 1979; Swanson et al. 1982b; Gregory et al. 1991; Naiman and Decamps 1997; FISRWG 1998; Naiman et al. 2000):

- climate
- light and water availability
- topographic features
- chemical and physical properties of the soil, including moisture and nutrient content
- the existence of tributary and groundwater flows
- natural disturbance regimes (e.g., floods, wind, fire, insect outbreaks, plant diseases, etc.)

The integrity of the aquatic and terrestrial ecosystems is greatly influenced by the quantity, composition, and structure of riparian plant communities. Plant communities that cover large areas and that have an array of vertical (e.g., trees vs. shrubs) and horizontal (e.g., young stands vs. old growth) structural characteristics can support numerous animal species (O'Neil et al. 2001). In addition, riparian vegetation, through its root system and input of woody debris, influences stream channel characteristics. Riparian vegetation also directly affects aquatic organisms by providing organic materials to the aquatic food web (Gregory et al. 1991).

Riparian plant communities typically change from the headwaters to the mouth because of differences in gradient, hydrology, geomorphology and disturbance regimes (Harr 1976; Kauffman et al. 2001). For example, steep slopes in headwater zones often restrict the extent of the riparian vegetation, which may closely resemble that of upland areas (McGarigal and McComb 1995). Mid-section zones tend to have a band of riparian vegetation that is influenced by channel dynamics (e.g., meandering, flooding). Riparian vegetation in large, low-gradient rivers is generally composed of specialized and disturbance-adapted species that flourish in floodplains where periodic inundation occurs (Naiman et al. 1992). For example, common riparian plant species such as willows and cottonwoods depend on flooding for regeneration.

Ecological functions of riparian corridors for fish and wildlife habitat

The ability of the riparian corridor to attract and support fish and wildlife is dependent on the structural and functional integrity of the aquatic, riparian and upland ecosystems (Knutson and Naef 1997; May et al. 1997b). Metro's Title 3 *Policy Analysis and Scientific Literature Review* (Metro 1997b) and this section examine the many functions that riparian corridors provide for fish and wildlife habitat.

Riparian contributions to aquatic habitat

Aquatic insects, amphibians, and fish are strongly influenced by the composition and structure of riparian areas and the contribution of riparian areas to instream habitat (e.g., large and small woody debris) and organic inputs (e.g., leaves, needles, insects). Salmonids are a general indicator of watershed health or degradation. Their survival depends on a high-quality, stable environment from tributary streams through major rivers to the ocean. They require cool, clean flowing water with a high level of dissolved oxygen; clean gravel in the streambed for reproduction, a variety of in-stream cover, sufficient food sources, and unimpeded access from spawning and rearing areas to the ocean. Four important factors influence streams as habitat for salmon: water quality, streamflow, physical structure of the stream corridor, and food supply. Riparian areas provide many functions that are vital for healthy aquatic habitat, including:

- Microclimate and shade
- Bank stabilization and sediment control
- Pollution control
- Streamflow moderation
- Organic matter input
- Large woody debris

The influence riparian areas exert on a stream is related to the size of the stream, its location in the watershed, the hydrologic pattern and local landforms (Naiman et al. 1992; Naiman et al. 1993). Retention of a natural riparian buffer has been shown to partially ameliorate the adverse effects of urbanization on aquatic wildlife (Horner et al. 2001; see also *Impacts of Urbanization* section).

Microclimate and shade

Riparian vegetation exerts strong control on the stream microclimate by protecting it against climatic changes caused by land use activities outside the riparian corridor (Naiman et al. 1992; Pollock and Kennard 1998; Kauffman et al. 2001). The **microclimate** of riparian corridors is uniquely different from upland areas because of its proximity to water, which influences soil moisture, temperature, and relative humidity (Thomas et al. 1979; Swanson et al 1982b; Naiman et al. 1992; Pollock and Kennard 1998; Kauffman et al. 2001). Variations in microclimate directly influence ecological patterns and processes (Chen et al. 1999).

The position of riparian areas along streams ensures adequate soil moisture available to riparian-associated plants throughout most of the year. For example, in Oregon headwater streams Olson et al. (2000) found cooler temperatures and increased relative humidity near the stream compared to upslope. Because of these factors, riparian vegetation is buffered from the stress of evapotranspiration during the summer (Swanson et al. 1982b; Naiman et al. 2000). During winter months, riparian areas can be warmer than upland areas because they are not exposed to the winds more common in higher elevations (Swanson et al. 1982b). According to Swanson et al. (1982b), the riparian zone is “one of the best suited portions of the watershed for seasonally prolonged metabolic activity.” Microclimate also influences water quality by helping regulate water temperature (Pollock and Kennard 1998).

Shade is another important function of riparian vegetation that influences water temperature. Water temperature is one of the most crucial environmental factors influencing salmon and other aquatic species. Most salmon have evolved to take advantage of temperature regimes in their home streams (Pauley et al. 1989). In general, salmon require cold water ranging in temperatures between 4° C and 17° C (39° F and 63° F) for spawning, incubation and rearing (Beauchamp et al. 1983; Pauley et al. 1986; Pauley et al. 1988; Pauley et al. 1989). Essentially all biological processes in salmon's life cycle are affected by water temperature including the timing of spawning, incubation and emergence from gravel, appetite, metabolic rate, development and growth rate, susceptibility to disease and parasites, timing of **smoltification** and ocean migration (Naiman et al. 1992; Spence et al. 1996).

Daily and seasonal water temperature are influenced by elevation, shade, streamflow, stream velocity, surface area, depth, undercut embankments, organic debris and the inflow of surface water and groundwater (Budd et al. 1987). Riparian vegetation moderates the amount of light reaching the stream channel by blocking or filtering solar radiation. The resulting shade helps to maintain cooler water temperature. The effectiveness of riparian vegetation in producing shade depends on the composition, height, and density of riparian vegetation, and the width of the stream channel and its orientation relative to solar angle (Gregory et al. 1991; Naiman et al. 1992; FEMAT 1993; Spence et al. 1996; Palone and Todd 1997; Kauffman et al. 2001). Riparian vegetation is less effective in providing shade and moderating stream temperature as streams increase in size. It has the greatest impact on headwater streams where it helps maintain temperature of surface water as well as shallow groundwater that feeds the stream. Although shading on larger rivers may have little or no influence on water temperature, overhanging riparian vegetation along the banks creates cooler microhabitat for fish and aquatic organisms (Palone and Todd 1997).

Bank stabilization and sediment control

Riparian vegetation provides bank stabilization and sediment control. Sediment delivered to streams and rivers originates from streambank erosion, from within the channel, from upland land use activities, and from natural disturbances (e.g., debris flows). Sediment occurs naturally in any stream, but changes in the **total sediment load** and particle size that exceed natural rates can have negative impacts on fish and other aquatic habitat (Beauchamp et al. 1983) (see *Impacts of Urbanization*).

Stable streambanks provide resistance to erosion. The root network of riparian vegetation increases resistance to erosion by anchoring soil and stabilizing the bank. Woody riparian species such as willow, alder and dogwood have a dense root network that is effective in protecting streambanks (Bureau of Land Management 1999). During periods of high water flow, streambanks are especially vulnerable to the erosive forces of water. The physical structure provided by riparian vegetation slows water, mechanically filters and stores fine silt and sediment, and holds materials in place (Swanson et al. 1982a; Gregory et al. 1991; Knutson and Naef 1997; Naiman and Decamps 1997). This process may also facilitate bank building as sediment is deposited on the streambank and floodplain, allowing the channel to narrow and deepen (Spence et al. 1996). Vegetative material also enters the system during high flows, contributing to the complexity of aquatic habitat.

Streams of all sizes benefit from the regulating influence that riparian vegetation has on the amount of sediment entering aquatic habitats. Riparian vegetation is especially important in headwater zones where many natural disturbances occur and where the cumulative effect of uninhibited sediment entry from many small streams can significantly impact larger downstream reaches (Knutson and Naef 1997). Unconstrained floodplains are important as sites for sediment retention (Kauffman et al. 2001).

Pollution control

Riparian vegetation can be effective in trapping excess nutrients, such as nitrogen and phosphorus found in fertilizers, and pollutants such as insecticides, herbicides and industrial chemicals carried in surface water runoff (see *Impacts of Urbanization*). Riparian vegetation functions as a nutrient filter by retaining sediment from overland flow (Spence et al. 1996; Knutson and Naef 1997; Naiman and Decamps 1997; Kauffman et al. 2001). Pollutants can be found in either the dissolved and particulate forms, although the particulate form is more common. The removal of fine sediment and organic matter also often removes a large percentage of pollutants (May 2000).

Riparian vegetation also takes up nutrients for plant growth from stream-adjacent soil solution and from stream water itself, as in the case of hydrophytic roots (adapted to grow in water). Plants store nutrients in the form of woody (long-term) and non-woody (short-term) plant material. Nutrients are released from dead organic matter by leaching and decomposition. Nutrient uptake also occurs during decomposition (Swanson et al. 1982a).

Microbial processes occurring in riparian areas may also reduce excess nutrients. These processes include immobilization of nutrients, denitrification of nitrate and degradation of organic pollutants (Palone and Todd 1997). Microorganisms take up or “immobilize” nutrients just as plants do, and these nutrients are re-released following the death and decomposition of microbial cells and are stored in soil organic matter. Denitrification is the process where anaerobic microoganisms (organisms that can live in the absence of oxygen) convert nitrate to nitrogen gas. Denitrification is a key nitrate removal mechanism in riparian areas (Naiman et al. 1992; Palone and Todd 1997). Degradation of organic pollutants occurs as microorganisms consume organic compounds as food sources (Palone and Todd 1997).

Streamflow moderation

Streamflow variability (i.e., volume and velocity) influences the structure and dynamics of stream ecosystems and creates a variety of habitats (e.g., deep pools, riffles, etc.) for salmonids and other aquatic organisms. Streamflow is the collection of direct precipitation and water that has moved over and through the landscape into the channel. As described in the ***Watershed Perspective*** section, the pathway water follows to reach the channel (i.e., surface water runoff vs. subsurface flow) affects the timing, quantity and quality of streamflow. In urbanized landscapes where surface water runoff, rather than infiltration, is the dominant pathway, increased peak storm flows and decreased summer flows to streams occur, both of which significantly degrade salmon habitat (Booth 1991; Schueler 1994; Booth and Jackson 1997; Morgan and Burton 1998; Karr et al. 2000; Booth et al. 2001). In addition, increases in the volume and velocity of surface water runoff often leads to increased frequency and magnitude of flooding (see *Impacts of Urbanization*).

Riparian and upland vegetation helps moderate streamflow by intercepting, absorbing and storing rainfall (Knutson and Naef 1997; Palone and Todd 1997). Streamflow can be affected by the abundance and distribution of riparian vegetation, which creates roughness that helps slow water movement to the stream. The roots of riparian plants increase soil porosity and promote water infiltration (Swanson et al.1982b; FISRWG 1998). Riparian-associated wetlands help moderate streamflow by reducing flood flows and the velocity of floodwaters. Wetlands are also important storage areas for flow, particularly during dry seasons, when they become a source of water to the stream (FEMAT 1993).

Healthy soils directly contribute to healthier water resources by storing water and nutrients, regulating the flow of water, and immobilizing and degrading pollutants (FISRWG 1998; Marx et al. 1999; Moses and Morris 2001). Soil is made up many components including inorganic mineral particles of various sizes (clay, silt and sand), organic matter in various stages of decomposition, and many species of living organisms. Healthy soils are vital in the establishment and nourishment of plants and provide habitat for millions of organisms. Areas with natural vegetation cover and leaf litter provide organic matter to the soil and usually have high infiltration rates (FISRWG 1998; Marx et al. 1999). Water that is stored in soil is slowly discharged to the stream through subsurface flow.

Soil quality is typically degraded along urban stream corridors where development activities often include removal of natural riparian vegetation, compaction of soil, and placement of fill (Marx et al. 1999; Moses and Morris 2001). Soil compaction reduces water infiltration and contributes to water runoff.

Organic matter input

Forest ecosystems adjacent to stream corridors provide over 99 percent of the energy and carbon sources in aquatic food webs (Budd et al. 1987). Riparian plant communities determine the quantity, quality, and timing of nutritional resources delivered to the stream channel (Swanson et al. 1982a; Gregory et al. 1991; Naiman and Decamps 1997). Leaves, fruit, cones, insects and other organic matter fall directly into the stream channel from the riparian area, or move by wind, erosion or as dissolved materials in subsurface water flowing from the hyporheic zone (Gregory et al. 1991; Naiman et al. l992). Insects are an essential food source in the early stages in the salmon’s life cycle (Cederholm et al. 2000). Fallen insects from riparian vegetation can make up 40 to 50 percent of the diet of trout and juvenile salmon during the summer months (Johnson and Ryba 1992).

Over 80 percent of the plant material input from deciduous riparian forests are leaves that are delivered to the stream over a six to eight week period during autumn. Cones and wood make up 40-50 percent of the material delivered from coniferous riparian forests (Naiman et al. 1992). Leaves from deciduous trees are high in nutrients and break down for processing in four to six months, whereas conifer needles may persist in streams for one to two years. Shrub and herb-dominated riparian communities also provide significant input to many streams (Gregory et al. 1991). These externally-derived materials are processed by detritivorous (shredders) insects that break down wood fragments, needles, leaves and other debris into smaller pieces.

The importance of salmon

In addition to organic material derived from adjacent riparian vegetation and from within the stream, many aquatic and terrestrial species rely on salmon eggs, fry, live adults and carcasses as a food source. Salmon were historically in many of the region's streams, and they still use certain streams as well as the mainstem Willamette River through downtown Portland. Salmon are a key link in biodiversity and productivity of Pacific Northwest streams, and forge a strong connection between aquatic and terrestrial ecosystems through nutrient cycling, as the following example illustrates (Cederholm et al. 2000; Cederholm et al. 2001).

Freshwater macroinvertebrates gain energy and mass by consuming algae, detritus, and bacteria. Every species of salmon fry rely on these spineless creatures (both aquatic and terrestrial) for food (Meehan 1996). The complexity of instream habitat and riparian vegetation increase the number and type of insects available to the tiny fish. The fish grow and some head out towards the Pacific Ocean, where they gather similar nutrients from the saltwater which will be carried back inland. Others are consumed by animals living in water and on land, cycling back into the nutrient pool.

The adult salmon, now ready to spawn, head back to their natal inland stream, where they lay millions of eggs. Many of the eggs are eaten by macroinvertebrates and other fish. A few make it to hatching, where they too are at risk of being eaten. Meanwhile, multitudes of adult fish have completed their life cycle and die in the stream, where they add nutrients that stimulate production of plants, algae and bacteria; are consumed by instream organisms, including salmon; or are consumed by seasonal congregations of wildlife such as Bald Eagles, river otter, gulls, merganser and black bear. A gull eats a salmon carcass, flies upslope and is taken by a Peregrine Falcon. The bear, having gorged on dead and live spawning salmon, moves upslope to eat huckleberries, where its excrement deposits salmon-based nutrients. Invertebrates opportunistically feed on all of these salmon products and disperse throughout the landscape. Animals are fed, soils are built, and plant communities grow.

Pacific Northwest ecosystems are adapted to enormous seasonal inputs of salmon eggs, fry and carcasses. Nearly 140 species of vertebrates have ecological relationships with, and 88 routinely interact with salmon (Cederholm et al. 2001). The significant reduction or loss of salmon in our streams causes a vast reduction in nutrients available in the water and on the land, with the potential to alter entire ecosystems. Salmon conservation will be necessary to recover and preserve the health and ecological integrity of the Pacific Northwest.

Large woody debris

Large woody debris (LWD), such as branches, logs, uprooted trees, and root wads, is an important component of aquatic habitats in the Pacific Northwest, both as a structural element and as cover from predators or protection from high streamflows. Large woody debris helps form channel features such as point bars, pools, riffles, runs, eddies, side channels, meanders, hydraulic complexity (e.g., variation in streamflow) and instream cover (e.g. overhanging vegetation, undercut banks) (Beschta 1979; Booth et al. 1997; Spence et al. 1996). Stream complexity is essential for salmon because at various life cycle stages they require different types of habitat. According to May et al. (1997b), LWD is the most important structural component to salmonid habitat.

Large woody debris also controls the routing of water and sediment, dissipates stream energy, protects streambanks, stabilizes streambeds, helps retain organic matter, and acts as a surface for biological activity (Swanson et al. 1982a; Harman et al. 1986; Bisson et al. 1997; Sedell et al. 1988; Bilby and Ward 1989; Gregory et al. 1991; Naiman et al. 1992; FEMAT 1993; Spence et al. 1996; May et al. 1997b). Large woody debris enters streams either directly from the adjacent riparian area or from hillslopes through a variety of mechanisms including toppling of dead trees, windthrow, debris avalanches, undercutting of streambanks and redistribution from upstream (FEMAT 1993; Spence et al. 1996; Naiman et al. 2000).

Over time, the influence of LWD may change, both in terms of its function and location within the watershed, but its overall importance is "significant and persistent" (May 2000). The characteristics of riparian vegetation determine the age, species, diversity, and size of the wood entering the stream, which in turn influences the persistence of LWD in the channel. For example, hardwoods decompose more quickly than conifers (Keim et al. 2000; Naiman et al. 2000). Conifers, therefore, have a greater ability to form and maintain structural features over time (Knutson and Naef 1997).

In steep headwater streams, large woody debris is generally located where it initially fell and is typically large enough to span the entire channel, affecting hydraulic processes by physically obstructing the streamflow and creating pools, riffles, rapids and waterfalls (Naiman et al. 1992). This results in less erosion to the streambed and banks, more sediment storage in the channel, and slower downstream movement of organic debris. By delaying transport of sediment downstream, rapid changes in sediment loading can be avoided (Swanson et al. 1982a; Bilby and Ward 1989; Naiman et al. 1992; Spence et al. 1996). The delayed transport of organic material downstream enhances its use as either a nutritional resource or habitat by aquatic organisms (Swanson et al. 1982a; Bilby and Ward 1989; Gregory et al. 1991). The ability of the stream to retain organic matter is enhanced when small woody debris, such as branches, sticks, and twigs accumulates, trapping leaves and other organic matter (Gregory et al. 1991).

Large woody debris becomes increasingly important in creating salmonid habitat in mid-section zones where it is a dominant channel-forming feature. In streams where LWD spans the width of the channel, it redirects the flow of water and alters water velocity, creating complexity and a number of pool types that are used by juvenile salmonids during summer (Beschta 1979; Naiman et al. 1992; Nickelson et al. 1992). Large woody debris in low-gradient zones is less of a channel-forming feature than in mid-section zones. In areas where LWD commonly accumulates, such as along outside bends of riverbanks and on upstream ends of islands, it influences meander cutoffs, provides cover for juvenile salmonids, and serves as habitat for invertebrate production (Naiman et al. 1992).

Riparian contributions to terrestrial habitat

Natural riparian areas are biologically diverse and complex ecosystems that contain more plant, mammal, bird, and amphibian species than the surrounding upland areas (Kauffman et al. 2001). Wildlife use riparian corridors more than any other type of habitat (Thomas et al. 1979). Riparian areas provide several functions important to wildlife, including:

- Food, cover and water

- Movement corridor
- Microclimate

Food, cover and water

Wildlife are attracted to riparian areas because of the abundance of food sources, cover, and proximity of drinking water. Access to water is critical for both riparian-dependent wildlife and for many upland species, especially in urban areas where access can be a limiting factor. Riparian areas are especially important areas during breeding season and provide wildlife with an energy-efficient habitat for rearing young due to the close proximity of food, water and cover, thereby minimizing energy expenditures by the adults and young.

The greater availability of water to plants in riparian areas increases plant biomass production, providing a complex and highly productive food web. Seeds, herbaceous vegetation and fruits, aquatic and terrestrial insects, and fungi are plentiful (Thomas et al. 1979; Mitchell 1998; Johnson and Ryba 1992). Riparian areas also provide predators with an abundance of prey species (Knutson and Naef 1997). In addition, spawning salmon and salmon carcasses also provide a seasonal high-energy food source to many wildlife species. A recent study conducted by Johnson et al. (cited by Cederholm et al. 2000) found that 137 species of birds, mammals, amphibians and reptiles common to Washington and Oregon consume salmon at one or more stages of a salmon's life cycle.

Riparian vegetation in the form of grasses, shrubs, trees and other plants provides wildlife habitat for reproduction, nesting, roosting, foraging and protection from the weather and from competitive and predatory species. Riparian areas often contain unique plant communities, both in composition and structural complexity (Kauffman et al. 2001; O'Neil et al. 2001). Structural complexity exists when there is a diversity of plant species, multiple canopy layers (e.g., deciduous vs. coniferous; shrubs vs. trees), and snags and downed woody material (Thomas et al. 1979; Knutson and Naef 1997; FISRWG 1998).

Many wildlife species are associated with specific plant communities; some require a certain age (e.g., old growth or pioneer species). Some species of invertebrates, birds and mammals rely on snags (standing dead trees) and downed and dead wood for a portion of their life history (see *Riparian Habitat Types And Species Associations*). Downed and dead woody material in various stages of decay provide diversity in the environment and are of varying significance for wildlife habitat (Thomas et al. 1979). Much of the biodiversity and productivity of the riparian area would disappear without this woody debris accumulation (Naiman et al. 1992).

The linear nature of riparian areas maximizes the development of edge habitat, an area where two different plant communities, successional stages, or vegetative conditions meet (Thomas et al. 1979). Some species benefit from the availability of edge habitat because edges contain plant communities that are characteristics to each adjoining habitat (Knutson and Naef 1997). Although edge habitat can promote high wildlife diversity, it can also have a negative impact on some species associated with interior portions of the riparian area (see *Impacts of Urbanization* section).

Movement corridors

Many wildlife populations rely on their ability to move between different types of habitat along riparian corridors, especially for species that would not otherwise cross large openings (Palone and Todd 1997). Riparian corridors, because of their linear shape, enable movement of wildlife between habitat patches (Thomas et al. 1979; Beier and Noss 1998; Palone and Todd 1997). Dispersal and establishment of new territories for feeding and breeding is important for many species. This allows for an exchange of genetic material between species populations and is critical for resilience to disease and other negative impacts (Cohen 1997). At least 95 percent of all terrestrial species in North America depend on corridors (Cohen 1997).

Riparian corridors also play a potentially important role within landscapes as corridors for plant dispersal and, according to Gregory et al. (1991), may be an important source of most colonists through the landscape.

Microclimate

Riparian and upland vegetation create a microclimate in riparian areas as described in *Riparian Contributions to Aquatic Habitat*. The microclimate of riparian areas is generally more moist and mild (cooler in summer and warmer in winter) than the surrounding area (Knutson and Naef 1997). This creates diverse habitat characteristics that are desirable to many species, particularly for amphibians year-round and for ungulates and other large mammals during hot, dry summers and severe winters (Knutson and Naef 1997).

The importance of seasonal streams and wetlands

Some reviewers question why Metro included seasonal water sources, such intermittent streams and wet-season wetlands, in the riparian corridor inventory. Extensive empirical evidence indicates that these habitats should be included as vital components of the region's natural resource inventories. Seasonal streams and wetlands exert important ecological controls on riparian ecosystems, support unique wildlife communities and greatly increase wetland and water connectivity. These functions are likely to profoundly influence aquatic ecosystems and wildlife.

Control and mediation of ecological processes

Seasonal streams and wetlands exert important ecological controls that influence wildlife by moderating hydrology and downstream inputs including water, nutrients, and sediments.

Seasonal wetlands. Seasonal wetlands moderate hydrology and reduce flooding by providing surface water storage, flood desynchronization, groundwater recharge and discharge, and shoreline stabilization (Winter 1988; FEMAT 1993; Hicks and Larson 1997). Wetlands also protect instream habitat by maintaining stream base flows via temporary surface water storage during storm events and groundwater recharge. Thus seasonal wetlands help maintain natural hydrologic parameters and, therefore, channel conditions (Richter and Ostergaard 1999).

Seasonal wetlands produce substantial amounts of plant materials, and also process a variable but important amount of organic matter produced elsewhere. This large amount of organic material provides the foundation of the food web; behind that follows invertebrates, amphibians, reptiles, birds and mammals (Harris 1988; FEMAT 1993). In New York, researchers compared four different wetland types ranging from temporary to permanent, and found that all demonstrated extensive nutrient cycling; rather than period of inundation, they found that hydrology and organic matter controlled nutrient uptake and processing (Groffman et al. 1996). Researchers in Massachusetts and Rhode Island found similar results (Duncan and Groffman 1994).

Seasonal wetlands improve water quality by removing excess nutrients, sediments, and chemical contaminants (FEMAT 1993; Hicks and Larson 1997; Whigham 1999; Thompson-Roberts and Pick 2000). Wetlands trap sediments and prevent them from silting streambeds (Braskerud 2002). This is important not only for maintaining instream habitat such as riffle-pool sequences, but also because nutrients such as phosphorus, heavy metals and other toxins typically bind to soil particles, and wetland storage prevents eroded soil particles from entering streams (Moore et al. 2000; Cooper and Gillespie 2001). Wetlands have excellent potential for denitrification and phosphorus removal (Zurayk et al. 1997; Kang et al. 1998; Tanner 2001; Dierberg et al. 2002). For example, seasonal alder-dominated wetlands in California removed substantial amounts of nitrogen and phosphorus (Busse and Gunter 2002). In North Carolina, wetlands removed 80% of nitrogen, 91% of sediment, and 59% of total phosphorus inputs during a storm event (Kao and Wu 2001).

Seasonal streams. Small headwater streams often comprise up to 85% of total stream length within a drainage network and collect most of the water and dissolved nutrients from adjacent terrestrial ecosystems (Harr 1976; Peterson et al. 2001; Meyer et al. 2003). Small and often ephemeral headwater streams are critical determinants of the integrity of downstream water and habitat quality (Vannote et al. 1980; Swanson et al. 1982b; Naiman et al. 1992). Headwater streams throughout North America exert control over nutrient exports to rivers, lakes, and estuaries (Peterson et al. 2001), and largely establish the basic chemical composition of unpolluted streams draining a landscape (Meyer et al. 2001). For example, the most rapid uptake of inorganic nitrogen occurs in the smallest headwater streams (Peterson et al. 2001).

In their natural state ephemeral streams typically contain dense growth and numerous debris dams that trap sediments, slow flow, and provide important habitat structure and sites for metabolic activity (May et al. 1997a; Meyer et al. 2001). The result is reduced flooding and less "flashiness" downstream – that is, the storm hydrograph peak is lower and water duration is longer. Thus more water is available over a longer period to grow riparian vegetation and maintain stable streams; instream and near-stream habitats remain more capable of supporting native wildlife when seasonal streams are protected.

Wildlife use of seasonal water resources. Seasonal water resources provide water, food sources and predator protection during critical life-history phases for many wildlife species, including amphibians, reptiles, birds and macroinvertebrates.

Seasonal wetlands. Seasonal wetlands provide critical amphibian habitat. Many amphibians migrate to ephemeral wetlands for breeding (Pechmann et al. 2001). Permanent wetland amphibian communities differ from those found in temporary wetlands (Snodgrass et al. 2000; Pechmann et al. 2001), probably relating to species' natural history requirements as well as predator influences. Researchers throughout the US have found that introduced fish or bullfrogs, which are associated with permanent wetlands, adversely affect native amphibian populations

(Lawler et al. 1999; Kupferberg 1997; Richter 1997; Kiesecker and Blaustein 1998; Zampela and Bunnell 2000). In the Puget Sound Lowlands ecoregion, Red-legged frog occurrence was negatively associated with the presence of exotic fish, and the spread of exotics was correlated with a shift toward greater permanence in wetland habitats regionally (Adams 1999). In addition, Red-legged frog and Pacific treefrog larvae experienced lower survival in permanent than in seasonal wetlands (Adams 2000). In the Puget Sound, Richter and Azous (1995) found that high amphibian species richness was related to low velocity flow and low water fluctuation, but not to seasonal persistence of water; although altered hydrology negatively impacted amphibians, species richness did not depend on whether the wetland was seasonal or permanent. Snodgrass et al. (2000) found no relationship between amphibian species richness and wetland size or seasonality, but found that seasonal wetlands support a unique group of species. "Short-hydroperiod wetlands," state the researchers, "are important in maintaining biological diversity across a landscape because they are likely to support species not found in longer-hydroperiod wetlands." Semlitsch (2000) commented that the loss of small, temporary wetlands may be especially harmful to amphibians because of their abundance and high species diversity in those habitats.

Seasonal wetlands are also very important to turtles, birds and the invertebrates that feed them. Western Pond Turtles regularly use seasonal wetlands (Hays et al. 1999). Overwintering Coho salmon use seasonal wetlands as off-channel rearing habitat (Richter and Ostergaard 1999). In northern California, Mallards preferentially selected seasonally flooded wetlands for brood-rearing and experienced higher fledging success than in permanent wetlands (Mauser et al. 1994). Shorebirds and waterfowl use seasonal wetlands for foraging; wintering waterfowl obtain a significant portion of nutrient reserves used for reproduction from macroinvertebrates during the overwintering period (Mauser et al. 1994; de Szalay and Resh 1997; de Szalay and Resh 2000; Isola et al. 2000). Given that the majority of waterfowl species in the Portland metro region use the region's wetlands for overwintering and migratory stopover (see Metro's Vertebrate Species List), seasonal wetlands in our urban region may be key to these species' reproductive success elsewhere.

Part of the importance of these wetlands is their rich invertebrate communities. Invertebrate communities are quickly established after flooding, with highly variable composition and abundance of species assemblages adding to biological diversity and food resources for other wildlife. Invertebrates are a foundation of riparian food webs, comprising significant portions of the nutritional requirements of amphibians, birds and small mammals (de Szalay and Resh 1997; Richter and Wisseman 1997). Invertebrates in seasonally flooded wetlands can produce a greater biomass of aquatic invertebrates than permanent wetlands – that is, they sometimes actually produce more pounds of invertebrates per unit area, per year compared to permanently flooded wetlands (Mauser et al. 1994).

Wetland preservation and mitigation programs across the country have typically focused on permanent wetlands, often assuming that bigger is better (Richter and Azous 1995; Snodgrass et al. 2000). Smaller, seasonal wetlands are generally afforded less (or no) protection by federal or state agencies (Whigham 1999; Naugle et al. 2001). Whigham (1999) states:

> "The most striking weakness in the current national wetlands policy is the lack of protection for 'dry-end' wetlands that are often the focus of debate for what is and what is not a wetland. From an ecological

> perspective, dry-end wetlands such as isolated seasonal wetland and riparian wetlands associated with first order streams may be the most important landscape elements. They often support a high biodiversity and they are impacted by human activities more than other types of wetlands…they may be more valuable than other types of wetlands because of important landscape and biodiversity functions that they perform."

Seasonal streams. Empirical evidence also clearly points to the importance of seasonal streams to wildlife. The Northwest Forest Plan, which provides protection for seasonal, or intermittent, streams, defines intermittent streams as "…any nonpermanent flowing drainage feature having a definable channel and evidence of annual scour or deposition" (Waters et al. 2001). Headwaters are typically intermittent, and comprise a high proportion of all intermittent streams in a drainage (Labbe and Fausch 2000; Peterson et al. 2001). Meyer et al. (2001) comment that headwater streams provide unique habitats for numerous species, and that their degradation and elimination from the landscape increases extinction vulnerability for aquatic invertebrate, amphibian, and fish species.

In the Pacific Northwest, juvenile Chinook salmon rely on intermittent streams for rearing habitat (Maslin et al. 1999). In Colorado, Labbe and Fausch (2000) found that the dynamics of intermittent streams exert important, multi-scale controls on a threatened fish population. In order of increasing spatial scale the key variables relating to the threatened fish were pools; temperature regime; flow variability and seasonality; and predation by nonnative fish. The importance of different variables at different spatial scales suggests that the entire system of intermittent streams is important to the species' survival.

Amphibians comprise the majority of vertebrates in western Oregon headwater streams, and are more abundant in streams with rocky substrate and wide forested buffers (Stoddard and Hayes 2004). Forest loss plus impervious surfaces alter hydrology, and altered hydrology typically causes streams to lose their rocky substrate. This implies that amphibians are at risk in urban areas, where damaged streams have narrow buffers and muddy bottoms. In western Oregon, Corn and Bury (1989) found that small headwater streams harbor significant amphibian communities, and that removal of vegetation has a long-lasting negative effect on all species.

In northwestern California, Waters et al. (2001) found significant differences between vegetation along intermittent streams and upland vegetation, with many more herbaceous species along the intermittent stream channels. They also found that a variety of riparian- and upland-associated vertebrate species relying on intermittent streams, including a number of species known to inhabit the Portland metro region. Also in northwestern California, Seidman and Zabel (2001) found significantly increased bat foraging activity along intermittent streams compared to upland sites. Bats eat flying insects, therefore the implication is a substantial increase in flying insects along intermittent streams compared to uplands. In Arkansas, Townsend's big-eared bats (which occur in the Portland metro region and are on the state Sensitive Species List, critical category) preferentially used intermittent streams for foraging during the breeding season (Clark et al. 1993). In South Dakota, Wood ducks regularly used emergent vegetation along intermittent streams for breeding areas (Granfors and Flake 1999).

Seasonal streams provide habitat for surprisingly diverse, sometimes unique macroinvertebrate communities (Bottorff et al. 1990; Gagen et al. 1998; de Szalay and Resh 2000; Euliss et al. 2001). Alabama researchers found little difference between invertebrate communities when comparing intermittent and perennial streams (Feminella 1996). In northern California streams, the subsurface macroinvertebrate communities for both perennial and intermittent streams had high density and taxa richness during the dryest summer months (del Rosario and Resh 2001). In coastal British Columbia headwater streams, researchers found that even the smallest streams with intermittent flow harbored true aquatic insects with 1-year life cycles, even during periods with no detectable flow (Muchow and Richardson 2000). There was no difference in macroinvertebrate species richness between intermittent and perennial streams, but intermittent streams produced as much as twice the number of adult stoneflies as continuous streams. Thus, intermittent streams may provide an ongoing source of riparian insects to other wildlife living near them, even when the streams are apparently dry.

However, headwater streams currently receive little protection at the national scale and as a result, many areas (including the Portland metro region) have experienced very substantial reductions in drainage density. Meyer et al. (2001) state, "This loss of headwater streams has profoundly altered the structure and function of stream networks, just as eliminating fine roots from the root structure of a tree would reduce its changes of survival."

Landscape-scale connectivity. Seasonal streams and wetlands add important connectivity to landscape-scale wetland assemblages and to the entire watershed (Semlitsch 2000). This hydrologic connectivity extends longitudinally from upper watershed reaches to downstream areas; laterally from stream channels to wetlands; and vertically to groundwater. Loss of hydrologic connectivity disrupts water-mediated transfer of matter, energy, and organisms within or between elements of the hydrologic cycle (Pringle 2001). Gibbs (1993) simulated loss of small, seasonal, unprotected wetlands and estimated an average increase in between-wetland distance of 67%, even though total wetland area would only decrease by approximately 19%. Thus, the loss of small wetlands across a landscape can have a disproportionately large effect on wetland connectivity.

Amphibians rely on wetland connectivity. For example, most Puget Sound amphibians migrate and disperse during wet conditions (December through May), when seasonal wetlands are likely to be present and providing important connectivity (Richter 1997). Studies in Minnesota demonstrate reduced amphibian species richness with greater wetland isolation at all spatial scales (Lehtinen et al. 1999; Lehtinen and Galatowitsch 2001). Salamanders are capable of moving several hundred meters per day (Richardson and Neill 1998; Semlitsch 1998); existing seasonal wetlands in the Portland metro region probably provide key connectivity during spring amphibian breeding and movement periods. Richter and Azous (1995) suggest that steps to prevent isolation of wetlands within the urban landscape will reduce losses of amphibian species.

Waterfowl also rely on the presence of small connecting wetlands. In the Prairie Pothole region of South Dakota, small seasonal wetlands were shown to influence habitat suitability of larger wetlands, with more waterfowl species in areas that were less fragmented by removal of such wetlands (Naugle et al. 2001). Partial loss of wetlands can have a dramatic negative impact on nesting birds (Weller 1988). Research in the Lower Klamath National Wildlife Refuge showed that Mallards prefer seasonally flooded wetlands for breeding, and suggested that survival of newly hatched ducklings was negatively impacted by reduced wetland connectivity (Mauser et al. 1994).

Thus it appears that these small, often seasonal streams and wetlands are key to maintaining or increasing regional biodiversity because they provide water resources, feeding areas rich with macroinvertebrates, and connectivity during critical life-history stages for many species. Large-scale retention of these resources may help prevent local, and ultimately regional, species extirpations.

In summary, seasonal streams and wetlands provide unique and critical ecological services that strongly influence hydrology, water quality, connectivity, and therefore, vegetation and wildlife communities. Their cumulative influence on the region's watershed health is profound. Empirical research offers compelling reasons to include seasonal water sources as part of the riparian corridor and as unique and important wildlife habitat. The entire stream/wetland network functions as a system, and severing the connection between intermittent and perennial water sources will compromise the long-term physical and biological integrity of the region's ecosystems.

Riparian habitat types and species associations

We have described, in general terms, the natural disturbance regime and the geomorphology, hydrology, and vegetative interactions that make riparian areas so biologically rich and variable. In this section we describe the riparian habitat types found in the Metro region and the wildlife species associated with them.

Each type of habitat is unique in terms of the specific functions and values it provides to wildlife. In turn, each wildlife species has its own set of requirements, thus different habitats and structural conditions are important to different species. To gain a better understanding of how wildlife in the Metro region uses various habitats, Metro compiled a list of all vertebrate species (Metro's Species List, Appendix 1) and their associations with habitat types and structural conditions that occur in the region. The following sections describe the number of species associated with each habitat type, and Table 1 provides an overview of riparian habitat use by wildlife in the region. The end of this section describes specific at-risk or extraordinarily valuable habitat areas, known as Habitats of Concern.

Table 1. Analysis of the importance of the three water-associated habitats (riparian, wetlands, and open water) for each major group of animals (29 total existing native species; based on Metro's Species List, Appendix 1).

Group	# Native Species	Riparian Dependent	Uses Riparian	Total % Using Riparian
Amphibians	16	11 species 69%	4 species 25%	15 species 94%
Reptiles	13	3 species 23%	6 species 46%	9 species 69%
Birds	209	103 species 49%	96 species 46%	198 species 95%
Mammals	54	15 species 28%	34 species 64%	49 species 91%
TOTAL	292	132 species 45%	140 species 48%	271 species 93%

Note: Fish were excluded because they are 100 percent water-associated. "Riparian Dependent" species are closely associated with at least one of the three habitats; "Uses Riparian" species are generally associated with or known to use at least one of the three habitats. Habitat types and species-habitat associations are based on Johnson and O'Neil's (2001) classification system.

Habitat classification scheme

To provide a general description of habitats in the Metro region we selected the habitat classification system described in *Wildlife-Habitat Relationships in Oregon and Washington* (Johnson and O'Neil 2001). Based on wildlife in our region, the book provides species-habitat relationships and cross-references other widely used habitat classification systems. Johnson and O'Neil (2001) describe wildlife habitat as a concept related to a particular wildlife species. Specifically, **habitat** is "an area with the combination of the necessary resources (e.g., food, cover, water) and environmental conditions (temperature, precipitation, presence or absence of predators and competitors) that promotes occupancy by individuals of a given species (or population), and allows those individuals to survive and reproduce" (Johnson and O'Neil 2001). This habitat scheme is provided as a tool to describe habitats and their relationships with species; Metro is not committed to the sole use of this scheme and will use other systems if they are deemed more appropriate. We have included Johnson and O'Neil's cross-references to other well-known schemes for water-associated habitats.

The broadest classification within this scheme is Habitat Type (e.g., Westside Lowlands Conifer-Hardwood Forest, Urban, etc.). There are five upland and three water-associated habitats (including riparian forest) in the Metro region. Each habitat type can be subdivided into structural conditions. For example, forested habitat structural conditions are based on average tree diameter at breast height (dbh), percent canopy cover, and number of canopy layers in the forest (described below). This yields 26 possible structural conditions within each of three forest types, or a total of 78 potential forest/structure combinations. Shrubland and grassland (grasslands have less than 10 percent shrubs) structural conditions include 20 possibilities. Agricultural lands may be cultivated cropland, improved pasture, orchards/vineyards/nursery, modified grasslands, or unimproved pasture. Urban habitats are divided into three categories based on urbanization intensity.

Habitat types and structural conditions constitute the level of detail in this paper, addressed through habitat descriptions and Metro's Species List (Appendix 1). The habitat types are sufficiently broad categories to be feasible in large-scale land use planning. Structural conditions provide a wide variety of finer level descriptions of conditions within each habitat type, and these may be useful for future on-the-ground habitat and species conservation, as well as an aid to determine restoration goals and priorities.

The utility of Johnson and O'Neil's habitat scheme is greatly enhanced by species-habitat/structural relationships for all species in the Metro region except fish. Johnson and O'Neil provide further information on what they term "Habitat Elements," those components of the environment believed to most influence wildlife species' distribution and success. Habitat Elements include attributes such as downed wood and leaf litter, shrub layers within forest stands, fungi, and snags (including decay classes for downed wood and snags); Johnson and O'Neil relate each vertebrate species to this level of detail. Thus, within the context of Johnson and O'Neil's habitat classification scheme, the full complement of wildlife habitats (we only address the first two here) would include:

Wildlife Habitats = Habitat Type(s) + Structural Condition(s) + Habitat Element(s)

Below we describe habitat types and each major group of associated species, based on the scientific literature. Upland habitat and wildlife descriptions are based on the same system and follow a similar format, but are discussed in the ***Upland Habitat*** section. Plant species that typically dominate each habitat type are listed in Johnson and O'Neil (2001). Other habitat classification schemes for riparian may also provide useful or more detailed approaches (e.g., Franklin and Dyrness 1973; Cowardin et al. 1979; Diaz and Mellen 1996; U.S. Fish and Wildlife Service 1997b; Adamus 1998).

Open water (lakes, rivers and streams)

This habitat type, including ponds and reservoirs, is widely distributed in the Metro area and contains four distinct zones: (1) the **littoral zone** is at the edge of lakes and is the most productive of the zones, with diverse aquatic beds and attached emergent wetlands (part of Herbaceous Wetland habitat). (2) The **limnetic zone** is deep open water dominated by **phytoplankton** and freshwater fish, extending to the limits of light penetration. (3) The **profundal zone** is below limnetic zone, and is devoid of plant life and dominated by **detritivores**. (4) The **benthic zone** includes bottom soil and sediments. Ponds and lakes are typically adjacent to Herbaceous Wetlands, while streams and rivers are often adjacent to Westside riparian wetlands or Herbaceous wetlands. Streams and rivers in the Willamette Valley are productive and typically contain high species diversity (Johnson and O'Neil 2001).

This habitat is called riverine and lacustrine in Anderson et al. (1998), Cowardin et al. (1977), Washington Gap Analysis Project (Cassidy 1997), Mayer and Laudenslayer (1988), and Wetzel (1983). However, this habitat is referred to as Open Water in the Oregon Gap II Project (Killsgaard 1999) and Oregon Vegetation Landscape-level Cover Types (Killsgaard and Barrett 1998).

Flooding is a major natural disturbance in these systems. In the Willamette Valley, floods are influenced by precipitation (rather than snowmelt runoff) and thus tend to be short duration events, although their influence on this habitat is profound. Seasonal and decadal trends in precipitation also influence water habitats. In the Metro region beavers played a historic role in creating many ponds and marshes, and are still present in reduced numbers. Human disturbances that negatively influence this habitat type include hydrologic changes, excess nutrient inputs, toxins, loss of habitat and water quality and quantity, and others (see *Impacts of urbanization*). Non-native species, including plants, fish and mollusks, pose a major threat to native organisms in this habitat. Management activities that would improve this habitat include planting and/or retaining vegetative buffers along streams to reduce toxins and sediments, reducing pollutant sources, managing stormwater and maintaining or restoring natural flow regimes, and decreasing impervious surfaces (particularly in close proximity to the stream).

Water is clearly an important resource in the Metro region, and a large number of **species at risk** depend on this habitat. Seventy-five Metro region vertebrate species, excluding fish (which are all dependent on this habitat), are closely associated with Open water habitats, second only to Herbaceous wetlands. Ten non-fish vertebrate species closely associated with this habitat are state- or federally-listed species at risk, plus two Canada Goose subspecies and two **extirpated** species. Twenty native fish species or subspecies are at risk (Appendix 1).

Herbaceous wetlands

Herbaceous wetlands are declining locally and nationally. These wetlands (including marshes, and wet sedge meadows) are sometimes termed “freshwater aquatic beds,” “emergent wetlands,” or “palustrine” habitats. Herbaceous wetlands are permanently, semi-permanently, or seasonally flooded. Patches of this habitat may be found adjacent to all habitats discussed in this section, although most frequently in valley bottoms and high rainfall areas such as the Willamette Valley. These wetlands occur in flat terrain and are typically, but not always, associated with a stream, river channel, or open water. In Willamette Valley riparian corridors, this habitat commonly forms a pattern with Westside riparian-wetlands habitats. Johnson and O’Neil do not make it clear whether springs, seeps and vernal wetlands are included, but our intention is that they be included in this habitat type.

In their widely used wetlands classification system, Cowardin et al. (1979) classify this habitat type as palustrine emergent wetlands. The Oregon Gap II Project (Killsgaard 1999) and Oregon Vegetation Landscape-Level Cover Types (Killsgaard and Barrett 1998) that would represent this type are wet meadow, palustrine emergent, and National Wetland Inventory (NWI) palustrine shrubland.

Herbaceous wetlands include a mixture of emergent herbaceous and grass-like plants, and may include floating or rooting aquatic forbs. A variety of hydrologic regimes limit or exclude woody plant invasion, but in drier areas of the Willamette Valley fire suppression can lead to invasion by Oregon Ash. As with other aquatic habitats, beavers play an important disturbance role in creating and maintaining this habitat. Direct alteration of hydrology (stormwater inputs, channeling, draining and damming) or indirect alteration (road building, vegetation removal, beaver removal) alter the amount and patterns of this habitat.

Excluding fish, 79 vertebrate species in the Metro region are closely associated with this habitat, more than any other habitat. Of these, seven are state or federal at-risk species, plus another two Canada Goose subspecies and one extirpated species. This habitat type also provides important off-channel habitat to salmonids.

Westside riparian-wetlands

Westside riparian-wetlands are patchily distributed along streams and water bodies in lowlands and foothills of the Willamette Valley, and have declined significantly through conversion to urban and agriculture land covers. This habitat often occurs as patches or linear strips within Westside lowlands conifer-hardwood habitats, although Urban and mixed environs is another common habitat within which Westside riparian-wetlands are nested. Herbaceous wetlands and Open water habitats are often nearby. In natural conditions large woody debris is abundant, but tree removal reduces woody debris inputs to terrestrial and aquatic systems.

This habitat includes all palustrine, forested wetlands and scrub-shrub wetlands at lower elevations on the westside, but drier portions of this habitat in riparian floodplains may not qualify as wetlands according to Cowardin's (1979) definition. Much of this habitat is probably not mapped as distinct habitat types by the Gap projects due to the relatively small scale on the landscape and difficulty of distinguishing forested wetlands (Johnson and O'Neil 2001). A portion of this habitat is mapped as the Oregon Gap II Project (Killsgaard 1999) and Oregon Vegetation Landscape-Level Cover Types westside cottonwood riparian gallery, palustrine forest, palustrine shrubland, NWI (National Wetland Inventory) palustrine emergent, and alder/cottonwood riparian gallery (Killsgaard and Barrett 1998).

Riparian plant communities in the Pacific Northwest typically include scattered patches of grasses and herbs on exposed portions of the active channel, with mosaics of herbs, shrubs and deciduous trees in the floodplain (Gregory et al. 1991). Conifers may dominate where surfaces have been stable for long periods of time, such as on old floodplain benches or along lower hillslopes. Forested riparian habitats contain much greater plant volume than non-forested habitats, and quantity and composition of the plants growing along water exert strong influences on animals living in the water and on the land. Much of this remaining habitat in the Metro region is degraded due to human-induced changes in hydrologic and nutrient cycles, but it is nonetheless of primary importance to wildlife in the region.

Riparian habitats are naturally dynamic, formed and regulated to a large extent by natural disturbance regimes. Flood frequency and intensity varies considerably with natural hydrologic regime and geomorphology. Other natural disturbance agents include debris flows, tree windthrow, beavers, and grazing by wild herbivores. Human changes to vegetation along waterways, as well as the addition of impervious surfaces, alter hydrology and otherwise modify this habitat (see *Impacts of urbanization*). Reed canarygrass is an abundant non-native invader in this habitat, along with other non-natives.

This valuable wildlife habitat has more closely associated species (64, excluding fish) than any other terrestrial habitat type, including many amphibians and birds. Eleven of these are species at risk in Oregon and/or nationally; two more are now extirpated from this region. The native turtles appear particularly vulnerable to habitat loss, degradation, fragmentation, and pressure by non-native turtles and bullfrogs (bullfrogs eat young turtles) (Adams 1999; Adams 2000).

Special Habitats of Concern

The Goal 5 Rule for Wildlife Habitat 660-23-110 (2) states that:

> "…local governments shall obtain current habitat inventory information from ODFW and other state and federal agencies. These inventories shall include at least the following: (a) Threatened, endangered, and sensitive wildlife species habitat information;(b) Sensitive bird site inventories; and (c) Wildlife species of concern and/or habitats of concern identified and mapped by ODFW..."

Habitats of Concern and areas vital to sensitive, threatened, or endangered animal or plant communities are an important component of a regional wildlife inventory. Habitats of Concern may include both riparian and upland habitats. A Habitat of Concern is a unique or unusually important wildlife habitat area, described as follows:

- **Priority conservation habitats.** ODFW identifies grasslands, deciduous oak and riparian forests, aquatic habitats, and urban natural area corridors as the top four Willamette Valley habitats at risk. The Oregon Biodiversity Project, in which ODFW and USFWS are partners, identifies native prairie grasslands, oak habitats, wetlands, and bottomland hardwood forest as conservation priorities in the Willamette Valley. The Oregon-Washington chapter of Partners in Flight (ODFW and USFWS are partners) considers grassland-savanna, oak woodland, and riparian forests to be priority conservation habitats. From these sources we conclude that native oak habitats, native grasslands, wetlands, and bottomland hardwood forests are priority conservation habitats. Less than one percent of historic Willamette Valley native oak and grassland habitats still exists. Over 70 percent of the bottomland hardwood forests have been lost. In the Willamette Valley, various sources document wetland losses between 40-57 percent of original, with continuing losses of more than 500 wetland acres per year.

- **Riverine islands and deltas.** Riverine islands and deltas provide unique habitat for shorebirds, waterfowl, nesting terns and gulls, and other wildlife through enriched food resources, sand and mudflats, and protection from predators and disturbance. Macroinvertebrate communities are denser and more diverse around river islands and deltas. Bald eagles winter, breed, and forage on islands in our area. Channel complexity and large wood, which are linked to island formation, have been substantially reduced from historic levels.

- **Habitat patches providing unique or critical wildlife functions.** Patches providing unique or critical wildlife functions should be considered on a site-by-site basis. Such habitats include migration corridors or stopover areas such as grassy hilltops, inter-patch connectors, biologically or geologically unique areas such as rocky outcrops or talus slopes important to many herptiles and bats. Habitat vital for a sensitive species or habitats that support at-risk plants fall into this category.

Impacts of urbanization

Aquatic habitats in urban and urbanizing areas of the Pacific Northwest are the most highly altered of any land use types (R2 Resource Consultants 1996). Habitat loss, alteration, and significant increases in the amount of impervious land cover characterize the Metro region. The

Metro region has lost approximately 400 miles of streams (about 30 percent of the original) (Metro 1997a). In addition, 213 miles are listed by the Department of Environmental Quality as water-quality limited (Oregon Department of Environmental Quality 1996). Ninety-six percent of the land in the Willamette basin under 500 feet in elevation is privately owned and has been converted to agricultural or urban use (Willamette Urban Watershed Network 2000). A recent study of tree cover in the Willamette/Lower Columbia Region found a reduction in tree canopy cover from 46 percent in 1972 to 24 percent at present (American Forests 2001). Average tree cover in the region's urban areas is only 12 percent, down from nearly 21 percent in 1972. Eleven percent of the Metro region's natural areas were lost between 1989-1999, with accompanying adverse effects on watershed hydrology and wildlife habitat. Groundwater volume is also declining (McFarland and Morgan 1996).

A relatively large body of scientific literature documents effects due to urbanization that are similar regardless of study area, and some of these studies are summarized in Appendix 2. Most of urbanization's adverse impacts originate from changes in the amount and timing of water runoff, loss of natural vegetation, or both. Often changes in one result in changes in the other.

Relevance of science in rural forested landscapes to urban systems

Urban ecology is a relatively new scientific field. The question arises as to whether the use of scientific data from non-urban ecosystems (e.g., natural forested habitats) is appropriate in an urban setting, where conditions are significantly different from relatively undisturbed systems. The City of Portland raised this issue to their peer review science panel (City of Portland 2000); reviewers concluded that applying science developed within non-urban forested settings was appropriate in urban habitats, provided that urban research was incorporated as available.

However, urban research is sparse. Scientists know a fair amount about impacts of urbanization on waterways and fish, but resulting ecosystem changes and the cascading effects on other wildlife species and habitats may be subtle and complex. Also, unlike naturally forested ecosystems, in urban ecosystems the removal of vegetation and other consequences to riparian and aquatic habitats are often permanent (Booth 1991).

Nonetheless, all of the natural structures, functions and processes occurring in non-urban settings also occur, mediated by human activities, in urban ecosystems. For example, the discussion of impervious surfaces below was founded on knowledge of the natural hydrologic cycle, augmented by regionally specific urban research. The concept of habitat simplification leading to simplified wildlife communities is well understood in non-urban settings, and can be applied to urban ecology. The impacts of nonnative species on native wildlife relate to competition, predation, and changes in **trophic** levels; these foundations in community ecology are not unique to urban environs. Thus scientific research conducted outside urban systems provides a theoretical framework for urban research, as well as providing **reference conditions** against which the differences between relatively undisturbed and human-altered systems can be compared.

Cumulative impacts

It is critical to recognize the cumulative nature of human impacts within a watershed. Watershed condition is a result of the cumulative effects of past and present human activities (May and Horner 2000). The Oregon Watershed Assessment Manual describes this effect (Watershed Professionals Network 1999):

> Cumulative effects can be defined as the changes to the environment caused by the interaction of natural ecosystem processes with the effects of land use and other human activities distributed through time and over the landscape…Individual actions that by themselves are relatively minor may impact resources when combined with other modifications that have occurred in the watershed. The current habitat condition at any location in a stream is a function of the watershed activities that currently occur upslope and upstream, added to the effect of historical activities. For example, in a typical managed forest, historical streamside timber harvest combined with stream cleaning, splash damming, and use of streams as transportation corridors have resulted in a legacy of low LWD frequency. Downstream in an agricultural area, streams were often channelized and riparian forests were removed. These historical changes combined with present-day expansion of suburban areas, for example, resulted in altered channel conditions throughout the watershed. (page 37)

Thus, accounting for cumulative effects remains one of the greatest challenges for managing wildlife habitats in an urban setting. A local example of cumulative effects follows.

The portion of the Willamette River running through the Metro region is influenced not only by the intensity of urbanization within its own watersheds, but also by the cumulative effects from land use and activities upstream. In December 2000, the Portland Harbor was listed as an EPA Superfund Site (U.S. Environmental Protection Agency 2001a). This six-mile reach of the Willamette River between the southern tip of Sauvie Island and Swan Island exemplifies the difficulties in balancing environmental and economic concerns. The harbor is an international commerce and industry portal contributing substantially to the regional economy, but it also provides a critical migratory corridor and rearing habitat for endangered salmonids and other wildlife (U.S. Environmental Protection Agency 2001a). Industrial facilities line the banks on both sides of the river, private and municipal wastewater outfalls add effluent, and sediments and toxins are input from upstream tributaries. Sediments in this reach of the Willamette contain high levels of many contaminants, including PCBs, heavy metals, arsenic, petroleum hydrocarbons, and pesticides such as DDT. A *Remedial Investigation and Feasibility Study* is the next step, designed to determine how much contamination is present, its location and extent, related threats to the public, and potential cleanup alternatives (U.S. Environmental Protection Agency 2001b). A binding agreement to proceed on this step has been signed by parties that voluntarily came forward to participate in the cleanup process; the EPA has not yet determined all potentially responsible parties.

Impervious surfaces and altered hydrology

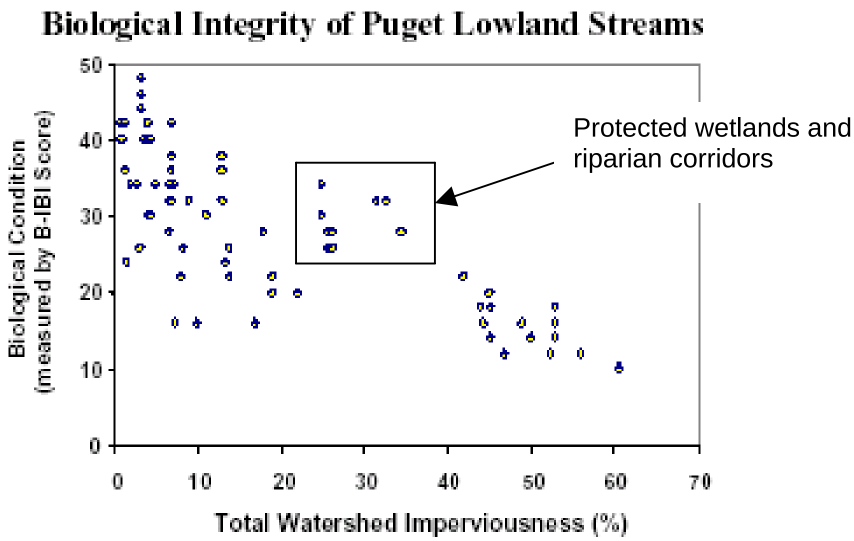
One of the most ubiquitous influences of urbanization on the functions and values of a watershed is the replacement of the natural landscape with pavement and other water-impervious (impenetrable) material such as roads, parking lots, driveways, sidewalks, and rooftops (May et al 1997a; Wilcove et al 1998; Booth 2000). Increased levels of impervious surfaces interrupt the hydrologic cycle, alter stream structure, and degrade the chemical profile of the water that flows through streams. These changes to water storage and delivery harm the environment in a variety of ways, and are cumulative within watersheds (McCarron et al. 1997; May and Horner 2000).

As Metro's (1997) Title 3 white paper indicates, the amount of rainwater that runs off the land rather than infiltrating increases with imperviousness. For example, in areas covered completely with natural vegetation approximately 15 percent of the rainwater runs directly off. In a typical single family home scenario (35-50 percent imperviousness), about 35 percent of the rainwater runs off. In a fully urbanized setting ($\geq$ 75 percent imperviousness), 61 percent of the water may run off the land. Local streams are adapted to local, native conditions; during storm events, all that water running quickly into streams acts like a giant corkscrew augering right down the stream channel. Streams are **incised** and the beds are widened, more sediments, toxins and water enter the system, and much of the wildlife that once lived in the stream disappears.

The percent of impervious surfaces within a watershed can indicate the intensity of urbanization and associated negative ecological impacts, but there is evidence that these effects can be mitigated. Research in the Pacific Northwest and in other regions indicates that when a watershed's **imperviousness** reaches approximately 5-10 percent, stream ecosystems and biotic communities show measurable evidence of degradation (Schueler 1994; Arnold and Gibbons 1996; Spence et al. 1996; May et al. 1997a); adverse ecological effects typically become quite severe when imperviousness reaches approximately 25-30 percent. Some researchers consider 10 percent imperviousness to be the lower end of an ecological threshold (the "65/10" rule, in which imperviousness targets are <10 percent and forest cover targets are 65 percent; see Booth 2000). However, recent evidence suggests that in fact, there is no lower threshold, and that degradation can occur at any level of imperviousness; further, it appears that activities such as protecting wetlands and riparian areas help lessen the impacts of urbanization (Figure 5) (Booth 2000). Thus, mitigating the effects of imperviousness, combined with maintaining relatively high levels of forest canopy cover, are probably keys to maintaining or improving ecological conditions in an urban setting (see *Restoration section* for some mitigation examples).

In general, the reason for the harmful effects of imperviousness is a combination of factors affecting the quality, quantity, and timing of stormwater delivered to the stream. Impervious surfaces prevent precipitation from infiltrating the soil and moving slowly to the stream, thereby reducing the "sponge" area in a watershed. Water may move quickly from impervious surfaces to the stream overland, or across the surface, carrying with it sediment and pollution; or it may be routed via pipes directly to the stream. The natural patterns of water delivery and filtration are either modified or completely bypassed. Stormwater from pipes is particularly damaging because it is discharged at high volumes and velocities, harming stream channels and altering the wildlife capable of living in or near the stream. The primary concept is that impervious surface and piping effects are highly detrimental to hydrology and waterways, but these effects may be decreased through some mitigation approaches (Figure 5).

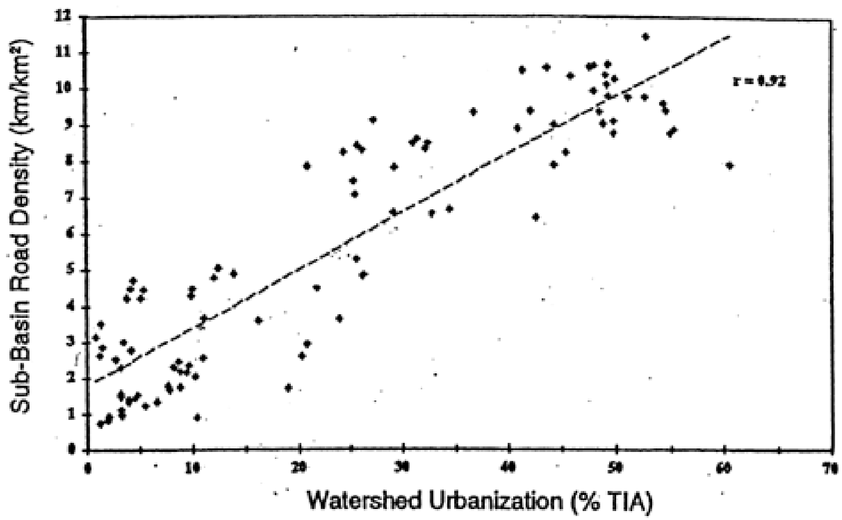
Figure 5. The influence of protecting wetlands and riparian corridors on aquatic biological integrity.



Compilation of biological data on Puget Lowland watersheds, reported by Kleindl (1995), May (1996), and Morley (2000). The pattern of progressive decline with increasing imperviousness is evident only in the upper bound of the data; significant degradation can occur at *any* level of human disturbance (at least as measured by impervious cover). Modified from Booth 2000 (the "protected wetlands and riparian corridors" portion of this graph was obtained from a talk given by James Karr at the 2001 At Water's Edge conference).

Imperviousness is typically quantified through two methods. The most common method is to measure the proportion of the basin area covered by imperviousness, or the **total impervious area** (TIA) (Schueler 1994). TIA may be measured directly through aerial photos, GIS layers or satellite data. An alternative TIA measure is to use GIS data to calculate the amount of "natural" surfaces (e.g. vegetation and soils), then subtract the proportion of natural surfaces from the total to estimate TIA. Transportation systems (streets and parking lots) typically comprise a majority of impervious surfaces, and road density is sometimes used as a proxy for TIA in jurisdictions lacking better data (Schueler 1995; May et al. 1997b). In the Puget Sound region, roads and parking lots account for over 60 percent of basin imperviousness in suburban areas and is strongly correlated with TIA (May et al. 1997b) (Figure 6). Ideally, however, TIA should be used rather than road density because it provides a more accurate measure of imperviousness.

Figure 6. Sub-basin road density vs. watershed urbanization (percent TIA).



Source: May et al. 1997.

The second method of measuring imperviousness is **effective impervious area** (EIA), referring specifically to the area where there is no opportunity for runoff from an impervious surface to infiltrate into the soil before it reaches a conveyance system (pipe, ditch, stream, etc.) (Washington State Department of Ecology 2000). In other words, impervious surfaces may not be considered part of EIA if the water has a chance to soak in. Table 2 provides an estimate of TIA versus EIA (without impervious mitigation measures) under various development intensities. To illustrate how EIA differs from TIA, consider a building with a driveway and roof, where stormwater runs off these surfaces and is routed through curbs and gutters to a storm drain, flowing directly to the stream. In this case, TIA would be the same as EIA. If the roof gutters were instead routed to a vegetated area, then the EIA would be less than the TIA. EIA could be further reduced by removing curbs along the driveway and allowing water to infiltrate into vegetation, soils or gravel, but TIA would remain the same unless impervious surfaces were removed.

Table 2. Presumed relationship between land use, TIA and EIA.

LAND USE	TIA (%)	EIA (%)
Low density residential (1 unit per 2-5 acres)	10	4
Medium density residential (1 unit per acre)	20	10
"Suburban" density (4 units per acre)	35	24
High density (multi-family or 8+ units per acre)	60	48
Commercial and industrial	90	86

Source: Booth and Jackson (1997)

Currently, EIA may be the most appropriate estimate of human influence on hydrology because it incorporates measures to mitigate adverse impacts. However, EIA may be difficult to measure, in part because the extent to which such mitigation efforts actually work is unknown. When EIA is significantly less than TIA, there is little doubt that imperviousness exerts a weaker influence on the environment than if the two were equal. The magnitude of this difference is unknown, but reducing effective imperviousness is clearly an important strategy in urban ecosystems.

The result of greater stormwater volumes traveling over impervious surfaces and being delivered too rapidly to streams is increased stream **flashiness** (Figure 7) and a reduction in summer base flows, sometimes causing perennial streams to turn intermittent or dry up completely (Harbor 1994). As a result, urbanized watersheds are prone to more frequent and bigger floods (Sovern and Washington 1996). For example, in King County, Washington, downstream from urbanized watersheds the largest floods were two to three times bigger than in nearby natural systems, while the frequency of smaller floods increased as much as tenfold (Booth 2000). Wigmosta et al. (1994) estimate that Pacific Northwest areas covered by impervious surfaces typical of suburban development have 90 percent less water storage capacity than naturally forested areas of the same size.

Local jurisdictions' code may impede low-impact development solutions designed to reduce stormwater impacts. In 2004, the Audubon Society of Portland produced a useful report entitled *Stormwater/Pavement Impacts Reduction (SPIR) Project Report* (Audubon Society of Portland 2004).

Floodplain and wetland alterations

Floodplains play a critical role in transporting high flows and moderating the effects of peak floods. Wetlands are usually part of the floodplain system. Stream degradation through incision and artificial barriers such as dams, floodwalls and levees, as well as wetland draining and alteration, may render a stream incapable of dispersing water, soil and nutrients to the floodplain (Rosgen 1993; Spence et al. 1996; Poff et al. 1997).

Recent research in Great Britain indicates that planting trees in the floodplain helps moderate floods a great deal, even while the trees are still young (The Economist, 21 October 2004). Comparing water infiltration, researchers measured nearly none in heavily grazed pastures. Ten cm per hour infiltrated into less heavily grazed pastures. But in areas planted with young (7-year-old) broad-leaved trees, 80 cm per hour soaked in.

In 1992, Holland et al. (1995) found that 40% of wetlands identified by the National Wetland Inventory in 1981/1982 had disappeared, with conversion to urban land the most common cause. A quarter of the remaining wetlands they studied were severely degraded by human activities.

Dams

Although dams provide many societal benefits including power generation, water storage, flood control, agricultural irrigation, and recreation, they influence watershed functions in fundamental ways (FISRWG 1998). Ecological problems associated with dams include erratic water volume and velocity (altered hydrology), increased streambank erosion, loss and fragmentation of riparian habitat, altered water chemistry, altered instream habitat, and blocked fish and instream wildlife passage (see also Tables 3 and 4). More than 85 percent of the inland waterways within the continental United States are now artificially controlled through dams (National Research Council [NRC] 1992), including all major Metro-region rivers. All salmon and steelhead in the Columbia Basin are affected to some degree by damming activities (Federal Caucus 2000).

Floodwalls and levees

Floodwalls and levees, installed to control floodwater and limit the access of a stream to its floodplain, cause hydrologic fragmentation by disrupting lateral and downstream stream-floodplain interactions. The floodwalls along Portland's downtown area provide a local example. Floodwalls and levees tend to eliminate riparian vegetation, increase flood heights and water velocities, and reduce sinuosity (Poff et al. 1997). In headwater and midsection stream zones, this leads to increased bank and channel erosion and channel incision. In lower reaches where velocity is slower, sediments drop out of the water, leading to excessive sedimentation. Thus in addition to onsite soil, vegetation and water loss due to these artificial barriers, fish and wildlife habitat is degraded in the area near the structure and downstream (Riley 1998).

Wetland loss and alteration

Natural wetland functions are adversely impacted by urban development when wetlands are fully or partially filled, drained, relocated, or otherwise substantially altered. Altered hydrology modifies wetlands in fundamental ways, including a shift toward upland plants and wildlife (Ehrenfeld and Schneider 1993; Ehrenfeld 2000). Urbanization is implicated in wetland loss in most U.S. watersheds and may account for as much as 58 percent of total wetland loss nationwide (Opheim 1997). Over half of the wetlands in the contiguous U.S. have been lost since the 1780's, and recent research indicates that wetland mitigation programs designed to result in "no net loss" are not working (Whigham 1999; National Academy of Sciences 2001).

In the Willamette Valley, various sources document wetland losses between 40-57 percent of original (Philip Williams and Associates, Ltd. 1996; Morlan 2000). Between 1982 and 1994 alone, 6,549 acres (9.9 square miles) of wetlands were lost in the Willamette Valley, with 28 percent of the total loss due directly to urbanization (Daggett et al. 1998). This excludes small wetlands <0.25 acres, which could not be assessed but may be critical to large-scale amphibian population dynamics (see Gibbs 1993) and surely experienced losses. The Willamette Valley continues to lose more than 500 wetland acres per year (Morlan 2000). For salmon, this translates to loss of off-channel winter salmonid habitat, summer rearing diversity, cool water sources for summer rearing, and flow buffering (Martin 1998). For wetland-dependent species such as amphibians and some bird species, loss of half of the total habitat over time is a severe consequence.

It is important to recognize that not all wetlands are created equal. Whigham (1999) notes, "From an ecological perspective, dry-end wetlands such as isolated seasonal wetlands and riparian wetlands associated with first order streams may be the most important landscape elements. They often support a high biodiversity and they are

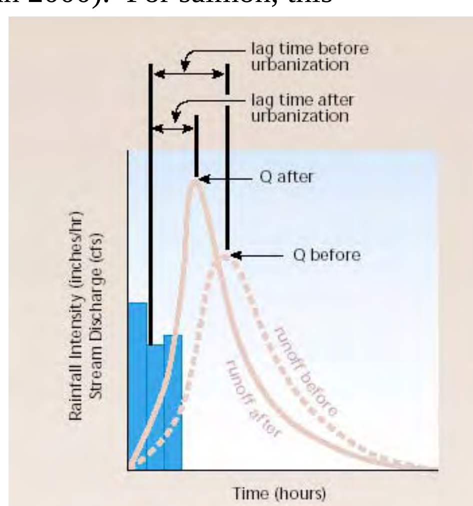


Figure 7. A comparison of hydrographs before and after urbanization. The discharge curve is higher and steeper for urban streams than for natural streams. (Source: FIRSWG 1988)

impacted by human activities more than other types of wetlands." Further, created wetlands may differ quite markedly from natural wetlands, thus achievement of "no net loss" may nonetheless result in substantially reduced wetland ecological functions (Brown and Lant 1999; Whigham 1999).

The vegetation unique to wetland areas is frequently removed as a result of urbanization, and altered stream channels (discussed next) effectively disconnect the stream from the wetlands and natural floodplain. Impervious surfaces such as buildings and parking lots aggravate the problem by causing rapid water runoff, altering the **hydrograph** by affecting the frequency, duration and magnitude of flood events, and reducing wetland infiltration and water storage (Figure 7) (Booth and Jackson 1997). As Figure 7 illustrates, the hydrograph's peak is taller and occurs sooner (a bigger flood that quickly overwhelms water storage) and the shape of the peak is narrower (shorter lag time, e.g., the water is not retained on the land). Many other adverse effects are documented, and some of these are listed in Table 3.

Table 3. Some effects of urbanization on wetland hydrology, geomorphology, plants and animals. Most of these effects also occur in or influence streams and riparian areas.

Hydrology:
Decreased stormwater storage results in increased surface runoff (= increased surface water input to wetland)
Increased stormwater discharge relative to baseflow discharge results in increased erosive force within stream channels
Changes in water quality (increased turbidity, increased nutrients, metals, organic pollutants, decreased O_2, etc.)
Culverts, outfalls, etc. result in more variable baseflow and low-flow conditions
Decreased groundwater recharge results in decreased groundwater flow, which reduced baseflow and may eliminate dry-season streamflow
Increased flood frequency and magnitude result in more scour of wetland surface, physical disturbance of vegetation
Increase in range of flow rates (low flows are diminished; high flows are augmented) may deprive wetlands of water during dry weather
Greater regulation of flows decreases magnitude of spring flush
Geomorphology:
Decreased sinuosity of wetland/upland edge reduces amount of ecotone habitat
Decreased channel sinuosity results in increased stream water discharge velocity to receiving wetlands
Alterations in shape of slopes (e.g., convexity) affects water gathering or water-disseminating properties
Erosion along banks from increased flood peak flow increases cross-sectional area of stream channels
Vegetation:
Large numbers of exotic species present; large and numerous sources for continuous re-invasion of exotics
Large amounts of land with recently disturbed soils suitable for weedy, invasive species
Depauparate species pool
Restricted pool of pollinators and seed dispersers
Chemical changes and physical impediments to growth associated with the presence of trash and pollutants
Small remnant patches of habitat not connected to other natural vegetation
Human-enhanced dispersal of some species
Trampling along wetland edges and periodically unflooded areas
Fauna:
Loss of critical habitat
Benefits species with small home ranges, high reproductive rates
Large predators virtually non-existent; increased small mammal abundance for some species, while others are susceptible to extirpation due to fragmentation and isolation
"Edge" species benefit, to the detriment of forest-interior species
Absence of wetland/upland zones of transition
Human presence and noise disrupt normal behaviors

Source: Modified from Ehrenfeld, 2000.

Stream channel modification

The hydrologic changes discussed above modify the stream channel. Rapid runoff associated with increased stormwater velocity and volume quickly erode and incise (**entrench**) the stream channel and banks. Channels widen and straighten (or are intentionally modified in these ways) to accommodate higher flows. This circumvents the natural evolution process of the channel; LWD, ponds, pools, riffles, streambanks and sandbars are simplified or washed away, eliminating critical habitat for fish, waterfowl, and other species (Arnold and Gibbons 1996; Spence et al. 1996; Prichard et al. 1998). For example, Coho salmon are extremely sensitive to alterations in channel characteristics because of their need for smaller streams, relatively low velocity niches, and large pools typical of undisturbed conditions in the Pacific Northwest. As impervious surfaces increase, fish species diversity and Coho abundance in the Pacific Northwest tend to decline (Lucchetti and Fuerstenberg 1993b).

Piping and culverting

Development practices such as piping and culverting caused the loss of about 400 miles of streams in the Metro Region (Metro Disappering Streams Map 1999). For example, in the City of Portland, the majority of streams that once existed on the inner east side of the Willamette River, as well as significant westside streams, were piped underground, resulting in a loss of the majority of the stream's ecological functions. Water is also frequently piped from rooftops, storm drains, and impervious surfaces. Piping water directly to the stream bypasses natural stream/vegetation interactions such as transport of organic material and sediments, erosion control, and filtration of toxins and excess nutrients; in addition, piping causes high volume, high velocity flows that directly enter the stream channel, altering channel form and functions (Booth 1991; R2 Resource Consultants 2000).

Piped streams and culverts also create impassable fish barriers that block entire stream reaches to migratory fish species and isolate remaining species, putting these populations at risk of reduced genetic diversity and/or extinction (Warren and Pardew 1998; May et. al 1997a; Schueler 1995; R2 Resource Consultants 2000). Fish barriers are addressed further in the ***Restoration*** section.

Channel straightening and armoring

Streams in urban settings are often intentionally widened, deepened, straightened, and sometimes armored with hard materials in order to confine flows, stabilize streambanks and increase a stream's capacity for localized flood control (R2 Resource Consultants 2000). In truth, such activities simply result in moving water more quickly downstream, disconnecting the stream from its floodplain, degrading riparian habitat and creating more problems elsewhere (e.g., Griggs 1981). These changes, accompanied by increased flood frequency and magnitude, result in a loss of stream complexity and off-channel fish and wildlife habitat (Booth 1991; Beechie and Sibley 1997).

Local examples

Johnson Creek watershed

The Johnson Creek watershed, a 135-km (52-square mile) area draining urbanized portions of Clackamas and Multnomah Counties, provides a local example of a watershed profoundly influenced by urbanization, but where important positive changes are taking place. This stream has been altered through clearing of riparian vegetation, damming, widening, deepening and armoring of the channel, and floodplain and upland development. Salmonids were once sufficiently abundant to support a small commercial fishery near SE 45th Avenue and Johnson Creek Boulevard (City of Portland 2000). However, steelhead were ESA-listed in 1998 and a coastal cutthroat trout listing is pending. In most reaches within the Johnson Creek watershed, physical habitat complexity normally associated with salmonid streams has been simplified, modified or eliminated. Water temperatures and fecal coliform levels make this stream among the most polluted in the Metro region (Environmental Quality 1998; Cude 2001). Flood frequency and severity have increased substantially over the past century.

The City of Portland's Bureau of Environmental Services has mapped the impervious surfaces for sub-units within the watershed using three classes: "sensitive" (0 to 10 percent impervious), "impacted" (11-25 percent), and "non-supporting" (26-100 percent impervious) (Meross 2000). A fourth classification delineates areas where no overland or piped water flows into the stream or its tributaries because water drains to sumps or a combined sewer system. Although the watershed's overall TIA is not provided, road densities suggest a TIA of approximately 35 percent (see Figure 6). However, 35 percent of the watershed is not piped directly to the stream but instead infiltrates groundwater through sump pumps, is directed to Portland's Combined Sewer System, or is hydrologically disconnected (see Map 6 in Meross 2000). Thus, EIA is probably substantially lower than TIA, but the disconnection of a third of the watershed's surfaces from the stream surely alters hydrologic patterns. Development near and within Johnson Creek's floodplains, combined with cumulative effects throughout the watershed, influence the stream system's water quality and hydrologic patterns. These issues illustrate the complex nature of urban effects on natural systems.

Multi-jurisdictional efforts to restore function to the Johnson Creek watershed are currently underway, including small dam removal, reconnecting floodplains and backwater channels to the stream, increasing sinuosity, and adding wetlands, vegetation and LWD. Houses within the floodplain are being purchased and removed from the floodplain in a "willing seller" program. Watershed-scale restoration efforts such as this have a better chance of success than site-specific restoration because they address the cumulative impacts of adjacent land use.

Pleasant Valley area

The Pleasant Valley area is a relatively rural watershed currently under study by the City of Portland and others. The watershed contains seven subwatersheds, including three below 10 percent TIA and four in the 11-25 percent range. All but one of these subwatersheds have been assessed (through GIS modeling and field data) as ecologically impaired, primarily due to past and current agricultural activities. Planners for this developing watershed are exploring whether sufficiently aggressive design standards for reducing EIA may make it possible to approach relatively high levels of TIA (e.g., up to 40 percent) in a subwatershed, yet still maintain properly functioning conditions similar to those typical at much lower TIA levels.

Some uncertainties arise when planning developments to reduce impervious surface impacts. For example, what will the TIA and EIA be at full build-out? How do we urbanize in the most ecologically sound way, and what is the EIA threshold below which it is possible to sustain ecological functions? The precise amount of impact reduction (mitigation) that reducing EIA might have is unknown and probably depends on the particular mitigation activity. Research into this question would benefit land use planning.

Impact of other land uses on stormwater runoff

Urbanization is not the only land use influencing watersheds in the Metro region. Other human activities, such as rural development and agriculture, road and dam building, and forestry, also routinely occur near and upstream of urban areas. Table 4 lists some of the typical negative effects on waterways caused by urbanization and other human-associated activities.

Table 4. Summary of potential effects of various land uses on riparian habitat elements needed by fish and wildlife.

Potential changes in riparian elements needed by fish and wildlife	Land Use					
	Urbanization	Agriculture	Recreation	Roads	Dams	Forestry
Riparian Habitat:						
Altered microclimate	X	X	X	X	X	X
Reduction of large woody debris	X	X	X	X	X	X
Habitat loss/fragmentation	X	X	X	X	X	X
Removal of riparian vegetation	X	X	X	X	X	X
Soil compaction/deformation	X	X	X	X		X
Loss of habitat connectivity	X	X	X	X		X
Reduction of structural and functional diversity	X	X	X	X		X
Stream Banks and Channel:						
Stream channel scouring	X	X	X	X		X
Increased stream bank erosion	X	X	X	X	X	X
Stream channel changes (width, depth)	X	X	X	X	X	X
Stream channelization (straightening)	X	X		X		X
Loss of fish passage	X	X		X	X	X
Loss of large woody debris	X	X	X	X	X	X
Reduction of structural and functional diversity	X	X		X	X	X
Hydrology and Water Quality:						
Changes in basin hydrology	X	X		X	X	X
Reduced water velocity	X	X			X	X
Increased surface water flows	X	X	X	X		X
Reduction of water storage capacity	X	X		X		X
Water withdrawal	X	X	X		X	
Increased sedimentation	X	X	X	X	X	X
Increased stream temperatures	X	X	X	X	X	X
Water contamination	X	X	X	X		X

Source: Knutson and Naef 1997.

Riparian vegetation loss and alteration

Habitat loss

Streams form the backbone for some of the most lush and diverse habitats available in the Metro region because they are highly productive and naturally collect nutrients, seeds, soil, and high quality food resources such as insects. In addition, all animals require water to live. As such, riparian areas are fundamentally important to wildlife (as Metro's Species List demonstrates). Loss of access to these habitats through removal, fragmentation or degradation harms wildlife. Riparian habitat loss is well documented in the region (e.g., Metro 1999; Yeakley et al. 2005). Habitat fragmentation is described in the ***Upland Habitat*** section, but also applies to riparian habitats. We described the functions of riparian vegetation above; here we focus primarily on the impacts of riparian habitat loss and hydrologic changes in a watershed.

Severely altered and unpredictable hydrologic regimes may strip riparian vegetation and prevent naturally adapted floodplain plants from colonizing sandbars and streambanks (Booth 1991; Schueler 1995). Groundwater levels may also become less predictable in urbanized watersheds, and riparian-specialist plants such as black cottonwood depend on relatively predictable groundwater levels to become established (Scott et al. 1999; Law et al. 2000). Riparian vegetation filters sediments and soil, slows runoff and stabilizes streambanks; without vegetation, stream banks and channels become damaged. Hydrology and riparian vegetation are linked, and changes in one create changes in the other. Ideally, native riparian vegetation should be present in some amount along every stream in the region.

Altered microclimate

Riparian vegetation creates an instream microclimate that maintains relatively constant water temperatures; when a riparian forest is removed, the monthly mean maximum temperature along smaller streams may increase 7-8° C (Budd et al. 1987). Vegetation also influences microclimates on the land by blocking wind, moderating temperatures, and increasing humidity. Widespread microclimate alterations change plant and animal communities (Saunders et al. 1999; Gehlhausen et al. 2000; Laurance et al. 2000). In terrestrial habitats, microclimate is influenced by edge effects (see also ***Riparian area width***), thus habitat fragmentation, including patch size and shape, influences local riparian microclimates.

Altered forest structure and composition

Forests in an urban setting are prone to structural simplification and invasion by nonnative species, and these effects are exacerbated in narrow forests (Marzluff et al. 1998; Pimental 2000). Local research provides some guidance on riparian corridor widths needed to control these influences (Hennings 2001; Hennings 2003; Hennings and Edge 2003; see also ***Riparian area width***.)

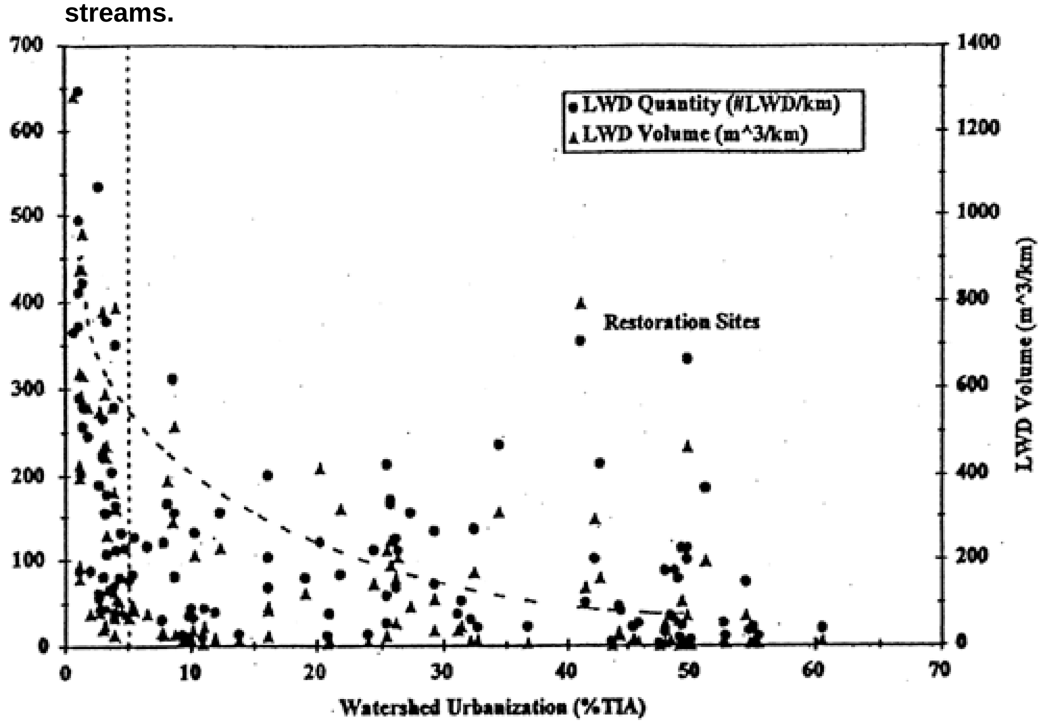
Loss of large woody debris and organic matter

Woody debris and vegetation both in the stream channel and in the floodplain add structural complexity and provide organic matter that becomes part of the food chain (Adams 1994; Prichard et al. 1998). These structures are often intentionally removed; for example, between 1867 and 1912, 88 km (55 miles) of the Willamette River above Albany, Oregon were improved for navigation by removing an average 61 snags per kilometer (Sedell et al. 1990). Large wood may also be removed from streams in an attempt to reduce flooding. In urban streams of the Pacific Northwest, large wood is significantly depleted through washout, downcutting, and direct removal (Booth et al. 1997). In the Puget Sound region, the amount of large woody debris in the channel is related to TIA (Figure 8), and drops off significantly after approximately five percent TIA (May et al. 1997a). The removal of riparian vegetation also results in loss of terrestrial LWD critical to soil health and wildlife habitat (Maser and Trappe 1984; FEMAT 1993). Retention of these materials is vital to a watershed's capacity to support fish and wildlife.

Beyond the structural importance of LWD, other, smaller organic debris provides carbon, the basic fuel for aquatic and terrestrial food webs (Allan 1995). Removing riparian vegetation also removes the primary source of these materials, reducing the stream's **carrying capacity** for organisms (Brown and Krygier 1970). In addition, when flow rates increase and channels are simplified, the retention time of organic debris is decreased because it quickly washes downstream (Webster and Meyer 1997). Thus urbanized streams tend to contain less food than undisturbed watersheds.

Spawning salmon and salmon carcasses provide marine-derived nutrients to many aquatic and terrestrial wildlife species. According to Cederholm et al. (2000): "The loss or severe depletion of **anadromous fish** stocks could have major effects on the population biology (i.e., age-class, longevity, dispersal ability) of many species of wildlife and thus on the overall health and functioning of natural communities…"

Figure 8. LWD quantity and watershed urbanization (percentTIA) in Puget Sound Lowlands streams.



Source: Horner and May 1998.

Pollution – thermal, physical and chemical

Thermal pollution: water temperature and dissolved oxygen

Water temperature is influenced by a variety of factors including streamflow, elevation, amount of shade, surface/groundwater interactions, undercut embankments, surface area, depth, and stream velocity (Budd et al. 1987). Urban streams tend to be warmer than non-urban streams; during warmer months, water flowing over impervious surfaces is often heated to 10 or 12 degrees above the temperature of water that passes through fields and forests (Budd et al. 1987; Schueler 1994). Warmer water cannot hold as much oxygen as cold water. Higher stream temperatures also increase metabolic rates, thus an organism living in warmer water needs more oxygen than the same species in cold water, yet less oxygen is available in warmer water (Spence et al. 1996).

Reduced dissolved oxygen levels can adversely affect salmon egg incubation, growth and development of juveniles, and behavior and physiology of adult fish (Pauley et al. 1986; Spence et al. 1996). For example, a slight increase in temperature at the low end of the optimal temperature range for incubation can cause early emergence of fry from the gravel, increasing exposure to high-flow events and flushing them downstream, in addition to other problems discussed earlier. Most salmon cannot tolerate temperatures above 23-26° C (73-79°F) for an extended period of time (Beauchamp et al. 1983; Pauley et al. 1989).

Physical pollution: sediments and sedimentation

Hydrology, geomorphology and vegetation influence the size and amounts of sediments (including gravel) delivered to the stream system. In urbanized watersheds, fine sediments are increased and approximately two-thirds of all sediments delivered into the stream originates from channel erosion, with the remainder arriving from upland (see Pollution discussion below) and upstream (Trimble 1997; Wood and Armitage 1997). Bank erosion is 30 times more common on non-vegetated streambanks exposed to currents than on vegetated banks (Beeson and Doyle 1995). Construction sites, although somewhat temporary in nature, cause significant erosion and transport of fine sediments to the stream (Spence et al. 1996), and each year in the U.S. an estimated 80 million tons of sediment are washed from construction sites into water bodies (Goldman et al. 1986).

Upon delivery to streams, these sediments are either suspended in the streamwater (creating increased turbidity) or deposited on the streambed (creating sediment build-up and embeddedness). High turbidity clogs fish gills and makes it hard to breath, and adult migrating salmon have been known to stop movement when encountering excessive turbidity (Pauley et al. 1986; Pauley et al. 1989). However, deposited sediments generally have a greater impact on fish than suspended sediments. Salmon, salamanders and many aquatic insects need relatively sediment-free gravel beds with suitable gravel in which to reproduce (Hawkins et al. 1983; May et al. 1997a). Fine sediment deposited on gravel can smother developing salmon eggs, inhibit fry emergence from spawning gravel and limit the production of benthic invertebrates, an important food source for fish and other aquatic species (Beauchamp et al. 1983).

At the same time, storage of sediments in the streambed is an important part of healthy stream function. For example, instream LWD plays an important role in sediment storage; the removal of large organic debris obstructing anadromous fish passage in an Oregon Coast Range stream accelerated downcutting of previously stored sediments, resulting in erosion of more than 5,000 cubic meters of sediment along a 250 m reach the first winter after debris removal (Beschta 1979). Problems occur when the volume of sediments entering waterways overload the stream system's natural capacity to store and transport the sediments.

Chemical pollution

Urban areas are where human population densities are highest. Humans are the primary source of pollutants, thus urbanized watersheds virtually always have pollution and water quality issues. Pollution can destroy food webs within stream systems. Impervious surfaces collect and concentrate pollutants from different sources and deliver these materials to streams during storms, and prevent percolation and natural filtering by soil and vegetation (Booth 1991; Arnold and Gibbons 1996; May et al 1997a). Concentrations of pollutants in streams increase with TIA (Schueler 1994; May et al. 1997a), and data collected in the Pacific Northwest suggest that pollution from urban areas is harming anadromous salmonids (Spence et al. 1996). Common urban pollutants include nutrients such as phosphorus and nitrogen, pesticides, bacteria, and miscellaneous contaminants such as PCBs and heavy metals. Development type influences the pollutants imposed on the stream system; for example, E. coli and phosphorus tends to be contributed from residential developments, whereas industrial areas tend to contribute high quantities of heavy metals (Table 5) (Arnold and Gibbons 1996; Morrisey et al. 2000).

Table 5. Typical urban pollutants. Surfaces exhibiting highest levels of runoff-borne pollutants, out of twelve surface types sampled in selected urban areas in Wisconsin.

	SURFACE		
POLLUTANT	**Highest levels**	**Second highest levels**	**Third highest levels**
E. coli (bacteria)	Residential feeder streets	Residential collector streets	Residential lawns
Solids (sediment)	Industrial collector streets	Industrial arterial streets	Residential feeder streets
Total phosphorus	Residential lawns	Industrial collector streets	Residential feeder streets
Zinc	Industrial roofs	Industrial arterial streets	Commercial arterial streets
Cadmium	Industrial collector streets	Industrial arterial streets	Commercial arterial streets
Copper	Industrial collector streets	Industrial arterial streets	Residential collector streets

Source: Arnold and Gibbons 1996

Pesticides

Farming and urban landscaping practices over the last half-century have resulted in an extraordinary increase in pesticide use, but effects on wildlife are not well known. Pesticides in urban areas originate primarily from lawn and garden care (Stinson and Bromley 1991). On a per-acre basis, urban land use contributes more pesticides than agriculture.

Aquatic organisms are particularly susceptible to water-borne toxins and typically have low tolerance levels; for example, low levels of **neurotoxic** pesticides such as Diazanon impair Chinook salmon's defensive olfactory responses and homing behaviors (Scholz et al. 2000). On land, the effects of pesticides have been studied most extensively for birds. Various pesticides have been responsible for numerous bird kills, and non-lethal and indirect exposure of terrestrial species to pesticides can lead to increased susceptibility to predation as well as changes in avian egg incubation behavior. Repeated pesticide exposure also adversely affects nutrition, reproduction and growth of animals such as gamebirds and waterfowl (Bennett 1992).

Some pesticides **bioaccumulate** in the organism and may remain in the environment for many decades. For example, DDT, a highly toxic form of **organochlorine pesticide** that was banned in the 1970's, is still routinely detected in Willamette Valley farm fields and organisms. For example, in the Tualatin Basin concentrations of organochlorine compounds in fish tissue usually exceeded those in streambed sediment concentrations by at least 10-fold (Bonn 1999). In the Portland/Vancouver area of the Columbia River, River otters have abnormally high concentrations of organochlorine and dioxin compounds (McCarthy and Gale 1999). Bald eagle eggs in the Columbia Slough area have been found to contain unsafe levels of DDE (a metabolite of DDT), PCBs, and dioxins and other toxins; the productivity of lower Columbia River eagles is well below levels of other eagle populations in the area (Lower Columbia River Estuary Program [LCREP] 1999).

Fecal coliform

Fecal coliform refers to the group of harmful bacteria present in animal (including human) feces (Pandey and Musarrat 1993). Escherichia coli (E. coli), a common type of fecal bacteria, may be fatal if left untreated (Ries et al. 1992; Carrasco et al. 1997; Oberhelman et al. 1998). In Washington State Taylor et al. (1995) found significant fecal coliform increases in urban wetlands as TIA exceeded 3.5 percent. Urban stormwater discharge, sewer overflows, and sewer pipe and septic system leakage are a primary means of these bacteria reaching urban waterways (Gibson et al. 1998). Fecal coliform may also enter waterways through overland flow, particularly runoff from residential streets, often in the form of pet feces.

The best way to prevent excessive fecal coliform from reaching streams is to remove the source (e.g., direct sewer overflow). Although that fails to prevent contamination from overland flow, appropriate forest buffers may effectively trap fecal coliform arriving through this route. Pennsylvania researchers found greatly reduced fecal coliform levels in areas where at least 50 percent of the riparian vegetation was intact within 100m (328 ft) of the stream (Brenner et al. 1991).

PCBs, heavy metals and other contaminants

Organochlorine compounds such as polychlorinated biphenyls (PCBs), heavy metals, and an assortment of other contaminants harm fish and wildlife (Rutherford and Mellow 1994). Although trace levels of heavy metals occur naturally, higher levels are toxic to fish and wildlife (May et al. 1997a). Metal contaminants increase in proportion with urbanization (Pouyat et al. 1995; Morrisey et al. 2000; Yuan et al. 2001). Industry and automobiles appear to be the primary sources in urban areas. In addition to heavy metals, hydrocarbons (gas and oil), toxins from rooftops, and industrial and household chemicals (e.g., paint, cleaning products) pollute urban streams (Gavens et al. 1982; Ely 1995). In London, Gavens et al. (1982) found a 3- to 10-fold increase in hydrocarbons in river sediments over a 120-year period. Arkoosh et al. (1991) found that juvenile Chinook salmon migrating through an urban estuary contaminated with PCBs bioaccumulated these pollutants and exhibited a suppressed immune response, whereas immune systems of uncontaminated fish in a nearby rural estuary were unaffected.

Nitrogen and phosphorus

Nitrogen and phosphorus exist naturally and provide nourishment to plants and animals. These are also common fertilizer components, and increase with urbanization (Arnold and Gibbons 1996; Corbett et al. 1997). Phosphorus is typically the biggest problem in urban watersheds, whereas nitrogen is the issue in agricultural watersheds. In Portland, groundwater test wells above and below residential developments showed significantly elevated phosphorus levels downslope of the developments (Sonoda et al. 2001). In Washington, total phosphorus levels in wetlands rose significantly when TIA exceeded just 3.5 percent (Arnold and Gibbons 1996). Increased quantities of nutrients delivered to the stream in the form of **wastewater** effluent, landscaping runoff, and agricultural runoff can lead to unrestricted instream plant growth (algae blooms); the process of plant decay consumes most of the oxygen in the stream, greatly reducing the quality of aquatic habitat (Arnold and Gibbons 1996; R2 Resource Consultants 2000). Riparian forests act as short- and long-term nutrient filters and sinks (Lowrance et al. 1984; Peterjohn and Correll 1984; Lowrance et al. 1997).

Local examples

Streams such as Fanno Creek appear on DEQ's list of 303(d) water quality-limited streams due to low levels of dissolved oxygen and above-normal temperatures and levels of coliform bacteria and chlorophyll. In the Clackamas River, although oxygen levels are high and nitrogen levels are low, temperatures are elevated. In the Columbia Slough, high nitrogen levels are deteriorating water quality. Johnson Creek makes the list due to high summer temperatures and elevated levels of fecal coliform bacteria found throughout the year, among other problems (Oregon Department of Environmental Quality 1998).

Bonn (1999) found elevated levels of lead and other contaminants locally in Ash Creek, Fanno Creek, and McKay Creek. The most urban site (Beaverton Creek at Cedar Hills Boulevard) contained the most contaminated bed sediments, including very high levels of organochlorines, arsenic, cadmium, lead and mercury.

In 1998 the United States Geological Survey completed a 5-year study of the Willamette River basin as part of a larger national study on water quality and stream ecology. The study showed that fish communities and stream habitat in the Willamette basin were among the most degraded of the 19 basins in which data was collected. Occurrence of parasites and external lesions on fish were five to ten times above normal in the Willamette basin, and pollution-intolerant fish species (e.g., trout and sculpin) were rare or absent. Elevated phosphorus concentrations in streams promoted nuisance plant growth. Concentrations of nearly 50 pesticides or pesticide breakdown products were found, ten of which exceeded federal guidelines for protection of freshwater aquatic life. Groundwater quality in the Willamette basin was better than surface water quality, but pesticides were detected in about one third of wells sampled. Volatile organic compounds such as fuel additives or degreasing solvents were also detected in groundwater below urban areas.

Wildlife use of urban riparian corridors

The previous discussion outlined some of the major effects of urbanization on natural ecosystems. This section addresses the general life history requirements and impacts of urbanization specific to each wildlife group (e.g., birds, mammals, etc.). When major changes occur within an ecosystem, the plants and animals depending on that system are altered, either directly or indirectly. Direct effects include altered ecosystem processes, habitat and food supply (Spence et al. 1996; Knutson and Naef 1997; Marzluff et al. 1998). Indirect effects include altered competition and predation patterns, which influence wildlife communities in fundamental ways, and indirect effects caused by urbanization such as disturbance. Thus urbanization causes changes in habitat quality and availability, with ensuing changes in food webs and predator and prey associations, simplification of habitat and wildlife communities, and loss of native biodiversity (May et al. 1997a; Marzluff et al. 1998; May and Horner 2000).

Urbanization affects some species positively, and some negatively. Species that thrive in urban habitats take advantage of abundant food and water, moderated temperatures (cities absorb heat during the day and release it at night), and abundant nesting sites that allow for prolonged breeding seasons, increased survival, and improved reproductive success (Knutson and Naef 1997; Marzluff et al. 1998; May and Horner 2000). However, other species are unable to thrive in areas with scarce natural habitat, reduced habitat quality and intense human activities. These species are out-competed by generalist and/or invasive species that dominate the urban landscape.

<u>Invertebrates</u>

General requirements

Invertebrates are one of the most diverse groups of life on the planet, and although influenced by human activities, can be surprisingly abundant in urban areas (Frankie and Ehler 1978; Dreistadt et al. 1990). This is reflected in Metro's invertebrate species list, which includes more than 425 species and is admittedly incomplete. Examples of this diversity include 119 butterfly species, 40 dragonfly species, and 56 kinds of bees. At least 84 are important prey species for salmonids and other fish (Xerces Society 2001). Nearly 100 are important predators on other species. Forty-nine are known to be important pollinator species, and these insects help form and maintain healthy riparian and upland plant communities. In addition, many aquatic invertebrates eventually emerge as flying terrestrial insects, thus they form a direct link between aquatic and terrestrial ecosystems. Over 150 species of terrestrial snails and slugs have been identified in moist forests of the Pacific Northwest; most have limited geographic ranges because they are poor dispersers (LaRoe et al. 1995). The number of non-native species living in the Metro region is unknown, nor is their potential influence on native species and habitats.

Invertebrates have a spectacular array of life history characteristics, and this adds to their diversity. For example, a given species of dragonfly may hatch in a headwater stream and feed on woody and organic debris. Moving downstream and undergoing several metamorphoses, its feeding strategy may change depending on the predominant food resources available in that stream reach. Finally, near the mouth of the river, the insect emerges from the stream, flies back to the headwaters, and breeds again to begin the cycle anew; this process may take seven years. That is, of course, if it is not eaten by a fish or bird on its way down- or upstream. Thus this species' life history revolves around the longitudinal and lateral flow of energy and resources in the stream system. This is just one invertebrate species; when one considers spiders, snails, beetles, butterflies, fleas and flies, the possibilities are vast. Variety at the base of the food web provides for biodiversity at higher levels. Also reflecting the variety of invertebrate species, their environmental needs are many, but water quality, vegetation, woody debris, and other organic matter are important (Schueler 1994; Spence et al. 1996).

Impacts of urbanization

Along with plants, insects form the base of aquatic and terrestrial food webs, thus reduced insect populations lower the land's carrying capacity for wildlife species that rely on insects as a major food source (or other species that rely on those species that prey on insects; ripple effect). Insects are also critically important pollinators that help create habitat. In the Pacific Northwest, watershed imperviousness between 5-10 percent causes macroinvertebrate diversity to drop sharply as pollution- and change-intolerant species are replaced by more resilient species (Schueler 1994; Horner et al. 1996; Spence et al. 1996; May et al. 1997a). Similar findings in the Portland metropolitan region and many other areas document adverse effects of urbanization on aquatic insects (e.g., Klein 1979; Benke et al. 1981; Garie and MacIntosh 1986; Frady et al. 2001; Cole and Hennings 2004).

Because some aquatic insects are highly sensitive to water quality and instream habitat conditions, insects may be used as biological indicators in an **Index of Biological Integrity** (IBI) (Karr and Chu 2000). In southwestern Oregon, an aquatic insect IBI provided a better method of distinguishing disturbed from undisturbed watershed than the Rapid Bioassessment Protocol (RBP) III used by Oregon Department of Environmental Quality (Fore et al. 1996). Numerous studies throughout the country document negative relationships between aquatic insect IBI's and increasing urbanization (e.g., Hachmöller et al. 1991; Kerans and Karr 1994; Elliott et al. 1997; Lerberg et al. 2000; Morley and Karr 2002).

<u>Fish</u>

General requirements

The Metro region provides habitat for 26 native fish species, plus at least one extirpated species. Fifteen more species (37 percent) are nonnative. Seven anadromous Pacific salmonid species (all members of the scientific genus *Oncorhynchus*) are native to Oregon. They include chinook, chum, coho, sockeye, steelhead and cutthroat trout (Brownell, 1999; Cederholm et al. 2000). Salmon survival depends on high-quality, stable environments from mountain streams, through major rivers to the ocean. Thus, salmonid habitat requirements serve as an indicator of the conditions needed for other fish species. Thirteen salmonid runs are federally ESA-listed, with two of these also state Threatened or Endangered. Another run is listed as Endangered only at the state level. Out of the entire genus, only resident rainbow trout are not considered to be at risk.

The Independent Scientific Advisory Board (ISAB) for the Northwest Power Planning Council and the National Marine Fisheries Service produced a recent review of agency salmon recovery strategies for the Columbia River Basin (ISAB 2001). Although the review found these documents to be basically scientifically sound, the ISAB concluded that, "…the overall answer to the question of whether the four documents will lead collectively to salmon recovery actions that have a high chance of succeeding is probably no." Their reasons included a lack of important scientific data necessary to resolve critical uncertainties, lack of clear institutional arrangements to carry the program out, and the fact that the status of many native salmonid stocks has become very grave.

Anadromous fish are born in fresh water but spend a large part of their lives in the ocean before returning to the rivers of their birth to reproduce. Their complex life cycles, or distinct stages of growth and development, are highly variable depending on the particular species and the run within the species. A general description of a salmonid's life cycle includes five stages: (1) spawning and incubation, (2) juvenile rearing in freshwater, (3) seaward migration, (4) growth and maturation, and (5) return migration to freshwater to spawn (Steelquist 1992; National Research Council 1992; Cederholm et al. 2000).

Salmon require cool, clean flowing water with a high level of dissolved oxygen; clean gravel in the streambed for reproduction, a variety of in-stream cover, a sufficient food source, and unimpeded access to and from spawning areas and the ocean. Four important factors influence streams as habitat for salmon: water quality (temperature, dissolved oxygen level, turbidity), streamflow, physical structure of the stream and food supply. For example, in Bellevue, Washington, environmental disturbances, including habitat alteration, increased nutrient loading, and degradation of the intragravel environment had strong, negative effects on coho salmon (Scott et al. 1986).

Water temperature is probably the most crucial environmental factor influencing salmon and other aquatic species. Essentially all biological processes in a salmon's life cycle are affected by water temperature including the timing of spawning, incubation and emergence from gravel, appetite, metabolic rate, development and growth rate, timing of smoltification and ocean migration (Spence et al. 1996). In general, salmon require cold water ranging in temperatures between 4 C and 17 C (39 F and 63 F) for spawning, incubation and rearing (Beauchamp et al. 1983; Pauley et al. 1986; Laufle et al. 1986; Pauley et al. 1988; Pauley et al. 1989).

Salmon prefer clear water with low concentrations of suspended sediments. The level of dissolved oxygen (DO) is also important for survival. Fish have elaborate gill structures to allow the uptake and use of oxygen needed for reproducing, feeding, growing and swimming (Spence et al. 1996). Salmon also need a variety of streamflow conditions that create a mix of habitat types (e.g., deep pools, riffles). According to Spence et al. (1996), optimum streamflow requirements vary by species, life cycle stage, and season.

The physical structure of a river or stream is important in determining the quality of fish habitat. Structural components include macrohabitat such as pools, eddies, riffles, runs, and side channels, and microhabitat such as cover (e.g., overhanging vegetation, undercut banks), boulders, coarse streambed material, and water velocity and depth. Large woody debris provides critical cover for salmonids (Dooley and Paulson 1998; May et al. 1997b). Stream complexity is essential for salmon because at various life cycle stages they require different types of habitat. Adult spawning salmon use pools for resting on their upstream migration. Once at their spawning grounds they require clean gravel of various sizes, depending on the species, with a minimum amount of sediment to build their redds. Juvenile salmon use a mix of habitat types depending on their life stage, the time of year, availability of food and the presence of other salmon. For example, newly hatched fry live in shallow areas until they increase in size and then shift into deeper, faster water. Pool habitats are favorable to many salmonids in the summer whereas side channels or beaver ponds are preferred during the winter (Spence et al. 1996)

Salmon consume a wide variety of organisms during their life stages. Aquatic and terrestrial insects, however, are their primary food source. Fallen insects from riparian vegetation can make up 40 to 50 percent of the diet of trout and juvenile salmon during the summer months (Johnson and Ryba 1992).

Impacts of urbanization

The adverse effects of urbanization on salmonid habitat include increased temperatures, low dissolved oxygen, increased turbidity and sedimentation, changes in streamflow patterns and floodplain **connectivity**, loss of physical habitat (pools, riffles, gravel beds, off-channel habitats, hyporheic flow), and loss of invertebrate prey (see Appendix 1 for some important prey species). Woody debris is the preferred cover for cutthroat trout and other salmonids (May et al. 1997b; Solazzi et al. 1997), and its documented loss in urban streams degrades salmonid habitat quality (Bauer and Ralph 2001). In general, Pacific Northwest salmonid abundance and habitat quality are considerably reduced when TIA reaches 5-15 percent (Booth 1991; Booth et al. 1997; Horner et al. 1996; Booth and Jackson 1997; May et al. 1997a), similar to patterns seen for macroinvertebrates. This results in a reduction in the load of salmon carcasses to nourish organisms in and near the stream (Fuerstenberg 1997). In Seattle, Lucchetti and Fuerstenburg (1993b) documented a marked shift from less tolerant Coho salmon to more tolerant cutthroat trout populations at 10-15 percent TIA. However, cutthroat trout are also susceptible to the impact of land management activities, particularly those that result in changes in pool depth and complexity. This may reduce habitat suitability and, therefore, the stream's carrying capacity for this species; persistence of this and other species may well depend on arresting the decline in quality and quantity of freshwater habitat (Reeves et al. 1997).

At the Salmon in the City conference (American Public Works Association 1998), participants came to several conclusions regarding salmonid issues in urbanized regions of the Pacific Northwest. First, relatively pristine watersheds that currently or potentially support wild salmonids must be protected. This includes maintaining effective impervious surfaces close to zero, retaining 60-70 percent canopy cover, and retaining broad buffers of undisturbed native vegetation along the majority of riparian corridors. In already urbanized watersheds it will be necessary to address the hydrological impacts of development, protect riparian corridors, restore physical habitat, and improve water quality if we are to maintain or improve salmonid populations.

Amphibians

General requirements

Sixteen native amphibian species live in the Metro region, including twelve salamanders and five frogs (plus one extirpated frog species). An additional species, the Bullfrog, is introduced and places considerable pressure on native species. Amphibians and birds are the two groups in our area most dependent on aquatic and riparian habitats. In the Metro region, 69 percent of native amphibian species (salamanders, toads and frogs) rely exclusively on stream or wetland related riparian habitat for foraging, cover, reproduction sites and habitat for aquatic larvae. Another 25 percent use these habitats during their life cycle. Six Metro-region amphibian species are state-listed species at risk; four species are considered at risk at the federal level.

Amphibians require both aquatic and terrestrial habitats to complete their life cycle, thus changes to either ecosystem may interfere with their success (Schueler 1995). Small non-fish bearing streams and beaver ponds may be important because they are free from competition and predation by fish (Metts et al. 2001). As with salmonids, amphibians have specific habitat requirements and are sensitive to environmental change. For example, Tailed Frogs occur only in streams with temperature ranges from 0-16º C, and increase in abundance as temperature declines; tadpoles require smooth, cobble-sized stones to which they attach with sucking mouthparts (Claussen 1973). Clean, relatively sediment-free water, rocky stream beds and woody debris are important to amphibians in western and southern Oregon (Bury et al. 1991; Welsh and Lind 1991; Butts and McComb 2000).

Impacts of urbanization

Amphibians have suffered worldwide declines over the past 20 years, with particularly noteworthy declines in the Pacific Northwest (LaRoe et al. 1995; Richter and Ostergaard 1999; Semlitsch 2000). Thus this may be the group most sensitive to human-induced habitat loss and alteration such as microclimate changes. For example, habitat fragmentation creates edge habitat, and edge habitats tend to have elevated temperatures and reduced humidity (Saunders et al. 1999; Gehlhausen et al. 2000; Laurance et al. 2000). Unlike other species groups, amphibians' skin is not waterproof, nor are their eggs, and such edge-induced changes may be lethal. Fragmentation and wetland isolation is also a problem because amphibians have small home ranges and cannot travel as freely as birds and mammals (Corn and Bury 1989; Richter and Azous 1995).

In the Puget Sound region, Richter and Azous (1995) found that amphibian **species richness** in 19 wetlands declined with increasing water fluctuation and urbanization (the two are linked); the study also found that small wetlands (< 2 hectares) supported surprisingly high species richness, and are often overlooked in conservation planning. This study suggests that stormwater adversely impacts sensitive aquatic-phase amphibians. In Missouri, Ahrens (1997) found a negative relationship between amphibian species richness and development density. Size and spatial isolation from other wetlands were the most important predictors for amphibian species richness in restored Minnesota wetlands; more species were found in larger, less isolated wetlands (Lehtinen and Galatowitsch 2001).

Urbanization, wetland loss and alteration of hydrologic cycles, which can kill larval amphibians through pond drying (altered hydrology and habitat) or increased predation, probably adversely affect amphibians in the Metro region. Removal of riparian forest overstory is known to harm two at-risk species, Tailed frogs and Torrent salamanders, as well as harming other amphibians (Kauffman et al. 2001).

As with salmonids, instream habitat quality and quantity, excessive sedimentation, and reduced woody debris are major issues for amphibians (Hawkins et al. 1983; Corn and Bury 1989; Butts and McComb 2000). Studies in other parts of the country document adverse effects due to wetland isolation, road density and environmental degradation (Delis et al. 1996; Mensing et al. 1998; Lehtinen et al. 1999; Knutsen et al. 2000). Bullfrogs may pose a major threat to native amphibians in the Metro region, where they both out-compete and predate native species (including non-amphibians such as young turtles and waterfowl) (Adams 1999; Adams 2000; Witmer and Lewis 2001). Bullfrogs are relatively insensitive to water quality and habitat fragmentation and can travel long distances overland, unlike most native amphibians.

Reptiles

General requirements

Thirteen native reptile species live in the Metro region, including two turtle, four lizard, and seven snake species. Two more turtle species are non-native. This is the least riparian-associated group; even so, 23 percent of native reptile species depend on water-related habitats and another 46 percent using them during their lives. Although most lizards and snakes are upland-associated, many species use riparian areas extensively for foraging because of the high density of prey species and vegetation. All of the turtle species are riparian/wetland obligates, and rely on large wood in streams and lakes for basking (Kauffman et al. 2001). The two native turtles are state and/or federal species at risk.

Reptiles are cold-blooded animals, and some species have special habitat requirements in order to collect the sun's energy. This translates into surfaces that are efficient heat collectors. For example, most lizard and snake species rely on **talus**, cliffs and rocky outcrops, or other rocky surfaces for gathering heat during cool periods. Crevices within these structures also provide important refuge during hot spells.

The reasons for species' reliance on riparian habitat are varied, and demonstrate the structural and functional diversity provided by riparian forests. For example, Western pond turtles eat a variety of foods such as insects, mollusks, fish, amphibians, and carrion. These animals require about six inches of forest leaf litter in which to overwinter and five or more inches of soil (with high clay content and good sun exposure) and close proximity to water for nesting (Oregon Department of Fish and Wildlife 2000). Riparian forests provide food and generate soil and leaf litter. The common garter snake, another riparian-dependent species, forages for amphibians, small fish, and earthworms and needs riparian denning sites with good cover, such as downed wood and good shrub and understory.

Impacts of urbanization

Little urban-specific information is available for reptiles in the Pacific Northwest, but in Missouri Ahrens (1997) found that reptile species richness was negatively correlated with high density residential and institutional land uses, but not with other land uses such as low density residential, commercial, industrial, recreational and roads. In Oregon, Western pond turtles are in serious jeopardy due to habitat loss and predation on hatchlings, and have dangerously restricted gene pools in the Metro region due to isolation (Gray 1995; Oregon Department of Fish and Wildlife 2000). Habitat connectivity is probably important to lizards and snakes, as well. Losses of LWD and beaver ponds for turtle basking and use by common garter snake are probably detrimental (Metts et al. 2001). The two non-native turtles with established populations (probably from released pets), common snapping turtle and red-eared slider, pose significant threats to native turtles (Gray 1995; Oregon Department of Fish and Wildlife 2000).

Birds

General requirements

Birds often represent a majority of vertebrate diversity in a region, and the 209 native bird species on Metro's Species List represent a full two-thirds (67 percent) of the region's native vertebrate species. An additional four non-native species have established breeding populations in the area. In the Metro region, about half (49 percent) of native bird species depend on riparian habitats for their daily needs, and 94 percent of all native bird species - the same percentage as amphibians - use riparian habitats at various times during their lives. Twenty-two bird species on Metro's list are state or federal species at risk. Nineteen of these are riparian obligates or regularly use water-based habitats. An additional riparian obligate, the Yellow-billed Cuckoo, is extirpated in the Metro region.

Bird abundance, species richness and diversity is typically higher in riparian habitats compared to other habitat types (Stauffer and Best 1980; LaRoe et al. 1995; Kauffman et al. 2001). This reflects greater plant volume and structural diversity (birds are highly 3-dimensional in their habitat use), and food, water and habitat resources associated with riparian vegetation (LaRoe et al. 1995). The occasional study seeming to refute these trends (e.g., McGarigal and McComb 1995; Murray and Stauffer 1995) is typically set in areas where there is little contrast between riparian and upland vegetation. The Oregon-Washington chapter of Partners In Flight offers conservation strategies for landbirds in coniferous forests and lowlands and valleys of western Oregon (Altman 1999; Altman 2000).

Impacts of urbanization

Birds are the most well-studied group of terrestrial urban wildlife. Urban bird communities are characterized by reduced diversity and species richness compared to undisturbed habitats, but increased total abundance due to domination by a few nonnative and urban-associated species (Penland 1984; Blair 1996). There tends to be a loss of species, particularly habitat specialists, over time (Aldrich and Coffin 1980; Hennings 2001). European Starlings, an abundant non-native species, are closely associated with riparian habitats and can comprise 50 percent or more of total birds in the region's narrow riparian forests (Hennings 2001; Hennings and Edge 2003). Neotropical migratory birds appear to respond negatively to development and rely heavily on riparian areas for migratory stopover habitat (Moore et al. 1993; Friesen et al. 1995; Nilon et al. 1995; Theobald et al. 1997; Mancke and Gavin 2000; Hennings 2001).

Breeding Bird Survey data from the Pacific Northwest indicate long-term Neotropical migratory bird declines, particularly for those species relying on older or riparian forests (Sharp 1995-1996). Some bird species, such as Rufous Hummingbirds, Winter Wrens, Brown Creepers and Pacific-slope Flycatchers, may be particularly sensitive to habitat fragmentation in the metro area and appear to need large habitat patches (McGarigal and McComb 1995; Hennings 2001; Hennings and Edge 2003). In Connecticut, Askins et al. (1987) found that for forest interior-dwelling bird species, both reduced patch size and increased patch isolation were detrimental.

At least 13 riparian-occurring breeding bird species that have declined significantly more rapidly in the Metro region than statewide over the past 32 years (Hennings 2001; Table 6). Along with fragmentation-sensitive species, these birds may be at risk in the Metro region and merit further study.

Table 6: Examples of some bird species whose trends differ substantially between the Metro area and all BBS routes statewide (1966-1998).

Metro region vs. Oregon
32-year Breeding Bird Survey

Species	Trend Difference (% per year)	Riparian or ag loss	Ground/low nester	Open-cup nester	Cavity or bag nest	Neotropical migrant	Insectivore
Yellow Warbler	-11.9	X		X		X	X
California Quail	-10.3	X	X				
Olive-sided Flycatcher	-7.6			X		X	X
Common Yellowthroat	-7.6	X	X	X		X	X
Brown-headed Cowbird	-7.3	X		X		X	
Swainson's Thrush	-6.4	X	X	X		X	X
Black-headed Grosbeak	-6.4	X		X		X	X
Bushtit	+3.1				X		X
Vaux's Swift	+6.2				X	X	X
Bewick's Wren	+6.4				X		X
Chestnut-backed Chickadee	+6.9				X		X

Source: Hennings 2001.
Note: Habitat loss is implicit for all species listed. Data compiled from 32-year (1966-1998) Breeding Bird Survey data.

Birds, like insects, can be good indicators of habitat conditions. As a group they are easy to observe, sensitive to environmental changes, and responsive to habitat fragmentation (see the ***Upland Habitat*** section). The Bureau of Land Management (no date) compiled a list of bird species as indicators of riparian vegetation condition in the western U.S., based on geographic area and potential vulnerability of the species. In the Metro region, six species are likely to place over 90 percent of their nests in riparian vegetation (or greater than 90 percent of their abundance occurs in riparian vegetation during the breeding season). These species vary in the vegetation layer used. For example, Common Yellowthroats and Song Sparrows most frequently use understory vegetation. Willow Flycatchers and Yellow-breasted Chats use understory and midstory. Yellow Warblers use midstory and canopy, and Wilson's Warblers use all three vegetation layers. Swainson's Thrush, Lazuli Bunting, Black-headed Grosbeak, and Warbling Vireo also make good indicator species. According to Breeding Bird Survey 32-year trends, each of these species have declined in the Metro region compared to statewide (except Wilson's Warbler and Lazuli Bunting, whose abundance was too low in the Metro region for analysis) (Sauer et al. 2000; Hennings 2001). These species may provide valuable monitoring tools to help assess existing and future riparian habitat conditions in the Metro region.

Mammals

General requirements

Mammals are another diverse group of species in the Metro region, with 54 native species. This is the terrestrial group with the highest number of non-native species (eight species, or 15 percent of total species; most are rodents). Of native species, 28 percent are closely associated with water-based habitats, with another 64 percent using these habitats at various points during their lives. Six out of nine bat species are state or federal species at risk. Three native rodent species are similarly listed.

Riparian resources are important to mammals for many of the same reasons they are important to amphibians and birds, i.e., diverse habitat structure, abundant coarse woody debris, good connectivity, access to water and a wealth of food resources (Butts and McComb 2000; Kauffman et al. 2001). In Pacific Northwest forests, multispecies canopies, coarse woody debris, and well-developed understories (dominated by herbs, deciduous shrubs and shade-tolerant seedlings) were important to small mammal biodiversity across a broad suite of spatial scales (Carey and Johnson 1995). Other Pacific Northwest studies have shown increased small mammal abundance and/or diversity with increasing coarse woody debris (McComb et al. 1993; Butts and McComb 2000; Wilson and Carey 2000). Riparian forests contain high amounts of coarse woody debris, and this may be why some studies document higher small mammal abundance in riparian habitats than in uplands (Doyle 1990; Menzel et al. 1999; Bellows and Mitchell 2000).

Bats in the Pacific Northwest are more abundant and diverse in habitats with increased roost availability and diversity, including a variety of tree, cliff, and cave roosts; canopy cover and structural complexity is very important to this sensitive group (Wunder and Carey 1996). Bats often roost in artificial structures, and bat-friendly habitats can be provided in both new and existing bridges and other structures at little or no extra cost (Tuttle 1997). This may be as simple as specifying appropriate crevice widths of three-fourths to one inch in expansion joints or other crevices. Tuttle (1997) offers designs for retro-fitting bat-friendly habitats into existing structures; one is called the Oregon Bridge Wedge, designed to provide day-roost habitat in bridges and culverts.

Mammals can profoundly influence habitat conditions for other animals. Beaver, a **keystone species** in riparian areas, play a critical role in the creation and maintenance of wetlands and stream complexity, and may have broad effects on physical, chemical, and biological characteristics within a watershed (Cirmo and Driscoll 1993; Snodgrass 1997; Schlosser and Kallemeyn 2000). Beaver can also create nuisance problems due to tree removal and unplanned flooding, but property damage can be minimized by activities such as protecting trees with exclosures (Olson and Hubert 1994; Snodgrass 1997; Oregon Department of Fish and Wildlife 2001). Historically, beavers were nearly extirpated from the Willamette Valley due to trapping, but populations have rebounded somewhat (Oregon Department of Fish and Wildlife 2001). Large herbivores such as deer browse on herbs and shrubs, which can promote vigorous growth (Kauffman et al. 2001). Cattle grazing can have severe detrimental consequences on riparian habitats (Knopf et al. 1988; Grant 1994). Medium-sized **carnivores** keep rodent and small predator populations in check while large carnivores control herbivore populations, with important implications for bird nest success (Berger et al. 2001). Rodents eat Spruce budworm, an insect whose outbreaks can cause significant forest loss (Jennings et al. 1991). Bats help regulate insect populations and may contribute to nutrient cycling, particularly in riparian areas (LaRoe et al. 1995).

Impacts of urbanization

Most mammal research has been conducted outside the urban setting. However, Dr. Michael Murphy's graduate students at Portland State University are providing insights into small mammal needs in the urban area (Murphy 2005). As yet unpublished, their research indicates that the following small mammals may need habitat patches of 10 ha or greater: shorttail weasel, Oregon vole, Northern flying squirrel, shrew-mole, white-footed mouse, Trowbridge's shrew, vagrant shrew, Douglas squirrel, Western gray squirrel, and Townend chipmunk. Conversely, non-native mammals tended to decrease in abundance in larger patches.

Bolger et al. (1997a) found that small mammal extirpation rates increased with fragmentation in urban habitats. The loss of habitat, connectivity, forest structural diversity, and LWD common in urban areas probably harm many mammals. Bats are generally intolerant of human disturbance and in western Oregon, are more abundant in old-growth than other forest types; Townsend's big-eared bat abundance has declined by 58 percent west of the Cascades since 1985 because of habitat alteration and human disturbance (LaRoe 1995). Nutria are the primary nonnative mammals using streams in the Pacific Northwest. Introduced for fur, nutria have established populations in at least 15 states, where they inflict wetland and agricultural damage and compete with beaver and muskrat for resources (Pedersen 1998; Abrams 2000). Pets, especially cats and dogs, can be disruptive and/or lethal to native birds and small mammals (see also Uplands chapter, Nonnative species section).

Riparian area width

The functions and values of riparian corridors with respect to fish and wildlife, as well as the impacts from urbanization, have been explored in the preceding sections. In this section we review the riparian area widths identified in the scientific literature that are necessary to protect habitat for fish and wildlife. Several recent literature reviews have addressed the effectiveness of various riparian area widths for maintaining specific riparian functions for both protecting water quality and preserving the biologic integrity of the riparian corridor (Budd et al. 1987; Johnson and Ryba 1992; FEMAT 1993; Castelle et al. 1994; Spence et al. 1996; Metro 1997; Wenger 1999; May 2000). The biological integrity of the riparian corridor depends, in part, on the width and condition of the riparian area, which dictates stream functions and ultimately the type of species that can live in and around streams.

A riparian buffer is defined as a strip of land established to mitigate the impacts of human activities on the stream ecosystem (Johnson and Ryba 1992; May 2000). Riparian buffers serve to protect natural functions as well as minimizing impacts of stormwater runoff and preventing property loss due to flooding (May 2000). The riparian buffer includes riparian habitat that provides key functions and values for many wildlife species dependent on the unique environment.

The effects of human activities on riparian and aquatic ecosystems are numerous and pervasive in the urban area, as discussed in the previous sections. A riparian buffer alone is not enough to maintain natural aquatic functions; additional efforts in managing stormwater runoff and protection of upland areas are essential in a comprehensive watershed protection plan (Knutson and Naef 1997). The appropriate size of a riparian buffer is likely to vary depending on the position of a stream in the landscape and the intensity of land use nearby (Todd 2000). Wider buffers may be required in urban areas with higher intensity land uses than in a forested or rural landscape (May 2000; Todd 2000). Wider buffers are critical in retaining functions and values for wildlife that utilize riparian areas. When we refer to a riparian buffer width we are referring to the width *on one side* of a stream, river or other water feature. The buffer is then to be applied on *both sides* of the stream or other water feature.

Fixed width vs. variable width buffer

Riparian buffers are commonly implemented to protect a wide range of functions provided by the riparian area, ranging from water quality and flood control to fish and wildlife habitat. The size, or width, of the buffer depends on the function(s) to be protected and the type of land use that occurs outside of the buffer area. Buffers are implemented as either a fixed width or a variable width requirement.

Fixed width buffers are typically based on a single parameter, such as a specific function (Castelle et al. 1994). They are often developed as a political compromise between protecting ecological functions and minimizing the impact on private property rights (May 2000). This type of buffer is relatively easy to enforce, provides for regulatory predictability, and costs less to administer because those applying the regulations do not need specialized skills (Johnson and Ryba 1992). Fixed width buffers, however, do not account for site-specific conditions, thus the riparian corridor may not be adequately protected in some areas, and in others the buffer might unnecessarily restrict development (Fischer and Fischenich 2000; Todd 2000). May and Horner (2000) stated that "…a one-size-fits-all buffer is not likely to work."

Variable width buffer programs account for site-specific conditions, providing a greater level of protection to important resources while reducing the impact on private property in certain instances (Johnson and Ryba 1992; May 2000). However, this type of buffer program is more expensive and difficult to administer and monitor and offers less predictability for land use planning purposes (Johnson and Ryba 1992; Castelle et al. 1994; Todd 2000).

A hybrid of the fixed and variable width buffer could conceivably address several of the problems with both while drawing on each method's strengths. A variable width buffer based on existing conditions and the intensity of the adjacent land use that is generalized to the extent possible might provide the best protection of the riparian corridor while respecting private property rights (Todd 2000).

Management areas vs. setbacks

Just as important as the width are the activities are allowed within the riparian buffer. Some riparian buffers are implemented as setbacks within which no disturbance is allowed, with the exception of restoration activities. Other riparian buffers are considered "management areas" within which a limited amount of activity may occur. This allows for some level of development as long as guidelines are followed so as to retain riparian functions. Human activities within the riparian buffer should be limited to prevent further degradation of riparian and aquatic habitat.

Extent

To the maximum extent possible, all perennial, intermittent and ephemeral streams should be protected from surrounding land use activities by a buffer (Mitchell 1998; May 2000). The effectiveness of a riparian corridor protection program depends on the amount of stream miles that are protected; the more miles protected, the more effective a program will be (Wenger 1999). As stated by Fischer et al. (2000): "Continuous buffers are more effective at moderating stream temperatures, reducing gaps in protection from non-point source pollution, and providing better habitat and movement corridors for wildlife."

Several functions important for fish and wildlife are influenced by the entire system of streams. For instance, nearly half of the large woody debris found in low gradient streams is delivered from upstream sources (Pollock and Kennard 1998). Studies have also found that the temperature of streams is influenced not only by the condition of adjacent forest but also by upland forest conditions and upstream conditions (Pollock and Kennard 1998).

The entire stream network functions as a system, thus removing the connection between intermittent and perennial streams may have detrimental consequences to the physical and biological components of stream ecosystems, particularly in the long term (Mitchell 1998; FEMAT 1993). Naiman et al. (1992) stated that intermittent streams are an important, often overlooked, component of aquatic ecosystems. For example, juvenile Chinook salmon rely on intermittent streams for rearing habitat (Maslin et al. 1999).

Riparian buffers are especially important along the small headwater streams that typically make up the majority of stream miles in any basin

Osborne and Kovacic 1993; Hubbard and Lowrance 1994; Lowrance et al. 1997; May et al. 1997a; Fischer et al. 2000). These smaller streams have more interaction with the land and riparian vegetation plays an integral role in reducing sediment and other pollutants, maintaining temperature regimes, and providing large woody debris and other organic inputs (FEMAT 1993). Riparian buffers along larger streams have less of an impact on water quality, however they often are longer and wider thus providing better wildlife habitat (Fischer et al. 2000).

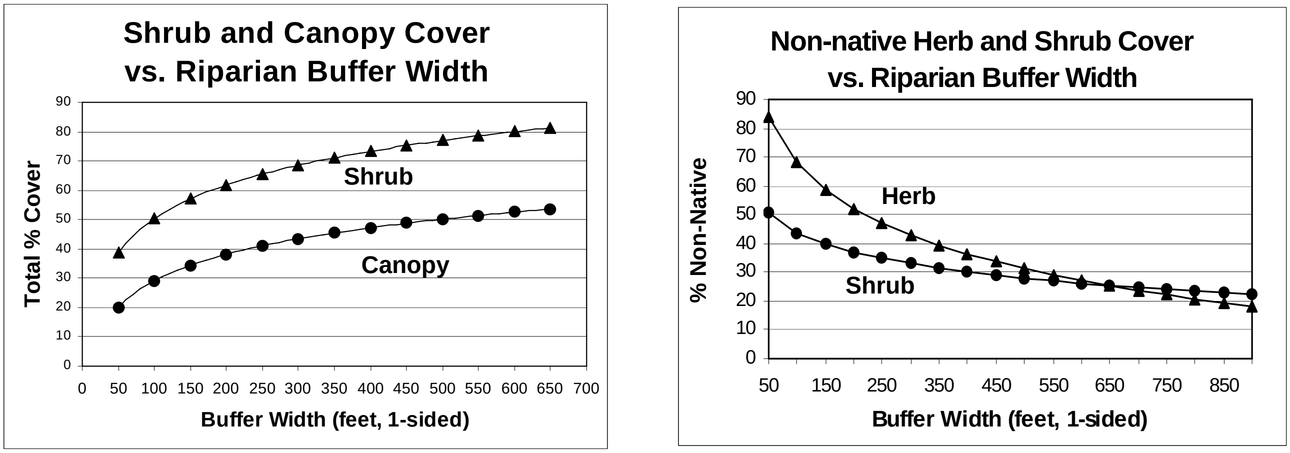
In urban areas the functions of the aquatic ecosystem are altered, as described in the previous section. Increased urbanization causes an increase in negative inputs such as contaminants, stormwater flow, and also reduces the amount of large woody debris and other organic inputs required for the survival of aquatic life (Booth et al. 1997; Todd 2000). Johnson and Ryba (1992) stated that " a large buffer in an area of high-intensity land use…is more essential than in low-intensity land use areas." FEMAT (1993) recommends 91 m (300 ft) on each side of fish bearing streams in a forested landscape, as well as protecting permanently flowing non-fish bearing streams; constructed ponds, reservoirs, and all wetlands greater than one acre; all lakes and natural ponds; and seasonal or intermittent streams, smaller wetlands, and unstable areas to a lesser extent. The protection of all of these areas is crucial to maintaining habitat for aquatic species, with further protection necessary for riparian-associated wildlife. In an urban area, with the greater impacts associated with urbanization, a protection scheme of less than that recommended by FEMAT in the forested landscape may not be sufficient to fully provide fish and wildlife habitat.

Vegetation

Riparian corridors should consist of native vegetation along the stream where appropriate (May 2000). As described throughout this chapter, native vegetation provides several crucial functions that enable the riparian corridor to provide high value fish and wildlife habitat. The quality of the vegetation in a riparian buffer is crucial to the provision of organic litterfall, large woody debris, shade, and other riparian functions (May 2000).

Forest width plays an important role in urban riparian plant community structure and composition. Watersheds with intact riparian forests are able to retain more riparian functions at higher levels of imperviousness (May et al. 1997b). Within the Metro region, researchers comparing rural versus urban habitats found that riparian forest width was the only significant predictor of native plant species richness (wider forests had more species), while native plant diversity was best explained by perimeter-to-area ratio, a measure of edge (smaller patches had lower diversity) (O'Neill and Yeakley 2000). In another Metro-area study, riparian forest width was the best predictor for nonnative plants along small streams; narrow forests contained higher percentages of nonnative herbaceous, shrub and tree cover than wider sites (Figure 9) (Hennings 2001; Hennings and Edge 2003). In addition, narrow forests were less structurally complex, with reduced shrub and canopy cover.

Figure 9. Relationships between riparian forest width and forest structure and composition measured along 54 small stream sites in the Metro region, surveyed July and August 1999.



Source: Hennings 2001.

Factors that influence buffer width

Several factors should be taken into consideration when determining the size of the riparian buffer. Floodplains, steep slopes, and wetlands are important resources in themselves and strongly influence the ability of the riparian area to provide key functions for fish and wildlife.

Floodplain

One of the important factors determining the width of the riparian area is the presence of floodplains. Unconstrained reaches typically have large floodplains compared to constrained reaches. The linkage between the stream and its floodplain is of critical importance to fish and wildlife (Knutson and Naef 1997; May 2000). The floodplain includes the limits of the stream channel migration zone and also represents the zone of interchange between land and water (Wenger 1999). Stream channels, except for those in steep gullies or canyons, naturally move as the result of seasonal flood events. The floodplain and channel migration zone is the area that could potentially become aquatic habitat, but currently provides riparian habitat (Pollock and Kennard 1998). A buffer zone should be wide enough to permit natural channel migration (Wenger 1999; May 2000).

The entire floodplain plays an important role in contaminant removal. According to the scientific literature, the riparian zone of influence includes the extent of the 100-year floodplain because of the movement of the stream or river across the floodplain through time (Gregory and Ashkenas 1990; Schueler 1995; Spence et al. 1996). It is important to protect the entire width of the floodplain because this area provides essential spawning and rearing habitat for fish and important year round habitat for turtles, beavers, muskrats and other wildlife. Therefore the riparian area width should include the extent of the 100-year floodplain (Wenger 1999; May 2000).

Steep slopes

The slope of the land on either side of a stream is one of the most significant variables in determining the effectiveness of a buffer in trapping sediments, retaining nutrients, preventing contaminants from reaching the stream, and reducing erosion. Steeper slopes have higher velocities of surface water flow, resulting in less time for nutrients and other contaminants to pass through the buffer and reach the stream (Wenger 1999). Mass wasting of unstable slopes contributes to degraded water and riparian habitat quality (Knutson and Naef 1997). Several researchers have observed that very steep slopes are unable to effectively remove contaminants from surface water flow (Wenger 1999). Steep slopes adjacent to all streams should be protected.

Steep slopes often occur on intermittent streams, where it is especially important to protect the slope to prevent increased landslides and erosion and provide habitat for species unique to these areas. FEMAT (1993) recommends buffers ranging from about 12-61m (40-200 ft) on intermittent streams, depending on the stability of the soil.

There is debate as to what constitutes a steep slope. Jurisdictions have defined steep as ranging from 10 to 40 percent slope. Metro defined steep slopes as 25 percent in the Stream and Floodplain Protection Plan (Title 3). May (2000) recommended that for slopes over 25 percent the buffer should be measured from the break in slope to reduce sediment loading from mass wasting events.

Wetlands

Wetland habitats frequently overlap with riparian areas, although some wetlands are isolated from streams or rivers. Isolated wetlands are often small but may have unique characteristics that allow specialized plant species to develop (FEMAT 1993). Wetlands provide many of the same functions as riparian areas, such as maintaining water quality, retaining water and reducing floods. Wetlands comprise a very small proportion of the landscape and yet provide for a significant number of specialized plant and animal species. Thus, riparian wetlands are significant enough to merit automatic inclusion in a protection scheme (FEMAT 1993; Wenger 1999). FEMAT (1993) recommended one site potential tree height or 46 m (150 ft) slope distance for wetlands greater than one acre, and two site potential tree heights or 91 m (300 ft) slope distance for lakes and natural ponds. May (2000) recommended that all riparian wetlands adjacent to the stream channel be protected from disturbance, and that a minimum buffer of 30-50 m (98 – 164 ft) should extend outward from the wetlands.

Site Potential Tree Height

Site potential tree height is often used as a standard of measurement within which several key riparian functions are provided. For example, several studies suggest that in order to supply large woody debris and maintain temperature and streambank stability, the width of the riparian corridor should be at a minimum equal to one site-potential tree height at maturity (FEMAT 1993; Spence et al. 1996; Pollock and Kennard 1998; May 2000). Thus, the term is used to communicate a general riparian standard that allows for the operation of multiple ecological functions; not just the functions directly attributed to trees.

Various definitions for site-potential tree height (SPTH) exist. For example, the Oregon Division of State Lands (DSL) defines the potential tree height as the dominant tree species at maturity. DSL provides a list of common riparian trees in Oregon in their Urban Riparian Inventory & Assessment Guide (Van Staveren et al. 1998) ranging from 15 feet to 120 feet. FEMAT (1993) defines the height of a site-potential tree as the average maximum height of the tallest dominant trees (200 years or more) for a given site class. The NMFS uses a similar definition but considers the tallest dominant trees within 100 years, given site conditions. According to the NMFS definition, these heights range from about 130 feet to over 200 feet for second-growth conifers in riparian areas; second-growth conifers are commonly found in Portland area forests.

Aquatic Habitat

Most anadromous and resident fish require deep pools for cover and to rest; riffles for foraging; and cold, well-oxygenated, gravel-bottomed streams to spawn and reproduce. The width and composition of the riparian area are factors that assist in maintaining habitat needed to support the various life cycles of fish and other aquatic species.

Temperature regulation and shade

An important factor influencing stream diversity and productivity is shade from riparian vegetation, which keeps stream temperatures cool. Elevated water temperature affects its ability to hold the oxygen required for aquatic life, and is particularly detrimental to cold water fish like salmon and trout. Intact riparian vegetation helps regulate water temperature. Beschta and Taylor (1988) found that many factors influence stream temperature in forested watersheds, one of the most important being intact riparian vegetation. Spence et al. (1996) identified site-specific factors that influence the riparian area's ability to provide shade including vegetation composition, stand height, stand density, latitude (which determines solar angle), topography, and stream orientation. Several studies conducted in the Cascade and Coast Ranges of western Oregon examined the effectiveness of riparian area widths for shade and temperature regulation and concluded that riparian area widths of at least 30 m (98 ft) provide adequate shade to stream systems (Spence et al. 1996). In most instances, riparian area widths maintained for other functions such as LWD are likely to be adequate to protect stream shading (Spence et al. 1996).

The temperature of groundwater entering streams also influences stream temperature (Brosofske et al. 1997). Removal of surrounding riparian and upland forest may increase groundwater temperature. However, on small streams shading is likely to be the most important factor in regulating temperature (Wenger 1999). In a literature review, Osborne and Kovacic (1993) found that buffer widths of 10-30 m (33-98 ft) can effectively maintain stream temperatures. However, newer research has found that buffer widths of 21-24 m (70-80 ft) are not sufficient to maintain stream temperatures that approximate natural conditions (Pollock and Kennard 1998). Brosofske et al. (1997) found that a buffer of 76 m (250 ft) is necessary to maintain natural shade levels and reduce the impact of solar radiation. Factors other than riparian vegetation also impact temperature, such as dams and industrial discharge.

Bank stabilization and sediment removal

Riparian vegetation helps to stabilize streambanks, making them less susceptible to excessive erosion. The Forest Ecosystem Management Assessment Team (FEMAT) (1993) concluded that most of the stabilizing influence of riparian root structure is probably provided by trees within a half of a potential tree height of the stream channel. All streams can be subject to channel erosion if the banks are not properly stabilized, and upstream sediments have a large impact downstream. Ensuring stable banks on the entire stream network, including intermittent and ephemeral streams, is important to maintaining a functioning aquatic system. In their natural state ephemeral streams typically contain dense growth and trap surface water sediment and slow flow, but they can provide a large quantity of in-stream sediment during storm events in disturbed areas. Clinnick (1985) proposes a minimum of a 20 m (66 ft) wide buffer on ephemeral streams.

As described in the *Impacts of Urbanization* section, sedimentation can be very detrimental to fish (particularly salmonids) and other aquatic organisms (Hicks et al. 1991). Riparian vegetation helps to control excess sediment from entering streams. In a study on California streams, Erman et al. (1977) found that a 31-meter (100-foot) vegetated buffer was successful in preventing sedimentation and thus maintaining background levels of benthic invertebrates (aquatic insects) in streams adjacent to logging activity. Moring (1982) assessed the effect of sedimentation following logging with and without buffer strips of 30 m (98 ft) and found that increased sedimentation from logged, unbuffered streambanks clogged gravel streambeds and interfered with salmonid egg development.

According to Belt et al. (1992), "Research suggests four things about buffer strip design to trap sediments and nutrients: 1) buffer strips should be wider where slopes are steep, 2) riparian buffers are not effective in controlling channelized flows originating outside the buffer, 2) sediment can move overland as far as 300 feet through a buffer in a worst case scenario, and 4) removal of natural obstructions to flow – vegetation, woody debris, rocks, etc. – within the buffer increases the distance sediment can flow." For a more detailed discussion of buffer widths for sediment see Metro's **Policy Analysis and Scientific Literature Review for Title 3** (1997).

Pollutant removal

In 1998 Metro adopted a plan for protecting water quality and floodplain management, but it did not specifically address wildlife issues. However, excess nutrients, metals, pesticides and other contaminants also impact the quality of habitat for fish and wildlife. Therefore, we revisit these issues briefly here, but for a more detailed discussion see Metro's **Policy Analysis and Scientific Literature Review for Title *3*** (1997).

Excess levels of phosphorous common to urban areas cause eutrophication in the stream system, as described in the *Impacts of Urbanization* section. Most phosphorous is carried to the stream attached to sediment, thus buffer widths that are sufficient to retain sediment should also prevent phosphorous from reaching the stream (Wenger 1999). However, riparian vegetation can only retain phosphorous over a short time period, after which the vegetation becomes oversaturated and actually releases phosphorous into the stream.

Nitrogen also contributes to eutrophication in aquatic ecosystems. A vegetated buffer along a stream is able to remove nitrogen through uptake by vegetation and by denitrification. Several studies have found that total nitrogen removal efficiencies in surface water flow increase with buffer width (Dillaha et. al 1988; Dillaha et. al 1989; Magette et. al 1989). Denitrification occurs under conditions of reduced oxygen availability, which correlates with soil moisture. Wetlands and hyporheic zones play an important role in denitrification. According to Wenger (1999), a minimum width of 15 m (50 ft) is necessary to reduce nitrogen levels, but wider buffers of 30 m (100 ft) or more would be more likely to include areas of denitrification.

Pesticides are meant to be deadly. When pesticides enter the stream they can cause direct mortality to many organisms as well as an array of sublethal effects (Cooper 1993). Pesticides used in landscaping commonly find their way to streams and rivers. Riparian vegetation plays an important role in preventing direct contamination of streams. Buffers can help to remove pesticides from surfacewater flow, but we were unable to locate current research to identify specific widths necessary to prevent them from reaching the stream (Wenger 1999).

Large woody debris and litter inputs

Large woody debris

As discussed previously, large woody debris (LWD) is an important structural component in Pacific Northwest streams west of the Cascade Range. Forested riparian areas are necessary to provide regular inputs of LWD; removal of trees and vegetation can have long-term negative effects (Booth et al. 1997; May et al. 1997b; Wenger 1999). The potential for trees or portions of a tree to enter the stream channel is primarily a function of distance from the stream channel in relationship to tree height and slope angle (FEMAT 1993). A review of the scientific literature shows that the probability that LWD will enter the stream channel is generally low at greater than one site-potential tree height, or the height of the dominant tree species at maturity (McDade et al. 1990; FEMAT 1993; Spence et al. 1996; Wenger 1999).

Sometimes seemingly conflicting science makes management decisions difficult. For example, the literature review for Washington State's Forests and Fish Report (CH2MHILL 2000) stated that, "Of all the inputs from riparian zones to streams, LWD delivery requires the widest riparian management zone (RMZ)." However, the same review showed McDade's (1987) data from small streams of the Cascade and Coast Ranges of Oregon and Washington, in which over 70 percent of the total LWD delivered to the channel originated within 50 feet of the channel, and over 90 percent within 100 feet of the channel. Spence et al. (1996) reviewed the literature and found that most recent studies suggest buffers approaching one site-potential tree height are needed to maintain natural levels of recruitment of LWD. Streams naturally migrate within the valley floor or floodplain, and LWD is also delivered to streams by flooding and landslides. The additional importance of LWD to terrestrial wildlife, as well as the importance of all organic matter to healthy soils (and, therefore, healthy riparian forests), argue for LWD buffers of at least one SPTH.

The Independent Multidisciplinary Science Team's (IMST) 1999 report to the Governor John Kitzhaber stated:

> Sharp demarcations between riparian forest and upslope forest, and between fish-bearing and nonfish bearing streams are not consistent with the historic pattern…Most models of large wood recruitment focus on riparian areas as the source, ignoring the important contributions made by upslope sources, especially from landslides. There is a critical need to restore the ecological processes that produce and deliver large wood to the streams from riparian as well as upslope areas.

In addition to lateral LWD inputs to the stream, studies show that up to half of the large woody debris found in lower gradient streams is transported from upstream sources (Pollock and Kennard 1998). This emphasizes the importance of protecting the entire stream network to allow for a sufficient level of large wood. Management activities such as forest thinning within a buffer also may reduce the amount of large woody debris that is provided to the stream; when possible, removal of large woody debris in riparian areas should be avoided.

Small woody debris and organic litterfall

Branches and other woody material play an important role in providing aquatic habitat. Smaller wood helps to create and maintain pools in smaller streams, often backing up against large wood (Pollock and Kennard 1998). Pollock and Kennard (1998) found that the majority of small woody debris is delivered to small and mid-sized streams from trees further than 31 m (100 ft) from the edge of the stream.

Smaller pieces of organic litter (e.g., leaves, needles and twigs) and terrestrial insects, important food sources for aquatic species, enter the stream primarily by direct leaf or debris fall (Spence et al. 1996). The effectiveness of riparian forests in the delivery of small organic debris decreases at distances further than one-half of a site potential tree height (FEMAT 1993). Benthic invertebrates rely on a supply of organic litter to maintain healthy communities. Erman et al. (1977) found that the composition of benthic communities in streams with buffers of 31 m (100 ft) were basically the same as streams in unlogged watersheds.

Terrestrial Habitat

Riparian areas provide essential life needs – food, water and cover – for many terrestrial species. Each species has unique habitat requirements; therefore, widths to protect wildlife can vary greatly. Riparian buffers established for water quality and to protect aquatic habitat may not meet the habitat requirements of terrestrial wildlife (Gregory and Ashkenas 1990). Narrower buffers may support a limited number of species, but wider buffers – at least in some places – will support a more diverse range of wildlife species. Connections to upland wildlife habitat can be especially important for many species.

Large woody debris and structural complexity

Large woody debris (LWD), both standing and fallen, is an important source of foraging, cover and nest sites for birds, mammals, reptiles, and amphibians. LWD provides nesting habitat for cavity nesting birds such as woodpeckers, chickadees and wrens. Downed logs provide cover for a number of amphibians common to riparian corridors, such as Long-toed salamanders and Torrent salamanders. The greater the width of the riparian area, the more wood that is potentially available for snag and downed wood habitat. The more snags present in the riparian area, the greater the wildlife species diversity tends to be (Cline and Phillips 1983). Just as the ability of forests to contribute LWD to aquatic habitat decreases at distances further than one site potential tree height, the effectiveness of upland forests to contribute snags and downed wood decreases at greater distances (FEMAT 1993).

Edge effect

One of the main reasons interior forest dwelling species do not survive successfully in narrow buffers is because of increased edge habitat (edge habitat is more fully discussed in the ***Upland Habitat*** section). Edge habitat occurs when two different habitat types meet, which provides opportunities for some species but also can lead to an increase in competition and predation, reducing interior habitat specialists. Studies in Virginia showed that interior forest birds only occurred in riparian corridors of at least 50 m (164 ft) wide (Tassone 1981), and another study showed that a minimum buffer of 100 m (328 ft) was recommended to support area-sensitive Neotropical migrants (Keller et al. 1993). In eastern forests the edge effect has been shown to extend up to 600 m (2,000 ft) from the edge (Wilcove et al. 1986).

Noise frequently impacts the ability of wildlife to carry on their natural functions within the urbanized landscape. Harris (1985) found that a mature evergreen buffer of 6.1 meters (20 feet) provides the same level of noise reduction as removing the source of the noise three times farther from the habitat without the vegetation. Groffman et al. (1990) found that a forested buffer of 32 meters (100 feet) would reduce the noise of commercial activity to background levels.

Movement corridors

Riparian buffers often may serve as movement corridors for wildlife and plants. Riparian corridors serve as travel and dispersal habitat even in undisturbed areas, due to the connectivity of streams and the diverse food sources available. Riparian areas and isolated wetlands often provide some of the only habitat available in urban areas, buffers around these features allow wildlife to travel through the urban environment with some level of protection (Castelle et al. 1994). There has been much debate over the functionality of corridors for terrestrial wildlife as a means of conservation, but the general consensus is that corridors are a valuable aspect of any wildlife protection plan (for more details on the pros and cons of corridors, see the ***Upland Habitat*** section).

Riparian corridors provide a logical base for a network of corridors allowing movement between upland habitat patches and riparian habitat. Naiman et al. (1988) found that there are some wetland-dependent birds and animals that require an adjacent upland area to meet their needs. Some amphibians, while they only require riparian habitat for a short time period, are unable to complete their life cycle without it (Castelle et al. 1994). In order to serve the needs of interior habitat specialists, movement corridors should be as wide as possible to provide at least some interior habitat and reduce the edge effect.

Microclimate

Riparian areas have a unique microclimate differentiated from upland habitat by a diversity of vegetation, leading to complex structure in the forest canopy, which impacts the amount of light, heat, and wind that penetrates the area. Moist soils help to keep temperatures lower than in surrounding areas as well. The stream channel width and topography of a riparian area influence the extent of the microclimate (FEMAT 1993). Brosofske et al. (1997) found that a buffer of about 76 m (250 ft) would be needed to approximate natural conditions at the stream. However, as stated in Pollock and Kennard (1998), a 76-m (250-ft) buffer will not maintain the microclimate in the riparian forest itself, which is important for riparian dependent plants and animals. Chen et al. (1995) found that changes in relative humidity could be measured 30-240 m

(98-787 ft) into the forest interior from the edge of a clearcut, while changes in soil temperature extended 60 m (197 ft) into the interior. Based on this information, FEMAT (1993) recommended a buffer width of approximately three tree heights in order to preserve most microclimate functions.

An important consideration with forested riparian buffers is the ability of the forest to withstand the force of high winds (Broderson 1973; Steimblums et al. 1984). For example, in northwest Washington, windthrow (uprooting of trees or tree trunk breakage) averaged 33 percent in riparian forest buffers within 1 to 3 years after clearcut harvest of adjacent timber (Grizzel and Wolff 1998). In a review of several studies, Pollock and Kennard (1998) determined that over 75 percent of buffers less than 24 m (80 ft) wide experienced significant blowdown, while only 14 percent of wider buffers lost a significant number of trees. They concluded that the minimum buffer width to maintain minimal windthrow losses over the long-term is 23 m (75 ft). In Mendocino County, California, researchers found that the prescribed 30-m buffers were inadequate to protect trees from greatly increased mortality (primarily through uprooting via windthrow) (Reid and Hilton 2001). Treefall rates were abnormally high for a distance of at least 200 m from clearcut edges, and these rates persisted for six years with somewhat lesser (but still unnaturally high) tree mortality from 6-12 years after clearcutting.

Wildlife needs

The U.S. Fish and Wildlife Service has published numerous scientific papers and a series of habitat suitability index (HSI) models regarding buffer widths for a variety of wildlife species (e.g., Raleigh 1982; Sousa and Farmer 1983; Doyle 1990; Darveau et al. 1995). These models have demonstrated a need for buffer widths ranging from 3 to 106.7 meters (10 to 350 feet) depending on the particular species (Castelle et al. 1994).

Studies recommending riparian corridor widths sufficient to meet the needs of many wildlife species are scarce, because species have different habitat requirements and may respond differently to the same width. FEMAT (1993) recommends a range of widths based on categories of streams, for example for fish-bearing streams the recommended width is two site-potential tree heights, or 91-m (300-ft) buffers on each side of the stream, and non-fishing bearing streams would have a buffer of 46 m (150 ft) on each side. Oregon's Division of State Lands (Van Staveren et al. 1998) recommends one site-potential tree height [ranging from 5-37 m (15-120 ft), depending on the habitat]. Johnson and Ryba (1992) found that the range of recommended width for terrestrial habitat was 67-200 m (220-656 ft). Wenger (1999) reviewed the scientific literature and determined that a 100-m (328 ft) minimum was required to protect diverse terrestrial riparian wildlife communities, but commented that some wider and larger blocks should be preserved to protect area-sensitive species.

The buffer widths discussed here were based primarily on non-urban habitats. In urban habitats edges may be unnaturally abrupt, biological communities such as predator-prey relationships are altered, and human disturbances are routine. It is possible that wildlife using urban riparian areas need wider buffers compared to non-urban habitats. Studies comparing urban and non-urban buffers in similar habitats would help elucidate such differences. Until more urban information is available, the empirical evidence for buffer widths discussed below provides valuable information, but may underestimate the needs of wildlife in urban ecosystems. Urban areas include concentrations of high intensity land use; thus urban stream buffers often are increased to account for future risk of encroachment and to mitigate for the impacts of adjacent land use (Todd 2000).

Fish

The reliance of fish on LWD and clean, cold water suggest that buffers to protect fish at least meet the minimum buffer widths for these two criteria. Several Pacific Northwest studies offer buffer width recommendations specific to salmonid protection. One salmonid run (Columbia River coho) is state-listed as endangered but not federally listed. In western Washington, Castelle et al. (1992) recommended 61-m buffers (200-ft) to protect the zone of habitat influence for salmonids. Knutson and Naef (1997) recommended 15–61 m (50-200 ft) buffers for Cutthroat trout, Rainbow trout and Steelhead.

In species-specific HSI’s, the U.S. Fish and Wildlife Service recommended 30-m (98-ft) buffers for Cutthroat trout, Rainbow trout and Chinook salmon (Hickman and Raleigh 1982; Raleigh et al. 1984; Raleigh et al. 1986). However, these HSI’s are old and were typically developed for specific projects. The reference to the 30m (98-foot) buffer was for erosion control and to maintain undercut stream banks characteristic of good trout habitat. Many of the other parameters that get used in the model (such as water temperature, dissolved oxygen, substrate size, percent pools, base flow, stream shading, etc.) require properly functioning conditions. The HSI does not state that these habitat conditions will be present if there is a 98 foot riparian width, and it does not address the broader upstream and upland impacts that may affect site-specific habitat conditions. HSI models are typically used to evaluate the impacts of a specific project and measure the effectiveness of associated mitigation. HSI models are often modified for specific projects to incorporate current and local (the models are used nationwide) information.

Insects

Little is known about buffer widths and terrestrial insects, but several studies have examined riparian corridor width and benthic insects. Erman et al. (1977) studied streams in northern California and commented, “stream invertebrates were far more effective in discerning logging impacts than the physical and chemical parameters measured.” This study recommended 30 m (100 ft) as the minimum buffer width for maintenance of benthic communities typical of undisturbed conditions. In Western Oregon, Gregory et al. (1987) recommended a minimum of 30-m (100-ft) buffers to maintain instream macroinvertebrate diversity. Benthic insects are highly dependent on organic debris, and these numbers generally match the range within which the majority of organic debris is contributed from riparian vegetation (Erman et al. 1977; McDade et al. 1990). However, certain species are highly sensitive to water quality and urbanized regions are pollution-prone (see *Impacts of Urbanization*). Although 30-m (100-ft) buffers may suffice for organic matter in urban habitats, wider buffers may be necessary to protect water quality important to aquatic insect communities.

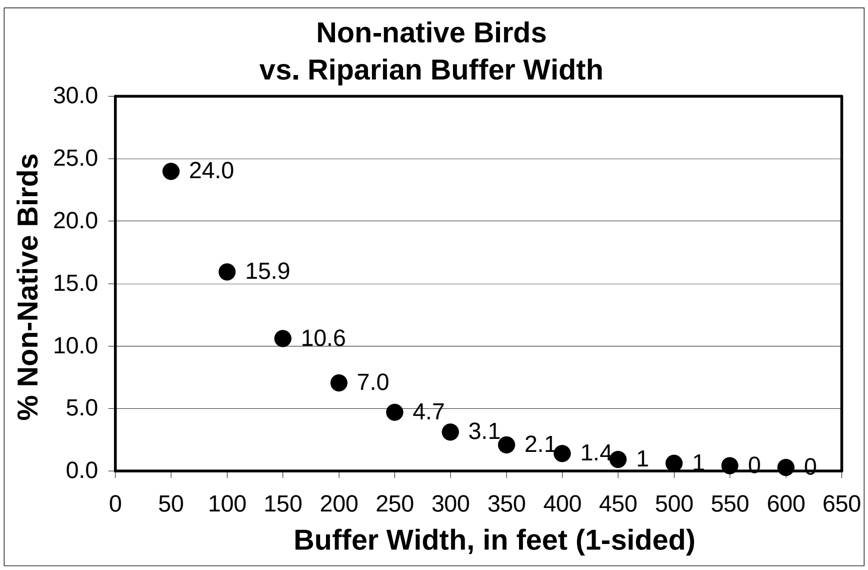
Birds

A relatively large body of literature is available to suggest buffer widths for various single species or groups of birds. In western Oregon, the abundance of four forest-associated bird species (Pacific-slope Flycatcher, Brown Creeper, Chestnut-backed Chickadee, and Winter Wren) increased with increasing buffer width through 70 m (230 ft); four species (Hammond’s

Flycatcher, Golden-crowned Kinglet, Varied Thrush and Hermit Warbler) that were relatively common in unlogged sites, rarely occurred even in the widest (70 m) buffers in logged sites (Hagar 1999). These species may be area-sensitive in this region and vulnerable to habitat fragmentation.

As a group, Neotropical migratory songbirds appear to require wider forests or larger habitat patches than resident and short-distance migratory species (Hennings 2003; Murphy 2005). It is unclear whether this is due to numerous area-sensitive species, other habitat requirements such as native shrubs, an aversion to human disturbance, or some combination of these and other variables. However, local data suggests that human disturbance and native shrubs are influential to this group, but that certain species (e.g., Winter Wren, Brown Creeper, Swainson's Thrush and Pacific-slope Flycatcher) may be area-sensitive (Hennings 2001). The data also shows that non-native bird density decreases with greater corridor widths, reducing predation and competition effects on native birds, as shown in Figure 10 below.

Figure 10. Relationship between riparian buffer width and percentage of non-native birds.



Source: Hennings 2001.

Neotropical migrants are often riparian-associated during the breeding season (Gates and Giffen 1991). In Pennsylvania, Croonquist and Brooks (1993) found that sensitive Neotropical migrant bird species did not occur in riparian zones unless undisturbed buffers greater than 25 m (82 ft) per side were present. Hodges and Krementz (1996) document 100 m (328 ft) as the minimum buffer width to support area-sensitive riparian NMB in Georgia. In Maryland and Delaware, Neotropical migratory species richness increased with corridor width, especially between 25-75 m (82-328 ft), while resident and short-distance migrant species remained stable regardless of buffer width (Keller et al. 1993).

In northern boreal forests, forest-breeding birds were sensitive to corridor width and required at least 60 m (197 ft) wide corridors (30 m – 98 ft – on each side of the stream) to maintain their numbers (Darveau et al. 1995). In southeastern British Columbia, 70-m buffers (230 ft) were necessary to accommodate riparian-associated birds (Kinley and Newhouse 1997). Studies in Vermont showed that 90 percent of forest-dwelling bird species were present when buffer widths reached 150-175 m (492-574 ft) (Spackman and Hughes 1995). Jones et al. (1988) recommended 75-200 m buffers (246-656 ft) to maintain native bird communities. In eastern Texas, 30-95 m (98-312 ft) buffers were necessary to maintain bird abundance and retain species preferring mature forest (Dickson et al. 1995).

Reptiles and amphibians

Little is known about buffer width requirements for reptiles and amphibians, but a few studies add important information. For example, Western Pond Turtles appear to need 100-m (330-ft) buffers for nesting (Knutson and Naef 1997), an important consideration because this species is state-listed species at risk and a Federal **species of concern** (Oregon Department of Fish and Wildlife 2000; U.S. Fish and Wildlife Service 2001). In the Carolina Bays, Burke and Gibbons (1995) found that 275-m (902-ft) buffers were required to protect all nesting and hibernation sites for certain freshwater turtle species. In western Oregon, 75-100 m (246-328 ft) may be necessary to protect riparian-dependent reptiles and amphibians (Gomez and Anthony 1998). The NRCS (1995) recommended minimum 30-m (98-ft) buffers to protect frogs and salamanders, and Rudolph and Dickson (1990) recommended the same buffer width for the full complement of reptiles and amphibians. The dependence of amphibians on LWD suggests a minimum of 30-m buffers (100 ft). In addition, connectivity between habitat patches is likely to be of particular importance to this relatively immobile group.

Mammals

Information about buffer width is scarce for this diverse group. However, as with amphibians, small mammals relying on woody debris probably require buffers sufficiently wide to provide woody debris. Jones et al. (1988) recommend minimum 67-93 m (220-295 ft) buffers to support many small mammal species, and similar widths were suggested by Allen (1983). In southwestern Oregon, Cross (1985) found riparian zones in mixed conifer forests supported a higher diversity and density of small mammals than uplands, and 67 m (200 ft) buffers supported small mammal communities comparable to nearby undisturbed sites. For American Beaver the NRCS (1995) recommended 91-m (300-ft) buffers, while Allen (1983) recommended 30-100 m (98-328 ft) buffers.

Less is known about large mammals, but it is likely that some species such as elk require wider buffers to meet food and other natural history needs such as movement, predator and disturbance avoidance (Phillips and Alldredge 2000). The NRCS (1995) suggested 61-m (200-ft) buffers for deer habitat, and Knutson and Naef (1997) proposed 183-m (600-ft) buffers to provide fawning habitat. Jones et al. (1988) recommended 100-m (328-ft) buffers to support large mammal populations.

Range of functional buffer widths

While studies result in a variety of recommended buffer widths for the riparian area, all recommend some level of protection for this important resource for fish and wildlife. If riparian buffers of sufficient width are maintained along streams in the urban area they can provide good quality habitat within an altered landscape (Knutson and Naef 1997). Table 7 below summarizes the range of riparian area widths recommended in the scientific literature to protect fish and wildlife habitat. In an urban area restoration is likely to play an important role in addition to protection of habitat that is currently in good condition (May 2000).

Table 7: Range of functional riparian area widths for fish and wildlife habitat

AQUATIC HABITAT			
Function		Reference	Functional width *(each side of stream)*
Temperature regulation and shade	Shade	FEMAT 1993	100 ft
	Shade	Castelle et al. 1994	50-100 ft
	Shade	Spence et al. 1996	98 ft
	Shade	May 2000	98 ft
	Shade	Osborne and Kovacic 1993	33-98 ft
	Shade/reduce solar radiation	Brosofske et al. 1997	250 ft
	Control temperature by shading	Johnson and Ryba 1992	39-141 ft
Bank stabilization and sediment control	Bank stabilization	Spence et al. 1996	170 ft
	Sediment removal and erosion control	May 2000	98 ft
	Ephemeral streams	Clinnick et al. 1985	66 ft
	Bank stabilization	FEMAT 1993	½ SPTH
	Sediment control	Erman et al. 1977	100 ft
	Sediment control	Moring 1982	98 ft
	Sediment removal	Johnson and Ryba 1992	10 ft (sand) – 400 ft (clay)
	High mass wasting area	Cederholm 1994	125 ft
Pollutant removal	Nitrogen	Wenger 1999	50-100 ft
	General pollutant removal	May 2000	98 ft
	Filter metals and nutrients	Castelle et al. 1994	100 ft
	Pesticides	Wenger 1999	>49 ft
	Nutrient removal	Johnson and Ryba 1992	33 – 141 ft
Large woody debris and organic litter	Large woody debris	Spence et al. 1996	1 SPTH
	Large woody debris	Wenger 1999	1 SPTH
	Large woody debris	May 2000	262 ft
	Large woody debris	McDade et al. 1990	150 ft
	Small woody debris	Pollock and Kennard 1998	100 ft
	Organic litterfall	FEMAT 1993	½ SPTH
	Organic litterfall	Erman et al. 1977	100 ft
	Organic litterfall	Spence et al. 1996	170 ft
Aquatic wildlife	Cutthroat trout	Hickman and Raleigh 1982	98 ft
	Brook trout	Raleigh 1982	98 ft
	Chinook salmon	Raleigh et al. 1986	98 ft
	Rainbow trout	Raleigh et al. 1984	98 ft
	Cutthroat trout, rainbow trout and steelhead	Knutson and Naef 1997	50 – 200 ft
	Maintenance of benthic communities (aquatic insects)	Erman et al. 1977	100 ft
	Shannon index of macroinvertebrate diversity.	Gregory et al. 1987	100 ft
	Trout and salmon influence zone (Western Washington)	Castelle et al. 1992	200 ft

Table 7 (continued) - TERRESTRIAL HABITAT			
Function		Reference	Recommended width *(each side of stream)*
	Willow flycatcher nesting	Knutson and Naef 1997	123 ft
	Frogs and salamanders	NRCS 1995	100 ft
	Full complement of herpetofauna	Rudolph and Dickson 1990	>100 ft
	Belted Kingfisher roosts	USFWS HEP Model	100 – 200 ft
	Deer	NRCS 1995	200 ft
	Smaller mammals	Allen 1983	214 – 297 ft
	Birds	Jones et al. 1988	246 – 656 ft
	Beaver	NRCS 1995	300 ft
	Minimum distance needed to support area-sensitive Neotropical migratory birds	Hodges and Krementz 1996	328 ft
	Western pond turtle nests	Knutson and Naef 1997	330 ft
	Pileated woodpecker	Castelle et al. 1992	450 ft
	Bald eagle nest, roost, perch Nesting ducks, heron rookery and sandhill cranes	Castelle et al. 1992	600 ft
	Pileated woodpecker nesting	Small 1982	328 ft
	Mule deer fawning	Knutson and Naef 1997	600 ft
	Rufous-sided towhee breeding populations	Knutson and Naef 1997	656 ft
	General wildlife habitat	FEMAT 1993	100-600 ft
	General wildlife habitat	Todd 2000	100-325 ft
	General wildlife habitat	May 2000	328 ft
Edge effect	Interior bird species	Tassone 1981	164 ft
	Neotropical migrants	Keller et al. 1993	328 ft
	Effect of increased predation	Wilcove et al. 1986	2,000 ft
	Noise reduction of a mature evergreen buffer	Harris 1985	20 ft
	Reduce commercial noise	Groffman et al. 1990	100 ft
LWD and structural complexity	Snags and downed wood	FEMAT 1993	1 SPTH outside the buffer
	Width necessary to minimize non-native vegetation	Hennings 2001	650 ft
	Travel corridor for red fox and marten	Small 1982	328 ft
	Minimum to allow for interior habitat species movement	Environment Canada 1998	328 ft
Microclimate	Maintain microclimate	May 2000	328 ft
	Prevent wind damage	Pollock and Kennard 1998	75 ft
	Approximate natural conditions	Brosofske et al. 1997	250 ft
	Maintain microclimate	Knutson and Naef 1997	200-525 ft
	Maintain humidity and soil temperature	Chen et al. 1995	98 – 787 ft

Acronyms:
SPTH: site potential tree height
NMFS: National Marine Fisheries Service
NRCS: National Resource Conservation Service
USFWS: U.S. Fish and Wildlife Service
FEMAT: Forest Ecosystem Management Assessment Team

Summary

Riparian areas are "hot spots" of biological diversity and productivity. While they occupy a relatively small proportion of the landscape, they provide a multitude of functions vital to fish and wildlife, watershed health, and society. The word "riparian" is derived from Latin "riparius" which means "of or belonging to the bank of a river." This paper uses the term "riparian corridor" to include the area of open water (stream channel, wetland, or lake), the adjacent riparian vegetation, and the area of direct interaction between the terrestrial (land) and aquatic (water) environment.

Beyond their essential importance to aquatic life such as salmon, riparian areas and adjacent water habitats contain more plant, mammal, bird, and amphibian species than do surrounding uplands.

Urbanization has resulted in the impairment of many of these functions and values provided by healthy riparian corridors. Some of the effects of urbanization include riparian loss, habitat alteration and fragmentation; changes in basin hydrology; filling and damaging of floodplains and wetlands; stream channel modification; and reduced water quality. These effects are cumulative from upstream and within a watershed. For example, studies show that ecosystem impairment begins as watersheds become more heavily urbanized (that is, where total impervious surfaces [pavement, rooftops] exceed 5-10 percent of the watershed area). In the Metro region, most watersheds exceed this level of impervious cover.

This section provides a review of riparian widths identified in the scientific literature that are necessary to protect habitat for fish and wildlife. Many animal species, from invertebrates to fish to mammals, depend on the riparian area for all or part of their life cycles. Deciding on appropriate widths for protection and restoration of riparian areas for fish and wildlife is complex. The literature provides the following guidelines in addressing this issue:

- Due to the pervasive effects of human activities in an urban environment, riparian area protection and restoration is not sufficient in itself to maintain healthy watershed function. Management of stormwater runoff and protection of upland intact forest areas is essential to protect and restore the ecological health of riparian systems for fish and wildlife and other values. Wider riparian corridors may be needed in urban areas with higher intensity land uses than compared to a rural landscape.
- To the maximum extent possible, all perennial, intermittent and ephemeral streams should be protected from surrounding land use activities. The entire stream network functions as a system, and removing the connection between intermittent and perennial streams will compromise the long-term physical and biological functioning of stream ecosystems.
- Riparian corridors should be wide enough to permit natural stream channel migration, and should maintain connectivity within the 100-year floodplain.
- Riparian corridors should consist of native vegetation where possible. Forest widths along streams, wetlands, and rivers play an important role in urban riparian community structure and composition. Urban research within the Metro region found that wider riparian forests had greater native plant diversity and abundance. Narrow forest widths were more likely to contain higher percentages of nonnative plants.

- Stream-associated wetlands, off-channel habitats and oxbows are valuable for fish and wildlife and should be included in protection programs.
- A range of riparian widths is recommended in the scientific literature to protect multiple riparian functions and values (see Table 7).

A comprehensive protection and restoration program should be based on the widths needed to provide for the long-term integrity of these complex and productive ecological systems.

UPLAND HABITAT

Introduction

In the Metro region we are fortunate to have retained some important natural areas such as Forest Park, the East Buttes, Cooper Mountain and other habitat that is essential for maintaining a diversity of wildlife species within the urban area. While some wildlife species that once inhabited our region are no longer found, remaining natural areas still provide habitat for many wildlife species, as well as recreational opportunities for humans (Houck and Cody 2000).

Metro's Regional Urban Growth Goals and Objectives (RUGGOs), adopted in 1995, state that: "A region-wide system of linked significant wildlife habitats should be developed. This system should be preserved, restored where appropriate, and managed to maintain the region's biodiversity." Also in 1995, citizens of the Metro region passed a $135.6 million bond measure to acquire natural areas within the Portland metropolitan region. Metro has since acquired over 6,000 acres of key habitat. Residents of the region have access to numerous parks and open spaces that provide habitat for a number of wildlife species. This system of parks, riparian corridors, and upland habitat has been called by some "greenfrastructure" and many consider it to be essential in maintaining a high quality of life in an urban area while providing for over 500,000 additional people projected to live in this region within 20 years (Metro 2000).

In this chapter we discuss the importance of upland habitats in the Metro region, including the following topics:

- Ecological definition of upland habitat
- Functions and values of upland habitat
- Upland habitat types in northwestern Oregon
- Impacts of urbanization on upland habitats
- Buffers and surrounding land use
- Upland habitat connectivity and patch size recommendations

Ecological definition of upland habitat

Upland habitat refers to all wildlife habitats that are not riparian, wetland, or open water habitats. However, it should be noted that wetlands are a natural component of upland areas and such wetlands are important for many species, especially during periods of drought (National Academy of Sciences 2001). A habitat can be described as the integration of the landscape and the essential resources of food, water and cover found within it (Linehan et al. 1995). While most species associated with upland habitats use riparian areas, they are dependent on upland areas for key aspects of their life history such as breeding, food, or shelter. Habitat types found in upland areas include grassland or meadow, shrubs, coniferous or deciduous forests, and rocky slopes. These land types provide crucial functions and values for many wildlife species.

Functions and values of upland habitat

All wildlife species depend on the surrounding environment to meet their needs, both long-term and short-term. Some wildlife species live in the Metro region all year round, while others migrate through and some use this region as wintering grounds. For example, elk migrate between upland areas in the summer and lowland areas in the winter. Other species are here only during the breeding season.

Breeding, foraging, dispersal, wintering habitat

All of the upland habitat types described below provide key functions for wildlife at different life stages. Wildlife must have access to areas in which to find food, water, and shelter, and numerous birds spend the winter in the Metro region taking advantage of the relatively mild climate (ODFW 1993). They need foraging habitat that provides food sources such as fruits and berries, or that can support sufficient prey to sustain carnivores. Wildlife species also require habitat suitable for breeding and rearing young. Some upland habitats provide essential areas for breeding species; others are crucial for foraging in both summer and winter. Upland habitat fragments may provide key connections between a variety of other upland and riparian habitats, allowing species to disperse for breeding, foraging, or shelter purposes.

Habitat may be considered in terms of vertical structure that runs the continuum from bare ground to grasses, other herbaceous plants, shrubs, small trees, and tall trees (Forman and Godron 1986). Wildlife species may be vertically stratified, some using the upper canopy, others reliant on the forest floor. Each part of this ecosystem provides important functions and values, both separately and as part of the sum of the whole. Most wildlife species utilize more than one type of habitat in the course of their life cycle (Forman and Godron 1986). Certain plant communities play key roles during specific life events, such as breeding or sheltering young.

Important functions of forested habitats

Forest communities provide essential habitat for wildlife in the Willamette Valley. Douglas-fir is the dominant tree found in this region. In areas that have been burnt, either historically by Native Americans or due to forest fires, Oregon white oak and big-leaf maple may precede forests of Douglas-fir (Larsen and Morgan 1998). Several other trees, while not dominant, provide important food sources for wildlife, including the Pacific madrone, hawthorn, cascara, red-osier dogwood and Pacific dogwood (ODFW 1993). In urban areas forests are frequently made up of second growth trees – trees that have grown after an area has been logged.

A healthy forest contains a multi-story canopy that includes a herbaceous layer, a shrub layer, and an upper canopy of native trees (Forman and Godron 1986). This vegetative community naturally contains downed wood and snags that provide key functions for wildlife such as food and nest cavities. Forests are essential for numerous species of wildlife in the Metro area (see Appendix 1 for species associated with forests in the Metro region). Both coniferous and deciduous forest communities are important. Native trees provide breeding, foraging, dispersal, and wintering habitat for a number of wildlife species. Forest strips may also provide dispersal corridors for interior habitat species.

Three-dimensional structure

The structure of a forest is crucial in terms of the level of function it is able to provide as habitat for wildlife (Guthrie 1974; Goldstein et al. 1986; Short 1986; Germaine et al. 1998). Each layer of the healthy forest multi-story canopy is important to different wildlife species at various life history stages. The horizontal spacing and density of foliage provides cover for protection and escape routes. Vertical layers provide places for perching, roosting, nesting, and feeding. The presence of a multi-story canopy can serve as an indicator for the types of species able to use a forest. For example, most Pileated Woodpecker nests are found in mature or old-growth forests with two or more canopy layers (Marshall et al. 1996). However, in urban areas Pileated Woodpeckers have been found to use second growth forests. The extent to which the canopy is open or closed also impacts the type of vegetation that grows in the forest. An open canopy allows more light lower to the ground, which in turn allows for a more diverse and abundant shrub layer. A healthy understory of native shrubs provides important woody structure for many bird species for nesting purposes.

Snags and downed wood

Dead and downed wood in forests serves a variety of functions for wildlife (Maser et al. 1988). Hollows and cavities in standing dead trees as well as logs and stumps provide shelter for many wildlife species. Over 100 wildlife species in the Pacific Northwest use snags, and about 53 of those species are dependent on cavities in the snags (Brown 1985; Neitro et al. 1985). These species include woodpeckers, owls, bats, small mammals, and amphibians. Many species of birds and small mammals use cavities in standing snags for nesting, roosting, feeding, and overwintering (Maser et al. 1988). Burrowing species use stumps, logs and large tree roots for burrow sites. Soft decaying logs provide habitat for some amphibians and reptiles, and also provide food for other species that eat fungi or invertebrates dependent on decaying wood (Maser and Trappe 1984). Coarse woody material on the forest floor provides moist sites for amphibians to find shelter from predators, foraging areas, and breeding habitat. Downed woody material provides habitat in the winter, catching snow and providing warm, dry areas for shelter (ODFW 1993).

Fallen trees provide opportunities for new plants to become established in the forest, by creating holes in the canopy to allow sunlight to reach the forest floor and by providing nutrients through the process of decay (Maser et al. 1988). Many old-growth trees started life as a seedling nourished by a rotting downed log, often called a "nurse log." Decaying wood is a major source of organic material in the soil (Maser and Trappe 1984). A decomposing fallen tree provides a variety of habitat functions as it proceeds through the stages of decay to finally become part of the forest floor. Woodpeckers and other wildlife species routinely forage for insects on downed logs.

Upland interactions with surrounding landscape

Upland habitat in urban areas is typically fragmented and intermingled with other land uses. Some land uses are more compatible for the functions and values important for wildlife than others. For example, in some cases low-density residential areas may have less of an impact on a habitat patch, depending on the species, than other land uses (Nilon et al. 1995). The type (native vs. nonnative) and abundance of species tends to change across the urban gradient, as the landscape changes from undeveloped, rural land to high intensity land uses in the downtown areas (Blair 1996). Habitat areas provide more functionality to wildlife if they are situated near other patches of similar habitat with some amount of connectivity between the fragments (Soulé 1991a,b; Duerkson et al. 1997).

Corridors and connectivity with surrounding habitat

Habitat corridors provide connections among various habitat patches within a fragmented landscape. Major functions provided by corridors include: habitat for some species within the corridor, opportunity to move between habitat fragments, and a source of environmental and biotic inputs on the surrounding habitat (Forman and Godron 1986). The value of connectivity has been debated in the scientific literature (Duerkson et al. 1997). While corridors provide many benefits, they also allow exotics, including mammals, birds, and plants, to more easily invade native habitats. Another potential downside of corridors is that they may provide opportunities for predation that would not otherwise occur, especially when they are narrow and lacking in vegetative cover. However, the benefits of corridors, particularly in preventing local extinctions, likely outweigh the risks (Soulé 1991a). (See *Impacts of Urbanization, Habitat Fragmentation* for more discussion on corridors).

Connectivity is important to wildlife for several reasons. Many species must migrate seasonally to meet basic needs for food, shelter and breeding, and connections between habitat patches allow this migration to occur (Duerkson et al. 1997). In addition, wildlife populations that are connected to each other are more likely to survive over the long term than an isolated population (Duerkson et al. 1997; Beier and Noss 1998). A population that exists on a connected system of habitats will be more likely to survive a catastrophic event on one patch, and the surviving population may be able to repopulate or revive an area that is in trouble. Finally, connectivity between habitats allows populations to interbreed, which aids in the vigor and survival of the overall population by reducing genetic inbreeding (Duerkson et al. 1997).

Connectivity with riparian areas

Prior to modern land use patterns, the landscape provided fish and wildlife habitat in an interconnected mosaic of habitat types (Forman and Godron 1986). Upland areas were functionally and physically connected with the streams, rivers, wetlands and lakes (riparian areas) that wended their way through valleys.

Most species of wildlife utilize riparian areas at some point in their life history. Many mammals must use riparian areas for water, food, and shelter. Because riparian areas frequently serve as corridors through an urbanized landscape, these areas also provide places for movement and dispersal. Over 60 percent of mammal species in the Northwest use riparian areas for breeding and feeding (Kauffman et al. 2001). In the Metro region, nearly half of all birds, and 45 percent of all non-fish vertebrate species are dependent on water-associated habitats. Nearly all vertebrates (93 percent, excluding fish) use these habitats (see Table 1), yet riparian areas comprise only a small fraction of the landscape. Thus, connections between upland habitats and riparian areas are very important for most wildlife species. Upland habitats that are physically connected to riparian areas will likely be more valuable for wildlife.

Local wildlife data affirms the importance of connectivity to water and riparian areas. In 1999, Oregon State University (OSU) conducted spring bird surveys along small streams in the Portland area (Hennings 2001; Hennings and Edge 2003). Concurrently, Metro (Parks and Greenspaces Department) developed a model to predict key habitats of interest for future conservation using four variables: size of habitat patch, proximity to other habitat patches, proximity to water resources, and species richness.[1] At Metro's request, OSU analyzed their bird data based on model criteria scores. Each of the four model variables appeared important to bird communities, and analyses suggested that habitat patches with more nearby water resources had higher bird diversity (Hennings 2001).

Upland habitat types in Northwestern Oregon

Prior to settlement by Europeans, the Willamette Valley consisted of a mosaic of large patches of riparian forests and wetlands, open white oak savannas and prairies, and hills of oak, Ponderosa pine and Douglas-fir (LaRoe et al. 1995). Native Americans historically set controlled fires that maintained the prairies, savannas, and oak woodlands throughout much of the valley for many years (ODFW 1993). Settlers were attracted to the Willamette Valley due to the fertile soils and abundant rainfall, providing ideal agricultural conditions. Most of the prairies have since been converted to farmland, and the original forests have almost all been logged (LaRoe et al. 1995; Oregon Natural Heritage Advisory Council 1998). The greatest change in vegetation type has been the loss of grassland and oak savanna; current estimates are that less than one percent of the historic extent still exists in small, scattered patches (Partners in Flight 2000).

Historic vegetation

Using data from land surveys for the General Land Office between 1851 and 1895, the Oregon Natural Heritage Program created a historical vegetation map for Oregon (Christy 1993). The data coverage was created at 1:24,000 scale using survey notes for township and section lines, with standard USGS 7.5-minute topographic maps as a base. This map shows that the Metro region was covered predominantly by closed and open canopy forest interspersed with prairie and savanna habitats especially in the lowlands of the Tualatin, Willamette, and Columbia River basins (see Figure 11 "Historical Vegetation of the Metro Region").

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[1] An index of species richness was determined by the Oregon Natural Heritage Program and applied to the natural areas identified by the model.

Figure 11. Historical vegetation of the Metro region (from Christie et al. 1993).

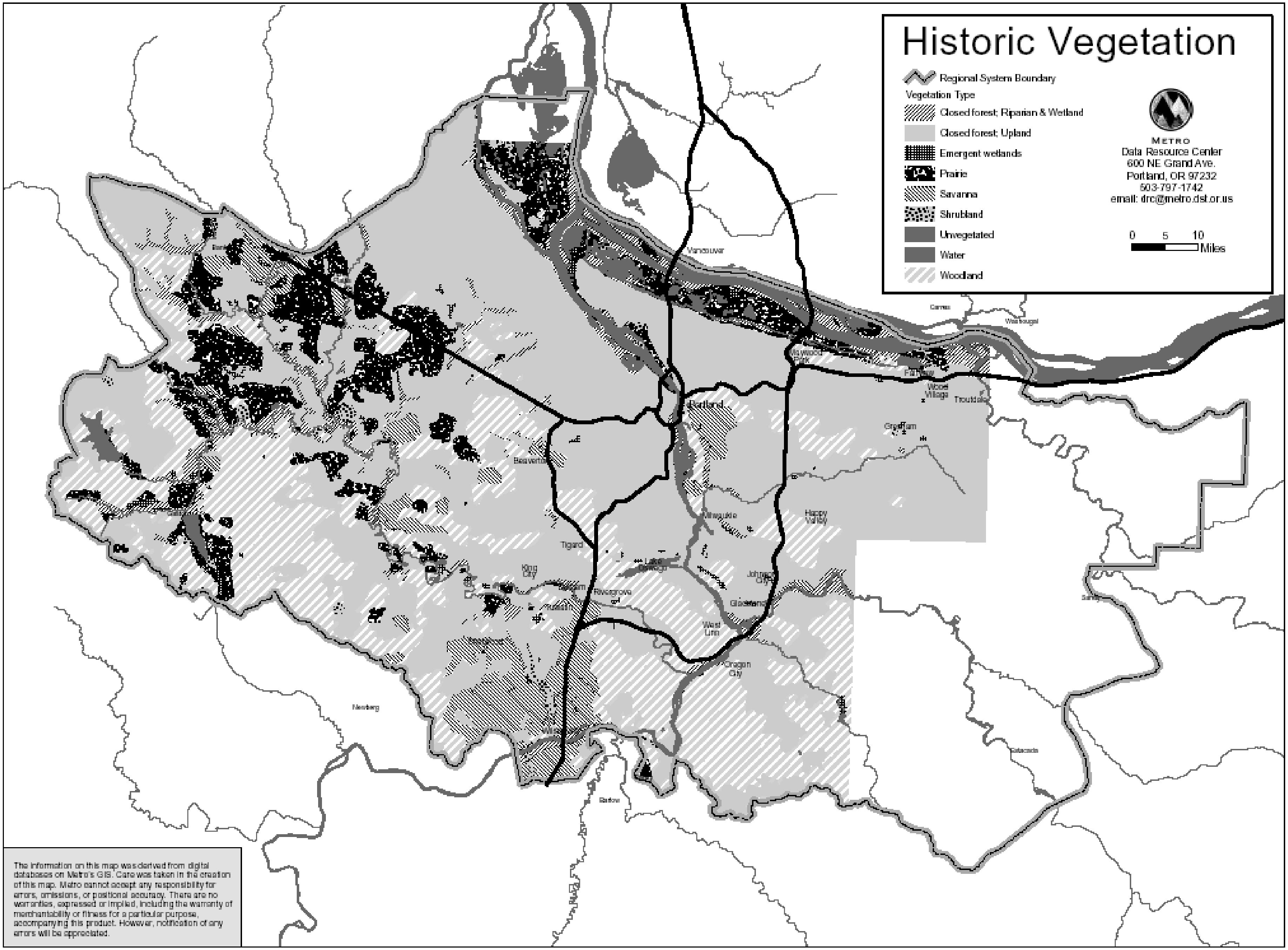


Table 8 gives the percentage breakdown for the types of vegetation that once covered the Metro region compared to current land cover data. The data show that forest canopy covered more than three fourths of the Clackamas, Sandy, Tualatin, and Willamette River basins within the Metro region. The Columbia River and Multnomah Channel contained significant amounts of riparian forest, wetland, dry prairie and savanna, and open water. The Tualatin River basin contained significant amount of dry prairie and savanna habitat.

Table 8. Percentage of vegetation cover for the Metro region: historical versus current

Vegetation Type	WATERSHED						
	Clackamas River	**Columbia River**	**Multnomah Channel**	**Sandy River**	**Tualatin River**	**Willamette River**	**All**
	Percent historic/current	*Percent historic/current*	*Percent historic/current*	*Percent historic/current*	*Percent historic/current*	*Percent historic/current*	*Percent historic/current*
Barren/Urban	<1 / 27	<1 / 52	0 / 3	0 / 45	<1 / 17	<1 / 29	<1 / 24
Upland closed forest canopy	68 / 28	40 / 3	53 / 32	82 / 8	47 / 23	52 / 25	49 / 22
Upland open forest canopy	16 / 9	4 / 10	1 / 3	0 / 16	28 / 8	30 / 15	25 / 10
Riparian/ wetland forest	11 / 2	16 / 2	10 / 2	12 / 4	6 / 1	3 / 2	6 / 1
Wetlands and wet prairies	<1 / <1	4 / 2	8 / 2	<1 / 1	3 / 1	<1 / <1	2 / <1
Dry prairie, savanna, and shrubland	2 / 6	14 / 10	21 / 17	0 / 10	16 / 6	10 / 5	14 / 6
Ag riparian/ wetland	0 / <1	0 / <1	0 / 2	0 / <1	0 / 1	0 / <1	0 / <1
Ag Upland	0 / 25	0 / 2	0 / 35	0 / 10	0 / 43	0 / 19	0 / 31
Water	2 / 2	22 / 19	7 / 3	6 / 6	<1 / <1	4 / 4	4 / 4
Total Acres	14,053	47,252	22,481	6,892	289,985	166,356	547,017

Source: Christy 1993, Metro 1998 land cover data.
Notes:
1) The Urban category underestimates the amount of land covered with urban development because it excludes urban uses that are also intermingled with open and closed forest canopy cover.
2) The table shows a 43 percent decline in forest cover from historic levels. Forest composition has also changed due to loss of old growth forests and white oak woodlands.
3) Current riparian/wetland forest is only 17 percent of historic levels. However, the difference is probably much greater due to the assumptions used to calculate current riparian/wetland forest cover. This cover type was estimated using 200-foot buffers along streams and wetlands. This significantly overestimates the actual amount of riparian forest given existing development patterns.
4) Historic dry prairie, savanna, and shrubland have been converted to non-native grasslands and shrublands.
5) Agriculture and urban categories comprise 55 percent of the land area in the region, representing a total conversion from the original land cover.

Another source of historical data for the metro region is the First Federal Township Survey Map of 1852 (Munch *No date*). This map gives an interesting overview of the region – its first settlement patterns of roads, platted lands, and cultivated fields, as well as natural features such as location of prairies, wetlands, and general topography. It shows that most of the cultivated fields were located in the prairies and savannas that characterized the lowlands of the Tualatin and Willamette valleys. The map shows lakes located in the Willamette River floodplain, now known as the Northwest Industrial District of Portland, and Sucker Lake, which has been renamed Lake Oswego.

The following types of vegetation communities have been particularly impacted by the change in the landscape over the past hundred years (summarized from Christy 1993, Johnson and O'Neil 2001).

Prairies included both wet and dry grasslands. Wet prairies were subject to seasonal floods and were found on poorly drained soils in valley bottoms. Dry prairies were found primarily along the edges of valleys and on well drained soils, and were dominated by perennial grasses. Savanna habitat was similar to dry prairies but also included widely scattered trees with some open tree groves. Trees typically were Oregon white oak, but also included Douglas fir or Ponderosa pine. In prairie habitats, canopy cover was generally less than 25 percent.

Oak woodlands consisted of a relatively open understory and were typified by a canopy of 50 percent or greater Oregon white oak. Other species included Big-leaf maple, Douglas-fir and Pacific madrone. The understory was predominantly poison oak, California hazel, snowberry, oceanspray, serviceberry, and sword fern. Historic distribution of oak woodlands was limited to low elevation dry areas with limited conifer competition. For example, oak woodland and oak savanna habitat once covered approximately 21 percent of the Tualatin Valley within the metro region.

Current Vegetation

Current vegetation in the Willamette Valley has changed dramatically from historic patterns as a result of human alteration of the landscape (Table 8). Key factors include agricultural cultivation, urban development, livestock grazing, exotic species introduction, suppression of natural fires, logging, drainage of wetlands, and **channelization** of streams and rivers (Partners In Flight 2000).

Native grassland has been reduced to only one percent of historic land coverage. Oak woodland habitat has been impacted by conversion of land to agriculture and invasion by exotics due to fire suppression, and current distribution is patchy. Conifer and deciduous forests have overtaken former grassland habitat. These forests are typically dominated by Douglas-fir, often with an understory of exotics such as Himalayan blackberry (Partners in Flight 2000). Riparian associated forests and shrub habitats have been radically changed from pre-settlement conditions. Over 70 percent of the bottomland hardwood forests have been lost.

While land cover data in Table 8 documents the historical loss of native habitats in the Metro region, recent data confirms the loss of habitat is ongoing due to the continuing conversion of land for development and other uses. For example, Metro conducted a study to document the loss of natural areas occurring between 1989 and 1997. The study documented a loss of 12 percent of the original 131,167 acres of natural areas inventoried in 1989 (Metro 1997a). With projected population increases of 500,000 people in the metro region over the next twenty years, habitat loss is likely to continue.

Mapping landcover types

One of the difficulties in large-scale ecosystem management is a lack of consistent data at scales fine enough to be biologically meaningful. Detailed habitat characterization over a large area requires a substantial amount of on the ground fieldwork to identify specific vegetative communities across the landscape. The cost of such an effort is prohibitive. To overcome the obstacle of identifying habitat to enable management and protection of wildlife, conservationists and planners have turned to data sources better suited for collecting information consistently on a large scale.

O'Neil et al. (1995) identify three components necessary to accurately assess ecological functionality of a habitat (vegetation composition, vegetation structure, and critical habitat components such as snags and water), but acknowledge that vegetation composition is the only component that is currently measurable. The authors state that "vegetation reflects many abiotic and biotic characteristics of an area…and has therefore been used as a surrogate for ecosystems in conservation assessments." The use of **coarse** (applicable on a large scale) data is appropriate for identifying important habitat areas, rather than focusing on protecting a specific wildlife species (O'Neil et al. 1995). Vegetation composition is measurable at a large scale, based on remote sensing and aerial photography.

One such data source is the Landsat Thematic Mapper (TM) images. In 1999, Metro Parks and Greenspaces Department contracted with Ecotrust to develop several digital products from the Landsat TM images for use in identifying regional natural areas and producing an urban forest canopy map. The Landsat TM data was chosen for several reasons: 1) the entire region is captured in a single scene, 2) the type of spectral information is ideal for classifying vegetation, and 3) Metro had previously used Landsat TM data in 1991, thus comparisons in vegetation changes over time are possible (Ecotrust 1999). Metro and Ecotrust developed a land cover classification scheme for categorizing the data based on the Anderson classification scheme, including 17 mutually exclusive classes (shown in Table 9 below). A two-acre minimum mapping unit was used. Ecotrust utilized digital orthophotos to support the Landsat TM data.

The land cover types contained in the data layer provide a basis for identifying the types of habitat found in the Metro region. The land cover data identifies open versus closed canopy forests, deciduous versus coniferous forests, various types of shrub habitats, and distinguished between agricultural and meadowlands. A limitation of the land cover data is the inability to identify detailed quality aspects of the habitat for wildlife, such as structure and critical habitat components. For example, the land cover data allows the identification of a coniferous closed canopy forest, but does not show if ivy or another invasive species has invaded the understory of that forest.

Ideally the land cover data would be ground-truthed to further identify specific habitat types and thus enable the association of species with mapped areas. However, when working at a regional scale many conservation efforts have chosen to utilize the coarse data in developing habitat protection plans (Robinson et al. 1995). There are several habitat classification schemes that could be used to further refine the land cover data based on fieldwork. As an example, we chose to use a habitat classification scheme developed by Johnson and O'Neil (2001). Although the habitat types described in this biologically based classification scheme cannot currently be mapped at a scale useful in the Metro region; the information provides additional detail on the types of vegetative communities to be found in this region. The scheme also provides species associations with each habitat type. Table 9 below describes the land cover types and provides a crosswalk to show how Johnson and O'Neil's classification scheme fits within Metro's existing data.

Table 9. Land cover types and crosswalk to Johnson and O'Neil's classification scheme

Land Cover Types	Description	Johnson & O'Neil's classification scheme
Water	Major rivers, lakes, ponds, reservoirs, and other standing water (from Metro's existing hydrology data)	Open water – lakes, rivers, streams
Barren and sparsely vegetated	Bare ground, sand, gravel, asphalt, structures, rock with less than 15% vegetated cover and less than 10% trees (no agriculture)	Urban and mixed environs
Agriculture		
Low structure	Pasture and other cultivated cropland with limited vegetative structure	Agriculture, pasture and mixed environs
High structure	Areas with high degree of vegetative structure such as orchards, groves, vineyards, canes, nurseries, Christmas trees	Agriculture, pasture and mixed environs
Forest		
Closed canopy = 75% tree crown closure		
Deciduous closed canopy forest	70% total crown closure deciduous	• Westside lowlands conifer-hardwood forest • Westside oak, dry Douglas-fir forest, woodlands
Mixed closed canopy forest	<70% total crown closure deciduous; <70% total crown closure coniferous	• Westside lowlands conifer-hardwood forest • Westside oak, dry Douglas-fir forest, woodlands
Conifer closed canopy forest	70% total crown closure coniferous	• Westside lowlands conifer-hardwood forest • Westside oak, dry Douglas-fir forest, woodlands
Open canopy = <75% tree crown closure		
Deciduous open canopy forest	70% total crown closure deciduous	• Westside lowlands conifer-hardwood forest • Westside oak, dry Douglas-fir forest, woodlands
Mixed open canopy forest	<70% total crown closure deciduous; <70% total crown closure coniferous	• Westside lowlands conifer-hardwood forest • Westside oak, dry Douglas-fir forest, woodlands
Conifer open canopy forest	70% total crown closure coniferous	• Westside lowlands conifer-hardwood forest • Westside oak, dry Douglas-fir forest, woodlands
Scattered canopy = <25% tree crown closure		
Deciduous scattered canopy forest	70% total crown closure deciduous	• Westside lowlands conifer-hardwood forest • Westside oak, dry Douglas-fir forest, woodlands
Mixed scattered canopy forest	<70% total crown closure deciduous; <70% total crown closure coniferous	• Westside lowlands conifer-hardwood forest • Westside oak, dry Douglas-fir forest, woodlands
Conifer scattered canopy forest	70% total crown closure coniferous	• Westside lowlands conifer-hardwood forest • Westside oak, dry Douglas-fir forest, woodlands
Shrub		
15% woody canopy cover, <10% crown closure of trees		
Closed canopy	75% total shrub/tree crown closure	No applicable habitat type
Scattered canopy	25% to <75% total shrub/tree crown closure	Westside grasslands
Open canopy	10% to <25% total shrub/tree crown closure	Westside grasslands
Meadow/grass	15% vegetative cover, <15% woody canopy cover, <10% tree cover	Westside grasslands

Source: Metro 2001.

As discussed in the ***Aquatic and Riparian Habitat*** section, Johnson and O'Neil (2001) describe eight habitats present in significant amounts in the Metro region. Of these, three are water-based classifications and are discussed in the ***Aquatic and Riparian Habitat*** section. The remaining five habitats include Westside Lowlands Conifer-Hardwood Forest, Westside Oak and Dry Douglas-fir Forest and Woodlands, Westside Grasslands, Agriculture Pasture and Mixed

Environs, and Urban and Mixed Environs, and comprise the majority of upland habitats available to native wildlife in this region. Trees, shrubs and herbaceous species common to each of these habitats are listed in Johnson and O'Neil's (2001) book. All scientific names (genus and species) and species-habitat associations are included with the species list (Appendix 1). Eighty-nine percent of all terrestrial species in the Metro region are associated with upland habitats, with at least 28 percent depending on these habitats to meet their life history requirements, as shown in Table 10 below. In this section, we provide an abbreviated list of **species at risk** closely associated with each habitat based on state and/or federal status, as described in Appendix 1 (species list).

Table 10. Analysis of the importance of terrestrial habitats within each major group of animals (292 total existing native species; based on Metro's Species List, Appendix 1).

Group	# Native Species	Upland Dependent	Uses Uplands	Total % Using Uplands
Amphibians	16	2 species 13%	13 species 81%	15 species 94%
Reptiles	13	0 species 0%	13 species 100%	13 species 100%
Birds	209	61 species 29%	120 species 57%	181 species 86%
Mammals	54	18 species 33%	32 species 59%	50 species 92%
TOTAL	292	81 species 28%	178 species 61%	259 species 89%

Notes:

1. "Upland Dependent" species are closely associated with at least one of the four upland habitats; "Uses Upland" species are generally associated with or known to use at least one of the four habitats.
2. Note that although the total percent *using* uplands was only 4 percent lower than water-associated habitats, the percent *dependent* upon uplands was considerably lower than water-associated habitats (28 percent versus 45 percent, respectively; see Table 1 in Riparian chapter). Water-associated habitats comprise only 10-15 percent of the land at most, and clearly represent critical wildlife habitat. However, uplands also provide connectivity to water and other natural areas, as well as unique habitat types to habitat specialists throughout the region.

Habitat types

Upland habitat types may include Habitats of Concern (see Special Habitats of Concern section under Aquatic and Riparian Habitat).

Westside lowlands conifer-hardwood forest

This habitat is widespread and prevalent in the Metro region. Historically and currently the most extensive of all natural habitats west of the Cascade Mountains, it often forms the matrix within which other habitats occur as patches and is very important to wildlife in this region. This habitat may be dominated by conifers, deciduous trees, or both, and tends to have structurally diverse understories. In nutrient-poor soil conditions evergreen shrubs dominate the understory, while nutrient-rich or moist sites contain more deciduous shrubs, ferns, and grasslike plants. Mosses are a major ground cover component, and older stands are rich with lichens.

Fire is the primary natural disturbance, with natural fire intervals ranging from less than one hundred to several hundred years. Fires in this habitat type are typically severe (e.g., often kill trees). Other significant sources of natural tree mortality include bark beetles, fungi, and landslides. Human management and disturbances include timber harvest and clearing for development. Widespread deforestation and subsequent reforestation in Douglas-fir monoculture has resulted in a reduction in canopy tree diversity and coarse woody debris in the Pacific Northwest, as well as excluding habitat succession to old growth stages.

Several wildlife species dependent on this habitat are at risk at the state and/or at the federal level. This includes one amphibian, the Northern Red-legged Frog. At-risk bird species dependent on this habitat include Band-tailed Pigeon, Northern Pygmy-owl, and Olive-sided Flycatcher. Mammals include two bat species (Long-legged Myotis and Silver-haired Bat) and a tree-dwelling rodent, the Red Tree Vole.

Westside oak and dry Douglas-fir forest and woodlands

This habitat is limited in area and declining in extent and condition in the Willamette Valley, and is therefore considered to be a Habitat of Concern. Conifers, deciduous trees or some combination of the two may dominate these typically dry woodlands. Canopy and understory structures are variable, ranging from single- to multi-storied, with large conifers sometimes emerging above deciduous trees in mixed stands. This habitat is too dry for Western hemlock and Western red cedar; lack of shade-tolerant tree regeneration, along with understory indicators such as Tall Oregongrape, help distinguish oak woodlands from Westside Lowlands Coniferous-Hardwood forests. Large woody debris and snags are less abundant than in other westside forested habitats. Sweet cherry (*Prunus avium*) and English hawthorn (*Crataegus monogyna*) have invaded and sometimes dominate this habitat's subcanopy in the Metro region.

The natural disturbance regime for this habitat is low to moderate severity fire, occurring every 50-100 years. Well adapted to this disturbance, oaks and madrones may resprout after fire. Because such fires do not kill all trees, varying tree density and multiple forest gaps created by fires are important contributors to structural diversity. Humans often use oak habitats for forestry, livestock grazing, and low-density residential development. Many oak stands in the Willamette Valley are degraded due to fire suppression and human disturbance-induced invasion by Scot's broom, non-native grasses and weedy species. In the absence of fire, this habitat converts to Douglas-fir forest; selective logging of Douglas-fir in oak stands can prevent loss of this important habitat. The historic distribution of oak woodlands was limited to low elevation dry areas with limited conifer competition.

Several wildlife species dependent on this habitat are considered at-risk at state and/or federal levels. These include Band-tailed Pigeon, Lewis' Woodpecker (extirpated as a breeding species), Acorn Woodpecker, and Western Bluebird. At-risk mammals include Western Gray Squirrel and Red Tree Vole.

Westside grasslands

Once widespread in the Willamette Valley, Westside Grasslands are now rare, limited, and currently declining due to fire suppression, conversion to agriculture and urban habitats, and invasion by non-native species. Native grasslands are considered to be a Habitat of Concern. In the Metro region, this habitat in its native form has virtually disappeared. Sometimes referred to as prairie or, in the Oregon Coast Range, grass balds, this habitat occurs near or adjacent to many other habitats. Often used for grazing and recreation, Westside Grasslands may be grassland or savanna, with less than 30 percent tree or shrub canopy cover. Bunchgrasses dominate native sites, with space between vascular plants covered with mosses, lichens and forbs. Rich diversity of native forbs is typical of sites in good condition. When present, tree and shrub species vary widely. Degraded sites tend to be dominated by exotic grasses. Grassland vegetation provides several essential wildlife functions and values. According to Partners in Flight (2000), 44 breeding bird species are highly associated with grassland/savanna areas in the Willamette Valley. Open meadows are also important to raptors, providing vital hunting grounds and in turn, keeping rodent populations in check.

Historically, dry soils and fire (lightning strikes and intentionally set by indigenous inhabitants to maintain food staples) eliminated or thinned invading trees, but fire suppression over the past century has led to Douglas-fir encroachment, converting many grasslands to shrublands and/or forests. Because grasses have rapid generation turnovers and do not block sun from taller plants, this habitat is particularly vulnerable to invasion by non-native species through human-associated disturbances such as vehicular use or grazing. Prescribed fires and other management activities can help control Scot's broom and Douglas-fir encroachment in these grasslands.

Several bird species dependent on this habitat are state and/or federally at risk, including Streaked Horned Lark (a subspecies of the Horned Lark), Vesper Sparrow and Western Meadowlark. The Western Meadowlark is Oregon's State Bird, and although once common, is now extirpated in the Metro region as a breeding species.

Agriculture, pasture and mixed environs

Occurring within a matrix of other habitat types, agricultural lands often dominate the landscape in flat or gently rolling terrain, on well-developed soils, and in areas with access to irrigation water. This habitat can be diverse, ranging from hayfields and grazed lands, to multiple crop types including low-stature annual grasses to row crops to mature orchards. Hedges, windbreaks, irrigation ditches, and fencerows provide especially important habitat for wildlife (Demers et al. 1995). USDA Conservation Reserve Program lands are included in this category and may provide valuable wildlife habitat. Agricultural lands are subject to exposed soils and harvesting at various times during the year and receive regular inputs of fertilizer and pesticides, thus influencing the quality of water-associated habitats.

The greatest conversion of native habitats to agricultural production occurred between 1950 and 1985, primarily as a function of U.S. agricultural policy (Gerard 1995). Since the 1985 Farm Bill and the economic downturn of the early to mid 1980's, the amount of land in agricultural habitat has stabilized and begun to decline (National Research Council 1989). The 1985 and subsequent Farm Bills contained conservation provisions encouraging farmers to convert agricultural land to native habitats (Gerard 1995; McKenzie and Riley 1995). Clean farming practices and single-product farms have become prevalent since the 1960's, resulting in larger farms and widespread removal of fencerows, field borders, roadsides, and shelterbelts (National Research Council 1989; Gerard 1995; McKenzie and Riley 1995). In Oregon, land-use planning laws prevent or slow urban encroachment and subdivisions into areas zoned as agriculture.

Because this habitat type is human-generated, there is no "natural" disturbance regime. Fire is nearly completely suppressed; in absence of fire or mowing, unimproved pastures become increasingly shrubby. Edges can be abrupt along habitat borders, with important implications for wildlife. Presence of non-cultivated or less intensively managed vegetation such as fencerows, roadsides, field borders and shelterbelts can enhance structural diversity. Integrated pest management plans and similar farming practices can help reduce the impacts of fertilizers and pesticides (Gerard 1995).

Twenty-nine percent of birds and 25 percent of mammals native to Oregon use croplands and pasturelands to meet their habitat needs (ODFW 1993). Agricultural fields left fallow for the winter often provide wintering habitat for migratory birds (ODFW 1993). Many of the species that use this habitat require the nearby associated aquatic habitats to meet their needs. Bird species at risk that depend on this habitat include Oregon Vesper Sparrow and Western Meadowlark. One mammal, the Camas Pocket Gopher, is at risk at the federal level.

Urban and mixed environs

These areas are widely distributed, but patchy. Urbanization in this scheme encompasses all habitats with impervious surfaces covering at least 10 percent of the land's surface (less than 10 percent is considered rural). Characterized by buildings and other structures, impervious surfaces and plantings of non-native species, urban environments provide habitat to some species requiring structures such as cavities, caves, cliffs and rocky outcrops, and ledges. This habitat is subdivided into low-density (10-29 percent impervious surfaces), medium density (30-59 percent impervious); and high density (60+ percent impervious) areas, described in detail in Johnson and O'Neil (2001). Many human-induced changes in urban areas are essentially irreversible; for example, building a house requires removing vegetation, scraping and leveling topsoil, building driveways and roads, and running sewers and utilities both above and underground. Canopy cover is reduced in these habitats, and structural features present in historical vegetation, such as snags and dead wood, are rare.

Frequent human disturbance is normal in urban habitats, and species that are disturbance-sensitive tend to be absent or reduced in numbers (Marzluff et al. 1998). The effects of urbanization on wildlife, including disturbance, habitat loss, conversion and fragmentation, and non-native species invasion, are discussed later in this chapter. Historical natural disturbance patterns are largely absent in urban habitats, although flooding, ice, wind, or fire still occur. Flooding and pollution is more frequent and more severe in areas with significant impervious surface cover and/or modified stream systems. Temperatures are elevated and background lighting is increased; wind velocities are altered by the urban landscape, often reduced except around the tallest structures downtown, where high-velocity winds are funneled around the skyscrapers. Urban development often occurs in areas with little or no slope and frequently includes wetland habitats. This habitat type is expected to increase at an accelerating pace locally and nationally (Parlange 1998).

Studies in the Pacific Northwest document declining wildlife diversity with increasing urbanization (Penland 1984). Nonnative species and generalists are most common in urban habitats. Few sensitive species are associated with this habitat, because sensitive species are often habitat specialists that are quickly out-competed by nonnatives and generalists. The only closely associated mammal of concern is Big Brown Bat, also known by the common name “house bat.” This non-migratory species often lives in a variety of artificial structures, eating termites and beetles (Csuti et al. 1997).

Many man-made or artificial structures provide key habitat for wildlife in the urban area (ODFW 1993). For example, bridges provide important bat habitat. Fences, powerlines and poles provide perches from which hawks and falcons search for prey, an important means of rodent control in urban and agricultural settings. Nest boxes and bird feeders provide valuable resources, as the continuing recovery of Western Bluebirds within the Metro area demonstrates. Chapman Elementary School in Portland is renowned for the annual roosting of thousands of Vaux’s swifts in the furnace chimney, and the school community is working to conserve these long-distance migrants (Robertson 1999). Since 1993 a pair of Peregrine Falcons has chosen the Fremont Bridge as a nesting place – similar to the high cliffs that would be attractive in the wild (Sallinger 2000). The bridge provides two important functions for the peregrine falcons: a high, inaccessible nesting spot and easy access to a constant food supply – nonnative pigeons and starlings. Several other nesting Peregrine pairs now also live in the city, and the young produced from these nests represent important contributions to this recovering species.

There are no species at risk dependent upon this habitat.

Impacts of Urbanization

The major impacts of urbanization on upland habitats fall into three main categories: habitat loss, habitat fragmentation, and human disturbance. These impacts change the ecological structure and function of naturally functioning systems in such a way that some wildlife populations decline, others thrive, and new species may arrive on the scene. Urban upland habitats are often fragmented, with residual patches of historic, native vegetation scattered amid urban, residential, and agricultural land uses (Ferguson 2001). The most successful species in the face of a changing landscape are generalists with the ability to adapt and use a variety of habitat types (ODFW 1993). Habitat specialists typically face the most difficulty when confronted with the impacts of urbanization.

Habitat loss and alteration

As discussed above, habitat loss is considered one of the leading causes of global species extinctions (Kerr and Currie 1995). In the Metro region, while we have retained some important natural areas within the urbanized landscape, the vegetation pattern has been dramatically changed since European settlement of the Willamette Valley (see Table 8 for estimated changes).

Habitat loss occurs due to destruction of the natural landscape, but also is a result of a change in the historical patterns of disturbance. Vegetative communities typically go through several stages of succession after a catastrophic event such as a fire or a flood. The historical landscape was composed of a mosaic of vegetation in several stages of succession, providing wildlife with important functions and values. For example, after a fire a typical vegetative community would be a meadow with native grasses. After several years, some shrubs may appear in certain areas, followed by larger trees, such as oak, creating a savanna-like habitat. Without the influence of another fire, conifers may gradually move in, growing taller than the oaks and overtaking the area (ODFW 1993). Each of these vegetative communities is important for a variety of wildlife, and the lack of natural evolutionary processes has reduced the variety of native habitats available. As described in the previous section, current vegetation differs dramatically from the vegetation and habitat historically found in the Metro region.

Habitat fragmentation

Habitat **fragmentation** along with general loss of habitat has been identified as a key factor in the decline of biodiversity throughout the world (Wilcox and Murphy 1985). As urbanization occurs, native habitat is destroyed and the remaining patches become fragmented, similar to islands in a sea of human altered landscape. Urbanization over the past few decades has typically occurred in a leapfrog fashion, and additional wildlife habitat and agricultural land has been converted to an urbanized landscape. Recently, there has been a push towards developing in a compact fashion, reducing the amount of land needed to provide necessary housing, commercial and industrial land. However, there are tradeoffs in encouraging a compact urban settlement pattern that contains sprawl and reduces rural development, as it could encourage habitat fragmentation. In the Metro region policy decisions have been made to simultaneously promote compact urban form that combats rural and habitat fragmentation outside the urban growth boundary and to knit together viable habitats inside the urban growth boundary.

Two theories are especially useful in understanding the unique situations of wildlife species in a fragmented habitat: island biogeography and **metapopulation** theory. Metapopulation theory helps to explain the population dynamics of wildlife species in a fragmented yet connected habitat, whereas island biogeography provides a useful framework for considering patch size, configuration, and connectivity for groups of species at the landscape scale. Both theories may be useful in urban habitats.

The theory of island biogeography has been applied to urban environments to further understand how habitat fragments function and as a basis for developing habitat protection plans (Davis and Glick 1978; Adams 1994; Duerkson et al. 1997). MacArthur and Wilson (1967) proposed the theory to explain species diversity on islands in the Pacific Ocean. It explains the number of species present on various islands based on a relationship between the immigration and extinction rates that are influenced by the size of the island and the distance from the mainland (Adams and Dove 1989). Many researchers have applied this theory to terrestrial habitat "islands", or patches of native habitat surrounded by other hostile land uses (Bolger et al. 1997a). Much of the research has focused on the species-area relationship, which indicates that species richness increases with habitat area (size).

Metapopulation theory can be used to describe subpopulations of wildlife inhabiting a series of connected patches on a landscape scale (Pulliam and Dunning 1997). The subpopulations are linked together by the movements of individuals between patches. A subpopulation on one patch could go temporarily extinct, but as long as the patch is connected to a populated patch it could be recolonized. This is called the **rescue effect**, and is crucial in the maintenance of small populations with limited habitat area (Pulliam and Dunning 1997).

In this section we discuss habitat fragmentation, using island biogeography and metapopulation theory to understand some of the impacts fragmentation has on wildlife. This section covers the issues of:

- Patch size
- Edge effect

- Distance effect
- Age effect
- Connectivity

Patch size

Davis and Glick (1978) first suggested applying island biogeography theory to urban ecosystems, describing each city as a collection of habitat islands. Small cities may be compared to islands close to the mainland, while a large city functions similarly to an island system far from the mainland. Increased urbanization causes more habitat fragmentation and reduces the connectivity necessary for maintaining species richness and preventing local extinctions. An established principle of island biogeography is that the extinction rate in an isolated habitat patch is negatively related to the size of the patch, or the *area effect*. Thus, extinction rates increase as patch size decreases. This phenomenon occurs even in relatively large habitat patches, due to the *edge effects* caused by habitat fragmentation (Soulé 1991a; Bolger et al. 1997a). That is, edge effects increase with increasing levels of fragmentation. Few empirical studies have been conducted to determine the appropriate patch size for various species, especially in an urban landscape (Hostetler and Holling 2000).

Large patches

Several studies have been conducted that indicate a larger habitat patch is better for the survival of native species. However, what constitutes a large patch is debatable and may vary geographically and by habitat type.

Most mammal research has been conducted outside the urban setting. However, Dr. Michael Murphy's graduate students at Portland State University are providing insights into small mammal needs in the urban area (Murphy 2005). As yet unpublished, their research indicates that the following small mammals may need large habitat patches: shorttail weasel, Oregon vole, Northern flying squirrel, shrew-mole, Trowbridge's shrew, vagrant shrew, Douglas squirrel, Western gray squirrel, and Townend chipmunk (see Appendix 1 for scientific names). Conversely, non-native mammals tended to decrease in abundance in larger patches. Hennings and Edge (2003) found

Wilcove (1985) studied the level of predation on Neotropical migratory songbirds in the northeastern U.S. and found an increased amount of predation in smaller forest patches. Bolger et al. (1997a), in a study of native rodent populations, found that species diversity increased with patch size. The habitat patches that did not contain native rodents were in general smaller fragments. Larger patches frequently retain more of the functions and values provided by native habitat. For example, many forest interior bird species are dependent on insects for food and a study in Ontario found that invertebrate biomass was 10 to 36 times higher in large forest patches than small forest patches (Burke and Nol 1998).

Much research supports a guideline that a single large patch is more beneficial than several small fragments for vertebrates and potentially other species (Soulé 1991a,b; Bolger et al. 1997a). The basic principal behind this is that extinctions of vertebrate species in similar habitat patches nearly always happen in a regular, predictable order (Patterson and Atmar 1986). Soulé et al.'s (1988) studies in canyons near San Diego, California support this theory. In the study the Roadrunner and Black-tailed Gnatcatcher always disappeared prior to other species, as they were most dependent on an undisturbed habitat. Other species would predictably be the last native survivors in an otherwise heavily impacted habitat. Smaller patches by their nature include more edge habitat, which provides more opportunity for habitat generalists and also allows predators increased access to the remaining interior areas.

Long-term trends in wildlife populations are directly related to the area of habitat available – the larger the patch size the longer a population can sustain itself (Duerkson et al. 1997). Some species require a certain amount of territory for foraging and breeding purposes. Other species are limited in population by the amount of resources available within a patch, thus the larger the patch the larger the population. Larger animals typically require a larger amount of land just to support their body mass. For example, a deer forages on a much larger range than a mouse. Predators require an even larger area of land that must support enough of their prey for a sustainable catch (Soulé 1991a).

Large predators play a crucial role in maintaining a functioning ecosystem, and they typically are unable to thrive on small habitat patches (Soulé 1991a; Berger et al. 2001). Large predators such as coyotes or cougars help to maintain biodiversity by suppressing smaller predators such as raccoons and maintaining a more sustainable population of herbivores, which may drastically influence riparian vegetation (Berger et al. 2001). Many smaller predators are extremely destructive to wildlife, especially ground and shrub nesting birds, when their population increases above the equilibrium (Soulé 1991a). Retaining the large predators allows for a functioning system in which populations of various species are kept at natural levels.

A study in the Seattle area that characterized the diet of coyotes in an urban environment found that house cats made up 13 percent of a coyote's diet in residential areas (Quinn 1997). Experts estimate that feral and domestic cats kill hundreds of million birds and perhaps a billion small mammals per year (Churcher and Lawton 1987; Mott 2004). However, this is not to imply that coyote abundance promotes natural biodiversity, but it provides an example to illustrate the importance of larger predators in an ecological system.

Small Patches

However, there are benefits to preserving smaller habitat patches in certain circumstances. Heske et al. (2001) concluded "…not all small patches are bad…" in a review of several studies on nest predation and songbirds. According to Soulé (1991a) small patches may be sufficient to preserve vegetation communities when the plants are not dependent on fire for regeneration, not subject to loss of genetic variability due to isolation, do not depend on animals for pollination or dispersal, and are able to compete in the absence of the natural disturbance caused by large animals and fire. Many species of rare butterflies are mostly sedentary as adults, and thus require maintenance of specific vegetation in small patches over a larger region (Smallidge and Leopold 1997). Butterflies also may require a series of successional habitats for different lifestages.

Small patches that are well connected to other patches will also provide important functions for wildlife species not dependent on interior habitat. Some species may be able to use small habitat patches that are individually too small by composing a home range made up of multiple habitat fragments (Dunning et al. 1992; Noss and Csuti 1997; Hostetler and Holling 2000). Other species may survive within the urban matrix if they have a series of relatively small patches that are connected by movement corridors (Bolger et al. 1997a). Proximity of small patches to stream corridors and wetlands undoubtedly elevates their significance for wildlife.

Quality of the habitat

The quality of the habitat in a patch is important, large patches that have degraded habitat will not support healthy wildlife populations even though edge effects are reduced (Martin 1993). Haire et al. (2000) found that the plant communities dominated by exotics had a negative effect on the abundance of Western Meadowlarks, demonstrating the importance of native vegetation within a habitat fragment for many species, particularly habitat specialists. In Arizona, Germaine et al. (1998) found a strong correlation between native vegetation and sensitive bird species in the urban area. Beissinger and Osborne (1982) compared bird communities in residential areas with mature trees and nearby undisturbed forests. They found that urbanization impacted the amount of vegetative cover, thus reducing the number of forest insect eating birds and increasing the number and diversity of birds able to glean food from the ground. The type of forest also impacts the quality of the habitat for certain songbirds. Studies have shown that nest predation is higher in coniferous forests than in deciduous forests due to the associated predators such as squirrels found in coniferous forests (Heske et al. 2001).

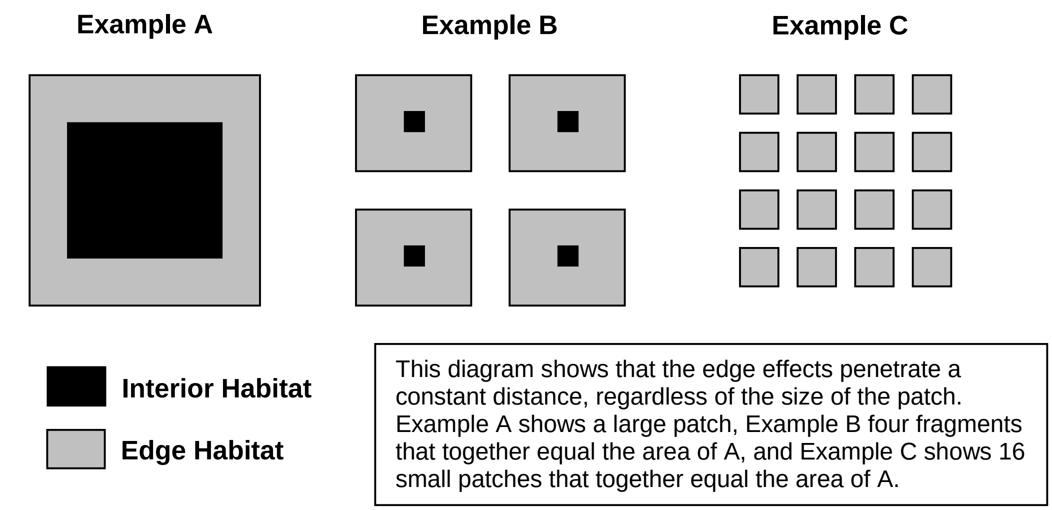
Edge effect

Xxxinsert lori's edge effects in this sectionEdge habitat occurs where one habitat type, such as a forest, meets a meadow, stream, road, or other natural or artificial habitat type (Forman and Godron 1986; Lidicker and Koenig 1996). The size of a patch, as well as the relationship with surrounding habitats, has a direct impact on the edge effect on wildlife populations. Species diversity is typically higher in edge habitats, but the number of habitat specialists, or species that require a particular type of habitat for survival, tends to decrease. Patch size and patch configuration both impact the amount of edge habitat – a large square will have less edge habitat and more interior habitat than a long, thinly shaped habitat (Soulé 1991a). Urbanization typically increases habitat fragmentation, providing more edge habitat and reducing the amount of original habitat (Lidicker and Koenig 1996).

The shape of a habitat patch can predict the effectiveness of the area in providing valuable habitat for wildlife. There are two general shapes of patches: circles or squares and rectangles or oblong shapes (Fleury and Brown 1997). Rectangular or oblong patches include more edge habitat and thus are less effective as wildlife habitat, especially for interior species. Circular or square patches often contain more species diversity, allow for increased foraging efficiency, and contain fewer barriers within the habitat patch than rectangular patches (Forman and Godron 1986).

Some species, often called habitat generalists, actually benefit from increased edge effect and fragmentation. Many predators such as foxes and coyotes are better able to hunt along edge habitats, where prey such as birds and small mammals are easier to find. Other species, for example the House Finch, Anna's Hummingbird, deer, and raccoons, have the ability to use resources provided in landscapes that have been altered by humans (Bolger et al. 1997b). Some species rely on interior habitat that is relatively undisturbed, such as the Swainson's Thrush and Winter Wren. Increased fragmentation frequently allows the edge species to thrive while interior dwellers decline (Soulé 1991a; Nilon et al. 1995; Hennings 2001; Hennings and Edge 2003). Most conservationists agree that too much edge habitat is detrimental for wildlife, and the focus when developing a habitat protection plan should be on retaining as much interior habitat as possible. Soulé (1991a) describes some of the major negative impacts of edge habitats as higher frequency and increased severity of fire; higher rates of hunting and poaching; and higher intensities of predation. Figure 12 below depicts the relationship between patch size and the amount of edge effect.

Figure 12: Relationship between patch size and edge effect.



Source: Adapted from Soulé, 1991.

The edge effect can penetrate far into the interior habitat necessary for certain species. Some studies have shown that certain impacts such as invasion by exotic plants and predation can penetrate up to 500 meters into the forest (Wilcove 1985). Bolger et al. (1997b) found that the abundance of interior habitat bird species was reduced within 200 to 500 meters of an edge. A study in southern Ontario found that ovenbirds, an interior habitat species, select nest sites more than 250 meters from the forest edge, a distance that is not possible in a small habitat fragment (Burke and Nol 1998). Interior habitat specialists may respond to edge effects far from the actual edge habitat (Lidicker and Koenig 1996). Some of the impacts the edge effect may have on interior species include reduced survival rates, reduced reproduction rates and increased emigration from unsuitable habitat (Bolger et al. 1997b). Friesen et al. (1995) found that the edge effects of residential development impacted the diversity and abundance of songbirds in forested habitat patches regardless of the patch size. The response of wildlife movement to edge habitat varies by species, some species will not approach the edge while others will move freely through the edge habitat to another area (Lidicker and Koenig 1996).

Distance effect

Animal movement frequency decreases in direct relation to the distance between habitat patches, and is called the *distance effect*. Increased habitat fragmentation impacts the ability of wildlife to disperse between habitat patches (Soulé 1991a). Dispersal of animals between patches helps to preserve populations by protecting against catastrophes and preventing genetic decline due to inbreeding (Soulé 1991a; Lidicker and Koenig 1996). The distance effect can be observed in compact island archipelagos that have more species diversity than remote islands, because proximity facilitates the rescue of endangered populations and allows for the recolonization of islands where extinctions have occurred. However, the distance between habitat fragments need not be great before it begins to have an impact if a species is unable to move through the matrix of modified habitat (Bolger et al. 1997a).

Age effect

Another impact of fragmentation is called the **age effect**. This refers to the amount of time a fragment has been separated from the "mainland" or the surrounding landscape by urbanization. The length of time that a habitat patch has been fragmented typically correlates to lower native species diversity. Bolger et al. (1997a) found that in a time span of 20-80 years all native rodents had disappeared in over half of the habitat patches studied. Soulé et al. (1988) found that the size of patch along with the length of time a patch had been fragmented explained most of the variation in the number of bird species found within a habitat patch.

Connectivity

"When urbanization is occurring…habitat fragmentation is inevitable, and one of the only practical mitigation measures is the establishment of corridors of natural habitat or linkages, such as underpasses, that permit dispersal across barriers." (Soulé 1991a)

Habitat corridors may be defined as strips of habitat that allow the movement of organisms through the landscape matrix and between habitat patches (Lidicker and Koenig 1996; Beier and Noss 1998). The general consensus is that connections between habitat fragments are crucial to the survival of many species, and that well designed corridors can play a key role in maintaining ecosystem vitality (Adams and Dove 1989; Soulé 1991a,b; Beier and Noss 1998). Corridors provide the opportunity for many species to traverse through habitat that is not suitable for permanent residency to find better habitat, find a mate, dispersal of post-breeding young, or to escape over-predation or other dangers in their current habitat (Lidicker and Koenig 1996). Corridors tend to be most effective if they are not overly long, if there are few gaps, if the width is consistent, and if the corridor does not harbor an excessive number of predators (Lidicker and Koenig 1996). The functional role of corridors is related to the scale at which animals perceive their environment, and little research has been conducted on the kinds of corridors necessary for specific species (Lidicker and Koenig 1996; Clergeau and Burel 1997). Metapopulation theory and modeling provides much of the support for the use of corridors in wildlife conservation (Hess 1994).

Connectivity is important for wildlife for several reasons. Wildlife populations that are connected to each other are more likely to survive over the long term than an isolated population (Lidicker and Koenig 1996; Duerkson et al. 1997). A population that exists on a connected system of habitat fragments will be more likely to survive a catastrophic event on one patch, and the surviving population may be able to repopulate or revive an area that is in trouble (Hess 1994). Many species must migrate seasonally to meet basic needs for food, shelter and breeding, and connections between habitat patches allow this migration to occur (Lidicker and Koenig 1996; Duerkson et al. 1997). Connectivity between habitats allows populations to interbreed, which aids in the vigor and survival of the overall population by reducing genetic inbreeding

(Duerkson et al. 1997). Corridors play an important role in urban areas to provide opportunity for migration and movement, especially between upland and riparian habitats.

Several studies show the importance of corridors and connectivity for wildlife. Clergeau and Burel (1997) studied the Short-toed Tree Creeper, a small bird, in an agricultural area of France. Their study confirmed that the birds relied on the habitat connectivity provided by hedgerows to contain home ranges and to avoid long flights. Bolger et al. (1997a) identified the lack of connectivity between habitat fragments as an important possible cause of the extinction of native rodent species in over half of the sites studied near San Diego, California. In a study of the dispersal behavior of three migratory bird species in North Dakota, Haas (1995) found that movements by adult birds between habitat patches occurred more frequently between sites connected by a wooded corridor than between unconnected patches.

The benefits of habitat corridors have been heavily debated in the scientific literature (Simberloff and Cox 1987; Adams and Dove 1989; Soulé 1991a; Lidicker and Koenig 1996). Connectivity is important within a fragmented landscape. However, while corridors provide many benefits, there are some potential disadvantages, although they have not been quantified (Simberloff and Cox 1987; Adams and Dove 1989). Researchers speculate that corridors may allow exotic species, including plants, animals, and birds, easier access to invade native habitats and may serve as reservoirs of edge and introduced species (Simberloff and Cox 1987; Simberloff et al. 1992). Corridors may also allow for easier transmission of disease, faster predator movement, and could concentrate species in one area leaving a population more vulnerable to a catastrophic event (Adams and Dove 1989; Simberloff et al. 1992; Duerkson et al. 1997).

Hess (1994) developed a model that showed a landscape of connected patches generally suffered fewer metapopulation extinctions than a landscape of isolated patches. Beier and Noss (1998) conducted a review of scientific studies on the benefits and negative aspects of corridors. While the overall conclusion was that the literature is not yet sufficient to declare the positive value of corridors, several studies showed that corridors function as travel connections for wildlife in real life, and no studies provided empirical evidence of negative impacts from corridors. The literature appears to indicate that the benefits of a connected landscape typically outweigh the potential negative effects of corridors, especially in urban environments (Soulé et al. 1988; Beier and Noss 1998).

Fleury and Brown (1997) developed a framework for the design of wildlife corridors that considered critical corridor characteristics. Some of the general principles identified in the study were:

- corridors should be oriented perpendicular to habitat patches to direct wildlife through the corridor;
- barriers or breaks in the corridor should be minimized;
- corridors should be as short as possible to reduce the risk of mortality;
- corridor width should be based on the minimum width needed for the target species highest on the food chain; and
- corridors should be shaped as close to a rectangle as possible.

The size and shape of a corridor can have a direct impact on the effectiveness of the corridor for wildlife movement. The most effective corridor shape is a rectangle, directing animals straight through the corridor from one habitat patch to another (Fleury and Brown 1997). Soulé (1991a) concluded that any shape other than rectangular can increase the amount of time that must be spent in edge habitat, and that the most effective corridors have straight sides and a constant width.

Human disturbance

Humans introduce a wide variety of changes to the environment, and the specific effects of these changes remain largely unknown. Because human population has grown so quickly during the past century, changes have been rapid and are accelerating. There is no single solution to the complex environmental challenges posed by humans, but focusing on the most pervasive issues is an effective way to begin addressing the problems. The most obvious result of human disturbance is the loss, alteration and fragmentation of habitat, as discussed above. Here we focus on human disturbance in natural areas and some of the consequences to wildlife and habitat.

Nonnative species

Nonnative species – those that originate from outside the U.S. – pose a major threat to native species. Over 50,000 species have been introduced in the U.S., both intentionally and unintentionally. Of all the species listed as threatened or endangered under the federal Endangered Species Act (ESA), 42 percent are at risk primarily due to nonnative species (Wilcove et al. 1998). Excluding the enormous expenses involved with ESA listings and subsequent recovery efforts, nonnative species cost the U.S. more than $138 billion per year in environmental damage and losses (Pimentel et al. 2000). The rate of species introductions is increasing sharply, and successful nonnative species introductions are usually irreversible (Allan 1995). At least 42 nonnative vertebrate species occur in Oregon and Washington; about half of these have achieved widespread distribution and pose a threat to native biodiversity (Witmer and Lewis 2001). Early detection and rapid response to new invasions are key to controlling nonnative invasions (Toney et al. 1998).

Nonnative plants and animals are typically generalists that can thrive in a variety of habitats. They tend to respond positively to disturbance and often lack natural predators (Parendes and Jones 2000). Native species are not evolutionarily adapted to compete with nonnatives (Allan 1995). Nonnative species may alter habitat, introduce diseases and parasites, change community structure, and compete or hybridize with native species, but predation is a common cause of the replacement of native species with nonnatives (Allan 1995). Nonnative invasions regularly occur in upland, riparian, and aquatic habitats (Witmer and Lewis 2001). In the northwestern U.S., recent decades have seen a shift from primarily herbaceous toward greater proportions of shrub and tree invaders (Toney et al. 1998).

In natural circumstances, one or more types of barriers may prevent nonnative plant or animal invasions. These include biological barriers, such as low seed production; physical barriers affecting travel pathways, such as oceans, mountains, or closed canopy forest; or environmental barriers, such as unsuitable light, soil or moisture conditions (Parendes and Jones 2000). Human disturbance is one common pathway for nonnatives to overcome these barriers (Witmer and Lewis 2001).

Nonnative species have a strong impact on native plants and wildlife in the Metro area. In the Metro region, problematic nonnative plants include Himalayan Blackberries, English Ivy and Reed Canarygrass. Japanese knotweed is gaining a foothold and kudzu, an aggressive nonnative plant that has devastated areas of the south, recently appeared in southwest Portland (Toney et al. 1998; Christ 2000). European Starlings were the most abundant bird species detected in 54 sites in this area (Hennings 2001). Starlings monopolize nest cavities and may eradicate native bird species in some small habitat patches (Weitzel 1988). Other nonnative birds in our area include House sparrow, Rock Dove (pigeon), Monk Parakeet, and Ring-necked Pheasant. Nonnative Fox Squirrels and Eastern Gray Squirrels are contributing to the decline of native Western Gray Squirrel populations (Marshall et al. 1996). House Mouse, Norway Rat, Black Rat and Nutria are other common Metro area nonnative animals. Common Snapping Turtles and Red-eared Sliders are two nonnative turtles that have successfully established breeding populations in our area (Witmer and Lewis 2001). The number of nonnative insects competing with natives (which include critical native plant pollinators) is probably quite significant, but unknown because insects are relatively unstudied. Management activities that minimize favorable conditions for nonnative species would greatly benefit native wildlife in our region.

Increased predation and competition

Urbanization tends to increase predation and competition in native wildlife communities, due to changes in habitat (see *Habitat fragmentation* section above) and wildlife community structure. These effects are well documented for birds (Small and Hunter 1988; Marzluff et al. 1998). In Seattle, Washington researchers are monitoring birds and small mammals across an **urban gradient**. Their data indicates that small mammals tend to increase with urbanization. These increases are accompanied by a decrease in bird nest success, because small mammals such as mice routinely eat bird eggs. Domestic cats pose another threat to native wildlife, and are the primary reason for injured native wildlife brought to the Audubon Society of Portland's Wildlife Rehabilitation Center (Sallinger 2001, personal communication), and in England were shown to cause at least 30 percent of sparrow mortality (Churcher and Lawton 1987). Increased competition from native birds can also be a problem; Brown-headed Cowbirds lay their eggs in host species' nests, effectively decreasing reproductive success of the host. Cowbirds are edge-associated and are quite successful around humans (Lown 1980; Brown 1994; Larison et al. 1998).

Roads

Roads, while important to society, have widespread negative impacts on native plants, fish, and wildlife. Direct road effects include geomorphic (sedimentation and landslides), hydrologic (intercept rainfall and subsurface water moving down hillslopes; concentrate flow; and divert or reroute water), site productivity (remove and displace topsoil, alter soil properties, change microclimate, and accelerate erosion), habitat fragmentation and alteration, and biological invasions (Gucinski et al. 2001). Forman (2000) estimates that one-fifth of U.S. lands are directly ecologically affected by public roads.

Roads are a leading threat to biodiversity, for a variety of reasons (Wilcove et al. 1998; Trombulak and Frissell 2000). Trees and other vegetation are removed to build the road. Roads fragment habitat, increase wildlife mortality, and promote dispersal of nonnative plants because they alter habitats, stress native species, and provide seed resources and dispersal corridors (Tyser and Worley 1992; Lonsdale and Lane 1994; Parendes and Jones 2000; Trombulak and

Frissell 2000). Road networks contribute more sediments to streams than any other land management activity, from both surface erosion and landslides, degrading water quality and smothering gravel beds (Jones et al. 2000; Gucinski et al. 2001; see also Riparian and Aquatic Habitat chapter). Contaminants such as oil, gas and other toxins washing off roadways may pollute adjacent areas and degrade habitat. Roads add substantially to the total load of impervious surfaces in a watershed.

Wildlife most at risk due to roads include species that avoid edge environments, occur in low densities, are unwilling or unable to effectively cross roads (e.g., amphibians), or seek roads for heat (snakes) or food (owls) (Fleury and Brown 1997). Comparing high and low density road areas in New York, Steen and Gibbs (2004) found altered sex ratios in turtle populations, with many more males in high road density areas. Aresco (2005) found similar results in Florida. This suggests that more females are killed on roads during nesting migration, thus fewer eggs are laid each year. Tennessee, roads significantly depressed the abundance and richness of insects living in the soil (Haskell 2000). In addition, road noise may negatively influence wildlife through behavior modification. For example, birds sing during the breeding season to attract mates and defend their territories, but this effort is wasted if it cannot be heard. Local data suggests that long-distance migratory species such as Black-headed Grosbeak and Common Yellowthroat are especially susceptible to negative road impacts (Hennings 2001); reports elsewhere support this observation (Forman and Deblinger 1999; Ortega and Capen 1999). There is evidence of a time lag between road-building and species loss in wetlands (Findlay and Bourdages 2000), emphasizing the need for long-term studies.

Recreational use and human disturbance

The protection of wildlife and habitat also provides recreational opportunities for people. This is positive in that people desire to connect with nature, and exposure to wildlife and natural areas encourages people to care about preserving those natural values. In addition, many local communities benefit from dollars spent on hunting and wildlife watching (Wiedner and Kerlinger 1990; U.S. Fish & Wildlife Service 1997a). However, recreation in wildlife habitats is negative in that human intrusions lead to alterations in habitat – for example, vegetation trampling, trails and roads – and may alter wildlife behavior, physiology and distribution.

Some wildlife species are more sensitive to human intrusions than others (Major 1990; Gutzwiller et al. 1998), and some life history phases are more vulnerable to disturbance than others. For example, in the Metro region Steller’s Jays and Swainson’s Thrushes may be especially vulnerable to recreational disturbances during the breeding season (Hennings 2001). Montana studies suggest that breeding birds and young are very vulnerable, and may abandon nests or fail to feed young when disturbed (Montana Chapter, The Wildlife Society 1999). In Madrid, bird abundance and species richness declined when pedestrians walked near sampling points (Fernández-Juricic 2000). Bats are particularly sensitive to human disturbance, especially during breeding or hibernation (Montana Chapter, The Wildlife Society 1999). Carnivores are mixed in susceptibility – some thrive near humans (e.g. skunks, raccoons, coyotes), but others, such as wolves, black bears and fisher, may abandon den sites when disturbed (Montana Chapter, The Wildlife Society 1999), and it may be no coincidence that these former Metro-area inhabitants are now conspicuously absent. In Colorado, elk experienced reproductive failure when repeatedly approached by humans (Phillips and Alldredge 2000).

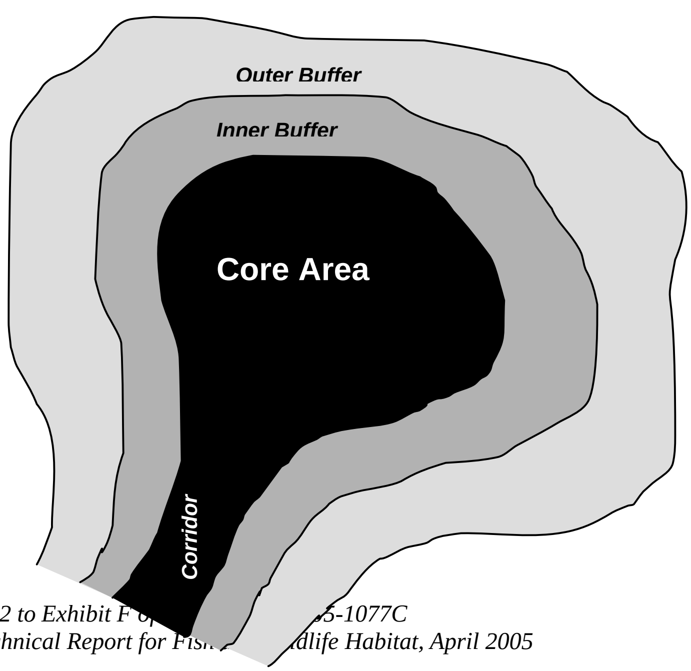
In addition to detrimental effects of roads and trails in natural areas, vegetation changes are another byproduct of recreational use. For example, in Washington State a recreational area was systematically exposed to vegetation trampling. In response, the amount of grasses and herbs increased, while the structurally important woody species decreased (Cole and Trull 1992). In a multi-state study including Washington, researchers found that one night of camping was sifficient to eliminate 30 to 50 percent of the vegetation from high-use portions of the campsite (Cole 1995). A Colorado study of military training on soil and vegetation properties found a 68 percent decrease in total above-ground plant mass, a 91 percent decrease in organic litter, decreased water infiltration and increased soil erosion when comparing high-use sites against a reference site (Whitecotton et al. 2000). As discussed above, roads (and similarly, trails) provide a means of nonnative plant invasion.

Buffers and Surrounding Land Use

The effectiveness of a habitat patch relates to the surrounding land use as well as its size, proximity, and connectivity to nearby patches. The landscape of an urbanized area is composed of habitat patches and connecting corridors embedded within a matrix of land altered by human activity (Linehan et al. 1995). Thus the matrix of the altered landscape covers more area than the habitat patches within it, and correspondingly plays a large role in the landscape dynamics. Friesen et al. (1995) studied the effects of residential development around forested habitat areas on Neotropical migrant songbirds in Ontario, Canada. The study found that the level of residential development drastically reduced the abundance and diversity of the songbirds, regardless of the size of the forest patch. The authors concluded that solely retaining intact forests is not enough to maintain healthy forest ecosystems that are able to support interior habitat specialists.

Habitat patches may be more valuable for wildlife and people if they are surrounded by a buffer zone within which low impact human activities may occur, reducing edge effects and leaving the

Figure 13. Example of a buffer system protecting a core area for wildlife habitat.



Core area: this area provides the highest level of protection for wildlife, with minimal disturbance allowed

Inner buffer: low impact human activities are allowed in an inner buffer, such as nature trails, wildlife observation areas, and play areas

Outer buffer: more disturbance is allowed in the outer buffer, such as low density or clustered residential development

Source: Adapted from Adams and Dove, 1989.

inner core habitat with as little disturbance as possible. While a buffer zone is by nature edge habitat, the "permeability" or softness of the edge has a direct impact on the ability of species to disperse and populate surrounding areas (Lidicker and Koenig 1996). Some species may be able to move through the matrix of land uses from one habitat fragment to another, while less mobile species may be trapped by the surrounding land uses. Berry et al. (1998) found that some bird species are more sensitive to urbanization of the landscape than others, indicating a need for additional buffers to protect habitat for these species.

One approach to counteracting the impact of edge effects is to protect habitat reserves by designing a system of buffers to protect wildlife from surrounding land uses, as well as to allow recreational use of a habitat reserve system. Figure 13 below depicts a core area and two types of buffers surrounding it. Little to no human disturbance would be allowed to intrude within the core area. The inner buffer could include nature trails and other opportunities for low impact human recreation, while the outer buffer could allow for low-density residential development or another low impact development type (Adams and Dove 1989; Adams 1994). Little research is available on the appropriate size of buffer widths and the types of activities that may occur within buffers that do not excessively impact interior habitat specialists.

Low-density residential uses are often seen as having the least impact on wildlife habitat, particularly for birds (Nilon et al. 1995). However, there are still several negative impacts such as an increase in small predators such as domestic cats and dogs, increased fragmentation due to roads and trails, and increased human use of habitat areas for recreation and relaxation. Theobald et al. (1997) found that clustered development patterns reduce the negative impacts of human disturbance on wildlife. The pattern of development was found to be more of an indicator of disturbance level than density. Blair (1996) found that the composition of bird communities changed from predominantly native species in undeveloped areas to nonnative birds in highly developed downtown areas. Studies have shown that habitat patches surrounded by agricultural uses have an especially high rate of nest predation (Heske et al. 2001).

Upland Habitat Patch Size and Connectivity Recommendations

Planning for wildlife habitat reserves in urban areas brings up many considerations, including the issue of providing habitat for species that are often sensitive to human activity while at the same time providing people the opportunity to use open spaces within the city for recreation and wildlife viewing (Johnson 1995). Some wildlife species have the ability to utilize many types of habitat and adapt well to the presence of people. Other species require a specific habitat type, and many species require the ability to migrate from one habitat type to another to fulfill basic needs such as foraging, breeding, and safe shelter. Habitat specialists will require the protection of larger reserves, but other wildlife species can be retained in the city if required habitat elements are provided within the context of urban development (Donnelly and Marzluff *in review*). Wildlife habitat can be provided in many ways: large natural areas, small portions of city parks that are left "wild", cemeteries, schoolyards, bridges and other man-made structures, and even backyards. Retaining native biodiversity will require a protection plan that utilizes an array of strategies to maintain and restore wildlife habitat.

Human impacts on wildlife can be minimized with the proper design of habitat reserves, based on the surrounding land uses. The movement needs of wildlife can be provided for using corridors, which may be described as linear (often narrow) strips of habitat embedded in other land uses that have value for wildlife by connecting fragmented patches of habitat (Adams and Dove 1989; Beier and Noss 1998). The effects of fragmentation can be combated to a certain extent by providing connections between remaining fragments. Soulé (1991a) states: "Wildlife corridors can be viewed as a kind of landscape health insurance policy – they maximize the chances that biological connectivity will persist, despite changing political and economic conditions." Corridor design, however, depends on the specific species or **species guild** that is being planned for as well as accounting for local conditions (Linehan et al. 1995). Human impacts can be further mitigated through management and design regulations for urban development as well as increasing the diversity and abundance of native vegetation in urban parks (Lancaster and Rees 1979).

Corridors often naturally follow utility rights of way, fencerows, trails, and riparian areas. The size of habitat patches are an issue in both rural and urban environments, as larger patch size typically provides more functions and values for wildlife than a smaller habitat area. However, small patches of unique habitat may provide the key in retaining sensitive species within an urban area. A functioning system of small patches can provide an overall benefit to wildlife if designed with connectivity in mind.

The most important conclusion from the scientific literature in planning to protect habitat for wildlife is that "the best way to maintain wildlife and ecosystem values is to minimize habitat fragmentation" (Soulé 1991a). There is no single method for retaining and restoring the natural ecosystems necessary for wildlife in the urbanizing landscape that has been proven to work. However, maintaining a system of habitat patches, large and small, that are as well connected as possible appears to be the most likely solution (Linehan et al. 1995).

While specific guidelines regarding patch size and shape, corridor width, and proximity have been developed in other regions, there are no universally applicable recommendations. For example, the Wildlife Division of Environment Canada (1998) has developed specific recommendations such as providing at least one 200 hectare forest patch that is a minimum of 500 meters in width to provide interior habitat within a subwatershed. In Arizona, Germaine et al. (1998) recommended retaining habitat patches greater than one hectare containing native vegetation throughout the urban matrix to allow provide for sensitive bird species. Table 11 below depicts a summary of planning guidelines derived from the scientific literature. In the future, as more local information becomes available, more precise recommendations may be developed for upland wildlife habitat.

Upland habitat areas play a crucial role in retaining native biodiversity as well as maintaining healthy ecosystems. As discussed above, urbanization of the landscape negatively impacts wildlife through habitat loss, habitat fragmentation, and human disturbance. In the Metro region we still have remnants of the diverse native habitat that blanketed our region prior to settlement in the 1850s. Abundant wildlife supported generations of Native Americans as well as European settlers arriving in the region. Today's residents continue to appreciate the accessibility of wildlife while enjoying the benefits of a city. The Metro region is projected to grow by around 500,000 people in the next twenty years. If retaining access to open spaces and the opportunity to view wildlife in the city is to remain a priority it becomes even more important to plan for a well conceived system of habitat preserves and corridors throughout the region.

Table 11. Planning guidelines for upland wildlife habitat

Guideline	Explanation	Supporting literature
Large patches are better than small patches, and they should be round or square to reduce the amount of edge effect	• Research shows that the edge effect ranges from 200-500 meters • Larger patches provide more interior habitat • Can support a larger number of individuals and a greater diversity of species • Can support a wildlife population for a longer time period • Provides greater opportunity for foraging and dispersal	Wilcove 1985 Forman and Godron 1986 Soulé 1991a Bolger et al. 1997a Duerkson et al. 1997 Fleury and Brown 1997 Germaine et al. 1998 Burke and Nol 1998 Environment Canada 1998
Small patches of unique habitat are worth saving	• Can retain unique vegetation communities • May provide "stepping stones" of habitat if in relatively close proximity, or in combination with habitat corridors • Can provide habitat for generalist and edge species • Especially important if near water resources	Soulé 1991a Dunning et al. 1992 Noss and Csuti 1997 Bolger et al. 1997a Environment Canada 1998 Hennings 2001
Connectivity to other patches is important, corridors should be as wide as possible, and it is cheaper to retain corridors than to create them after the fact	• Can play a key role in maintaining ecosystem vitality and the survival of may species • Connected populations are more likely to survive over the long term • Allows populations to interbreed, maintaining genetic variability • Provides movement corridors for seasonal migration, finding better habitat, finding a mate, dispersal of post-breeding young, and escape routes	Adams and Dove 1989 Soulé 1991a Linehan et al. 1995 Lidicker and Koenig 1996 Bolger et al. 1997a Clergeau and Burel 1997 Fleury and Brown 1997 Environment Canada 1998
Connectivity and/or proximity to water resources is valuable	• Habitat patches near water resources have increased diversity of wildlife • Most wildlife species use riparian areas for some aspect of their life history • Over 60 percent of mammals in the Northwest use riparian areas for breeding or feeding • Riparian corridors frequently serve as travel routes, especially in urban areas	Forman and Godron 1986 Environment Canada 1998 Hennings 2001 Kauffman et al. 2001
Buffers can help protect wildlife from human disturbance	• Surrounding land uses have an impact on the effectiveness of a habitat patch in providing functions and values to wildlife • People like to use natural areas and open space for recreation • A buffer zone allows for human use of a selected part of a habitat patch, while protecting wildlife from excessive disturbance	Adams and Dove 1989 Adams 1994 Nilon et al. 1994 Friesen et al. 1995 Linehan et al. 1995 Lidicker and Koenig 1996

Protecting upland habitat areas in this region will be a challenge while also ensuring enough land for urban development. However, the integration of these two seemingly contradictory goals is a central tenet of the Region 2040 Growth Concept, the Regional Framework Plan, and the Urban Growth Management Functional Plan. It is also much cheaper to protect existing habitat than to attempt to restore degraded habitat. The Metro Parks and Greenspaces Department and local park providers have been purchasing key natural areas throughout the region from willing sellers with the 1995 bond measure. Acquisition of habitat is one of the best methods to ensure a piece of land will remain in its natural state. However, there is not enough money available to purchase the amount of land necessary to provide a functioning system of habitat reserves and corridors that could maintain native biodiversity in the region. Education and incentives for landowners to manage private property to provide wildlife habitat would help to meet objectives of retaining native wildlife. A regulatory program that helps to guide urban development in a way that retains as much functional value for wildlife as possible will most likely be a necessary tool, combined with acquisition and incentive programs, to meet the objective of maintaining the region's biodiversity and implementing the Region 2040 Growth Concept. This approach may be most appropriate when planning for future urban areas that are brought within the urban growth boundary, when it would be possible to plan for wildlife preserves and corridors.

RESTORATION IN AN URBAN ENVIRONMENT

Introduction

Environmental degradation affects everyone. The ecological impacts associated with increasing human populations stress the environment, and it is critical to find ways to reduce these stresses if people, plants and wildlife are to be protected. Rapid population growth and dwindling salmon runs in the Metro region add a sense of urgency to such efforts. There is no quick or easy answer; most people do not want to contribute to fish and wildlife extinctions or widespread environmental degradation, yet few are certain what changes could be made to avert such problems.

Metro's Regional Urban Growth Goals and Objectives (RUGGOs) call for Metro to "protect, restore and ensure to the maximum extent practicable the integrity of streams, wetlands and floodplains, and their multiple biological, physical and social values" (Metro 1995). Accordingly, the purpose of this chapter is to outline an approach to habitat restoration that is based on science, relevant to urban ecosystems, and grounded in reality.

Urbanization negatively affects native fish and wildlife through impairment of the natural functions that create and maintain suitable habitat. Some degree of measurable resource degradation can be detected at virtually any level of urban development, but degradation can be mitigated by activities such as increasing or retaining forest canopy cover and reducing effective impervious surfaces (Shaw and Bible 1996; Booth et al. 1997; Booth 2000). Restoration can assist the recovery of functions necessary for watershed health; in turn, healthy watersheds can support people, fish and wildlife. Efforts to protect and restore habitat can, in many instances, also benefit humans by reducing flood damage and protecting water quality (Lucchetti and Fuerstenberg 1993a,b).

Successful restoration depends on addressing the causes of environmental degradation, rather than the symptoms. Goodwin et al. (1997) suggest asking several questions related to the causes of degradation: Is the disturbance local to the riparian area or does it originate outside in the adjacent upland or watershed? Is the disturbance ongoing, and if so, can it be eliminated? And finally, will recovery occur naturally if the disturbance is removed? The answers to these questions can help guide a restoration plan.

Four major impact categories – altered hydrology, water quality, loss of natural vegetation cover, and impervious surfaces – appear repeatedly in the literature addressing urban ecology. Combined with the presence of humans in the system, these impacts lead to: diminished stream channel and riparian corridor integrity; degraded water quality (chemistry); habitat loss, simplification and fragmentation; altered food webs; nonnative and invasive species invasions; changes to climate and microclimate conditions; and harassment, noise, vibration, light, and other human disturbances to wildlife.

These impacts cannot be realistically addressed through site-specific or small-scale restoration approaches; virtually all recent restoration literature suggests that watersheds are the *minimum* spatial unit for which restoration master planning should occur (e.g., Spence et al. 1996; Goodwin et al. 1997; Hollenbach and Ory 1999; IMST 1999; Watershed Professionals Network 1999; IMST 2001b). In urbanized regions such as ours, impacts in one watershed may influence adjacent or downstream watersheds. Thus all watersheds within the urban area, plus all adjacent watersheds, should be considered in a master restoration plan. The National Marine Fisheries Service (2000b) commented on the importance of considering restoration projects in a large-scale context:

> Projects planned and carried out based on at least a watershed-scale analysis and conservation plan and, where practicable, a sub-basin or basin-scale analysis and plan, are likely to be the most beneficial. NMFS strongly encourages those involved in watershed restoration to conduct assessments that identify the factors impairing watershed function, and to plan watershed restoration and conservation activities based on those assessments. Without the overview a watershed-level approach provides, habitat efforts are likely to focus on "fixes" that may prove short-lived (or even detrimental) because the underlying processes causing a particular problem may not be addressed.

Much of the information available on restoration deals with waterways because of their importance to humans, fish and wildlife, vulnerability to degradation, and influence on other parts of the landscape. In addition, many regional restoration efforts focus on instream and riparian restoration within limited areas to address ESA-listed salmonid recovery (Spence et al. 1996). These are good reasons to focus on stream systems, but this approach fails to adequately protect functions critical to other wildlife species and also fails to take into account the majority of the watershed: uplands.

Uplands provide unique and important wildlife habitat, such as oak-madrone and native grasslands (Larsen and Morgan 1998). Upland habitats also influence stream functions; for example, the amount of forest canopy cover strongly influences the health of Pacific Northwest streams (Shaw and Bible 1996; Booth et al. 2001). Uplands are vital components in any watershed, and the ecological principles and restoration concepts addressed in this chapter are meant to provide a restoration framework at the watershed scale or larger; therefore, uplands are implicitly included here and should be considered in watershed restoration planning. Well-planned watershed conservation and restoration efforts today may prevent future ESA listings, and will almost certainly benefit people and wildlife.

Definition of restoration and other terminology

Most definitions of ecological restoration involve the functional recovery of human-degraded ecosystems. For example, the Society for Ecological Restoration (SER) defines **ecological restoration** as the process of assisting the recovery and management of ecological integrity. Ecological integrity includes a critical range of variability in biodiversity, ecological processes and structures, regional and historical context, and sustainable cultural practices (SER 2000) (Appendix 3). The Oregon Division of State Lands defines riparian restoration as “the rehabilitation of riparian areas to improve degraded functions” (Van Staveren et al. 1998). Title 3 defines restoration as the process of returning a disturbed or altered area or feature to a previously existing natural area; restoration activities reestablish the structure, function, and/or diversity to that which occurred prior to human impacts (Metro 1997b). The National Marine Fisheries Service (NMFS) considers a "habitat restoration activity" to be an activity whose primary purpose is to restore natural aquatic or riparian habitat processes or conditions; it is an activity that would not be undertaken but for its restoration purpose (NMFS 2000b).

Full ecological restoration is probably not possible in urban areas, because some changes are relatively permanent (such as roads and structures) and due to the cumulative nature of changes to urban watersheds (Beschta 1995; Goodwin et al. 1997). In reality, urban "restoration" may represent a range of improvements in function and condition over time, limited in an urban setting to what is actually achievable - in other words, an ecologically, economically and socially acceptable range of options that re-establishes natural functions. The end goal is sustainability, under a new urban equilibrium that supports diverse wildlife communities and healthy ecosystems.

The scientific literature reflects this reality through a variety of terms, all defining lesser versions of full restoration (e.g., restoring targeted functions rather than the full range of original functions). Title 3 defines **Mitigation** as measures used to reduce the adverse effects of a proposed project by considering, in the following order: a) avoiding the impact altogether by not taking a certain action or parts of an action; b) minimizing impacts by limiting the degree or magnitude of the action and its implementation; c) rectifying the impact by repairing, rehabilitating or restoring the affected environment; d) reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action by monitoring and taking appropriate measures; and e) compensating for the impact by replacing or providing comparable substitute water quality resource areas (Metro 1997b). Mitigation will not necessarily result in a net ecological gain.

Enhancement is the alteration and/or active management of existing habitat to improve particular functions and values (Kauffman et al. 1997); enhancement activities may or may not return the site to pre-disturbance conditions, but create or recreate functions and processes that occur naturally. SER suggests the term **rehabilitation** for projects that are unlikely to achieve full ecosystem restoration, commenting that the term "restoration" is frequently applied inappropriately to site- or species-specific projects, or those designed to attain economic objectives (Clewell et al. 2000). SER is a leading scientific restoration organization and provides standardized terminology that is widely used and understood by restoration specialists. However, outside of scientific circles the term "restoration" is commonly used to refer to activities such as enhancement and rehabilitation. For the purposes of this document we will use the term "restoration" instead of rehabilitation or enhancement, while recognizing that full ecological restoration is unlikely in the urban environment.

Types of restoration

Passive restoration

Passive restoration allows natural processes to return through reducing or halting activities that cause degradation or prevent recovery (Kauffman et al. 1997). In riparian corridors, this often means removing the damaging influences and letting the river or stream do the work (Hollenbach and Ory 1999). Passive restoration techniques include retaining riparian buffers, altering land use designs in a watershed to reduce soil erosion and increase stormwater infiltration, keeping toxic chemicals out of the water, managing the adverse impacts of construction, and reintroducing or allowing the presence of beaver (Horner et al. 2001). Many Best Management Practices (discussed below) are forms of passive restoration.

Active restoration

Active restoration refers to changing the ecosystem to reestablish desired biological and physical functions. Some forms of active restoration – such as planting native vegetation and removing exotic vegetation and fish-blocking culverts – have a relatively low risk of failure, even in an urban setting. Other active restoration efforts – such as making instream improvements – are less likely to succeed in an urban setting because of **cumulative impacts**, and should be used with caution. Some active restoration options are discussed in the BMPs and Site Specific Restoration section (see also Table 13 and Appendix 4).

Elements of successful restoration

A limited set of urban literature and substantial non-urban literature can provide clues as to how to approach urban restoration. Several concepts appear repeatedly in the literature and appear important to successful restoration efforts. These fall under the categories of master planning, using a scientific approach, monitoring and adaptive management, and considering urban-specific impacts.

SER provides a set of general, conceptual guidelines for conceiving, organizing, conducting, and assessing ecological restoration projects (Clewell et al. 2000). These guidelines apply to any ecosystem, terrestrial or aquatic, and are available online at SER's website. SER advises that plans for restoration projects should contain, at a minimum, the following items:

- A baseline ecological description of the kind of ecosystem designated for restoration, which accounts for the regional expression of that ecosystem in terms of the **biota** and poignant features of the abiotic environment.
- An evaluation of how the proposed restoration will integrate with other components of the regional landscape, especially those aspects of the landscape that may affect the long term sustainability of the restored ecosystem.
- Explicit plans and schedules for all on-site preparation and installation activities, including plans for contingencies.
- Well developed and explicitly stated performance standards, by which the project can be evaluated objectively.
- Monitoring protocols by which the performance standards can be measured.
- Provision for the procurement of suitable planting stocks and for supervision to guarantee their proper installation.
- Procedures to expedite promptly any needed post-installation.

Master planning for restoration

Ecosystems are incredibly complex with numerous interactions between components, and any attempts to restore urban ecosystems must start with master planning. Planners should consider the largest spatial and time scales possible for a framework, then use a hierarchical scheme (e.g., basin; subbasin; watershed; subwatershed; stream reach) for master planning, implementation and monitoring (U.S.D.A. Forest Service and U.S.D.I. Bureau of Land Management 1999). The minimum unit considered for the plan should be the watershed, and ecological rather than political boundaries are recommended in order to provide consistent treatment of functionally related areas, and because every part of the watershed can contribute to improved or reduced ecological functions. Watershed assessments should be conducted for all involved watersheds prior to restoration prioritization. Forming a vision that incorporates ecological, socioeconomic, and cultural values prior to embarking on watershed assessment and shaping a plan of action will help keep restoration efforts on track and help identify acceptable restoration strategies (see Fausold and Lilieholm 1999; Fight et al. 2000). Reference sites (relatively undisturbed watersheds that allow comparison to predisturbance conditions) will be necessary to identify functions that have been lost or altered in urban watersheds, and to provide ecological benchmarks of success or failure (Beschta 1995; Harris 1999; FIRSWG 1998).

Long-term funding sources, realistic goal-setting and creating successful partnerships must be addressed at the outset (Grayson et al. 1999). Long-term funding sources for monitoring and evaluation will help ensure implementation of the master plan. Goal-setting must be ecologically and financially feasible and success is unlikely without engaging stakeholders. The creation of successful partnerships is critical, including an interdisciplinary scientific team, agencies, local governments, communities, watershed councils, and other stakeholders. These partnerships will build consensus and increase information resources, expertise, and potential person-hours available for working on the project (FIRSWG 1998). Having one responsible party will help keep the master plan on course and will increase accountability for results.

Scientific approach

One of the difficulties in urban restoration is that land use planners and land managers are typically not scientists and lack the knowledge and vocabulary to take a scientific approach to ecosystem management. Furthermore, planners are obliged to consider conflicting resource needs between humans and wildlife. While societal needs clearly must be considered, the scientific literature indicates that a rigorous scientific approach, including hypothesis formation and testing, is the best way to ascertain what is possible, what might be effective and whether the desired results have been achieved (Bradbury et al. 1995; Henry and Amoros 1995). Henry and Amoros (1995) commented that: “Ecological restoration is a recent discipline that should be conducted scientifically and rigorously to move from a trial-and-error process to a predictive science to increase its success and the self-sustainability of restored ecosystems.”

SER offers a set of ecological principles and guidelines for managing land use (Dale et al. 2000) in which they propose five actions to develop the science that is needed by land managers:

1. Apply ecological principles to land use and land management.
2. Explore ecological interactions in both pristine and heavily used areas.
3. Develop spatially explicit models that integrate social, economic, political, and ecological land-use issues.
4. Improve the use and interpretation of onsite and remotely sensed data to better understand and predict environmental changes and to monitor the environment.

5. Communicate relevant ecological science to users (including landowners and the general public).

A scientific approach lends credibility to restoration efforts and also provides systematic, repeatable methodologies that can be applied over large areas for consistency and comparability. The emphasis should be on restoring natural processes, and linkages among soils, geology, hydrology, biota, and other ecosystem components must be recognized (Roni et al. 2002). An interdisciplinary approach addressing physical, biological, and social issues is important because each is a critical factor in ecosystem degradation (Booth et al. 2001).

Consider the metapopulation

A restoration approach should be developed that addresses habitat requirements of populations and metapopulations, not just individual fish and wildlife needs (Lidicker and Koenig 1996; Watershed Professionals Network 1999; Dale et al. 2000; Roni et al. 2002; see also Figure 14). This approach requires addressing connectivity (as discussed in the Habitat Fragmentation section) as well as a hierarchical view of populations and space, with corresponding factors important to protection and restoration of habitat.

Address urban-specific issues

In order to address the cumulative impacts wrought by urbanization, we must know the most common and critical causes of environmental degradation, the reason why restoration efforts most commonly fail, and develop an overall strategy for a more successful approach (Booth et al. 2001). The critical factors in addressing watershed hydrology are impervious surfaces (see City of Olympia 1996), stormwater management (see Urban Watershed Institute 2001), and vegetative cover, with the goal of restoring a more natural flow regime in streams (Poff et al. 1997; Booth et al. 2001; Roni et al. 2002). In terrestrial riparian and upland habitats, controlling exotic species and restoring habitat connectivity and quality is vital. In all watersheds, education and community outreach is not just appropriate but crucial. Considering socioeconomic factors, however, is separate from and in addition to a scientific approach to restoration.

Monitoring

Habitat conditions must be linked to wildlife. Ecological conditions are best assessed by biological response to those conditions, because the complexity and health of natural systems is reflected in the structure and diversity of plant and wildlife communities (Lammert and Allan 1999; Roni et al. 2002). Monitoring may comprise a major portion of restoration budgets, because at least 10 years of monitoring are necessary to detect a biological response to activities and account for natural fluctuations in fish and wildlife numbers (Kondolf 2000; Roni et al. 2002).

A monitoring program to measure progress in protecting and restoring urban fish and wildlife habitat should include a set of biological indicators that are particularly responsive to environmental conditions, including urbanization (Bauer and Ralph 2001). In addition, instream measures such as Total Maximum Daily Loads (TMDLs; a set of standards developed by the Oregon Department of Environmental Quality to protect beneficial uses such as drinking water, salmonid spawning, recreation and agriculture) may be necessary (Watershed Professionals Network 1999). Streamflow and discharge measures provide important hydrological monitoring indicators, and these have been empirically developed and tested for the Pacific Northwest (see Booth et al. 2001). Spence et al. (1996) discuss programs for monitoring implementation (compliance) and assessment (effectiveness) and offer a general monitoring framework, as well as recommendations for biological and other types of indicators. McCarron et al. (1997) discuss bioassessment approaches to evaluate cumulative effects. Appendix 6 provides some potential indicators of the success of restoration activities seen repeatedly in the scientific literature.

Adaptive management

Adaptive management is a type of natural resource management that implies making decisions as part of an on-going process, as new information is received and incorporated into plans and activities. Adaptive management provides the opportunity for course correction through evaluation and action, thus it provides a bi-directional flow of information (FIRSWG 1998; National Marine Fisheries Service 1996a; CH2MHILL 2000; Kondolf 2000). Monitoring the results of activities makes adaptive management possible by allowing assessment of whether resource goals, objectives, and targets are being achieved.

General strategy for urban restoration

The success of restoration depends on ecosystem response to anthropogenic (human-caused) disturbances (resistance) and the system's capacity to recover after disturbances are halted (resilience) (Kauffman et al. 1997). Specifically, resistance is the capacity of an ecosystem to maintain natural function and structure after a natural disturbance or an introduction of an anthropogenic perturbation; resilience is the capacity of species or ecosystems to recover after a natural disturbance or following the cessation of an anthropogenic perturbation.

Ecosystem resilience may change with significant alterations to the disturbance regime (Jones et al. 2000). For example, increased flooding and debris flows are a known side effect of road systems, but the patchy nature of these disturbances leave numerous headwater and side-channel refuges for aquatic wildlife. These refuges are part of the resilience of the system. However, if significant portions of the stream network are damaged or removed (e.g., this region's loss of approximately 25 percent of original streams), the system's resilience to disturbance is reduced.

Reduced floodplain connectivity provides another example of loss of ecosystem resilience. A group of scientists convened in 1998 by the Oregon Department of Fish and Wildlife voted the two most critical long-term salmonid conservation measures along the Willamette River to be restoring floodplain function and hydrologic integrity, and improving water quality (Martin 1998). Restoration of the floodplain function and hydrologic integrity would likely result in improved resistance to disturbance (e.g., reduced flooding, fewer sediments and toxins entering the waterway), as well as improved resilience (e.g., biotic recovery after floods, recovery from recreational trampling, etc.). In highly disturbed areas such as urban regions, elements and processes that promote ecosystem resilience and, therefore, recovery should be protected, preserved, and fostered (Ebersole et al. 1997). These include floodplain, hydrologic, and riparian connectivity.

Functional restoration should be based on science, but approached with good business sense by weighing ecological benefits against project costs. How can we achieve the most significant results per restoration dollar? How can watersheds and projects be prioritized to achieve this practical approach? There are a number of references available to assist this process. For example, Nehlsen (1997) described an Oregon-based ecosystem approach to prioritizing watersheds for restoration and salmonid recovery (the Bradbury framework; Bradbury et al. 1995) and provided a sample application that was applied with apparent success at three different spatial scales. Richter (1997) recommended urban-oriented criteria for the restoration and creation of wetland habitats of Pacific Northwest amphibians, as well as a long-term monitoring strategy (Richter and Ostergaard 1999). Schueler (1995) offered an extensive set of recommendations regarding site planning for urban stream protection. May et al. (1997b) published a series of habitat quality indices for urbanization effects in Puget Sound Lowlands streams. In addition, below we offer a general strategy for prioritization of urban restoration sites and projects, based on first preserving the most ecologically intact areas, then prioritizing remaining habitats for functional restoration.

Preserve the best

By the time large-scale efforts to protect, conserve and restore urban watersheds are considered, substantial ecological damage has typically already occurred. Pristine habitats are scarce or absent, and habitats in excellent or good condition are limited. It is much easier to protect a high-quality area than to restore functions to an ecologically degraded area (Bradbury et al. 1995), and in the long run protection may be less expensive than restoration. Thus, the first ecological priority for protecting fish and wildlife habitat in any urbanized region should be to recognize and preserve high-quality, low-development watershed areas. Protection of these areas within Metro's jurisdictional boundary should be included in a restoration master plan; however, any program would need to include an Economic, Social, Environmental and Energy (ESEE) analysis to weigh the consequences of protection plans. Protection may be accomplished through a number of means, including direct land purchase, conservation easements, and land use regulations. A recent urban-rural gradient study suggested that two locations along the gradient – the most remote portions of the landscape, and at the outer envelope of urban expansion – may hold disporportionate influence over water quality in the future (Wear et al. 1998).

Identification of sensitive, critical, or refuge habitats (at-risk habitats and species) to conserve remaining biodiversity provides one way to identify which areas to protect. This can be accomplished through identification and protection of endangered habitats, and through identifying habitats critical to state- or federally-listed species, including specific areas such as known nest sites. Metro's species list includes state- and federally-listed vertebrate species.

The Oregon Biodiversity Project, launched in 1994 to develop a statewide strategy to conserve Oregon's biological diversity, identified four general habitat types – native prairie grasslands, oak savannas and woodlands, wetlands, and bottomland hardwood forest – as conservation priorities in the Willamette Valley (Defenders of Wildlife 2000). These habitats should be identified in the Metro region and protected. Roni et al. (2002) reviewed methods for identifying and prioritizing conservation areas, and Table 12 provides an example of a prioritization scheme for protecting sensitive, critical or refuge habitats in Larimer County, Colorado (note that economic interests are built into the scheme). Other habitat ranking systems are also available in the literature (see Rossi and Kuitnen 1996; Csuti et al. 1997).

Table 12. Example of a prioritization scheme for protecting sensitive, critical or refuge habitats.
Local conditions mapped for environmental protection as part of the Partnership Land Use System (PLUS) developed by Larimer County, Colorado.

Environmental Value	Definition	Data Source
Conservation sites	Areas containing one or more imperiled species (plants or animals)	Field surveys by Colorado Natural Heritage Program
Habitat for economically important species	Winter range and migration corridors for mule deer, elk, and pronghorn antelope	Field surveys by Colorado Division of Wildlife
Areas of high species richness	Areas where predicted vertebrate species richness exceeds 95 percent of all areas included in the analysis	Vegetation map derived from Thematic Mapper satellite image Habitat modeled from vegetation associations of all vertebrate species in county
Rare plant communities	Plant communities covering less than 3 percent (individually) of the land area of the county	Vegetation map derived from Thematic Mapper satellite image

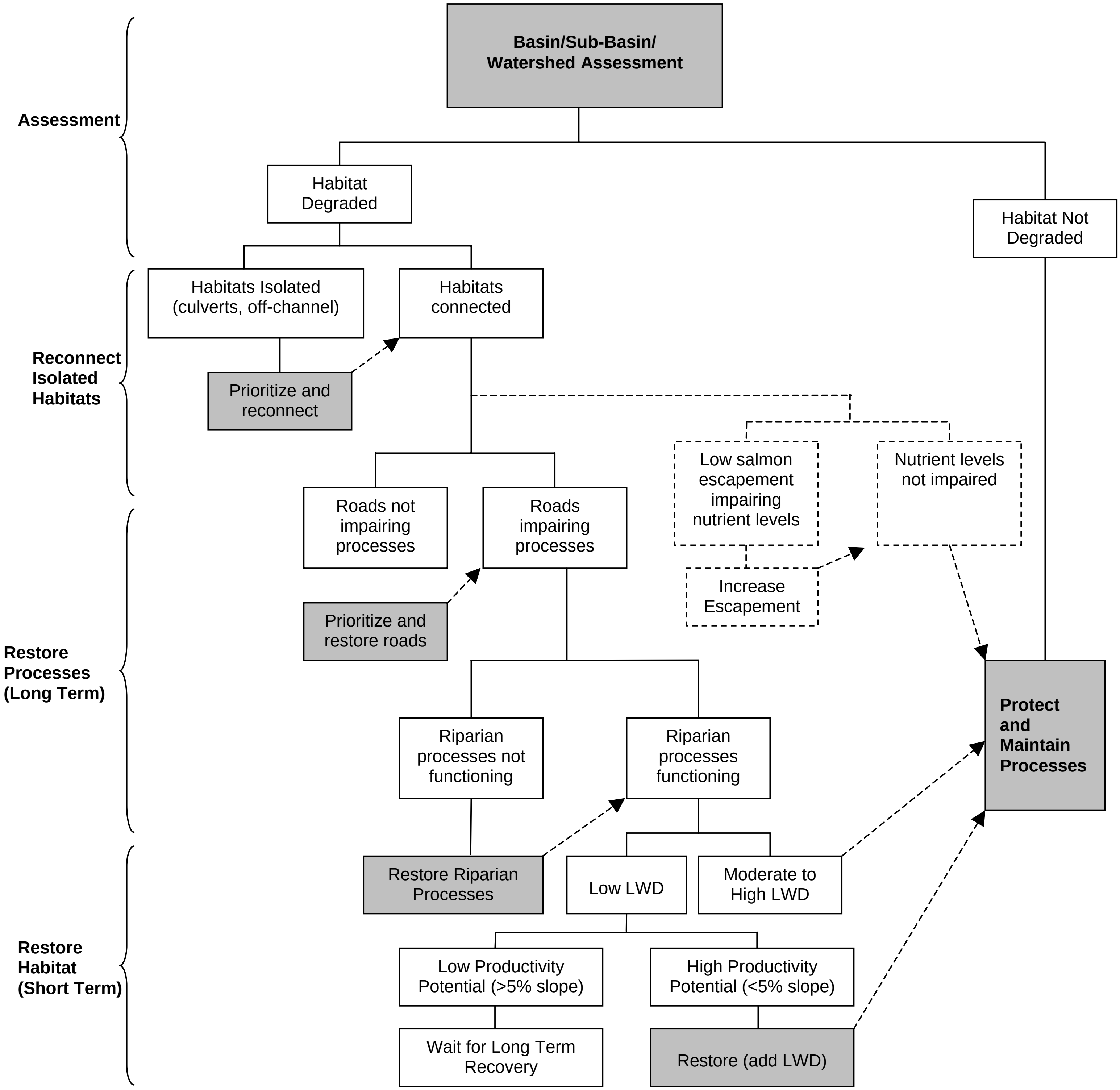
Source: Society for Ecological Restoration's website, 2001.
Note: While the criteria may change geographically, this provides an example of a habitat conservation prioritization scheme.

Home-range sizes vary considerably among different species. Certain species, such as some Neotropical migratory birds, seem to require larger habitat patches to successfully live or reproduce (see *Impacts of Urbanization, Habitat Fragmentation*). In addition, local evidence indicates that Neotropical migrants respond negatively to roads near their habitat patch (Hennings 2001); although unstudied, this is likely to be true for some mammals and other species. Thus preserving as many large habitat patches as possible, particularly those not divided by roads, is another means of preserving the best remaining habitats in the region. The value of these patches is further enhanced if other natural areas are nearby, because animal movement between patches may help prevent local extinctions.

Restore the rest

The scientific literature indicates that the best restoration candidates are moderately degraded areas, because severely degraded areas are much more difficult to restore (Kauffman et al. 1997; Booth et al. 2001). Therefore, the first priority is to aggressively restore streams and other habitats where recovery of ecosystem functions and processes is possible. Next, improve the most degraded sites by analyzing and addressing the acute cause(s) of degradation. Finally, where complete recovery is not feasible but well-selected efforts may yield direct improvement, restore selected elements of moderately degraded urban watersheds. All of these actions should take place under the umbrella of a watershed master plan. Figure 14, on the following page, shows a salmon-oriented hierarchical prioritization scheme.

Figure 14. An example of a salmon-based hierarchical strategy for prioritizing restoration in Pacific Northwest watersheds.



Source: Roni et al. 2001

Develop wisely

Planning for development is an important part of an environmental protection or enhancement plan. Setting an urban growth boundary (UGB) is one example. Another is Metro's 2040 Growth Concept, which defines the form of regional growth and development for the Portland metropolitan region. The Growth Concept was adopted in the Region 2040 planning and public involvement process in December 1995. The 2040 Growth Concept is implemented through the Regional Framework Plan (RFP), adopted in 1998. The RFP includes specific land use guidelines, such as a stream and floodplain protection plan. Metro also has a Greenspaces Master Plan, ensuring the acquisition and protection of natural areas and open spaces within and near the UGB.

It is much more difficult to repair environmental damage than to prevent it. Based on a large volume of scientific literature, much of it specific to the Pacific Northwest, is it clear that responsible development should:

- Plan well to reduce impervious surfaces such as transportation network
- Retain and add forest canopy cover
- Plan storm sewer and runoff systems with past, current, and future hydrology in mind

Figures 15 and 16 illustrate Pacific Northwest examples of how planning can influence environmental conditions. In Figure 15, land planners assess the opportunity to mitigate the influences of urbanization on hydrology through projected land-use changes and construction of proposed detention ponds and bypass pipelines. Note that while the future alternative does not return the hydrology to predevelopment conditions, it projects a marked improvement over current conditions. Figure 16 estimates the interaction of forest canopy cover and imperviousness in a rural setting. The graph suggests that about 65 percent canopy cover is needed to protect stream channel stability under typical rural development conditions.

Control nonnative species

As discussed in previous chapters, nonnative species ("exotics") pose a major threat to native plants and animals in the United States, particularly in urban areas due to the concentration of people. SER (1993) recommends the following regarding nonnative species:

1. The control of exotic species should be an integral component of all restoration projects and programs.
2. Monitoring of exotics and periodic reassessment of their control should be integrated into all restoration plans and programs.
3. Highest priority should be given to the control of those species that pose the greatest threats, namely:
   - Exotics that replace native key (keystone) species.
   - Exotics that substantially reduce native species diversity, particularly with respect to the species richness and abundance of conservative species.
   - Exotics that significantly alter ecosystem or community structure or functions.
   - Exotics that persist indefinitely as sizable sexually reproducing or clonally spreading populations.
   - Exotics that are very mobile and/or expanding locally.
4. Restoration plans and management programs should include contingencies for removing exotics as they first appear and for implementing new control methods as they become available.
5. Control programs should cause the least possible disturbance to native species and communities and, for this reason, may be phased over time.

6. The restoration and management program must, of necessity, be strategic. Protection of native habitats, levels of infestation, appropriate resource allocation, and knowledge of control methods should be integrated into the monitoring and management program.
7. Exotic species should not be introduced to the site in the restoration plan.
8. Native species should also be evaluated for their potential threat to native communities. Weedy native species should be avoided in restoration plans as well as native planting stocks representing non-native ecotypes.

Upland habitat restoration

Most watershed assessment methodologies deal primarily with aquatic and riparian habitat conditions, with little attention paid to upland conditions. This may be appropriate in non-urban watersheds, but upland components play a critical role in urban watershed health (Hollenbach and Ory 1999; Booth et al. 2001). For example, vegetation slows and stores water runoff and pollutants, while impervious surfaces do exactly the opposite. Adding native canopy cover provides one means of mitigating the negative effects of impervious surfaces (Shaw and Bible 1996; Booth et al. 2001). Other potential mitigating effects are offered through various sources (e.g., porous pavement; lawn management techniques [Watershed Protection Techniques 1994]; reducing the effects of imperviousness, Center for Watershed Protection 1998, 2001).

Small streams versus large rivers

Restoration of small streams and large rivers requires different methodologies, due in part to the extensive floodplain interactions associated with large rivers and damming (Sparks et al. 1990; Sparks 1995; Poff et al. 1997), but the two are linked. Local governments, including Metro, have potentially greater influence over small streams that originate or are largely contained within the urban area than over larger rivers, and small streams account for over three quarters of the total stream length in the United States (Lowrance et al. 1997). Restoration of large river systems depends on renewal of physical and biological interactions between the main channel, backwaters, and floodplains, and often involves managed flooding and floodplain reconnection (Sparks et al. 1990; Gore and Shields 1995; Stanford et al. 1996; Molles et al. 1998).

The Willamette River has been confined to a single channel with little sinuosity, high flow velocities, and low levels of habitat diversity to control floods and water resources, and has experienced a fourfold decrease in surface water volume from historic levels (Gore and Shields 1995). These modifications are due, in part, to restrictions of the river's bank, dams and flood control. Snagging and streamside forest removal has further isolated the river from much of its floodplain (Sedell and Froggatt 1984). Restoration of this river will pose a daunting task, much more so than dealing with small streams; however, small streams must be addressed in order to restore large rivers into which they feed. This re-emphasizes the importance of first addressing the whole system rather than individual components (Regier et al. 1989).

Figure 15. Modeled flow-duration curve for Des Moines Creek, Washington, displaying dramatic improvement in future flow durations relative to current. Analysis assumes projected land-use changes and construction of proposed detention ponds and bypass pipelines. (Source: Booth 2000)

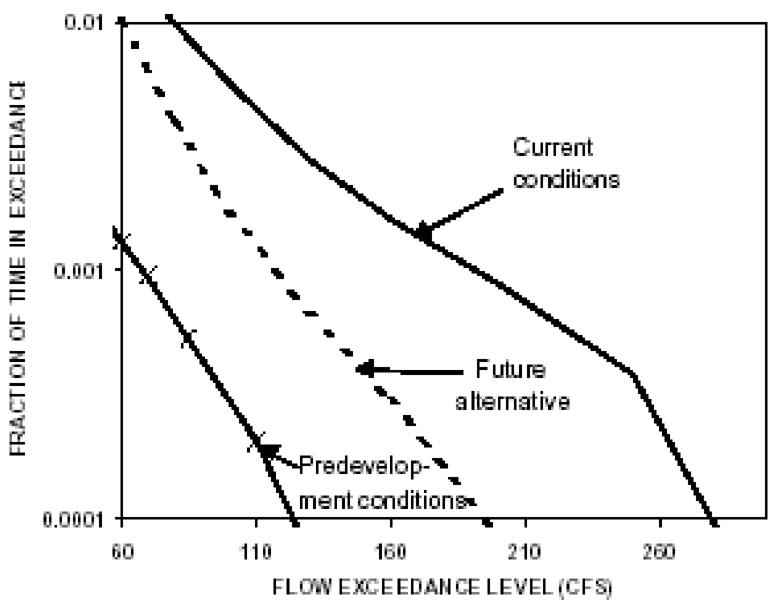
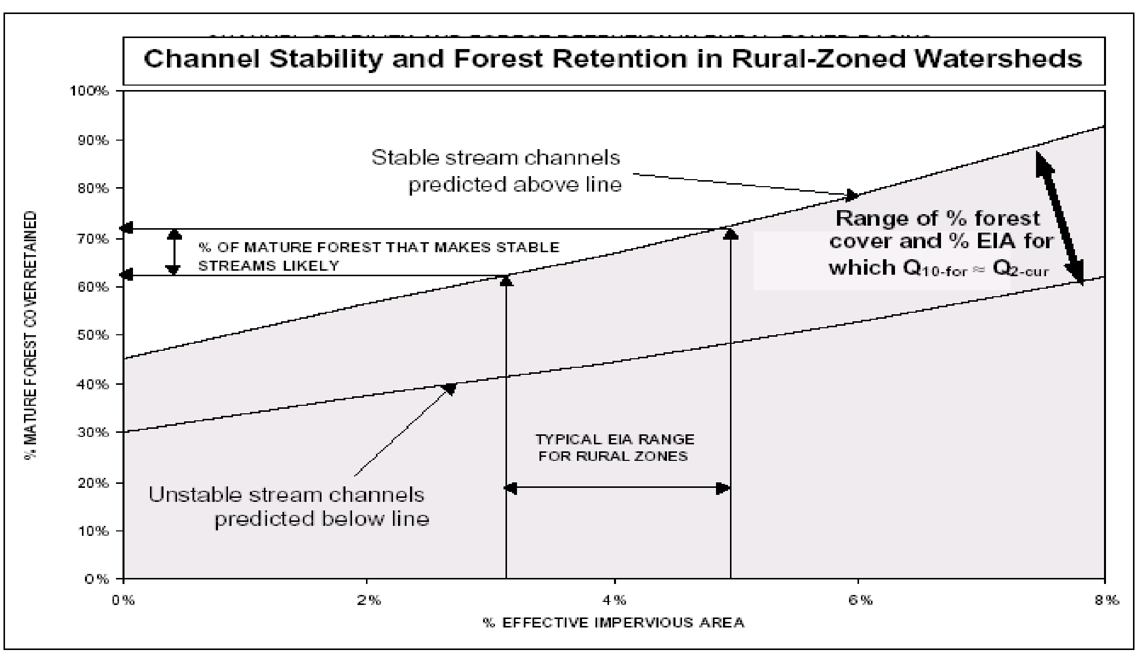


Figure 16. Booth's (2001) model predicting the amount of mature forest needed under rural conditions in order to maintain stable streams. Conditions of forest cover and impervious surface in an HSPF-modeled watershed with moderate slopes and till soils relative to the channel-stability criterion $Q_{2\text{-cur}} = Q_{10\text{-for}}$ [see Booth et al. 2001 for variable descriptions]. The range of forest-retention values reflects uncertainty in the hydrologic parameters; the range of effective impervious areas reflects variation in rural land cover conditions. Note the relatively high range of forest canopy cover predicted to be necessary to maintain stable streams in the typical EIA range for rural zones. Source: Booth et al. (2001)



BMPs and specific restoration activities

Best Management Practices

Some restoration tools are known as Best Management Practices (BMPs), and these tend to be most effective when implemented throughout a watershed. Several examples of BMPs are available online (e.g., Strassler and Strellec 1999; Clark County Washington 2000; O'Brien 2001; Urban Water Resources Research Council 2001). Many relate to impervious surface management and reducing the impacts of stormwater. Metro's Greenstreets efforts and Metro's Water Resources Policy Advisory Committee recommendations are available now as best management practices for local governments within the region.

BMPs may be site-specific or very general. For example, construction BMPs may require silt fences to reduce sediment inputs to the stream during construction. On the other hand, a BMP may apply over a large spatial scale. For example, riparian/wetland buffers are a common BMP. Horner and May (1999) found that, "The retention of a wide, nearly continuous riparian buffer in native vegetation has greater and more flexible potential than other option to uphold biological integrity when development increases. Upland forest retention also offers valuable benefits, especially in managing any development occurring in previously undeveloped or lightly developed watersheds" (see Figure 5). Buffer issues and design are discussed in detail in the ***Riparian Area Width*** section.

Site-specific restoration activities

Site-specific efforts are essential components of habitat restoration, but cumulative impacts in urban watersheds may cause these projects to fail, and may even cause further damage (Frissell and Nawa 1992; Booth et al. 1997; Hollenbach and Ory 1999; Watershed Professionals Network 1999; Roni et al. 2002). Another common cause of restoration project failure is disregarding geomorphic factors at the watershed scale (Kondolf 2000). In addition, many issues related to long-term persistence of salmonids and other species involve much larger spatial scales and hence require statewide or multistate planning (Spence et al. 1996; IMST 1999; National Marine Fisheries Service 2000a; IMST 2001b).

Few site-specific restoration activities should take place without a watershed assessment and careful master planning, which should including addressing existing and future development through hydrology, impervious surfaces and natural vegetation cover. However, below we will discuss a few methodologies commonly used in urban areas, and their apparent success or failure. In addition Appendix 6 outlines some potential restoration activities, keyed by function, and provides some suggestions for indicators of ecological change based on a literature review.

The Center for Watershed Protection (CWP), in cooperation with the U.S. EPA, has recently published the first of 11 manuals, dubbed the "Urban Subwatershed Restoration Manual Series." The eleven manuals are:

1. An Integrated Framework to Restore Small Urban Watersheds
2. Methods to Develop Restoration Plans for Small Urban Watersheds
3. Storm Water Retrofit Practices
4. Stream Repair and Restoration Practices

5. Riparian Management Practices
6. Discharge Prevention Practices
7. Previous Area Management Practices
8. Pollution Source Control Practices
9. Municipal Practices and Programs
10.The Unified Stream Assessment: A User's Manual
11. The Unified Subwatershed and Site Reconnaisance: A User's Manual

The manuals are available through CWP's website at www.cwp.org.

In the Pacific Northwest, riparian and upland forests are a key contributor to watershed health (Booth et al. 1997; May et al. 1997; Horner and May 1999; Booth 2000; Horner et al. 2001). The value of revegetating stream banks and riparian areas cannot be overemphasized. Pacific Northwest studies show positive relationships between the percentage of intact riparian forest in a watershed and instream biotic integrity (May et al. 1997; Horner et al. 2001; see also Figures 5 and 16). Retaining and adding upland vegetation is also very important for mitigating the hydrologic impacts associated with urbanization (Booth et al. 1997; Horner and May 1999; Booth 2000; Horner et al. 2001). Local watershed councils, the Natural Resources Conservation Service, and Oregon Department of Fish and Wildlife are good resources for revegetation and site-specific restoration techniques.

Frissell and Nawa (1992) evaluated rates and causes of damage or failure for 161 fish habitat structures in 15 streams in southwest Oregon and Washington after floods with a 2-10 year recurrence interval. The structures were comprised primarily of instream log or boulder clusters. Damage and failure was prevalent, particularly in low-gradient streams with signs of recent watershed disturbance, high or elevated sediment loads, high peak flows, and/or unstable channels; the authors suggested that commonly prescribed structural modifications are often inappropriate and counterproductive in such streams (e.g., those found in this urban region). Only two types of structures – cabled natural woody debris and individual boulder placements – experienced impairment or failure in less than half the cases. All log weir designs had high rates of impairment or failure, and one type, the downstream-V weir, failed or was impaired in every instance. Boulder structures had lower failure rates than log weirs in low-gradient streams, but most boulder structures the authors studied were in relatively stable southwest Washington streams. Shields et al. (1995a, 1995b) found stone weirs to be a successful rehabilitation technique in an incised lowland Mississippi stream.

Booth et al. (1996) provide design approaches for urban channel rehabilitation, with emphasis on large wood and the various hazards associated with such projects in an urban setting. The authors state that while large wood is critical to the health of most Pacific Northwest streams, instream placement of such structures in urban environments is hampered by lack of geomorphic and channel type considerations and greatly increased peak flows (see also Moses and Morris 2001). Possible loss of flood conveyance, the potential for the wood to clog existing channel constrictions, and the possibility of flow diversion causing bank erosion further complicate placement of this critical stream component. This is not meant to imply that large wood placement cannot be a valuable restoration tool in urban settings. However, the complexity and variability of these stream systems mandates a great deal of forethought, careful study of the effectiveness of projects conducted in similar settings, long-term post-project evaluation, and communication of the results to others.

Keim et al. compiled an annotated bibliography of selected guides for stream habitat improvement in the Pacific Northwest (Keim et al. 2004). The Oregon Watershed Enhancement Board (OWEB) provides guidelines on conducting restoration projects in a watershed (OWEB 1999). Many other references are available on specific restoration techniques and their effectiveness (e.g., Oregon Department of Forestry and Oregon Department of Fish and Wildlife 1995; Dooley and Paulson 1998; Riley 1998; Morris and Moses 1999; Roni 2001). Table 13, on the following page, shows the typical response time, duration, variability of success and certainty of success of various common restoration techniques.

Table 13. Typical response time, duration, variability in success and certainty of success of common active restoration techniques.

Restoration Type	*Specific Action*	Years to achieve response	Longevity of action (years)	Variability of success among projects	Certainty of success
Reconnect isolated habitats	Culverts	1 to 5	10 to 50+	Low	High
	Off-channel	1 to 5	10 to 50+	Low	High
	Estuarine	5 to 20	10 to 50+	Moderate	Moderate to high
Roads	Removal	5 to 20	Decades to centuries	Low	High
	Alteration	5 to 20	Decades to centuries	Moderate	Moderate to high
Riparian	Fencing	5 to 20	10 to 50+	Low	Moderate to high
	Riparian replanting	5 to 20	10 to 50+	Low	Moderate to high
	Rest-rotation or grazing strategy	5 to 20	10 to 50+	Moderate	Moderate
	Conifer conversion	10 to 100	centuries	High	Low to moderate
Instream restoration	Artificial log structures	1 to 5	5 to 20	High	Moderate[a]
	Natural LWD placement	1 to 5	5 to 20	High	Moderate[a]
	Artificial log jams	1 to 5	10 to 50+	Moderate	Moderate[a]
	Boulder placement	1 to 5	5 to 10	Moderate	Moderate[a]
	Gabions	1 to 5	10	Moderate	Moderate[a]
Nutrient enhancement	Carcass placement	1 to 5	Unknown	Low	Moderate to high
	Stream fertilization	1 to 5	Unknown	Moderate	Moderate to high
Excavate or create new habitats	Off-channel	1 to 5	10 to 50+	High	Moderate
	Estuarine	5 to 10	10 to 50+	High	Low
	Instream	See various instream restoration techniques above			

Source: Roni et al. 2002
[a] Low to high depends upon species and project design.

Fish passage

If fish cannot pass through a culvert or other blockage, the entire upstream reach is rendered uninhabitable. The Oregon Department of Fish and Wildlife is the lead state agency for all types of fish passage concerns in Oregon, and has produced guidelines regarding fish passage (Robison et al. 1999). Key measurements of interest in fish-blocking culverts include culvert and adjacent slopes, outlet drop, and outlet pool dimensions, as well as the shape of the culvert and local hydrologic information (Robison et al. 1999). The ODFW guidelines specify maximum velocities, entrance drops, and minimum water depth criteria for culverts. Examples of fish passage-oriented restoration include culvert replacement, connecting upstream reaches of piped streams to lower sections, and “daylighting” of piped streams (IMST 2001a). Further guidance on specific culvert design and implementation strategies are offered in an annotated bibliography by Moore et al. (1999). The Inventory section of this report indicates piped stream sections in the Metro area.

Fish passage issues will necessarily be addressed in Metro’s Goal 5 program phase. Metro’s Regional Culvert Survey (1999-2000) augmented existing culvert inventories by the Oregon Department of Fish and Wildlife and several local governments by examining culverts located within a geographic area corresponding roughly to the Metro Urban Growth Boundary that had not been included in the previous surveys. Metro’s survey identified almost 1,500 unexamined culverts. Fieldwork determined that approximately 150 of these inhibit fish passage. Site-specific structures such as culverts can be more easily addressed than watershed TIA, and their carefully planned removal or appropriate modification represents significant opportunities for stream enhancement. However, both are critical issues that need to be addressed in urban ecosystems, and master planning plays an important role in such efforts; for example, it is sensible to remove downstream barriers before upstream barriers, and to remove barriers blocking larger areas than those blocking smaller areas.

Restoration costs and funding

Funding is clearly a limiting factor in many restoration efforts, particularly when dealing with large-scale efforts such as those necessary to restore urban regions. Funding for large-scale projects is unlikely without collaboration with appropriate partners. Sometimes partial funding may be provided by revenues from restoration activities; for example, the City of Seattle developed a Habitat Conservation Plan (HCP) for the Cedar River Watershed, a relatively undeveloped watershed near the urban region (City of Seattle 2004). Seattle estimates the total HCP costs at $113,078 (in 1998 dollars) and comments that some funding may be generated from the sale of water, timber, and surplus land outside the watershed, in addition to grants and contributions. The Oregon Watershed Enhancement Board, U.S. Fish and Wildlife Service, and numerous other agencies and organizations are potential funding partners for local efforts. Wy'East Resource Conservation and Development (2002), the U.S. EPA (1999), and other online resources provide guidance for restoration funding opportunities.

Measuring success of restoration activities

Ecological conditions are best assessed by biological response to those conditions (Roni et al. 2002), thus wildlife (i.e., aquatic invertebrates, breeding birds, etc.) and plant surveys are appropriate measures of a given site’s ecological value. In addition, surveys conducted in a scientifically sound, repeatable way will provide valuable baseline data with which to gauge ecological changes in the future and will add credibility to restoration efforts. However, there are a number of other appropriate non-biological indicators of ecological change, such as water chemistry and sedimentation. May et al. (1997b) offer suggestions on hydrologic parameters of interest for monitoring changes in Pacific Northwest streams over time. Appendix 6 provides some suggestions for indicators of ecological change.

Recommendations of the Oregon Progress Board

The Oregon Progress Board proposes a set of key indicators to guide the state’s basic environmental monitoring program, but cautions that these indicators are not sufficient to fully convey environmental conditions (Oregon Progress Board 2000). When possible and appropriate, these indicators should be used in assessment and monitoring efforts in order to standardize methodologies statewide to allow comparisons. The indicators include:

- ***Water Quantity:*** a) the degree to which stream flows meet ecological needs based on the proportion of instream water rights that can be met; b) the proportion of streams and rivers with good to excellent water quality according to the Oregon Water Quality Index

- ***Freshwater Wetlands:*** change in area of freshwater wetlands as compared to historical distribution (acres/percent)
- ***Riparian Ecosystems:*** a) the amount of intact or functional riparian vegetation found along streams and rivers; b) trends in the health of stream communities using an index comparing invertebrate populations to those expected in healthy aquatic habitats.
- ***Freshwater fish communities:*** the percentage of wild, native fish populations, including salmon, that are classified as healthy.
- ***Agricultural ecosystems:*** a) trends in soil quality and erosion rates; b) area of land in agricultural production.
- ***Urban areas:*** a) percentage of assessed groundwater that meets the current drinking water standards; b) frequency that the Air Quality Index exceeds the existing standards; and c) the amount of carbon dioxide emitted.
- ***Biological diversity:*** a) change in area of native vegetation types; b) percentage of at-risk species that are protected in dedicated conservation areas; and c) number of nuisance invasive species.

Proper functioning condition (PFC)

Proper Functioning Condition (PFC) is a qualitative method for assessing habitat conditions developed by the Bureau of Land Management and others; the term PFC describes both a specific assessment process and a defined, on-the-ground condition of a given habitat (Prichard et. al 1998; FIRSWG 1998). PFCs delineate how well the physical processes are functioning in a stream, wetland or other habitat. For example, Prichard (1998) provides a user guide to assessing PFCs in **lotic** (a flowing body of fresh water such as a stream or river) areas and defines riparian-wetland areas to be functioning properly when sufficient vegetation, landform, or large woody debris is present to provide certain functions, including:

- Dissipate stream energy associated with high waterflows, thereby reducing erosion and improving water quality;
- Filter sediment, capture bedload, and aid floodplain development;
- Improve floodwater retention and groundwater recharge;
- Develop root masses that stabilize streambanks against cutting action;
- Develop diverse ponding and channel characteristics to provide the habitat and the water depth, duration, and temperature necessary for fish production, waterfowl breeding, and other uses; and
- Support greater biodiversity.

The PFC technique is not a substitute for inventory of monitoring protocols designed to yield detailed information on the habitat or populations of plants or animals dependent on an ecosystem. For example, proper functioning condition in a stream does not necessarily indicate the presence of shrub habitat critical to riparian-dependent bird species (FIRSWG 1998). However, PFC can be a useful tool for watershed analysis when combined with other watershed and habitat condition information. National Marine Fisheries Service has developed a PFC system based on a “Matrix of Pathways and Indicators” (NMFS 1996b) and is currently developing an urban-specific set of pathways and indicators (Liverman personal communication 2002).

Grayson et al. (1999) offer advice on the assessment of wetland habitat restoration projects in urban wetlands, commenting that restoration goals have often been unrealistic because they failed to consider that urban wetlands are subjected to ongoing anthropogenic disturbances, which fundamentally alter wetland functions.

Case studies

Skagit Watershed Council

The Skagit Watershed Council (Beamer et al. 2000) developed a two-tiered strategy for identifying stream restoration and protection actions: the Strategy Application and Case by Case Screening. The two tiers result in a final, single prioritization list. In the Strategy Application tier, habitat types are classified and locations identified where six landscape disturbance diagnostics (hydrology, sediment supply, riparian conditions, floodplain conditions, isolated habitat, and water quality) are identified as impaired, partially impaired or functioning. A list of desired restoration and protection actions is created based on habitat type classifications, landscape disturbance diagnostics, and best available information. In the Case by Case Screening tier, proposed projects are screened for consistency with the Strategy on an individual basis using best available information, and a list of projects determined to be consistent with the Strategy is formed. The end product is a prioritization scheme of desired restoration and protection actions for expected costs and benefits. Beamer et al. (2000) used a cost-effectiveness prioritization scheme.

Puget Sound Lowlands

Booth et al. (2001) developed what they consider to be a robust approach to urban stream restoration based on the extensive knowledge gained in the Puget Sound Lowland region over the past few decades. The approach blends knowledge from the physical, biological, and social sciences by documenting the consequences of urban development on urban streams, understanding the causes of the resulting ecological degradation, and using that understanding to evaluate restoration strategies and techniques. They offer specific recommendations for restoration efforts in urbanized watersheds, including:

- ***Evaluate stream conditions:*** Make direct, systematic, and comprehensive evaluation of stream conditions in areas of low to moderate development.
- ***Mitigating urban hydrologic conditions is crucial:*** The hydrologic consequences of urban development cannot be reversed without extensive redevelopment of urban areas, which is infeasible in the near future. Likewise, the recovery of physical and biological conditions of streams is infeasible without hydrologic restoration over a large fraction of the watershed land area. This conflict can be resolved only if there are particular, ecologically relevant characteristics of stream flow patterns that can be managed in urban areas. Effective hydrologic mitigation will require approaches that 1) can delay the timing of stormflow discharges in relatively small storms and 2) can store significant volumes of rain for at least days or weeks. In the long run the goal should be to mimic the hydrologic responses across the hydrograph [a chart that measures the amount of water flowing past a point as a function of time] and not just truncate the high or low flow components. The rate of rise and decline of the hydrograph is just as important as the existence of peaks and lows. This almost certainly requires greater reliance on hillslope (“onsite”) storage to better emulate the hydrologic regime of undisturbed watersheds, either through dispersed infiltration, onsite detention, or forestland preservation.
- ***Riparian vegetation is important, but is not enough to maintain biological integrity:*** The effectiveness of localized patches of riparian corridor in maintaining biological integrity varies as a function of basin-wide urbanization. Where overall basin development is low to moderate, natural riparian corridors have significant potential to maintain or improve biological condition. Protecting high-quality wetland and riparian areas that persist in less-developed basins may also serve as a source of colonists (be they plants, invertebrates, fish, etc.) to other local streams that are subject to informed restoration efforts. At the same time, even small patches of

urban land conversion in riparian areas can severely degrade local stream biology. As both a conservation and restoration strategy, protection and re-vegetation of riparian areas is critical for preventing severe stream degradation, but these measures alone are not adequate to maintain biological integrity in streams draining highly urban basins.

- ***Education of property owners is crucial:*** Approaches must be developed to address the unanticipated, and unappreciated, consequences on channel conditions of human actions in the name of backyard improvements. Regional and national efforts now fall particularly short in this regard.
- ***Instream projects are unlikely to be effective:*** There is little evidence that instream projects can reverse even the local expressions of watershed degradation in urban channels. Addition of LWD to the urban streams we examined produced more physical channel characteristics typical of undisturbed streams, such as pools and sediment storage sites formed by LWD. Any increase in sediment storage and grade control in these moderate-slope alluvial channels was less assured. The steepest project reaches examined did not store more sediment, although LWD provided more grade control in the steepest reaches. Stabilizing or retaining sediment to reduce downstream sedimentation and associated flooding was not accomplished by adding LWD to the channel. No positive effect on biological condition from the restoration activities was detected over the time scales sampled; the physical characteristics in the reach that did change displayed no clear relationship to biological condition.
- ***Channel stabilization is rarely effective in the urban area:*** Aggressive efforts at channel stabilization during the period of active watershed urbanization will probably achieve only limited rehabilitation gains at high and perhaps unnecessary cost, even though bank armoring projects are constructed in the name of stream-habitat "improvement." Most lowland channels achieve a stable physical form some years or decades following urbanization, with or without human intervention. Yet the restabilization of urban channels, either by natural processes or by direct intervention, is generally incompatible with true "rehabilitation," because the resulting channel is rarely biologically hospitable and often is socially unwelcome as well.

Specific steps to watershed assessment

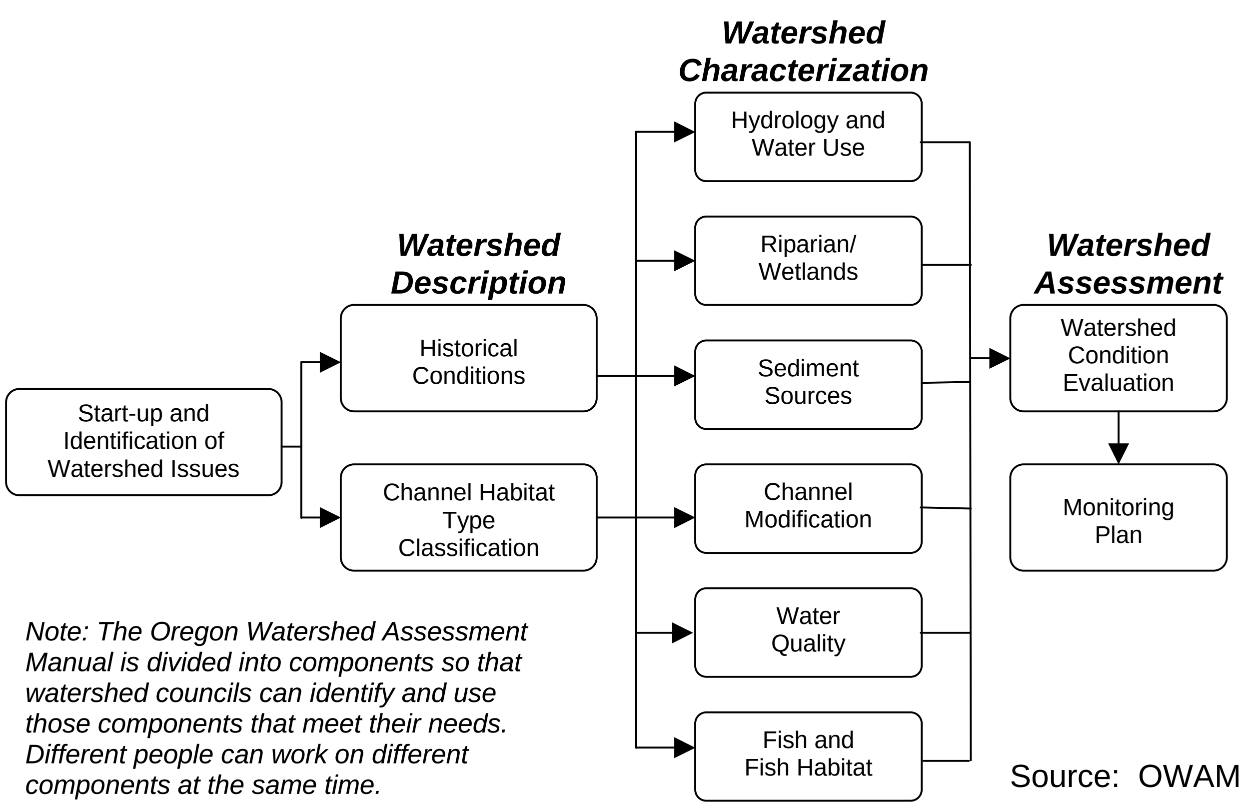
Without clearly defined goals that can be measured by quantifiable data, restoration attempts are likely to fail due to loss of momentum, project "scope creep," and lack of adaptive management. The precise and correct restoration mission, goals, and objectives, and appropriate performance indicators of restoration success or failure, must be defined early in the restoration process (Henry and Amoros 1995). All of the watershed assessment techniques referenced here deal with goal-setting, which is different for each project and hence will not be discussed here. However, assessment of success is less clearly delineated. The following section and Appendix 6 deal with measuring success in restoring ecological functions. This section provides an overview of the watershed assessment process.

Watershed assessment is a process for evaluating how well a watershed is functioning; it includes steps for identifying issues, examining the history of the watershed, describing its features, and evaluating various resources within the watershed. The overall goal is to figure out where, within a given watershed, natural functions relating to fish and wildlife habitat and watershed health should be restored. Specifically, the goals of a watershed assessment are to identify features and processes important to fish habitat and water quality, determine how natural processes are influencing those resources, understand how human activities are affecting fish habitat and water quality, and evaluate the cumulative effects of land management practices over time. This helps us determine which features and processes in a watershed are working well and which are not. Roni et al. (2002) proposed a method to place site-specific restoration within a watershed context. The underlying assessment and restoration objectives are more important than the specific assessment methodology chosen (Booth et al. 2001).

Several step-by-step methodologies exist to guide watershed assessment, but the general frameworks are similar (e.g., Bradbury et al. 1995; Regional Interagency Executive Committee 1995; Spence et al. 1996; U.S.D.A. Forest Service 1997; FIRSWG 1998; Prichard 1998; van Staveren et al. 1998; Watershed Professionals Network 1999; Sholz and Booth 2001). In general, the underlying assessment and subsequent restoration objectives are more important than the specific assessment methodology chosen (Booth et al. 2001), although some methodologies perform best at relatively specific spatial scales (discussed below). Figure 17 outlines one methodology, the Oregon Watershed Assessment Manual (OWAM), that dovetails with statewide efforts to standardize data collection and untangle the complex process of watershed assessment (Watershed Professionals Network 1999). This method, like others, includes components on getting started (e.g., setting up teams, subdividing watersheds, etc.), watershed description (overall characteristics in current and historical contexts), watershed characterization (individual watershed functions or components, such as hydrology and sediment sources), and watershed assessment (evaluation of conditions and formation of a monitoring plan).

Spatial scale is an important consideration in selecting an assessment method. For example, the Interior Columbia Basin Ecosystem Management Project provides assessment protocols for four geographic levels: broad scale (basin-level), mid-scale (subbasin; 4th field HUCs), fine-scale (watershed 5th field HUCs), and site-scale (project/site analysis, including NEPA analysis) (U.S.D.A. Forest Service and U.S.D.I. Bureau of Land Management 1999). The Oregon Watershed Assessment Manual (Watershed Professionals Network 1999) deals with **ecoregions**,

Figure 17. Components of the Oregon Watershed Assessment Manual.



Note: The Oregon Watershed Assessment Manual is divided into components so that watershed councils can identify and use those components that meet their needs. Different people can work on different components at the same time.

Source: OWAM 1999.

or landscapes sharing fundamental characteristics. Ecoregions may be described at different spatial levels; the OWAM assessment procedure uses Level III and IV ecoregions; our region (Level III) is the entire Willamette Valley.

Conducting an assessment of a very large basin, as in the case of the Bradbury Process (Bradbury et al. 1995), may help establish regional priorities, but this coarse-scale approach will not be of much value for specific project prioritization and development (Watershed Professional Network 1999). This is due to the difficulty in compiling and interpreting large amounts of data in meaningful way. On the other hand, comprehensive assessment in a very small basin is too site-specific to be useful in an urbanized region because it fails to address cumulative impacts. However, if the proper method is selected (based on spatial scale), individual assessments may be compiled for larger assessments. For example, using the HUC codes described in the **Inventory Chapter**, 5^{th} field assessments (e.g., the Johnson Creek watershed) can be combined to form a composite assessment of a larger basin or ecoregion.

The OWAM assessment process begins by looking at the entire watershed, because streams and their channels are the result not only of surrounding landform, geology, and climate, but of all upslope and instream influences as well. OWAM relies on existing data, local knowledge of land managers, and field surveys in order to reveal which natural and human-altered processes influence watershed health. The assessment bridges the gap to site-specific conditions by stratifying the stream network into Channel Habitat Types (CHTs), determined by the slope of the channel bottom and valley width. This helps identify segments of the stream network with high potential for biological production and which are sensitive to disturbance, in order to identify:

- Areas with highest potential for improvement
- High-priority areas for restoration
- Types of improvement actions that will be most effective

After analysis and planning identify the restoration actions needed and the actions are implemented, monitoring is used to track progress. The assessment template defines ecological indicators that can be monitored to track the restoration process. Other monitoring methods are available in the literature; for example, Scholz and Booth (2000) offer a monitoring strategy for urban streams in the moist Pacific Northwest that includes riparian canopy, bank erosion and bank hardening, and instream large woody debris.

Regional and local conservation, assessment and restoration efforts

There are numerous local or regional examples of watershed conservation, assessment and restoration efforts. Each may provide valuable insights into how to go about large-scale conservation planning and some, such as Clean Water Services' (formerly Unified Sewerage Agency) Watersheds 2000, may provide data relevant to conservation in the Metro region. Several such projects are described below. The Oregon Watershed Enhancement Board provides a list of current watershed restoration groups in Oregon (OWEB 2002).

There is significant overlap between many of the restoration projects listed here and many more ongoing projects that we have not mentioned. No one particular project addresses the range of problems and opportunities unique to the entire Metro region. All such projects should be brought into a larger regional restoration plan, if possible. This will help prioritize projects on a basin-wide scale and prevent duplicative or harmful projects, thereby making the best use of limited watershed restoration funds.

The Urban Watershed Institute

The Urban Watershed Institute (UWI) was launched in 1999 in response to increasingly complex urban environmental challenges (UWI 2001). While this is not an on-the-ground assessment or restoration effort, it may provide a valuable resource to those embarking on such efforts. UWI offers accredited classes (e.g., urban watershed assessment, wetlands and urban stream ecology, stream and watershed restoration methods, etc.), workshops and conferences to clarify environmental regulations and present strategies for achieving stream protection and regulatory compliance through multi-disciplinary approaches and new techniques and technologies. UWI's mission is to provide multidisciplinary training and encourage innovative partnerships to improve the ecological condition of urban watersheds.

The Gap Analysis Program

This is a nationwide program managed by U.S.G.S. Biological Resources Division (Shaughnessy and O'Neil 2001). The program focuses on working with each state to develop digital data layers used with GIS to identify the "gaps," or natural land cover types and native vertebrate species not adequately represented in existing network of conservation lands. This is a coarse-filter approach, working from the statewide scope to larger geographic regions.

King County, Washington

King County is ahead of the Metro region in regional watershed planning and implementation, reflecting governmental response to habitat degradation caused by the Seattle region's large population and growth rates over the past decades. King County has also collaborated considerably with University of Washington scientists to fill their research needs. Although there are differences, the Seattle and Portland regions are ecologically relatively similar and have been developed over roughly the same time period. Thus we can capitalize on our northern neighbors' successes and review their failures to aid planning and restoration efforts in the Metro region.

King County and others have initiated the Puget Sound Ecosystem Restoration Initiative, a proposed program to restore habitat for salmon and other species throughout the Puget Sound Basin (King County Department of Natural Resources 2001). The initiative's goals are to identify, prioritize, and construct the most effective habitat projects in the 17 watersheds comprising the basin, implemented by the Army Corps of Engineers and other local and state agencies, tribes, and key private interests. Two key elements are comprised in the initiative: identifying the best habitat projects in the Puget Sound basin to construct, and constructing them quickly and effectively. Designed to complement other local, state, and federal programs for salmon recovery, the plan will recognize prior habitat studies and plans, focus new studies and technical assistance where they are most needed, and establish priorities across the entire basin. If implemented, this science-based plan may provide an excellent model for similar efforts in the Portland Metro region.

In 2004, the King County Council approved limits on developing rural land (Langston 2004). The changes include requiring rural residents to keep half to two-thirds of their property covered in forest or natural vegetation, depending on the property size, to protect habitat, prevent flooding and erosion and protect water quality.

The Pacific Northwest Ecosystem Research Consortium (PNERC)

PNERC is an interdisciplinary research group comprised of scientists from Oregon's state universities, the U.S. EPA, private research consultants, and others (PNERC 2001). The consortium's goals are to understand the ecological consequences of societal decisions in the Pacific Northwest, develop transferable tools to support management of ecosystems at multiple spatial scales, and strengthen linkages between ecosystem research activities and ecosystem management applications in the Pacific Northwest. Specific objectives are to characterize ecosystem condition and change, identify and understand critical processes, and evaluate outcomes (including modeling alternative future scenarios and potential consequences of these alternatives to humans and the environment). PNERC offers several data products, including maps modeling Willamette Valley land use from the 1850's, existing habitats in the Willamette Valley, and Habitat Suitability Index models for wildlife species in which wildlife trends may be modeled under various future alternatives. All major conservation strategies in the Pacific Northwest should establish contact with PNERC to better plan and coordinate science-based conservation efforts.

The Northwest Power Planning Council

The Northwest Power Act, passed in 1980, created the Northwest Power Planning Council to give the governors of Oregon, Washington, Montana and Idaho valuable tools to address energy, fish and wildlife concerns in the region (Northwest Power Planning Council 1998). These tools include substantial input into investment of power ratepayer money in energy, fish and wildlife initiatives, an open forum for public debate, and the capability to provide high-quality, independent analyses of complex resource issues. The Council's responsibility is to mitigate the impact of hydropower dams on all fish and wildlife in the Columbia River Basin through a program of enhancement and protection, and provides guidance and recommendations on hundreds of millions of dollars per year of projects funded through Bonneville Power Administration revenues. The Council has undertaken a number of important restoration-related activities in recent years, including input on subbasin inventory, assessment and planning; development of a fish and wildlife program for the Columbia Basin; and publication of several major scientific reports.

The Columbia River Inter-Tribal Fish Commission

The Commission developed a tribal approach to salmon recovery through protecting and restoring watersheds in the Columbia Basin (Hollenbach and Ory 1999). This effort emphasizes the importance of the entire watershed, including uplands, to well-functioning rivers and streams based on science, ecology, and traditional Native American understanding and respect for the natural world. It includes healthy human communities as part of healthy landscapes. The Inter-Tribal Fish Commission endorsed the Governor's Watershed Enhancement Board Watershed Assessment Manual as a good watershed assessment resource (although Oregon-specific, and many tribal lands involved are located in Washington). The Inter-Tribal report includes contact information for organizations related to watershed assessment, conservation land acquisition, water acquisition and instream flow conservation, placing instream structures, beaver reintroduction, monitoring and evaluation, and a large section on fundraising opportunities.

The Oregon Plan for Salmon and Watersheds

The Oregon Plan was initiated in 1997 and has provided legislative support and funding for: watershed restoration, local level restoration actions to improve watershed health, water quality, and conserve or restore habitats that support native salmon and trout. In addition, it provides guidance to shape rural and urban communities in an ecologically sound manner. This is the most comprehensive conservation effort ever undertaken by any state (Nicholas 2001). The Willamette Restoration Initiative (see below) is part of The Oregon Plan. The Plan's principles (abbreviated here) are simple but poignant: seek truth, learn, and adapt; be humble about our place on the earth; obey the law and live up to commitments; respect people and nature (the two are inseparable); act voluntarily; exercise patience; build partnerships, make friends, and strengthen community; strive to let rivers be rivers, and untame, a little, our watersheds; share information, decision-making and responsibility for action; consider our children's needs; and (our favorite) never give up hope.

The Oregon Watershed Enhancement Board (OWEB)

OWEB is an independent state agency created by a legislative act (House Bill 3225; an earlier version was GWEB, the Governor's Watershed Enhancement Board) (Nicholas 2001). It is funded by state lottery dollars obtained through Ballot Measure 66, passed by voters in 1998. This agency created the Oregon Watershed Assessment Manual, discussed previously, and ties into The Oregon Plan for Salmon and Watersheds. OWEB provided about $32 million in funds during the 1999-2001 biennium to conduct watershed enhancement projects statewide. OWEB does not yet have a system for verifying watershed investment results. NMFS generally supports OWEB's efforts.

The Oregon Biodiversity Project

The Oregon Biodiversity Project is part of The Biodiversity Partnership, an alliance of organizations and individuals involved in cooperative efforts to conserve Oregon's biological diversity (Defenders of Wildlife 2000). Defenders of Wildlife took the lead on the project, with major participation from The Nature Conservancy and the Oregon Natural Heritage Program. The key idea is to pioneer a collaborative approach to conservation planning, with a large-scale view of identifying conservation priorities for Oregon's native species and the habitats and ecosystems that support them. The Biodiversity Project aims to improve land stewardship with emphasis on private landowner incentives; expand the existing network of conservation lands; improve biodiversity information to enhance decision-making and adaptive strategies; increase public awareness; and demonstrate and test collaborative approaches to biodiversity conservation that could provide a model for other states or regions. Resources produced by this project would be valuable to any Oregon watershed aiming to link wildlife and habitats in a restoration plan.

The Willamette Restoration Strategy

This strategy was developed through the Willamette Restoration Initiative (WRI) to supplement the Oregon Plan for Salmon and Watersheds, as directed by Governor John Kitzhaber and in consultation with the state Legislature (Jerrick 2001). The Strategy focuses on improving fish and wildlife habitat, enhancing water quality, and managing floodplains in the Willamette Basin, within the context of human habitation and projected population growth. Developed through a diverse advisory group including government, natural resource, and business interests, the Strategy offers four key recommendations and 27 critical actions it believes are necessary to restore the health of the Willamette Basin. The 27 critical actions and Metro's current activities that contribute to these actions are in Appendix 7. The four key recommendations are:

1. Use the Habitat Conservation and Restoration Opportunities map developed by WRI as a tool to guide restoration decisions in the basin.
2. Use environmental indicators from the Oregon State of the Environment Report 2000 (Oregon Progress Board 2000) to guide development of basin-specific restoration targets, and provide a new system for accurately tracking restoration progress.
3. Begin the process of establishing a sound restoration investment plan for the basin by clearly identifying existing assets and forecasting future needs and funding sources.
4. Provide for an organization to continue the refinement of the Willamette Restoration Strategy and track its implementation.

As Appendix 7 indicates, there are many ways in which Metro currently contributes to these efforts. However, Metro could contribute more substantially in the future by directly tying conservation efforts to WRI's restoration targets, thereby strengthening a regional approach to managing watershed health within the Willamette Basin and providing a more unified approach to the multitude of ecological problems facing our region.

The Lower Columbia River Estuary Plan

The Lower Columbia River Estuary Plan's mission is to preserve and enhance the water quality of the estuary to support its biological and human communities (Jerrick 1999). Developed by the Governors of Oregon and Washington, the U.S. EPA and other parties, this project relates to the Metro region because the water, and all of the sediments and pollutants contained therein, derive from or pass through this region to reach the estuary – an excellent example of cumulative effects. The Estuary Plan offers strategies for aquatic ecosystem monitoring, information management, and a program for analysis and inventory. The Estuary Plan's board is currently working with NMFS to tie their efforts more closely to ESA-related salmonid conservation efforts.

City of Portland

The City of Portland, which has jurisdiction over the largest city in the state, has undertaken many efforts to protect the environment. For example, the City's Bureau of Environmental Services has developed: a Clean River plan for the Willamette; a long-term strategy for eliminating combined sewer outflows and incentives for reducing effective impervious areas; and strong public outreach including the Community Watershed Stewardship Program (which funds restoration, education and citizen involvement activities) (City of Portland 2001). The City is also developing a comprehensive, science-based program for watershed restoration and fish recovery program with tie-ins to other local and regional programs. This program has the potential for guiding a regional urban framework for managing watershed health and restoration. A brief description of the City of Portland's response to the ESA is included in Appendix 8.

Watersheds 2000

Clean Water Services' (formerly Unified Sewerage Agency) Watersheds 2000, involving a number of local project partners, is an inventory of the location and condition of streams in Washington County, Oregon, one of the three counties encompassing the Metro region. The project will also identify on-the-ground projects likely to improve the health of these streams and will help Clean Water Services and its partners make informed resource management decisions (Clean Water Services 2001). This effort has collected a large body of quantitative and qualitative stream and riparian corridor data that will be available to Metro and the public beginning approximately June 2001. These data could greatly reduce costs involved in initiating an urban watershed restoration master plan, particularly if the same data collection methodologies could be applied to other jurisdictions within the Metro region.

The Tualatin River Watershed Council

The Tualatin River Watershed Council provides an example of an effective watershed council, with a citizen biological monitoring program, educational activities, native riparian enhancement projects, and cooperative efforts with other local organizations such as Clean Water Services, Friends of Trees, and Stop Oregon Litter and Vandalism (SOLV) (Tualatin River Watershed Council 2001). They have obtained funding from a variety of sources for these activities and have a fully funded watershed coordinator position overseeing all watershed projects, related activities, and communications with other groups. Such efforts can provide valuable information for larger scale planning efforts.

The Johnson Creek Watershed

The Johnson Creek Watershed has received more attention than most watersheds in the Metro region because urbanization greatly increased flood risks in that area. The Portland Multnomah Progress Board, in cooperation with the Johnson Creek Watershed Council and many other governmental and non-governmental organizations, assessed current watershed conditions and prepared a strategy toward salmonid recovery in the Johnson Creek (Multnomah County) watershed (Meross 2000). This and other watershed assessments and restoration plans should be integrated into any regional plans addressing watershed health.

Oregon Department of Fish and Wildlife

The Oregon Department of Fish and Wildlife is directly involved with wildlife conservation in the metro region. For example, ODFW's Wildlife Diversity Program emphasizes protection and management of the 88 percent of the state's native fish and wildlife species that are not hunted, angled or trapped (the so-called "nongame" species; ODFW 1993). The plan is a blueprint for addressing the needs of Oregon's native fishes, amphibians, reptiles, bird and mammals, and contains information on all species and habitats in the state. ODFW also provides technical input to various Metro programs, including Goal 5 (as does the U.S. Fish and Wildlife Service). ODFW's website provides information on naturescaping, threatened and endangered species, timing for instream projects to protect salmonids, exotic species, and various technical reports on fish, wildlife and habitat (see ODFW's website at www.dfw.state.or.us). ODFW also manages the Sauvie Island Wildlife Area, an area remarkably important to migratory songbirds and waterfowl.

The Urban Ecosystem Research Consortium (UERC) of Portland-Vancouver

The UERC is a consortium of people from various universities and colleges, state and federal agencies, local governments, non-profit organizations and independent professionals interested in supporting urban ecological research and creating an information-sharing network of people that collect and use ecological data in the Portland/Vancouver area. The UERC's mission is to advance the state of the science of urban ecosystems and improve our understanding of them, with a focus on the Portland/Vancouver metropolitan region, by fostering communication and collaboration among researchers, managers and citizens at academic institutions, public agencies, local governments, non-profit organizations, and other interested groups. The UERC hosts annual symposia for people involved in natural resources issues in this metropolitan area. In January 2005, the UERC held its third annual symposium with over 300 attendees. Symposia proceedings and other UERC information are available online at http://www.esr.pdx.edu/uerc/.

USFWS and Metro Greenspaces Program

Since 1991, the U.S. Fish and Wildlife Service (USFWS) has funded the Greenspaces Program to support habitat restoration, natural resource conservation, and environmental education efforts in the Portland, Oregon and Vancouver, Washington metropolitan area. USFWS works in partnership with Metro to award cost-share funding under the following programs:

- Conservation and Restoration Program: This program is designed to benefit fish and wildlife by supporting natural resource conservation, restoration and enhancement projects as well as efforts that will build upon current information and knowledge about local fish and wildlife and their habitats.
- Environmental Education Grant Program: This program supports environmental education programs and projects that teach about ecological principles and local watersheds, foster community involvement in habitat conservation issues, and promote citizen stewardship of urban natural areas.

Summary

The cumulative nature of human impacts in a watershed make return of the full, original range of ecological functions unlikely. The real question is whether we can improve, or even maintain, the range of ecological functions currently existing in the Metro region. Addressing impervious surfaces, natural vegetation cover, and hydrology are keys to success in formulating watershed plans. The danger that we face is that while a number of ambitious, large-scale restoration plans have been made there is no guarantee of follow-through, and in fact many of these efforts have faltered. This loss of project momentum is a common scenario, and results in a tremendous waste of funds that could have been used to make direct watershed improvements. A science-based restoration master plan encompassing the entire Metro region is one way to answer this question. In this way, each jurisdiction could be assured that other jurisdictions are contributing to reducing the cumulative effects of urbanization, with shared efforts and results. Actions are needed now, before all watersheds in the region are degraded beyond the point of repair.

Preventing further degradation and improving current conditions will require a collective effort of everyone in the region. These efforts are vital to protect some of the fundamental values expressed by Oregonians – a healthy environment, access to nature, and a legacy of these values for future generations. The process of restoring health to our environment will cost money, time, and effort, but we believe it can, and in fact *must* be done in order to sustain future generations of people, fish and wildlife.

CONCLUSION

This technical report provides us with a foundation to answer the questions we set out to address, as described below.

What are the key ecological attributes that characterize a healthy watershed?

- Uplands dominated by native forest cover
- Continuous stream corridors with healthy, fully functioning riparian zones
- Floodplains connected with river channels
- Relatively unaltered hydrologic regimes
- Intact hyporheic zones
- Natural (or ecologically sustainable) input rates of sediment, organic matter, and nutrients that support healthy, productive and diverse fish and wildlife populations
- Lateral, longitudinal and vertical connections between system components
- Natural (or ecologically sustainable) rates of landscape disturbances

What are the functions and values of fish and wildlife habitat and how can they be retained?

- For riparian corridors, we can characterize the main fish and wildlife habitat functions in six main categories: microclimate and shade; streamflow moderation and water storage; bank stabilization and pollution control; large wood and channel dynamics; organic material sources; and riparian wildlife habitat and connectivity.
- Native vegetation plays a critical role in a watershed, particularly the longitudinal and lateral connectivity of the riparian corridor.
- Downed wood and snags (or large woody debris), frequently found in natural ecosystems but often lacking in disturbed environments, are crucial in providing high quality habitat in both aquatic and terrestrial ecosystems.
- Retention of key functions in riparian corridors will require a varying buffer width based on site-specific conditions.
- Upland habitat is important for many wildlife species. Important guidelines in developing a conservation plan for upland habitat are: large patches are better than small patches; small patches of unique habitat are worth saving; connectivity to other patches is important; and connectivity and/or proximity to water resources is valuable.
- Habitat fragmentation is a critical issue; thus buffers and surrounding land use play an important role in maintaining the functions of remaining habitat.

What are the species of fish and wildlife that characterize the biodiversity of our region?

- There are 292 native vertebrate species in the Metro region. Ninety-three percent use riparian areas, with 45 percent dependent on those areas to meet life history requirements. Eighty-nine percent of all terrestrial species in the Metro region are associated with upland habitats, with at least 28 percent depending on these habitats.
- In the Metro region several species of salmonids are listed as threatened under the federal Endangered Species Act. There are also numerous species that are identified as at risk both by the state and federal agencies. However, in this region we still have much habitat worth protecting and restoring for the purpose of retaining existing species and preventing future listings.

What are the impacts of urbanization on healthy watershed function and fish and wildlife habitat?

- Urban environments have similar ecological problems worldwide; including habitat loss, habitat damage and alteration (instream and terrestrial), modified hydrology, introduced species, and human disturbance.
- In the Metro region we have already lost about 400 miles of streams and many of the remaining stream miles suffer from degraded water quality, fragmentation, and simplification of riparian corridors for fish and wildlife.
- Human disturbance has played a major role in modifying fish and wildlife habitat; including the introduction of nonnative species, pollution, and habitat alteration and simplification.

What is restoration and how is it best approached in an urban context?

- Ecological restoration is the process of assisting the recovery and management of ecological integrity. Ecological integrity includes a critical range of variability in biodiversity, ecological processes and structures, regional and historical context, and sustainable cultural practices (SER 2000).
- Urban "restoration" may represent a range of improvements in function and condition over time, limited in an urban setting to what is actually achievable - in other words, an ecologically, economically and socially acceptable range of options that re-establishes natural functions. The end goal is sustainability, under a new urban equilibrium that is different from that in the original ecosystem, but which supports diverse wildlife communities and healthy ecosystems.
- Addressing hydrology, impervious surfaces, and natural vegetation are keys to success.

Metro will utilize the information in this technical report to help in the development of a regional Goal 5 program to protect fish and wildlife habitat. Specifically, the technical report will help to inform the following steps in the Goal 5 process:

- developing criteria to determine significant riparian and upland wildlife habitat and to address the location, quality, and quantity requirements of the Goal 5 rule;
- conducting an ESEE analysis to weigh the consequences of protection of significant fish and wildlife habitat and allowing development of the resources, and to identify the tradeoffs for decision makers; and
- formulating a program to protect fish and wildlife habitat that is scientifically based.

Integrating the needs of people with the needs of fish and wildlife in an urban environment is not an easy task. There has been debate on the value of providing habitat reserves in urban and developing areas, considering the difficulty many species have cohabiting with humans and the economic value of developable land in urban areas (Linehan et al. 1995). However, a large body of evidence indicates that people living in urban areas appreciate access to fish and wildlife habitat (Adams and Dove 1989; Adams 1994; U.S.D.A. Forest Service and N.O.A.A. 2000). According to the National Survey on Recreation and the Environment, over 86 percent of Americans think it is important to protect wildlife habitat, and 93 percent believe that the natural environment has intrinsic value (U.S.D.A. Forest Service and N.O.A.A. 2000).

Metro's policies have consistently placed a high level of importance on the protection of the natural environment as a means of maintaining the high quality of life citizens of this region expect. This technical report provides an important framework to guide us in doing just that.

GLOSSARY

Abiotic – something that is not living (e.g., rock).

Age effect – refers to the amount of time a fragment has been separated from the "mainland" or the surrounding landscape by urbanization.

Algal bloom – a condition that occurs when excessive nutrient levels and other physical and chemical conditions facilitate rapid growth of algae. Algal blooms may cause changes in water color. The decay of the algal bloom may reduce dissolved oxygen levels in the water.

Allochthonous – refers to something formed somewhere other than its present location. Examples include leaf litter, insects, etc. falling into a stream. Antonym of autochthonous.

Anadromous fish – fish that are born in freshwater, spend a significant portion of their life in the ocean, and return to natal streams as adults to spawn.

Aquatic – having to do with water.

Armoring (channel armoring) – the formation of a resistant layer of relatively large particles resulting from removal of finer particles by erosion.

At risk species, or species at risk – a catch-all term for species that are officially listed in some manner through state and/or federal Endangered Species Act programs (see Species List for technical definitions).

Autochthonous – Refers to something formed in its present location. Example includes instream algae. Antonym of allochthonous.

Baseflow – Streamflow that results from precipitation that infiltrates into the soil and eventually moves through the soil to the stream channel. This is also referred to as ground water flow, or dry-weather flow.

Benthic zone – associated with stream bottoms

Bioaccumulation – storage of a chemical within a living organism at concentrations higher than found in the surrounding environment.

Biological oxygen demand – indicator of organic pollutants in an effluent measured as the amount of oxygen required to support them. The greater the BOD the greater the pollution and less oxygen available for higher aquatic organisms.

Biodiversity – full range of variety and variability within and among living organisms and the ecological complexes in which they occur. The concept of biodiversity encompasses ecosystem processes, species diversity and genetic variation.

Biota – plants and animals living in a habitat.

Biotic – something that is living, or pertaining to living things.

Carnivore – an animal that feeds on other animals.

Carrying capacity – the maximum sustainable size of a population in a given ecosystem.

Channelization – the process of changing and straightening the natural path of a waterway.

Coarse scale data – applicable on a large spatial scale.

Connectivity – for streams, the physical connection between tributaries and the river, between surface water and groundwater, and between wetlands and these water sources. For terrestrial habitat, concept is similar but in this context refers generally to sufficient connectivity to allow wildlife passage between habitat patches.

Cumulative impacts – the sum of effects from all factors that influence the condition of a watershed that together have a greater impact than if each acts alone

Denitrification – reduction of nitrate or nitrite to molecular nitrogen or nitrogen oxides by microbial activity (dissimilatory nitrate reduction) or by chemical reactions involving nitrite (chemical denitrification). Results in the effective removal of substances which, in high amounts, are toxic to animals.

Detritivore – any organism that eats decaying organic matter.

Diatoms – single-celled creatures with hard, silica-based shells. Frequent aquatic residents that form part of the aquatic food web.

Discharge – the volume of water moving down a channel per unit of time. Alternatively, the volume of water released from a dam or powerhouse at a given time, usually expressed in cubic feet per second.

Disturbance – any relatively discrete event in time that disrupts ecosystem, community, or population structure and changes resources, substrate availability, or the physical environment. In aquatic systems, refers to any significant fluctuation in the supply or routing of water, sediment, or woody debris that causes a measurable change in channel morphology and leads to a change in a biological community.

Diversity – see also biological diversity. In ecology, this term usually refers to how many different kinds of plants and animals are found in an area.

Ecoregion – land areas with fairly similar geology, flora and fauna, and landscape characteristics that reflect a certain ecosystem type.

Ecosystem – the totality of components of all kinds that make up a particular environment; the complex of biotic community and its abiotic, physical environment

Edge – the area of transition between two different vegetation communities, such as forest and meadow. Also refers to human-made systems, such as the transition between a natural area and a residential development.

Effective impervious area (EIA) – the area where there is no opportunity for surface runoff from an impervious surface to infiltrate into the soil before it reaches a conveyance system (pipe, ditch, stream, etc.). An example of an EIA is a shopping center parking lot where the water runs off the pavement and directly goes into a catch basin where it then flows into a pipe and eventually to a stream. In contrast, some homes with impervious roofs collect the roof runoff into roof gutters and send the water down downspouts, where it can be directed either into a pipe or dumped on a splash block. Roof water dumped on a splash block then has the opportunity to spread out into the yard and infiltrate into the soil. Such roofs are not considered to be 100 percent effective impervious area.

Endangered Species Act – 1973 Act of U.S. Congress, amended several times subsequently, that elevates the goal of conservation of listed species above virtually all other considerations. The act provides for identifying (listing) endangered and threatened species or distinct segments of species, monitoring candidate species, designating critical habitat, preparing recovery plans, consulting by federal agencies to ensure that their actions do not jeopardize the continued existence of listed species or adversely modify critical habitats, restricting importation and trade in endangered species or products made from them, restricting the taking of endangered fish and wildlife. The act also provides for cooperation between the federal government and the states.

Enhancement – is the alteration and/or active management of existing habitat to improve particular functions and values; enhancement activities may or may not return the site to pre-disturbance conditions, but creates or recreates functions and processes that occur naturally

Entrenchment – the vertical containment of a river and the degree to which it is incised in the valley floor. A stream may also be entrenched by the use of dikes or other structures.

Ephemeral streams – streams that flow only during or immediately after periods of precipitation, generally less than 30 days per year.

Erosion – the movement of soil particles resulting from the actions of water or wind. Erosion produces sediment that moves in suspension from its site of origin by air, water, or gravity.

Eutrophication – rapid increase in the nutrient status of a water body, natural or occurring as a by-product of human activity. Excessive production leads to anaerobic conditions below the surface waters. Especially refers to high concentrations of nitrates and phosphates in water, which may lead to algal bloom.

Evaporation – conversion of liquid water into water vapor. See also evapotranspiration and transpiration.

Evapotranspiration – a collective term that includes water discharged to the atmosphere as a result of evaporation from the soil and surface-water bodies and as a result of plant transpiration. *See* also evaporation and transpiration.

Extinct – complete loss of a species, i.e., no surviving individuals exist.

Extirpated – a species that has gone locally extinct.

Fecal coliform – present in large numbers in the feces and intestinal tracts of humans and other warm-blooded animals, and can enter water bodies from human and animal waste. Some fecal coliform bacteria may cause illness, and if a large number of fecal coliform bacteria (over 200 colonies/100 milliliters (ml) of water sample) are found in water, it is possible that pathogenic (disease- or illness-causing) organisms are also present in the water.

Flashiness – generally refers to high variability of stream flow. The ratio of the flow that is exceeded 90 percent of the time to the flow exceeded 10 percent of the time (90:10 ratio) is indicative of the flashiness or variability of stream flow. Excessive stream flashiness may be caused by human impacts such as impervious surfaces and loss of vegetative cover, resulting in hydrologic alterations that change the biotic communities able to live in and near the stream.

Floodplain – the area immediately adjacent to the stream or river channel that becomes inundated with overbank flows during large storm events.

Flood-pulse concept – identifies the predictable advance and retraction of water on the floodplain of a pristine system as the principal agent in enhancing biological productivity and maintaining diversity in the system.

Flow (streamflow) – water flowing in the stream channel. It is often used interchangeably with discharge.

Food web – the complex system of transfer of energy among living things; in other words, what eats what.

Fragmentation – the breaking up of once contiguous habitats or populations that may result in decreasing patch or population size and increasing isolation.

Geomorphic – of or resembling the earth, its shape, or surface configuration. See also geomorphology.

Geomorphology – the study of present-day landforms, including their classification, description, nature, origin, development, and relationships to underlying structures. Also the history of geologic changes as recorded by these surface features. The term is sometimes restricted to features produced only by erosion and deposition.

Gradient – the slope of a stream channel. Also pertains to the ecological concept of change across space or time; for example, an urban gradient refers to differences observed from undeveloped to heavily developed areas.

Groundwater – generally all subsurface water as distinct from surface water; specifically, that part of the subsurface water in the saturated zone (a zone in which all voids are filled with water) where the water is under pressure greater than atmospheric.

Habitat – an area with the combination of the necessary resources (e.g., food, cover, water) and environmental conditions (temperature, precipitation, presence or absence of predators and competitors) that promotes occupancy by individuals of a given species (or population), and allows those individuals to survive and reproduce.

Headwaters – the smallest streams that combine to form a larger stream; the uppermost reaches of a river or stream.

Herbivore – animals that eat primarily vegetation.

Hydrograph – a graph showing the water level (stage), discharge, or other property of a river volume with respect to time.

Hydrologic cycle – the continuous cycling of water from atmosphere to earth and oceans and back again.

Hyporheic zone – the saturated sediment underneath a stream or river channel and below the riparian area where groundwater and channel water mix. Properties of both groundwater and channel water are blended in the hyporheic zone, significantly changing the water's chemical composition and stimulating biological activity.

Imperviousness – the ability to repel water, or not let water infiltrate. Pertaining to impermeable surfaces, or materials preventing fluids from passing through.

Index of Biological Integrity (IBI) – an integrative expression of site condition across multiple metrics. An index of biological integrity is often composed of at least seven metrics. The plural form is either indices or indexes.

Infiltration capacity – the maximum rate at which water can enter the soil at a particular point under a given set of conditions.

Insectivore – a species whose primary food is insects.

Intermittent streams – streams that flow only during certain times of the year, but usually more than 30 days per year.

Invertebrates – see macroinvertebrates.

Keystone species – species whose effect on community structure is out of proportion to its abundance.

Large woody debris (LWD) – any large piece of woody material that intrudes into a stream channel or is present in terrestrial habitats. Also known as Large Wood, Large Organic Debris.

Limnetic zone – deep open water dominated by phytoplankton and freshwater fish, extending to the limits of light penetration. Profundal zone below limnetic zone, devoid of plant life and dominated by detritivores. Benthic zone includes bottom soil and sediments.

Littoral zone – at edge of lakes is the most productive with diverse aquatic beds and emergent wetlands (part of Herbaceous Wetland habitat).

Low-gradient zone – portions of a stream that flow along a gradual or relatively flat slope.

Macroinvertebrates – animals without backbones that can be seen with the naked eye. Includes insects, crayfish, snails, mussels, clams, etc.

Meander – following a winding and turning course. A meandering stream is an alluvial stream characterized by a series of pronounced alternating bends.

Metapopulation – a collection of localized populations that are geographically distinct, yet are genetically interconnected through movement of individuals among populations. See also Rescue effect.

Microclimate – the climate of a small, specific area rather than an entire area. More specifically, the photosynthetically active radiation, air or water temperature, and vapor pressure deficit present at a specific site. Chen et al. (1999) describe microclimate as the suite of climatic conditions measured in localized areas near the earth's surface.

Mid-section zone – the portion of a stream between the headwaters and low-gradient zone, which tends to have a band of riparian vegetation that is influenced by channel dynamics (e.g., meandering, flooding).

Mitigation – measures used to reduce the adverse effects of a proposed project by considering, in the following order: a) avoiding the impact altogether by not taking a certain action or parts of an action; b) minimizing impacts by limiting the degree or magnitude of the action and its implementation; c) rectifying the impact by repairing, rehabilitating or restoring the affected environment; d) reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action by monitoring and taking appropriate measures; and e) compensating for the impact by replacing or providing comparable substitute water quality resource areas.

Nutrient cycling – all the processes by which nutrients are transferred from one organism to another. For instance, the carbon cycle includes uptake of carbon dioxide by plants, ingestion by animals, and respiration and decay of the animal.

Organochlorine pesticide – A class of organic pesticides containing a high percentage of chlorine. Includes dichlorodiphenylethanes (such as DDT), chlorinated cyclodienes (such as chlordane), and chlorinated benzenes (such as lindane). Most organochlorine insecticides were banned or severely restricted in usage because of their carcinogenicity, tendency to bioaccumulate, and toxicity to wildlife.

Organochlorine compound – synthetic organic compounds containing chlorine. As generally used, term refers to compounds containing mostly or exclusively carbon, hydrogen, and chlorine. Examples include organochlorine insecticides, polychlorinated biphenyls (PCBs) and some solvents containing chlorine.

Overflow channel - An abandoned channel in a floodplain that may carry water during periods of high stream or river flows.

Overland flow – precipitation runoff that occurs when the precipitation rate exceeds the infiltration rate of the ground's surface; water flowing over the surface of the earth.

Oxbow – a meander severed from the main channel; an abandoned stream meander.

Oxbow lake – a body of water created after clay, other material, or channel dynamics plugs the oxbow from the main channel.

Passive restoration – allows natural processes to return through reducing or halting activities that cause degradation or prevent recovery.

Perennial stream – a watercourse that flows throughout the year or most of the year (90 percent), in a well-defined channel. Also known as a live stream. Flows continuously during both wet and dry times; baseflow is dependably generated from the movement of groundwater into the channel.

pH – the negative log of the hydrogen ion concentration (-log10 [H+]); a measure of the acidity or alkalinity of a solution, numerically equal to 7 for neutral solutions, increasing with increasing alkalinity and decreasing with increasing acidity. The scale is 0-14. Aquatic organisms tend to be restricted in the pH range in which they can survive.

Phytoplankton – free-floating microscopic aquatic organisms capable of photosynthesis.

Pool – an area of relatively deep slow water in a stream that offers shelter to fish.

Precipitation – any form of water, such as rain, snow, sleet, or hail, that falls to the earth’s surface.

Profundal zone – is the deepest part of the ocean or lake where light does not penetrate. This layer usually has fewer nutrients, more silt, and

fewer organisms than the surface.

Reference condition – conditions that represent the optimal or best attainable conditions for habitats or ecosystems.

Rehabilitation – improvements to a natural resource that return it to a good condition but not the condition prior to disturbance.

Rescue effect – see also Metapopulation. A subpopulation on one habitat patch could go temporarily extinct, but as long as the patch is connected to a populated patch it could be recolonized. This effect is crucial in the maintenance of small populations with limited habitat area.

Respiration – the physical and chemical processes by which an organism supplies its cells and tissues with the oxygen needed for metabolism and relieves them of the carbon dioxide formed in energy-producing reactions; any of various energy-yielding oxidative reactions in living matter.

Riffle – area of a stream or river characterized by a rocky streambed and turbulent, fast-moving, shallow water.

Riparian area – the land and vegetation adjacent to waterbodies such as streams, rivers, wetlands and lakes that are influenced by perennial or intermittent water and hydric soils (soils formed under periodic saturation or flooding). Riparian areas are dynamic biological and physical systems that act as the interface between terrestrial (land) and aquatic (water) ecosystems.

Riparian corridor – includes the stream or river; riparian vegetation; off-channel habitat such as wetlands and side channels, and the floodplain; the hyporheic zone; and the zone of influence.

Riparian vegetation – the plant communities occurring within the riparian area that are adapted to wet conditions and are distinct from upland communities.

River Continuum Concept – the best known longitudinal model for rivers, the River Continuum Concept (RCC) attempts to generalize and explain observed longitudinal changes in stream ecosystems. It proposes that rivers exhibit continuous longitudinal changes and identifies the relationships between the progressive changes in stream structure, such as channel size and stream flow, and the distribution of species. According to the RCC, characteristics of particular reaches are associated not only with discrete factors such as water temperature, but with their positions along the length of the river. The model is especially useful at the basin and stream scale, because it accounts for observed longitudinal shifts in biotic communities.

Salinity – the concentration of salt in water, usually measured in parts per thousand (ppt).

Salmonids – fish that belong the Salmonidae family. This includes salmon and steelhead.

Saturated overland flow – runoff that occurs when the water table rises to the ground surface, usually during a large rainstorm, causing groundwater to break out of the saturated soil and to travel as overland flow.

Sediment – particles and/or clumps of particles of sand, clay, silt, and plant or animal matter carried in water.

Sediment load – mass of sediment passing through a stream cross section in a specified period of time, expressed in millions of tons (mt). Amount of sediment carried by running water. The sediment that is being moved by a stream.

Sedimentation – occurs when eroded soil is deposited by runoff into rivers, harbors and lakes, degrading water quality.

Smoltification – the physiological changes anadromous salmonids undergo in freshwater while migrating toward saltwater that allow them to live in the ocean.

Sinuosity – the amount of curvature in the channel and is computed by dividing the channel centerline length by the length of the valley centerline.

Species at risk – see At risk species.

Species guild – a group of organisms with similar functional characteristics, such as trophic or migratory levels.

Species of concern – species which the U.S. Fish and Wildlife Service is reviewing for consideration as candidates for listing under the Endangered Species Act.

Species richness – the number of species in a given area or habitat.

Stormflow (stormwater) – precipitation that reaches the channel by moving downslope as overland flow or as shallow subsurface flow.

Substrate – the material forming the underlying layer of streams, may be bedrock, gravel, boulders, sand, clay, etc.; materials such as rocks or logs found in streams that can provide habitat for aquatic organisms

Subsurface flow – precipitation runoff that occurs when the precipitation rate exceeds the infiltration rate of the ground's surface; water flowing under the shallow surface of the earth when there is a relatively impermeable layer underneath permeable topsoil.

Surface water – an open body of water, such as a stream or a lake.

Talus – a sloping heap of loose rock fragments lying at the foot of a cliff or steep slope.

Terrace – a berm or discontinuous segments of a berm, in a valley at some height above the floodplain, representing a former abandoned flood plain of the stream.

Terrestrial – living or growing on land.

Total impervious area (TIA) – the total amount of actual impervious surface on a site or within a drainage area, basin, or subbasin.

Total sediment load – includes bed sediment load, suspended sediment load, and wash load (that part of the suspended load that is finer than the bed material; limited by supply rather than hydraulics).

Transpiration – diffusion of water vapor from plant leaves to the atmosphere; transpired water originates from water taken in by roots.

Trophic – pertaining to feeding and nutrition. Formally, an organism's position in the food chain, determined by the number of energy-transfer steps to that level.

Turbidity – measure of extent to which light passing through water is reduced due to suspended materials. Cloudiness of water, measured by how deeply light can penetrate into the water from the surface. The cloudy appearance of water caused by the presence of suspended material.

Upland – land above water level and beyond ground that is saturated by water for any length of time; they are formed by the larger geologic processes over time. Uplands contain plants that grow in drier soils and may provide habitat for different kinds of animals than a riparian zone.

Urban gradient – an environmental gradient is a spatially varying aspect of the environment which is expected to be related to species composition; the urban gradient is a specific type of environmental gradient representing a gradient of urbanization conditions.

Velocity – speed.

Wastewater – water that carries wastes from homes, businesses, and industries.

Watershed – all the land and tributaries draining to a body of water; a drainage basin which contributes water, organic materials, nutrients, and sediments to a river, stream or lake.

Watershed assessment – is a process for evaluating how well a watershed is functioning; it includes steps for identifying issues, examining the history of the watershed, describing its features, and evaluating various resources within the watershed.

Wetlands – wetlands may occur adjacent to stream channels and within the floodplain of the riparian corridor. They are defined as ecosystems that depend on frequent and recurrent shallow inundation or saturation at, or near, the soil surface. Swamps, marshes, bogs and similar areas are generally considered wetlands. Plant communities of wetland habitats are dominated by species adapted to survive and grow under extended periods of anaerobic (absence of oxygen) soil conditions.

Zone of influence – refers to the transition area between the riparian area and the upland forest where vegetation is not directly influenced by hydrologic conditions, but where vegetation still influences the stream by providing shade, microclimate, fine or large woody materials, nutrients, organic and inorganic debris, terrestrial insects, and habitat for riparian associated wildlife.

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† = derived directly from empirical evidence (primary literature)
‡ = urban study, includes urban study sites or conveys urban-specific information

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APPENDICES

APPENDIX 1

Metro Region Species List:

Purpose and Limitations

The purpose of Metro's Species List is threefold:

1. To identify fish and wildlife species occurring in the Metro region.
2. To identify the relative importance of various types of habitat to fish and wildlife species.
3. To provide a biologically meaningful way in which to describe the biodiversity of the Metro region.

THE LIST IS NOT A STATEMENT OF POLICY. In keeping with Metro's Streamside Vision Statement, the focus of the list is on native fish and wildlife species whose historic ranges include the metropolitan area and whose habitats are or can be provided for in urban habitats. Urban habitats may never be conducive to significant populations of some species, such as black bear and cougar. Further analysis and Metro Council deliberation will help determine (to the extent possible) the type, amount, and location of fish and wildlife habitats that should be protected and/or restored. For example, landowner incentives will be developed for conservation purposes.

This list contains:

1. All known native vertebrate species that currently exist within the Metro region (the final version will include a map of area involved) for at least a portion of the year and could be found in the region through diligent search by a knowledgeable person. Vagrant species (those that do not typically occur every year) are not included on this list.
2. Extirpated (locally extinct) native vertebrate species known to have inhabited the region in the past.
3. Nonnative vertebrate species with established breeding populations in the region.

The species list is based on the opinion of more than two dozen local wildlife experts. The Oregon Natural Heritage Program (ORNHP), Endangered Species Act (ESA), and Oregon Department of Fish and Wildlife (ODFW) status categories were obtained from ORNHP's February, 2001 *Rare, Threatened and Endangered Plants and Animals of Oregon* publication. Habitat associations were obtained from Johnson and O'Neil's new book, *Wildlife Habitats and Relationships in Oregon and Washington*. The taxonomic standards for common and scientific names for birds is based on the American Ornithological Union Check-list. We are also developing a separate aquatic and terrestrial invertebrate list, but this will not be as comprehensive in scope as the vertebrate species list.

For questions or comments regarding this list, please contact Lori Hennings at Metro (503/797-1726).

Metro Region Species List:
Key to Notations

* Indicates species that are non-native (also known as alien or introduced) to Metro region.

( ) Parentheses indicate a species that was historically present but was extirpated from the Metro region within approximately the last century.

1 **Code** (type of animal)
A = Amphibians
B = Birds
F = Fish
M = Mammals
R = Reptiles

2 **Migratory Status** (indicates trend for the majority of a given species in the Metro region):
A = Anadromous (fish; lives in the ocean, spawns in fresh water)
C = Catadromous (fish; lives in fresh water, spawns in the ocean)
M = Migrates through area without stopping for long time periods
N = Neotropical migratory species (birds; majority of individuals breeding in the Metro region migrate south of U.S./Mexico border for winter)
R = Permanent resident (lives in the area year-round)
S = Short-distance migrant (from elevational to regional migration, e.g., across several states)
W = Winters in the Metro region

3 **Federal Status** is based on current Endangered Species Act listings. **E** = Endangered, **T** = Threatened. Endangered taxa are those which are in danger of becoming extinct within the foreseeable future throughout all or a significant portion of their range. Threatened taxa are those likely to become endangered within the foreseeable future.
LE = Listed Endangered. Taxa listed by the U.S. Fish and Wildlife Service (USFWS) or the National Marine Fisheries Service (NMFS) as Endangered under the Endangered Species Act (ESA), or by the Departments of Agriculture (ODA) and Fish and Wildlife (ODFW) of the state of Oregon under the Endangered Species Act of 1987 (OESA).
LT = Listed Threatened. Taxa listed by the USFWS, NMFS, ODA, or ODFW as Threatened.
PE = Proposed Endangered. Taxa proposed by the USFWS or NMFS to be listed as Endangered under the ESA or by ODFW or ODA under the OESA.
PT = Proposed Threatened. Taxa proposed by the USFWS or NMFS to be listed as Threatened under the ESA or by ODFW or ODA under the OESA.

C = Candidate taxa for which NMFS or USFWS have sufficient information to support a proposal to list under the ESA, or which is a candidate for listing by the ODA under the OESA.
SoC = Species of Concern. Former C2 candidates which need additional information in order to propose as Threatened or Endangered under the ESA. These are species which USFWS is reviewing for consideration as Candidates for listing under the ESA.

4 **ODFW Status** (state status) is based on current Oregon Department of Fish and Wildlife "Oregon Sensitive Species List," 2001. See Federal Status (above) for definitions of LT and LE.
SC (Critical) = Species for which listing as threatened or endangered is pending; or those for which listing as threatened or endangered may be appropriate if immediate conservation actions are not taken. Also considered critical are some peripheral species which are at risk throughout their range, and some disjunct populations.
SV (Vulnerable) = Species for which listing as threatened or endangered is not believed to be imminent and can be avoided through continued or expanded use of adequate protective measures and monitoring. In some cases the population is sustainable, and protective measures are being implemented; in others, the population may be declining and improved protective measures are needed to maintain sustainable populations over time.
SP (Peripheral or Naturally Rare) = Peripheral species refer to those whose Oregon populations are on the edge of their range. Naturally rare species are those which had low population numbers historically in Oregon because of naturally limiting factors. Maintaining the status quo for the habitats and populations of these species is a minimum requirement. Disjunct populations of several species which occur in Oregon should not be confused with peripheral.
SU (Undetermined Status): Animals in this category are species for which status is unclear. They may be susceptible to population decline of sufficient magnitude that they could qualify for endangered, threatened, critical or vulnerable status, but scientific study will be required before a judgement can be made.

5 **ORNHP Rank (ABI – Natural Heritage Network Ranks)**: ORNHP participates in an international system for ranking rare, threatened and endangered species throughout the world. The system was developed by The Nature Conservancy and is maintained by The Association for Biodiversity Information (ABI) in cooperation with Heritage Programs or Conservation Data Centers (CDCs) in all 50 states, in 4 Canadian provinces, and in 13 Latin American countries. The ranking is a 1-5 scale, primarily based on the number of known occurrences, but also including threats, sensitivity, area occupied, and other biological factors. On Metro's Species List the first ranking (**rank**/rank) is the Global Rank and begins with a "G". If the taxon has a trinomial (a subspecies, variety or recognized race), this is followed by a "T" rank indicator. A "Q" at the end of this ranking indicates the taxon has taxonomic questions. The second ranking (rank/**rank**) is the State Rank and begins with the letter "S". The ranks are summarized below.

1 = Critically imperiled because of extreme rarity or because it is somehow especially vulnerable to extinction or extirpation, typically with 5 or fewer occurrences.
2 = Imperiled because of rarity or because other factors demonstrably make it very vulnerable to extinction (extirpation), typically with 6-20 occurrences.
3 = Rare, uncommon or threatened, but not immediately imperiled, typically with 21-100 occurrences.
4 = Not rare and apparently secure, but with cause for long-term concern, usually more than 100 occurrences.
5 = Demonstrably widespread, abundant, and secure.
H = Historical Occurrence, formerly part of the native biota with the implied expectation that it may be rediscovered.
X = Presumed extirpated or extinct.
U = Unknown rank.
? = Not yet ranked, or assigned rank is uncertain.

6 **ORNHP List** is based on Oregon Natural Heritage Program data.
List 1 contains taxa that are threatened with extinction or presumed to be extinct throughout their entire range.
List 2 contains taxa that are threatened with extirpation or presumed to be extirpated from the state of Oregon. These are often peripheral or disjunct species which are of concern when considering species diversity within Oregon's borders. They can be very significant when protecting the genetic diversity of a taxon. ORNHP regards extreme rarity as a significant threat and has included species which are very rare in Oregon on this list.
List 3 contains species for which more information is needed before status can be determined, but which may be threatened or endangered in Oregon or throughout their range.
List 4 contains taxa which are of conservation concern but are not currently threatened or endangered. This includes taxa which are very rare but are currently secure, as well as taxa which are declining in numbers or habitat but are still too common to be proposed as threatened or endangered. While these taxa currently may not need the same active management attention as threatened or endangered taxa, they do require continued monitoring.

7 **Riparian Association** indicates use of any of the 4 water-based habitats. Single "X" in any habitat type (upland or water-associated) indicates general association; "XX" indicates close association, as per Johnson and O'Neil 2001.

8 **Habitat Types** based on Johnson and O'Neil (2001). These habitats are described more fully within the text of the upland and riparian chapters.
WLCH = Westside Lowlands Conifer-Hardwood Forest
WODF = Westside Oak and Dry Douglas-fir Forest and Woodlands
WEGR = Westside Grasslands
AGPA = Agriculture, Pasture and Mixed Environs

URBN = Urban and Mixed Environs
WATR = Open Water - Lakes, Rivers, Streams
HWET = Herbaceous Wetlands
RWET = Westside Riparian-Wetlands

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Appendix 1. Species list and habitat associations for species normally occurring within the Metro region. Study area is the Metro jurisdictional boundary plus 1 mile buffer, plus UGB study areas.

			Migratory	Federal	ODFW	ORNHP	ORNHP	Riparian	Habitat Type[8]								
Code[1]	Common Name	Genus/Species	Status[2]	Status[3]	Status[4]	Rank[5]	List[6]	Assn.[7]	WATR	HWET	RWET	WLCH	WODF	WEGR	AGPA	URBN
F	River Lamprey	*Lampetra ayresi*	A	SoC	None	G4/S4	4	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F	Western Brook Lamprey	*Lampetra richardsoni*	A	None	None	None	None	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F	Pacific Lamprey	*Lampetra tridentata*	A	SoC	SV	G5/S3	2	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F	White Sturgeon	*Acipenser transmontanus*	A	None	None	None	None	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F*	American Shad*	*Alosa sapidissima*	A	N/A - alien	N/A - alien	N/A - alien	N/A - alien	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F	Chiselmouth	*Acrocheilus alutaceus*	R	None	None	None	None	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F*	Goldfish*	*Carassius auratus*	R	N/A - alien	N/A - alien	N/A - alien	N/A - alien	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F*	Common Carp*	*Cyprinus carpio*	R	N/A - alien	N/A - alien	N/A - alien	N/A - alien	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F	Peamouth Chub	*Mylocheilus caurinus*	R	None	None	None	None	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
(F)	(Oregon Chub - extirpated from Metro area)	*Oregonichthys crameri*	R	LE	SC	G2/S2	1	(XX)	(XX)	(XX)	N/A	N/A	N/A	N/A	N/A	N/A
F	Northern Pikeminnow (Squawfish)	*Ptychocheilus oregonensis*	R	None	None	None	None	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F	Longnose Dace	*Rhynichthys cataractae*	R	None	None	None	None	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F	Leopard Dace	*Rhynichthys falcatus*	R	None	None	None	None	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F	Speckled Dace	*Rhynichthys osculus*	R	None	None	None	None	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F	Redside Shiner	*Richardsonius balteatus*	R	None	None	None	None	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F	Largescale Sucker	*Catostomus macrocheilus*	R	None	None	None	None	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F*	Brown Bullhead*	*Ameiurus nebulosus*	R	N/A - alien	N/A - alien	N/A - alien	N/A - alien	XX	XX	XX	N/A	N/A	N/A	N/A	N/A	N/A
F	Eulachon (Columbia River Smelt)	*Thaleichthys pacificus*	A	None	None	None	None	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F	Coastal Cutthroat Trout, SW WA/Col. R. ESU	*Oncorhynchus clarki clarki*	A	PT	SC	G4T2Q/S2	2	XX	XX	X	N/A	N/A	N/A	N/A	N/A	N/A
F	Coastal Cutthroat Trout, Upper Will. R. ESU	*Oncorhynchus clarki clarki*	A	SoC	None	G4T?Q/S3?	4	XX	XX	X	N/A	N/A	N/A	N/A	N/A	N/A
F	Chum Salmon, Columbia River ESU	*Oncorhynchus keta*	A	LT	SC	G5T2Q/S2	1	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F	Coho Salmon, Oregon Coast ESU	*Oncorhynchus kisutch*	A	LT	SC	G4T2Q/S2	1	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F	Coho Salmon, Lower Columbia R./Southwest Washington ESU	*Oncorhynchus kisutch*	A	C	LE	G4T2Q/S2	1	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F	Rainbow Trout (resident populations)	*Oncorhynchus mykiss*	R	None	None	None	None	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F	Steelhead (anadromous Rainbow Trout), Oregon Coast ESU	*Oncorhynchus mykiss*	A	C	SV	G5T2T3Q/S2S3	1	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F	Steelhead, Lower Columbia River ESU	*Oncorhynchus mykiss*	A	LT	SC	G5T2Q/S2	1	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F	Steelhead, Upper Willamette River ESU, winter run	*Oncorhynchus mykiss*	A	LT	SC	G5T2Q/S2	1	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F	Steelhead, Middle Columbia River ESU	*Oncorhynchus mykiss*	A	LT	SC/SV	G5T2Q/S2	1	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F	Steelhead, Snake River Basin ESU	*Oncorhynchus mykiss*	A	LT	SV	G5T2T3Q/S2S3	1	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F	Steelhead, Upper Columbia River ESU	*Oncorhynchus mykiss*	A	LE	None	G5T2Q/SU	None	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F	Sockeye Salmon, Snake River ESU	*Oncorhynchus nerka*	A	LE	None	G5T1Q/SX	1 - ex	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F	Chinook Salmon, Lower Columbia R. ESU	*Oncorhynchus tshawytscha*	A	LT	SC	G5T2Q/S2	1	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F	Chinook Salmon, Upper Will. R spring run	*Oncorhynchus tshawytscha*	A	LT	None	G5T2Q/S2	1	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F	Chinook Salmon, Snake River Fall-run ESU	*Oncorhynchus tshawytscha*	A	LT	LT	G5T1Q/S1	1	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F	Chinook Salmon, Snake River Spr/Sum.run	*Oncorhynchus tshawytscha*	A	LT	LT	G5T1Q/S1	1	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F	Chinook Salmon, Upper Col. R. Spring-run	*Oncorhynchus tshawytscha*	A	LE	None	G5T1Q/SU	None	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F	Mountain Whitefish	*Prosopium williamsoni*	R	None	None	None	None	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F	Sand Roller	*Percopsis transmontanus*	R	None	None	None	None	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A

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			Migratory	Federal	ODFW	ORNHP	ORNHP	Riparian	Habitat Type[8]							
Code[1]	**Common Name**	**Genus/Species**	**Status[2]**	**Status[3]**	**Status[4]**	**Rank[5]**	**List[6]**	**Assn.[7]**	**WATR**	**HWET**	**RWET**	**WLCH**	**WODF**	**WEGR**	**AGPA**	**URBN**
F*	Mosquitofish*	*Gambusia affinis*	R	N/A - alien	N/A - alien	N/A - alien	N/A - alien	XX	XX	XX	N/A	N/A	N/A	N/A	N/A	N/A
F	Three-spined Stickleback	*Gasterosteus aculeatus*	R	None	None	None	None	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F	Prickly Sculpin	*Cottus asper*	R	None	None	None	None	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F	Reticulate Sculpin	*Cottus perplexus*	R	None	None	None	None	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F*	Green Sunfish*	*Lepomis cyanellus*	R	N/A - alien	N/A - alien	N/A - alien	N/A - alien	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F*	Pumpkinseed Sunfish*	*Lepomis gibbosus*	R	N/A - alien	N/A - alien	N/A - alien	N/A - alien	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F*	Warmouth*	*Lepomis gulosus*	R	N/A - alien	N/A - alien	N/A - alien	N/A - alien	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F*	Bluegill*	*Lepomis macrochirus*	R	N/A - alien	N/A - alien	N/A - alien	N/A - alien	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F*	Smallmouth Bass*	*Micropterus dolomieu*	R	N/A - alien	N/A - alien	N/A - alien	N/A - alien	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F*	Largemouth Bass*	*Micropterus salmoides*	R	N/A - alien	N/A - alien	N/A - alien	N/A - alien	XX	XX	X	N/A	N/A	N/A	N/A	N/A	N/A
F*	White Crappie*	*Pomoxis annularis*	R	N/A - alien	N/A - alien	N/A - alien	N/A - alien	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F*	Black Crappie*	*Pomoxis nigromaculatus*	R	N/A - alien	N/A - alien	N/A - alien	N/A - alien	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F*	Yellow Perch*	*Perca flavescens*	R	N/A - alien	N/A - alien	N/A - alien	N/A - alien	XX	XX	X	N/A	N/A	N/A	N/A	N/A	N/A
F*	Walleye*	*Stizostedion vitreum vitreum*	R	N/A - alien	N/A - alien	N/A - alien	N/A - alien	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F	Starry Flounder	*Platichthys stellatus*	R	None	None	None	None	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
A	Northwestern Salamander	*Ambystoma gracile*	R	None	None	None	None	XX	XX	XX	XX	X	X	X	X	X
A	Long-toed Salamander	*Ambystoma macrodactylum*	R	None	None	None	None	XX	XX	XX	XX	X	X	X	X	X
A	Pacific Giant Salamander	*Dicamptodon tenebrosus*	R	None	None	None	None	XX			XX	X	X	X		X
A	Cope's Giant Salamander	*Dicamptodon copei*	R	None	SU	G3/S2	2	XX	X		XX	X				
A	Columbia Torrent Salamander	*Rhyacotriton kezeri*	R	None	SC	G3/S3	2	XX			XX	X				
A	Cascade Torrent Salamander	*Rhyacotriton cascadae*	R	None	SV	G3/S3	2	XX			XX	X				
A	Rough-skinned Newt	*Taricha granulosa*	R	None	None	None	None	XX	XX	XX	XX	X	X	X	X	X
A	Dunn's Salamander	*Plethodon dunni*	R	None	None	None	None	X			X	X	X			X
A	Western Red-backed Salamander	*Plethodon vehiculum*	R	None	None	None	None	X			X	X	X			X
A	Ensatina	*Ensatina eschscholtzii*	R	None	None	None	None	X			X	XX	X	X	X	X
A	Clouded Salamander	*Aneides ferreus*	R	None	SU	G3/S3	3					X	X		X	X
A	Oregon Slender Salamander	*Batrachoseps wrighti*	R	SoC	SU	G4/S3	1	X			X	X				
A	Western Toad	*Bufo boreas*	R	None	SV	G4/S4	4	XX	XX	XX	XX	X	X	X	X	X
A	Tailed Frog	*Ascaphus truei*	R	SoC	SV	G4/S3	2	XX			XX	X				
A	Pacific Chorus Frog (tree frog)	*Hyla regilla*	R	None	None	None	None	XX	XX	XX	XX	X	X	X	X	X
A	Northern Red-legged Frog	*Rana aurora aurora*	R	SoC	SV/SU	G4T4/S3	2	XX	XX	XX	XX	XX	X	X	X	X
(A)	(Oregon Spotted Frog - extirpated)	*Rana pretiosa*	R	C	SC	G2G3/S2	1	(XX)	(XX)	(XX)	(XX)	(X)	(X)	(X)	(X)	
A*	Bullfrog*	*Rana catesbeiana*	R	N/A - alien	N/A - alien	N/A - alien	N/A - alien	XX	XX	XX	XX	X	X	X	X	X
R*	Common Snapping Turtle*	*Chelydra serpentina*	R	N/A - alien	N/A - alien	N/A - alien	N/A - alien	XX	XX	XX	X				X	X
R	Painted Turtle	*Chrysemys picta*	R	None	SC	G5/S2	2	XX	XX	XX	X		X		X	X
R	Northwestern Pond Turtle	*Clemmys marmorata marmorata*	R	SoC	SC	G3T3/S2	1	XX	XX	XX	XX	X	XX	X	X	X
R*	Red-eared Slider*	*Trachemys scripta elegans*	R	N/A - alien	N/A - alien	N/A - alien	N/A - alien	XX	XX	XX	X				X	X
R	Northern Alligator Lizard	*Elgaria coerulea*	R	None	None	None	None	X			X	X	X	X		X

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			Migratory	Federal	ODFW	ORNHP	ORNHP	Riparian	Habitat Type[8]								
Code[1]	**Common Name**	**Genus/Species**	**Status[2]**	**Status[3]**	**Status[4]**	**Rank[5]**	**List[6]**	**Assn.[7]**	**WATR**	**HWET**	**RWET**	**WLCH**	**WODF**	**WEGR**	**AGPA**	**URBN**
R	Southern Alligator Lizard	*Elgaria multicarinata*	R	None	None	None	None	X			X	X	X	X	X	X
R	Western Fence Lizard	*Sceloporus occidentalis*	R	None	None	None	None					X	X	X	X	X
R	Western Skink	*Eumeces skiltonianus*	R	None	None	None	None					X	X	X	X	X
R	Rubber Boa	*Charina bottae*	R	None	None	None	None	X			X	X		X	X	X
R	Racer	*Coluber constrictor*	R	None	None	None	None						X	X	X	X
R	Sharptail Snake	*Contia tenuis*	R	None	SV	G5/S3	4	X			X	X	X	X	X	X
R	Ringneck Snake	*Diadophis punctatus*	R	None	None	None	None	X			X	X	X	X	X	X
R	Gopher Snake	*Pituophis catenifer*	R	None	None	None	None						X	X	X	X
R	Western Terrestrial Garter Snake	*Thamnophis elegans*	R	None	None	None	None	X		X	X		X	X	X	X
R	Northwestern Garter Snake	*Thamnophis ordinoides*	R	None	None	None	None	X			X	X	X	X	X	X
R	Common Garter Snake	*Thamnophis sirtalis*	R	None	None	None	None	XX		XX	XX	X	X	X	X	X
B	Red-throated Loon	*Gavia stellata*	W / M	None	None	None	None	XX			XX					
B	Pacific Loon	*Gavia pacifica*	W / M	None	None	None	None	XX			XX					
B	Common Loon	*Gavia immer*	W / M	None	None	None	None	XX	X	XX						
B	Pied-billed Grebe	*Podilymbus podiceps*	S / N	None	None	None	None	XX	X	XX	X					
B	Horned Grebe	*Podiceps auritus*	W / M	None	SP	G5/S2B, S5N	2	XX	XX	XX						
B	Eared Grebe	*Podiceps nigricollis*	W	None	None	None	None	XX	XX	XX						
B	Western Grebe	*Aechmophorus occidentalis*	W	None	None	None	None	XX	XX	XX						
B	Clark's Grebe	*Aechmophorus clarkii*	W / M	None	None	None	None	XX	XX	XX						
B	Doubled-crested Cormorant	*Phalacrocorax auritus*	R / S	None	None	None	None	XX	XX	X	X					X
B	American Bittern	*Botaurus lentiginosus*	S / N	None	None	None	None	XX		XX					X	
B	Great Blue Heron	*Ardea herodias*	R	None	None	None	None	XX	XX	XX	XX	X	X	X	XX	X
B	Great Egret	*Ardea alba*	W / M	None	None	None	None	XX	XX	XX	XX	X	X	X	X	X
B	Green Heron	*Butorides virescens*	N / S	None	None	None	None	XX	X	XX	XX					
B	Black-crowned Night Heron	*Nycticorax nycticorax*	S	None	None	None	None	XX	XX	XX	X					
(B)	(California Condor - extirpated)	*(Gymnogyps californianus)*	R	LE	None	G1SX	1-ex	(X)			(X)			(X)		
B	Turkey Vulture	*Cathartes aura*	N	None	None	None	None	X		X	X	X	X	X	X	X
B	Greater White-fronted Goose	*Anser albifrons*	W / M	None	None	None	None	XX	XX	XX					XX	
B	Snow Goose	*Chen caerulescens*	W / M	None	None	None	None	XX	XX	XX					XX	
B	Ross's Goose	*Chen rossii*	W / M	None	None	None	None	XX	XX	XX					XX	
B	Canada Goose	*Branta canadensis*	VARIABLE	None	None	None	None	XX	XX	XX	X				XX	
B	Dusky Canada Goose	*Branta canadensis occidentalis*	W / M	None	None	G5T2T3/ S2N	4	XX	XX	XX	X				XX	
B	Aleutian Canada Goose (wintering)	*Branta canadensis leucopareia*	W / M	LT	LE	G5T3/S2N	1	XX	XX	XX	X				XX	
B	Trumpeter Swan	*Cygnus buccinator*	W / M	None	None	None	None	XX	XX	XX					XX	
B	Tundra Swan	*Cygnus columbianus*	W / M	None	None	None	None	XX	XX	XX					XX	
B	Wood Duck	*Aix sponsa*	S	None	None	None	None	XX	XX	X	XX	X			X	

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Code[1]	**Common Name**	**Genus/Species**	**Status[2]**	**Status[3]**	**Status[4]**	**Rank[5]**	**List[6]**	**Assn.[7]**	**WATR**	**HWET**	**RWET**	**WLCH**	**WODF**	**WEGR**	**AGPA**	**URBN**
B	Gadwall	*Anas strepera*	W / M	None	None	None	None	XX	XX	XX				X	X	
B	Mallard	*Anas platyrhynchos*	R	None	None	None	None	XX	X	XX	XX				X	X
B	Eurasian Wigeon	*Anas penelope*	W / M	None	None	None	None	XX	XX	X					X	
B	American Wigeon	*Anas americana*	W / M	None	None	None	None	XX	X	XX	X				XX	
B	Blue-winged Teal	*Anas discors*	W / M	None	None	None	None	XX	X	XX				X	XX	
B	Cinnamon Teal	*Anas cyanoptera*	N	None	None	None	None	XX	X	XX				X	XX	
B	Northern Shoveler	*Anas clypeata*	W / M	None	None	None	None	XX	XX	XX				X	X	
B	Northern Pintail	*Anas acuta*	W / M	None	None	None	None	XX	XX	XX					X	
B	Green-winged Teal	*Anas crecca*	S	None	None	None	None	XX	X	XX	X			X	X	
B	Canvasback	*Aythya valisineria*	W / M	None	None	None	None	XX	XX	XX						
B	Redhead	*Aythya americana*	W / M	None	None	None	None	XX	XX	XX						
B	Ring-necked Duck	*Aythya collaris*	W / M	None	None	None	None	XX	X	X	XX					
B	Greater Scaup	*Aythya marila*	W / M	None	None	None	None	XX	XX							
B	Lesser Scaup	*Aythya affinis*	W / M	None	None	None	None	XX	XX	XX						
B	Surf Scoter	*Melanitta perspicillata*	W / M	None	None	None	None	X	X							
B	Harlequin Duck	*Histrionicus histrionicus*	W / M	SoC	SU	G4/S2B, S3N	2	XX	XX		XX					
B	Bufflehead	*Bucephala albeola*	W / M	None	SU	G5/S2B,S5N	4	XX	XX	XX	X					
B	Common Goldeneye	*Bucephala clangula*	M	None	None	None	None	XX	XX	X						
B	Barrow's Goldeneye	*Bucephala islandica*	W / M	None	SU	G5/S3B,S3N	4	XX	XX	X						
B	Hooded Merganser	*Lophodytes cucullatus*	W / M	None	None	None	None	XX	XX	X	XX	XX				
B	Common Merganser	*Mergus merganser*	W / M	None	None	None	None	XX	XX		XX	XX				
B	Red-breasted Merganser	*Mergus serrator*	W / M	None	None	None	None	X	X							
B	Ruddy Duck	*Oxyura jamaicensis*	W / M	None	None	None	None	XX	XX	XX						
B	Osprey	*Pandion haliaetus*	N	None	None	None	None	XX	XX		X	X	X		X	X
B	White-tailed Kite (appears to be undergoing range expansion)	*Elanus leucurus*	W / M	None	None	G5/S1B, S3N	2	X			X	X		X	XX	
B	Bald Eagle[a]	*Haliaeetus leucocephalus*	S	LT[a]	LT	G4/S3B, S4N	2	XX	XX	X	X	X	X	X	X	X
B	Northern Harrier	*Circus cyaneus*	N	None	None	None	None	X		X	X			X	X	X
B	Sharp-shinned Hawk	*Accipiter striatus*	N	None	None	None	None	X		X		X	X	X	X	X
B	Cooper's Hawk	*Accipiter cooperii*	S	None	None	None	None	X		X	X	X	X	X	X	X
B	Northern Goshawk	*Accipiter gentilis*	W / M	SoC	SC	G5/S3	2	X		X	X	X	X			
B	Red-shouldered Hawk (appears to be undergoing range expansion)	*Buteo lineatus*	?	None	None	None	None	X			X	X			X	
B	Red-tailed Hawk	*Buteo jamaicensis*	S / N	None	None	None	None	X		X	X	X	X	X	XX	X
B	Rough-legged Hawk	*Buteo lagopus*	W / M	None	None	None	None	X		X	X	X	X	X	X	X
B	American Kestrel	*Falco sparverius*	S	None	None	None	None	X		X	X	X	X	X	X	X
B	Merlin	*Falco columbarius*	W / M	None	None	G5/S1B	2	X	X	X	X	X	X	X	X	X

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B	American Peregrine Falcon	*Falco peregrinus anatum*	N	None	LE	G4T3/S1B	2	X	X	X	X	X	X	X	X	X
B*	Ring-necked Pheasant*	*Phasianus colchicus*	R	N/A - alien	N/A - alien	N/A - alien	N/A - alien	X		X	X	X	X	XX	XX	X
B	Ruffed Grouse	*Bonasa umbellus*	R	None	None	None	None	XX			XX	XX	X		X	
B	Blue Grouse	*Dendragapus obscurus*	R	None	None	None	None	X			X	XX	X			
B*	Wild Turkey*	*Meleagris gallopavo*	R	N/A - alien	N/A - alien	N/A - alien	N/A - alien	X			X	X	X	X	X	X
(B)	(Mountain Quail - extirpated)	*Oreortyx pictus*	R / S	SoC	SU	G5/S4?	4	(X)			(X)	(X)	(X)		(X)	(X)
B	California Quail	*Callipepla californica*	R	None	None	None	None	X		X	X	X	X	X	X	X
B	Virginia Rail	*Rallus limicola*	R / S	None	None	None	None	XX		XX					X	
B	Sora	*Porzana carolina*	S / N	None	None	None	None	XX		XX					X	
B	American Coot	*Fulica americana*	R / S	None	None	None	None	XX	XX	XX					X	X
B	Lesser Sandhill Crane	*Grus canadensis*	W / M	None	None	None	None	XX		XX					XX	
B	Black-bellied Plover	*Pluvialis squatarola*	M	None	None	None	None	X	X						XX	
B	American Golden-plover	*Pluvialis dominica*	W / M	None	None	None	None	X	X						XX	
B	Semipalmated Plover	*Charadrius semipalmatus*	M	None	None	None	None	XX	XX						X	
B	Killdeer	*Charadrius vociferus*	S / N	None	None	None	None	X		X	X	X	X	X	XX	X
B	Greater Yellowlegs	*Tringa melanoleuca*	W / M	None	None	None	None	XX	XX	XX	X			X	X	
B	Lesser Yellowlegs	*Tringa flavipes*	W / M	None	None	None	None	XX	XX	XX	X			X	X	
B	Solitary Sandpiper	*Tringa solitaria*	W / M	None	None	None	None	XX	XX	XX	XX			X	X	
B	Spotted Sandpiper	*Actitis macularia*	N	None	None	None	None	XX	X	X	XX				X	
B	Semipalmated Sandpiper	*Calidris pusilla*	W / M	None	None	None	None	XX	XX							
B	Western Sandpiper	*Calidris mauri*	W / M	None	None	None	None	XX	XX	XX					X	
B	Least Sandpiper	*Calidris minutilla*	W / M	None	None	None	None	XX	X	XX					X	
B	Baird's Sandpiper	*Calidris bairdii*	W / M	None	None	None	None	XX	X	XX					X	
B	Pectoral Sandpiper	*Calidris melanotos*	W / M	None	None	None	None	XX	X	XX					X	
B	Dunlin	*Calidris alpina*	W / M	None	None	None	None	XX	XX	XX					XX	
B	Short-billed Dowitcher	*Limnodromus griseus*	W / M	None	None	None	None	X		X					X	
B	Long-billed Dowitcher	*Limnodromus scolopaceus*	W / M	None	None	None	None	XX	X	XX					XX	
B	Common Snipe	*Gallinago gallinago*	S / N	None	None	None	None	XX		XX				X	XX	
B	Wilson's Phalarope	*Phalaropus tricolor*	W / M	None	None	None	None	XX	X	X						
B	Red-necked Phalarope	*Phalaropus lobatus*	W / M	None	None	None	None	X	X							
B	Bonaparte's Gull	*Larus philadelphia*	M / W	None	None	None	None	XX	X						X	X
B	Mew Gull	*Larus canus*	W / M	None	None	None	None	XX	XX						X	X
B	Ring-billed Gull	*Larus delawarensis*	W / M	None	None	None	None	XX	XX	X					X	X
B	California Gull	*Larus californicus*	S	None	None	None	None	XX	XX	X					X	X
B	Herring Gull	*Larus agentatus*	W / M	None	None	None	None	XX	XX	X					X	X
B	Thayer's Gull	*Larus thayeri*	W / M	None	None	None	None	XX	XX	X					X	X

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			Migratory	Federal	ODFW	ORNHP	ORNHP	Riparian	Habitat Type[8]							
Code[1]	**Common Name**	**Genus/Species**	**Status[2]**	**Status[3]**	**Status[4]**	**Rank[5]**	**List[6]**	**Assn.[7]**	**WATR**	**HWET**	**RWET**	**WLCH**	**WODF**	**WEGR**	**AGPA**	**URBN**
B	Western Gull	*Larus occidentalis*	R / S	None	None	None	None	X	X							XX
B	Glaucous Gull	*Larus hyperboreus*	W / M	None	None	None	None	XX	XX	X						X
B	Glaucous-winged Gull	*Larus glaucescens*	W / M	None	None	None	None	XX	X							XX
B	Caspian Tern	*Sterna caspia*	N	None	None	None	None	XX	XX	XX						
B	Forster's Tern	*Sterna forsteri*	M	None	None	None	None	XX	XX	XX						
B	Common Tern	*Sterna hirundo*	W / M	None	None	None	None	X	X							
B*	Rock Dove*	*Columba livia*	R	N/A - alien	N/A - alien	N/A - alien	N/A - alien							X	XX	XX
B	Band-tailed Pigeon	*Columba fasciata*	S	SoC	None	G5/S4	4	XX			XX	XX	XX		X	X
B	Mourning Dove	*Zenaida macroura*	S	None	None	None	None	XX			XX	X	X	X	XX	X
B	Barn Owl	*Tyto alba*	R / S	None	None	None	None	X		X	X		X	X	XX	X
B	Western Screech-Owl	*Otus kennicottii*	R	None	None	None	None	X		X	X	X	X		X	X
B	Great Horned Owl	*Bubo virginianus*	R	None	None	None	None	X		X	X	X	X	X	X	X
B	Northern Pygmy-Owl	*Glaucidium gnoma*	R	None	SC	G5/S4?	4	X		X	X	XX	X		X	X
(B)	(Northern Spotted Owl - extirpated from Metro region)	*(Strix occidentalis caurina)*	(S)	LT	LT	G3T3S3	1					(XX)	(X)			
B	Barred Owl	*Strix varia*	R	None	None	None	None	X			X	XX	X			X
B	Long-eared Owl	*Asio otus*	W / M	None	None	None	None	X		X		X	X	X	X	
B	Short-eared Owl	*Asio flammeus*	W / M	None	None	None	None	XX		XX				X	XX	
B	Northern Saw-whet Owl	*Aegolius acadicus*	R / S	None	None	None	None	X			X	XX	XX		X	X
B	Common Nighthawk (nearly extirpated)	*Chordeiles minor*	N	None	SC	G5/S5	4	X	X	X	X	X	X	X	X	X
B	Vaux's Swift	*Chaetura vauxi*	N	None	None	None	None	XX	XX	X	X	X	X	X		X
B	Anna's Hummingbird	*Calypte anna*	R	None	None	None	None	X			X	XX	X			X
B	Rufous Hummingbird	*Selasphorus rufus*	N	None	None	None	None	X		X	X	X	X	X	X	X
B	Belted Kingfisher	*Ceryle alcyon*	S	None	None	None	None	XX	XX		XX					
B	Lewis's Woodpecker (extirpated as breeding species)	*Melanerpes lewis*	W / M	SoC	SC	G5/S3B, S3N	4	X			X		XX	X	X	X
B	Acorn Woodpecker	*Melanerpes formicivorus*	R	SoC	None	G5/S3?	4						XX	X		X
B	Red-breasted Sapsucker	*Sphyrapicus ruber*	S	None	None	None	None	X			X	X	X	X	X	X
B	Downy Woodpecker	*Picoides pubescens*	R	None	None	None	None	XX			XX	X	X		X	X
B	Hairy Woodpecker	*Picoides villosus*	R	None	None	None	None	X			X	X	X	X	X	X
B	Northern Flicker	*Colaptes auratus*	R	None	None	None	None	X			X	X	X	X	X	X
B	Pileated Woodpecker	*Dryocopus pileatus*	R	None	SV	G5/S4?	4	X			X	X	X		X	X
B*	Monk Parakeet*	*Myiopsitta monachus*	R	N/A - alien	N/A - alien	N/A - alien	N/A - alien	XX			XX		X		X	XX
(B)	(Yellow-billed Cuckoo; extirpated)	*Coccyzus americanus*	N	SoC	SC	G5/S1B	2	(XX)			(XX)					
B	Olive-sided Flycatcher	*Contopus cooperi (= borealis)*	N	SoC	SV	G5/S4	4	X			X	XX				
B	Western Wood-Pewee	*Contopus sordidulus*	N	None	None	None	None	X			X	X	X		X	X
B	Willow Flycatcher (western OR race)	*Empidonax traillii brewsteri*	N	None	SV	G5TU/S1B	4	XX			XX	X	X		X	X

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B	Hammond's Flycatcher	*Empidonax hammondii*	N	None	None	None	None					X	X			
B	Dusky Flycatcher	*Empidonax oberholseri*	M	None	None	None	None	X			X	X	X			
B	Pacific-slope Flycatcher	*Empidonax dificilus*	N	None	None	None	None	X			X	XX	X			
B	Say's Phoebe	*Sayornis saya*	N	None	None	None	None							X	X	X
B	Western Kingbird	*Tyrannus verticalis*	N	None	None	None	None						X	X	X	X
B	Northern Shrike	*Lanius excubitor*	W / M	None	None	None	None	X		X				X	XX	
B	Cassin's Vireo	*Vireo cassinii*	N	None	None	None	None					X	XX			X
B	Hutton's Vireo	*Vireo huttoni*	R / S	None	None	None	None	X			X	X	XX		X	X
B	Warbling Vireo	*Vireo gilvus*	N	None	None	None	None	XX			XX	XX	X		X	X
B	Red-eyed Vireo	*Vireo olivaceus*	N	None	None	None	None	XX			XX	X				
B	Steller's Jay	*Cyanocitta stelleri*	R	None	None	None	None	X			X	X	X		X	X
B	Western Scrub-Jay	*Aphelocoma californica*	R	None	None	None	None	X			X	X	XX	X	X	X
B	Gray Jay	*Perisoreus canadensis*	R	None	None	None	None	X			X	X	X			X
B	American Crow	*Corvus brachyrhynchos*	R	None	None	None	None	X		X	X	X	X	X	XX	XX
B	Common Raven	*Corvus corax*	R	None	None	None	None	X		X	X	X	X	X	X	X
B	Streaked Horned Lark	*Eremophila alpestris strigata*	S	SoC	SC	G5T2/S2?	2							XX	X	X
B	Purple Martin	*Progne subis*	N	SoC	SC	G5/S3B	2	XX	XX	X	X	X	X	X		X
B	Tree Swallow	*Tachycineta bicolor*	N	None	None	None	None	XX	XX	XX	XX	X	X	X	X	X
B	Violet-green Swallow	*Tachycineta thalassina*	N	None	None	None	None	X	X	X	X	X	X	X	X	X
B	Northern Rough-winged Swallow	*Stelgidopteryx serripennis*	N	None	None	None	None	XX	XX	XX	XX	X	X	X	X	X
B	Cliff Swallow	*Petrochelidon pyrrhonota*	N	None	None	None	None	XX	XX	X	XX	X	X	X	X	X
B	Barn Swallow	*Hirundo rustica*	N	None	None	None	None	XX	XX	XX	XX	X	X	X	XX	X
B	Black-capped Chickadee	*Poecile atricapilla*	R	None	None	None	None	X		X	X	X	X	X	X	X
B	Mountain Chickadee	*Poecile gambeli*	W / M	None	None	None	None	X			X	X	X			X
B	Chestnut-backed Chickadee	*Poecile rufescens*	R	None	None	None	None	X			X	X	X		X	X
B	Bushtit	*Psaltriparus minimus*	R	None	None	None	None	X			X	X	X		X	X
B	Red-breasted Nuthatch	*Sitta canadensis*	R	None	None	None	None	X			X	X	X		X	X
B	White-breasted Nuthatch	*Sitta carolinensis*	R	None	None	None	None	X			X		X	X	X	X
B	Brown Creeper	*Certhia americana*	R	None	None	None	None	X			X	X	X	X	X	X
B	Bewick's Wren	*Thryomanes bewickii*	R	None	None	None	None	X		X	X	X	X		X	X
B	House Wren	*Troglodytes aedon*	N	None	None	None	None	X			X	X	X	X	X	X
B	Winter Wren	*Troglodytes troglodytes*	R	None	None	None	None	X			X	X	X			X
B	Marsh Wren	*Cistothorus palustris*	N	None	None	None	None	XX		XX						
B	American Dipper	*Cinclus mexicanus*	R / S	None	None	None	None	XX	XX	X	XX					
B	Golden-crowned Kinglet	*Regulus satrapa*	R	None	None	None	None	X			X	XX	X			X
B	Ruby-crowned Kinglet	*Regulus calendula*	W / M	None	None	None	None	X		X	X	X	X	X	X	X
B	Western Bluebird	*Sialia mexicana*	S	None	SV	G5/S4B, S4N	4					XX	XX	X	X	X

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Code[1]	**Common Name**	**Genus/Species**	**Status[2]**	**Status[3]**	**Status[4]**	**Rank[5]**	**List[6]**	**Assn.[7]**	**WATR**	**HWET**	**RWET**	**WLCH**	**WODF**	**WEGR**	**AGPA**	**URBN**
B	Townsend's Solitaire	*Myadestes townsendi*	W / M	None	None	None	None	X			X	X	X		X	X
B	Swainson's Thrush	*Catharus ustulatus*	N	None	None	None	None	X			X	X	X		X	X
B	Hermit Thrush	*Catharus guttatus*	S	None	None	None	None	X			X	X	X		X	X
B	American Robin	*Turdus migratorius*	S	None	None	None	None	X		X	X	X	X	X	X	X
B	Varied Thrush	*Ixoreus naevius*	W / M	None	None	None	None					XX	X		X	X
B*	European Starling*	*Sturnus vulgaris*	R / S	N/A - alien	N/A - alien	N/A - alien	N/A - alien	XX		X	XX	X	X	X	X	XX
B	American Pipit	*Anthus rubescens*	W / M	None	None	None	None	X		X				X	XX	
B	Cedar Waxwing	*Bombycilla cedrorum*	S	None	None	None	None	X		X	X	X	X		X	X
B	Orange-crowned Warbler	*Vermivora celata*	N	None	None	None	None	X			X	X	X	X	X	X
B	Nashville Warbler	*Vermivora ruficapilla*	N	None	None	None	None	X			X	X	X		X	
B	Yellow Warbler	*Dendroica petechia*	N	None	None	None	None	XX			XX					
B	Yellow-rumped Warbler	*Dendroica coronata*	S	None	None	None	None	X		X	X	X	X		X	X
B	Black-throated Gray Warbler	*Dendroica nigrescens*	N	None	None	None	None	XX			XX	XX	XX		X	X
B	Townsend's Warbler	*Dendroica townsendi*	S / N	None	None	None	None	X			X	X	X		X	X
B	Hermit Warbler	*Dendroica occidentalis*	N	None	None	None	None	X			X	XX	X			
B	MacGillivray's Warbler	*Oporornis tolmiei*	N	None	None	None	None	X			X	X	X		X	
B	Common Yellowthroat	*Geothlypis trichas*	N	None	None	None	None	XX		XX	XX	X	X	X		X
B	Wilson's Warbler	*Wilsonia pusilla*	N	None	None	None	None	XX			XX	XX	X		X	X
B	Yellow-breasted Chat	*Icteria virens*	N	SoC	SC	G5/S4?	4	XX			XX	X	X		X	
B	Western Tanager	*Piranga ludoviciana*	N	None	None	None	None	X			X	XX	XX			X
B	Spotted Towhee	*Pipilo maculatus*	R	None	None	None	None	X			X	X	XX		X	X
B	Chipping Sparrow	*Spizella passerina*	N	None	None	None	None	X			X	X	X	X	X	X
B	Oregon Vesper Sparrow	*Pooecetes gramineus affinis*	S / N	SoC	SC	G5T3/S2B, S2N	2							XX	XX	
B	Savannah Sparrow	*Passerculus sandwichensis*	S / N	None	None	None	None	X		X	X			XX	XX	X
B	Fox Sparrow	*Passerella iliaca*	W / M	None	None	None	None	X			X	X	X		X	X
B	Song Sparrow	*Melospiza melodia*	R	None	None	None	None	X		X	X	X	X	X	X	X
B	Lincoln's Sparrow	*Melospiza lincolnii*	S / N	None	None	None	None	XX		XX	XX	X			X	
B	Swamp Sparrow	*Melospiza georgiana*	W / M	None	None	None	None	XX		XX	XX				X	
B	White-throated Sparrow	*Zonotrichia albicollis*	W / M	None	None	None	None								X	X
B	Harris's Sparrow	*Zonotrichia querula*	W / M	None	None	None	None								X	X
B	White-crowned Sparrow	*Zonotrichia leucophrys*	S	None	None	None	None	X		X	X	X	X	X	X	X
B	Golden-crowned Sparrow	*Zonotrichia atricapilla*	R	None	None	None	None	X		X	X	X	X	X	X	X
B	Dark-eyed Junco	*Junco hyemalis*	S	None	None	None	None	X			X	X	X		X	X
B	Black-headed Grosbeak	*Pheucticus melanocephalus*	N	None	None	None	None	X			X	X	X		X	X
B	Lazuli Bunting	*Passerina amoena*	N	None	None	None	None	X			X	X	X	X	XX	X
B	Red-winged Blackbird	*Agelaius phoeniceus*	S	None	None	None	None	XX		XX	X			X	X	X

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Code[1]	Common Name	Genus/Species	Status[2]	Status[3]	Status[4]	Rank[5]	List[6]	Assn.[7]	WATR	HWET	RWET	WLCH	WODF	WEGR	AGPA	URBN
B	Tricolored Blackbird	*Agelaius tricolor*	S	SoC	SP	G3/S2B	2	XX		XX					X	
B	Western Meadowlark (extirpated as breeding species)	*Sturnella neglecta*	W / M	None	SC	G5/S5	4	X		X				XX	XX	
B	Yellow-headed Blackbird	*Xanthocephalus xanthocephalus*	N	None	None	None	None	XX		XX					X	
B	Brewer's Blackbird	*Euphagus cyanocephalus*	S	None	None	None	None	X		X	X		X	X	XX	X
B	Brown-headed Cowbird	*Molothrus ater*	S / N	None	None	None	None	X		X	X	X	X	X	XX	X
B	Bullock's Oriole	*Icterus bullockii*	N	None	None	None	None	XX			XX		XX		X	X
B	Purple Finch	*Carpodacus purpureus*	S	None	None	None	None	XX			XX	X	XX		X	X
B	House Finch	*Carpodacus mexicanus*	R	None	None	None	None	X		X	X	X	X	X	XX	XX
B	Red Crossbill	*Loxia curvirostra*	R / S	None	None	None	None	X			X	X	X			X
B	Pine Siskin	*Carduelis pinus*	S	None	None	None	None	X		X	X	X	X		X	X
B	Lesser Goldfinch	*Carduelis psaltria*	S	None	None	None	None	XX			XX	X	XX	X	X	X
B	American Goldfinch	*Carduelis tristis*	S	None	None	None	None	X		X	X	X	X	X	X	X
B	Evening Grosbeak	*Coccothraustes vespertinus*	W / M	None	None	None	None	X			X	X	X			X
B*	House Sparrow*	*Passer domesticus*	R	N/A - alien	N/A - alien	N/A - alien	N/A - alien								XX	XX
M*	Virginia Opossum*	*Didelphis virginiana*	R	N/A - alien	N/A - alien	N/A - alien	N/A - alien	X			X	X	X	X	XX	XX
M	Vagrant Shrew	*Sorex vagrans*	R	None	None	None	None	X		X	X	X	X	X	X	X
M	Pacific Water Shrew	*Sorex bendirii*	R	None	None	None	None	XX		X	XX	X	X			
M	Water Shrew	*Sorex palustris*	R	None	None	None	None	XX			XX	X				
M	Trowbridge's Shrew	*Sorex trowbridgii*	R	None	None	None	None	X			X	XX	X		X	X
M	Shrew-mole	*Neurotrichus gibbsii*	R	None	None	None	None	X		X	X	XX	X		X	X
M	Townsend's Mole	*Scapanus townsendii*	R	None	None	None	None	X		X	X	X	X	X	X	X
M	Coast Mole	*Scapanus orarius*	R	None	None	None	None	X			X	XX	X	X	X	X
M	Yuma Myotis	*Myotis yumanensis*	R / S	SoC	None	G5/S3	4	XX	XX	XX	XX	X	X	X	X	X
M	Little Brown Myotis	*Myotis lucifugus*	R / S	None	None	None	None	X	X	X	X	X	X	X	X	X
M	Long-legged Myotis	*Myotis volans*	R / S	SoC	SU	G5/S3	4	X	X	X	X	XX	X	X	X	X
M	Fringed Myotis	*Myotis thysanodes*	R / S	SoC	SV	G4G5/S2?	2	X	X	X	X	X	X		X	X
M	Long-eared Myotis	*Myotis evotis*	R / S	SoC	SU	G5/S3	4	X	X	X	X	X	X	X	X	X
M	Silver-haired Bat	*Lasionycteris noctivagans*	L	SoC	SU	G5/S4?	4	X	X	X	X	XX	X	X	X	X
M	Big Brown Bat	*Eptesicus fuscus*	R / S	None	None	None	None	X	X	X	X	X	XX	X	XX	XX
M	Hoary Bat	*Lasiuris cinereus*	L	None	None	G5/S4?	4	X	X	X	X	X	X	X	X	X
M	Pacific Western Big-eared Bat	*Corynorhinus townsendii townsendii*	R / S	SoC	SC	G4T3T4/S2?	2	XX	XX	X	X	X	X	X	X	X
M	Brush Rabbit	*Sylvilagus bachmani*	R	None	None	None	None	X			X	X	X	X	X	X
M*	Eastern Cottontail*	*Sylvilagus floridanus*	R	N/A - alien	N/A - alien	N/A - alien	N/A - alien	X			X				X	X
M	Mountain Beaver	*Aplodontia rufa*	R	None	None	None	None	XX			XX	XX				
M	Townsend's Chipmunk	*Tamias townsendii*	R	None	None	None	None	X			X	XX	X			X
M	California Ground Squirrel	*Spermophilus beecheyi*	R	None	None	None	None					X	X	X	X	X

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M*	Eastern Fox Squirrel*	*Sciurus niger*	R	N/A - alien	N/A - alien	N/A - alien	N/A - alien							XX	XX	XX
M*	Eastern Gray Squirrel*	*Sciurus carolinensis*	R	N/A - alien	N/A - alien	N/A - alien	N/A - alien						XX		X	XX
M	Western Gray Squirrel	*Sciurus griseus*	R	None	SU	G5/S4?	3					X	XX		X	X
M	Douglas' Squirrel	*Tamiasciurus douglasii*	R	None	None	None	None		XX	XX	X					
M	Northern Flying Squirrel	*Glaucomys sabrinus*	R	None	None	None	None	X			X	XX	XX			X
(M)	(Western pocket gopher)	*(Thomomys mazama)*	(R)	None	None	None	None					(XX)	(XX)	(X)	(X)	(X)
M	Camas Pocket Gopher	*Thomomys bulbivorus*	R	SoC	None	G3G4/S3 S4	3							XX	XX	X
M	American Beaver	*Castor canadensis*	R	None	None	None	None	XX	XX	XX	XX	X	X		X	X
M	Deer Mouse	*Peromyscus maniculatus*	R	None	None	None	None	XX		XX	XX	XX	XX	XX	XX	XX
M	Bushy-tailed Woodrat	*Neotoma cinerea*	R	None	None	None	None	X			X	XX	XX		XX	X
M	Western Red-backed Vole	*Clethrionomys californicus*	R	None	None	None	None	X			X	X				
M	Heather Vole	*Phenacomys intermedius*	R	None	None	None	None	X			X		X			
M	White-footed Vole	*Arborimus (= Phenacomys) albipes*	R	SoC	SU	G3G4/S3	4	XX			XX	XX				
M	Red Tree Vole	*Arborimus (= Phenacomys) longicaudus*	R	SoC	None	G3G4/S3S4	3	X			X	XX	XX			
M	Gray-tailed Vole	*Microtus canicaudus*	R	None	None	None	None							XX	XX	
M	Townsend's Vole	*Microtus townsendii*	R	None	None	None	None	XX		XX	X	X	X	X	X	
M	Long-tailed Vole	*Microtus longicaudus*	R	None	None	None	None	XX		XX	XX	X	X	X	X	
M	Creeping Vole	*Microtus oregoni*	R	None	None	None	None	X			X	X	X	X	X	X
M	Water Vole	*Microtus richardsoni*	R	None	None	None	None	X			X	X				
M	Common Muskrat	*Ondatra zibethicus*	R	None	None	None	None	XX	XX	XX	XX				X	X
M*	Black Rat*	*Rattus rattus*	R	N/A - alien	N/A - alien	N/A - alien	N/A - alien								X	XX
M*	Norway Rat*	*Rattus norvegicus*	R	N/A - alien	N/A - alien	N/A - alien	N/A - alien								X	XX
M*	House Mouse*	*Mus musculus*	R	N/A - alien	N/A - alien	N/A - alien	N/A - alien								XX	XX
M	Pacific Jumping Mouse	*Zapus trinotatus*	R	None	None	None	None	XX		X	XX	X	X		X	
M	Common Porcupine	*Erethizon dorsatum*	R	None	None	None	None	XX		X	XX	XX	XX		X	X
M*	Nutria*	*Myocastor coypus*	R	N/A - alien	N/A - alien	N/A - alien	N/A - alien	XX	XX	XX	XX				X	X
M	Coyote	*Canis latrans*	R	None	None	None	None	X		X	X	X	X	X	X	X
M	Red Fox	*Vulpes vulpes*	R	None	None	None	None	X			X	X	X	XX	X	X
M	Gray Fox	*Urocyon cinereoargenteus*	R	None	None	None	None	X			X	XX	X	X	X	
(M)	(Gray Wolf - extirpated)	*(Canis lupus)*	S	None	None	None	None	(X)			(X)	(X)	(X)	(X)		
M	Black Bear	*Ursus americanus*	S	None	None	None	None	X		X	X	X	X	X	X	X
(M)	(Grizzly Bear)	*(Ursus arctos)*	(R)	LT	None	G4/SX	2-ex	(X)			(X)	(X)		(X)		
M	Common Raccoon	*Procyon lotor*	R	None	None	None	None	XX	X	XX	XX	X	X	X	XX	XX
M	Ermine	*Mustela erminea*	R	None	None	None	None	X			X	X	X	X	X	
M	Long-tailed Weasel	*Mustela frenata*	R	None	None	None	None	X		X	X	X	X	X	X	X
M	Mink	*Mustela vison*	R	None	None	None	None	XX	XX	XX	XX	X	X	X	X	X

Appendix 1. Species list and habitat associations for species normally occurring within the Metro region. Study area is the Metro jurisdictional boundary plus 1 mile buffer, plus UGB study areas.

			Migratory	Federal	ODFW	ORNHP	ORNHP	Riparian	Habitat Type[8]							
Code[1]	**Common Name**	**Genus/Species**	**Status[2]**	**Status[3]**	**Status[4]**	**Rank[5]**	**List[6]**	**Assn.[7]**	**WATR**	**HWET**	**RWET**	**WLCH**	**WODF**	**WEGR**	**AGPA**	**URBN**
M	Striped Skunk	*Mephitis mephitis*	R	None	None	None	None	X		X	X	X	X	X	X	X
M	Western Spotted Skunk	*Spilogale gracilis*	R	None	None	None	None	X			X	X	X	X	X	X
M	Northern River Otter	*Lontra canadensis*	R	None	None	None	None	XX	XX	XX	XX					X
M	Mountain Lion (Cougar)	*Puma concolor*	S	None	None	None	None	X		X	X	X	X		X	X
M	Bobcat	*Lynx rufus*	S	None	None	None	None	X		X	X	X	X	X	X	X
M*	Domestic Cat (feral)*	*Felis domesticus*	R	N/A - alien	N/A - alien	N/A - alien	N/A - alien	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
M	California Sea Lion	*Zalophus californianus*	S	None	None	None	None	XX	XX							
M	Roosevelt Elk	*Cervus elaphus roosevelti*	S	None	None	None	None	X		X	X	X	X	X	X	X
(M)	(Columbian White-tailed Deer)	*(Odocoileus virginiana leucurus)*	(R)	LE	SV	G5T2QS2	1	(X)		(X)	(X)	(X)	(XX)	(X)	(X)	(X)
M	Mule Deer	*Odocoileus hemionus*	R	None	None	None	None	X		X	X	X	X	X	X	X

[a] Bald eagle is currently proposed for de-listing at the federal level.

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Appendix 2. Review of key findings of urban stream studies examining the relationship of urbanization on stream quality.

Reference	Location	Biological Parameter	Key Finding
Benke, Willeke, Parrish and Stites 1981	Atlanta	Aquatic insects	Negative relationship between number of insect species and urbanization in 21 streams
Black and Veatch 1994	Maryland	Fish/insects	Fish, insect and habitat scores were all ranked as poor in 5 subwatersheds that were greater than 30% TIA
Booth 1991	Seattle, WA	Fish habitat / channel stability	Channel stability and fish habitat quality declined rapidly after 10% TIA
Booth et al. 1996	Washington	Aquatic habitat	There is a decrease in the quantity of large woody debris found in urban streams at around 10% TIA
Couch et al. 1997	Atlanta, Georgia	Fish, habitat	As watershed population density increased, there was a negative impact on urban fish and habitat
Crawford & Lenat 1989	North Carolina	Aquatic insects and fish	A comparison of three stream types found urban streams had lowest diversity and richness
Galli 1991	Maryland	Stream temperature (aquatic habitat)	Stream temperature increased directly with subwatershed impervious cover
Galli 1994	Maryland	Brown trout	Abundance and recruitment of brown trout declined sharply at 10-15% TIA
Garie and McIntosh 1986	New Jersey	Aquatic insects	Drop in insect taxa from 13 to 4 noted in urban streams
Hicks and Larson 1997	Connecticut	Aquatic insects	A significant decline in various indicators of wetland aquatic macroinvertebrate community health was observed as TIA increased to levels of 8-9%
Horner et al. 1996	Puget Sound, Washington	Insects, fish, water quality, riparian zone	Steepest decline of biological functioning after 6% TIA. There was a steady decline, with approximately 50% of initial biotic integrity at 45% TIA
Jones and Clark 1987	Northern Virginia	Aquatic insects	Urban streams had sharply lower diversity of aquatic insects when human population density exceeded 4 persons/acre (estimated 10-25% TIA)
Jones et al. 1996	Northern Virginia	Aquatic insects and fish	Unable to show improvements at 8 sites downstream of BMPs as compared to reference conditions
Klein 1979	Maryland	Aquatic insects/fish	Macroinvertebrate and fish diversity declines rapidly after 10% TIA
Limburg and Schmidt 1990	New York	Fish spawning	Resident and anadromous fish eggs and larvae declined sharply in 16 tributary streams greater than 10% TIA
Luchetti and Fuersteburg 1993	Seattle	Fish	Marked shift from less tolerant coho salmon to more tolerant cutthroat trout populations noted at 10-15% TIA at 9 sites
MacRae 1996	British Columbia	Stream channel stability (aquatic habitat)	Urban stream channels often enlarge their cross-sectional area by a factor of 2 to 5. Enlargement begins at relatively low levels of TIA.
Maxted and Shaver 1996	Delaware	Aquatic insects and habitat	No significant differences in biological and physical metrics for 8 BMP sites versus 31 sites without BMPs (with varying TIA)
May et al. 1997	Washington	Insects, fish, water quality, riparian zone	Physical and biological stream indicators declined most rapidly during the initial phase of the urbanization process as the TIA exceeded the 5-10% range
MWCOG 1992	Washington, D.C.	Aquatic insects and fish	There was a significant decline in the diversity of aquatic insects and fish at 10% TIA
Pedersen and Perkins 1986	Seattle	Aquatic insects	Macroinvertebrate community shifted to chironomid, oligochaetes and amphipod species tolerant of unstable conditions.

Appendix 2 (continued)

Reference	Location	Biological Parameter	Key Finding
Pedersen and Perkins 1986	Seattle	Aquatic insects	Macroinvertebrate community shifted to chironomid, oligochaetes and amphipod species tolerant of unstable conditions.
Richards et al. 1993	Minnesota	Aquatic insects	As watershed development levels increased, the macroinvertebrate community diversity decreased
Schueler and Galli 1992	Maryland	Fish	Fish diversity declined sharply with increasing TIA; loss in diversity began at 10-12% TIA
Schueler and Galli 1992	Maryland	Aquatic insects	Insect diversity metrics in 24 subwatersheds shifted from good to poor over 15% TIA
Shaver, Maxted, Curtis and Carter 1995	Delaware	Aquatic insects	Insect diversity at 19 stream sites dropped sharply at 8 to 15% TIA.
Shaver, Maxted, Curtis and Carter 1995	Delaware	Habitat quality	Strong relationship between insect diversity and habitat quality; majority of 53 urban streams had poor habitat
Steedman 1988	Ontario	Aquatic Insects	Strong negative relationship between biotic integrity and increasing urban land use/riparian condition at 209 stream sites. Degradation begins at about 10% TIA
Steward 1983	Seattle	Salmon	Marked reduction in coho salmon population noted at 10-15% TIA at 9 sites
Taylor 1993	Seattle	Wetland plants / amphibians	Mean annual water fluctuation was inversely correlated to plant and amphibian density in urban wetlands. Sharp declines noted over 10% TIA
Taylor et al. 1995	Washington	Wetland water quality	There is a significant increase in water level fluctuation, conductivity, fecal coliform bacteria, and total phosphorus in urban wetlands as TIA exceeds 3.5%
Trimble 1997	California	Sediment loads (aquatic habitat)	About 2/3 of sediment delivered into urban streams comes from channel erosion
U.S. EPA 1983	National	Water quality / pollutant concentration	Annual phosphorus, nitrogen, and metal loads increased in direct proportion with increasing TIA
Weaver 1991	Virginia	Fish	As watershed development increased to about 10%, fish communities simplified to more habitat and trophic generalists
Yoder 1991	Ohio	Aquatic insects / fish	100% of 40 urban sites sampled had fair to very poor index of biotic integrity scores

Sources: Schueler 1994, Caraco et al. 1998

SOCIETY FOR ECOLOGICAL RESTORATION

APPENDIX 3.

Guidelines for Developing and Managing Ecological Restoration Projects

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June 24, 2000

The following guidelines are suggested for conceiving, organizing, conducting, and assessing ecological restoration projects. Adherence to these guidelines will reduce errors of omission and commission that compromise project quality. The guidelines are applicable to any ecosystem, terrestrial or aquatic. They are useful in any context – public works projects, stewardship programs, mitigation projects, private land initiatives, etc. The guidelines are generic and were developed as essential background for managers, policy makers, and the interested public as well as for professional and volunteer restoration practitioners. Design issues and the details for planning and implementing restoration projects lie beyond the scope of these guidelines. We leave such complexities to the authors of manuals and the presenters of workshops who address these topics.

The mission of every ecological restoration project is to reestablish a functional ecosystem of a designated type that contains sufficient biodiversity to continue its maturation by natural processes and to evolve over longer time spans in response to changing environmental conditions. The two attributes of biodiversity that are most readily attained by restoration are species richness and community structure. The restoration ecologist must assure adequate species composition and species abundance to allow the development of suitable community structure and to initiate characteristic ecosystem processes. Concomitantly, the restorationist must provide appropriate physical conditions to sustain these species.

If restoration cannot be fully achieved, then the project should be re-designed as *rehabilitation,* which we define as any ecologically beneficial treatment short of full restoration. Management actions that cause ecological damage do not qualify as restoration. Unfortunately, *restoration* is applied inappropriately to projects that sacrifice biodiversity and impair ecological functions to accomplish single-species management or to attain economic objectives. Continued indiscriminate use will cause *ecological restoration* to lose its meaning as a creditable conservation strategy. Restoration projects can accommodate particular species and can satisfy economic objectives as long as ecosystem integrity is not compromised.

Once a project site is restored, it may require periodic management, as do many other natural areas, to maintain ecosystem health in response to continuing human-mediated impacts. These guidelines do not address post-project management specifically, although some of the guidelines are readily adaptable for that purpose.

The project guidelines are numbered for convenience; they do not necessarily have to be initiated in numerical order. We recommend that a narrative be written in response to the issues raised in each guideline. Collectively, these narratives will comprise a comprehensive guidance document for planning and executing the project.

CONCEPTUAL PLANNING

Conceptual planning identifies the reasons why restoration is needed and the general strategy for conducting it. Conceptual planning is conducted when restoration appears to be a feasible option but before a decision has been made to exercise that option. The written conceptual plan captures the essence and character of the potential restoration.

1. Identify the project site location and its boundaries. Project boundaries are delineated, preferably on a large-scale aerial photograph and also on soil and topographic maps that show the watershed and other aspects of the surrounding landscape.

2. Identify ownership. The name and address of the landowner is given. If an organization or institution owns or manages the land, the names and titles of key personnel are listed. The auspices under which the project will be conducted are noted – public works, mitigation, etc.

3. Identify the need for restoration. Tell what happened at the site that warrants restoration. State the intended benefits of restoration.

4. Identify the kind of ecosystem to be restored and the type of restoration project. The ecosystem to be restored is designated along with any particular habitats and plant or animal communities of that ecosystem that are targeted for restoration. The type of restoration is selected from the following list of five options. It is important to make this initial distinction to avoid misunderstandings later. Restoration projects at diverse project sites may include more than one of these options:

1) *Repair of a damaged ecosystem.* This option attempts to return a site to its historic or preexisting condition. Commonly a few minor aspects of the preexisting ecosystem cannot be fully restored. These should be identified and accepted as exceptions. Restoration work takes place at the same site where damage occurred. Such restoration has been termed *in-kind* (the historic type of ecosystem is restored) and *onsite* (restoration occurs at the same location where the historic ecosystem was damaged). Restoration with respect to the following four options is not necessarily *on-site,* and some are not *in-kind.*

2) *Creation of a new ecosystem of the same kind to replace one that was entirely removed.* The term *creation* signifies that the restored ecosystem must be entirely reconstructed on a site denuded of its vegetation (terrestrial systems) or its benthos (aquatic systems). Creations are commonly conducted on surface mined lands and <u>in</u> brownfields (severely damaged urban and industrial lands).

3) *Creation of another kind of regional ecosystem to replace one which was removed from a landscape that became irreversibly altered.* This option is important for restoring natural areas in an urban context where, for example, original hydrologic conditions cannot be restored.

4) *Creation of a replacement ecosystem where an altered environment can no longer support any previously occurring type of regional ecosystem.* The replacement ecosystem may consist of novel combinations of indigenous species that are assembled to suit novel site conditions as, for example, at a retired solid waste disposal site.

5) *Creation of a replacement ecosystem, because no reference system exists to serve as a model for restoration.* This option is relevant in densely populated regions of Eurasia, where many centuries of land use have obliterated all remnants of original ecosystems.

5. Identify restoration goals, if any, that pertain to social and cultural values. Goals are the ideals that a restoration project attempts to achieve. Goals relating to social and cultural values may be prescribed as long as they are congruent with the primary goal of reestablishing a functional ecosystem that contains sufficient biodiversity to continue its maturation by natural processes and to evolve over longer time spans in response to changing environmental conditions. Social values are largely economic. They may consist of the production of goods such as timber, forage, and fisheries at restored sites. Or they may comprise natural services including the protection of recharge areas and potable water supplies, detention of floodwaters, attenuation of erosion and sedimentation, noise reduction, immobilization of contaminants, transformation of excess nutrients, generation of pollinators for crops, generation of predators of crop pests, and provision of recreational opportunities and consequent tourism. They can also conserve germ plasm of economic species and serve as refugia for wildlife and for rare species. Cultural values include aesthetic amenities and the revival of historical environments as aspects of preserving cultural heritage. If the goal is to restore a fixed cultural landscape, then the project may have to be re-designated as rehabilitation.

6. Identify physical site conditions in need of repair. Some examples of conditions that are amenable to restoration are improvements in water quality, removal of structures to reestablish a more natural hydrologic regime, and improvements to the soil in terms of compaction, organic matter content, and nutrient content.

7. Identify stressors in need of regulation or re-initiation. Stressors are re-occurring external conditions that maintain the integrity of an ecosystem by discouraging the establishment of competitive species that cannot tolerate particular stress events. Examples are fires, anoxia caused by flooding or prolonged hydroperiods, periodic drought, salinity shocks associated with tides and coastal aerosols, freezing temperatures, and unstable substrates caused by water, wind or gravity as on beaches, dunes, and flood plains.

8. Identify biotic interventions that are needed. Some characteristic species of plants and animals may require reintroduction or their existing populations need to be augmented. Nuisance species and exotic species may require removal or control. Mycorrhizal fungi, N-fixing bacteria, and other microbial species may need to be introduced.

9. Identify landscape restrictions, present and future. The biota at a project site is affected by off-site conditions, particularly land usage. Restoration should not be attempted in landscapes that can no longer support the kind of ecosystem designated for restoration or which will likely be compromised later by the effects of land usage offsite. To the extent possible, future threats to the integrity of the restored ecosystem should be minimized by mechanisms such as zoning or binding commitments from neighboring landowners.

Some aquatic ecosystem restoration depends entirely on improving the watershed, and all restoration work is accomplished offsite. Examples of impacts from offsite include water pollution, turbidity, and agricultural runoff. The hydrologic regime in any project site can be altered offsite by dams, drainage projects, diversions of runoff caused by highways and other public works, and by the impervious surfaces characteristic of developed land. Water tables are lowered by transpiration from trees and are raised, sometimes dramatically, by timber harvest. Fire frequency is reduced by intentional suppression and by landscape fragmentation that interrupts the cover of flammable vegetation. Exotic species colonization onsite is commonly traced to infestations offsite. The presence or abundance of birds and other mobile animals depends on the health of other ecosystems in the landscape upon which they partially depend.

10. Identify project-funding sources. Potential external funding sources should be listed if internal funding is inadequate.

11. Identify labor sources and equipment needs. New personnel may have to be hired, volunteers invited, and other labor contracted. The availability of special equipment must be determined.

12. Identify biotic resource needs. Biotic resources include seeds, other plant propagules, nursery-grown planting stocks, and animals for establishment at the project site.

13. Identify the need for securing permits required by government agencies. Dredge and fill permits may be required for tasks involving rivers and wetlands. Other permits may be applicable for the protection of endangered species, historic sites, etc.

14. Identify permit specifications, deed restrictions, and other legal constraints. If restoration is being conducted as mitigation, compliance with permit specifications must be incorporated into the restoration plan or re-negotiated. Restrictive covenants and zoning regulations may preclude certain restoration activities. Legal restrictions on ingress and egress could prevent some restoration tasks from being accomplished. If the restoration is being placed under conservation easement, the timing of the easement must be satisfied.

15. Identify project duration. Short-term restoration projects are generally more costly than longer-term projects. The longer the project, the more the practitioner can rely on natural processes and volunteer labor to accomplish specific restoration objectives that are identified below in Guideline #27. In accelerated restoration programs such as mitigation projects, costly interventions must substitute for these natural processes.

16. Identify strategies for long-term protection and management. Restoration is futile without reasonable assurance that the project site will be protected and properly managed into the indefinite future. Protection could be secured with conservation easements or the legal transfer of the property to a public resource agency or non-governmental organization.

PRELIMINARY TASKS

Preliminary tasks are those upon which project planning depends. These tasks form the foundation for well-conceived restoration designs and programs. Preliminary tasks are fulfilled after conceptual planning results in the decision to proceed with the restoration project.

17. Appoint a restoration ecologist who is responsible for technical aspects of restoration. Restoration projects are complex, require the coordination of diverse activities, and demand numerous decisions owing in part to the stochastic nature of ecological processes. For these reasons, leadership should be vested in an individual who maintains overview of the entire project and who has the authority to act quickly and decisively. The restoration ecologist may delegate specific tasks but retains the ultimate responsibility for the attainment of objectives. Nonetheless, restoration responsibilities are sometimes divided according to the organizational charts of larger corporations and government bureaus. Pluralistic leadership augments the potential for errors in project design and implementation. In mitigation projects, agency personnel become silent co-partners with the restoration ecologist when they mandate particular restoration activities as permit specifications. This practice reduces the restoration ecologist's capacity for flexibility and innovation, including the prompt implementation of adaptive management actions. The preparation of a written guidance document, based upon responses to these guidelines, will help promote the judicious execution of the restoration project in cases of pluralistic leadership and in negotiating permit specifications with government agencies.

18. Appoint the restoration team. The team includes the restoration ecologist, the project manager, other technical personnel who may contribute to the project, and anyone else whose input will critically affect the project. It is essential that the responsibilities of each individual are clearly assigned and that each person be given concomitant authority. The restoration ecologist and the project manager should maintain open lines of communication. If restoration is one component of a larger project, the restoration ecologist should enjoy equal status with other project planners to prevent actions that could compromise restoration quality or inflate costs.

19. Prepare a budget to accommodate the completion of preliminary tasks. Time and resources as well as funding need to be allocated for these tasks.

20. Document existing project site conditions and describe the biota. Project evaluation depends in part upon being able to contrast the project site before and after restoration. Properly labeled and archived photographs are fundamental. Camera locations should be recorded, so that before and after photos can be compared. Videotapes, aerial photographs, and oblique aerial photos from a low-flying aircraft are helpful. Soils and other physical site conditions should be described. To the extent possible, species composition should be listed and species abundance estimated. The structure of all component communities should be described in sufficient detail to permit objective means of evaluating the performance of projects subsequent to their implementation.

21. Document the project site history that led to the need for restoration. The years in which impacts occurred should be recorded. Historical aerial photos are helpful. Disturbance features should be photographed.

22. Conduct pre-project monitoring as needed. Sometimes it is useful or requisite to obtain baseline measurements on such parameters as water quality and groundwater levels for a year or more prior to initial project installation. If so, these measurements will continue after the project begins as part of the monitoring program.

23. Gather baseline ecological information and conceptualize a reference ecosystem from it upon which the restoration will be modeled and evaluated. The kind of ecosystem that has been selected for restoration must be described in sufficient detail to develop restoration objectives and to serve as a comparison for evaluating the completed restoration project. Documentation of the pre-project site conditions (Guideline #20) may contribute substantially to the reference. Generally, no one site contains the range of variability that is representative of the ecosystem designated for restoration. Therefore, the reference system should be conceptualized from the collective attributes of several sites. These attributes should include both the biotic and abiotic (physical) components. They should include seral (developmental) descriptions, because a comparison between an ecologically young restoration site and a mature reference system requires assumptions that are difficult to substantiate. The description of the reference system can be the citation of existing documents, a report of baseline ecological studies conducted by the restoration team, or a combination thereof.

24. Gather pertinent autecological information for key species. The restoration ecologist should have access to whatever knowledge is available regarding the recruitment, maintenance, and reproduction of key species. If necessary, trials and tests can be conducted by the restoration team prior to project installation.

25. Conduct investigations as needed to assess the effectiveness of restoration methods. Novel and unusual restoration methods may require testing prior to their implementation at the project site.

26. Decide if ecosystem goals are realistic or if they need modification. On the basis of information gained from carrying out the aforementioned guidelines, the project team should conduct a feasibility study to determine if the type of restoration (Guideline #4) and the original project goals (Guideline #5) were realistic. If not, modifications should be proposed.

27. Prepare a list of objectives designed to achieve restoration goals. Objectives are the specific activities to be undertaken for the satisfaction of project goals. The restoration ecologist should list all objectives needed to achieve each project goal. Objectives may be executed directly through the establishment of project features or passively through suitable project design. In either case, objectives are explicit, measurable, and have a designated time element. Objectives can cover a wide array of specific actions. They may be hydrological, e.g., the filling of a drainage ditch to improve sheet flow; pedological, e.g., the amendment of organic matter to improve soil texture; or biological, e.g., the prompt removal of a particular exotic species that threatens ecosystem integrity. Other objectives may pertain to re-introducing fire according to a specific prescription, removing an abandoned road, or establishing a windbreak. Certain objectives may require actions that take place offsite to improve conditions onsite. Some restoration projects can be accomplished with one or few objectives. For example, perhaps all that is needed is to install culverts beneath a road to improve drainage, assuming the vegetation can recover passively.

28. Secure permits required by regulatory and zoning authorities. These are the permits identified in guidelines #13 and #14.

29. Establish liaison with other interested governmental agencies. Potential interested agencies should be notified of the project. Later, site tours can be conducted for agency personnel and progress reports dispatched to them. This networking could expedite assistance, should it become needed.

30. Establish liaison with the public and publicize the project. Local residents automatically become stakeholders in the restoration. They need to know how the restored ecosystem can benefit them personally. For example, the restoration may attract ecotourism that will benefit local businesses, or it may serve as an environmental education venue for local schools. If residents favor the restoration, they will protect it and vest it with their political support. If they dislike the restoration, they may vandalize or otherwise disrespect it.

31. Arrange for public participation in project planning and implementation. The restoration team should make every effort to involve local residents or other interested members of the public to participate in project planning and installation. By doing so, the participants develop a feeling of ownership, and they will be more likely to assume a stewardship role for the completed project. Volunteer labor by local residents or by ecotourists may reduce overall project costs. However, such labor requires coordination, special supervision, and additional liability insurance.

32. Install roads and other infrastructure needed to facilitate project implementation. The degree to which infrastructure is provided should be weighed against the costs of down time caused by its absence and against considerations of safety and opportunities for public relations tours.

33. Engage and train personnel who will supervise and conduct project installation tasks. Project personnel who lack restoration experience or knowledge of particular methods will benefit from attending workshops and conferences that provide background information. Otherwise, the restoration ecologist should provide training.

INSTALLATION PLANNING

Installation plans describe how the project will be implemented, i.e., project design. The care and thoroughness with which installation planning is conducted will be reflected by how aptly project objectives are realized.

34. Describe the interventions that will be implemented to attain each objective. The restoration ecologist should identify all actions and treatments needed to accomplish each objective listed in Guideline #27. Detailed instructions are prepared for implementing each of these interventions. Concomitantly, the needs for labor, equipment, supplies, and biotic stocks are identified.

Restoration projects should be designed to reduce the need for mid-course corrections that inflate costs and cause delays. Special care should be given to describing site preparation activities, i.e., those interventions that precede the introduction of biotic resources. Once biotic resources are introduced, it may become exceedingly difficult to repair dysfunctional aspects of the physical environment.

Some interventions can be accomplished concurrently and others must be done in sequence. The need for sequencing should be clearly identified. Some restoration activities require follow-up activities or continuing periodic maintenance following installation. These tasks are predictable and can be written into the implementation plans under their respective objectives. Examples of maintenance tasks include the repair of erosion on freshly graded land and the removal of competitive weeds and vines from around young plantings.

35 State how much of the restoration can be accomplished passively. Restoration tasks initiate or accelerate natural processes. Nearly all manifestations of restoration are accomplished by these processes and not by the direct artifice of the restorationist. For example, a small quantity of plants may be introduced as nursery stock with the expectation that these plants will propagate and increase substantially in density. Many restoration projects make no provision for introducing species of animals. The assumption is that, 'if we build it, they will come.' The restoration plan should acknowledge those aspects that are expected to develop passively, i.e., without intervention. If passive restoration is not realized, then additional interventions must be prescribed (see Guideline #47).

36. Prepare performance standards and monitoring protocols to measure the attainment of each objective. A performance standard (also called a design_criterion) provides evidence on whether or not an objective has been attained. This evidence is gathered by monitoring in accord with a prescribed protocol or methodology. Performance standards require careful selection for their power to measure the completion of an objective. Monitoring tells the restoration ecologist to what degree a given objective has been attained. It is essential that performance standards and monitoring protocols be selected prior to any project installation activity. Otherwise, the objectivity of the performance standard will be compromised by the initial results of installation. Monitoring protocols must be geared specifically to performance standards. Other information is extraneous and inflates project costs. Monitoring protocols should be designed so that data are readily gathered, thereby reducing monitoring costs. They should be empirical to facilitate their objective interpretation.

37. Schedule the tasks needed to fulfill each objective. Scheduling can be complex. Planted nursery stock may have to be contract-grown months or longer in advance of planting and must be delivered in prime condition. Older, root-bound stocks are generally worthless. If direct seeding is prescribed, seed collecting sites will have to be identified. The seed must be collected when ripe, possibly stored, and perhaps pre-treated. Site preparation for terrestrial systems cannot be scheduled when conditions are unsuitable. For example, soil manipulations cannot be accomplished if flooding is likely, and prescribed burning must be planned and conducted in accordance with applicable fire codes. The availability of labor and equipment can further complicate scheduling. Workdays may have to be shortened for safety during especially hot weather and in lightening storms. Wet weather may cause equipment to bog down. Schedules should reflect these eventualities.

Most objectives are implemented within the first or second year of installation. Some objectives may have to be delayed. For example, the re-introduction of plants and animals with specialized habitat requirements may have to be postponed several years until habitat conditions become suitable.

38. Procure equipment, supplies, and biotic resources. Care should be taken to assure that regional ecotypes of biotic resources are obtained to increase the chances for genetic fitness and to prevent needless and harmful introductions of non-indigenous ecotypes and species.

39. Prepare a budget for installation tasks, maintenance events, and contingencies. Budgeting for planned objectives is obvious. However, budgeting for unknown contingencies is just as important. No restoration project has ever been accomplished exactly as it was planned. Restoration is a multivariate undertaking, and it is impossible to account for all eventualities. Examples of contingencies are severe weather events, depredations of deer and other herbivores on a freshly planted site, colonization by invasive species, vandalism, and unanticipated events elsewhere in the landscape that impact the project site. The need to conduct at least some remediation is a near certainty. Generally, the cost of remediation increases in relation to the time it takes to respond after its need is discovered. For these reasons, contingency funds should be available on short notice.

INSTALLATION TASKS

Project installation fulfills installation plans. If planning was thorough and supervision adequate, installation will generally proceed smoothly and within budget.

40. Mark boundaries and secure the project area. The project site should be staked or marked conspicuously in the field. Fencing and fire lanes should be installed as needed. This guideline is sometimes ignored until it results in a contingency, such as a neighbor's cattle escaping into a freshly planted project site.

41. Install monitoring features. Permanent transect lines, staff gauges, piezometer wells, etc., need to be installed and marked.

42. Implement restoration objectives. Restoration tasks were identified in Guideline #34. The restoration ecologist must supervise project installation or delegate supervision to project team members. Responsibility for proper implementation should not be entrusted to subcontractors, volunteers, and labors crews who are doing the work. The cost of retrofitting exceeds the cost of appropriate supervision.

POST-INSTALLATION TASKS

The attainment of objectives may depend as much on follow-up activities as it does to the care given to initial installation activities. The importance of post-installation work cannot be overemphasized.

43. Protect the project site against vandals and herbivory. Project sites attract dirt bike riders, feral swine, deer, geese, nutria, etc. Beaver can destroy a newly planted site by plugging streams and culverts. Appropriate preventive actions should be taken.

44. Perform post-implementation maintenance. Conduct maintenance activities that were described in Guideline #34.

45. Reconnoiter the project site regularly to identify needs for mid-course corrections. The restoration ecologist needs to inspect the project site frequently, particularly during the first year or two following an intervention, to schedule maintenance as needed and to react promptly to contingencies.

46. Perform monitoring as required to document the attainment of performance standards. Measurements of water levels and certain water quality parameters are generally conducted on a regular schedule. Otherwise, monitoring should not be required until monitoring data will be meaningful for decision-making. Monitoring and the reporting of monitoring data are expensive. Regular reconnaissance (Guideline #45) negates the need for frequent monitoring.

47. Implement adaptive management procedures as needed. Adaptive management as a restoration strategy is essential, because what happens at one stage in restoration dictates what needs to happen next. A restoration plan must contain built-in flexibility. If reconnaissance or monitoring reveal that objectives are not being met, then alternative interventions may have to be attempted. The project manager should realize that restoration objectives may never be realized for reasons that lie beyond the control of the restoration ecologist. If so, then new goals (Guideline #5) and objectives (Guideline #27) may have to be adopted if a functional ecosystem is to be returned to the project site.

EVALUATION

The installation of a project does not guarantee that its objectives will be attained or its goals achieved. Restoration differs from most civil engineering projects for which the results are more predictable. Restored ecosystems are dynamic and require evaluation within the context of an indefinite temporal dimension.

48. Assess monitoring data to determine if performance standards are being met. If performance standards are not being met within a reasonable period of time, refer to Guideline #47.

49. Describe aspects of the restored ecosystem that are not covered by monitoring data. This description should commence when project work has been essentially completed. The description should compliment the documentation that was conducted prior to the initiation of restoration activities (Guideline #20) to allow before and after comparisons.

50. Determine if project goals were met, including those for social and cultural values. Based on monitoring data and other documentation (Guidelines #46, #49), evaluate the restoration with respect to its project goals. These will include the primary goal to restore a functional ecosystem that emulates the reference ecosystem at a comparable ecological age (Guideline #4). They will also include any secondary goals with respect to social and cultural values (Guideline #5).

51. Publish an account of the restoration project and otherwise publicize it. Publicity and documentation should be incorporated into every restoration project for the following reasons: Published accountings are fundamental for instituting the long-term protection and stewardship of a completed project site. Policy makers and the public need to be appraised of the fiscal and resource costs, so that future restoration projects can be planned and budgeted appropriately. Restoration ecologists improve their craft by becoming familiar with how restoration objectives were accomplished.

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Appendix 4.

Selected restoration activities and potential indicators of the effects of management activities, based on ecosystem function. Please read the Restoration chapter and take note of cautionary advice regarding planning and implementing restoration activities in an urban setting, particularly instream modifications.

Function or Value	Selected Potential Restoration Activities	Some Potential Indicators of Management Activity Effects
Water quality (sediment filtering, nutrient/pollutant filtering, erosion control and stream bank stability)	• Increase riparian and upland vegetation (especially woody vegetation) in watershed • Vegetative filter strips (VFS) • Control sediment inputs through BMPs and regulatory measures • Promote development of healthy soils through native plant communities (increases soil retention and filtering capacity) • Limit development and impervious surfaces near stream • Remove or modify sewer outfalls • Artificial wetlands (bioswales and water detention structures) • Public education to keep toxins out of storm drains • Reduce or eliminate industrial discharges • Promote alternatives to pesticides and chemical fertilizers • Promote passage of more water through wetlands and undeveloped floodplains • Retain/increase springs, seeps and wetlands • Increase late summer flows	• Benthic index of biological integrity (B-IBI) (Booth 1991; Spence et al. 1996; Karr and Chu 2000; Booth et al. 2001) • Piezometers or small wells to test groundwater and hyporheic water quality (Fernald et al. 2000) • Water quality tests such as temperature, sediment/turbidity, pH, dissolved oxygen, conductivity, nitrogen and phosphorus, herbicides/pesticides, suspended/floating matter, trash loading, odor, and chemical contamination (National Marine Fisheries Service 1996; Spence et al. 1996; FIRSWG 1998; Hollenback and Ory 1999) • Percent catchment in various types of vegetation and wetland cover (Spence et al. 1996) • Total impervious area, effective impervious area, or road density and location (National Marine Fisheries Service 1996; Schueler 1994; May et al. 1997b) • Intergravel dissolved oxygen in sites where fine particulate organic matter is present (Spence et al. 1996)
Microclimate and shade	• Terrestrial: reduce microclimatic edge effects by addressing size, shape of habitat patches • Aquatic: provide vegetative shade over stream • Terrestrial and aquatic: increase forest width	• Terrestrial: measures of air temperature, relative humidity, soil moisture and temperature, solar radiation, and wind speed (Spence et al. 1996; Saunders et al. 1999; Gehlhausen et al. 2000; Laurance et al. 2000) • Aquatic: water temperature (Budd et al. 1987; Beschta et al. 1988)
Sources of stream flow and flood storage (hydrology)	• Reduce impervious surfaces in watershed • Remove or modify sewer outfalls • Add riparian and upland vegetation; increase riparian forest width • Reconnect streams to floodplain • Retain/increase springs, seeps and wetlands (sources of cold water) • Allow channel meanders • Limit development near stream • Control water inputs artificially to mimic natural conditions • Protect natural and create new detention ponds to detain increased peak runoff • Groundwater recharge (increases late summer flows)	• B-IBI (urban land cover correlates equally well in Pacific Northwest with B-IBI at subbasin, riparian, and local scales) (Booth 1991; Spence et al. 1996; Karr and Chu 2000; Booth et al. 2001) • Hydrographs (historic vs present) and stream gauges (Brookes 1987; Hollenbach & Ory 1999) • Annual and interannual streamflow patterns such as T_{qmean}, $T_{0.5}$ yr and CV_{AMF}, quality and timing of peak and low flows (Spence et al. 1996; Booth et al. 2001) • Channel scour (Spence et al. 1996) • Discharge (Spence et al. 1996)

Function or Value	Selected Potential Restoration Activities	Some Potential Indicators of Management Activity Effects
	• Dam removal/modification to more closely mimic natural flow regime • Reintroduce/allow beaver (increases water storage) • Increase late summer flows	• Width/depth ratio, streambank condition, floodplain connectivity, change in peak/base flows, increase in drainage network (National Marine Fisheries Service 1996)
Organic materials	• Increase native vegetation, particularly in riparian areas (although note that small mammals and amphibians require woody debris, thus this should also be addressed in uplands) • In riparian areas, increase conifer:hardwood ratio (large wood from coniferous trees lasts longer instream) • Increase stream connectivity with and ecological integrity of floodplain (floodplain delivers organic materials to stream and riparian areas during flood events) • Addition of fish carcasses to stream	• Measure woody debris and leaf litter or retention time of same (relatively straightforward; Webster and Meyer 1997) • Measure instream nutrient retention time, nutrient spiraling, nutrient cycling (relatively complex; Allan 1995; Cederholm et al. 2000; Cederholm et al. 2001) • GIS: measure forest width and conifer:hardwood ratio or amount and types of vegetative cover (Schueler 1994; Xiang 1996)
Channel dynamics	• Reconnect isolated habitats (instream and terrestrial) • Use a variety of methods (TIA reduction, forest canopy increase, sediment control) to modify flow and sediment regimes to resemble undisturbed conditions • Reduce stream crossings • Control sediment inputs • Remove or modify fish passage barriers • Road removal or alteration • Structural additions (large wood, boulders) • Bank stabilization (vegetation plantings, gabion structures, etc.) • Fencing to avoid livestock grazing • Rest-rotation or grazing strategy • Conifer conversion • Dam removal/modification • Addition of large wood, boulders	• Benthic index of biological integrity (Spence et al. 1996; Karr and Chu 2000; Booth et al. 2001) • Fish-IBI (Regier et al. 1989) • Fraction of bed sediment below a threshold size (measures potentially lethal reductions in permeability allowing flow of oxygenated water to substrate) (Booth et al. 2001) • Cross section and bankfull channel boundary measurements, flood stage surveys, width-to-depth ratios, rates of bank or bed erosion (FIRSWG 1998; Prichard 1998) • Relative Bed Stability Index (Olsen et al. 1997, from Booth et al. 2001) • Riparian forest width measures (Spence et al. 1996) • Channel sinuosity measures (Spence et al. 1996) • Connectivity measures (aerial photography or fragmentation program such as FRAGSTATS) (FIRSWG 1998; FRAGSTATS available at http://www.umass.edu/landeco/research/fragstats/fragstats.html)
Habitat and connectivity	• Reconnect isolated habitats • Consider habitat patch size and shape • Increase native canopy and shrub cover • Control invasive and nonnative plants • Add water sources for wildlife • Plant food resources for wildlife • Manage to increase instream and terrestrial large woody debris • Introduce controlled fire regime to mimic natural disturbances • Improve fish passage	• Bird and wildlife use (FIRSWG 1998) • Large woody debris, instream and terrestrial (Beschta 1979; Dooley and Paulson 1988; FIRSWG 1988; Booth et al. 1997) • Riparian-dependent birds (Spence et al. 1996; Bureau of Land Management 2001) • Aerial photography (FIRSWG 1998) • B-IBI (Booth 1991; Spence et al. 1996; Karr and Chu 2000; Booth et al. 2001) • Sensitive fish (e.g., salmonids) (Spence et al. 1996) • Presence of area-sensitive species (needing large habitat patches) (Keller et al. 1993; Hodges and Krementz 1996;

Function or Value	Selected Potential Restoration Activities	Some Potential Indicators of Management Activity Effects
		Wenger 1999) • Instream habitat elements: substrate, large woody debris, pool frequency and quality, off-channel habitat, and refugia; % road crossings with inadequate culverts, % unscreened diversions, % impassable dams, frequency of off-channel habitats and LWD in riparian zone (National Marine Fisheries Service 1996; Spence et al. 1996) • Terrestrial habitat elements: percent vegetative cover, species density, size and age class distribution, planting survival and reproductive vigor (FIRSWG 1998) • Physical barriers such as culverts (National Marine Fisheries Service 1996) • Nonnative species (Spence et al. 1996) • % riparian zone within 100 m with natural riparian woody plants (Spence et al. 1996) • Beaver sign (Spence et al. 1996)
Reducing human disturbance	• Reduce edge effects • Reduce road effects • Limit trails (especially paved) in large habitat patches for Neotropical migratory birds, which are disturbance-sensitive • Reduce nonnative species through direct removal and/or habitat manipulations • Preserve endangered habitats and habitats critical to endangered species	• Presence, abundance, diversity of sensitive species, or sensitive species index such as B-IBI or Neotropical migratory breeding bird surveys (Spence et al. 1996; Karr and Chu 2000; Booth et al. 2001; Moore et al. 1993; Friesen et al. 1995; Nilon et al. 1995; Theobald et al. 1997; Mancke and Gavin 2000; Hennings 2001; Hennings and Edge 2003) • Bird nesting success studies and studies on associated predators (Small and Hunter 1988; Marzluff et al. 1998; Heske et al. 2001) • Vegetation surveys (Hennings 2001; Hennings and Edge 2003; Roni et al. 2002) • Recreational use surveys (FIRSWG 1998)

EXHIBIT F—ORDINANCE NO. 05-1077C

ATTACHMENT 3.

METRO'S PHASE I ECONOMIC, SOCIAL, ENVIRONMENTAL, AND ENERGY (ESEE) ANALYSIS

This report is available for review in the Metro Council's files or on Metro's website: **http://www.metro-region.org/nature**. In addition, copies may be requested from the Metro Planning Department, 600 N.E. Grand Ave., Portland, OR 97232, or by calling 503-797-1555.

METRO'S PHASE I ESEE ANALYSIS
April 2005

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METRO
People places • open spaces
Clean air and clean water do not stop at city limits or county lines. Neither does the need for jobs, a thriving economy, and good transportation choices for people and businesses in our region. Voters have asked Metro to help with the challenges that cross those lines and affect the 24 cities and three counties in the Portland metropolitan area.

A regional approach simply makes sense when it comes to protecting open space, caring for parks, planning for the best use of land, managing garbage disposal, and increasing recycling. Metro oversees world-class facilities such as the Oregon Zoo, which contributes to conservation and education, and the Oregon Convention Center, which benefits the region's economy.

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CHAPTER 1: INTRODUCTION

Purpose and Objectives

Metro's authority to plan for fish and wildlife habitat protection in the region derives from State Land Use Planning Goal 5: Natural Resources, Scenic and Historic Areas, and Open Spaces. The Goal 5 administrative rule (OAR 660-023) recognizes Metro's unique planning role and gives Metro the option to develop a functional plan to protect regionally significant fish and wildlife habitat[1] (OAR 660-023-080(3)). In 1996 the Metro Council voted to recognize the regional significance of fish and wildlife habitat and include protection in the functional plan.

In October 2000, the Metropolitan Policy Advisory Committee (MPAC) approved a vision for fish and wildlife habitat protection for the region, which was adopted by the Metro Council.

> The overall goal is to conserve, protect and restore a continuous ecologically viable streamside corridor system, from the streams' headwaters to their confluence with others streams and rivers, and with their floodplains in a manner that is integrated with the surrounding urban landscape. This system will be achieved through conservation, protection and appropriate restoration of streamside corridors through time. (Metro 2000)

In achieving the overall goal, the vision statement emphasizes the importance of balancing several goals, including livable communities and a strong economy with protection and enhancement of fish and wildlife habitat. Integrating the needs of people with the needs of fish and wildlife in an urban environment is not an easy task. There is debate on the value of protecting habitat in urban and developing areas, considering the difficulty many species have cohabiting with humans and the economic value of developable land in urban areas. Metro's policies have consistently placed a high level of importance on the protection of the natural environment as a means of maintaining the high quality of life citizens of this region expect.

The general economic, social, environmental, and energy (ESEE) tradeoffs of allowing, limiting, and prohibiting conflicting uses in fish and wildlife habitat areas are described in this report. The next step of Metro's planning process is to identify the specific ESEE tradeoffs of several program options, after which the Metro Council will make a decision to allow, limit, or prohibit conflicting uses in fish and wildlife habitat areas.

Description of the Goal 5 ESEE process

The Goal 5 process follows three steps. The first step is to identify regionally significant fish and wildlife habitat, which Metro completed in 2002. The economic, social, environment and energy (ESEE) analysis is the second step. Metro is now completing the first phase of a regional ESEE analysis. Metro will next apply the tradeoffs identified in the first phase of the analysis to several options for protection to evaluate where and how to protect fish and wildlife habitat. This will provide the Metro Council the information they need to make a decision about where development should be allowed, limited, or prohibited. The third step is to develop a program to

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[1] In this report, when we use the term "fish and wildlife habitat" we are referring to "regionally significant fish and wildlife habitat" as identified in Metro's Goal 5 Inventory.

protect significant fish and wildlife habitat. After Metro adoption, local cities and counties will have 2-4 years to comply with the regional fish and wildlife habitat protection program.

Oregon State Planning Goal 5 requires an analysis of the economic, social, environmental, and energy (ESEE) consequences that could result from a decision to allow, limit, or prohibit conflicting uses in fish and wildlife habitat. The rule requires that this analysis be completed before actions are taken to protect or not protect any regionally identified fish and wildlife habitat. Specifically, the rule requires the following steps:

1. Identify conflicting uses;
2. Determine the impact area;
3. Analyze the ESEE consequences; and
4. Develop a program to achieve Goal 5.

First, governments must identify conflicting uses that exist, or could occur, with regard to significant Goal 5 resource sites (fish and wildlife habitat). A conflicting use is a land use or activity that may negatively impact fish and wildlife habitat. Second, the rule requires a determination of the impact area, representing the extent to which land uses or activities in areas adjacent to habitat could negatively impact the habitat. The impact area identifies the geographic limits within which to conduct the ESEE analysis for significant fish and wildlife habitat. Third, the ESEE consequences analysis considers the impact of a decision to either fully protect fish and wildlife habitat, fully allow conflicting uses, or limit the conflicting uses. Jurisdictions that choose to limit conflicting uses must do so in a way that "protects the resource to the desired extent." The standards identified by the state for completing the ESEE analysis are procedural rather than substantive. Findings must show that the steps of the ESEE analysis are met, but OAR 660-23-040 states that: "[t]he ESEE analysis need not be lengthy or complex, but should enable reviewers to gain a clear understanding of the conflicts and consequences to be expected."

Regional policies guide Metro's ESEE analysis

Metro's role in identifying fish and wildlife habitat protection measures and incentives within its boundary has been established with adoption of the *Regional Urban Growth Goals and Objectives (RUGGOs)*, *Region 2040 Growth Concept* and the *Urban Growth Management Functional Plan*. Fish and wildlife habitat, by their very nature, cross jurisdictional boundaries and require management through regional, watershed-wide protection strategies. Metro has a role in working with local jurisdictions to determine the protection of these important habitats, just as it determines parking standards, transportation networks and land use densities for the region. Through extensive public involvement, the Metro Council has identified the need to balance natural resource protection with urban development while the region grows.

The Metro Council has adopted several policies following the direction of citizens that influence the ESEE consequences analysis. These policies provide the framework for protecting natural resources while managing urban growth in the region. Fish and wildlife habitat play a key role in maintaining the livability of the Metro region. Table 1-1 below summarizes key regional policies guiding Metro's work.[2]

[2] More extensive descriptions of these policies may be found in *Appendix A*.

Table 1-1. Regional policies guiding habitat protection efforts.

Policy	Description and relevance to habitat protection
Metro Charter *1992*	Required Metro to address issues of regional significance, such as land use and transportation planning as well as regional parks and open spaces. Identified the protection of natural systems – floodplains, rivers, streams, and wetlands – as a cornerstone for regional policies.
Greenspaces Master Plan *1992*	Articulated the vision for a cooperative, interconnected system of parks, natural areas, trails, and green ways for fish, wildlife and people. Recommended tools to protect greenspaces, such as acquisition, education and restoration. In 1995, voters passed a bond measure directing Metro to purchase regionally significant natural areas. Since then, more than 8,000 acres of natural areas have been acquired for permanent protection.
Future Vision Report *1995*	A key document in guiding land use management for the protection of fish and wildlife habitat. While not a regulatory document, it has greatly influenced the content of Metro's regional plans. States that the region should manage watersheds to protect, restore and maintain the integrity of streams, wetlands and floodplains, and their multiple biological, physical and social values. Identifies the need for restored ecosystems protected from future degradation.
Metro 2040 Growth Concept *1994*	Describes the preferred form of growth and development for the region, including how much the UGB should ultimately be expanded, ranges of density within the boundary, and which areas should be protected as open space. Basic philosophy is to preserve access to nature and build better communities.
Regional Urban Growth Goals and Objectives (RUGGO's) *1995*	Identifies goals and planning activities for the Metro region. Two objectives relate to water resources, and a third relates to wildlife habitat: Objective 12, Watershed Management and Regional Water Quality and Objective 13, Urban Water Supply; Objective 15, Natural Areas, Parks, Fish and Wildlife Habitat calls for an open space system capable of sustaining or enhancing native wildlife and plants.
Regional Framework Plan *1998*	Sets out the land-use, transportation, parks, water resources, natural hazards and related policy directives for the region's future. Three chapters address fish and wildlife habitat: Chapter 3: protection of lands outside the UGB for natural resource, future urban or other uses; Chapter 6: parks, open spaces and recreational facilities; and Chapter 7: water sources and storage.
Stream and Floodplain Protection Plan (Title 3) *1998*	Adopted by Metro as part of the Urban Growth Management Functional Plan, it establishes regional performance standards to address water quality and floodplain management. Recommends actions for the protection of fish and wildlife habitat. The completed sections of Title 3 meet the requirements for Statewide Planning Goal 6 (water quality) and Goal 7 (flood management).

As shown in the table above, Title 3 of Metro's Urban Growth Management Functional Plan addresses water quality, flood management, and fish and wildlife habitat conservation. Section 5(C) of Title 3 describes the steps that Metro must follow in order to establish a program to protect fish and wildlife habitat. These steps, shown below, relate to the process outlined in the state's Goal 5 administrative rule.

1) Establish criteria to define and identify regionally significant fish and wildlife habitat areas.
2) Adopt a map of regionally significant fish and wildlife areas after (a) examining existing Goal 5 data, reports and regulations from cities and counties, and (b) holding public hearings.
3) Identify inadequate or inconsistent data and protection in existing Goal 5 data, reports, and regulations on fish and wildlife habitat.
4) Complete Goal 5 economic, social, environmental, and energy (ESEE) analyses for mapped regionally significant fish and wildlife habitat areas only for those areas where inadequate or inconsistent data or protection has been identified.

5) Establish performance standards for protection of regionally significant fish and wildlife habitat that must be met by the plans' implementing ordinances of cities and counties.

Steps 1 and 2, establishing an inventory of regionally significant fish and wildlife habitat, have been completed and were adopted by the Metro Council in 2002.[3] Step 3 requires Metro to conduct an analysis of local jurisdictions' existing Goal 5 programs to determine inadequacy or inconsistency of these programs across the region. Metro's *Local Plan Analysis* satisfies the requirement (step 3) by providing a thorough analysis of local Goal 5 city and county programs (Metro 2002a). The analysis concludes that there are many inconsistencies and inadequacies in fish and wildlife habitat protection in the Metro region. Step 4 is the economic, social, environmental, and energy (ESEE) analysis. A region-wide analysis must be conducted that considers the economic, social, environmental, and energy consequences of allowing, limiting, or prohibiting conflicting uses before a program can be developed (Step 5).

Metro's approach to the analysis

Goal 5 has previously been completed by city or county governments, focusing on the natural resources (or other Goal 5 resources) that fall within their specific jurisdictions. However, Metro was given the ability to choose to protect Goal 5 resources at a regional level in the state administrative rule. Streams and rivers, forests and meadows, and the fish and wildlife that inhabit them do not acknowledge jurisdictional boundaries. The economy of the region also functions at a larger scale than just one city or county. Just as it makes sense to plan for transportation needs across the Portland metropolitan region (Metro region), consideration of the protection of fish and wildlife habitat at a larger scale allows for greater understanding of the connections between habitats and the functions of the ecosystem as a whole. Now the task at hand is to weigh the economic, social, environmental, and energy (ESEE) consequences of protecting fish and wildlife habitat within the Metro region. Many issues are similar to those encountered at a city or county; however, some are different such as Metro's ability to add land to the urban growth boundary (UGB) to prevent a net loss of buildable land due to fish and wildlife protection.[4]

Metro's approach for conducting a region-wide ESEE consequences analysis focuses on achieving the goals of the 2040 Growth Concept. The goals in the Growth Concept, the Future Vision, the Regional Framework Plan (implemented through the Urban Growth Management Functional Plan) and Metro's Vision Statement for Protecting Fish and Wildlife Habitat all specify that the region should manage growth while protecting the natural environment, maintaining a high quality of life, and providing affordable housing options.

Development of the 2040 Growth Concept included the balancing of goals in some ways similar to an ESEE analysis. Citizens and policymakers chose to increase density in centers and along major transportation routes (e.g., light rail, main streets) to minimize sprawl and avoid the addition of more land to the urban growth boundary. Green corridors and protection along streams and rivers was identified as a critical component of maintaining a high quality of life in a densely populated region. Transportation plays a critical role in the overall concept: without

[3] See Metro's *Riparian corridor and wildlife habitat inventories* (Metro 2002d) and *Technical Report for Goal 5* (Metro 2002c).
[4] This topic is discussed in more detail at the end of this chapter.

efficient public transit as well as opportunities to walk, bike or drive from home to shops, jobs, and recreation the compact communities envisioned would not function. Metro's current efforts to protect fish and wildlife habitat help further the goals in the 2040 Growth Concept.

Metro has taken a regional approach to the ESEE analysis, considering the overall tradeoffs of protecting or not protecting fish and wildlife habitat. The analysis is general and contains qualitative and, where possible, quantitative, descriptions of tradeoffs. The conflicting use and economic analyses contain specific acreage figures but at a regional scale. Additional analysis will be conducted in the next step of the planning process in the evaluation of the tradeoffs of several program options. Frequently, a consequence could fall in more than one ESEE category. For example, flooding has negative economic consequences (cost to repair damaged structures), social consequences (families lose irreplaceable items like photos), environmental consequences (changes to the stream system), and energy consequences (energy used to repair buildings). Many consequences cross categories and Metro staff used professional judgement to determine which category was most effective for describing the consequences.

This ESEE analysis does not result in a final decision to allow, limit, or prohibit conflicting uses in fish and wildlife habitat. The analysis describes the tradeoffs in a general fashion to help the Metro Council evaluate program options during the next step of the planning process. The Metro Council will complete the ESEE by making allow, limit, or prohibit decisions for fish and wildlife habitat.

Local Goal 5 programs

Most of the local jurisdictions in the Metro region have adopted Goal 5 programs that have been acknowledged by Oregon's Department of Land Conservation and Development as being in compliance with the state rule. Some of these programs were developed prior to Goal 5 rule revisions in 1996, while a few have been done more recently. The rule requires local jurisdictions to balance the need to protect natural resources against other state goals such as housing (Goal 10) and transportation (Goal 12) while providing ample opportunity for citizen involvement (Goal 1). Thus, the state rule allows local jurisdictions' Goal 5 programs to be in compliance with state law while being inconsistent with each other. However, Metro's code required an analysis of the consistency of local fish and wildlife protection prior to conducting a regional ESEE analysis and a regional protection program.

Metro staff conducted an analysis of local Goal 5 programs beginning in 1999 and culminating in a report to the Metro Council (Metro 2002a). The analysis demonstrated that there are many inconsistencies and inadequacies in fish and wildlife protection in the Metro region. An important reason for the inconsistency in local protection is that the Goal 5 rule does not set a specific standard, rather it lays out a process for jurisdictions to follow. The process described by state law allows jurisdictions to choose which resources to protect and the level of protection received after balancing the consequences of protection with the economic, social, and energy needs within the jurisdiction. Most jurisdictions choose to "limit" conflicting uses in fish and wildlife habitat areas, the Goal 5 rule defines this choice as "conflicting uses should be allowed in a limited way that protects the resource to the desired extent." This language gives local governments wide discretion in designing protection programs.

Metro's Regional Urban Growth Goals and Objectives (RUGGOs) and the Vision Statement emphasize the importance of protecting fish and wildlife habitat and recognize the need to provide a more consistent level of protection throughout the region. Metro's ESEE analysis identifies the tradeoffs of allowing, limiting, or prohibiting development consistently across the region.

Federal and state habitat protection policies

There are many policies that focus attention on the protection of fish and wildlife habitat. This section provides a brief overview of the key federal and state policies that set requirements for jurisdictions and agencies for fish and wildlife habitat protection.[5] While Metro is not required by law to address most of the policies described in Table 1-2 on the following page, a regional fish and wildlife habitat protection plan will help to meet the goals described by many of the federal and state policies.[6]

The federal Endangered Species Act and the Clean Water Act most specifically relate to Metro's current efforts to protect fish and wildlife habitat. NOAA Fisheries is currently developing recovery plans for listed salmon species. Metro's inventory of regionally significant fish and wildlife habitat has identified habitat upon which listed salmon depend for some part of their life histories. Coordinating Metro's program with NOAA Fisheries recovery plan as it is developed will not only assist in long-term recovery of the species, but also with local compliance with the ESA.

The Oregon Department of Environmental Quality (DEQ) is required by the federal Clean Water Act to maintain a list of steam segments that do not meet water quality standards, called the 303(d) list (DEQ 2003a). Many of the region's streams are 303(d) listed as water-quality impaired due to elevated temperatures.[7] Once a stream or river segment is 303(d) listed, the DEQ is responsible for developing water quality standards that protect beneficial uses of rivers, streams and lakes. These standards, called Total Maximum Daily Load (TMDL) determinations, are specific to 303(d) listed segments of rivers and streams and the problems identified in those segments, but are developed using a comprehensive approach that considers a larger geographic area, such as a watershed (DEQ 2003).

TMDLs outline how much pollution a water body can receive and still not violate water quality standards. Once TMDL standards are established, the state monitors water quality and reviews available data and information to determine if these standards are being met and water is protected. A stream or river segment can be "de-listed," or removed from the 303(d) water quality limited list, when TMDL determinations are made, or when new data indicates the

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[5] Additional descriptions of these policies may be found in *Appendix A*.
[6] Metro must address activities on land owned by Metro, such as the take provisions of the ESA, local standards adopted to comply with the CWA, and state wetland laws.
[7] Appendix B includes two tables showing the DEQ's 1998 and 2002 303(d) listings of water quality limited water bodies in the Metro region (courtesy Don Yon, Oregon DEQ, 2003). Note that the 1998 list is substantially longer than the 2002 list. This does not mean that the water quality has improved; stream reaches that were on the 1998 list, but not on the 2002 list, typically indicate that a TMDL was developed, not that the particular pollution problem was solved.

waterbody meets water quality standards. The 303(d) listing identifies the problem(s); TMDLs provide a plan to improve water quality and meet federal clean water standards.

Metro's Stream and Floodplain Protection Plan (Title 3), described earlier, addresses water quality. However, many streams in the region still suffer from degraded water quality, and more recent science calls for greater protections than were in place when Title 3 was developed. Current efforts to improve water quality for fish habitat will also help to meet the federal standards in the Clean Water Act.

Table 1-2. Federal and state policies guiding fish and wildlife habitat protection.

Policy	Description
Federal policies	
Endangered Species Act (ESA)	The purpose of the ESA is "to provide a means whereby the ecosystems upon which endangered species and threatened species depend may be conserved." Requires federal agencies to identify critical habitat for endangered and threatened species, create a recovery plan for those species and in some circumstances issue regulations that provide for the conservation of such species. Above all, the act prohibits any individual, group of individuals, states, cities and counties from "taking" a listed species.[1] Twelve species of salmon and steelhead are listed as either threatened or endangered in the Columbia River and Willamette River Basins.
Clean Water Act (CWA)	Sets a national goal to "restore and maintain the chemical, physical and biological integrity of the Nation's waters." In Oregon, the CWA is implemented by the DEQ with review and approval by the U.S. EPA. The DEQ has the responsibility for protecting the beneficial uses of rivers, streams and lakes of the state. Beneficial uses include drinking water, cold water fisheries, industrial water supply, recreation and agricultural uses.
Northwest Power Act	Requires the Bonneville Power Administration to implement a Fish and Wildlife Program that mitigates for the degradation to both fish and wildlife habitat caused by the Columbia Hydropower System. Complying with the Fish and Wildlife Program is achieved primarily through subbasin plans developed with oversight from the Northwest Power Planning Council.
Magnuson-Stevens Fishery Conservation and Management Act	Requires federal agencies to consult with NOAA Fisheries on activities that may adversely affect essential fish habitat (EFH). Defines EFH as "those waters and substrate necessary to fish for spawning, breeding, feeding or growth to maturity." The Pacific Fishery Management Council identified EFH for pacific coast salmon. Those areas generally include "waters and substrate necessary for salmon production needed to support a long-term sustainable salmon fishery and … a healthy ecosystem."
State policies	
Oregon Plan for Salmon and Watersheds	The mission of the Oregon Plan is "to restore our native fish populations – and the aquatic systems that support them – to productive and sustainable levels that will provide substantial environmental, cultural and economic benefits." Initiated to address restoration of coastal coho salmon, the Oregon Legislature later incorporated other related efforts into one overarching framework. Designed to restore the healthy function of Oregon's natural aquatic systems.
Native Fish Conservation Policy	The purpose of the policy is: "to ensure the conservation and recovery of native fish in Oregon." Focuses on "naturally produced native fish" which are those fish species that "reproduce and complete their full life cycle in natural habitats." The reason for this focus on naturally produced fish is that those "native fish are the primary basis for Endangered Species Act de-listing decisions and the foundation for long-term sustainability of native species and hatchery programs."
Oregon Endangered Species Act	Intended to manage the listed "species and their habitats so that the status of the species improves to a point where listing is no longer necessary." Species are listed when they are: (1) native, and (2) in danger of extinction throughout any significant portion of its range (endangered) or (3) likely to become an endangered species within the foreseeable future throughout any significant portion of its range (threatened).
Oregon Wetland Regulatory Program	The Oregon Division of State Lands (DSL) administers Oregon's removal/fill law. Using similar definitions as the federal government, DSL determines wetland boundaries and water bodies that meet the definition of "waters of the state." A permit is required for fill or removal equal to or exceeding 50 cubic yards or more of material in any waters of the state at one location.
Essential Indigenous Anadromous Salmonid Habitat	In an effort to identify and protect essential habitat for salmon and trout, the Oregon Legislature in 1993 required DSL to identify essential indigenous anadromous salmon habitat. DSL has defined such habitat as: "habitat that is necessary to prevent the depletion of indigenous anadromous salmonid species during their life history stages of spawning and rearing."

[1]The term "take" means to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to engage in any such conduct.
Acronyms: DEQ: Department of Environmental Quality; EPA: Environmental Protection Agency; NOAA: National Oceanic and Atmospheric Administration.

Public opinion on habitat protection

In a national survey on biodiversity, respondents strongly agreed (69 percent) with the statement "[w]e have a personal responsibility to the earth to protect all plant and animal life"; and strongly agreed (71 percent) with the statement "[n]ature provides me with inspiration and peace of mind." (Belden, Russonello & Stewart, 2002). Residents of the Metro region are known for placing a high value on the natural environment, which some believe adds to a high quality of life. Many people move to the region to take advantage of the close proximity to hiking, biking, boating and other outdoor activities. Residents also enjoy access to nature in the city: hiking in Forest Park, boating on the Willamette, birding at Smith and Bybee Lakes. Residents of the region have emphasized the protection and restoration of parks and open spaces through public surveys over the last several years. Metro has been particularly interested in public opinion regarding the protection of fish and wildlife habitat in recent years.

Several opinion surveys were conducted in 2001, including a May 2001 Davis and Hibbits phone survey commissioned by Metro, an October 2001 Moore Information survey sponsored by KGW-TV and the Portland Tribune, and an informal "SurveyPoint" poll available by phone and on Metro's website. Results from all three studies demonstrated that Metro residents place great value on protecting natural resources and maintaining the region's quality of life. In 2002 Davis, Hibbitts, & McCaig conducted a survey for Clean Water Services in Washington County that showed a mix of values related to healthy streams. The general public and streamside property owners rated clean drinking water, clean rivers and streams, and open space for fish and wildlife habitat as being "most important"; but rated healthy fish populations in local streams and adequate water in streams for fish and wildlife as being "least important". This contradiction is especially interesting since clean rivers and streams locally are a requirement for healthy fish populations regionally.

Metro held "Coffee Talks" from September 2001 through January 2002, a series of 93 small group dialogues in various locales throughout the urban region. Discussions focused on the urban growth boundary, fish and wildlife habitat protection, and transportation. The Coffee Talks were advertised via local radio, television, and newspapers. In addition, approximately 90,000 citizens received an October 2001 "Let's Talk" about fish and wildlife newsletter, including some 45,000 property owners with land in the inventory. An important component of these talks involved whether the public thought it was important to protect fish and wildlife habitat in the urban region and if so, how this should be accomplished. This public feedback was distributed to Metro staff and Councilors for consideration in the planning process. One important outcome of this process was indication of strong public support for Metro's efforts to maintain and enhance natural habitat areas.

In March 2002, Metro held a regional conference and five localized workshops to garner public opinion and participation entitled "Let's Talk" (Metro 2002b). Metro undertook a major notification process to encourage attendance to these activities, including the fall 2001 Natural Resource Protection mailing of nearly 90,000 to property owners and interested parties; press releases to major and local newspapers; partnership with KGW, a major local television station; and follow-up calls to neighborhood associations, business interests and other parties to encourage participation. About 1,000 people attended the conference and workshops. The results confirm the importance of natural resource protection to the area's citizens, and interest in several strategies for natural resource protection emerged – perhaps most notably, financial incentives for protection as well as disincentives for failing to protect these resources.

Overview of Metro's fish and wildlife habitat inventory

Metro has the authority pursuant to Oregon Administrative Rule chapter 660, division 23, to identify "regional resources." A regional resource is defined by the Goal 5 rule as "a site containing a significant Goal 5 resource, including but not limited to a riparian corridor, wetland, or open space, which is identified as a regional resource on a map adopted by Metro ordinance." Metro's Goal 5 work addresses the following Goal 5 resources: riparian corridors, associated wetlands, and wildlife habitat. This report uses the term "regional resource" or "resource" interchangeably with "riparian corridors and upland wildlife habitat," or simply "fish and wildlife habitat." A regional approach to inventorying fish and wildlife habitat requires a consistent level of data and analysis across the entire Metro region. Metro's fish and wildlife habitat inventory is based on the best available information that can be applied consistently at a regional scale.

Metro completed its inventory of fish and wildlife habitat in 2002. Metro took an ecological functions approach to define the riparian corridor and identify upland wildlife habitat, based on its extensive scientific literature review (Metro 2002c). This approach combines geographic information system (GIS) mapping technology, scientific recommendations, and fieldwork for an inventory that encompasses the entire Metro region. The methodology assigns values to fish and wildlife habitat features that allows comparison of their cumulative importance. Below is a short overview of the current state of fish and wildlife habitat in the region, followed by a description of the inventory methodology.

State of the region's fish and wildlife habitat

Habitat loss, alteration, and significant increases in the amount of impervious land cover characterize the Metro region. More than one-fourth of all surface streams (about 400 miles) have been removed or piped underground, and many of the remaining stream miles suffer from degraded water quality, fragmentation, and simplification (loss of structural and functional diversity) of riparian corridors for fish and wildlife. Ninety-six percent of the land in the Willamette basin under 500 feet in elevation is privately owned and has been converted to agricultural or urban use (Willamette Urban Watershed Network 2000). A recent study of tree cover in the Willamette/Lower Columbia Region found a reduction in tree canopy cover from 46 percent in 1972 to 24 percent at present (American Forests 2001). Average tree cover in the region's urban areas is only 12 percent, down from nearly 21 percent in 1972. Eleven percent of the Metro region's natural areas[8] were lost between 1989-1999, with accompanying adverse effects on watershed hydrology and wildlife habitat.

Below are some examples of changes in our region's fish and wildlife habitat over time. The Metro region has experienced substantial vegetation loss, harming wildlife and habitat. For example:

[8] Identified by Metro's Parks and Greenspaces Department, includes undeveloped areas providing fish and wildlife habitat value.

- There has been a ***43 percent decline in forest cover*** from levels prior to substantial urbanization (i.e., 1850's), with very serious repercussions for wildlife and hydrology. Forest composition has also changed due to loss of old growth forests and white oak woodlands. The species depending on these habitats are disappearing (Metro 2002c).
- ***Current riparian/wetland forest is only 17 percent of historic levels***. Riparian wildlife habitat has more closely associated species (64, excluding fish) than any other terrestrial habitat type, including 11 species at risk in Oregon and/or nationally, with at least two more species now lost from this region (Metro 2002c).
- Of all habitat types in the Metro region, the greatest change in vegetation type has been the ***near-complete loss of grassland and oak savanna***; current estimates are that less than one percent of the historic extent still exists in small, scattered patches. ***Grassland bird species are declining precipitously*** in the Metro area, with several species lost and more that will disappear from the region if trends continue.[9]
- ***Agriculture and urban land uses comprise 55 percent*** of the land area in the region. Urban land cover is overtaking agricultural lands in the Metro region, with important hydrologic and wildlife repercussions.[10]

The riparian corridors and wildlife habitat that remain in our region, especially those providing a high ecological functional value, are scarce and diminishing as more land is urbanized.

Riparian corridors

As described in Metro's Technical Report for Goal 5 (science review; Metro 2002c), the riparian corridor refers to the land and vegetation adjacent to waterbodies such as streams, rivers, wetlands and lakes that are influenced by perennial or intermittent water. According to the scientific literature reviewed, riparian corridors provide important ecological benefits for fish and wildlife including:

1. Microclimate and shade
2. Streamflow moderation and water storage
3. Bank stabilization, sediment and pollution control
4. Large wood and channel dynamics
5. Organic matter input

The ecological functions listed above provide the basis for Metro's delineation of riparian corridors. In the spring of 2001, Metro launched an effort to map the ecological functions of riparian corridors and the specific landscape features that are associated with these functions. Features include stands of trees, woody vegetation, meadows, wetlands, steep slopes, and flood areas that are located along the region's streams and rivers. Based on the scientific literature, Metro identified areas where landscape features make a substantial, or "primary," contribution to providing an ecological function to the stream. Areas identified as "primary" receive a score of

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[9] See Table 8 in Metro's *Riparian Corridor and Wildlife Habitat Inventories*, Metro 2002d.
[10] Agricultural lands are more water-permeable than urban lands, and are used by grassland species as "surrogate" grassland habitat.

six points. Landscape features that fall within the outer part of the range described in the scientific literature provide riparian function to a lesser degree and are said to serve a "secondary function" and receive one point. All areas that provide function to the stream are thus mapped and receive a score.

The scores are additive for any given landscape feature and reflect relative ecological function at any given point on the map. For example, a location on the map could contribute significantly to all five functions listed above and receive a score of 30 (five primary functions times six points each). Another location may receive primary scores for three functions (three primary functions times six points) plus secondary functions for up to two other functions (18 points for primary functions, plus two points for secondary functions). Still another location may receive only a single point for one secondary function (for example, developed floodplains). ***The Metro Council determined that all areas receiving a score for providing riparian ecological function are regionally significant.***

Wildlife habitat

The Goal 5 rule defines wildlife habitat as

> …[A]n area upon which wildlife depend in order to meet their requirements for food, water, shelter, and reproduction. Examples include wildlife migration corridors, big game winter range, and nesting and roosting sites. (OAR 660-023-0110(1)(b)).

The rule does not provide specific guidance on how to identify significant wildlife habitats other than referring to the standard inventory process (OAR 660-23-030) and minimum consultation requirements outlined in OAR 660-23-110. The Goal 5 rule allows a jurisdiction flexibility in defining the area for which a significance determination must be made.

Metro's approach to identifying the region's important wildlife habitats was based on a combination of: (1) best available scientific literature; (2) GIS modeling; (3) field studies to address the Goal 5 rule to determine the location, quantity and quality of potential wildlife habitat, as well as the adequacy of that information; and (4) local expertise to identify locations of sensitive species and habitats (Habitats of Concern). The model assigns values to wildlife habitat features that allow comparison of their cumulative importance to the regional wildlife habitat network. In early 2001, Metro mapped wildlife habitat based on specific features associated with these characteristics. Features include stands of trees, woody vegetation, meadows, and wetlands located within the region. The wildlife model is based on four criteria:

1. habitat patch size (minimum patch size of 2 acres unless a Habitat of Concern),
2. proximity to water sources,
3. proximity to other natural areas, and
4. forest interior habitat.

In brief, larger habitat patches are more valuable to native wildlife than smaller patches because more species are retained over time, and species sensitive to human disturbance still have a place to live. Rounder patches are better than long, narrow patches to reduce negative edge effects. Water within or near habitat patches is important so animals can drink. Connectivity to other natural area patches is key to maintaining biodiversity; sometimes local populations become extinct and connectivity provides the means for reintroducing that species, as well as maintaining the genetic diversity important to the long-term health of a population.

Metro's model accounts for edge effects and habitat quality, as verified by scientific fieldwork conducted in 2001. The habitat attributes positively associated with increasing scores[11] in Metro's GIS model include:

- More downed wood and logs
- More food resources
- A wider variety of food resources
- Food availability over longer periods
- Fewer non-native trees
- Fewer non-native shrubs
- Fewer non-native herbs
- Increased structural diversity
- More wildlife cover available throughout the year
- More nesting and den sites (snags, root wads, rocky crevices, etc.)
- Less human disturbance onsite or nearby
- Better wildlife diversity onsite
- More year-round availability of water
- Healthier stream channel morphology
- More vegetative cover near water sources
- More types of water resources (streams, wetlands, etc.)

Each habitat patch was ranked and assigned a score for each of the model criteria, relative to other habitat patches. Sites were subsequently separated into three classes, of up to three possible points, for each criterion. The scores are additive for any given habitat patch and reflect relative wildlife habitat value for each of the habitat patches identified on the map. In addition to the wildlife habitat model, Metro worked with local experts and agency staff to identify "Habitats of Concern." Habitats of Concern are those sites known to be critical for sensitive species or to be scarce and declining in the Metro region. ***The Metro Council determined that all areas receiving a score of two or greater are regionally significant, plus sites identified as a Habitat of Concern.***

Fish and habitat classification

Metro's inventories of fish and wildlife habitat provide a wealth of information on the relative ecological value of specific sites across the region. The inventory methodology distinguished between habitat function with as much precision as possible to make an informed decision on regional significance. The upland wildlife habitat was evaluated separately from the riparian wildlife habitat areas. However, a method of classifying the fish and wildlife habitat together becomes useful in the ESEE to facilitate distinguishing the tradeoffs of protecting or not

[11] Statistically significant results of simple linear regression. For more detailed statistical findings, see Metro's *Riparian corridors and wildlife habitat inventory* (Metro 2002c).

protecting the habitat areas and, later, in the protection program. For the ESEE analysis, Metro classified fish and wildlife habitat based on the ecological function scores into six classes, under two main categories: riparian/wildlife and upland wildlife. Each class covers a geographically discrete portion of the inventory, and may include riparian and/or wildlife functions and also may be a Habitat of Concern. Class I riparian/wildlife and Class A upland wildlife are the highest value. More description of the classification system may be found in the *Conflicting Uses* chapter.

Definition of allow, limit, prohibit

In Metro's ESEE analysis the consequences of allowing, limiting, or prohibiting identified conflicting uses on fish and wildlife habitat are described. The Goal 5 rule requires that a program be developed that is based on and supported by the ESEE analysis, and that describes the degree of protection intended for the fish and wildlife habitat. Although the ESEE consequences analysis is described in terms of "allow, limit, or prohibit," the Goal 5 program may be some combination of the three scenarios, such as "strictly limit" (between prohibit and limit), "limit," or "moderately limit" (between limit and allow).

Allow a conflicting use

According to the Goal 5 rule, "a local government may decide that the conflicting use should be allowed fully, notwithstanding the possible impacts on the resource site." The Goal 5 rule also requires that the ESEE analysis "demonstrate that the conflicting use is of sufficient importance relative to the resource site, and must indicate why measures to protect the resource to some extent should not be provided." [660-23-040 (5)(a)] For example, the economic and social benefits of allowing an industrial use may outweigh the environmental and energy benefits of protecting the fish and wildlife habitat because of the additional jobs and increased tax base the development may create.

A decision to allow the conflicting use does not necessarily preclude habitat protection. All development in a fish and wildlife habitat area would be subject to existing local, state, and federal government regulations. For example, Title 3 (water quality) setbacks are required for new development along streams. In addition, incentives and/or educational materials could be developed to encourage stewardship and other voluntary protection measures.

Limit conflicting use

According to the Goal 5 rule, "a local government may decide that both the resource site and the conflicting uses are important compared to each other, and, based on the ESEE analysis, the conflicting uses should be allowed in a limited way that protects the resource site to a desired extent." [660-23-404(5)(b)]

A program to limit a conflicting use can be designed to allow some level of development with certain restrictions to protect the fish and wildlife habitat to the maximum extent possible. For example, the disturbance area may be limited in size ("x" number of square feet) and location (as far from the water feature as possible). Design standards may also be required to lessen the impact on the habitat (e.g., tree retention, cluster development, impervious surface reduction, etc.). In addition, mitigation standards may be required to replace lost habitat functions (e.g., plant native vegetation).

Prohibit a conflicting use

A Goal 5 resource (i.e., fish and wildlife habitat) would receive the highest level of protection with a decision to prohibit conflicting uses. According to the Goal 5 rule, "a local government may decide that a significant resource site is of such importance compared to the conflicting uses, and the ESEE consequences of allowing the conflicting uses are so detrimental to the resource, that the conflicting uses should be prohibited." [660-23-404(5)(c)] For example, development may be prohibited within a highly valuable riparian corridor with intact vegetation. Some development, however, may be allowed if all economic use of a property is lost through full protection. This could occur when a parcel of otherwise developable land is located fully within a riparian corridor.

Impact of ESEE decision on the UGB

A decision to limit or prohibit conflicting uses in fish and wildlife habitat areas could impact the amount of buildable land available to meet the jobs and housing needs of the Metro region within the UGB. If land for employment and housing were protected, then the Metro Council is required to consider either increasing densities or changing design type designations in other parts of the region. If the 20-year demand for growth still cannot be met, the Metro Council has the authority to expand the UGB to meet regional needs. At the regional level, expanding the UGB has the potential to mitigate the negative consequences on jobs and housing of limiting or prohibiting development. However, not all uses are "substitutable" or able to be relocated from one part of the region to another. For example, it is easier to relocate housing than water-dependent industrial uses. Expanding the UGB to allow for protection of fish and wildlife habitat may be one method to minimize clashes with conflicting uses. However, such a decision may increase expenditures associated with extending infrastructure, vehicle miles traveled, and other development related expenses.

Organization of this report

This ESEE analysis describes the tradeoffs associated with allowing, limiting, or prohibiting conflicting uses in fish and wildlife habitat areas. The goals are to follow the steps outlined in the Goal 5 rule and to provide sufficient information for the Metro Council to evaluate program options for the protection of fish and wildlife habitat.

The second chapter, *Impact Areas*, identifies the area within which conflicting uses adversely affect the fish and wildlife habitat. Chapter three, *Conflicting Uses,* describes the land uses and activities that negatively impact fish and wildlife habitat, including a substantial amount of data related to the inventory, fish and wildlife habitat classification, and acreage figures for types of conflicting uses.

Chapters four through seven *(Economic Consequences, Social Consequences, Environmental Consequences,* and *Energy Consequences)* contain Metro's analysis of the ESEE consequences for the region.

Chapter eight, *Summary and Conclusions,* highlights the main ESEE tradeoffs and the implications for the next step of Metro's planning process in the development of a fish and wildlife habitat protection plan.

CHAPTER 2: IMPACT AREAS

Introduction

One step of the economic, social, environmental, and energy (ESEE) analysis is to identify "impact areas." The ESEE analysis is conducted for both the resource area (in this case, regionally significant riparian corridors and wildlife habitat) and the impact area. Under the Goal 5 rule, Metro may develop a program that applies to both the regionally significant fish and wildlife habitat and the impact area.

Definition of the impact area

Under the Goal 5 rule, Metro must identify an impact area for all regionally significant fish and wildlife habitat:

> *Local governments shall determine an impact area for each significant resource site. The impact area shall be drawn to include only the area in which allowed uses could adversely affect the identified resource. The impact area defines the geographic limits within which to conduct an ESEE analysis for the identified significant resource. (OAR 660-23-040(3))*

Simply put, the impact area defines an area where allowed land uses or activities could harm the fish and wildlife habitat. The impact area may be larger than the identified significant fish and wildlife habitat or it may be as small as the fish and wildlife habitat itself. For example, impact areas for riparian corridors could encompass lands outside the corridor that contribute to riparian function. Development near streams and wetlands removes vegetation that would otherwise contribute to riparian function by providing shade, sedimentation control, and water storage. Developed areas near streams and wetlands can be included within impact areas because they are sources of run-off from impervious surfaces, human disturbance, noise, lighting, toxins, fertilizers and pesticides. Each of these influences may adversely affect riparian areas and wildlife habitat.

The Goal 5 rule allows substantial discretion in determining the impact area for fish and wildlife habitats. Recent court decisions dictate that the size and extent of the impact area can be quite large, so long as there are reasons to support the impact area decision.[12] For example, the extent of an impact area could include the entire watershed.

As documented in Metro's science paper, the effects of urbanization on the functions and values of fish and wildlife habitat are pervasive.[13] A compelling case can be made for identifying the entire watershed as an impact area based on the cumulative effects of urbanization, such as road density, impervious surfaces and altered hydrology, vegetation loss and alteration, and species depletion. However, doing so may necessitate an ESEE analysis for the entire watershed, which significantly encumbers the Goal 5 planning process. Stormwater management through watershed planning may be more realistic for addressing these larger, more pervasive effects of

[12] Sanders v. Yamhill County, 34 Or LUBA 782 (1998).
[13] Metro's Technical Report for Goal 5, August, 2002, pages 33-50.

urbanization on the function of fish and wildlife habitats.[14] Metro's current work plan calls for addressing regional stormwater issues following completion of the fish and wildlife program.

Local examples[15]

Local jurisdictions complying with the Goal 5 rule have used a variety of means to determine impact areas, with approaches ranging from simple to complex. In the simplest approach the impact area and the fish and wildlife habitat area can be the same, and some local jurisdictions have selected that option. For example, the city of Fairview, city of St. Helens, and Deschutes County consider the impact area to be the same as the habitat area. Note that Fairview, under the old Goal 5 rule, stated, "the Fairview impact area could reasonably be the entire City." However, Fairview did not identify a specific impact area outside of the habitat area, as it would serve "no useful purpose."

Some jurisdictions utilize setbacks to define impact areas. For example, the city of Wilsonville chose to implement a 25-foot impact area in addition to the habitat area "because it was protective of the resource, provided a reasonable review of development, and allowed a buffer area for the storm sewer system."

Other jurisdictions assign impact areas that vary based on fish and wildlife habitat. For example, Lake Oswego uses the impact area to refer to "the area where development siting standards are recommended to mitigate identified adverse impacts." The City's definition of the impact area varies based on the habitat type (e.g., 30-foot impact area on each side of a Class 1 stream, with different impact areas for other types of stream). The impact area width ranges from 25-30 feet (in which no new structures may be built), but there is an additional 10-foot construction setback. However, upon development and drawing of the final plat, the 30-foot setback outer line then becomes the hard-and-fast line and everything within becomes the protection area. For upland tree groves there are no impact areas.

In Tualatin, the impact area also varies based on the habitat type. The impact area for wetlands includes the wetland plus a 25-foot setback surrounding the wetland. Some upland wildlife habitat within 50 feet of certain wetlands plus any adjacent steeply sloped areas are also included in the impact area. Open space areas do not include any additional land as an impact area, and for forested habitat sites the impact area extends to the edge of the canopy. These examples are a sampling of the broad range of choices available for designating impact areas.

Metro's approach

Metro's riparian corridor inventory covers a substantial portion of the landscape and describes the features that provide function to the riparian corridor. Areas that received a score of one to 30 are identified as regionally significant habitat. The wildlife habitat inventory excludes substantial low-structure vegetation, most forested habitat patches less than two acres, and habitat patches scoring less than two in the model (approximately 2,070 acres in the 2-20 acre size range). The potential impacts of adjacent land use on wildlife habitat are important.

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[14] Stormwater management and watershed planning are identified in Metro's Regional Growth Goals and Objectives, the Regional Framework Plan, and Title 3 as issues of regional concern.
[15] See Metro's *Local Plan Analysis* (Metro 2002) for more information.

However, the advantages of additional impact areas may be higher for vulnerable riparian areas (within 150 feet of a water feature) than for upland wildlife habitat. Therefore, a larger impact area for riparian areas close to water features has been identified than for wildlife habitat and riparian resources further than 150 feet from water.

Riparian impact areas beyond the existing inventory include the areas adjacent to the most vulnerable resources such as streams, wetlands and lakes with little or no riparian vegetation. All land uses in a watershed impact the streams within it, but Metro's scientific literature review indicates that the area providing the most important ecological functions to the stream generally falls within 150 feet. Therefore the ***riparian impact area*** has been defined as the area within 150 feet of a stream, wetland or lake that otherwise is not included in the inventory. Developed floodplains that are included in the inventory do not have an additional impact area. The ***vegetation impact area*** is defined as 25 feet around all remaining resources to protect the tree root zone area and low-structure vegetation. Using this method to identify the impact area adds 16,323 acres to the inventory of regionally significant fish and wildlife habitat to be analyzed for ESEE consequences.

There are many ways to determine impact areas under the Goal 5 rule. Metro's impact area focuses primarily on two aspects of the Goal 5 fish and wildlife habitat inventories: primary functional criteria for streams and waterbodies, and tree root-zone protection. This impact area protects the vulnerability of the fish and wildlife habitat. An ecologically appropriate impact area designation also helps Metro and its partners identify key restoration areas.

Riparian corridor impact area

Aquatic resources such as streams, wetlands and lakes may be strongly influenced by adjacent land use, and their degradation may cause cascading negative effects downstream. For example, an eroding streambank has negative consequences for instream habitat both onsite and downstream. This is particularly true when there is little or no existing vegetation nearby. When these conditions exist, streams, rivers, and wetlands are unlikely to receive the benefits of any Goal 5 program without additional impact areas. These water resources are likely to be in close proximity to developed areas where runoff, sediments, excess nutrients and pollutants can make their way directly to the water without the moderating influences provided by vegetation. These resources may be the areas most adversely impacted by adjacent land uses and practices.

While all land uses in a watershed impact the water bodies within it, the scientific literature review shows that the area providing primary function to the stream generally falls within 150 feet[16]. Adjacent land use has the strongest influence on waterways within the 150-foot zone, where the majority of primary ecological functions are either being provided, or would be if the area were not developed. Areas with secondary ecological functions may extend substantially further than 150 feet from the stream. These resources likely play lesser, but cumulatively important, roles in regional stream health and an argument can be made for impact areas on existing secondary resources. However, basing impact areas on secondary functions *that should*

[16] To review the literature on recommended widths, see Table 7 in *Metro's Technical Report for Goal 5*, July 2002; for GIS mapping descriptions for the two inventories, see Tables 4 and 5 in *Metro's Riparian Corridor and Wildlife Habitat Inventories*, August 2002.

exist but don't would be difficult to model and would necessitate inclusion of the entire watershed as the impact area. These data support Metro's impact area for riparian areas of 150 feet from the water body.

Tree root zone protection

In the case of wildlife habitat, adverse edge effects are an important driver of ecological value and are incorporated into Metro's wildlife habitat model via habitat patch size and habitat interior. Edge effects are a function of human influences occurring at or near a forest or wetland edge; therefore it could be argued that impact areas are already accounted for in wildlife habitat patches. For example, a habitat patch narrower than 400 feet contains virtually no interior habitat. Therefore, human influences such as disturbance and nonnative species may be relatively pervasive; impact areas may serve no purpose in such cases. However, tree root zone compaction could theoretically result in a gradual shrinking of forested habitat over time due to tree damage around the edges of the habitat.

Tree root protection is important because root damage affects the entire tree. Soil compaction above the roots is a key culprit. The drip-line is the full area beneath the tree canopy. Certified arborists state that the root zone of a tree typically extends at least one-and-a-half to two times the distance of the drip-line; some experts indicate root spread may extend as far as two to three times the distance of the drip-line (Appleton et al. 2000; Ryan et al. 2002). A Metro GIS survey of trees in our region indicates that the drip-line for relatively mature trees is about 65 feet. Therefore, Metro's impact area for root zone protection is 25 feet.[17]

A 25-foot impact area is also appropriate for addressing non-forested habitat areas. Low structure vegetation can be quite fragile and vulnerable to disturbances such as trampling, motorized and non-motorized traffic, grazing, etc. Physical disturbance in herbaceous habitats often leads to nonnative or invasive species proliferation (Alberta Riparian Habitat Management Program). This is an issue in for both native herbaceous habitats and agricultural lands, where noxious weeds may rapidly spread and can cause severe crop losses resulting in economic hardship.

Summary

A 150-foot riparian impact area and 25-foot vegetation impact area will:

- Provide all fish and wildlife habitat with an impact area (except developed floodplains).
- Provide the most sensitive fish and wildlife habitat with wider impact areas.
- Provide impact areas to address tree root zones.
- Allow the potential to address areas that are already degraded, but where negative inputs may strongly influence onsite and downstream water quality and key wildlife habitat (such as wetlands).
- Meet the requirements of the Goal 5 rule.

[17] Take the drip line times the recommended distance: 65 x 1.75 = 113.75. Subtract out the drip line: 113.75 – 65 ft = 48.75. Divide by two to get the radius for a 1-sided impact area: 48.75 / 2 = 24.4 ft.

CHAPTER 3: CONFLICTING USES

Introduction

A key step in the economic, social, environmental, and energy (ESEE) analysis is to identify conflicting uses that "exist, or could occur" within regionally significant fish and wildlife habitat and identified impact areas. A conflicting use is a "land use, or other activity reasonably and customarily subject to land use regulations, that could adversely affect a significant Goal 5 resource" (OAR 660-23-010(1)). Identifying conflicting uses is important in order to focus the ESEE consequences analysis on various land uses and related disturbance activities that may negatively impact fish and wildlife habitat.

The following sections describe:

- Metro's method for identifying conflicting uses from a regional perspective,
- the relationship of generalized regional zones to Metro's fish and wildlife habitat inventory,
- the relationship of the 2040 design type hierarchy to Metro's fish and wildlife habitat inventory,
- the relationship of impact areas to generalized regional zones, and
- conflicting uses by Metro's generalized regional zones.

The consequences of allowing, limiting or prohibiting the conflicting use are covered in each of the ESEE analyses, discussed in the following chapters.

Identifying Conflicting Uses

The Goal 5 rule directs local governments to identify conflicting uses in their ESEE analysis by examining "land uses allowed outright or conditionally within the zones applied to the resource site and impact area" (OAR 660-23-040(2)). The Goal 5 rule does not, however, address how conflicting uses should be identified for a regional ESEE analysis.

Metro has taken a regional approach in identifying conflicting uses. Metro is responsible for developing regional policies for managing growth, protecting natural resources, directing regional investment in a mix of transportation options, as well as other policies. Metro does not, however, have zoning authority. Instead, local governments are responsible for implementing regional policy using their comprehensive planning and zoning authority. Consequently, Metro is relying on its compilation of local jurisdictions' zoning codes to provide the framework for identifying conflicting uses (Metro's regional zones and generalized regional zones), as described in the next section. In addition, Metro's 2040 Growth Concept is also described to address conflicting uses that "could occur" over time.

Regional zones and generalized regional zones

Metro's Data Resource Center (DRC) developed "regional zones" and "generalized regional zones" as a GIS data layer to perform regionwide analyses. These regional zones are based on a compilation of local government zoning designations. Each local jurisdiction has a unique array of zoning categories, with literally hundreds of zoning codes that regulate land use in the 24 cities and three counties within Metro's jurisdiction. Although zoning categories are similar among jurisdictions, the actual permitted uses and density requirements often vary. Metro compiled local city and county zoning codes and assigned them to one of 26 regional zones as shown in Table 3-1 below. Table 3-1 also shows the generalized regional zones into which the 26 regional zones are further aggregated. Local jurisdictions had an opportunity to review the compilation and assignments, and corrections were made based on their comments.

Table 3-1. Regional zones & generalized regional zones.

Regional zones	Generalized regional zones
SFR1 Single Family 1 – detached housing with minimum lot sizes from 20,000 square feet and over.	***SFR Single-family Residential***
SFR2 Single Family 2 – detached housing with minimum lot sizes ranging from 12,000 to 20,000 square feet.	
SFR3 Single Family 3 – detached housing with minimum lot sizes ranging from 8,500 to 12,000 square feet.	
SFR4 Single Family 4 – detached housing with minimum lot sizes from 6,500 to 8,500 square feet.	
SFR5 Single Family 5 – detached housing with minimum lot sizes ranging from 5,500 to 6,500 square feet.	
SFR6 Single Family 6 – detached housing with minimum lot sizes from 4,000 to 5,500 square feet.	
SFR7 Single Family 7 – detached housing with minimum lot sizes up to 4,000 square feet.	
MFR1 Multi-family 1 – housing and/or duplex, townhouse and attached single-family structures allowed outright. Maximum net allowable densities range from 2 to 25 units per acre, with height limits usually set at 2 1/2 to 3 stories.	***MFR Multi-family Residential***
MFR2 Multi-family 2 – housing accommodating densities ranging from 25 to 50 units per acre. Buildings may exceed three stories in height.	
MFR3 Multi-family 3 – housing accommodating densities ranging from 50 to 100 units per acre.	
MFR4 Multi-family 4 – housing accommodating densities greater than 100 units per acre. This is the densest of the multi-family zones and would require greater use of vertical space and buildings with multiple stories.	

Note: Local jurisdictions are the ultimate source for actual zoning of any given property.

Table 3-1 (cont.). Regional Zones & Generalized Regional Zones

Regional Zones (cont.)	Generalized Regional Zones (cont.)
MUC1 Mixed Used Center 1 – combines residential and employment uses in town centers, main streets and corridors.	***MUC Mixed Use Centers***
MUC2 Mixed Use Center 2 – combines residential and employment uses in light rail station areas and regional centers.	
MUC3 Mixed Use Center 3 – combines residential and employment uses in central city locations. Mixed use is weighted toward residential development.	
CN Neighborhood Commercial – small scale commercial districts permitting retail and service activities such as grocery stores and laundromats supporting the local residential community. Floor space and/or lot size is usually limited from 5,000 to 10,000 square feet.	***COM Commercial***
CG General Commercial – larger scale commercial districts, often with a more regional orientation for providing services. Businesses offering a wide variety of goods and services are permitted and include highway and strip commercial zones.	
CC Central Commercial – allows a full range of commercial activities typically associated with central business districts. More restrictive than general commercial in the case of large lot and highway oriented uses, but usually allows multi-story development.	
CO Office Commercial – districts accommodating a range of business, professional and medical office facilities, typically as a buffer between residential areas and more intensive uses.	
PF Public Facilities – generally provides for community services such as schools, churches, government offices, hospitals, libraries, correctional facilities, public parks, public recreation facilities and public utilities.	
IL Light Industrial – districts permitting warehousing and light processing and fabrication activities. May allow some commercial activities.	***IND Industrial***
IH Heavy Industrial – districts permitting light industrial and more intensive industrial activities such as bottling, limited chemical processing, heavy manufacturing and similar uses.	
IMU Mixed Use Industrial – districts accommodating a mix of light manufacturing, office and retail uses.	
IA Industrial Area – districts designated exclusively for manufacturing, industrial, warehouse and distribution related operations.	
FF Agriculture or Forestry – activities suited to commercial scale agricultural production, typically with lot sizes of 30 acres or more.	***RUR Rural***
RRFU Rural or Future Urban – residential uses permitted on rural lands or areas designated for future urban development with minimum lot sizes of one acre or more.	
POS Parks and Open Space – preservation of public and private open and natural areas.	***POS Parks and Open Space***

Note: Local jurisdictions are the ultimate source for actual zoning of any given property.

Metro's 26 regional zones provide a clear representation of general land uses allowed outright over the regional landscape. The general zones do not, however, represent land uses allowed conditionally within zones because these vary among local jurisdictions and are not explicitly captured in the regional zones. Disturbance activities associated with conditional uses will be considered in the *Conflicting Uses by Generalized Regional Zones* section.

According to the Goal 5 rule, the ESEE analysis "may address each of the identified conflicting uses, or it may address a group of similar conflicting uses" (OAR 660-23-040(5)). The 26 regional zones are further aggregated into seven major land use categories (generalized regional zones, see Table 3-1): single-family residential, multi-family residential, mixed use, commercial, industrial, rural, and parks and open space. These seven generalized regional zones represent a group of similar conflicting uses and are used in the ESEE analysis for identifying the consequences of allowing, limiting, or prohibiting conflicting uses within fish and wildlife habitat.

Metro's 2040 Growth Concept

Metro's 2040 Growth Concept helps to identify where conflicting uses are likely to occur over time. The 2040 Growth Concept map[18] shows the general location of the 2040 design types inside the urban growth boundary (UGB), as well as several outside the UGB, but inside Metro's jurisdiction. Areas outside the UGB are primarily designated as rural reserves. In December 2002, the Metro Council approved a major expansion of the UGB. The decision brings approximately 18,880 acres into the boundary. These areas have been held at a rural level of development and do not yet have urban zoning. These areas will be the focus of detailed concept planning based on the 2040 Growth Concept principles and land uses will intensify in these areas over time.

Metro's 2040 Growth Concept (adopted in 1995) defines the form of regional growth and development for the Metro region. The concept encourages land use and transportation policies that will allow the Metro area cities and counties to manage growth, protect natural resources, and make improvements to facilities and infrastructure while maintaining the region's quality of life. The concept reflects important values identified by the people who live in this region: access to nature, protection of farmland and natural areas, safe and stable neighborhoods, a diversity of housing types, transportation choices, and a healthy economy.

The concept provides an expression of the region's goals through land use and identifies various design types as the "building blocks" of the regional strategy for managing growth. The centerpiece of the 2040 Growth Concept is the development of centers – compact, mixed-used areas inside the UGB with employment, housing, retail, and cultural and recreational activities, and a pedestrian-friendly environment with access to a variety of transportation choices.

The success of the 2040 Growth Concept depends in large part on the implementation of regional transportation priorities. The Regional Transportation Plan (RTP) groups the 2040 design types into a hierarchy based on transportation investment priority. This hierarchical scheme also helps

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[18] To view the 2040 Growth Concept map online: http://www.metro-region.org/library_docs/land_use/concept.pdf

to focus economic development priorities (see *Economic Consequences* chapter) in areas that are most important to achieving the goals of the 2040 Growth Concept. For the purposes of Metro's Goal 5 ESEE analysis, a modified grouping of the 2040 design types is proposed as follows:

Primary land use components

The central city, regional centers, industrial areas, and intermodal facilities are centerpieces of the 2040 Growth Concept. Implementation of the Growth Concept is largely dependent on the success of these primary components:

- *Central City.* Downtown Portland serves as the region's major regional center and also functions as a hub for cultural activities and employment for the entire metropolitan area.

- *Regional Centers.* Regional centers are located throughout the region and serve large market areas outside the central city (e.g., Hillsboro, Gresham). They are intended to become the focus of compact development, redevelopment, and high-quality transit service.

- *Industrial Areas (non-water dependent).* The region's economy depends on a strong base of industry. The Growth Concept identifies areas to be devoted to this use. For purposes of Goal 5, industrial areas have been further divided into non-water dependent and water dependent. Industrial areas that are not water dependent typically demand proximity to high quality transportation and access to an employee base.

- *Industrial Areas (water dependent).* The metropolitan area developed as a city based on a prime location at the confluence of the Columbia and Willamette Rivers. The Portland Harbor consists of several marine terminals that provide access to cities throughout the Pacific Rim, as well as access to the rest of the United States with rail and highway service. Several industrial properties are located on the harbor adjacent to this transportation network.

- *Intermodal transportation facilities.* The region's continued strength as a national and international distribution center is dependent on the provision of adequate intermodal facilities. These facilities include marine terminals, freight facilities for trucking, airports and railroads.

Secondary land use components

- *Town Centers.* Town centers include compact development and a relatively high level of transit service, but they are meant to be smaller and less dense than regional centers. Town centers provide local shopping, employment, and cultural and recreational opportunities within a local market area (e.g., Forest Grove, Milwaukie).

- *Main Streets.* Main streets are similar to town centers but on a smaller scale. Main streets typically serve the immediate neighborhood and sometimes have a traditional commercial identity that may draw visitors from other parts of the region.

- *Station Communities.* Station communities are areas of development centered around light rail or high-capacity transit stations. These areas include mixed-use, compact development and provide a mix of transportation options such as light rail, bus, bicycling, walking and auto.

Tertiary design type components

- *Inner Neighborhoods.* These areas include primarily residential development and are accessible to employment. Inner neighborhoods generally have better access to jobs and shopping than outer neighborhoods and lot sizes are typically smaller.

- *Outer Neighborhoods.* These areas are farther away from large employment centers and have larger lot sizes and thus lower densities than inner neighborhoods.

- *Employment centers.* Employment centers are designated to receive various types of employment and may include residential development that serves the needs of employees.

- *Corridors.* Corridors are major streets that serve as key transportation routes for people and goods. Corridors are not intended to be as dense as centers, but provide a mix of uses such as higher density residential, office, commercial, and retail.

Other

- *Parks and Open Spaces.* Parks and open space include recreational parks, streams and trail corridors, wetlands, floodplains and other natural areas. These areas play a key role in maintaining the quality of life citizens of the region enjoy. Access to both recreational parks and natural areas has been identified as a high priority by residents. These areas are unlikely to provide opportunities for residential, commercial, or industrial development.

- *Rural.* Rural lands outside the urban growth boundary.

The 26 regional zones and seven generalized regional zones, together with the 2040 Growth Concept described in this section, allow for a regional picture of both existing and potential future conflicting uses. The next section describes the relationship of the seven generalized regional zones with Metro's Goal 5 fish and wildlife habitat inventory.

Relationship of generalized regional zones and 2040 design types to Metro's Goal 5 inventory of regionally significant fish and wildlife habitat

This section takes a closer look at where conflicting uses and Goal 5 fish and wildlife habitat overlap. Metro's Goal 5 inventory of regionally significant fish and wildlife habitat is analyzed in the following ways: geographical boundaries (i.e., UGB, Metro's jurisdiction); development status (i.e., developed and vacant); generalized regional zones and development status; generalized regional zones, fish and wildlife habitat classification and development status; and 2040 design types hierarchy and fish and wildlife classification. In addition, impact areas are summarized by generalized regional zones and development status. This information provides context in the ESEE analysis by quantifying the extent (i.e., acreage) to which fish and wildlife habitat may be impacted by allowing, limiting, or prohibiting the conflicting uses.

Distribution of land within the UGB and Metro's jurisdictional boundary

Figure 3-1 below shows the urban growth boundary and Metro's jurisdictional boundary (before December 2002). The land area within Metro's jurisdiction is comprised of approximately 227,540 acres within the UGB and 53,120 outside the UGB for a total of over 280,660 acres (not including water features), or about 438 square miles. The 2002 UGB expansion areas (hatched areas on map) include approximately 18,800 acres, most of which are inside Metro's jurisdiction (over 3,100 acres are currently outside Metro's jurisdiction). The gray area on the map represents regionally significant fish and wildlife habitat.

Figure 3-1. Metro's fish and wildlife habitat inventory, UGB, jurisdictional boundary & expansion areas.

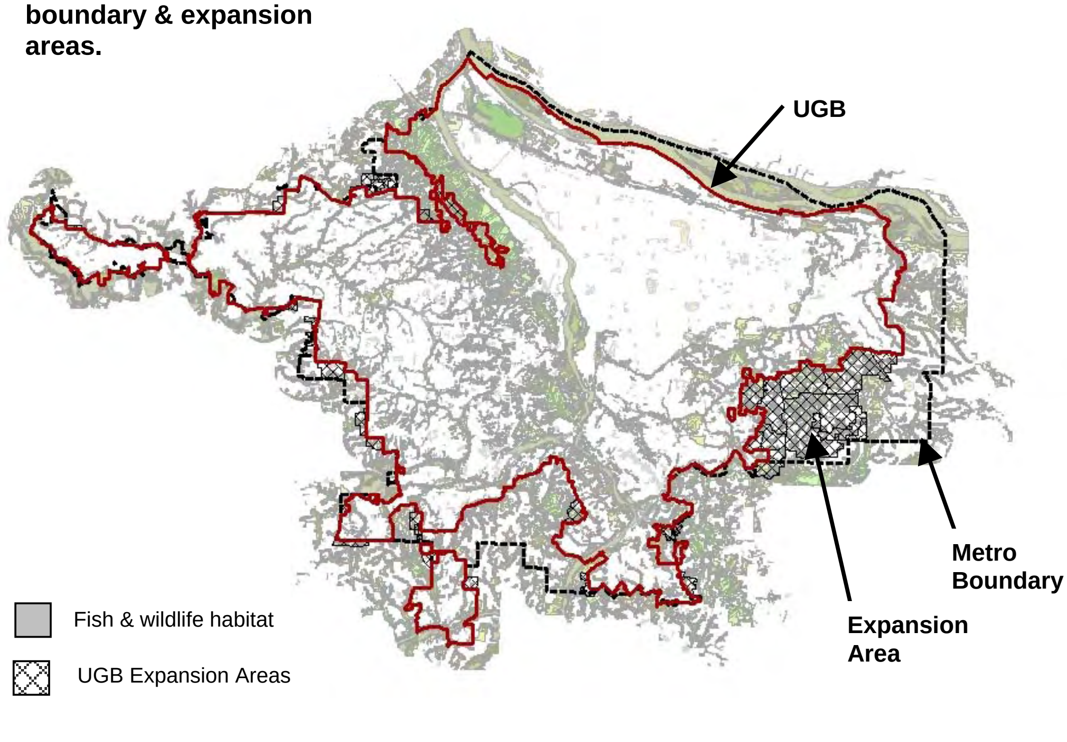


Table 3-2 disaggregates non-habitat and habitat lands into three geographical areas: inside the UGB, UGB expansion areas, and the remaining areas in Metro's jurisdiction outside of the UGB. The total acreage shown in the table includes approximately 3,100 acres in the expansion areas that are currently outside Metro's jurisdiction. Approximately 81,700 acres of fish and wildlife habitat are within, or will be within, Metro's jurisdictional boundary (almost 29 percent of the total land area). Within the UGB, 24 percent of the total land area is fish and wildlife habitat (53,671 acres). UGB expansion areas include over 8,200 acres of fish and wildlife habitat (44 percent of the expansion area). Fifty-three percent of the remaining areas in Metro's jurisdiction outside the UGB (19,794 acres) are fish and wildlife habitat.

Two-thirds (66 percent) of the total fish and wildlife acres are within the UGB. The other third (28,026 acres) is located in the expansion areas and the remaining areas in Metro's jurisdiction outside the UGB.

Table 3-2. Fish and wildlife habitat by Metro's jurisdictional status.

Geographical Area	**Total Acres*** (Non-habitat and habitat)	**Fish and wildlife habitat**		
		Habitat Acres	*% of Geog. Area*	*% of Total Habitat*
Inside UGB (before Dec. 2002)	227,539	53,671	24%	66%
UGB Expansion Areas (Dec. 2002)**	18,799	8,232	44%	10%
Remaining areas in Metro's jurisdiction outside UGB	37,404	19,794	53%	24%
Total Acreage	283,742	81,697	29%	100%

Source: Metro's Regional Land Information System (RLIS) data base
*Water areas removed (~8,000 acres of habitat)
**UGB expansion areas include approximately 3,100 acres that are currently outside Metro's jurisdiction

Distribution of land by development status

In this section, both non-habitat and habitat lands are broken out by development status (developed and vacant) within the three geographical areas (see Table 3-3). A description of each development status follows to provide a better understanding of Table 3-3.

Developed refers to land that has improvements and specific land uses. There are two subsets within the developed category: urban and parks. *Urban*, as used in this report, refers to land developed in accordance with the specific zoning (e.g., single-family residential, commercial, industrial, etc.).

Parks refer to Metro's inventory of public and private parks and open space, golf courses, cemeteries, trails, and other uses. Parks are categorized as developed land because they are generally not available for urban development in Metro's analysis of buildable lands within the UGB.

Vacant refers to land that has no buildings, improvements or identifiable land use. Metro's vacant lands inventory also includes vacant portions of developed tax lots that are 1/2 acre

(20,000 square feet) or greater. The vacant category also has two subsets: constrained and buildable.

Constrained land consists of environmentally sensitive land – Title 3 Water Quality and Flood Management Areas (i.e., river and stream corridors, wetlands, floodplains, steep slopes 25 percent or greater adjacent to water features); land in public ownership (that otherwise would be buildable); already platted single-family lots; and buffers on major utility lines (50-75 feet). Title 3 areas alone are used to calculate constrained land outside the UGB. Constrained land is not necessarily unbuildable. For example, from 1998 to 2000, 363 acres (seven percent) of undeveloped Title 3 vegetated corridors were developed and 568 acres (9 percent) of floodplains were developed (Metro 2003).

Buildable land is what remains after subtracting out vacant constrained land from total vacant acres. Vacant, buildable land provides the basis for estimating the region's 20-year land supply for dwelling units and employment inside the UGB.

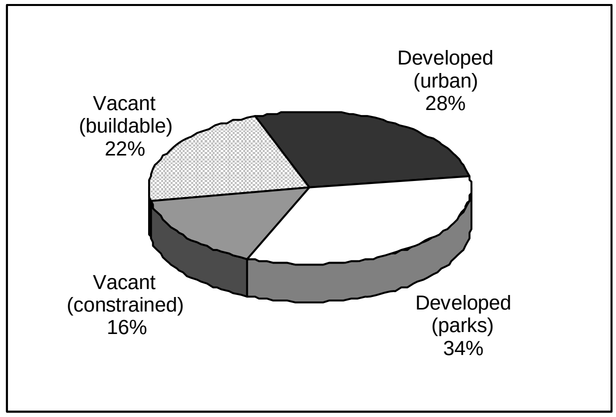
Forty-four percent of the total vacant, buildable acres (both non-habitat and habitat land) in Table 3-3 are classified as fish and wildlife habitat (28,355 acres/64,178 acres). Approximately 41 percent of the total vacant buildable acres within the UGB is fish and wildlife habitat (11,923 acres/29,146 acres). Outside the UGB, 47 percent of the total vacant buildable acres (16,431 acres/35,031 acres) is fish and wildlife habitat.

Table 3-3. Non-habitat and habitat lands by development status.

Geographical Area	Non-habitat acres				Fish and wildlife habitat acres				Total Acres
	Developed		Vacant		Developed		Vacant		
	Urban	*Parks*	*Constr.*	*Buildable*	*Urban*	*Parks*	*Constr.*	*Buildable*	
Inside UGB (before 12/02)	143,263	9,216	4,166	17,223	15,041	18,258	8,449	11,923	227,539
UGB Expansion Areas (12/02)	3,791	377	0	6,399	1,262	716	552	5,703	18,799
Remaining areas in Metro's jurisdiction	4,701	708	0	12,201	2,161	5,028	1,877	10,728	37,404
Total Acreage	151,754	10,301	4,166	35,823	18,464	24,001	10,878	28,355	283,742

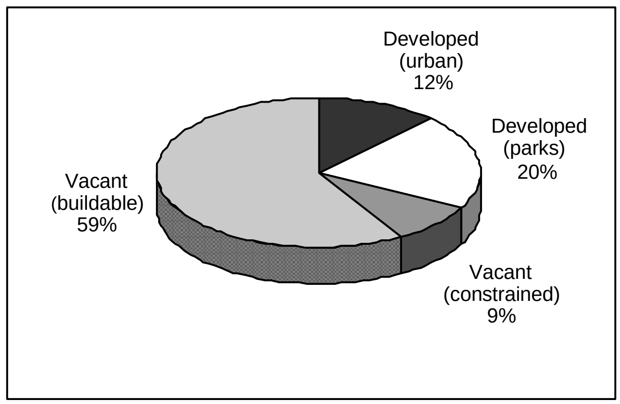
Figures 3-2 and 3-3 show the proportion of fish and wildlife habitat by development status inside the UGB and outside the UGB in expansion areas and Metro's jurisdiction (based on Table 3-3). Thirty-eight percent of the fish and wildlife habitat inside the UGB is vacant (buildable plus constrained); 62 percent is considered developed (urban plus parks). Within the expansion areas and remaining areas in Metro's jurisdiction, 32 percent of the land is developed and 68 percent is vacant.

Figure 3-2. Fish and wildlife habitat by development status inside UGB.



Developed land is included in the Goal 5 fish and wildlife habitat inventory for several reasons. First, developed areas along streams that lack significant vegetation are mapped with a 50-foot default area to recognize essential riparian function. Second, vegetated portions of developed lots are included in the Goal 5 inventory where they contribute riparian function and/or wildlife habitat value. For example, dense forest canopies over developed subdivisions are included in the inventory where the canopy meets the applicable mapping criteria (Metro 2002d).

Figure 3-3. Fish and wildlife habitat by development status in expansion areas & remaining areas in Metro's jurisdiction.



The development status of fish and wildlife habitat provides some insight into the vulnerability of the habitat to potential adverse impacts from conflicting uses. The least vulnerable fish and wildlife habitat is that in park status; however, protection is not guaranteed. For example, a park may be developed for recreational uses (e.g., ball fields) rather than left in a natural state. Fish and wildlife habitat classified as developed (urban) is less vulnerable than those that are vacant. Changes often occur, however, on developed land. For example, a lot may be subdivided, expansion of existing facilities may occur, or management practices may change (e.g., tree cutting). Vacant, constrained fish and wildlife habitat, as pointed out above, may also be developed but less intensively in many cases. Vacant, buildable fish and wildlife habitat is the most vulnerable to adverse impacts.

Distribution of fish and wildlife habitat by generalized regional zones and development status

This section presents regionally significant fish and wildlife habitat by generalized regional zones and development status (Tables 3-4 and 3-5) within the UGB (before December 2002), and in UGB expansion areas and the remaining areas in Metro's jurisdiction.

The largest proportion of fish and wildlife habitat is zoned for single-family residential development (46 percent). Nearly 27 percent of single-family zoned habitat land (6,687 acres) is considered buildable, which also represents the largest proportion of total buildable habitat land (56 percent).

The parks and open spaces (POS) category contains the next highest proportion of fish and wildlife habitat (20 percent). However, the POS category significantly under-represents the amount of land actually used as parks in the region because many local jurisdictions do not have a separate zone for parks and open space. Instead, parks are allowed outright or conditionally in all or most zones. In such cases, parks and open space generally retain the underlying zoning. To address this issue, parks are identified separately under the "developed" land category in the tables below. For example, there are over 5,500 acres of parks (based on Metro's parks and open space inventory) that are zoned single-family residential.

Fourteen percent of fish and wildlife habitat is zoned for industrial use (7,721 acres); of that, 23 percent is considered buildable (1,761 acres). Although only seven percent of fish and wildlife habitat is zoned for rural uses inside the UGB, over half of it is buildable and represents the second highest proportion (17 percent) of total buildable habitat land.

Table 3-4. Total fish and wildlife habitat by generalized regional zones inside UGB.*

Generalized Regional Zones	Fish and wildlife habitat acres					
	Developed		Vacant		Total	
	Urban	*Park*	*Constrained*	*Buildable*	*Dev. & Vac*	*% of Total*
SFR	9,300	5,557	3,277	6,687	24,821	46%
MFR	975	704	462	470	2,610	5%
MUC	406	100	266	512	1,284	2%
COMM	649	1,144	451	429	2,672	5%
IND	2,620	972	2,368	1,761	7,721	14%
RUR	380	193	1,261	2,015	3,923	7%
POS	483	9,577	359	48	10,468	20%
NO ZONE**	155	11	5	1	172	0%
TOTAL	*14,968*	*18,258*	*8,449*	*11,923*	*53,671*	*100%*

*****Before December 2002
******Some habitat areas within the UGB (0.3%) have no zoning designation.

Most of the fish and wildlife habitat in UGB expansion areas and the remaining areas in Metro's jurisdiction has rural zoning (89 percent; Table 3-5). Sixty-three percent of rural habitat land is considered buildable (15,772 acres).

Table 3-5. Total fish and wildlife habitat acres by generalized regional zones in expansion areas and remaining areas in Metro's jurisdiction.

Generalized Regional Zones	Fish and wildlife habitat acres					
	Developed		Vacant		Total	
	Urban	*Park*	*Constrained*	*Buildable*	*Dev. & Vac*	*% of Total*
SFR	163	231	16	460	871	3%
RUR	2,860	3,982	2,356	15,772	24,969	89%
POS	324	1,521	43	109	1,997	7%
MFR, MUC, COM, IND	77	9	13	90	189	1%
TOTAL	*3,423*	*5,743*	*2,429*	*16,431*	*28,026*	*100%*

Distribution of fish and wildlife habitat by classification and generalized regional zones

In this section, Metro's fish and wildlife habitat inventory is divided into six classifications, each representing discreet areas on the landscape: Class I, II and III riparian/wildlife corridors, and Class A, B, and C upland wildlife habitat. Metro has created these classifications as a tool to distinguish higher value habitat from lower value habitat. This information can then be used for analyzing conflicting uses and ESEE consequences, and for developing a Goal 5 program. Figures 3-4 and 3-5 show the breakdown of regionally significant fish and wildlife habitat by classification (53,671 habitat acres in UGB; 28,026 habitat acres outside UGB). The following sections describe these classifications and present tables that show each fish and wildlife habitat classification by generalized regional zone.

Figure 3-4. Fish and wildlife habitat by classification within the UGB.

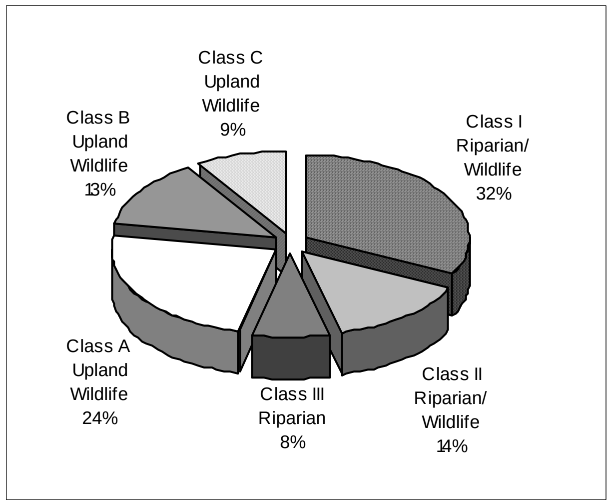
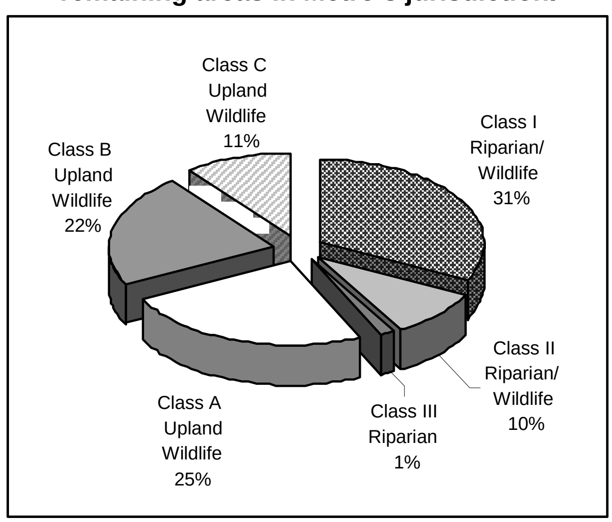


Figure 3-5. Fish and wildlife habitat by classification in UGB expansion areas & remaining areas in Metro's jurisdiction.



Class I riparian/wildlife corridors

Class I riparian/wildlife corridors is the largest classification, representing 32 percent of total fish and wildlife habitat inside the UGB and 31 percent outside the UGB. These areas are predominantly high value riparian corridors that provide three to five primary functions (scoring 18-30 points in the riparian model). The primary functions include: 1) microclimate and shade; 2) streamflow moderation and water storage; 3) bank stabilization, sediment and pollution control; 4) large wood and channel dynamics; and 5) organic material sources. Class I riparian corridors include rivers, streams, stream-associated wetlands, undeveloped floodplains, forest canopy within 100 feet of a stream, and forest canopy within 200 feet of streams with adjacent steep slopes.

Wildlife habitat is also included in high value riparian/wildlife corridors. For example, an area providing riparian function may also have habitat value in the wildlife model. Habitats of Concern are unique or unusually important wildlife habitat areas and are considered high value habitat. Where Habitats of Concern coincide with any riparian/wildlife corridor, the area of overlap is elevated to a Class I riparian/wildlife corridor.

Table 3-6 shows that single-family residential, rural, and industrial development contain the largest concentration of Class I riparian/wildlife corridors (40 percent, 18 percent, and 17 percent, respectively) and the largest portion of buildable land (42 percent, 33 percent, and 14 percent, respectively) inside the UGB. Outside the UGB (Table 3-7), 80 percent of Class I riparian/wildlife corridors is zoned rural and 18 percent is in parks and open space. Forty percent of rural zoned Class I riparian/wildlife corridors inside the UGB is considered buildable. Overall (i.e., inside and outside the UGB), only seven percent of all buildable land (non-habitat and habitat) is Class I riparian/wildlife corridors.[19]

Table 3-6. Class I riparian/wildlife corridors by generalized regional zones inside UGB.

Generalized Regional Zones	Class I Riparian/Wildlife Corridors					
	Developed		Vacant		Total	
	Urban	*Park*	*Constrained*	*Buildable*	*Dev. & Vac*	*% of Total*
SFR	1,661	2,414	1,868	942	6,886	40%
MFR	206	377	296	71	949	6%
MUC	74	57	194	97	423	2%
COMM	104	607	242	84	1,036	6%
IND	427	713	1,441	326	2,907	17%
RUR	113	85	922	739	1,858	18%
POS	111	2,812	246	9	3,176	11%
NO ZONE*	38	8	3	0	50	0%
TOTAL	*2,734*	*7,073*	*5,212*	*2,267*	*17,285*	*100%*

***Some habitat areas within the UGB (0.3%) have no zoning designation.

Table 3-7. Class I riparian/wildlife corridors by generalized regional zones in expansion areas and remaining areas in Metro's jurisdiction.

Generalized Regional Zones	Class I Riparian/Wildlife Corridors					
	Developed Acres		Vacant Acres		Total	
	Urban	*Park*	*Constrained*	*Buildable*	*Dev. & Vac*	*% of Total*
SFR	24	41	16	74	155	2%
RUR	571	2,635	1,867	2,098	7,172	80%
POS	288	1,288	37	18	1,631	18%
MFR, MUC, COM, IND	15	7	11	17	50	1%
TOTAL	*898*	*3,971*	*1,931*	*2,207*	*9,008*	*100%*

Class II riparian/wildlife corridors

Class II riparian/wildlife corridors comprise 14 percent of total fish and wildlife habitat inside the UGB and ten percent outside the UGB (see Figures 3-4 and 3-5). These areas are medium value riparian/wildlife corridors that provide one to two primary functional values (scoring six to

[19] (2,267 acres + 2,207 acres)/64,178 total buildable acres = 6.97%

17 points in the riparian model) or a combination of one primary function and one or more secondary functions. Wildlife habitat is included in these areas where it coincides with the medium value riparian habitat. Class II riparian/wildlife corridors include rivers, streams, 50-foot area along developed stream segments, forest canopy or low structure vegetation within 200 feet of streams, and portions of undeveloped floodplains extending beyond 300 feet of streams. Class II riparian/wildlife corridors are elevated to Class I when they contain Habitats of Concern.

Forty-four percent of fish and wildlife habitat inside the UGB is zoned single-family residential; 22 percent is industrial (Table 3-8). Outside the UGB (Table 3-9), 95 percent of the habitat is zoned rural. Only about five percent[20] of the total vacant buildable land (non-habitat and habitat land) is classified as Class II riparian/wildlife corridors.

Table 3-8. Class II riparian/wildlife corridors by generalized regional zones inside UGB.

Generalized Regional Zones	Class II Riparian/Wildlife Corridor					
	Developed Acres		Vacant Acres		Total	
	Urban	*Park*	*Constrained*	*Buildable*	*Dev. & Vac*	*% of Total*
SFR	1,385	666	527	708	3,285	44%
MFR	207	78	75	62	422	6%
MUC	64	17	45	100	226	3%
COMM	134	250	137	75	596	8%
IND	448	114	684	378	1,623	22%
RUR	88	23	269	186	566	8%
POS	64	571	41	13	689	9%
NO ZONE*	42	2	2	0	47	1%
TOTAL	*2,432*	*1,721*	*1,780*	*1,521*	*7,454*	*100%*

***Some habitat areas within the UGB (0.3%) have no zoning designation.**

Table 3-9. Class II riparian/wildlife corridors by generalized regional zones in expansion areas and remaining areas in Metro's jurisdiction.

Generalized Regional Zones	Class II Riparian/Wildlife Corridors					
	Developed Acres		Vacant Acres		Total	
	Urban	*Park*	*Constrained*	*Buildable*	*Dev. & Vac*	*% of Total*
SFR	15	14	1	42	71	3%
RUR	348	214	438	1,568	2,569	95%
POS	14	8	1	6	29	1%
MFR, MUC, COM, IND	21	1	1	9	32	1%
TOTAL	*398*	*237*	*442*	*1,625*	*2,702*	*100%*

Class III riparian/wildlife corridors

Class III riparian corridors comprise eight percent of total fish and wildlife habitat inside the UGB and one percent outside the UGB (see Figures 3-4 and 3-5). These are low value areas that have riparian value only (located outside of wildlife habitat areas) such as developed floodplains and smaller forest canopies that are disassociated from streams (less than 20 acres). Thirty-seven percent of Class III riparian/wildlife corridors inside the UGB are single-family residential; another 37 percent is industrial (Table 3-10). Overall, most of Class III areas are developed (84 percent), typically in floodplains. Class III riparian corridors outside the UGB are predominantly rural land (90 percent) and mostly buildable (58 percent; Table 3-11). These are probably undeveloped forest canopies of less than 20 acres.

[20] (1,521 acres + 1,625 acres)/64,178 acres = 4.9%

Table 3-10. Class III riparian/wildlife corridors by generalized regional zones inside UGB.

Generalized Regional Zones	Class III Riparian Corridors					
	Developed Acres		Vacant Acres		Total	
	Urban	*Park*	*Constrained*	*Buildable*	*Dev. & Vac*	*% of Total*
SFR	1,186	84	55	174	1,499	37%
MFR	245	5	7	35	293	7%
MUC	183	0	2	23	209	5%
COMM	272	16	4	25	318	8%
IND	1,389	16	31	59	1,496	37%
RUR	45	5	2	46	98	2%
POS	115	33	3	2	153	4%
NO ZONE *	29	0	0	0	29	0%
TOTAL	*3,464*	*161*	*104*	*364*	*4,094*	*100%*

***Some habitat areas within the UGB (0.3%) have no zoning designation.**

Table 3-11. Class III riparian/wildlife corridors by generalized regional zones in expansion areas and remaining areas in Metro's jurisdiction.

Generalized Regional Zones	Class III Riparian Corridors					
	Developed		Vacant		Total	
	Urban	*Park*	*Constrained*	*Buildable*	*Dev. & Vac*	*% of Total*
SFR	13	1	0	7	21	6%
RUR	116	10	1	203	330	90%
POS	8	0	0	0	8	2%
MFR, MUC, COM, IND	6	0	1	2	9	2%
TOTAL	*142*	*11*	*2*	*212*	*368*	*100%*

Class A upland wildlife habitat

Class A upland wildlife habitat comprises 24 percent of the fish and wildlife habitat inside the UGB and 25 percent outside the UGB (see Figures 3-4 and 3-5). These are high value wildlife habitat areas scoring seven to nine points in the wildlife model. Examples include upland portions of large forest patches and large contiguous patches such as Forest Park. This category may also contain areas providing secondary functions for riparian corridors and Habitats of Concern located outside of riparian/wildlife corridors.

Within the UGB, forty-five percent of Class A upland wildlife habitat is zoned as single-family residential and 44 percent is parks and open space (Table 3-12). Seventy-seven percent of buildable land located within Class A upland wildlife habitat is zoned single-family zoning. Ninety percent of Class A wildlife habitat in UGB expansion areas and the remaining areas in Metro's jurisdiction is zoned for rural uses (Table 3-13), and most of this acreage is buildable (72 percent).

Table 3-12. Class A upland wildlife habitat by generalized regional zones inside UGB.

Generalized Regional Zones	Class A Upland Wildlife Habitat					
	Developed Acres		Vacant Acres		Total	
	Urban	*Park*	*Constrained*	*Buildable*	*Dev. & Vac*	*% of Total*
SFR	1,677	1,285	286	2,486	5,734	45%
MFR	85	129	42	94	350	3%
MUC	17	23	9	112	161	1%
COMM	29	53	21	49	152	1%
IND	80	98	47	238	462	4%
RUR	45	27	10	234	316	2%
POS	94	5,557	43	7	5,700	44%
NO ZONE*	4	0	0	0	4	0%
TOTAL	*2,031*	*7,171*	*457*	*3,219*	*12,879*	*100%*

***Some habitat areas within the UGB (0.3%) have no zoning designation.**

Table 3-13. Class A upland wildlife habitat by generalized regional zones in expansion areas and remaining areas in Metro's jurisdiction.

Generalized Regional Zones	Class A Upland Wildlife Habitat					
	Developed Acres		Vacant Acres		Total	
	Urban	*Park*	*Constrained*	*Buildable*	*Dev. & Vac*	*% of Total*
SFR	34	175	0	191	400	6%
RUR	615	862	34	4,682	6,193	90%
POS	10	209	2	35	256	4%
MFR, MUC, COM, IND	7	0	0	23	30	0%
TOTAL	*666*	*1,246*	*36*	*4,931*	*6,879*	*100%*

Class B upland wildlife habitat

Class B upland wildlife habitat makes up 13 percent of the fish and wildlife habitat inside the UGB and 22 percent outside the UGB (see Figures 3-4 and 3-5). These are medium value upland wildlife habitat areas scoring four to six points in the wildlife model. These areas include upland portions of medium sized forest patches with low structure connector patches along streams and rivers. This habitat category may also contain areas providing secondary functions for riparian corridors. Within the UGB, seventy-two percent of Class B upland wildlife habitat is zoned single-family residential; a large portion (68 percent) is developed, parks, and constrained land (Table 3-14). Outside the UGB, 96 percent of the habitat is zoned for rural uses. Eighty-three percent of these rural zoned lands are buildable (Table 3-15).

Table 3-14. Class B upland wildlife habitat by generalized regional zones inside UGB.

Generalized Regional Zones	Class B Upland Wildlife Habitat					
	Developed		Vacant		Total	
	Urban	*Park*	*Constrained*	*Buildable*	*Dev. & Vac*	*% of Total*
SFR	2,339	794	409	1,657	5,199	72%
MFR	119	47	23	95	284	4%
MUC	23	0	9	111	143	2%
COMM	50	128	15	76	269	4%
IND	58	5	25	262	350	5%
RUR	89	28	29	419	565	8%
POS	52	298	27	2	378	5%
NO ZONE*	17	0	0	0	17	0%
TOTAL	*2,747*	*1,299*	*537*	*2,622*	*7,205*	*100%*

*****Some habitat areas within the UGB (0.3%) have no zoning designation.

Table 3-15. Class B upland wildlife habitat by generalized regional zones in expansion areas and remaining areas in Metro's jurisdiction.

Generalized Regional Zones	Class B Upland Wildlife Habitat					
	Developed		Vacant		Total	
	Urban	*Park*	*Constrained*	*Buildable*	*Dev. & Vac*	*% of Total*
SFR	54	0	0	93	147	2%
RUR	805	171	12	4,869	5,856	96%
POS	5	16	3	47	71	1%
MFR, MUC, COM, IND	12	0	0	28	41	1%
TOTAL	*876*	*187*	*15*	*5,037*	*6,115*	*100%*

Class C upland wildlife habitat

Class C upland wildlife habitat represents nine percent of the fish and wildlife habitat inside the UGB and 11 percent outside the UGB (see Figures 3-4 and 3-5). These are less valuable upland wildlife habitat areas scoring two to three points in the wildlife habitat model. They include forest patches and smaller connector patches along streams and rivers. This category may also contain areas providing secondary functions for riparian corridors.

Within the UGB, single-family zoning is applied to 47 percent of Class C wildlife habitat. Industrial and rural zoning are applied to 19 percent and 11 percent, respectively (Table 3-16). Over 40 percent of the total land in this habitat category is buildable inside the UGB. Almost all of the land outside the UGB (96 percent; Table 3-17) is zoned rural, 82 percent of which is buildable.

Table 3-16. Class C upland wildlife habitat by generalized regional zones inside UGB.

Generalized Regional Zones	Class C Upland Wildlife Habitat					
	Developed		**Vacant**		**Total**	
	Urban	*Park*	*Constrained*	*Buildable*	*Dev. & Vac*	*% of Total*
SFR	1,052	314	132	721	2,219	47%
MFR	113	69	18	113	313	7%
MUC	44	2	6	70	122	3%
COMM	59	90	32	120	301	6%
IND	218	26	142	498	884	19%
RUR	73	25	29	393	520	11%
POS	48	308	1	16	372	8%
NO ZONE*	26	0	0	0	26	
TOTAL	*1,633*	*834*	*360*	*1,929*	*4,756*	*100%*

***Some habitat areas within the UGB (0.3%) have no zoning designation.

Table 3-17. Class C upland wildlife habitat by generalized regional zones in expansion areas and remaining areas in Metro's jurisdiction.

Generalized Regional Zones	Class C Upland Wildlife Habitat					
	Developed		**Vacant**		**Total**	
	Urban	*Park*	*Constrained*	*Buildable*	*Dev. & Vac*	*% of Total*
SFR	21	1	0	54	76	3%
RUR	406	89	4	2,350	2,849	96%
POS	0	0	0	2	2	0%
MFR, MUC, COM, IND	15	1	0	12	28	1%
TOTAL	442	91	4	2,418	2,955	*100%*

Relationship of Metro's fish and wildlife habitat inventory to the 2040 Design Type Hierarchy

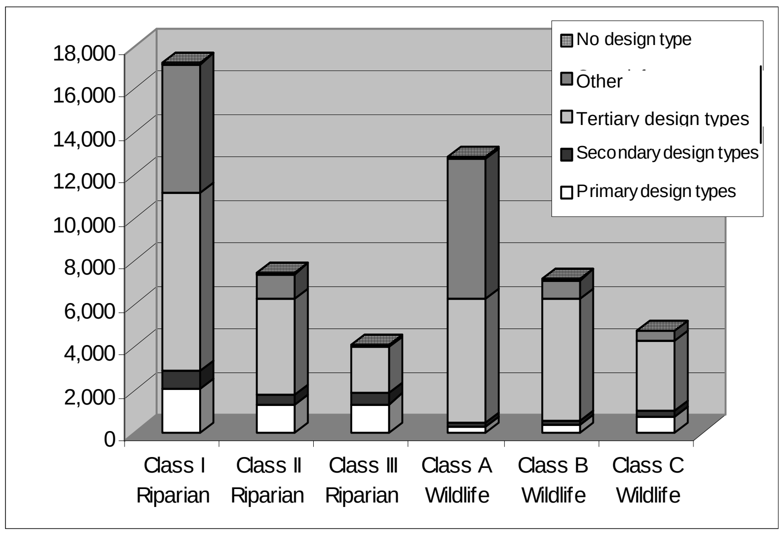
This section examines the relationship of Metro's fish and wildlife habitat inventory to the 2040 design type hierarchy described in the first section. Table 3-18 shows that over half of the fish and wildlife habitat (55 percent) falls into the tertiary design type category (i.e., inner and outer neighborhoods, employment centers, corridors); 28 percent is other design types (i.e., parks and open space, rural); and 11 percent is primary design types (city center, regional centers, industrial centers, intermodal transportation facilities). Only 14 percent of buildable fish and wildlife habitat coincides with primary design types, whereas 79 percent is in the tertiary design type category. This information is not included for the area outside the UGB because design types are not applied for the most part. Where they are applied, the location of the design types is very general.

Table 3-18. Fish and wildlife habitat acreage by 2040 design type hierarchy and development status inside the UGB.

2040 Design Type Hierarchy	Development Status					
	Developed		Vacant		Total	
	Urban	*Park*	*Constrained*	*Buildable*	*Dev. & Vac*	*% of Total*
Primary design types	2,205	66	2,082	1,712	6,064	11%
Secondary design types	1,070	212	525	762	2,570	5%
Tertiary design types	11,460	3,038	5,685	9,384	29,568	55%
Other design types	271	14,818	92	6	15,187	28%
No design types	34	123	65	59	282	1%
Total	*15,041*	*18,258*	*8,449*	*11,923*	*53,671*	*100%*

Figure 3-6 shows the distribution of fish and wildlife habitat classes by 2040 design type hierarchy.[21] For example, most of Class I riparian/ wildlife corridors (14,350 acres; 83 percent) falls within the tertiary design type and other design type categories; almost all of Class A upland wildlife (12,305 acres; 96 percent) coincides with these two categories.

Figure 3-6. Distribution of fish and wildlife habitat classes by 2040 design type priority inside UGB.



Impact Areas

Impact areas, as described in the previous section, define an area where allowed land uses or activities could harm the fish and wildlife habitat. Development activities near streams and wetlands often remove vegetation that would otherwise contribute to riparian function by providing shade, sedimentation control, and water storage. Developed areas also contribute runoff from impervious surfaces, human disturbance, noise, lighting, toxins, fertilizers and pesticides; each of these influences may adversely affect riparian areas and wildlife habitat. Tables 3-19 and 3-20 break out impact area acreage by generalized regional zones and development status. Over 13,300 acres are included as impact areas inside the UGB and 82 percent are developed. Over half of the impact area inside the UGB is zoned for single-family use; 19 percent is industrial zoned land. Impact areas outside the UGB (3,000 acres) are primarily zoned for rural uses (92 percent). Fifty-nine percent of the impact area outside the UGB is considered buildable.

[21] Figure 3-6 does not reflect design types adopted through the Pleasant Valley Concept Plan.

Table 3-19. Impact areas by generalized regional zones inside UGB.

Generalized Regional Zones	Impact Areas					
	Developed		Vacant		Total	
	Urban	*Park*	*Constrained*	*Buildable*	*Dev. & Vac*	*% of Total*
SFR	5,833	400	254	634	7,121	53%
MFR	903	67	39	92	1,101	8%
MUC	309	15	32	103	459	3%
COMM	645	159	33	89	926	7%
IND	1,625	86	251	585	2,547	19%
RUR	205	20	53	263	541	4%
POS	139	397	8	8	552	4%
NO ZONE*	70	0	0	0	70	1%
TOTAL	*9,729*	*1,144*	*670*	*1,774*	*13,317*	*100%*

*****Some habitat areas within the UGB (.3%) have no zoning designation.

Table 3-20. Impact areas by generalized regional zones in expansion areas and remaining areas in Metro's jurisdiction.

Generalized Regional Zones	Impact Areas					
	Developed		Vacant		Total	
	Urban	*Park*	*Constrained*	*Buildable*	*Dev. & Vac*	*% of Total*
SFR	59	1	0	43	103	3%
RUR	932	105	0	1,722	2,759	92%
POS	53	4	0	4	61	2%
MFR, MUC, COM, IND	65	0	0	18	83	3%
TOTAL	1,109	110	0	1,787	3,006	100%

The next section describes the activities that occur within each zone that may conflict with regionally significant fish and wildlife habitat.

Conflicting Uses by Metro's Generalized Regional Zones

The seven generalized regional zones provide the framework for identifying conflicting uses at a regional scale and the potential consequences, or impacts, to regionally significant fish and wildlife habitat. These generalized regional zones, by themselves, are not conflicting uses. It is the development activities and other disturbances (e.g., clearing land, adding impervious surfaces, replacing natural vegetation with non-native vegetation, etc.) permitted by the local zoning that potentially conflict with fish and wildlife habitat. These activities can generate negative impacts on natural vegetation and soil, the hydrologic and erosional processes in a watershed, and the physical characteristics of fish and wildlife habitat.

This section describes some of the common disturbance activities associated with land uses that are allowed outright or conditionally within Metro's generalized regional zones and that conflict with fish and wildlife habitat. The consequences, or impacts, to regionally significant fish and wildlife habitat are described in each of the ESEE analyses that follow this section.

According to the Goal 5 rule, a local government, following the standard ESEE process, complies with the rule if it identifies "at least the following activities as conflicting uses in riparian corridors:

> (a) The permanent alteration of the riparian corridor by placement of structures or impervious surfaces, except for:
> (A) Water-dependent or water-related uses; and
> (B) Replacement of existing structures with structures in the same location that do not disturb additional riparian surface area; and
>
> (b) Removal of vegetation in the riparian area, except:
> (A) As necessary for restoration activities, such as replacement of vegetation with native riparian species;
> (B) As necessary for the development of water-related or water-dependent uses; and
> (C) On lands designated for agricultural or forest use outside UGBs." (OAR 660-23-090(7))

Past land use practices, and perhaps to a lesser degree current land use practices, can negatively impact fish and wildlife habitat. Some of the common disturbance activities are listed in Table 3-21. Among the most obvious disturbances are the removal of vegetation and the placement of structures and impervious surfaces. Removal of vegetation from streambanks, floodplains, and upland wildlife areas fundamentally alters the stream hydrology resulting in many adverse effects (e.g., increased erosion, sedimentation, increased flooding, loss of habitat, etc.). Increased levels of impervious surfaces reduce groundwater infiltration, increase stormwater runoff, and degrade water quality (see *Environmental Consequences* chapter).

Disturbance activities occur in all regional zones; however, the degree to which these disturbances occur depends on the intensity of the land use (e.g., single-family residential vs. mixed use center), and the form and layout of the development (cluster development vs. evenly distributed development). The remainder of this section describes the disturbance activities in each of following generalized regional zones.

- Single family residential
- Multi-family residential
- Mixed Use Centers
- Commercial
- Industrial
- Rural
- Parks and Open Space

Single family residential (SFR 1-7)

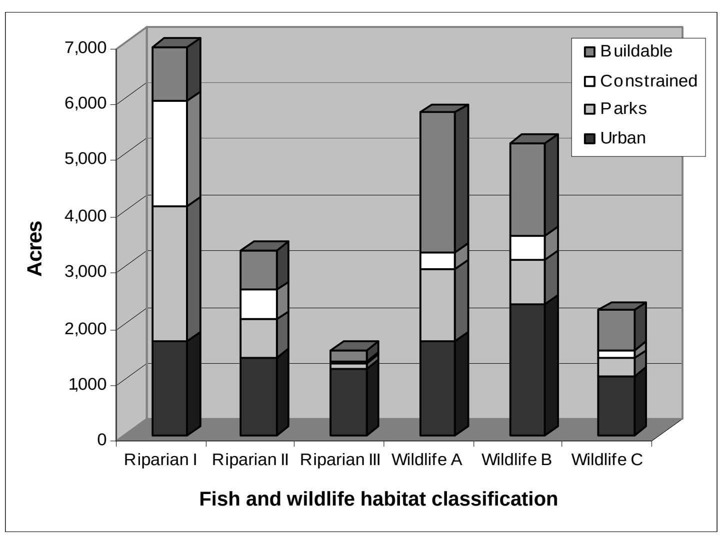
Single-family residential (SFR 1-7) generally allows detached and attached housing on lot sizes up to 20,000 square feet. Conditional uses that often occur in single-family residential zones include: residential recreational centers, churches, schools, daycare facilities, nursing homes, retail sales and service, basic utilities, parks and open areas, etc.

The largest portion of Metro's Goal 5 fish and wildlife habitat inventory– 46 percent – is zoned for single-family residential uses (24,821 acres; see Table 3). Figure 3-7 shows the distribution of SFR fish and wildlife habitat by classification and development status. Over 50 percent of SFR habitat land is classified as high value riparian/wildlife corridors and upland wildlife habitat (12,620 acres); 44 percent of it is vacant (17 percent constrained; 27 percent buildable). Twenty-one percent of SFR habitat land is classified as Class B upland wildlife habitat; 13 percent is

Table 3-21. Common disturbance activities.

- Clearing vegetation and removing native soils
- Grading, excavation, filling, hauling, and soil compaction
- Adding impervious surfaces by constructing buildings, sidewalks, driveways, parking areas and roads
- Modifying streams such as channelizing, piping, widening, deepening, straightening and armoring streambanks to confine flows, increase capacity for flood control, and stabilize streambanks
- Installing utility connections such as sewers and stormwater pipes; septic tanks (in rural areas); building sewer pump stations and water towers
- Building stormwater control structures
- Constructing roads, stream crossings (e.g., bridges), installing culverts
- Landscaping with non-native vegetation (e.g., establishment of lawns, addition of non-native landscape features – trees, shrubs, groundcover, etc.)
- Introducing non-native fish and wildlife species
- Using fertilizers, pesticides and herbicides
- Building fences and other wildlife barriers
- Using toxins in households and businesses
- Generating runoff from household and business activities
- Other (pets, lights, noise, litter, garbage, etc.)

Figure 3-7. Distribution of SFR zoned habitat land by classification and development status in UGB.



riparian/wildlife II. Overall, the developed/vacant status of SFR habitat land is 60/40 percent (respectively). Twenty-seven percent of the vacant land is buildable. Outside the UGB in expansion areas and remaining areas in Metro's jurisdiction, only three percent of fish and wildlife habitat is currently zoned for single-family residential. UGB expansion areas, which are predominantly zoned for rural uses, will eventually be upzoned to accommodate single-family residential development as well as a mix of other uses (e.g., multi-family, commercial, industrial, etc.).

Common development activities that occur in areas zoned for single-family residential include: preparing the site by clearing vegetation and grading; installing utility connections (e.g., stormwater pipes; sewer pipes); building roads and sidewalks; creating stormwater detention facilities; and constructing dwelling units, garages, accessory buildings, driveways, and parking areas. Past development practices included piping or modifying streams (e.g., channelizing, deepening, widening) and filling wetlands. These activities are now widely regulated and are less likely to occur.

Other disturbance activities occurring in SFR land that potentially impact fish and wildlife habitat include: landscaping with non-native vegetation (e.g., lawn, ornamental plants, etc.); applying pesticides, herbicides, and fungicides; building fences and other wildlife barriers; generating runoff; using household toxins; allowing pets to roam freely; generating noise, and using outdoor lighting.

As described earlier, the removal of natural vegetation and the placement of structures and impervious surfaces are the most prevalent disturbances in nearly all zones. Some land uses may require more site preparation (e.g., vegetation removal, grading, etc.) and more impervious surface coverage (e.g., buildings, parking, etc.) than others. For example, a two-acre parcel developed as a single-family subdivision may add less impervious surfaces than an industrial development that requires a large percentage of total land area to accommodate manufacturing, warehousing and transportation facilities. Within SFR zones, however, vegetation removal and impervious surface coverage are highly variable, depending on development practices. For example, some communities may not require that trees and native vegetation be conserved during the development process. Residential streets may be designed to be wider than necessary for serving small volumes of traffic. Development practices that incorporate natural resources into the design (e.g., cluster design) and reduce overall imperviousness (e.g., narrow street design, shared parking) are likely to have less impact on fish and wildlife habitat.

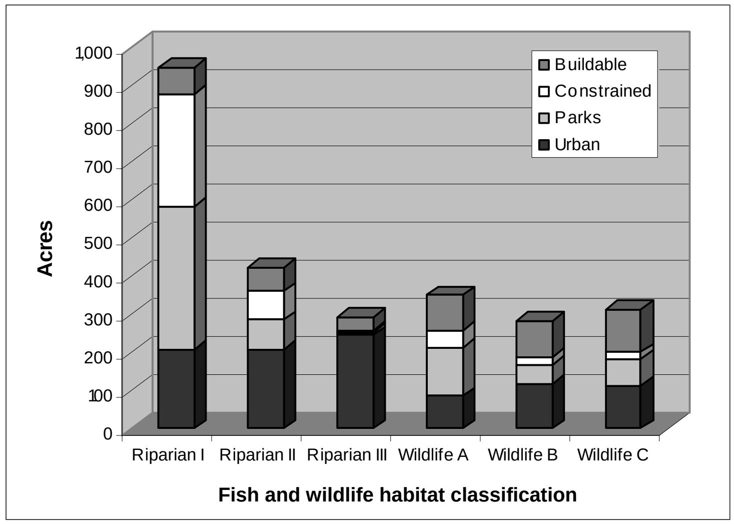
Multi-family residential (MFR 1-4)

Multi-family residential (MFR1-4) includes land for apartment complexes, duplexes, garden apartments, rowhouses, townhouses, condominiums, and other attached single-family structures. These range in densities from two to 25 units per acre with height limits usually set at 2-1/2 to 3 stories (MFR1) to densities greater than 100 units and multiple stories (MFR4). Some mixed-use and neighborhood-scale commercial uses may be allowed under certain circumstances. Conditional uses may include churches, governmental facilities, utility structures, schools, residential recreational centers, group living facilities, etc.

Five percent of the Goal 5 fish and wildlife habitat inventory is zoned as MFR (2,610 acres; see Table 3-4). Figure 3-8 shows the distribution of MFR land by habitat classification and development status. Half of the MFR zoned habitat is classified as high value riparian/wildlife corridors and upland wildlife habitat (1,299 acres). Overall, the total developed/vacant status of MFR habitat is 64/36 percent respectively. Most of the buildable land is found in the three upland wildlife categories.

Development activities that occur in areas zoned for multi-family residential are similar to those found in single-family residential areas. Vegetation is removed, impervious surfaces are added, household activities are similar. Multi-family development may add more impervious surface than single-family residential to accommodate for parking. However, in many cases multi-family residential construction can clear less land area to construct the dwelling units than a typical single-family subdivision. Certain disturbance activities may be more common in single-family than in multi-family residential uses. For example, pesticide, herbicide and fertilizer use may be greater in single-family developments with landscaped yards.

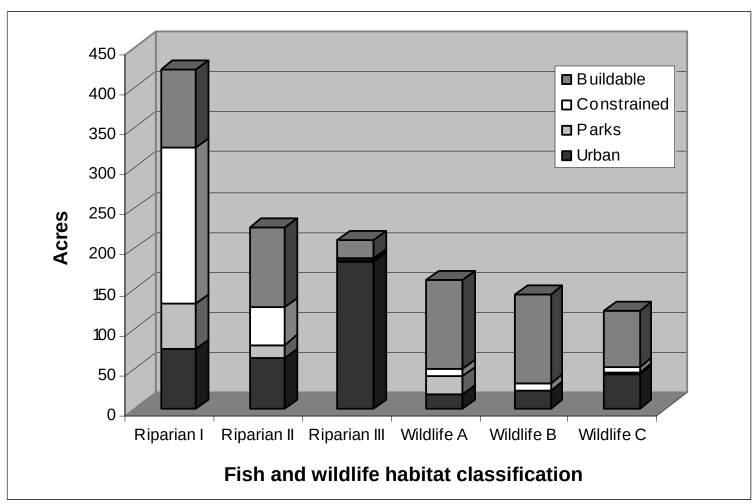
Figure 3-8. Distribution of MFR zoned habitat land by classification and development status in UGB.



Mixed use centers (MUC)

Mixed use centers (MUC) include residential along with commercial uses in town centers, main streets, corridors, light rail station areas, regional centers and the central city. Development types generally permitted include moderate-density to high-density multi-family residential uses, attached single-family dwellings, locally-oriented commercial, retail, services, office uses, community service, and daycare. Mixed-use centers have a strong pedestrian and transit orientation.

Figure 3-9. Distribution of MUC zoned habitat land by classification and development status in UGB.



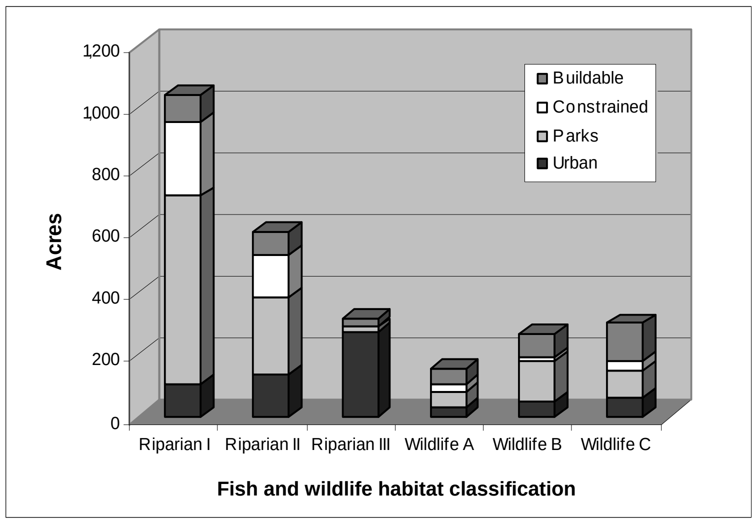
Only two percent of fish and wildlife habitat is zoned for mixed use (1,284 acres; see Table 3-4). Figure 3-9 shows the distribution of MUC land by habitat classification and development status. Fifty-one percent of habitat zoned for mixed use is Class I and II riparian/wildlife corridors (649 acres); 33 percent is upland wildlife habitat (426 acres); and 16 percent is Class III riparian (210 acres). About 40 percent of MUC zoned habitat is buildable.

Similar development activities to those described in the SFR and MFR sections occur in mixed-use centers: vegetation is cleared, impervious surfaces are added. A higher level of imperviousness may occur in these areas as a result of parking requirements and road networks. Other disturbance activities may be different from residential uses. For example, the use of pesticides and herbicides is likely to be less significant in mixed-use centers. The design of mixed-use centers determines the severity of impacts on the fish and wildlife habitat.

Commercial (COM)

Commercial (COM) districts are similar to mixed use zoning in that they tend to be closer to central urban areas or related corridors of commercial activity. Commercial uses include a wide range and scale of retail and service businesses, office, and civic uses in a concentrated area. Public facilities (PF) such as schools, churches, government offices, hospitals, libraries, correctional facilities, public recreation facilities, and public utilities are also included in this category. Conditional uses typically allowed in commercial areas include group living facilities (e.g., nursing homes, boarding houses), churches, schools, jails and related facilities, basic utilities, radio transmission facilities, transit park and rides, rail lines and utility corridors, etc.

Figure 3-10. Distribution of COM zoned habitat land by classification and development status in UGB.



Five percent of fish and wildlife habitat is zoned for commercial development (2,672 acres; see Table 3-4). Figure 3-10 shows the distribution of commercial land by habitat classification and development status. Thirty-nine percent of the land is classified as high value riparian/wildlife corridors; only eight percent of that is buildable. Upland wildlife habitat comprises only a small potion (nine percent) of commercial land. The developed/vacant status of COM habitat land is 67/33 percent (respectively).

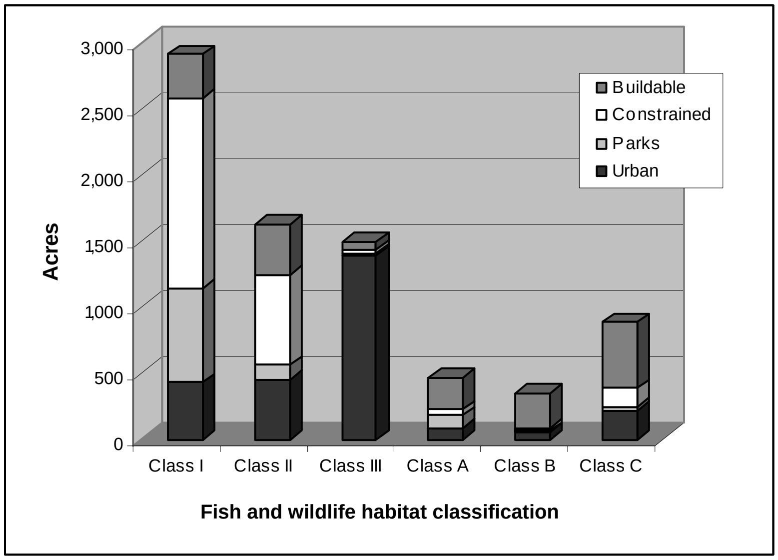
The disturbance activities related to commercial uses are similar to those described for SFR and MFR uses; however, in many cases these activities are more intense. Clearing and grading are usually more extensive for commercial development. Roads and parking lots are important features of commercial development to allow for customer access and visitation. Additional traffic around commercial areas creates more pollutants on roadways, which are eventually washed into streams and rivers. In addition, increased traffic creates hazards to wildlife when moving from one habitat area to another. Large parking lots result in more impervious surfaces than are typically required for residential uses and mixed use areas.

Some of the disturbance activities are less of an issue in commercial development than in residential areas. For example, application of fertilizers, pesticides and herbicides may be reduced, unless the commercial development incorporates extensive landscaping. Impacts to the fish and wildlife habitat from domestic pets are also less relevant in commercial development.

Industrial (IND)

Industrial zones allow a variety of industrial uses from light manufacturing (e.g., fabrication) to heavy manufacturing (e.g., chemical processing) to mixed use industrial (e.g., a mix of light manufacturing, office and retail uses). Supporting commercial services such as restaurants and banks may be allowed outright, depending on the zone, or permitted with limitations. Conditional uses may include junkyards and wrecking yards, basic utilities, commercial recreation facilities, and waste related services.

Figure 3-11. Distribution of IND zoned habitat land by classification and development status in UGB.



Industrial zoned land represents a fairly significant portion of the Goal 5 fish and wildlife habitat inventory – 14 percent (7,721 acres; see Table 3-4). Industrial land tends to be large, flat parcels that may intersect with fish and wildlife habitat in lower density areas of the region, often bordering rivers, streams or wetlands. This fact is apparent from Figure 3-11; over 2,900 acres, or 38 percent of industrially zoned habitat, is high value riparian/wildlife corridors. Over sixty percent of Class I is considered vacant, most of which is constrained land. The developed/vacant status of total IND habitat land is 47/53 percent (respectively).

Disturbance activities in industrial development are similar to those found in residential and commercial areas, but to a greater degree depending on the intensity of the industrial activity (e.g., light industrial vs. heavy industrial). Industrial development is typically land intensive, meaning it requires a large percentage of total land area to accommodate manufacturing, warehousing, transportation facilities, etc. Site preparation for industrial development frequently requires complete site clearing and grading. Past development practices retained few, if any, natural resources on the site and the entire site was covered with impervious surfaces. Current regulations require that impervious surfaces be set back from water features, and that riparian areas be planted with native vegetation.

Some industrial uses require a substantial amount of water for use in manufacturing processes (e.g., cooling equipment) that is later released to the rivers at an increased temperature. This process impacts instream habitat for fish and other aquatic species. Industrial areas may contribute high quantities of heavy metals and other toxic materials. In addition, the use, storage, and transport of hazardous materials often occurs in industrial uses.

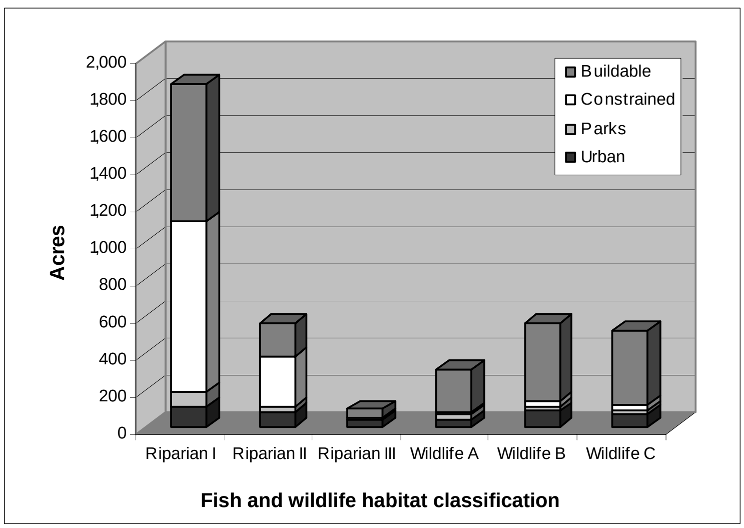
Mining typically occurs on industrially-zoned land. In the Metro region, mining is focused on aggregate resources (naturally occurring concentrations of stone, rock, sand and other materials used for urban development and road building). Aggregate resources are regulated as Goal 5 resources. Instream and off-channel mining of aggregate resources has direct and significant negative impacts on the aquatic ecosystem. Extraction of sand and gravel from within a stream channel may change the way in which water and sediment move through a stream system and altering stream characteristics (e.g., channel morphology and substrate, channel stability, etc.). Off-channel mining practices often include construction of berms and dikes to prevent flood flows from spilling into excavation areas. These structures can prevent the natural lateral migration of the stream.

Marine terminals, freight facilities for trucking, airports and railroad mostly occur in industrial zoned areas. These land uses have similar disturbance activities as land intensive industrial uses. Airports have the additional impact of noise and light. The Goal 5 rule exempts water-dependent or water-related uses, which are generally located in industrially zoned areas, from being identified as conflicting uses. (OAR 660-23-090(7)) However, activities related to these uses have detrimental impacts on instream aquatic habitat.

Rural (RUR)

The rural generalized zoning category includes RRFU (Rural Residential and Future Urban) and FF (Agricultural and Forestry). Rural residential lands provide the opportunity for single-family housing on lots of one acre or more in a rural or semi-rural environment. This designation also includes areas set aside for future urban development. Some of the local zones that fall into the RRFU category also allow agriculture, horticulture, greenhouses, nurseries, timber growing, and raising of livestock and animals.

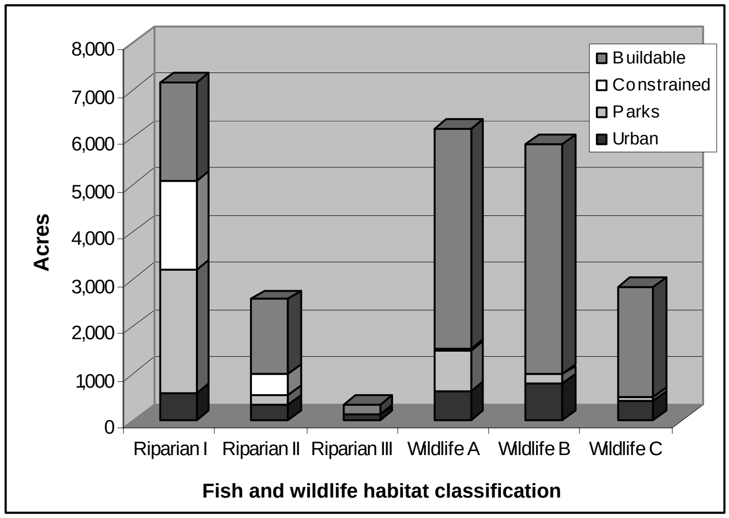
Figure 3-12. Distribution of RUR habitat land by classification and development status in UGB.



Fourteen percent of the fish and wildlife habitat inside the UGB (before December 2002) is zoned for rural use (7,721 acres; see Table 3-4). Not surprisingly, fish and wildlife habitat zoned for rural uses is a much higher proportion (89 percent) in UGB expansion areas and the remaining areas within Metro's jurisdiction (24,969 acres; see Table 3-5). Figure 3-12 shows that most of the rural zoned habitat land within the UGB is Class I and Class II riparian/wildlife corridors (62 percent). Over half (51 percent) the total habitat land zoned for rural uses inside the UGB is considered buildable.

Figure 3-13 shows the distribution of rural fish and wildlife habitat in UGB expansion areas and the remaining areas in Metro's jurisdiction. Fifty-four percent of habitat zoned for rural uses is high value Class I riparian/wildlife corridors and Class A upland wildlife habitat; more than half of that is buildable. Over 8,200 acres of the 18,800 acres in UGB expansion areas (44 percent) are significant fish and wildlife habitat. These areas will eventually be upzoned from rural zoning to accommodate urban development.

Figure 3-13. Distribution of RUR habitat land by classification and development status outside UGB.



Rural disturbance activities are similar to single-family and multi-family residential, except that there is typically less impervious surface. The larger lots generally spread out the impact of development and produce less stormwater runoff. However, the use of pesticides, herbicides and fertilizers may be greater in rural developments where agricultural uses are allowed. In addition, grazing of livestock can cause soil erosion, soil compaction, deterioration of water quality, and simplification of native vegetation diversity.

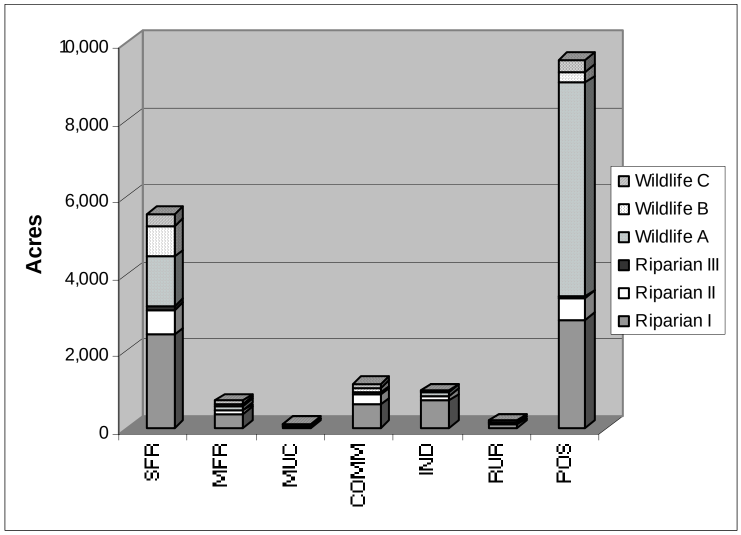
Agricultural uses and forestry, suitable to commercial scale production (typically with lot sizes of 30 acres or more), are allowed in the FF (Agriculture or Forestry) regional zone. Commercial farm and forest uses can involve extensive removal of native vegetation and habitat and are considered a conflicting use within the UGB. However, the Goal 5 rule exempts identifying agricultural and forest use outside the UGB as conflicting uses. (OAR 660-23-090(7)) Clearing vegetation, plowing fields, exposing bare soils and other farming and forestry practices (e.g., use of harvesting equipment) can heavily impact fish and wildlife habitat (e.g., soil erosion, soil compaction, etc.).

Parks and open space (POS)

Twenty percent of the Goal 5 fish and wildlife habitat inventory (10,470 acres; see Table 3-4) is actually zoned as parks and open space. An additional 8,680 acres are included in Metro's parks and open spaces inventory, but are zoned something other than POS. Parks and open space are allowed outright or conditionally in all of the generalized regional zones, although to varying degrees, and often retain the underlying zoning. Metro excludes parks and open space from the buildable land supply for estimating the region's 20-year land supply for dwelling units and employment inside the UGB.

Figure 3-14 shows park acreage by generalized zones and habitat classification. The largest number of park acres occurs in POS and SFR zoning.

Figure 3-14. Parks and open space by generalized regional zones and habitat classification.



The disturbance activities associated with parks and open space vary depending on the intensity of use. Many developed parks provide ball fields, tennis courts, picnic areas, recreational trails, maintenance facilities, parking lots, and other amenities. Disturbance activities in parks create impacts that are similar to those described for residential uses; however, generally a smaller percentage of land is covered by impervious surfaces. Maintenance practices used in many parks are similar to residential landscaping practices and can negatively impact habitat. Off-leash dog use in some of these parks impacts water quality.

Undeveloped open space, on the other hand, has the least amount of disturbance activities. These areas provide important wildlife habitat. Publicly owned open space provides recreational opportunities for people and a connection to nature and exposure to wildlife. Human activities such as hiking and biking, however, can negatively impact the fish and wildlife habitat.

Summary

Metro identified conflicting uses from a regional perspective by examining generalized regional zones (Metro's compilation of local jurisdictions' zones) and by considering Metro's 2040 Growth Concept. The conflicting use chapter analyzed Metro's Goal 5 fish and wildlife habitat inventory (e.g., habitat class, development status) and its distribution among generalized regional zones, 2040 design type priorities, and impact areas. Disturbance activities that are likely to occur within the generalized regional zones are also described. Some key points from this chapter include:

Figure 3-15. Total acreage in Metro's jurisdiction.

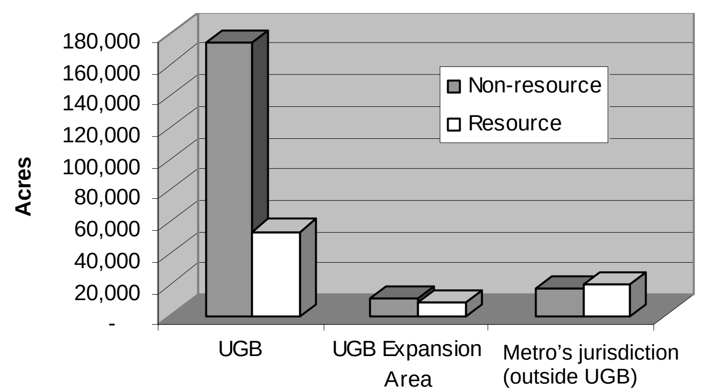
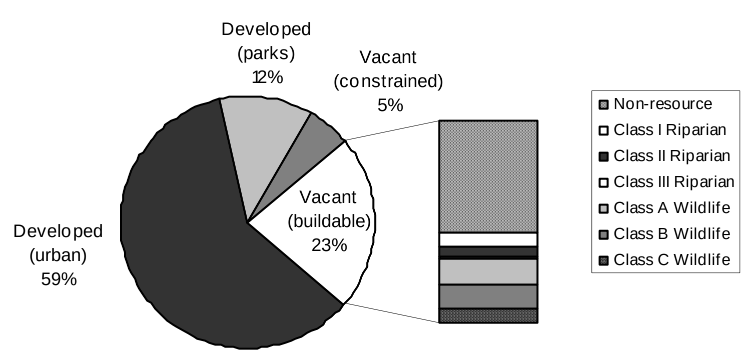


Figure 3-16. Percentage of total acreage in Metro's jurisdiction by development status.



- Metro's jurisdiction is comprised of approximately 280,660 acres, or about 438 square miles (not including water features). Figure 3-15 shows a comparison of non-habitat land with habitat land in three geographical areas: the UGB (pre-December 2002), UGB expansion areas (December 2002), and the remaining areas in Metro's jurisdiction outside the UGB (see Figure 3-1 map).
- About 29 percent of the total acreage in the three geographical areas represented in Figure 3-15 is regionally significant fish and wildlife habitat (81,700 acres).
- Approximately two-thirds of fish and wildlife habitat are within the UGB.
- Twenty-three percent of the total land area (both non-habitat and habitat) is vacant buildable land (64,175 acres). Almost half of the vacant buildable land in Metro's jurisdiction is fish and wildlife habitat (see Figure 3-16).
- Twenty-eight percent of vacant fish and wildlife habitat is already constrained by existing environmental regulations.
- The highest quality riparian/wildlife corridors (Class I) comprise about seven percent of the total supply of buildable land, while the highest quality upland wildlife (Class A) is 13 percent of the total supply of buildable land.

- The generalized regional zones, by themselves, are not conflicting uses. It is the development activities and other disturbances (e.g., clearing vegetation; adding impervious surfaces such roads, sidewalks, buildings and parking lots; landscaping with non-native vegetation; use of chemicals and contaminants) that generate negative impacts to fish and wildlife habitat.
- Forty-seven percent of fish and wildlife habitat is zoned single-family residential; over half is classified as high value riparian/wildlife and upland wildlife.
- Twenty percent of the fish and wildlife habitat is zoned for parks and open space. However, 34 percent of the fish and wildlife habitat is used as a park or open space.
- Fourteen percent of fish and wildlife habitat is zoned for industrial use. Of this amount, 44 percent overlaps with high value habitat, and over half is vacant.
- Metro has identified approximately 16, 300 acres as impact areas; over half are zoned single-family residential; 19 percent are zoned industrial; 82 percent is developed.
- 2040 design types are prioritized into four categories: primary land use components, secondary land use components, tertiary land use components, and other. Over half of the fish and wildlife habitat overlap with tertiary land use components (i.e., inner and outer neighborhoods, employment centers, corridors); 28 percent of the habitat is other design types (i.e., parks and open space, rural), 11 percent is in a primary category (i.e., central city, regional centers, industrial areas, intermodal transportation facilities); and five percent is secondary land uses (i.e., town centers, main streets, and station communities).

Figure 3-17. Distribution of habitat classification by generalized regional zones inside the UGB.

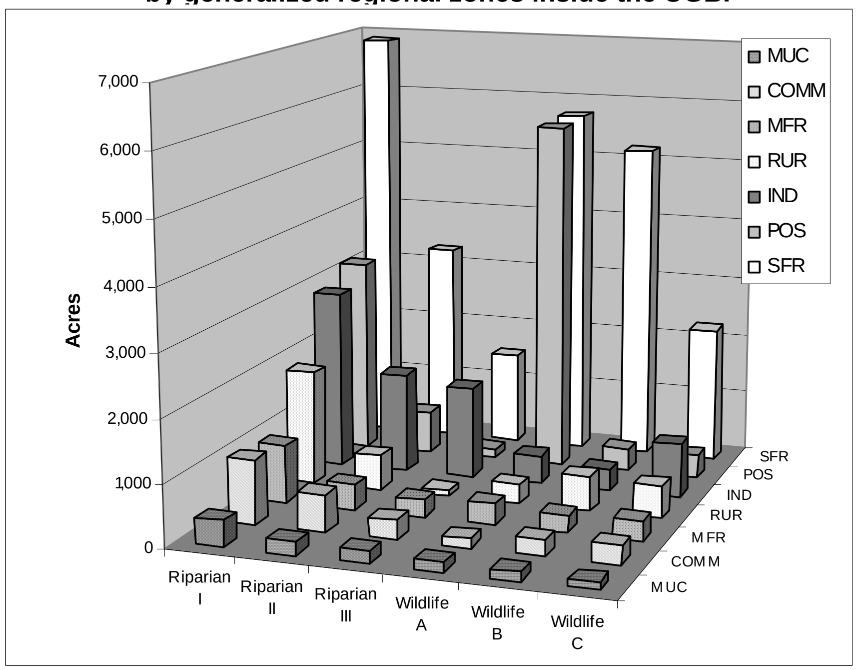
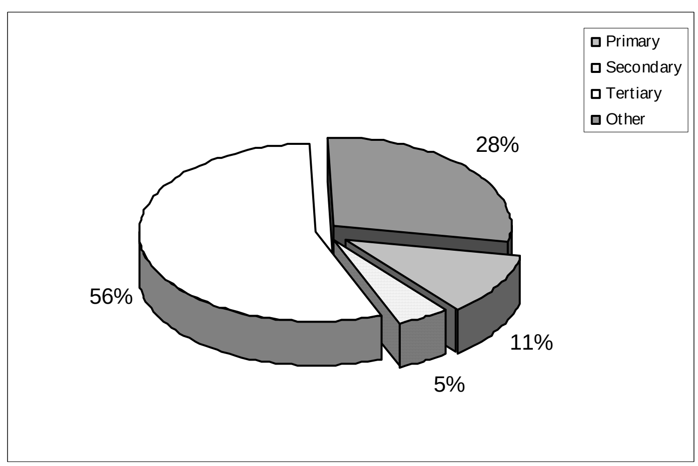


Figure 3-18. Percentage of fish and wildlife habitat by 2040 design type hierarchy.



The next four chapters consider the ESEE consequences of allowing, limiting, or prohibiting conflicting uses in fish and wildlife habitat areas.

CHAPTER 4: ECONOMIC CONSEQUENCES

Introduction

This chapter focuses on the economic consequences of protecting or not protecting fish and wildlife habitat. The competition between developing fish and wildlife habitat and protecting the ecosystem services provided by these areas lies at the heart of economic analysis. Metro contracted with ECONorthwest, a well-respected economic consulting firm, to provide insights into this competition and identify supporting information for the economic analysis. ECONorthwest conducted a review of the relevant literature[22] that focused on the factors that influence the market value for developable land and the economic value of ecosystem services provided by fish and wildlife habitat.

This chapter begins by providing an overview of the region's economy and the economic principles guiding the analysis. It then briefly outlines the major analytical tasks involved. The remainder of the chapter summarizes ECONorthwest's analysis[23] and describes the tradeoffs of protecting or not protecting fish and wildlife habitat by addressing the following questions:

- How is land ranked based on the economic importance for development?
- How is land ranked based on the economic importance for ecosystem services?
- What are the interactions between development value and ecosystem services value of fish and wildlife habitat?
- What are the potential economic consequences of allowing, limiting or prohibiting conflicting uses?

Background and context

Metro region's economy

The economic structure of the region's economy has shifted over time from one driven by resource industries (timber, agriculture, and metals) to more knowledge-based and service-oriented industries. This restructuring has occurred as productivity, labor trends and capital investments have re-shaped the national economy over the last half century and forced regional economies like the Portland area to adapt in order to prosper. And indeed the Portland area has prospered – witnessed by its above-average population and job growth over the last several decades.

Early on, cities on the West Coast emerged because of proximity to trade routes and abundant natural resources of which residents could take advantage. This region was blessed with plentiful rainfall and rich soil for agriculture in the Willamette Valley and plentiful trees for harvesting logs for homes and industry. Portland's proximity at the confluence of two great rivers provided cheap and convenient access/connections for farm goods and supplies to and

[22] See Appendix C: *Final Draft Literature Review for the Economic Portion of Metro's Goal 5 ESEE Analysis* (ECONorthwest 2003)
[23] See Appendix C: *Final Report for the Economic Portion of Metro's Goal 5 ESEE Analysis* (ECONorthwest 2004).

from various sea and inland trade routes. Portland became a major seaport and transportation hub for West Coast trade.

Agriculture in the northern Willamette Valley has changed over time as farm production has become more competitive nationwide. Farms that once produced foodstuffs for the Portland area no longer are the dominant agricultural industry. Today instead, the major agricultural producers are nursery growers and grass seed farming.

With the onset of World War II, the region's economy shifted to producing goods for the war effort. Ship building and ancillary manufacturing arose to briefly become a key industry during the 1940's. Since then, ship building has declined. However, the transportation equipment industry remains a significant industry in the region, but the components of this industry have shifted away from ship building to the production of rail cars (Gunderson), aircraft parts manufacturing (Boeing) and heavy diesel truck production (Freightliner).

After construction of the Bonneville Dam and other dams along the Columbia River, metals manufacturing and fabrication (particularly aluminum) became an important component of the regional economy. The dams provided an opportunity to create jobs and generate cheap and plentiful electricity for residents in the region. The enormous surplus of electricity attracted Reynolds Aluminum and others to locate aluminum smelting plants in and around the region. As the aluminum industry matured, the Northwest aluminum industry's competitive advantage steadily waned. A combination of higher electricity prices, diminished electrical supplies, and global competition has forced most of the region's aluminum smelters out of business. The metal industry in the region has evolved into a secondary industry that mostly handles recycling of scrap metals.

Before the 1980's regional recession, timber products (logging and paper) were engines of growth for the State and metropolitan area economies. This is no longer the situation. Continued concerns over logging of old growth forests and associated decline of species have led to restricted harvest levels on federal forest lands. In addition, competition from Canadian sources and southeast U.S. producers has increased over time. Continued productivity enhancements in the industry also add to the long-term employment declines in this industry. As a result, the forest products industry is a smaller part of the regional economy.

As the region's traditional resource industries came under increased competitive pressures, the metropolitan area experienced the emergence of a new industry – the so-called high-tech industry. High-tech had its nascent beginning in 1946 with Techtronix and 30 years later with Intel. The high-tech industry really came into prominence in the 1990's as Intel and other multi-national firms from Asia invested over $10 billion in the area alone. The high-tech sector, popularly known as Silicon Forest, which is largely concentrated in Hillsboro, with smaller "clusters" in Tualatin and Gresham, is not monolithic but is comprised of different companies specializing in various fields of expertise. The region's specialties in the high-tech field include semi-conductors, electro-scientific instruments, printer and parts manufacturing, and visual projection devices.

The transport of goods and services has always been an important component of the metropolitan economy. The Port of Portland continues to be a key economic component to this region's economic health. The factors that made Portland a key location for commerce are still here today and may be even stronger today than before. International travel and the trading of goods and services overseas is much greater today. The regional economy is much more globally bound, so the infrastructure and technology to move goods and people overseas and around the country are very important to the growth and prosperity of the region.

As the region's basic or traded sectors grow and attract new businesses and the people who work for these companies, the region has experienced a multi-fold increase in services and retail. Every city has needs and these needs are provided by the numerous entrepreneurs who everyday provide the goods and services residents living in the city demand. As the region's population grows, so have the number of shopkeepers. Like all metropolitan areas in the U.S., there has been an evolution in how goods and services are supplied to consumers. One example is the rapid growth of Mega-stores and regional malls that did not exist half a century ago.

As described above, the region's economy has shifted over time from resource-based industries to more knowledge-based and service-oriented industries. This transition has added complexity to the region's economy and competition for natural resources. The following section briefly describes the economic principles upon which this analysis is based.

Economic principles

The following six economic principles help define the approach to the analysis of economic tradeoffs of developing lands that contain significant riparian and/or wildlife habitat or protecting this habitat and the associated ecosystem services that benefit society.

1. *Market prices for land can be used as a measure of development value.* Property markets for developable land meet most of the criteria for a well-functioning market. Many sellers and buyers participate in the market, there is free entry to and exit from the market, and buyers and sellers have access to information on the attributes of land that provide development value. For these reasons, market prices for land provide a good measure of development value. Participants in a market can measure or rank the development potential or importance of properties based on property value.
2. *Ecosystem services have economic value.* Ecosystem services are the benefits to society of well-functioning ecosystems such as riparian areas that mitigate flooding, help filter toxins and sediment from surface runoff and provide recreational and other amenity values. Society also benefits from wildlife habitat that helps support populations of species with commercial, recreational, and cultural value.
3. *Property markets may capture some, but not all, of the values of ecosystem services.* Property markets can provide information on the value of some ecosystem services, such as the value associated with proximity or access to recreational resources or scenic vistas. Property values typically do not reflect the value of other ecosystem services, such as water quality or wildlife habitat services.
4. *Property markets may not capture public policy or planning goals.* Just as property markets fail to reflect the full value to society of ecosystem services, these markets may also fail to capture the value of public policy or planning goals that affect land use. For example, properties with the highest market value may not necessarily be the most

important lands from a public policy perspective. Specific to this project, the hierarchy of design types as described by the 2040 Growth Concept emphasizes certain land use types in certain locations. Public policy consideration drives the design of the hierarchy, not market prices. As a result, the 2040 Growth Concept may emphasize the importance of a relatively low valued land use, such as industrial development, in an area that, if left to property markets, would develop into a higher valued use, such as a residential development.

5. *There is competition for the fish and wildlife habitat resources at issue in this study.* In the past, discussions of the competition for natural resources focused on the tradeoffs of developing or using a resource and the associated jobs created or supported versus protecting the resource for its intrinsic or non-use value. This is the 'jobs vs. the environment' argument. Such an approach assumed two competing demands for a resource: 1) that protecting the environment would not generate or support jobs, and 2) that development use would not generate negative impacts beyond affecting non-use values.

   Today, the competition for resources is more complex with more demands on a finite amount of natural resources. The dynamics of the competition extend far beyond a choice of jobs or the environment. A distinction can be made between demands on the resource that have use and non-use values. The range of demands with use values include commercial use of the resource, the ecosystem services provided by the resources, the impacts of the resources and development values on location decisions of retirees, workers and businesses and other quality-of-life impacts and options to use the resources in the future.[24] Demands with non-use values include the intrinsic value of the resources.
6. *A static analysis likely will fail to inform stakeholders or decision makers adequately of the economic tradeoffs*. A static analysis is similar to taking a snapshot of analytical conditions. This approach assumes no changes in factors that could influence the outcome of a decision to develop or to protect resources. An alternative approach that considers how changes or adjustments affect the economic analysis will likely provide a more complete description of the economic tradeoffs than ignoring these adjustments. In this case, dynamic adjustments may include expanding the urban growth boundary (UGB) and the substitutability of land within the UGB. Such a dynamic approach also considers the likely restoration efforts that can help mitigate the negative impacts of development on regionally significant fish and wildlife habitat. A dynamic approach that considers likely changes, adjustments, or possible mitigation efforts will provide decision makers with a more complete view of the likely economic impacts than will a static approach.

Framework for the economic analysis

The framework for the economic analysis consists of four major analytical tasks, briefly described below.

[24] See Appendix C, *Final Draft Literature Review for the Economic Portion of Metro's Goal 5 ESEE Analysis* (ECONorthwest, 2003), for more information on the competing demands for natural resources.

- *Rank fish and wildlife habitat based on the economic importance for development (development value).* In this analytical task, a method was developed to rank the relative importance of land for development using three criteria: land value, employment and 2040 design types.

- *Describe economic value of ecosystem services provided by fish and wildlife habitat.* In this task, the economic value of ecosystem services is described based on ECONorthwest's economic literature review. Metro's ranking of fish and wildlife habitat for ecological function serves as a proxy for the economic value of ecosystem services.

- *Compare the ranking of economic importance for development (development value) with Metro's ranking of ecological value for fish and wildlife habitat.* This comparison provides information on the amount and distribution of significant interactions between development use and habitat protection.

- *Describe the economic consequences of allowing, limiting, or prohibiting development of regionally significant fish and wildlife habitat.* In this task, reference is made back to the previous tasks that describe the context for the analysis of economic tradeoffs. Economic factors (e.g., land value, employment, 2040 design types and value of ecosystem services) are described that may be affected by a Goal 5 decision.

How is land ranked based on the economic importance for development?

Not all land has the same economic importance for development, just as not all fish and wildlife habitat have the same ecological value. For example, land zoned for parks has less economic importance compared to land zoned for industrial uses. This analysis ranks land based on economic importance for development, or "development value." This approach helps weigh the economic consequences of protecting or not protecting fish and wildlife habitat.

Development value of land can be ranked in many ways. Methods include ranking land based on property value, distance from city center, the amount of vehicle and pedestrian traffic that passes by, or local economic development priorities that target specific economic sectors or land uses. Developing an exhaustive list of methods and applying them to the lands that contain fish and wildlife habitat goes beyond the scope of this analysis. Instead, this analysis focuses on a three measures that provide a general understanding of the development values: land value, employment potential associated with development (employment density) and 2040 Growth Concept planning goals.

Property markets provide a good measure of a property's development value because factors that affect a parcel's development potential (i.e., location and use) are typically widely known and easily measured.[25] The location factors that influence property values include availability of

[25] See Appendix C, *Final Draft Literature Review for the Economic Portion of Metro's Goal 5 ESEE Analysis* (ECONorthwest, 2003), for more information.

urban infrastructure services, transportation access, and zoning and other regulations. Use factors include a property's amenities, physical terrain and lot size and shape.

The second measure for describing the importance of land for development is the employment potential associated with development. Land values and employment potential describe current conditions. For insights into relative importance for development in the future, a third measure is used that ranks land using Metro's 2040 Growth Concept planning goals described by the 2040 design types.[26] The following sections describe these three measures.

Rank lands based on land value

Market prices reflect a parcel's location and use factors. Distribution of land value was modeled based on local tax assessor data and mapped using GIS. County assessors' data on value (compiled by Metro) is a reasonable proxy for market value for purposes of identifying a range of property values from high to low. "Reasonable proxy" means that there is a relatively high correlation between values in the assessor's data and market values. That is, a high value in the assessor's database will also have a high market value. Given the limitations on assessed value from Measures 5 and 50, it is expected that assessed values will be less than market values. However, this data is used to describe a range of property values from high to low, not as a measure of market value for any one property.

The data on land value was used for ranking lands, not the value of land plus improvements. Land value reflects the expected value of land in the best uses supported by the market and allowed by public policy. Including the value of improvements would bias the analysis against undeveloped land. Property without improvements would likely be constrained to the lower end of the range of values if the range included the value of improvements.

The database of assessed values excludes land uses that do not pay property taxes, such as public schools and some hospitals, and underestimates the value of other land uses that pay limited property taxes, such as low-income housing. Land value reflects the amenity values associated with fish and wildlife habitat, but likely does not capture the value of other ecosystem services such as those associated with water quality and flood management.

Map 1 shows the distribution of land value across the Metro region. Land value is divided into "low," "medium" and "high" values. Habitat lands with assessed values equal to or greater than $8.00 per square foot have high development value. Habitat lands with assessed values greater than $4.50 and less than $8.00 have medium development value. Habitat lands with assessed value below $4.50 per square foot have low development value.[27] Values are expressed as mean dollars per square foot. Map 1 shows that the highest values are centered on the city of Portland and surrounding concentrations of population and commercial activity. Areas of medium value surround the high valued areas and include areas of suburban population and commercial concentrations. Low values are found in the remaining outlying areas.

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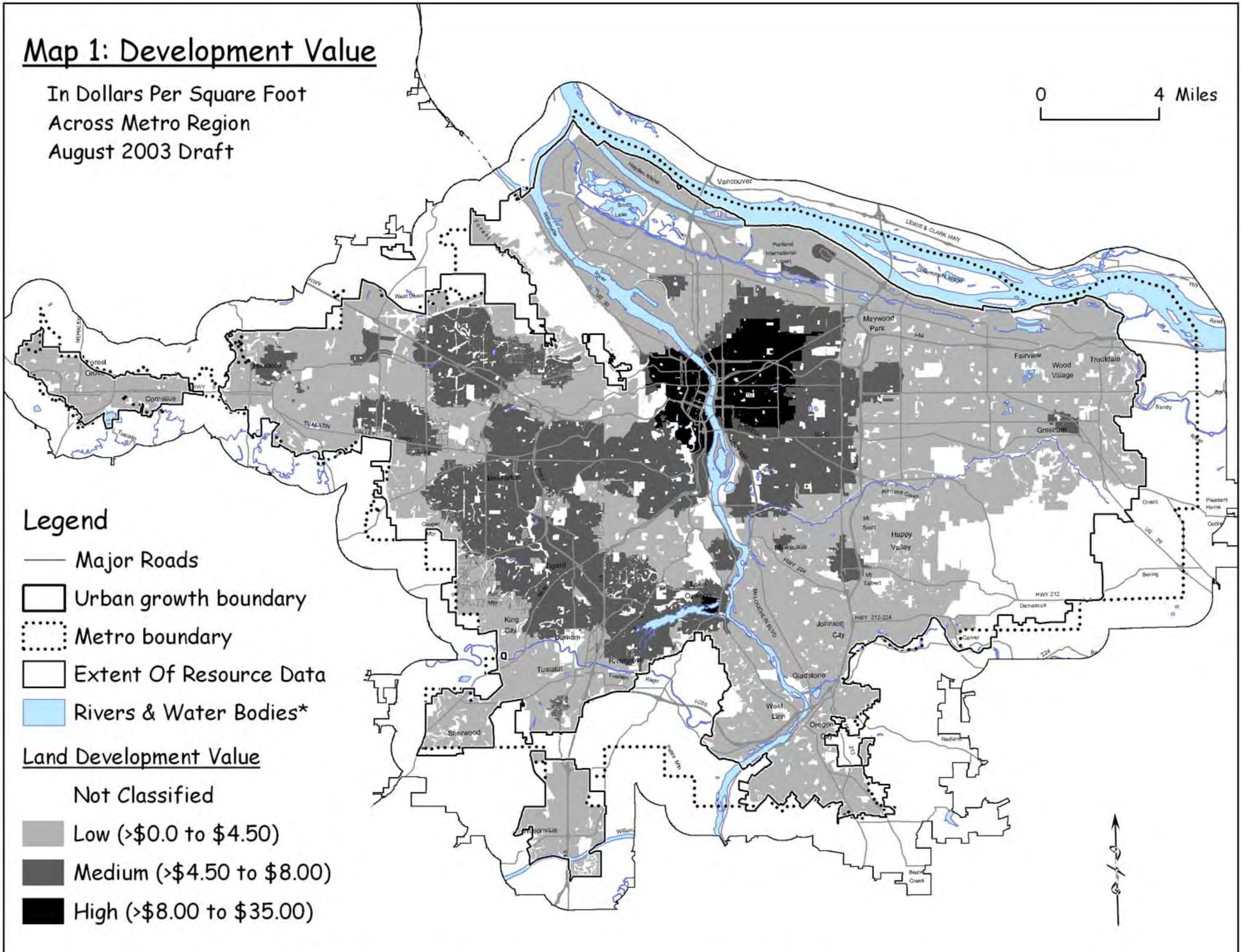
[26] See Conflicting Use chapter for description of 2040 design types.

[27] See Appendix C, *Final Report for the Economic Portion of Metro's Goal 5 ESEE Analysis* (ECONorthwest 2004), for more information

Map 1a depicts the distribution of land values for the subset of lands in Metro's jurisdiction that contain fish and wildlife habitat. The large majority of these acres fall in the outlying or low category. Map 1b shows only those habitat lands that are ranked high for the quality of fish and wildlife habitat characteristics. Another way of describing the lands shown in Map 1b is that they represent the development value of lands that contain the most significant fish and wildlife habitat

Map 1: Development Value

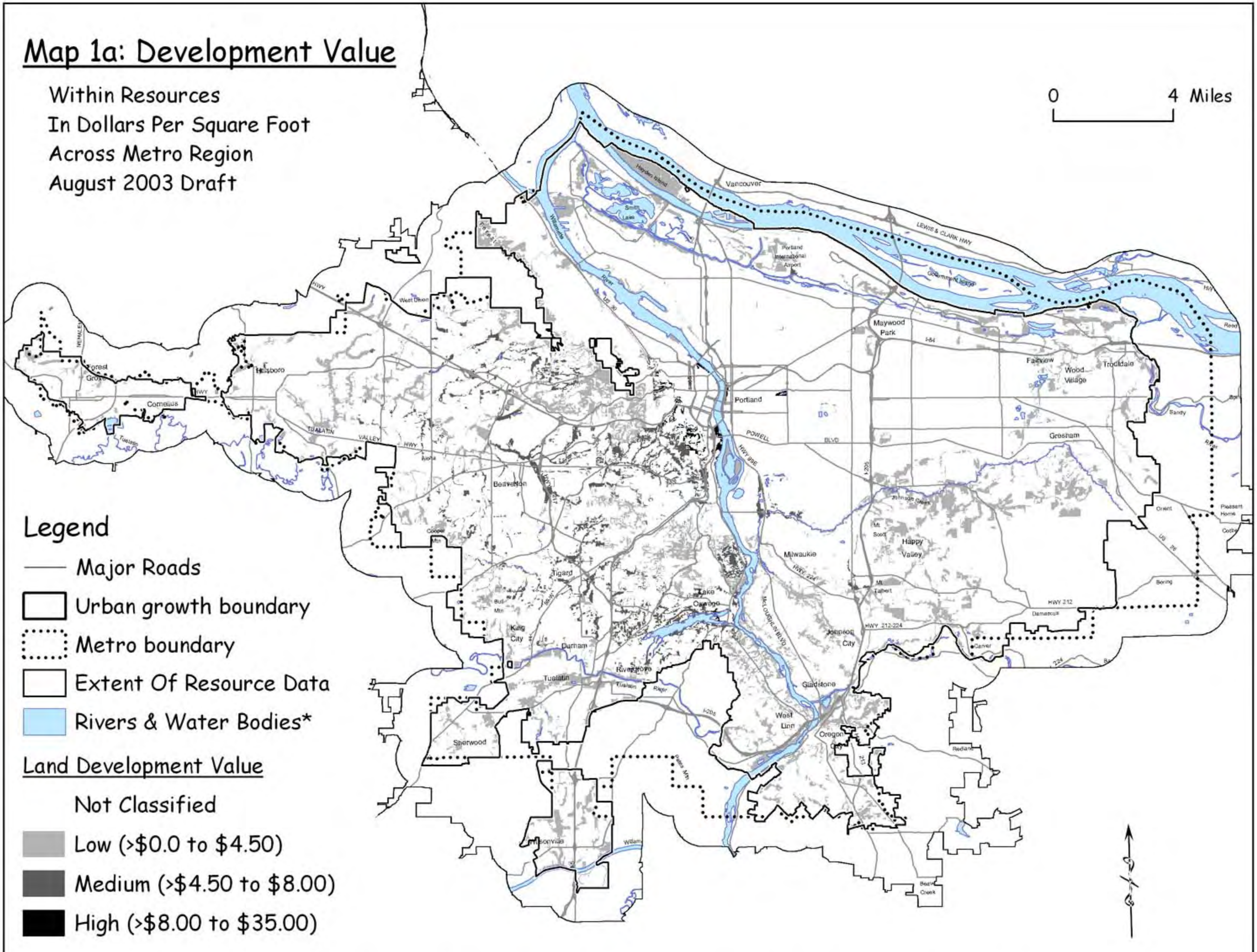
In Dollars Per Square Foot
Across Metro Region
August 2003 Draft



*rivers & water bodies greater than 2 acres in size - J:\houk\Goal5\ESEE\EconomicAnalysis\ECONorthwest\maps091103\Map 1 Development Value.mxd

Map 1a: Development Value

Within Resources
In Dollars Per Square Foot
Across Metro Region
August 2003 Draft



Legend

Major Roads
Urban growth boundary
Metro boundary
Extent Of Resource Data
Rivers & Water Bodies*

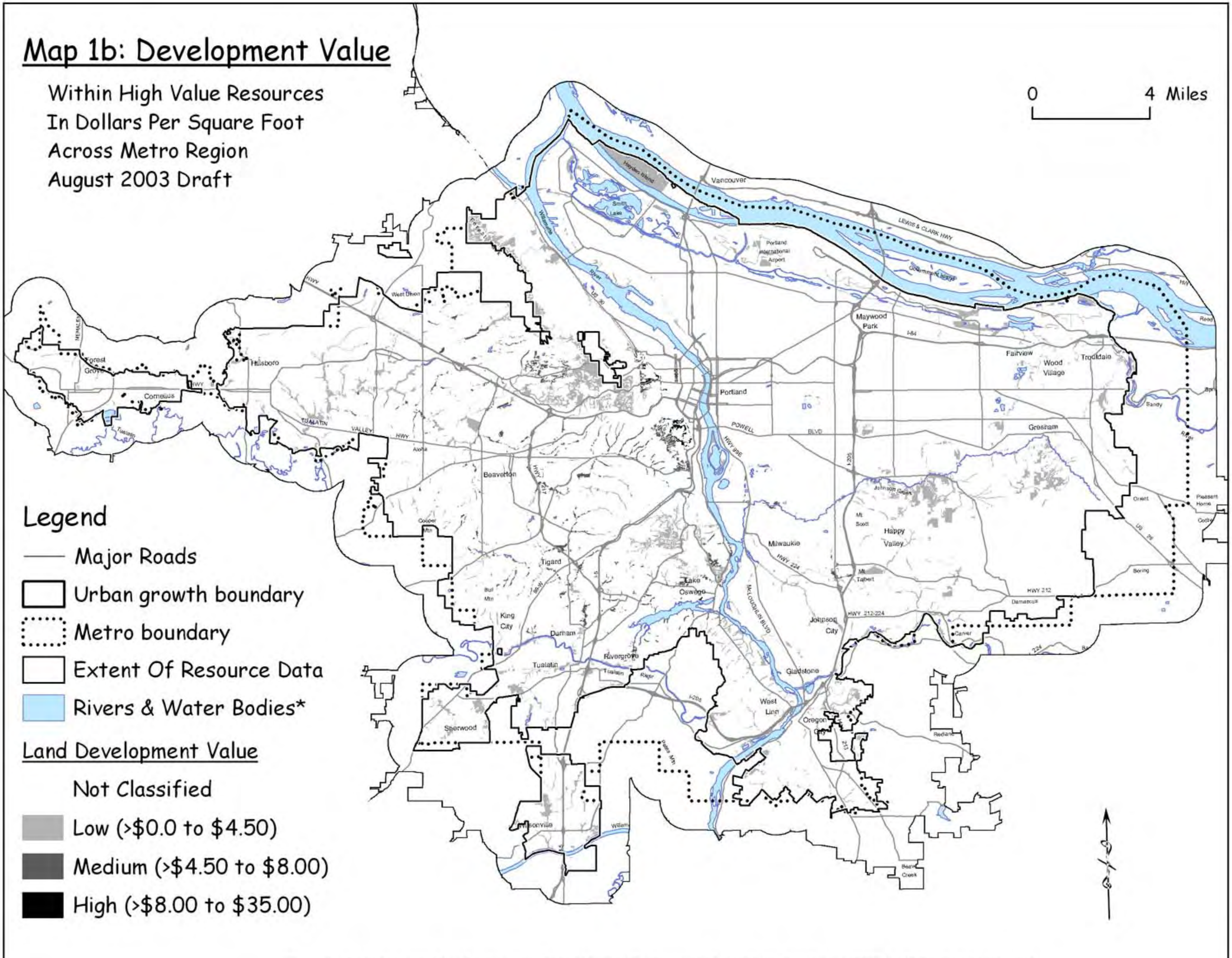
Land Development Value

Not Classified
Low (>$0.0 to $4.50)
Medium (>$4.50 to $8.00)
High (>$8.00 to $35.00)

*rivers & water bodies greater than 2 acres in size - J:\houk\Goal5\ESEE\EconomicAnalysis\ECONorthwest\maps091103\Map 1 Development Value.mxd

Map 1b: Development Value

Within High Value Resources
In Dollars Per Square Foot
Across Metro Region
August 2003 Draft



Legend

Major Roads

Urban growth boundary

Metro boundary

Extent Of Resource Data

Rivers & Water Bodies*

Land Development Value

Not Classified

Low (>$0.0 to $4.50)

Medium (>$4.50 to $8.00)

High (>$8.00 to $35.00)

*rivers & water bodies greater than 2 acres in size - J:\houk\Goal5\ESEE\EconomicAnalysis\ECONorthwest\maps091103\Map 1b Development Value.mxd

Rank lands based on employment potential

Employment potential associated with development is a way of ranking economic importance of land. The more employees that land can support, the more valuable it is for development. Employment density was modeled as employees per gross acre across the Metro region (using State 202 employment data[28]) and mapped using GIS. Jobs were assigned to vacant or undeveloped land based on jobs in surrounding areas with similar zoning.

Employment density was divided into "low," "medium" and "high" employment. Habitat lands with employment density equal to or greater than 16 jobs per acre have high development value. Habitat lands with employment density greater than four and less than 16 jobs per acre have medium development value. Habitat lands with employment density of four jobs per acre or less have low development value.[29]

The methodology for assigning jobs to vacant land and for defining three categories of employment density assumes that jobs are tied to a specific location and cannot move to other locations in the Metro region. This assumption is certainly not strictly correct; in some instances it may not be even approximately correct. To the extent that land uses that support these jobs can move elsewhere in the UGB, or be directed elsewhere in the future, these alternatives will help mitigate potential negative employment impacts of limit and prohibit decisions.

The measure of employment density does not capture the relative importance of residential development; however, ranking land based on land value, as described in the previous section, provides a measure of the relative development value of residential areas. Another limitation of this analysis is that it does not distinguish among jobs that are more "important" and those that are less "important" to the region's economy.

Map 2 shows the distribution of lands ranked by employment density. The low, medium and high categories in Map 2 correspond to the break points described above. Compared with the distribution of development values as described by land value (see Map 1), lands that support employment occupy a smaller subset of Metro's jurisdiction. That is because Map 2 excludes lands that do not support employment, primarily residential and park lands. Map 2 shows that lands that support employment predominate in the Portland city center and along transportation routes.

Map 2a depicts the distribution of employment density for the subset of lands in Metro's jurisdiction that contains significant fish and wildlife habitat. The large majority of these lands fall in the outlying or low category.

Map 2b shows the subset of lands from Map 2a that are ranked high for the quality of fish and upland wildlife habitat characteristics. Map 2b shows the employment density for lands that contain the most significant fish and wildlife habitat. Policy decisions that protect the most significant habitat would have the greatest impact on these lands.

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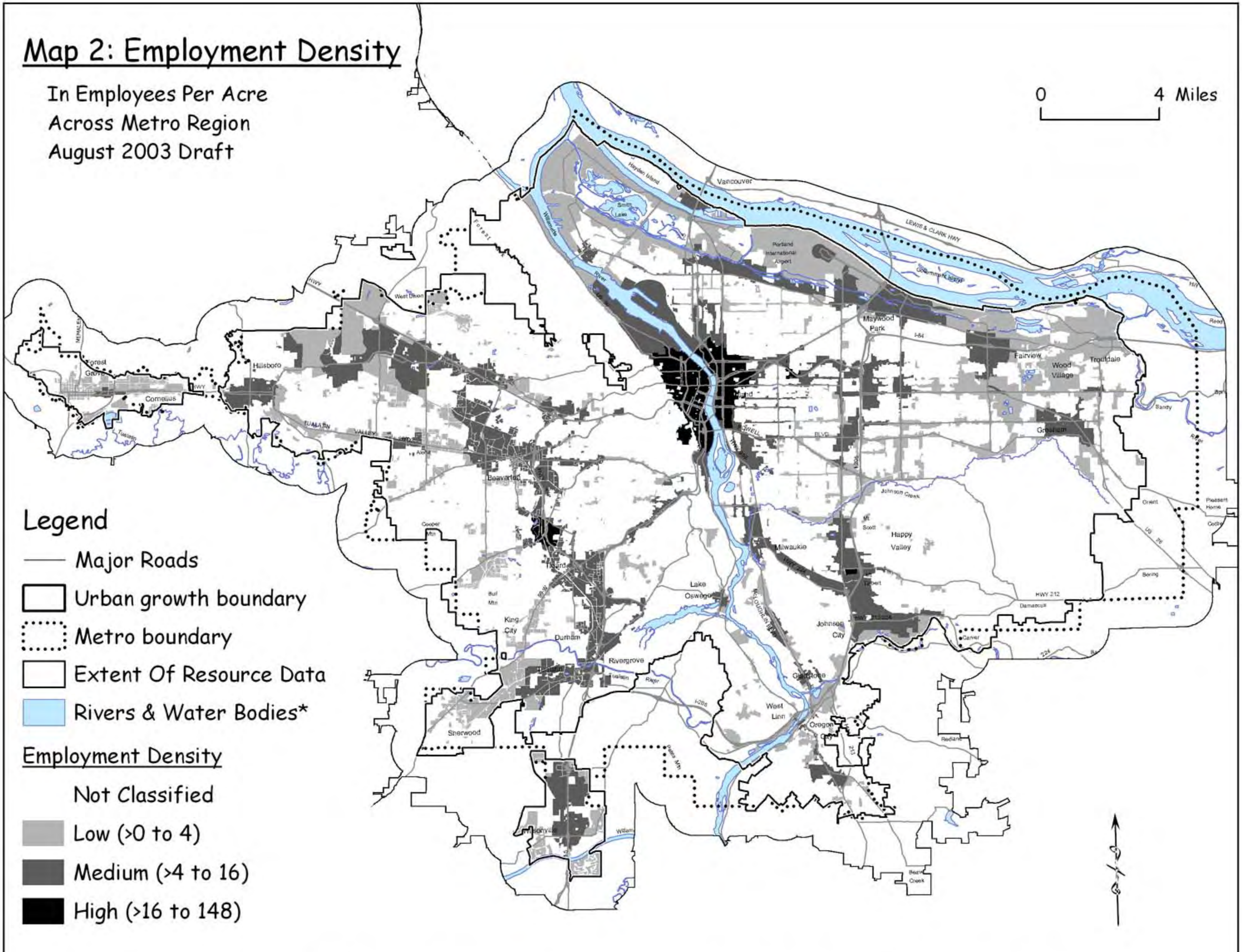
[28] 2002 employment data for the metropolitan region are from the Oregon Department of Revenue (referred to as the Employment Security, 202 tapes).
[29] See Appendix C: *Final Report for the Economic Portion of Metro's Goal 5 ESEE Analysis* (ECONorthwest 2004).

Map 2: Employment Density

In Employees Per Acre
Across Metro Region
August 2003 Draft



Legend

Major Roads
Urban growth boundary
Metro boundary
Extent Of Resource Data
Rivers & Water Bodies*

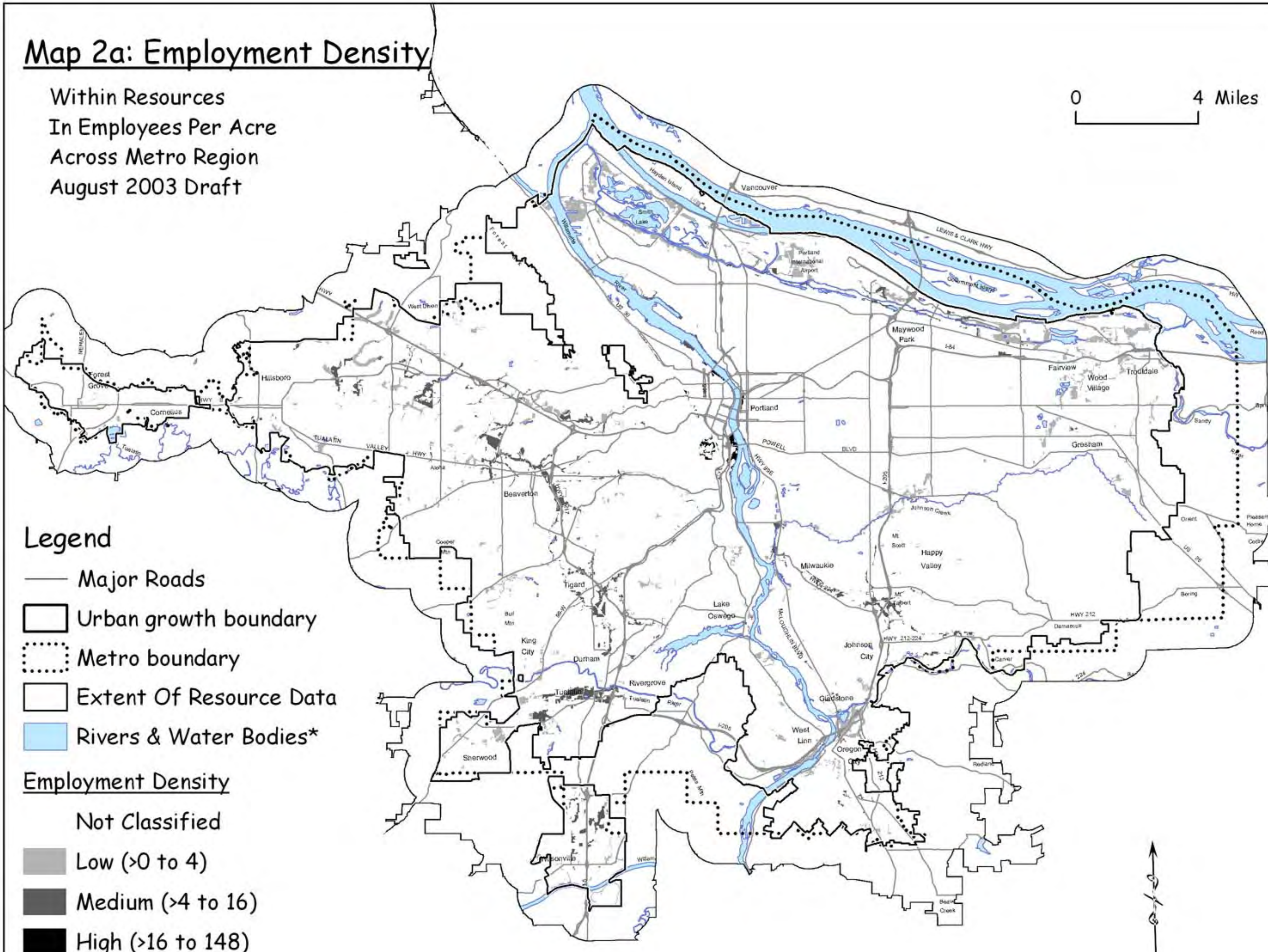
Employment Density

Not Classified
Low (>0 to 4)
Medium (>4 to 16)
High (>16 to 148)

*rivers & water bodies greater than 2 acres in size - J:\houk\Goal5\ESEE\EconomicAnalysis\ECONorthwest\maps091103\Map 2 Employment Density.mxd

Map 2a: Employment Density

Within Resources
In Employees Per Acre
Across Metro Region
August 2003 Draft



Legend

Major Roads
Urban growth boundary
Metro boundary
Extent Of Resource Data
Rivers & Water Bodies*

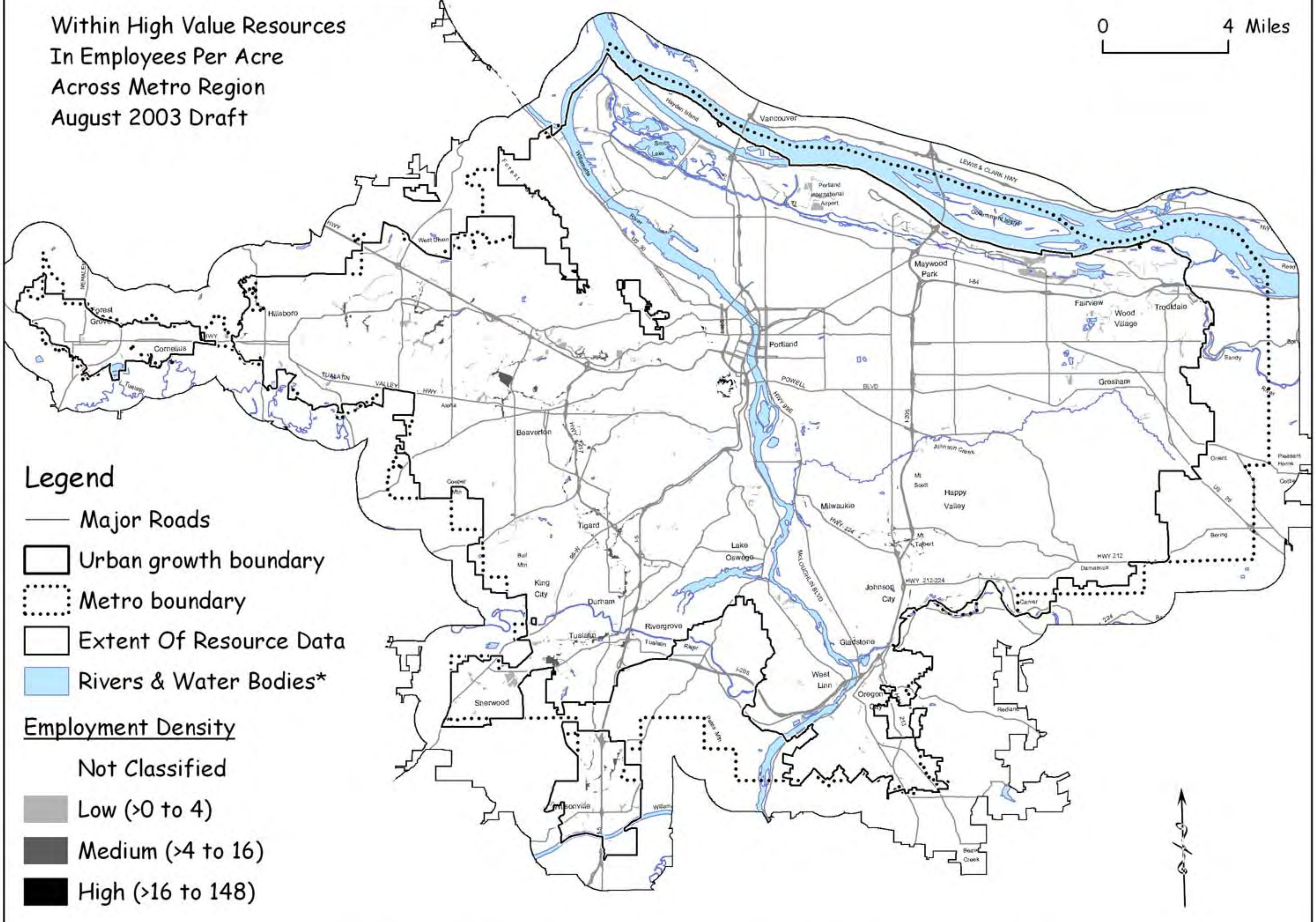
Employment Density

Not Classified
Low (>0 to 4)
Medium (>4 to 16)
High (>16 to 148)

*rivers & water bodies greater than 2 acres in size - J:\houk\Goal5\ESEE\EconomicAnalysis\ECONorthwest\maps091103\Map 2a Employment Density.mxd

Map 2b: Employment Density

Within High Value Resources
In Employees Per Acre
Across Metro Region
August 2003 Draft



*rivers & water bodies greater than 2 acres in size - J:\houk\Goal5\ESEE\EconomicAnalysis\ECONorthwest\maps091103\Map 2b Employment Density.mxd

Rank lands based on 2040 design types

Land value and employment density provide snapshot views of current conditions. For insights into future development patterns and associated economic importance of land, the 2040 design type hierarchy was used. As described in the *Conflicting Use* chapter, the success of the 2040 Growth Concept depends in large part on the implementation of regional transportation priorities. The Regional Transportation Plan (RTP) groups the 2040 design types into a hierarchy based on transportation investment priority. This hierarchy also helps to focus economic development priorities in areas that are most important to achieving the goals of the 2040 Growth Concept. For the purposes of this economic analysis, a modified grouping of the 2040 design types was used as follows:

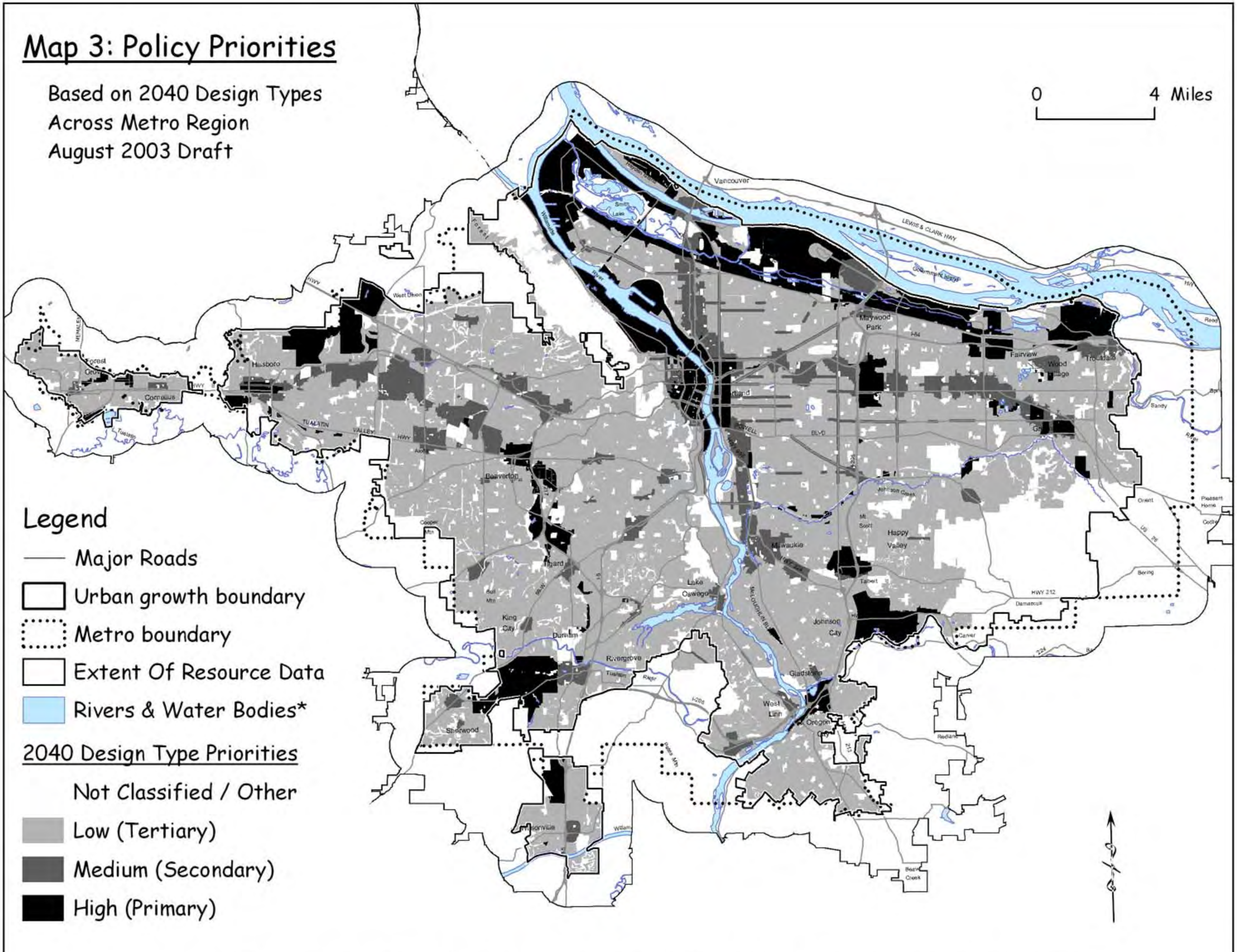
- *Primary land use components* – central city, regional centers, industrial areas, and intermodal facilities
- *Secondary land use components* – town centers, main streets, station communities
- *Tertiary land use components* – inner and outer neighborhoods, employment centers, corridors, future urban lands
- *Other land use components* – parks and open space, rural lands

In general, land values and employment densities are expected to be higher for primary components and decrease moving from primary to secondary to tertiary and finally to other land use components.

Maps 3, 3a, and 3b show the distribution of the four categories of 2040 design types. Map 3a shows the subset of lands in Map 3 that contain significant Goal 5 fish and wildlife habitat. Metro's Goal 5 decision will affect these lands. Map 3b shows the subset of lands in Map 3a that support the most significant Goal 5 fish and wildlife habitat.

Comparing Maps 1, 2, and 3 show that primary design types are distributed across more of Metro's jurisdiction than are areas of high land value or employment density, which are concentrated mostly in the downtown Portland area. This is especially true along the Columbia River and the Willamette River outside of downtown Portland. These industrial areas have low land values and employment densities for the most part, but have a primary design type designation. One interpretation of this difference is that the design types reflect public policies to support or enhance the industrial areas along the rivers for future development. Even though these areas have low land values and employment densities relative to the Portland city center, public policy considerations dictate that these industrial lands should be emphasized or enhanced for reasons other than land value or employment density.

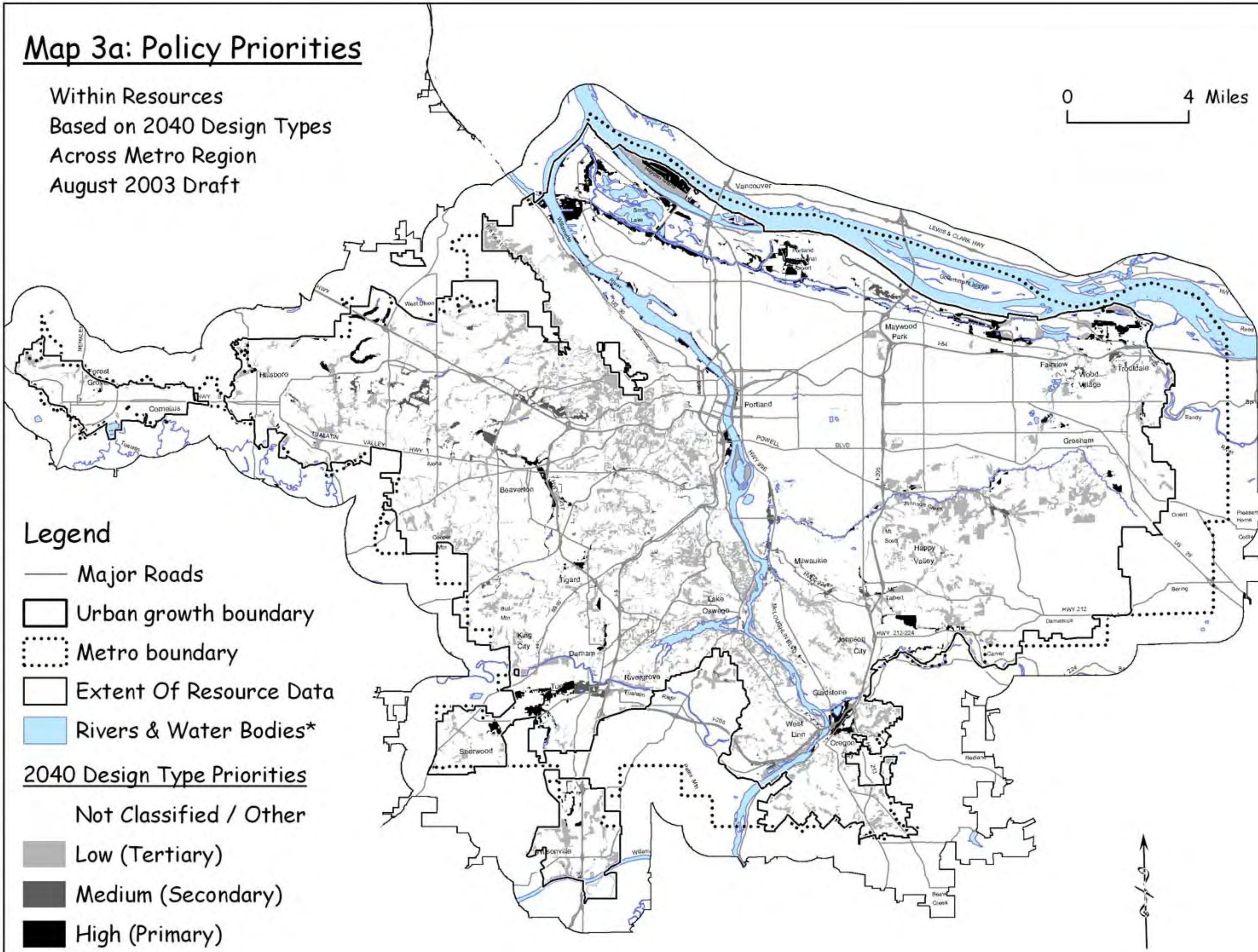
The preceding paragraph describes differences in distribution among the three measures of development value. There are also similarities. For example, just as most lands in Metro's jurisdiction rank low for land value and employment density, most lands also rank in the tertiary or other design type. Another similarity is that, with the exception of lands along the rivers, the distribution of lands with high and medium employment density has a pattern similar to the distribution of lands ranked primary and secondary design types.



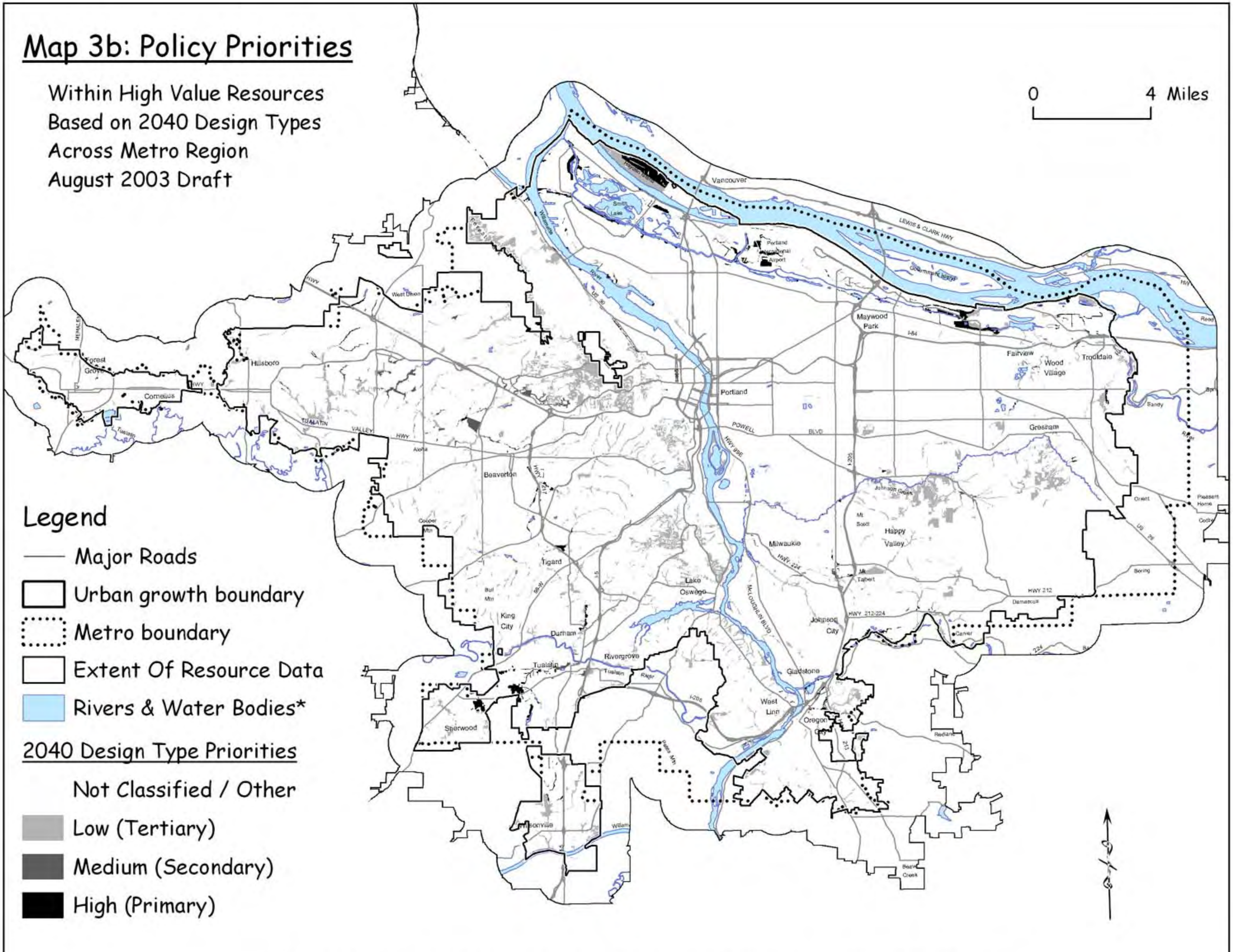
*rivers & water bodies greater than 2 acres in size - **These names could change in the future - J:\houk\Goal5\ESEE\EconomicAnalysis\ECONorthwest\maps\Map 3 Policy Priorities.mxd

Map 3a: Policy Priorities

Within Resources
Based on 2040 Design Types
Across Metro Region
August 2003 Draft



*rivers & water bodies greater than 2 acres in size - J:\houk\Goal5\ESEE\EconomicAnalysis\ECONorthwest\maps091103\Map 3a Employment Density.mxd



*rivers & water bodies greater than 2 acres in size - J:\houk\Goal5\ESEE\EconomicAnalysis\ECONorthwest\maps091103\Map 3b Policy Priorities.mxd

Limitations of the ranking methods

Land value

This method excludes land uses exempt from property taxes or underestimates the economic importance of lands that pay taxes at a diminished rate. Lands exempt from tax assessments—for example, schools, universities, and some hospitals—do not appear in the data base or analysis for this measure of economic importance. This method also underestimates the economic importance of lands with restricted or diminished tax assessments—for example, low-income housing, urban-renewal areas, and other land uses that benefit from public policies that subsidize tax payments. The analysis includes these lands in the ranking, but the rankings may not reflect these parcels' full value.

Employment density

This analysis calculates the average employment density across all land uses in a given GIS map unit. This method may underestimate or overestimate the employment density for some individual parcels. For example, the employment density for a GIS map unit that includes residential areas surrounding a university or hospital may underestimate the employment ranking for these facilities because of the relatively low employment densities found in the residential areas. The opposite is also true. Because the method calculates the average employment density per map unit, properties with lower-than-average densities will be represented by an average measure for the entire map unit that overestimates the employment density for these parcels.

Employment density does not distinguish between "more" important or "less" important jobs as described by employment income or employment multipliers. Employment density provides stakeholders and decisionmakers with employment information that exceeds the requirements for a Goal 5 ESEE analysis. Also, Metro uses employment density when addressing other land use issues that have employment consequences.[30] Finally, the 2040 design types capture to some degree the economic importance of land as described by employment multipliers.

2040 design types

The 2040 design types exclude certain land uses or underestimate the relative importance of a given land use. For example, several educational institutions are not located in designated design type areas. In other cases, what some consider a regionally significant land use, such as a regional medical center, is included in a lower level design type.

The land uses of concern—those for which the three methods used in the economic analysis either exclude or underestimate their economic importance—fall predominantly into four general categories: 1) transportation, 2) utilities, 3) education, and 4) health care. The following subsection briefly describes the relative economic importance of these land uses.

Transportation facilities and utilities: To stay competitive, cities must have modern and efficient physical infrastructure, including roads, bridges, water and sewer systems, airport and cargo facilities, energy systems and telecommunications. The economic literature shows a correlation between economic growth and transportation facilities and utility services. Well-functioning and efficient physical infrastructure helps promote improvements in productivity.

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[30] See the Metro report, *Technical Report: 1999 Employment Density Study*, April 6, 1999, revised May 5, 1999.

The quality of, and access to, transportation facilities and utilities can also directly influence production costs.

Education: The economic literature distinguishes between the economic importance of primary and secondary education, from college, university and post-graduate studies. Many high-skilled or knowledge-based workers can choose where they want to live, they can apply their skills to a variety of industries or have the ability to telecommute. Because they can pick and choose their locations, they choose those with quality amenities, including good elementary and secondary schools.

Given the current high demand for skilled labor, economic growth and development depends in part on access to a critical mass of employable persons with the necessary training and education. An educated workforce has become the primary location factor for growing companies.
The most competitive cities recognize that businesses must locate near or have access to knowledge centers. Among the most important knowledge-based organizations are colleges and universities that provide trained personnel and research capacities. Companies also depend on training and continuing education facilities that help them become and remain learning organizations.

Increasing evidence suggests that promoting innovation, creativity, flexibility and adaptability will be essential to keeping U.S. cities economically vital and internationally competitive. Innovation is particularly important in industries that require an educated workforce. High-tech companies need to have access to new ideas typically associated with a university or research institute.

Medical services: Medical services contribute to a region's economic growth and development in a number of ways. In many municipalities, hospitals and medical clinics are among the largest employers. For example, in the Portland area, OHSU is the region's top employer. Medical schools and research facilities provide important education related services that help support the growth and development of knowledge-based businesses. The availability of high quality and diverse medical services also contributes to a region's quality of life, which helps attract and retain high skilled, and highly educated workers.

How is land ranked based on the economic importance for ecosystem services?

Ecosystem services are the beneficial outcomes, for the natural environment or people, that result from ecosystem functions. Overlap exists between the ecological functions of riparian corridors and upland wildlife habitat and the ecosystem services that benefit society and have economic value (see Table 4-1). For example, the ecosystem function of tree canopy and foliage shading streams helps reduce air and water temperatures, which may benefit society by reducing cooling demands in summer and by protecting species such as salmon that have recreational, commercial and intrinsic value. The ecosystem functions of streamflow moderation and water storage help moderate flooding, which benefits society by reducing flood damage and flood management costs. The ecosystem functions of bank stabilization and sediment and pollution control may help reduce landslides and maintain water quality, which benefits society through avoided costs to filter and treat water. Wildlife habitat may benefit society by supporting species with commercial and recreational value. Riparian corridors and wildlife habitat provide amenity benefits such as scenic views and open space.

Table 4-1: Ecological functions, wildlife characteristics and related ecosystem services that benefit society.

Ecological Functions (Riparian)	**Ecosystem Services**
Microclimate shade and cooling	Moderating summer temperatures, which reduces energy demand for cooling.
Stream flow moderation and improved water storage	Reduced flood damage and flood-management costs.
Bank stabilization and sediment and pollution control	Improved water quality. Reduced demand for water filtration and treatment. Reduced landslides and related damage and clean-up costs.
Large woody debris and channel dynamics	Reduced flood damage and flood-management costs.
Well-functioning riparian areas in general	Amenity and intrinsic values associated with riparian areas.
Ecological Functions (Wildlife Characteristics)	
Habitats of concern and habitats for unique and sensitive species	Increased population of salmon and associated increase in commercial, recreational, spiritual and intrinsic value.
Well-functioning wildlife habitats in general	Amenity and intrinsic values associated with wildlife habitat.

Source: ECONorthwest 2003.

Describing the value of ecosystem services is more challenging than describing the value of development related attributes. No single measure of the economic value of ecosystem services captures the complete value of all services provided by riparian corridors and upland wildlife habitat. ECONorthwest's literature review[31] describes various studies (e.g., hedonic analysis, replacement cost, avoided cost, travel cost, contingent valuation, benefit-transfer) that provide information and perspectives on the value of ecosystem services. The review also reports values for a range of ecosystem services (e.g., flood management, water quality, habitat that supports salmon, amenity and intrinsic values) as described in academic literature and other sources.

During the inventory process, regionally significant riparian corridors and upland wildlife habitat were determined based primary and/or secondary ecological services they provide. ECONorthwest concluded in their literature review that Metro's inventory and ranking of riparian corridors and upland wildlife habitat provide a basis from which to identify the ecosystem services provided by this habitat that have value to society. Even though the inventory ranking did not focus on the economic value of these habitats, it provides insights into the relative economic importance. That is, resources that ranked high (for ecological functions) provide more of the type of ecosystem services that society values than do areas that ranked low.

For the ESEE analysis, riparian corridors and upland wildlife habitat were divided into six classifications (three riparian, three wildlife), each representing discreet areas on the landscape

[31] Appendix C: *Final Draft Literature Review for the Economic Portion of Metro's Goal 5 ESEE Analysis* (October 2004).

(see description in the *Conflicting Use* chapter). This was done to distinguish higher value habitat from lower value habitat for consideration of allow, limit and prohibit consequences. This analysis assumes that areas that provide more of the ecological functions and wildlife characteristics provide more ecosystem services and value to society than do areas that provide fewer functions and characteristics. It also assumes that actions that enhance or protect ecosystem services will have positive economic consequences, and actions that degrade these services will have negative economic consequences, specific to these services. For purposes of this analysis, the six classifications have been grouped into three categories: high value, medium value and low value (see Table 4-2).

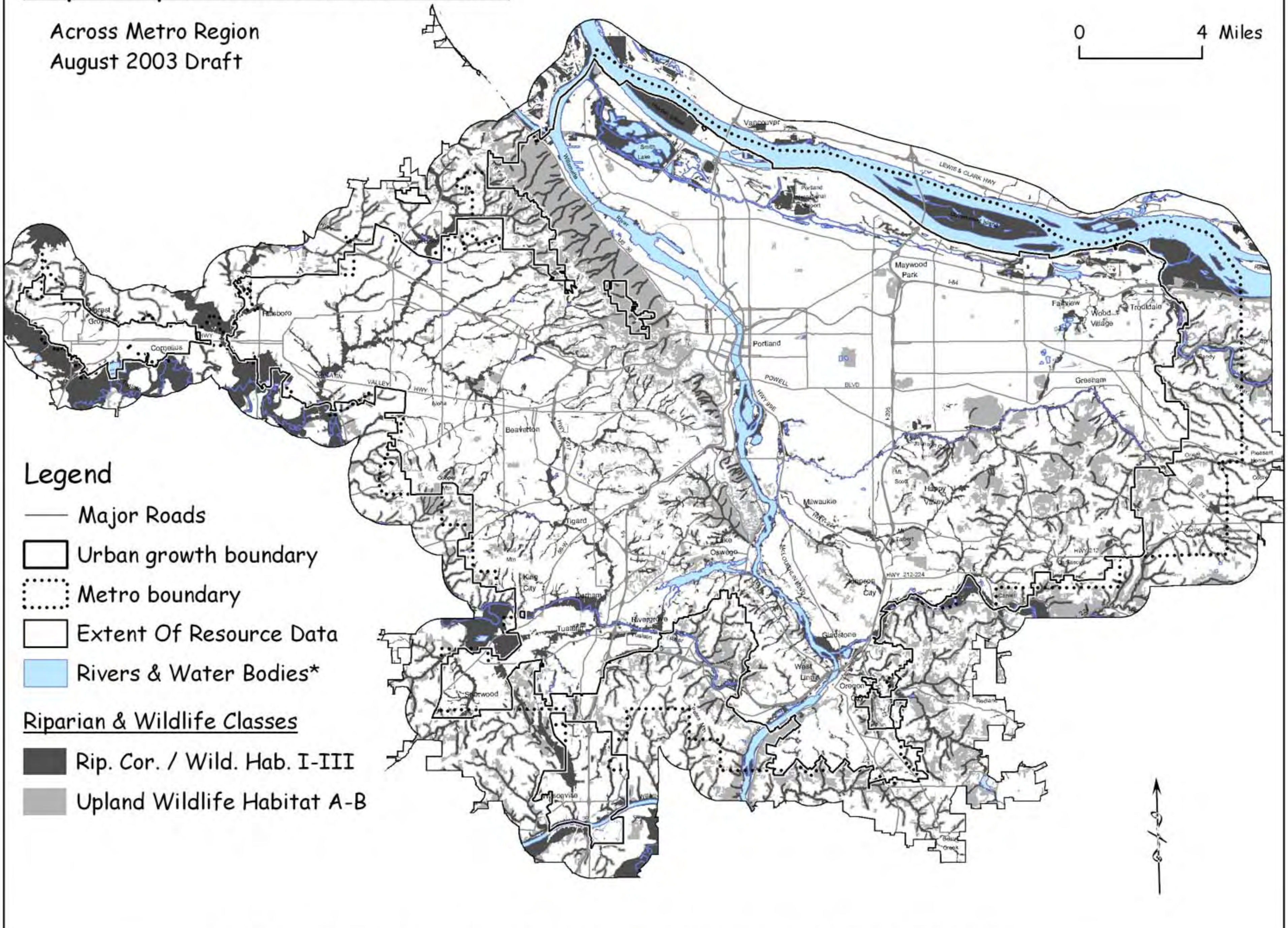
Table 4-2. Ranking for economic importance for ecosystem services.

High Value Habitat	Medium Value Habitat	Low Value Habitat
Class I riparian/wildlife corridors	Class II riparian/wildlife corridors	Class III riparian corridors
Class A upland wildlife habitat	Class B upland wildlife habitat	Class C upland wildlife

Map 4 shows the distribution of the riparian and wildlife habitat classes across Metro's jurisdiction. The map shows that with one notable exception, the area between the Willamette and Columbia rivers, fish and wildlife areas cover much of Metro's jurisdiction. The areas with little or no fish or wildlife habitat are historically the most intensely developed areas. Map 4a shows the distribution of the highest valued habitat lands: Class I riparian/wildlife corridors and Class A upland wildlife habitat.

Map 4: Riparian & Wildlife Classes

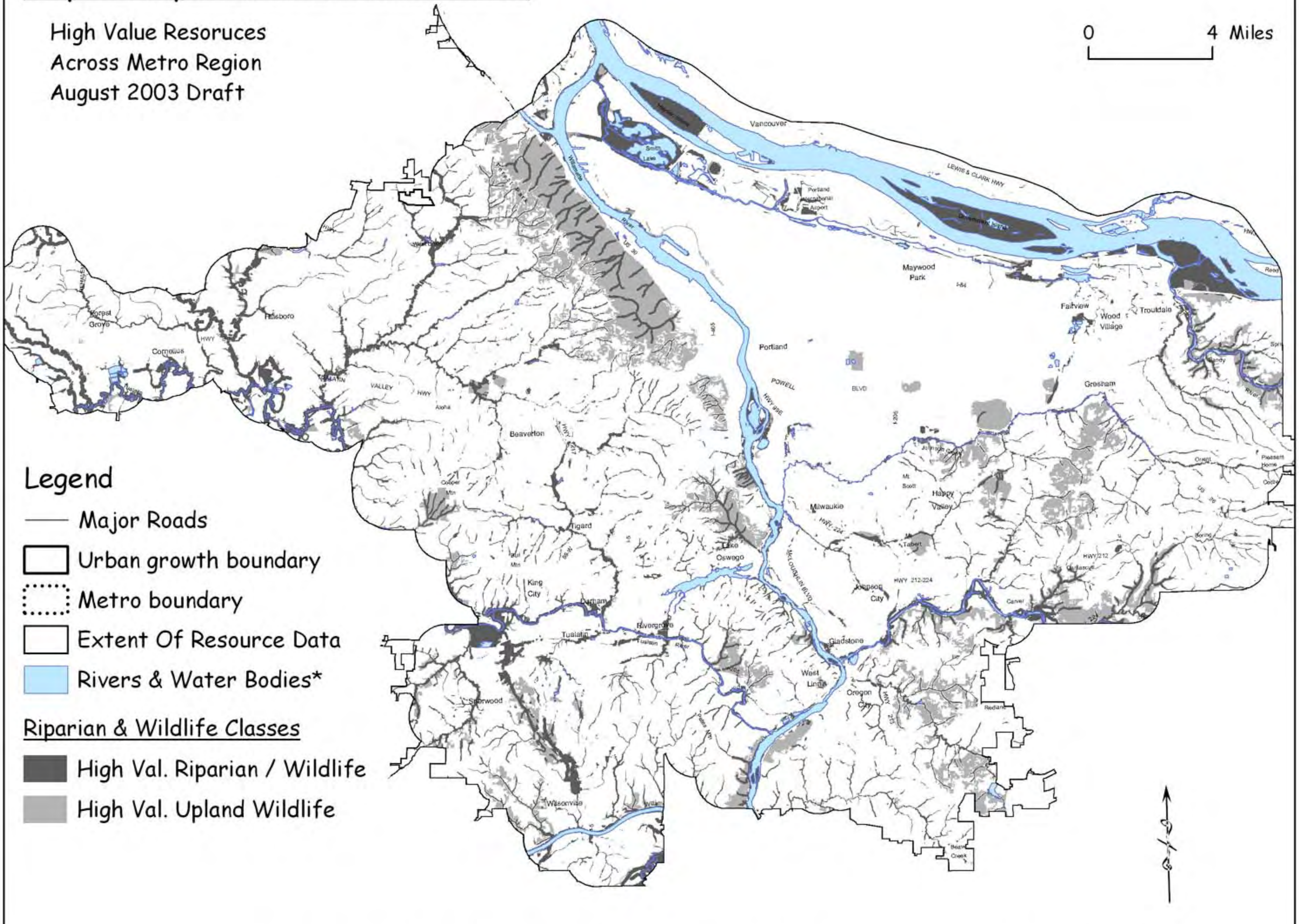
Across Metro Region
August 2003 Draft



*rivers & water bodies greater than 2 acres in size - J:\houk\Goal5\ESEE\EconomicAnalysis\ECONorthwest\maps091103\Map 4 Riparian & Wildlife Classes.mxd

Map 4a: Riparian & Wildlife Classes

High Value Resoruces
Across Metro Region
August 2003 Draft



*rivers & water bodies greater than 2 acres in size - J:\houk\Goal5\ESEE\EconomicAnalysis\ECONorthwest\maps091103\Map 4a Riparian and Wildlife.mxd

What are the interactions between development value and ecosystem services value of fish and wildlife habitat?

The *Conflicting Use* chapter described lands within the UGB, in UGB expansion areas and the remaining areas within Metro's jurisdiction (outside the UGB) in various ways. This section relies on that data and other data generated from this economic analysis to provide insight on the amount and distribution of significant interactions between development use and habitat protection. This information is relevant because the economic consequences of allowing, limiting, or prohibiting development differs by development value and ecosystem services value.

To provide background for this analysis, this section begins by recapping information from the *Conflicting Use* chapter on the development status of fish and wildlife habitat, and the potential conflicts based on generalized regional zones. It then presents data and analysis on the economic interactions between development value (land value, employment density, 2040 design types) and habitat type (Class I-III riparian corridors, Class A-C upland wildlife).

Development status of fish and wildlife habitat and impact areas

The development status is relevant to the economic analysis because it can influence the type, amount and timing of the economic consequences of allow, limit and prohibit decisions. Of the four development categories shown in Table 4-3 below, lands in the developed/park status would be least affected by Metro's Goal 5 decisions. To the extent that lands in this development status includes private lands such as golf courses, these uses may be affected in some way by Goal 5 decisions, but any impact will be more limited compared with potential impacts to land in developed urban uses.

Table 4-3: Fish and wildlife habitat by development status and as a percentage of total lands in the development status in the UGB (2002).

Development Status	% of Fish & Wildlife Habitat	% of Total in Development Status
Developed (parks)	34%	66%
Developed (urban)	28%	10%
Vacant (constrained)	16%	67%
Vacant (buildable)	22%	41%
Total	100%	(not applicable)

Development on lands in the vacant constrained status is already affected more by Title 3 (Water Quality and Flood Management) and other regulations. Goal 5 decisions may have impacts on these lands; however, it will be to a lesser degree than on vacant land unconstrained by Title 3 or other regulations. Goal 5 decisions may affect lands in the developed/urban status in the future if the properties are redeveloped or existing uses expand to cover more of the property. Lands in the vacant buildable status may be most immediately affected by Goal 5 decisions.

Table 4-3 also shows habitat lands as a percentage of total lands (both fish and wildlife habitat and non-fish and wildlife habitat) in development categories in the UGB. For example, 34 percent of fish and wildlife habitat are in the developed/parks category and they account for approximately 66 percent of the total developed/parks in the UGB. Developed/urban lands account for 28 percent of fish and wildlife habitat, but these lands represent just 10 percent of total developed/urban acres in the UGB. Vacant constrained lands contain 16 percent of the fish and wildlife habitat, representing 67 percent of total vacant constrained acres in the UGB. Twenty-two percent of fish and wildlife habitat is vacant buildable, and these lands account for a significant percentage (41 percent) of the total vacant buildable acres in the UGB.

Figure 4-1: Development status of impact areas.

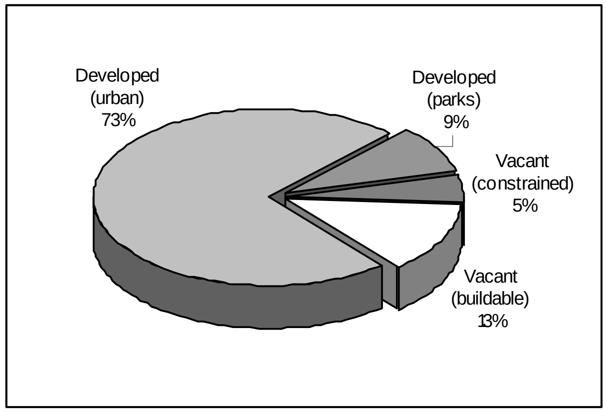
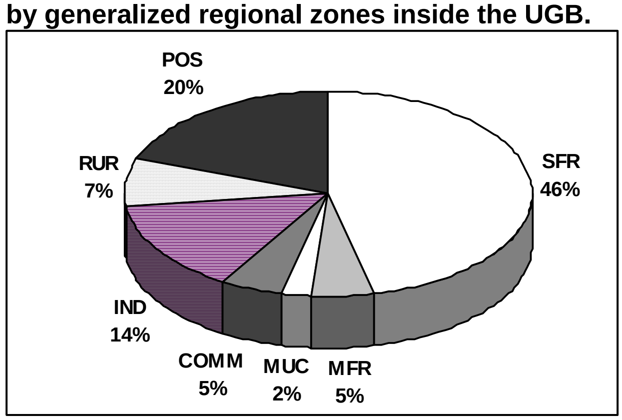


Figure 4-1 shows that most impact areas (see Chapter 2: *Impact Areas* for definition) are developed as urban. The distribution of development values for impact areas follow the distributions of land value, employment density and 2040 design types described earlier for lands containing fish and wildlife habitat. Most impact areas are characterized by low land value or employment density, or design types that have low land value and employment.

Fish and wildlife habitat by generalized regional zones

As Figure 4-2 shows, approximately 46 percent of the fish and wildlife habitat occur on lands zoned as single-family residential. Other zones with a significant percentage of fish and wildlife habitat are parks and open space (20 percent) and industrial (14 percent). Together, these three zones account for 80 percent of the fish and wildlife habitat.

Figure 4-2: Percentage of fish & wildlife habitat by generalized regional zones inside the UGB.



Lands outside the UGB and within Metro's jurisdiction are primarily zoned rural residential, and agricultural and forestry lands. Relative to the Portland City center, these lands have low land value and employment density. These lands have not yet been categorized by 2040 design types.

Fish and wildlife habitat classifications

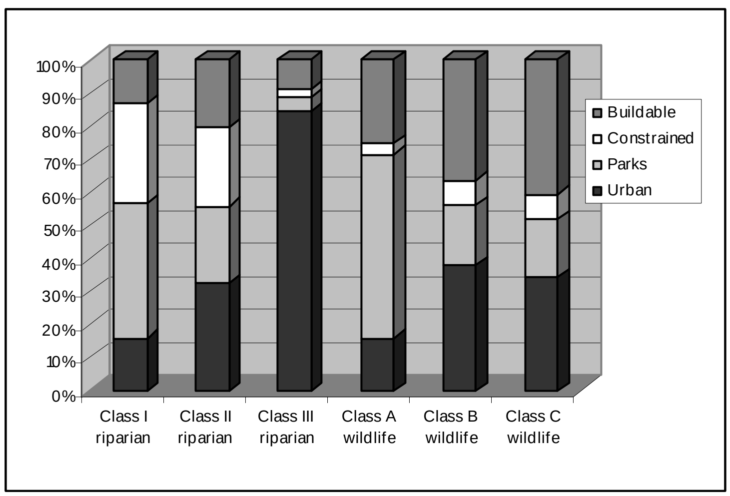
Fish and wildlife habitat classifications are defined in the *Conflicting Use* chapter. Table 4-4 shows the percentage of fish and wildlife habitat in each classification. Notice that the percentage declines from Class I to Class III and from Class A to Class C. Fifty-six percent of the inventory lands is in high value riparian/wildlife corridors (Class I) and upland wildlife habitat (Class A). Twenty-seven percent of the inventory land is medium value (Class II/B) and the remainder (17 percent) is low value fish and wildlife habitat.

Table 4-4: Percentage of fish and wildlife habitat by habitat classifications.

Fish and wildlife habitat classification	Percent of total fish & wildlife habitat
Riparian/wildlife Class I	32%
Riparian/wildlife Class II	14%
Riparian Class III	8%
Upland Wildlife Class A	24%
Upland Wildlife Class B	13%
Upland Wildlife Class C	9%
Total	100%

Figure 4-3 shows that, in general, the percentage of land in a given habitat type (i.e., riparian/wildlife corridors, upland wildlife habitat) that is developed as urban increases moving from high value (Class I/A) habitat to low value habitat (Class III/C). For example, 16 percent of Class I riparian/wildlife corridors is developed as urban, whereas 85 percent of Class III is developed as urban. These results are consistent with the map of significant fish and wildlife habitat (Map 4), which shows very few significant resources in areas with the longest history of more intensive urban development.

Figure 4-3: Fish and wildlife habitat classification by development status.



Much of the Class I/A land is in parks and opens space: 41 percent of Class I lands and 56 percent of Class A lands. This percentage drops significantly when moving to Class II/B, 23 percent and 18 percent, respectively.

The greatest percentage of vacant constrained land falls in Class I and II riparian/wildlife corridors (30 percent and 24 percent, respectively). This makes sense because many of these areas are located in floodplains. In the vacant buildable status, a higher percentage of habitat lands is upland wildlife habitat compared to riparian/wildlife corridors.

Development value

Development value, or the economic importance of land for development, is measured by land value, employment value, and 2040 design type hierarchy. The following analysis describes the interaction between individual measures of development value and fish and wildlife habitat.

Land value

Table 4-5 below demonstrates that the percentage of fish and wildlife habitat classifications with no land value (as determined by tax assessors)[32] declines from Class I riparian/wildlife and Class A upland wildlife habitat to Class III riparian and Class C upland wildlife. The percentage of lands with low and medium land value increases across these same classes of riparian and upland wildlife habitat. None of the lands in Class I and only three percent of lands in Class III have high land value. One percent of land in the remaining classes are categorized as having high land value.

Map 1a shows the overlap of the three classes of land value on fish and wildlife habitat. Map 1b shows the overlap on high valued habitat lands (Class I/A) only. These maps illustrate the distribution of land value described in Table 4-5. Comparing Map 1a with Map 4 (Riparian and Wildlife Classes) shows that a significant portion of the lands that contains fish and wildlife habitat does not support development value as measured using land value. Map 1b shows that a relatively small percentage of the fish and wildlife habitat that support land value are ranked high valued habitat (Class I/A).

Table 4-5: Percentage of fish and wildlife habitat by land value.

Land Value	Riparian/ Wildlife I	Riparian/ Wildlife II	Riparian III	Upland Wildlife A	Upland Wildlife B	Upland Wildlife C
% of habitat with no land value (as determined by tax assessor)	43%	25%	7%	57%	19%	19%
% of habitat with **low** land value	48%	61%	69%	38%	59%	62%
% of habitat with **medium** land value	9%	14%	22%	4%	22%	18%
% of habitat with **high** land value	0%	1%	3%	1%	1%	1%
Total	100%	100%	100%	100%	100%	100%

Employment Value

Table 4-6 lists the percentage of fish and wildlife habitat classifications that does not support employment and, the percentage categorized as having low, medium, and high employment density, relative to the Portland city center.[33] The table shows that much of the fish and wildlife habitat is zoned for uses that does not support significant amounts of employment. For example,

[32] Excludes a measure of the land value of public institutions, such as parks and schools, and public infrastructure such as roads, sewer and water services.
[33] See the full table of interactions in the Appendix for the number of acres by zoning type ranked low, medium and high employment density.

83 percent of Class I riparian/wildlife corridors and 95 percent of Class A upland wildlife habitat are zoned for single-family residential, multi-family residential, rural, and parks and open space. Of the acres in zonings that support employment, such as industrial, commercial and mixed use, 11 percent of Class I lands and three percent of Class A lands are categorized as having low employment density relative to the Portland city center.

In general, the percentage of lands that does not support employment declines from Class I/A to Class III/C. However, the percentage of lands with low employment value increases from Class I/A to Class III/C. Two out of the six classes of significant fish and wildlife habitat, Class II and III, have lands designated as high employment value. However, these lands represent a very small percentage, one and two percent respectively, of the total lands in these classes.

Table 4-6: Percentage of fish and wildlife habitat by employment density value.

Employment Density	Riparian/ Wildlife I	Riparian/ Wildlife II	Riparian III	Upland Wildlife A	Upland Wildlife B	Upland Wildlife C
% of habitat that does not support employment	83%	72%	51%	95%	91%	75%
% of habitat supporting **low** employment	11%	18%	30%	3%	5%	18%
% of habitat supporting **medium** employment	6%	9%	17%	2%	4%	7%
% of habitat supporting **high** employment	0%	1%	2%	0%	0%	0%
Total	100%	100%	100%	100%	100%	100%

Map 2a shows the overlap of the three classes of employment density on all classes of fish and wildlife habitat. Map 2b shows the overlap of the three classes of employment density on high valued habitat (Class I/A) only. These maps illustrate the distributions shown in Table 4-6. Maps 2a, employment density, and Map 4, fish and wildlife habitat inventory, illustrate that much of the inventory is zoned parks and open space or residential, which are not considered employment generating uses. Also, of the habitat lands that do support employment, very little of these lands support high employment densities. Map 2b shows the same trends but for high valued habitat lands (Class I/A) only. Comparing Map 1a with Map 2a shows that more of the fish and wildlife habitat lands support development value as measured by land value compared with development value measured by employment density.

2040 design types

Table 4-7 shows the distribution of fish and wildlife habitat classifications by the 2040 design type hierarchy. This distribution differs from the trends described for land value and employment density. In general, more of the fish and wildlife habitat have high economic value from a policy perspective than from a land value or employment generation perspective. Map 3a shows the overlap of the three design type priorities on all classes of fish and wildlife habitat. Map 3b shows the same overlap but for high valued habitat lands (Class I/A) only. As with land value and employment, much of the fish and wildlife habitat does not support development values as measured by 2040 design types (see Map 3a compared with Map 4). Map 3b and Map 4 show that, relative to the total distribution of fish and wildlife habitat, the overlap of high valued habitat with primary 2040 design types covers a small area.

Table 4-7: Percentage of fish and wildlife habitat by 2040 design type hierarchy.

2040 Design Type Hierarchy	Riparian/ Wildlife I	Riparian/ Wildlife II	Riparian III	Upland Wildlife A	Upland Wildlife B	Upland Wildlife C
% Other design types that do not support development value	35%	15%	2%	52%	13%	10%
% Tertiary **(low)**	48%	60%	52%	44%	79%	68%
% Secondary **(medium)**	5%	6%	13%	2%	3%	7%
% Primary **(high)**	12%	18%	33%	2%	5%	15%
Total	100%	100%	100%	100%	100%	100%

Comparing Table 4-7 with Tables 4-5 and 4-6 illustrates that more fish and wildlife habitat have development value when ranking these lands using design types than rankings based on land value or employment. However, a significant percentage of lands still falls in the low valued development category (tertiary). Except for Classes A and B (upland wildlife habitat), which have a relatively small percentage of land in the high category (primary), the other classes have a significantly larger percentage of land in the high category, relative to land value and employment measures. As illustrated in the next table (Table 4-8), much of this high valued land is zoned for industrial use.

Single-family residential, parks and open space, and industrial generalized regional zones account for 80 percent of significant fish and wildlife acres (see Figure 4-4). Cross referencing the number of habitat acres for these zoning types with primary, secondary, tertiary and other 2040 design types illustrates interactions between habitat land and future land use as described by the design types. Table 4-8 shows the major interactions.

Table 4-8: Interactions between fish and wildlife habitat by zoning and 2040 design types hierarchy in the UGB (2002).

Generalized Regional Zones	% of Fish & Wildlife Habitat Classified as Tertiary & Other	% of Fish & Wildlife Habitat Classified as Primary
Single-family residential	98%	1%
Parks and open space	98%	0.3%
Industrial	33%	60%

Source: Data analysis by Metro staff and ECONorthwest.

Ninety-eight percent of fish and wildlife habitat acres zoned as single-family residential and parks and open space is classified as tertiary or other design types, but only 33 percent of industrial acres is classified by these design types. In contrast, sixty percent of fish and wildlife habitat acres in industrial zoning is classified as a primary 2040 design type, with one percent or less of single-family and parks and open space acres in the primary design type.

As illustrated in Tables 4-5 and 4-6, estimating development value using land value or employment found that the large majority of fish and wildlife habitat acres either do not support development value or have a low value, relative to acres in the Portland city center. Estimating development value using 2040 design types has similar results for land in single-family or parks and open space zoning but not for acres in industrial zoning, as noted above. To the extent that 2040 design types describe future development patterns in the UGB, it appears that the future interactions between high development values and significant fish and wildlife habitat will occur mostly on land zoned for industrial use.

Combined measures

The analysis above describes the interaction between *individual* measures of development value, for example, land value, employment, 2040 design types, and fish and wildlife habitat. The following analysis describes the interactions between the *combined* measures of development values and significant fish and wildlife habitat.

As described above, the development value of acres containing significant habitat was ranked based on high, medium, and low land values and employment density. For these same acres development value is also described using primary, secondary, tertiary and other 2040 design types. The "other" design type includes parks, open space, and rural lands, which are expected to have a low development value.

Table 4-9 describes the interactions between the combined measures of development value and fish and wildlife habitat for the three zoning types, single-family residential, parks and open space and industrial, which account for 80 percent of the acres of significant habitat. The second column in Table 4-9 lists the percentage of habitat acres that fall into the "other" design type. The percent of habitat acres that score low on all three measures of development value is listed in the third column. The fourth column lists the percentage of habitat acres that score at least one medium value and no high values. The percentage of habitat acres that scored high on at least one measure of development value is shown in the fifth column.

Table 4-9: Interactions fish and wildlife habitat by zoning and combined measures of development value in the UGB (2002).

Generalized Regional Zones	% of Habitat Acres Classified as "Other" Design Type	% of Habitat Acres with All Low Measures	% Habitat Acres with at Least One Medium Measure, No High Measures	% of Habitat Acres with at Least One High Measure
Single-family Residential	17%	61%	21%	2%
Parks and Open Space	81%	17%	2%	0.3%
Industrial	10%	14%	15%	61%

Source: Data analysis by Metro staff and ECONorthwest.

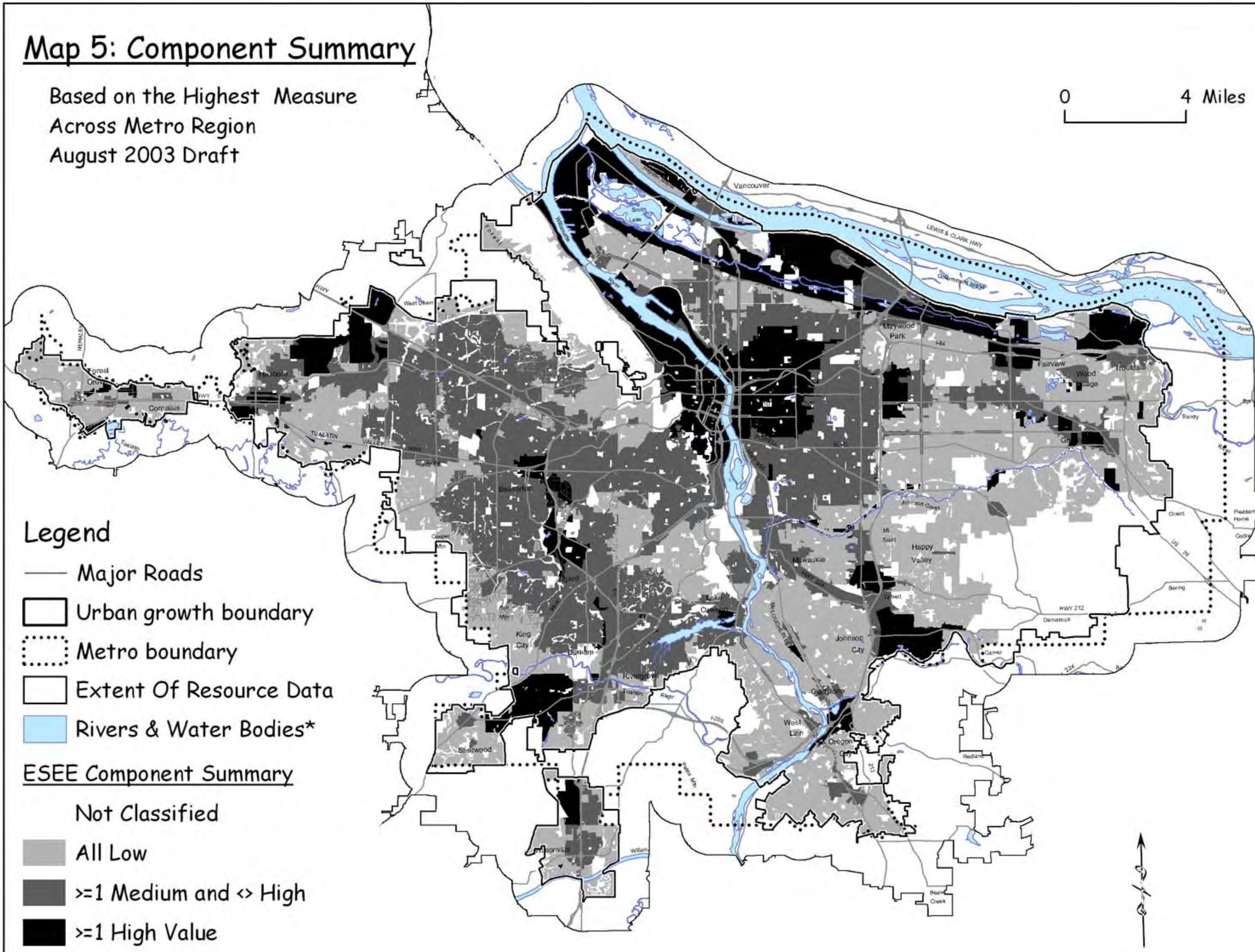
Similar to the results illustrated in Table 4-8, Table 4-9 shows how interactions for industrial lands differ from interactions for single-family or parks and open space. For example, approximately 17 percent of fish and wildlife habitat in single-family zoning is in the "other" design type; 61 percent scored low on all three measures of development value. For parks and open space the percentage of habitat acres in these two categories is even higher, approximately 98 percent. In contrast, for habitat acres in industrial zoning, approximately 24 percent is in these two low categories, with approximately 61 percent of the industrial acres scoring high on at least one measure of development value. As noted in Table 4-7, most of these acres scored high on the 2040 design type measure of development value. A very small percentage of habitat acres in single-family or parks and open space scored high on any of the measures of development value.

Maps 5, 5a and 5b show the distribution of the three combined measures: areas that scored low on all three measures of development value, areas that scored medium on at least one measure without scoring high on any measures, and areas that scored high on at least one measure. Map 5a shows the overlap of the combined measures on all habitat lands and Map 5b shows the overlap of combined measures on high valued habitat lands (Class I/A) only.

Comparing Map 5 with Maps 1 (Land Value), 2 (Employment Density) and 3 (2040 Design Type Hierarchy) illustrates that areas outside the Portland city center that ranked high on at least one measure ranked high on the 2040 design types. Map 5a shows this same distribution for lands that overlap with significant fish and wildlife habitat. As shown on Map 5b much of the high value fish and wildlife habitat lands overlap with lands that scored low on all three measures of development value. However, for a significant portion of this map there is an overlap of high valued habitat with areas that scored high on at least one measure of development value. In most cases these lands scored high on 2040 design types and are zoned industrial.

Map 5: Component Summary

Based on the Highest Measure
Across Metro Region
August 2003 Draft



Legend

Major Roads

Urban growth boundary

Metro boundary

Extent Of Resource Data

Rivers & Water Bodies*

ESEE Component Summary

Not Classified

All Low

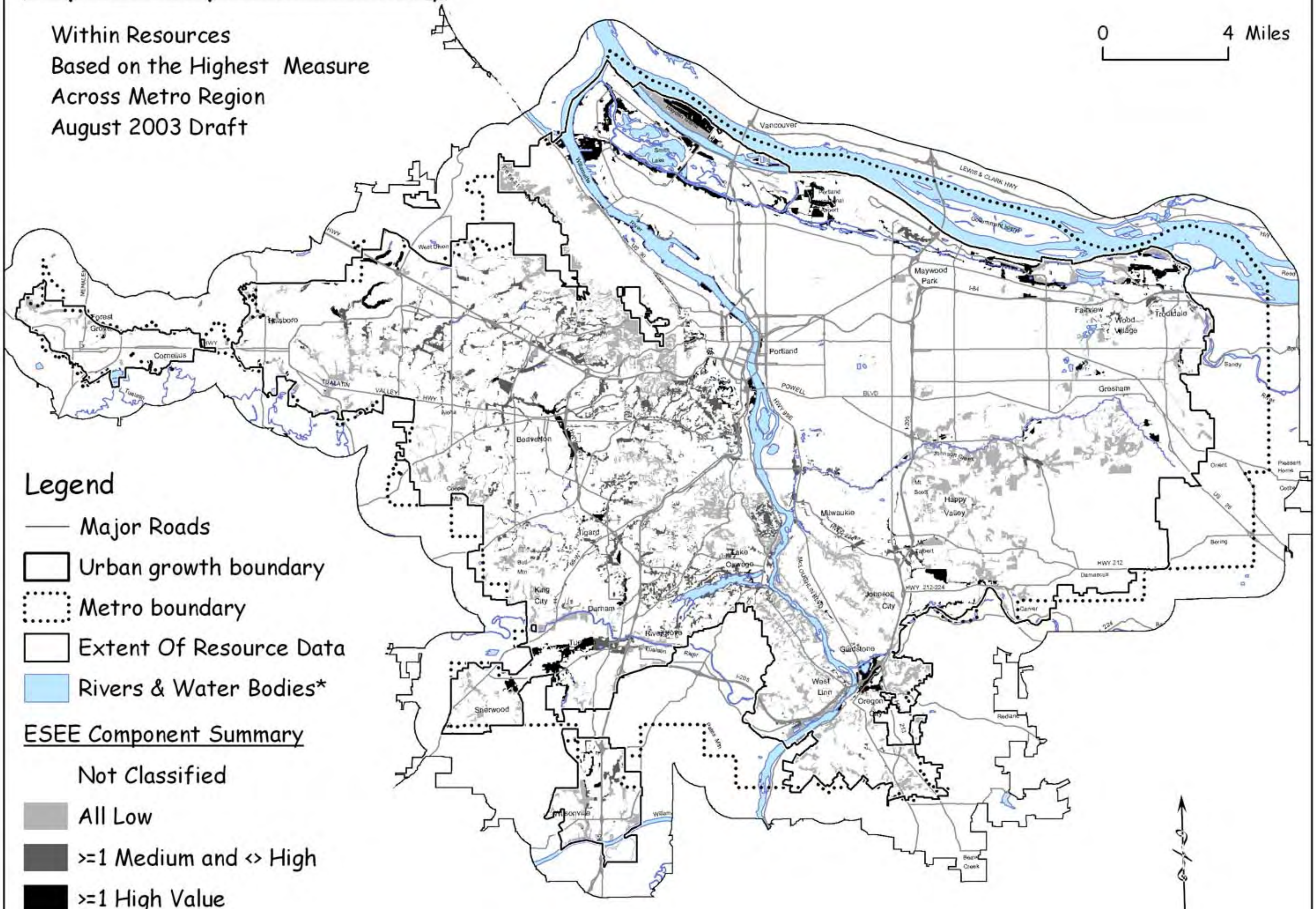
>=1 Medium and <> High

>=1 High Value

*rivers & water bodies greater than 2 acres in size - J:\houk\Goal5\ESEE\EconomicAnalysis\ECONorthwest\maps\Map 5 Component Summary.mxd

Map 5a: Component Summary

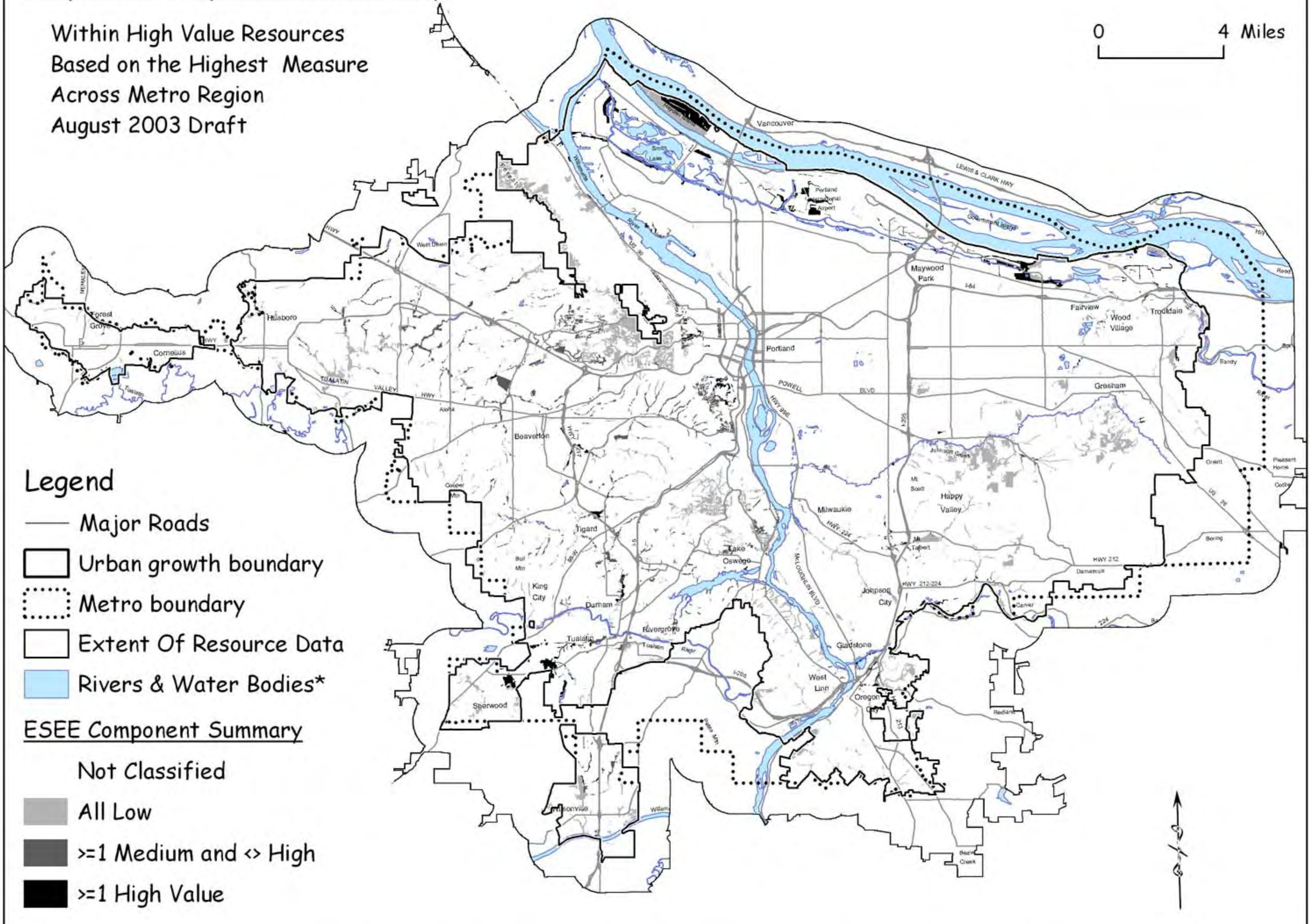
Within Resources
Based on the Highest Measure
Across Metro Region
August 2003 Draft



*rivers & water bodies greater than 2 acres in size - J:\houk\Goal5\ESEE\EconomicAnalysis\ECONorthwest\maps091103\Map 5a Employment Density.mxd

Map 5b: Component Summary

Within High Value Resources
Based on the Highest Measure
Across Metro Region
August 2003 Draft



Legend

Major Roads

Urban growth boundary

Metro boundary

Extent Of Resource Data

Rivers & Water Bodies*

ESEE Component Summary

Not Classified

All Low

>=1 Medium and <> High

>=1 High Value

*rivers & water bodies greater than 2 acres in size - J:\houk\Goal5\ESEE\EconomicAnalysis\ECONorthwest\maps\Map 5b Component Summary.mxd

Summary of interactions

- *Land value, zoning and habitat:* The zoning for a majority of fish and wildlife habitat lands, approximately 64 percent, support development value. The remainder fall into POS zoning or contain water bodies. Of the lands with development value, most fall into the low land value category.
- *Employment, zoning and habitat:* Approximately 78 percent of the fish and wildlife lands do not support employment. These lands are zoned SFR, MFR, RUR and POS. Of the lands that do support employment, most fall into the low employment category.
- *2040 design type and habitat:* The distribution of fish and wildlife habitat lands by 2040 design types differs from the distributions described above for land value and employment. In general, categorizing lands using 2040 design types yields a distribution with a greater percentage of the lands having development value, and for the lands that have development value, more of the lands rank in the higher-valued design types.
- *2040 design type, zoning, and habitat:* Three generalized regional zones, SFR, POS and IND, account for 80 percent of the habitat acres. Ninety-eight percent of the fish and wildlife habitat lands zoned SFR and POS fall into the lowest design type[34]. In contrast, 33 percent of the lands zoned IND fall in the lowest design type and 60 percent is ranked in the primary, or highest, design type.
- *Land value, employment, 2040 design type, zoning and habitat:* Focusing on fish and wildlife habitat lands zoned SFR, POS and IND, approximately 98 percent of POS lands, and approximately 78 percent of SFR lands ranked in the lowest category for all three measures of development value (land value, employment and 2040 design type). In contrast, 25 percent of lands zoned IND ranked in the lowest categories for all three measures of development value. Over 60 percent of IND lands ranked in the highest category for at least one measure.
- *Goal 5 allow, limit, prohibit impacts:* The large majority of Goal 5 allow, limit and prohibit decisions will impact lands zoned SFR, POS and IND. Impacts on lands zoned SFR and POS will have little or no employment impacts and will affect lands ranked low on the land-value scale. The majority of impacts on lands zoned IND will affect lands ranked high on at least one measure of development value.

The fact that Goal 5 decisions would primarily affect acres with lower land values and employment densities does not mean that limit or prohibit decisions on these acres would generate trivial economic consequences. The low category for these development values are relative to land values and employment densities found in the Portland city center and do not represent an absolute measure of land value or employment. The actual impacts of limit or prohibit decisions on property values or employment will depend on the specifics of the decision, the details of the Goal 5 program that implements the decision, actions that may mitigate any negative impacts, and specifics of the individual parcels affected.

[34] This includes lands in the tertiary design type, and lands in the "other" design type that includes parks, open space and rural reserves.

What are the potential economic consequences of allowing, limiting or prohibiting conflicting uses?

This section describes the economic consequences of decisions to allow, limit, or prohibit land uses that conflict with significant fish and wildlife habitat. Four categories of economic consequences of Goal 5 decisions are considered in this analysis:

- The changes in the values of the goods and services citizens receive are referred to as *economic values*. The economic values at issue in this analysis include the impact of Goal 5 decisions on property values (location and site factors) and the values of ecosystem goods and services provided by riparian and wildlife areas (e.g., flood management, water quality, habitat that supports salmon, amenity and intrinsic values).
- The changes in the level of economic activities within the local economy such as the impact on the level of local employment and income, changes in tax payments and transportation impacts are referred to as *economic impacts*.
- The changes in the development patterns over the coming decades are outlined by the *2040 design types.*
- The changes in the distributions of costs and benefits within the economy, especially changes affecting groups of special concern, such as property owners that shoulder a disproportionate amount of the negative consequences of a policy decision, are referred to as *economic equity*. Equity tradeoffs in this analysis include tradeoffs by type of land use, as described by zoning type, and the geographic distribution of economic tradeoffs.

The sections that follow describe: 1) the baseline for the analysis of economic tradeoffs, 2) the potential economic consequences based on the four categories listed above, 3) the summary of economic consequences of allow, limit or prohibit decisions and 4) the factors that influence economic consequences.

Baseline for the analysis of economic tradeoffs

The existing, non-Goal 5, regulatory protection of fish and wildlife habitat provides the baseline for the analysis of economic tradeoffs of Goal 5 allow, limit and prohibit decisions. An allow decision will permit developing significant habitat to the limits allowed by existing, non-Goal 5 protection measures. Goal 5 limit or prohibit decisions provide a marginal *increase* in protection above and beyond existing protection measures.

For lands in Metro's jurisdiction, Title 3 of the Urban Growth Management Function Plan (Title 3) describes existing protection measures and is the baseline against which the Goal 5 management decisions will be measured. Title 3 regulates development that affects water quality, flood management and fish and wildlife conservation.

Because Title 3 implements statewide land-use goals, it affects lands in all the local jurisdictions within Metro's jurisdiction. Local jurisdictions, however, may adopt protection measures that exceed Title 3 regulations. The economic tradeoffs of Goal 5 allow, limit and prohibit decisions in these jurisdictions will differ from the tradeoffs in jurisdictions where Title 3 represents the baseline protection in the following ways:

- Allow decisions will overestimate the negative impacts of development on Goal 5 fish and wildlife habitat and associated ecosystem services. An allow decision will also overestimate the benefits on development values.
- Limit and prohibit decisions will overestimate the benefits of habitat protection and will overestimate the negative impacts on development values.

Potential economic consequences

This section describes potential economic consequences by the four economic factors – economic values, economic impacts, 2040 design types and economic equity – and how Goal 5 decisions may impact these factors.

Economic Values

Property values in development – the factors that affect the development value for land fall into two general categories: location factors and use factors.

Location factors include:

- Availability and quality of public infrastructure, for example, roads, sewer, water and electric. Land-use decisions that hinder or make more difficult the provision of infrastructure services may negatively impact the values of the affected properties.
- Access to the site. Actions that limit or impede access to a site may negatively impact the site's property value.
- Agglomerative economies associated with the location. Decisions that promote or allow the development of agglomerative economies, such as clustering of commercial or industrial developments, will help maintain or enhance development values of these activities. Decisions that inhibit the development of such agglomerative economies may have the opposite effect.
- Existing zoning or other land-use regulations. Zoning and other regulations can have positive and negative impacts on a property's value. For example, waterfront properties zoned for industrial use might have higher property values if they were zoned residential. In another example, a residential zoning may protect property values by excluding incompatible land uses (e.g., a gas station).

Use factors include:

- Amenities of the site, for example, views, access to parks, water and other open spaces. Actions that protect or enhance a location's amenities, may also protect or enhance the impact that amenities have on property values.
- Physical terrain, for example, hilly or flat. Grading hills and other changes to a parcel's physical terrain may increase the parcel's usability and development value. Actions that limit grading hills or other changes to a parcel's physical terrain may negatively impact the parcel's property value.
- Lot size, shape and buildable area. Actions that limit a parcel's usable area may negatively impact the parcel's development value. Impacts from limiting a parcel's usable area will likely be the most common way that limit or prohibit decisions could influence development values.

Values of ecosystem services – Chapter 6 of the report describes the environmental consequences of allow, limit and prohibit decisions on fish and wildlife habitat and on the associated ecological functions and wildlife characteristics. As described in literature review (see Appendix C), the ecological functions of fish and wildlife provide ecosystem services that benefit society. Actions that protect or enhance these services will also protect and enhance their value. Actions that degrade ecosystem services will have the opposite effect. As services degrade, society either does without the service, restores the degraded habitat or replaces some lost or degraded services by building engineered projects (e.g., upgrading a water-treatment plant that provides clean water).

Ecosystem services include:

- Flood management. Fish and wildlife habitat help mitigate flooding by moderating flow intensities and absorbing runoff. Actions that reduce flood management services may increase flooding of area homes and businesses, and increase flood related damages and government expenditures for flood clean up and mitigation.
- Water quality. Fish and wildlife habitat help control soil erosion and landslides that cause sedimentation. Habitat areas also help filter toxins and sediment from surface runoff before they enter streams and other water bodies. Degrading these services may increase the flow of sediment and contaminants into area waters. Degraded water quality may increase filtration costs for businesses and municipalities. Increased concentrations of toxins and sedimentation may also increase the costs of projects mandated by regulatory agencies to bring water quality into compliance with federal and state water-quality laws (e.g., the Clean Water Act).
- Moderating water and air temperatures. Vegetation in fish and wildlife habitats provides shade that helps reduce air temperatures and the "heat island effect" in summer. Moderating air temperatures in summer helps reduce electricity costs associated with air conditioning. Actions that remove this vegetation may increase summer air temperatures and cooling costs.
- Stormwater services. Fish and wildlife habitats absorb rainfall that otherwise would flow into stormwater systems. Replacing these habitats with impervious surfaces will increase stormwater flows and management costs. These costs can be substantial.
- Salmon habitat. Fish and wildlife habitat support salmon populations and related commercial, recreational and cultural values. Actions that protect salmon habitats also help protect these values. Actions that degrade habitats may have the opposite effect.
- Amenities. Fish and wildlife habitat provide view, open space, and water-related amenities and associated amenity values for properties in proximity to habitat. Actions that protect these amenities also protect the contribution this habitat make toward property values. Actions that degrade the habitat have the opposite effect.
- Recreation. Fish and wildlife habitat support recreation activities including wildlife viewing, fishing and activities associated with parks and open space. Degrading these habitats may also degrade recreation related ecosystem services.
- Intrinsic and option values. Intrinsic values are the values people find inherent in a habitat or species for itself, rather from the use or consumption of the habitat. These values represent the amounts residents or society would pay to protect a habitat, or expect in payment to degrade the habitat. Option values represent the value of protecting a habitat or species for future use or enjoyment. Actions that degrade fish and wildlife habitat also degrade the intrinsic and option values associated with the habitat. Such decisions also increase the risks of an irreversible outcome, for example, extinction of a salmon species, which may have negative economic consequences in the future.

- Carbon sequestration. Chapter 7 describes the energy consequences of allow, limit and prohibit decisions on fish and wildlife habitat, including the carbon-sequestration benefits of trees and other vegetation. Removing the vegetation negatively impacts the sequestration benefits and associated economic value.

To the extent that fish and wildlife habitat provide multiple ecosystem service, the true or full values of services at risk from actions that degrade habitat are the cumulative values of the affected services.

Economic Impacts

Employment – for lands that support employment, e.g., commercial, industrial and mixed use, the factors that influence land value also influence employment. For example, actions that affect access to a site or a property's developable area will also likely affect the employment potential of the site. In general, however, Goal 5 decisions will impact land values more than employment (or income) for the following reasons:

- A large percentage of the fish and wildlife habitat are zoned for land uses that do not support employment. Of the remaining lands, many have low employment densities relative to densities in the Portland city center.
- A portion of the lands containing habitat zoned commercial or industrial have previously been developed and currently support employment. Goal 5 decisions will not affect this employment. A Goal 5 decision on these lands may affect future employment through redevelopment of properties.

Actions that protect or degrade fish and wildlife habitat may impact jobs that depend on these habitats. For example, protecting salmon habitat may help support jobs that depend on commercial and recreational salmon harvests. In this example, many of the jobs associated with salmon harvests may be located outside Metro's service area.

Income – income tradeoffs of protecting or degrading fish and wildlife habitat will follow employment tradeoffs

Property taxes **–** impacts of protecting or degrading fish and wildlife habitat will follow impacts on property values. This is especially true for lands zoned commercial and industrial that have not yet been developed. Limiting development on these lands may negatively impact property values and associated property taxes. Limiting development may have the opposite effect on property values and associated tax payments for residential property surrounding or adjacent to properties currently undeveloped. Protecting fish and wildlife habitat on these lands may have a beneficial impact in property taxes, especially over the long term.

Payroll taxes – the payroll tax tradeoffs of protecting or degrading fish and wildlife habitat will follow employment and income tradeoffs.

Business taxes – the business tax tradeoffs of protecting or degrading fish and wildlife habitat will follow the tradeoffs for property value, employment and income for lands zoned commercial, industrial and mixed use.

Transportation costs – transportation costs increase with the number of vehicle miles traveled (VMT). Planning guidelines that address transportation costs, such as the 2040 design types, promote more compact development that limits VMT and transportation costs. Actions that push development out towards the UGB or beyond will increase VMT and transportation costs relative to actions that promote more compact development.

2040 Design Types

The 2040 Growth Concept outlines the Portland metropolitan region's plan to accommodate expected population growth over the coming decades, while addressing housing, transportation, open space and employment needs. The 2040 design types represent land-use categories (e.g., central city, main streets, neighborhoods, rural reserves/open space) that embody the Growth Concept's transportation, housing and other land-use goals. The 2040 Growth Concept anticipates expected population growth while:

- Maintaining access to nature.
- Protecting wildlife habitat.
- Promoting efficient use of land.
- Supporting a vibrant economy.
- Providing transportation options.
- Promoting development along transportation corridors.
- Minimizing sprawl and VMT.

Activities that protect or degrade fish and wildlife habitat may have mixed impacts on the 2040 Growth Concept's goals and associated design types. Protecting and maintaining access to these habitats supports the growth concept and design types' emphasis on habitat protection. However, if protecting habitat displaces development to the extent that it promotes sprawl, expanding the UGB and the number of VMT, protection actions may inhibit or limit the design types. Alternatively, developing habitat may limit UGB expansion and associated consequences, but may also conflict with the growth concept's goals that address habitat protection and access to natural areas.

The growth concept's goals regarding development density and transportation considerations may mitigate the impacts of habitat protection on sprawl. Increasing the efficiency of land use by promoting higher development densities along transportation corridors complements the habitat protection goals by accommodating, to some extent, land uses that might otherwise be displaced to outside the UGB.

Economic Equity

Geographic distribution of impacts – in general, locations within Metro's jurisdiction that have been developed more intensely over longer periods of time have the least amount of fish and wildlife habitat. As a result, Goal 5 protection measures will have limited or no negative impacts on development in these locations.

Distribution of impacts by land use – approximately 80 percent of the lands containing fish and wildlife habitat fall into three generalized regional zones: single-family residential (SFR), parks and open space (POS), and industrial (IND). Potential economic tradeoffs associated with Goal 5 protection will fall primarily on lands in these zoning categories. As a group, lands in other zoning categories will experience limited Goal 5 economic tradeoffs.

Distribution of impacts by Goal 5 treatment – Goal 5 treatments will affect the distribution of positive and negative economic tradeoffs. Allow treatments do not increase habitat protection beyond Title 3 or local regulatory measures and place no additional restrictions on land use and development. Developers and property owners will enjoy most, if not all, of the benefits. Habitat-associated ecosystem services and those that benefit from the habitat and services will suffer most, if not all, of the negative economic tradeoffs. Results for prohibit treatments will have the opposite effect. Development interests will suffer most, if not all, of the restrictions. Habitat, ecosystem services, and those who benefits from the habitat and services will experience most, if not all, of the benefits. Limit treatments offer the most equitable distribution of tradeoffs because they generate positive and negative tradeoffs for development and resource interests.

Summary of economic consequences

Summarized below are some of the economic consequences of allowing, limiting or prohibiting conflicting uses.

Allow conflicting uses

Allowing conflicting uses means no additional protection of Goal 5 fish and wildlife beyond the baseline protection provided by Title 3, or by local protection measures that exceed Title 3 guidelines.

- No impediments to development or negative impacts on the development value of land.
- Development-related employment, income and taxes will be unaffected by Goal 5.
- No Goal-5 related increase in VMT, transportation costs or UGB expansion.
- Amenity-related property values and associated property taxes for undeveloped lands zoned SFR and RUR that are adjacent to Goal 5 habitat lands may be less for this scenario relative to limit and prohibit scenarios.
- Flood mitigation services will decline, flood damage and clean-up costs may increase.
- Erosion and sedimentation will increase, as will concentration of toxins in streams and other water bodies. Water-quality expenditures (e.g., for filtration and treatment) by businesses and municipalities may increase. Municipal expenditures that address water-quality regulations (e.g., the federal Clean Water Act) may increase.
- Summer temperatures and the urban “heat island effect” may increase with an associated increase in cooling costs.
- Developing fish and wildlife habitat will increase the amount of impervious surfaces, which will increase stormwater flows and treatment costs.
- Development that negatively impacts salmon habitat may affect commercial, recreational and cultural harvests. Municipal expenditures that address habitat regulations (e.g., Endangered Species Act) may increase.

- Degrading fish and wildlife habitat may negatively affect recreational opportunities and values that depend on these habitats.
- Negative impacts on intrinsic values for fish and wildlife habitat.
- Developing fish and wildlife habitat now or in the near-term precludes developing them in the future or protecting them for future generations. This reduces the option values associated with the habitats.
- Carbon sequestration and air-pollution removal will decline with an associated decline in air quality and related values of air-quality services.
- Businesses that rely on fish and wildlife habitat and associated ecosystem services may experience a decline in sales, employment and income relative to the limit or prohibit scenarios. Employment and business-related tax payments may also decline.
- Allowing conflicting uses will negatively affect the 2040 Growth Concept and design types that emphasize protecting habitat and maintaining access to habitat.
- The large majority, if not all, of the negative economic tradeoffs of this option affect fish and wildlife habitat, associated ecosystem services and economic factors (e.g., jobs, incomes and values, that depend on these habitats). Development interests suffer little or no negative economic tradeoffs.

Limit conflicting uses

Limiting conflicting uses strikes a balance between completely developing the Goal 5 fish and wildlife habitat and protecting them. This alternative provides opportunities including: developing lands in ways that minimize negative environmental and economic tradeoffs; supporting the development goals embodied by the 2040 design types; and protecting the most important habitats.

- Will generate a mix of positive and negative economic tradeoffs for development interests and for the habitats and associated ecosystem services. Developing habitat will generate positive impacts on development values, employment, income and tax payments. However, these impacts will be less than for the allow scenario. The habitat will likely suffer some degradation, but not to the extent generated under the allow scenario.
- The consequences for the 2040 design types will be mixed. Protecting fish and wildlife habitat to a greater extent, compared with the allow scenario, may increase VMT if protecting habitat displaces development and pushes it out toward the UGB or beyond. This may also increase the next UGB expansion and transportation costs. However, protecting habitat is consistent with the planning goals reflected in the design types.
- Will generate a more equitable distribution of positive and negative economic tradeoffs, compared with either the allow or prohibit scenarios. Development interests and habitat will both experience positive and negative economic tradeoffs.

Prohibit conflicting uses

Prohibiting conflicting uses will prevent development actions that conflict with, or degrade, fish and wildlife habitat. This scenario emphasizes habitat protection. Protection measures will exceed the baseline protection provided by Title 3, or by local protection measures that exceed Title 3 guidelines.

- Amenity-related property values and associated property taxes for lands zoned SFR and RUR that are adjacent to fish and wildlife habitat may be greater for this scenario relative to limit and allow scenarios.
- This alternative will provide the greatest amount of flood mitigation services and value.
- Erosion and sedimentation will be less than limit or allow alternatives, as will concentration of toxins in streams and other water bodies. Water quality expenditures (e.g., for filtration and treatment) by businesses and municipalities may be the least under this alternative. Municipal expenditures that address water quality regulations (e.g., the federal Clean Water Act) may decline, especially over the long term.
- This alternative will have the greatest mitigating effect on summer temperatures, the urban "heat island effect," and associated cooling costs.
- Prohibiting development in fish and wildlife habitat will generate the least amount of impervious surfaces, and will generate the least amount of stormwater flows and treatment costs.
- This scenario will protect the greatest amount of salmon habitat and may positively affect commercial, recreational and cultural harvests. Municipal expenditures that address habitat regulations (e.g., Endangered Species Act) may decline, especially over the long term.
- This alternative will preserve the greatest amount of recreational opportunities and the associated recreational values.
- The intrinsic and options values for the fish and wildlife habitat will be preserved.
- Maintaining the greatest amount of vegetation will maximize carbon sequestration, air pollutant removal and the related values of air quality services.
- This alternative will provide the greatest support to businesses that rely on fish and wildlife habitat and associated ecosystem services.
- Prohibiting conflicting uses will support the aspects of the 2040 Growth Concept and design types that emphasize protecting habitat and maintaining access to habitat.
- This alternative will have the greatest negative impact on the development value of land.
- Development related employment, income and tax payments will also suffer the greatest under this alternative.
- Aspects of the 2040 design types that minimize VMT and sprawl will be negatively impacted if protection measures displace development within the UGB.
- The large majority, if not all, of the negative economic tradeoffs of this alternative affect development interests. The economic values and activities supported by fish and wildlife habitat suffer little or no negative economic tradeoffs, relative to allow and limit alternatives.

Factors that influence economic consequences

The description of economic tradeoffs in the previous section assumes no reaction by stakeholders and decision makers that would impact the economic tradeoffs. This static approach ignores, for example, the possibility that restoring fish and wildlife habitat may mitigate some of the negative economic tradeoffs of development on these habitats. A more dynamic view of economic tradeoffs considers alternatives that could help mitigate negative tradeoffs and enhance positive tradeoffs. This section describes a number of these dynamic factors.

Substitutability of land uses
Moving proposed land uses that conflict with fish and wildlife habitat to alternative locations may mitigate negative economic tradeoffs for both the land use and habitat. The previously conflicting land use can take place without impacting habitat. Substituting a non-conflicting or less conflicting land use in the habitat area will protect, to some extent, the property's development value. Such a move will also protect, to some extent, the quality and quantity of the property's fish and wildlife habitat.

The feasibility of substituting land uses depends on the types of land uses at issue and the availability of suitable sites outside habitat areas. The more specific or unique the development requirements, the less likely the development can take place elsewhere. For example, water-dependent industrial development must take place in specific locations—relatively large lots with water access. This limits the extent to which the land use can avoid conflicting with habitat by moving elsewhere. By comparison, residential land uses have relatively few development specific requirements and take place throughout Metro's jurisdiction.

Expanding the Urban Growth Boundary
Protecting fish and wildlife habitat may reduce the amount of developable land within the UGB. If this is the case, expanding the UGB could mitigate this loss while protecting fish and wildlife habitat within the existing UGB. However, expanding the UGB may promote sprawl and negative sprawl-related impacts including increased VMT and transportation costs, and possibly minimizing the effectiveness of the 2040 design types.

Encourage development practices that minimize conflicts with fish and wildlife habitat
Encouraging development practices that minimize conflicts with resources may help mitigate negative economic tradeoffs for both development and the resources. These practices include low-impact development projects that minimize impervious surfaces and manage stormwater in ways that more closely mimic natural systems. Cluster developments for residential lands is another example. This type of development localizes housing sites and associated land-use activities (e.g., roads) while avoiding developing fish and wildlife habitat. In another example property owners may sell future development rights while retaining ownership without restrictions on existing land uses.

Restoring degraded fish and wildlife habitat
Restoring already-degraded fish and wildlife habitat could offset a portion of the negative impact of new development on habitat elsewhere. In some cases, restoration opportunities may lie outside the existing UGB or Metro's jurisdiction.

Economic consequences by generalized regional zone
Below is a brief description of the economic consequences by the seven generalized regional zones (matrices describing the consequences may be found in (See Appendix D):

- **Single-family residential (SFR):** Lands zoned SFR account for almost half, 46 percent, of Goal 5 fish and wildlife habitat. Protection actions on these lands will primarily affect property values and related tax payments with little or no direct impacts on employment and income. Since SFR developments typically retain more vegetation and tree cover than other types of development, this land use will conflict less with habitat and retain more ecosystem services and associated economic values than other development uses. Encouraging low impact developments and cluster development patterns may help mitigate negative economic tradeoffs for development and resources.

- **Multi-family residential (MFR):** MFR lands account for approximately five percent of Goal 5 fish and wildlife habitat. Economic tradeoffs will be similar to SFR lands except that MFR development typically retains less vegetation cover and fewer ecosystem services and associated values.
- **Commercial (COM):** Approximately five percent of Goal 5 fish and wildlife habitat are on lands zoned COM. Habitat protection actions may negatively affect property values, employment, income and related tax payments. COM developments involve extensive landscape modifications that negatively affect ecosystem services and the economic values of services. These negative impacts are comparable to, or greater than, the degradation of ecosystem services and values associated with MFR developments.
- **Industrial (IND):** IND lands account for approximately 15 percent of lands containing Goal 5 fish and wildlife. Economic tradeoffs will be similar in type and extent to tradeoffs for COM lands.
- **Mixed-use centers (MUC):** Approximately three percent of Goal 5 fish and wildlife habitat are on lands zoned MUC. Economic tradeoffs will be similar to developments on lands zoned MFR and COM. Limiting MUC developments will have mixed impacts on 2040 design types and the underlying 2040 Growth Concept. Protecting fish and wildlife habitat supports the Growth Concept's goals of maintaining access to nature and protecting habitat. Limiting MUC developments, however, may negatively impact the design type's emphasis on promoting more efficient land use and minimizing sprawl and VMT.
- **Rural residential (RUR):** RUR lands account for approximately seven percent of Goal 5 fish and wildlife habitat. Economic tradeoffs of developing RUR lands will be similar to SFR except less intensive given the more dispersed nature of RUR developments.
- **Parks and Open Space (POS):** Approximately 20 percent of the Goal 5 fish and wildlife habitat are on lands zoned POS. Protection measures may limit recreation activities that require facilities (e.g., ball fields and golf courses, and related infrastructure such as parking lots). This limitation may negatively impact property values for private parklands more than parks on public lands. Park and open space land uses may be the least intrusive on habitats and associated ecosystem services and economic values.

Summary Points

This section lists the summary points from the analysis of economic consequences.

- Fish and wildlife habitat lands were ranked for their economic importance for development or development value using three measures: land value, employment density and 2040 design type hierarchy.
- Fish and wildlife habitat lands provide ecological functions (e.g., bank stabilization, streamflow moderation, shade, etc.) that also provide ecosystem services (e.g., reduce flood damage, improve water quality). Ecosystem services have economic value. The analysis assumes that habitat that ranked high (for ecological functions) provide more of the type of ecosystem services that society values than do areas that ranked low.
- The Goal 5 programs may protect services such as flood management, water quality, amenity, and salmon-habitat values across a broad area that may affect residents throughout

the UGB and downstream from the UGB. Protecting these ecosystem services may also reduce municipal expenditures to provide these same services, especially over the long term.

- Prohibiting development protects habitat and associated values, but will limit development related economic benefits.
- Limiting development preserves some level of development and habitat values.
- Protecting fish and wildlife habitat within the existing UGB preserves habitat in close proximity to current population distributions but increases the probability of expanding the UGB sooner or to a greater extent than otherwise would be the case if protection measures displace developable land.
- Protecting habitat on the urban fringe protects development interests close in, but reduces access to habitat and associated ecosystem services for the majority of the population within the existing UGB.
- The details of the program options applied at the parcel level will dictate the type and extent of positive and negative economic tradeoffs for Goal 5 habitat protection measures.
- The fact that Goal 5 decisions would primarily affect land with lower property values and employment density does not mean economic consequences of limit or prohibit decisions would be trivial. The low category of land value and employment is relative to values and employment in the Portland city center. The cumulative property value or number of employees affected may be significant depending on the type of decision, the details of the Goal 5 program that implements the decision, actions that may mitigate the negative impact (e.g., expanding the UGB), and specifics of the individual parcels affected.
- Goal 5 programs that include fish and wildlife habitat restoration activities may mitigate the need to implement more severe limit decisions. That is, a program that includes habitat restoration may result in more allow or limit decisions, compared with a program that excludes habitat restoration. However, restoration plans should be developed in the context that restoring degraded habitat may be more expensive, and in the end provide fewer or lower quality ecosystem services, compared with protecting high quality habitat.

CHAPTER 5: SOCIAL CONSEQUENCES

Introduction

This chapter focuses on the social consequences of protecting or not protecting fish and wildlife habitat. Areas providing fish and wildlife habitat provide many important social benefits. However, protecting these areas places a burden on property owners. In this chapter the social benefits and burdens of protecting or not protecting fish and wildlife habitat are described by addressing the following questions:

- What do fish and wildlife habitat contribute to our cultural heritage and sense of place?
- How does protecting fish and wildlife habitat affect our health?
- What educational values are provided by fish and wildlife habitat?
- How does protecting fish and wildlife habitat affect public safety?
- What are the social impacts of protecting fish and wildlife habitat on the land supply?
- How does protecting fish and wildlife habitat affect property rights (private and public)?
- What fish and wildlife habitat will we leave for future generations to enjoy?
- What are the potential social consequences of allowing, limiting, or prohibiting conflicting uses as they relate to Metro's generalized zones?

Metro's fish and wildlife habitat protection efforts are being conducted under State Land Use Planning Goal 5. Land use planning is largely a negotiated social and political process that involves people, their communities, and their governments in decision making. Thus, the social issues include not only those related to land use plans specifically but also those of democracy, participation, and community process. Planning is a public social process representing multiple needs and values. The overall planning context and the importance of social participation are discussed in the section below.

Framework for the social analysis

Citizens have indicated the importance of protecting the air and water, endangered species and natural areas. Federal,[35] state, regional, and local policies reflect these choices. Publicly supported programs (e.g., Metro's Parks and Greenspaces program) exemplify the value placed on natural resources. Over 40 local groups (largely volunteers) focus their work on preserving and restoring streams and rivers, including watershed councils and conservation groups, land trusts, friends groups, specific stream groups, and the Willamette restoration initiative.[36] The public interest and outreach programs sponsored by parks and recreation programs and non-profit organizations provide opportunities for social gatherings, education, recreation, and conservation activities.

The value placed on ecosystem health by citizens in the region highlights the importance of conserving fish and wildlife habitat. The long-term, less tangible benefit of ecosystem health (intrinsic value of habitat) exists along with short-term amenity benefits to property owners and

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[35] Endangered Species Act, Clean Water Act, etc. See *Introduction* chapter and *Appendix A* of ESEE report for more detail on policies that protect fish and wildlife habitat.
[36] See Metro's *Riparian Corridor and Wildlife Habitat Inventories* (Metro 2002d) for more information.

others. Some of the social benefits that arise from a healthy ecosystem are clean water, improved salmon and other wildlife habitat, biodiversity of plant and animal species, relief from urban stress, flood mitigation, educational and recreational opportunities, and neighborhood amenities.

In this analysis we consider the possible impacts of protecting or not protecting fish and wildlife habitat on human needs and social values. This analysis does not undertake a survey of people's values; however, it does point to a range of relevant and acknowledged values that bear on the protection of fish and wildlife habitat. Some of the relevant values considered in the analysis are ecological, economic, health, educational, aesthetic, and sense of place or regional identity. A range of values is associated with these issues, and sometimes they conflict with each other.

Linking human needs and comprehensive planning

The existing and planned functions[37] of the Metro region serve the needs of individuals, organizations and communities. These functions cover a range of security and welfare needs as well as the need for freedom and identity. Oregon's comprehensive planning goals parallel the diversity of social organization that supports human development. The planning goals address an array of concerns such as farms, industry, water quality, historic preservation, citizen involvement and urbanization. Land use policies specifically address such social functions as land for housing and employment, location of public facilities, and provision of recreation and natural areas.

Metro's 2040 Growth Concept was designed to help the Metro region continue to grow in a way that maintains a high quality of life. This includes livable neighborhoods, good transportation options, a strong economy, a vibrant culture, and access to nature while retaining aspects of the local character that provide continuity with the past and make this region unique.

Natural resources are one touchstone of this region's uniqueness. Without the proximity of forests, rivers, scenic mountain views, and farmland valleys, the region's natural and cultural identity would be diminished. Oregon's planning goals recognize that the land use planning program needs to preserve significant fish and wildlife habitat. This recognition of natural resource protection is a form of valuation that society places on nature to meet a variety of general needs and desires related to resource dependency, urbanization, and enjoyment of life.

Social participation and public legitimacy

This analysis focuses on the tradeoffs of protecting or not protecting fish and wildlife habitat from a social point of view. However, a key social consideration of any protection program is a well-designed and transparent public outreach and involvement process. Without plentiful opportunities for meaningful public comment, a program (regulatory or voluntary) is unlikely to succeed, and with good public involvement the success of implementation is more likely. It is important to identify the range of opinions of those who have a stake in the development of potential policies to protect fish and wildlife habitat.

Natural resource protection engenders strong stakeholder claims. The value placed on natural resources differs among individuals and stakeholder groups, and the natural resources in question

[37] For example, housing, schools, roads and transportation, industrial zones, and parks.

are not always equally distributed. Some people view natural resources as public or common goods, while others view them as private property. Citizens have given the government the responsibility for overseeing the management and allocation of public resources while also protecting private property rights.

Regulations to protect natural resources require a degree of social agreement for acceptance and cooperation to be effective. According to Uphoff and Langholz (1998), three key elements must be in place for natural resource protection to be effective: (1) a legal/coercive element, (2) an economic/profit motive element, and (3) a cultural/social acceptance element. Without social approval it may be impossible to prevent motivations of monetary self-interest or to counter illegal activity intended to circumvent laws protecting common goods. Social processes that uphold legitimacy and participation in decision making are thus essential for long-term public policy support and successful implementation.

It is important to respect the right of citizens to participate in identifying key issues of interest and concern. Without an adequate level of citizen involvement and direction, a program may be less likely to be accepted and runs the risk of being viewed as too technical or bureaucratic (Lane 2001, Brechin et al. 2002). The disproportionate influence of "powerful interests" can be ameliorated with open planning processes. Public resource management and allocation is political and involves the values of a broad range of people. Broad citizen involvement allows for a transparent process, develops trust, and leads to negotiated agreements that build locally acceptable commitments (Creighton 1983).

Citizen involvement is formalized in Oregon's land use planning system as Statewide Planning Goal 1. When stakeholders are provided with an opportunity to participate, programs are more likely to be successful. People and communities may see their interests in protecting the region's fish and wildlife habitats differently and may thus express different priorities in terms of their immediate needs and values. But, from a social perspective, this process of participation and opportunity for citizen involvement in the planning process is central. It is important that citizen involvement be a key aspect of program development and that the issues raised in the analysis below be considered.

What do fish and wildlife habitat contribute to our cultural heritage and sense of place?

Fish and wildlife habitat once covered the entire Metro region. "Historical evidence indicates that at the time of the Oregon Trail migration, the majority of the Portland region was in a continuous canopy" (Poracsky 2000). People have been drawn to the Willamette Valley and the confluence with the Columbia River for centuries because of the abundant natural resources available to provide a good quality of life. Lewis and Clark missed the mouth of the Willamette River twice as they explored the Columbia River, due to the forested islands screening it from view. After they were told by Native Americans of the river's existence they went back to explore and were duly impressed (Riddle 2000). Wildlife were abundant: "[Lewis and Clark] camped across the river from the island and in their journals bemoaned being kept awake by the 'horid' noise of the geese, ducks, and swans" (Matrazzo 2000). Just a few decades later the rivers were completely changed:

> River traffic was crowded with ferries carrying passengers back and forth to the east and west banks, and river steamers taking sightseers on excursions up the Willamette to the "Niagara of the West," up the Columbia to the Gorge, or downriver to the ocean. (Riddle 2000)

Today the remnants of habitat provide residents with a sense of regional identity and preserve some of the fish and wildlife species that have so shaped the development of this region.

Cultural heritage

Nature and wildlife are part of our region's unique identity. Residents of this region consistently say that contact with nature is important, and they value the natural biological diversity that is part of the Willamette Valley.[38] Robin Cody (2000), co-author of the book *Wild in the City: A guide to Portland's natural areas* (Houck and Cody 2000), states: "Although Portlanders are now a fully urbanized people, the rivers still make us who we are. Never too deeply buried in the urban ethos is an imaginative truth, that not so long ago we emerged to a riverside clearing, the sons and daughters of pioneers, self-selected for rugged individuality."

As Oregonians, state symbols are part of the cultural identity of residents in the Portland metropolitan region. The Western Meadowlark was selected as Oregon's state bird by schoolchildren in 1927 (Marshall et al. 2003). It is currently a state-listed Species of Concern, and has been nearly extirpated from the Portland metropolitan region due to loss of native grasslands (a Habitat of Concern here) and development encroachment. However, some birds still winter over in the region, and bird-watchers often seek them out in areas such as the agricultural lands around the Tualatin River. The state fish, Chinook salmon, has five runs in or near this region, and all five are federally listed as Threatened or Endangered. Loss of these species and their habitats implies an irreplaceable cultural loss.

Fish and wildlife play key roles, currently and historically, in Native American religion and culture. Levi Holt, former commissioner of the Columbia River Inter-Tribal Fish Commission (CRITFC), comments:

> The tribes always treated water as a medicine because it nourished the life of the earth, flushing poisons out of humans, other creatures and the land. We knew that to be productive, water must be kept pure. When water is kept cold and clean, it takes care of salmon. (Hollenbach and Ory 1999)

The CRITFC (2002) states that "without salmon returning to our rivers and streams, we would cease to be Indian people." CRITFC holds fundraisers each year, and so far the Spirit of the Salmon Fund has raised over $1.5 million for the commission and its member tribes to spend on salmon recovery activities. The federal government also has treaty obligations that ensure the availability of Chinook salmon and steelhead trout for tribal fishing (*U.S. v. Washington* 1974).

This identification with nature and wildlife by the majority of the region's residents is reflected in many ways. For example, the 100-year-old Audubon Society of Portland is older than the

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[38] May 2001 Davis and Hibbits phone survey commissioned by Metro, an October 2001 Moore Information survey sponsored by KGW-TV and the Portland Tribune, and an informal "SurveyPoint" poll available by phone and on Metro's website in 2001.

national Audubon Society and is the largest chapter in the country, with over 10,000 members and 1,000 volunteers. Each year thousands of residents flock to the Wild Arts Festival to buy wildlife art and meet the authors of wildlife-related books; salmon and birds are probably the most common art themes in this area. Metro's annual Salmon Festival takes place at Oxbow Regional Park, located in the scenic Sandy River Gorge eight miles east of Gresham. Native Chinook salmon have migrated for thousands of years from the Pacific Ocean to the Sandy River and may be viewed spawning at the park during the festival and throughout October. Nature and wildlife are prominent subjects in the Portland Art Museum and in art galleries throughout the region.

Residents of the region also care specifically about at-risk wildlife and habitats. For example, in a 1997 poll conducted by the *Oregonian*, the decline of the region's salmon topped the list of residents' environmental worries (Brinckman 1997). The underlying reason was that salmon represent the Northwest's heritage and serve as a gauge of water quality and environmental health. Residents frequent rare habitats such as the oak woodland/wetlands complex in Oaks Bottom and river islands such as Sauvie Island. Such places harbor unique plant and wildlife communities and represent native habitats that were once common here, which makes them especially valuable to the region.

In 1999, Metro surveyed a diverse group of stakeholders, whose consensus on the most appropriate criteria for defining regionally significant fish and wildlife habitat included the presence of threatened, endangered, state sensitive, or state-listed species (Metro 1999a). Declining species most often depend on sensitive or declining habitats, such as riparian, Oregon white oak, undeveloped hilltops and river islands, or native grasslands. Loss of these species and the habitats they depend on is irreversible. In 2002, Metro conducted a public outreach effort in which over 2,400 residents participated (Metro 2002b). Environmental protection was identified as one of the three key issues deserving greater emphasis.

Contact with nature and the rich diversity of species and habitats native to this region are important parts of the region's cultural heritage; to the extent that these habitats are lost, so is a part of our culture, heritage, and natural history.

Sense of place and neighborhood character

The relation of people to place and land is an essential experience. Humans have been sensitized over millions of years by their co-evolution with the landscapes and species on the planet. The experience people have growing up is influenced by the climate, seasons, terrain, vegetation, and local animals. Home or neighborhood terrain, playgrounds, backyards, local parks, and scenic views, as well as the urban experiences of work, leisure, and travel in the region all influence the sense of place people feel, including their level of attachment to particular places.

The Metro region is well defined by its landscape: major rivers, hills, trees, the rainy season and summer heat. It includes views of Mt. Hood and Mt. St. Helens. The region is defined by the many streams and rivers, including the Willamette River running through the urban core, the Tualatin in the west and the Clackamas in the east, and the Columbia River leading to the Pacific Ocean. Forest Park provides opportunities for hiking in the city as well as defining our views of downtown Portland – skyscrapers framed against the forest and hills. This region is unique:

"Few cities in the nation can boast putting oceans, mountains, fresh strawberries, spawning salmon, and spectacular waterfalls in the same sentence, much less in the same day" (Seltzer 2000).

Bioregionalism is a landscape term expressing a reciprocal interaction of people and place, nature and society. Respect for place becomes a key feedback response for promoting the quality of life that people seek (Bethold-Bond 2000). Our regional identity includes the urban landscape that spans the river harbors, downtown Portland, and the cities and towns with a mix of new and old structures, known neighborhood features, gathering places, workplaces, city parks, museums, restaurants and stores. People are socially connected to the entirety of the built and natural environment, through street trees, gardens, walks, bicycle rides, and automobile trips. People have a regional identity in addition to other place-based identities (e.g., a neighborhood or watershed).

Historical perspectives on the changing Oregon landscape, the people who settled here, and the treatment of the environment, explain some of the region's uniqueness as well as common responses to life and development issues. In Terence O'Donnell's (1988) history of the 10,000 years of settlement since the "land came to rest and humans arrived to live from it," the people that chose to come to Oregon are described as being of modest ambition, respectable folks, self-sufficient and independent, seeking some measure of retreat and quiet.

> To delineate with any exactitude the character of either a person or a place is a futile exercise. Nonetheless, and perhaps as this and impressionistic history of Portland suggests, certain traits have appeared again and again in the town's expression of itself. There is the value placed on nature, a rather curious value for a city to embrace. One observer has commented that Portlanders are 'reluctant to face the facts of urban life, only its amenities'." (O'Donnell & Vaughn 1984)

A counter-perspective to immigrant sensibilities or attachment to place is reflected in an account of the utility of the land and the realities of capital and markets. Many people moved to Oregon to profit from the abundant natural resources. For many years it seemed there was no end to the board feet to be logged from the forests and the number of salmon caught from the rivers.

> Nearly a century and a half of American settlement has produced a regional landscape which has grown increasingly less distinctive and progressively less stable…. Northwesterners have frequently acted as if the natural world exists largely as something to buy and sell and as if the regional ecology were infinitely malleable. (White 1983)

These perspectives on the value of natural resources represent the conflicting values placed on natural resources and the changing views over time.

Scenic values

Trees, open space, and streams define the visual appeal of the Portland metropolitan region. Tree-covered hills blanket the cities and towns; removal of large sections of the canopy would change the visual appeal residents of the region enjoy. Fish and wildlife habitat can provide scenic value regardless of the degree of physical accessibility. People can enjoy a view of a stream, open space, or forest even if they are not able to explore it. However, people's perceptions of what makes up a "scenic" view may differ. Some consider densely vegetated hillsides to be attractive, while others are attracted to open, park-like land. Most fish and wildlife habitat value is derived from the more densely vegetated areas. There are also economic values placed on scenic views, as described in the *Economic Consequences* chapter of this report.

Natural resources buffer land uses from each other

Fish and wildlife habitat can help to buffer incompatible land uses from each other. Open space, tree canopy, and streams provide physical, noise, and visual buffering that can separate land uses and reduce off-site impacts. Trees not only help to control noise pollution but add the soothing sounds of wind rustling through leaves and branches. A U.S. Department of Agriculture publication reports that a 100-foot wide and 45-foot tall patch of trees can reduce noise levels by 50 percent (U.S. Department of Agriculture 1998). For example, a residential area buffered from industrial uses by a forest or stream will be more desirable than a residential area without the buffer.

How does protecting fish and wildlife habitat affect our health?

Health is a social issue. It encompasses both physical and mental well being. Fish and wildlife habitat provide benefits that affect both our physical and mental health. According to the Academy of Leisure Sciences (2002), recreation and leisure activities may be one of the best methods of curbing rising medical costs. Recreation contributes to healthy living, and healthy people need less medical care. People have long recognized the value of nature in contributing to our mental and physical well being. In fact, the ancient Egyptians created gardens to restore the spirit.

Recreational opportunities

Land use planning is tied to environmental quality and to recreational and leisure activity, both of which have a direct effect on people's health. Air and water quality is one aspect of this, along with opportunities for physical exercise through recreation and mental health benefits derived from proximity to nature. Recreation helps to fuel the human spirit, strengthen the physical self, and create a series of connections to others, community, and the environment that are as necessary to life as air and water.

Psychologists Sachs and Segal (1994) found that activities such as a walk in the woods gives a boost to the immune system that lasts two or three days. Exercise helps people live longer. Several studies have shown that middle-aged adults who exercise live on average about two years longer (Nieman 1998). Aside from improved cardiopulmonary benefits and quality of life, researchers have found that exercise had a beneficial effect on the happiness of cancer survivors: those exercising reported 19 additional hours of happiness per week than those not exercising (Courneya et al. 2003).

Natural areas provide tangible value in urban environments for people and communities. Natural resources, open space, parks, greenways, and trail systems are described generally as amenities in an urban area. The region's natural resource amenities include a mix of local parks and natural scenery, plus access to wilderness destinations within a two-hour drive. Hiking in Portland's Washington Park, driving to the scenic Columbia Gorge, weekend camping visits to the Cascades or the Oregon Coast, and boating on the Willamette River are some examples of recreation opportunities in the region. People enjoy walking and spending time in their neighborhoods and backyards in livable communities. Many people move to the Metro region specifically for the abundance of recreational opportunities located in and near the urban area.

The Metropolitan Greenspaces Master Plan, adopted by the Metro Council in 1992, describes a vision for a unique regional system of parks, natural areas, greenways, and trails for fish, wildlife and people. The plan identifies 57 urban natural areas and 34 trail and greenway corridors that define green infrastructure for the Metro region. In 1995 voters approved a bond measure ($135 million) to purchase sites identified in the plan. Local park providers, schools, businesses, and citizen groups are implementing the plan through a combination of open space acquisition, land-use standards, incentives, and stewardship.

Residents and local governments are working with Metro to ensure that people have access to nature close to home as well as efficient ways to get to work, school, or shopping. When originally conceived 100 years ago, the regional trail system was going to be 40 miles long, circling the city of Portland. The Metro area has grown substantially since then. The Metropolitan Greenspaces Master Plan expanded the concept to 25 cities and four counties within the Portland/Vancouver metropolitan region. Today, plans call for an 800-mile network of land trails, water trails, and greenways. Nearly 30 percent of the land-based trails are complete. Recreation and access to nature are important values to citizens of this region.

Recreational activities help to keep people well. While protecting fish and wildlife habitat on private land does not provide most residents of the region with direct recreational opportunities, it does contribute to overall ecosystem health. A healthy ecosystem means continued presence of fish in streams and birds and other wildlife in natural areas. Many citizens have moved to this region for the opportunity to engage in fishing, canoeing, sea kayaking, and other activities on the region's streams and rivers. Birdwatching is a popular pastime, especially visits to Smith and Bybee Lakes and Sauvie Island.

Impact of sprawl

A healthy urban environment is typified by neighborhood amenities such as access to nature (in the form of parks or openspace views) and pedestrian-scale development that provides both aesthetic and functional value. The modern predominance of door-to-door automobile trips, congestion, stresses, and pollution detracts from our health and enjoyment of city living. An article on integrative medicine identifies the "biopsychosocial interface" of the built environment, implicating urban planning and public policy in the process:

> While the trend toward increasing urban sprawl has impacts on land use, transportation, and economic and social development, less attention has been paid, until recently, to the fact that the way that our communities are designed can also have serious health consequences. (Horowitz 2002)

Horowitz describes the common health threats of auto-dependent urban sprawl as respiratory problems from air pollution, toxicity in air and water supplies, various stress factors, lack of physical exercise or activity, obesity, and impaired access to nature. Urban and suburban sprawl can isolate people socially. Urban stress also arises from noise, crime, litter, or blight in neighborhood settings. However, increased density does not always have a positive impact on health. For instance, densely settled areas may allow for faster transmittal of communicable diseases. Not all neighborhoods face these issues, and social inequities between income groups and neighborhoods are well known and linked to health and environmental justice issues.

Environmental quality

Having intact natural systems helps keep the air and water clean in urban areas. Urbanization contributes to poor air quality and higher levels of industrial pollutants and results in other adverse effects such as high summer "heat island" temperatures.[39] Polluted air and water can cause many physical ailments such as asthma and bronchitis, allergies, and gastrointestinal problems. Poor air quality can prevent children from playing outside on summer days and can prevent adults from exercising outdoors or commuting by foot or bicycle. Retaining natural areas in the region helps to mitigate the negative impacts of development on human health.

Fish and wildlife depend on clean air and water to thrive. Fish are especially sensitive to poor water quality, such as that caused by the presence of toxins and other chemicals. Some people depend on fishing as a supplementary food source, and eating contaminated fish can negatively affect their health. Negative impacts include increased cancer risk and other health effects such as immunological, reproductive, developmental or nervous system disorders (U.S. Environmental Protection Agency 2002). Native Americans in the Columbia Basin eat fish at rates six to 11 times the national average and thus may be at a higher risk for negative impacts (U.S. Environmental Protection Agency 2002). Toxic fish are of particular concern for pregnant women and young children. Therefore, protecting fish and wildlife habitat may help keep those who eat fish from the region's rivers healthy.

Mental health and stress

The sight of natural areas enhances our mental health. Edward O. Wilson (1986) described this in his "biophilia hypothesis," which posits that human beings are attracted to nature because they are inextricably linked to the natural world and emotionally dependent on it. In discussing related research, the Trust for Public Lands (1994) points to information in over 100 studies describing the benefits of stress reduction from "experiences in wilderness and urban nature areas." Dr. Roger Ulrich of Texas A&M's Center for Health Systems and Design supports this research. He is cited in popular health literature regarding his studies on the positive response patients exhibit when exposed to natural environments:

> "…[J]ust looking at certain types of everyday nature is quickly effective in producing a mild, open-eyed relaxation response… Anger and fear also both diminish to the point of measurable improvement." (Ulrich quoted in British United Provident Association [BUPA] 2002)

Ulrich has found that passive scenic values reduce stress, lower blood pressure, and enhance medical recovery (Ulrich et al. 1991). Anytime people have a chance to look out a window at greenspace, or to be outdoors, they experience some benefit associated with a connection to nature, all other factors being equal (BUPA 2002, Baker 2002). Even pictures of nature can positively affect hospital patients. A study in a Swedish hospital found that heart surgery

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[39] See *Energy Consequences* chapter for more discussion on Urban Heat Island effects.

patients viewing a landscape with trees and water "experienced less anxiety, and required fewer strong pain doses, than control groups assigned no pictures" (Ulrich et al. 1993).

Nature and spiritual values

Spiritual values are associated with a deeper reverence for nature and the outdoors. Beyond the benefits of exercise or stress relief, spirituality binds human beings and nature in a larger whole. Some people feel their closest connection with religion or the spiritual world when in the woods or by a river. Over the past few centuries the rise of science and rationalism provided humankind the opportunity to exert more control over nature and distanced people from their spiritual connections to nature (Rockefeller 1992). Most people today live in urban environments, with many children growing up not learning how the natural environment functions and supports our well being.

Many religions reflect beliefs of a larger mutual arising of knowing, meaning, and sense between people, nature and cosmos. Respect for the land, a morality of caring that extends to the type of utility we place on nature, is evident in Western spiritual traditions. On the other hand, another school of thought focuses on the "man over nature" model that focuses on the utilitarian value of animals and ecosystems (Rockefeller 1992). Lately many of the major religious organizations, such as the World Council of Churches, the U.S. Conference of Catholic Bishops, and the National Religious Partnership for the Environment have actively supported environmental protection policies and describe the connection between faith and the ecological health of the planet (Schueller 2001). For example, the Catholic Bishops of the Northwest issued a letter on caring for the Columbia River watershed, spurred by the economic and ecological conflicts evident in the region (Columbia River Pastoral Letter Project 2000). The letter described "…a vision that promotes justice for people and stewardship of creation."

Native American culture and spirituality is based on an appreciation of the natural world, as described by Margaret Saluskin of the Yakama Tribe below.

> Salmon was presented to me and my family through our religion as our brother. The same with the deer. And our sisters are the roots and berries. And you would treat them as such. Their life to you is just as valuable as another person would be. (Hollenbach and Ory 1999).

Spiritual awareness of the importance of nature has led to the philosophy and teaching of ethics, as expressed by such inspirational leaders as John Muir, Aldo Leopold, and Henry David Thoreau (Rockefeller 1992). It has also given rise to new philosophies, such as deep ecology, and to religions that view nature as sacred, such as paganism and Gaia (goddess)-based religions. Deep ecology is a philosophy based on the sacred relationship with Earth and all beings, an international movement for a viable future, a path for self-realization, and a compass for daily action (Drengson 1999). Nature provides inspiration and the chance for people from many religions and viewpoints to explore and enjoy their spirituality.

What educational values are provided by fish and wildlife habitat?

The existence of healthy ecosystems and fish and wildlife species enhances educational values and promotes recreation opportunities such as wildlife viewing, nature painting, and photography. Healthy ecosystems also provide “living laboratories” for active educational programs from volunteer monitoring to formal scientific research. While these values and opportunities are realized mostly on public lands, private open space and natural resources also contribute substantially to maintaining healthy ecosystems and habitat for fish and wildlife species. These activities are not limited to public lands, as some private lands are dedicated to wildlife sanctuaries and environmental education facilities. In addition, roads and adjacent public parks afford viewing opportunities on adjacent private lands.

Nearby natural areas provide important educational opportunities

The importance of a variety of accessible natural areas for educational programs is evidenced by the wide array of non-formal education providers[40] and formal education providers[41] in the region. These entities provide programs for children and adults to learn about the environment, natural and cultural history, fish and wildlife species and their habitats, social studies, and civics.

Natural areas can provide a focal point for teaching people about how government works and how they can be involved in improving their neighborhood, city, or region. This public participation improves community understanding of environmental, social, and political issues.

Park districts such as Metro Parks and Greenspaces, Portland Public Parks, Tualatin Hills Parks and Recreation District, and North Clackamas County Parks District host hundreds of outdoor activities and environmental education programs, involving thousands of youth and adults on an annual basis. Metro’s Parks and Greenspaces department developed a map depicting the locations of all the nature centers and environmental learning centers in the region. Non-profit groups such as the Audubon Society of Portland, Friends of Trees, and SOLV have extensive education and volunteer programs aimed at restoring fish and wildlife habitats and increasing people’s awareness of the habitats and species within the region.

Natural areas provide opportunities for interdisciplinary education

More and more schools are recognizing the value of natural areas and the environment as an effective focus for integrated, interdisciplinary studies in all areas – social studies, arts, science, and mathematics. This model, *using the environment as an integrated context for learning* (EIC), has been shown to improve critical thinking skills, achievement in standardized tests and improved student attitudes about learning and civility toward others (Leiberman and Hoody 1998).

Public school districts, such as Portland Public Schools and North Clackamas School District, provide magnet schools focused on environmental learning. These schools fully incorporate public open spaces in their curriculum, providing an integrated context for all subject areas. Public and private schools also have “adopted” natural areas adjacent to or near the school grounds as a project-based approach to the overall curriculum. Happy Valley Environmental School, for example, uses the city-owned wetlands in this way and has helped build walkways

[40] For example, Tualatin Hills Nature Park, Jackson Bottom Wetlands Preserve, Tryon Creek State Park.
[41] For example, public and private schools, community colleges, universities, professional training institutes.

and restore native vegetation. Three Rivers Charter School in the Wilsonville-West Linn School District uses its grounds and adjacent lands to integrate all subjects.

Publicly owned open space and natural areas provide the bulk of recreation and educational opportunities within the region. However, private lands and wildlife sanctuaries, such as the 112-acre Audubon Society of Portland campus and the OES March/Montclair wetlands complex, also make a substantial contribution to the region's environmental education and recreation opportunities. Corporate parks, with associated natural areas, provide passive and active recreational opportunities for workers while enhancing the overall workplace environment.

How does protecting fish and wildlife habitat affect public safety?

Land that provides functional fish and wildlife habitat is often located on steep slopes and on floodplains in the urban area, since those lands pose more difficulties to develop. Protecting vegetative cover in these areas may reduce public safety hazards like landslides and floods. However, negative impacts of protecting or increasing trees and vegetative cover include possible increased risk of wildfires and increased numbers of undesirable species. Fish and wildlife habitat may also have an impact on reducing crime and violence.

Flooding and landslides

Trees and vegetative cover provide slope stability, prevent stream bank erosion, and allow for permeable soils to absorb and hold floodwaters, while conserving fish and wildlife habitat. Any conservation and restoration of habitat lands would likewise help with the prevention of natural and environmental hazards such as landslides, flooding, stormwater runoff, and erosion. The costs to property owners and insurance companies from landslides, flooding, and erosion can be significant if development is not carefully engineered; even then downstream properties may be affected by vegetative clearance or surface runoff. Thus, habitat conservation provides social benefits to property owners and communities that are located in higher risk locations.

Goal 7 of the Statewide Planning Goals requires local governments to reduce risk from natural hazards. The rule states that "local governments shall adopt comprehensive plans (inventories, policies and implementing measures) to reduce risk to people and property from natural hazards." Approximately 28 percent of the vacant, buildable land in Metro's inventory is environmentally constrained. The fish and wildlife inventory represents ecosystem functions and biodiversity in the region, and environmental constraints represent hazards and safety protection (e.g., floods, landslides, and water quality). This convergence of functions illustrates multiple benefits from habitat protection – preventing natural hazards and protecting fish and wildlife habitat. It also demonstrates that much of the remaining fish and wildlife habitat is located in the more difficult to develop areas.

Wildfires and windstorms

Besides flooding and landslides, wildfires are another type of natural hazard. Urban wildfires are risks for property owners associated with dry trees, brush, and vegetation in close proximity to built structures that in drought conditions or hot summer weather. Managing fish and wildlife habitat to encourage native vegetative cover while also managing for any fire hazard is a balancing act. The risks would be less in cool, moist riparian areas than the drier upland habitats. Spatial buffering could minimize risks to people and structures. Trees intermingled with houses, businesses, roads, and utility lines can pose hazards in windstorms as well.

Nuisance species

Preserving fish and wildlife habitat could allow nuisance species to continue to live in proximity to people. However, several species have adapted to live in the most urban environments and are likely to stay, such as raccoons and opossums. Wetlands and areas of standing water allow mosquitoes to breed and may contribute to diseases such as the West Nile virus. However, if wetlands are healthy the natural ecosystem controls mosquito populations (Scheirer 1994, Ladd and Frankenberger 2003).

Crime and violent behavior

The presence of trees and grass can lower the incidence of aggression and violent behavior, as was found by Bill Sullivan and Francis Kuo in a study of residents of public housing in Chicago (Kuo and Sullivan 2001a). Greenery reduces mental fatigue, which allows for more positive interactions between people. Neighborhood green areas can also increase community ties and support networks (Kuo et al. 1998). Additionally, tree canopy (as opposed to dense shrubs) in urban areas may actually reduce crime (Kuo and Sullivan 2001b). The study found that, compared with apartment buildings that had little or no vegetation, buildings with high levels of greenery had 52 percent fewer total crimes, including 48 percent fewer property crimes and 56 percent fewer violent crimes.

What are the social impacts of protecting fish and wildlife habitat on the land supply?

The urban land supply is a representative social issue because it relates to people's basic needs for housing, jobs and urban services. A constriction of the existing land supply could negatively affect the social needs these lands serve (e.g., housing and employment). An urban growth boundary (UGB) expansion could offset the impacts, but the urbanizing rural land spreads the development pattern further towards the periphery of the region. This could increase travel times[42] and congestion and could encroach further on fish and wildlife habitat in rural areas.

Metro's fish and wildlife habitat inventory covers developed, vacant, and buildable land. (See *Conflicting Use* chapter for more information.) If there are changes to the regional land supply, the Goal 5 rule allows governments to meet competing needs by compensating for reductions in the buildable land inventory. The rule states that a government shall:

> (a) Amend its urban growth boundary to provide additional buildable lands sufficient to compensate for the loss of buildable lands caused by application of Goal 5;
> (b) Redesignate other land [inside the UGB] to replace identified land needs… (OAR 660-23-070(1)).

[42] Please see this report's *Energy Consequences Analysis* chapter for more description of the impacts of urbanizing rural land.

One of Metro's key tasks is the identification of buildable land, which defines where new development can occur. The buildable land supply influences housing availability and affordability, employment, and manufacturing locations. It also influences transportation system planning and general accessibility, along with public facility siting (e.g., cultural centers, schools, utility, and maintenance facilities). Land supply also affects public capital expenditures as urban services are spread out over larger areas.

Vacant land, redevelopable land, and infill sites provide the basis for housing and employment growth in the region. All vacant land is not considered *buildable*. Some of it is environmentally constrained (Title 3 lands in floodplains and adjacent steep slopes), and some is in public ownership and serves other needs (e.g., schools, parks, utility easements). The buildable land inventory is reviewed periodically to ensure that there is an adequate 20-year supply to meet forecasted housing and employment demand.[43]

Whether protection of fish and wildlife habitat will constrain buildable lands will not be determined until a program option is chosen. The Goal 5 rule allows for a range of approaches to conflicting uses: development may continue, be limited in some manner, or be prohibited in certain areas. Consistent with Metro's existing policies to protect water quality and floodplains, the assumption is that habitat protection may restrict design and management on some lands but will not prevent all development in order to prevent regulatory takings. Potential social impacts of constraining the land supply are described below.

Housing opportunities and affordability

Residential zones make up the largest component of buildable land in the fish and wildlife habitat inventory. Approximately 60 percent of the vacant, buildable habitat within the urban growth boundary is zoned residential,[44] and of that 66 percent is not environmentally constrained. Thus, the residential buildable land supply appears to be the most sensitive to possible impacts of fish and wildlife habitat protection.

The types of housing opportunities available may change depending on habitat protection. Rather than reduce the number of housing units allowed on a lot, regulations may allow for the same units in a denser configuration, such as rowhouses, condominiums, or apartments. Clustering units on smaller lots in a subdivision may allow fish and wildlife habitat to be preserved. These potential changes have social impacts. Many people who might choose to purchase or rent a single-family home with a large yard will not view these other housing options as equivalent. The location of the housing is important as well. Housing opportunities closer to existing employment, shopping, and entertainment will not be replaced by residentially zoned land in areas on the urban fringe.

Housing affordability may be affected if protecting fish and wildlife habitat results in changes to the land supply. Some studies have shown that maintaining an urban growth boundary and limiting the supply of buildable land increase the cost of housing (Staley and Mildner 1999). Further limits to the land supply may cause a commensurate increase in housing costs. However,

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[43] Buildable lands are described in December 1999 Update to the Technical Appendix to the Urban Growth Report.
[44] SFR: 56%, MFR: 4%

another recent study found that market demand, not land constraints or growth management policies, is the primary determinant of housing prices (Nelson et. al 2002). In some instances denser housing is more affordable than large-lot single-family homes, so that policies supporting increased density may result in lower housing costs. Housing developed on the periphery of the region may or may not be affordable, depending on the costs involved in bringing urban services to new areas. Limiting or prohibiting conflicting uses could have a negative impact on housing affordability but may not, depending on the type of development allowed and other market forces.

Impacts on quantity and nature of employment opportunities

Employment opportunities typically occur on land that is zoned for commercial, industrial, or institutional uses. Vacant land zoned for commercial, industrial, or mixed-use development makes up 28 percent of the land within the fish and wildlife habitat inventory, and almost half is not environmentally constrained. Development of these uses on land containing fish and wildlife habitat can sometimes occur in such a way that some or most of the habitat functional value is retained.

The location of these lands is an important factor in determining the social impact of allowing, limiting, or prohibiting use in these areas. Metro is able to add land to the UGB if employment capacities are reduced due to habitat protection. However, it is important to consider the social impacts of adding employment land on the urban fringe. Will job opportunities located in newly developed areas be equivalent to lost opportunities located near existing concentrations of housing? Residents choosing to work in locations further from their homes will incur additional travel expenses as well as a reduction in quality of life due to more time spent commuting and away from home. Additionally, the types of jobs may be different, as a company that might choose to locate in an existing commercial or industrial area may not choose to move to a new location.

How does protecting fish and wildlife habitat affect property rights (private and public)?

Metro's Goal 5 fish and wildlife habitat inventory covers both public and private land. Habitat coincides with residential, commercial, and industrial property as well as with public land such as parks, greenspaces, schools, and public facilities. Property ownership and land use regulations are sensitive issues that are central to habitat protection. Property is subject to law and review by people and social institutions concerned with the use of land. Changes to property use are negotiated in this public-private dynamic.

Natural resource stewardship exacerbates the question of government oversight because ecosystems cross property lines and jurisdictional boundaries. Ecosystem continuity is one criterion for successful environmental stewardship, and this larger view tends to reside with public sector planning and oversight. Government has a responsibility to uphold the public trust, including the protection of valued public resources, once identified and agreed upon.

Property owners have many concerns about regulations limiting development on their land. People purchase a property with the expectation of a certain use; thus regulatory certainty is an important factor. A change in regulations affecting land development and use could have an economic impact, but there is also a social aspect relating to individuals' perceptions of their rights and roles in our society. Restrictions on the use of property can also contribute to feelings of political alienation and may cause people to invest in property or businesses elsewhere.

Americans have a history of strong individual property rights

Property is considered by many to be one of the basic institutions of human society, similar to family and religion. In America the rights that come along with owning a piece of property have been especially revered. Many people believe that individual property owners should determine the most appropriate and beneficial use of their property. These beliefs date back to frontier times in America, when land was conquered and tamed.

The legal concept of property consists of a number of rights that are guaranteed by the government (Sargent et. al 1991). A common idiomatic description of property rights is the reference to a "bundle of sticks," where each stick represents rights the owner has in regard to the land. Some sticks are reserved by the government, such as the right to tax and the right to control the type of private use on the land (Meyer 2001). Conferred rights depend on public oversight and responsibilities associated with land ownership. The benefits, agreements, and responsibilities tied to property are varied and are negotiated over time by law and public policy. There are also informal cultural aspects of property such as status conferred by property, how property is kept, and related social conduct by property owners.

Land ownership issues are complex because individuals have expectations of what they can do with their land while society at large has expectations of how land should be managed.[45] Environmental conservation and natural resource scarcity are two examples of how common issues affect both public and private property interests. Natural resource protection, for the sake of the public good, has become a factor in the debate about land use and resource management, which involves multiple types of property and uses. However, many residents of the region consider unregulated ownership of property (or as few regulations as possible) to be important. Thus, if Metro were to implement regulations to limit or prohibit conflicting uses in identified fish and wildlife habitat, such limitations on the activities of a private property owner would have a social impact on those property owners and other citizens who feel strongly about the rights of private property owners to use their property as they see fit, unfettered by government regulation.

Takings

The "Takings Clause" of the Fifth Amendment to the U.S. Constitution provides that private property shall not be taken for public use without just compensation. This clause was part of the U.S. Constitution as initially ratified, and it represents a bedrock principle of American law. Article I, section 18 of the Oregon Constitution contains a similar requirement. Not many people

[45] Property rights are a function of what others are willing to acknowledge. A property owner's actions are limited by the expectations and rights of other people, as formally sanctioned and sustained in law (Meyer 2001).

would disagree that if the government physically takes private property and puts it to public use, to build a road, for example, the landowner should be justly compensated for the value of the property that was taken. This is normally done through a condemnation procedure. A more difficult question arises, however, when the government does not physically confiscate property but rather regulates how private citizens may use their property. The U.S. Supreme Court has issued numerous decisions interpreting and refining the meaning of the federal Takings Clause in the context of such alleged "regulatory takings."[46] Such jurisprudence makes it clear that the meaning of the Takings Clause in the context of regulatory takings is still vigorously and passionately debated.

In 2000, this issue was put before the people of Oregon in the form of Ballot Measure 7. Measure 7 asked if property owners should be compensated for any decrease in the market value of their property caused by the imposition of new governmental regulations. The measure passed, but the Oregon Supreme Court later overturned the measure on procedural grounds (it had not been adopted as required by the Oregon Constitution). A recent report by the City Club of Portland on ballot Measure 7 (from the 2000 election) addressed regulatory takings. The report suggests that compensation to property owners is reasonable at a certain agreed-upon threshold of regulatory appropriation, as it relates to existing allowed uses (not anticipated or speculative uses). The report suggests government is accountable for its regulatory impacts and should estimate these impacts and make exceptions when unfair burdens exist (City Club of Portland 2002).

Thus, in summary, it is clear that people have strong feelings about the takings issue; feelings that go beyond concern about a loss in the economic value of property. There are people who believe, for example, that the *Dolan v. City of Tigard* decision should be interpreted to require the government to compensate any landowner whose ability to develop their property is at all limited by a government regulation. Others legally dispute that interpretation, and a legal recitation of the interpretation of Supreme Court cases is inappropriate in this analysis. The point of raising this issue is that it goes to the question of individual rights in our society and the relationship between individuals and government. Some who believe that more compensation should be provided when the government regulates the use of private property might feel alienated from government when courts have ruled that certain regulations do not constitute compensable takings. Put another way, if regulations are imposed that may decrease property owners' freedom to use their property as they wish, some will believe that the government has "taken" their property, regardless of whether a court would find that such an action was a constitutional "taking" for which they should be compensated.

If the Metro Council chooses to limit or prohibit conflicting uses on some fish and wildlife habitat, a program to protect these areas will be developed in such a way that a legal taking does not occur, similar to current regulations to protect water quality and prevent flooding (Title 3). However, many landowners believe that additional regulations require compensation, and that a regulatory program should also include incentives.

[46] See, e.g., *Agins v. Tiburon*, *Nollan v. California Coastal Commission*, *Dolan v. City of Tigard*, *Penn Central Transp. Co. v. New York City*, *Lucas v. South Carolina Coastal Council*, and *Palazzolo v. Rhode Island*; see also *Dodd v. Hood River County* (9th Circuit decision).

Personal financial security

Real property is one of the largest economic investments many people make and is an important and sensitive social issue. Property represents issues of security, income, housing, and employment opportunity. The ability to use land as it is zoned implies a social and economic purpose or right – perhaps described as certainty or security. Private investment in property is tied to a potential income stream or return on investment, which usually results from a combination of local plans and development conditions, general market conditions, upkeep, and improvements. Investors in property seek clarity about the regulatory framework. Regulations that result in reductions to property value may affect people's ability to draw on the equity in their homes to fund retirement, education, and other activities. Thus, limiting or prohibiting conflicting uses, if it results in reduced property values, can have a negative social impact.

At the same time, because property overlaps with and can affect natural resource systems – land, water, air, ecosystems – property is also tied to common goods which are needed and valued by society at large as well as by individuals. The impact of natural areas on quality of life, property values, and regional attractiveness is an economic consideration as well. For example, local studies (Lutzenhiser and Netusil 2001, Bolitzer and Netusil 2000) have shown that proximity to some types of natural areas actually increase property values, thus preservation of these habitats could positively impact nearby property owners. Private individuals and firms can capture the value of location, such as nearby parks, open space or schools, or good accessibility to services or transportation infrastructure. This results in higher demand and higher dollar valuation of these properties. On the other hand, public parks, schools, highways, and other perceived amenities capture individual or commercial value by the usage, time, and willingness of people to pay for them. Negative impacts such as congestion, noise, nuisance, crime, pollution, or diminished natural features can affect adjacent property values as well as the community.

Distribution of benefits and burdens

When a community makes habitat allocation decisions, social equity issues and questions of policy fairness may arise. There are several social equity considerations. Who may be affected if fish and wildlife habitat identified in the inventory is protected? Who benefits, and who is burdened by a habitat protection program? If some property owners are burdened, is the benefit gained commensurate with the burdens on property owners? The affected parties could include individual property owners, families, and businesses as well as other entities such as public agencies, non-profits, and community organizations.

Fish and wildlife habitat is fixed in location at a given point in time; therefore, the distribution of the assets and liabilities resulting from the habitat is inherently uneven. Uneven distribution of the habitat is not in itself an inequity, since these natural assets were not publicly allocated in the past and cannot be reallocated at present. The habitat exists in nature, is partially attributable to historic development trends, and is a feature of the landscape today. If Metro were to develop a plan to restore or acquire fish and wildlife habitat and thus invest publicly in conserving these areas, then social equity concerns might arise. Currently, distributive concerns are minimized because of the fixed character of the habitat and the lack of funds to develop restoration or acquisition programs targeted to the fish and wildlife habitat inventory.

Public access to many of the fish and wildlife habitat inventory sites identified by Metro is limited, and public benefits are more indirect than direct. Indirect public benefits are derived from the value of maintaining biodiversity in the region and from general environmental health and water quality improvements. The more direct benefits of being located near fish and wildlife habitat accrue to those nearby. While streams and rivers are a public resource, streamside property owners benefit more from actions taken to protect and enhance stream health. Those same property owners may "pay" for their location with the increased risk of flooding and sometimes additional regulations to maintain the public values of the habitat. Amenity values[47] that benefit property owners may be considered as offsets against burdens these same owners may face in shouldering the responsibility of conserving these resources.

Fish and wildlife habitat can add value to property (Bolitzer and Netusil 2000) and is related to the demand for these locations. On the other hand, if the fish and wildlife habitat substantially hinders development of the property or acts as a nuisance, then there are inequities to consider. If the benefits and burdens are relatively equal, then some of the equity issues may be neutral.

The property owners most affected by a decision to limit or prohibit conflicting uses are single-family residential (46 percent), followed by industrial land (14 percent). However, developed land is likely to be less affected than vacant land.[48] All residents of the region will benefit from the retention of fish and wildlife habitat, even though public access may be unavailable on all but publicly owned land. The benefits arising from protecting fish and wildlife habitat have been described throughout this social analysis. Thus, the burden may fall disproportionately on one group of property owners to provide the benefit for the common good. A protection program that includes incentives and carefully considers the impact of regulations may reduce the burden on the selected property owners.

Public property rights

Ownership of property is defined as an aggregate of rights that are guaranteed and protected by the government. However, the government retains some rights in trust for the people. For example, environmental quality and fish and wildlife habitat are not owned by anyone. They are public resources that the government can act to preserve, which is the concept of the public trust doctrine.

For example, the public has a right to clean air and water. Landowner actions on private land affect the quality of both air and water. Therefore, government regulations at the federal level have been developed to protect public rights through the Clean Air Act and the Clean Water Act. Similarly, fish and wildlife are important natural resources that typically cross legal boundaries, moving from one property to another. An individual does not own the wildlife that inhabits or crosses his or her land (*Geer v. Connecticut* 1896). If society has identified specific species of fish or wildlife as important to protect, through the Endangered Species Act or other means, then a government has the responsibility to act to maintain the species in trust for the people.

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[47] See *Economic Consequences Analysis* for more description of amenity values.
[48] Developed land: single family, 37 percent; industrial, 34 percent. See *Conflicting Uses* chapter for more data.

In law, the public trust doctrine serves as a foundation of the public's right for common use and access of public resources (although this doctrine has traditionally been restricted to the interpretation of navigable waterways and tidelands). The public trust doctrine can theoretically be applied to all public trust resources. Private individuals do not own public trust resources. The Oregon beaches are one example of a public trust resource. The Oregon legislature affirmed the public's right to access or use of a common area (the beach) on Oregon's coast (between low tide and the line of vegetation defined in ORS 390.770) even if privately owned. This is not so much about a right of public access as about the responsibility to preserve the associated public value (availability of that experience) inherent to this unique coastal environment (Oregon Department of Land Conservation and Development 2003a, "Beach Bill"). Access is not required to protect a public trust resource. Protecting air and water quality or wildlife, while affecting private property rights, does not require providing public access to private land.

Controversy and legal conflicts are likely regarding the differences in public trust assertions and private right claims when these concepts overlap in policy making, such as with developing a program to protect regionally significant fish and wildlife habitat. Establishing the value of these habitats from both a public and private perspective is important in identifying the social concerns of protecting fish and wildlife habitat.

What fish and wildlife habitat will we leave for future generations to enjoy in the Metro region?

Sustainable development and other social movements by local, national and international groups have fostered a new urgency in planning and development. Interdisciplinary thinking seeks to reconcile natural resources, human needs, social responsibility, and ethics. Preserving biodiversity has an intrinsic value as well as a potential future value with regard to science, health, cultural heritage, and the economy. The overarching message of social-environmental policy is human interdependence with the natural world. Resource scarcity and environmental degradation temper production and consumption patterns around the world. This new social awareness leads to shifts in how growth and development occur, from the workplace to people's backyards.

Social values that support society's interdependence with nature, as opposed to control over nature, indicate an awareness of the biophysical limits of the environment. While everyone does not adhere to sustainable development's goal of a moral obligation to preserve the natural world, some see this as recognition of deeper social values that extend to future generations. The U.S. Conference of Catholic Bishops (USCCB) states that

> …[W]e simply cannot leave this problem for the children of tomorrow. As stewards of their heritage, we have an obligation to respect their dignity and to pass on their natural inheritance, so that their lives are protected and, if possible, made better than our own. (USCCB 2001)

Resource dependency is a defining characteristic of living systems. An essential challenge for modern development is how to design and manage for humanity's interdependence with nature. This is not just an ecological, engineering, or market question; it is also increasingly a social and policy issue. Attention to human-induced environmental problems has emerged as a result of our increased population, resource scarcity, waste generation and the combined effects on health and long-term survival. In urban metropolitan areas these effects can be seen with growth: more people, more pollution, and a scarcity of open space (Donnelley 1998, Lange 2003, Lazaroff 2003, McClure 2003).

Intergenerational equity

How do people manage for environmental stability, health, and the integrity of the planet's ecosystem for future generations? The interdependency of people and nature is a reciprocal relationship. Feedback or awareness is key to the stability of the ecosystem. Sustainable development embraces this idea. It has captured the common sense notion of moderation, of realizing that biophysical limits exist and exercising caution with resources that may not be easily replenished. This current awareness extends to monitoring the most basic ecosystem attributes, such as climate conditions, air, water and soil quality, and species diversity.

Originally written 30 years ago, the Oregon Statewide Planning goals repeatedly cite "carrying capacity"[49] when assessing development and impacts on the environment. The following two phrases are repeated as considerations in nine planning guidelines (for natural resources, air and water quality, natural hazards, recreation, economic development, housing, public facilities, transportation, and urbanization):

> Plans … should consider as a major determinant the carrying capacity of the air, land and water resources of the planning area. The land conservation and development actions provided by such plans should not exceed the carrying capacity of such resources. (Oregon Department of Land Conservation and Development 2003b)

These are general parameters of evaluation and specific application of this principle is often hard to estimate. As more attention is paid to sustainability, renewed attention to what carrying capacity means becomes relevant. A decision to limit or prohibit conflicting uses in fish and wildlife habitat areas meets the social goal of retaining natural resources for future generations to enjoy.

What are the potential social consequences of allowing, limiting, or prohibiting conflicting uses?

The Goal 5 process requires local governments to make a decision to allow, limit, or prohibit conflicting uses to protect fish and wildlife habitat based on balancing the consequences of the four ESEE factors. A description of what it might mean to allow, limit, or prohibit conflicting uses is described in the Chapter 3, *Conflicting Uses*. The social consequences analysis is limited by the hypothetical context of policy changes. In general, the social considerations as they relate to specific property development are focused on people's rights and interests in effecting policy and on the value people place on the long-term existence of fish and wildlife habitat. Below is a general description of the social impacts of allowing, limiting or prohibiting conflicting uses, a

[49] *Carrying capacity* as defined by DLCD: Level of use which can be accommodated and continued without irreversible impairment of natural resources productivity, the ecosystem and the quality of air, land and water resources.

summary of the differences of the consequences by regional zone, and the key points learned from the social analysis. Several matrices relating the social impacts to Metro's generalized regional zones may be found in Appendix D.

Potential social consequences

Allow conflicting uses

A decision to allow conflicting uses in fish and wildlife habitat areas would have positive and negative social consequences. Property owners would not be concerned about impacts to property rights, there would be no takings issues, and the burden of protecting fish and wildlife habitat would be equally distributed. For residential land in particular, there might not be a change in personal financial security or the right to maintain and develop land within the existing regulatory framework. There would be no change in the number or type of housing options, and housing affordability might not be affected. Industrial landowners could continue to develop using land intensive practices. Employment opportunities under current zoning might not change. Additionally, less fish and wildlife habitat might mean a decreased risk of urban wildfires and nuisance species.

However, a decision to allow conflicting uses would have several negative impacts. The fish and wildlife habitat that forms a major portion of our cultural heritage, sense of place, and regional identity might be eroded and possibly lost. The salmon that are so important to Native American culture and the heritage of the Pacific Northwest would stand less of a chance of surviving. Some property owners might be concerned that property values would diminish due to potential loss of nearby natural areas. Public health could suffer due to poor air and water quality, fewer recreational opportunities, reduction in opportunities for mentally restorative nature visits, and possibly higher levels of aggression and violence. Opportunities for children and adults to learn about the environment specifically and to integrate environmental learning with traditional subjects to form a cohesive approach would be lost. Loss of tree canopy and vegetation could increase the risk of floods and landslides. Fewer companies might locate to this region if the quality of life and outdoor recreation are negatively affected. An allow decision would not provide for intergenerational equity, since people today would not be saving fish and wildlife habitat for future generations to enjoy.

Limit conflicting uses

A decision to limit conflicting uses in fish and wildlife habitat areas would be a compromise, attempting to minimize the negative social impacts of either allowing or prohibiting conflicting uses. If development occurred with minimal impact to the fish and wildlife habitat, social values could be maintained while reducing the effect on property owners. This type of approach could maintain housing and employment options while preserving as much habitat as possible. Some or most of our cultural heritage, neighborhood character, sense of place, and scenic values would be preserved. Negative impacts on public health could be reduced, and most educational opportunities could be retained. Benefits such as stress reduction, decrease in aggression and violent behavior, and positive impacts on mental health might not be lost. Salmon would be provided with more of a chance to recover and impacts on Native American culture and regional identity would be lessened. Risk of floods and landslides would be reduced, and there would be more intergenerational equity. However, an increase in habitat could result in more urban wildfires and nuisance species. Regulations limiting conflicting uses might not be equitably distributed among property owners, and there may be impacts on property rights as well as takings concerns.

Prohibit conflicting uses
A decision to prohibit conflicting uses in fish and wildlife habitat areas would preserve all of the important social values and public benefits provided by habitat described above. However, such regulations would result in an unequal distribution of burden among property owners, with a negative impact on property rights. Takings concerns would likely become an issue. While property owners with existing homes might not be affected, vacant land might not be allowed to develop in the same way as currently allowed. Housing and employment options might be reduced, with a resulting need to increase densities or expand the urban growth boundary. More land would be needed to meet housing and employment demand if conflicting uses were prohibited on additional land within the urban growth boundary.

Social consequences by generalized regional zone

Most of the social consequences are similar across zones (matrices describing the consequences may be found in Appendix D); the differences are identified below.

- **Single-family residential (SFR):** For single-family uses, a decision to allow could maintain personal financial security (equity) if property values are not affected. A limit or prohibit decision might reduce options for large lot homes if they are allowed under current zoning. However, in some instances larger lots could reduce the impact on fish and wildlife habitat and could be allowed under a limit decision, depending on the type of program.
- **Multi-family residential (MFR):** A limit or prohibit decision may reduce opportunities to develop at high densities in fish and wildlife habitat areas. This could affect property owners by reducing the number of units that could be built on a specific property, reducing development potential. However, a program could be designed to minimize the impact by allowing clustered development or transferring density.
- **Mixed-use centers (MUC):** An allow decision would have no impact on current 2040 densities or development in centers, supporting the achievement of the 2040 Growth Concept. A limit or prohibit decision may impact achievement of the 2040 Growth Concept by curtailing growth in centers, depending on the type of program implemented.
- **Commercial (COM) & Industrial (IND):** For commercial and industrial land the most important social consequence of a limit or prohibit decision is the potential to impact job creation and the location of future jobs.
- **Rural (RUR):** In rural areas the focus is on the future opportunities for housing and employment that could be minimized when the land is urbanized.
- **Parks and open space (POS):** An allow decision would maintain or increase opportunities for active recreation, while a decision to limit or prohibit could reduce opportunities for active recreation, depending on the program.

Summary points

- Protection of fish and wildlife habitat preserves many important social values. These include our cultural heritage, regional identity, sense of place, and neighborhood character. Property owners may also benefit from the retention of fish and wildlife habitat through increased property values. Opportunities for education abound in areas with healthy fish and wildlife habitat.

- The distribution of the regulatory burden on property owners to protect fish and wildlife habitat for the general public benefit is a critical social concern. Private property rights are a fundamental cornerstone of American life, and additional regulations reducing development rights may be seen as an attack on personal financial security as well as a possible taking. However, there are public rights to clean air and water, as well as healthy fish and wildlife, which serve as a counterbalance to this view.
- Fish and wildlife habitat provide positive benefits to public health and safety, but there are some negative effects. There are many obvious benefits of recreation, as well as the mental health and stress relief found in nature. Additionally, minimizing the incidence of flooding and erosion contributes to public safety. However, increased forest canopy and vegetation could lead to wildfire risks and potential damage from windstorms.
- People today have a responsibility to provide future generations with some of the same benefits that current residents enjoy. Sustainable development practices allow for development to occur today while maintaining a certain amount of intergenerational equity.

CHAPTER 6: ENVIRONMENTAL CONSEQUENCES

Introduction

Urban areas are, by their nature, heavily impacted by human activities. In turn, humans are part of the ecosystem in which they live, and human welfare ultimately depends in part on the vital services, such as shade, fresh air and clean water, provided by natural resources. The urban growth boundary (UGB) designates a limit to physical expansion of the urban area; to contain the negative ecological effects associated with urban sprawl and to protect valuable forest and agricultural lands. The UGB is effective at this: current aerial photographs clearly show that more natural resources and farmland remain outside the UGB than within it.

What are the consequences to regionally significant fish and wildlife habitat of allowing, limiting, or prohibiting land uses that conflict with habitat functions? Full protection of remaining fish and wildlife habitat will preserve existing habitat functions. Fully allowing conflicting uses in fish and wildlife habitat will reduce or remove existing ecological functions, with associated negative impacts on fish, wildlife and people. However, consequences for the broadest category – limiting conflicting uses within fish and wildlife habitat – depend on the definition of limit. Limiting conflicting uses implies that some limited amount of development or other conflicting use(s) will occur in conflict with fish and wildlife habitat areas. The consequences depend on the extent and type of land use and the habitat's ecological importance in the regional system, influenced by the program selected in the next phase of the Goal 5 process. Figure 6-1 provides a general illustration of the potential environmental consequences of this decision process; actual consequences depend on the program selected and its implementation effectiveness.

Figure 6-1. Range of potential consequences of prohibiting, limiting, and allowing conflicting uses within fish and wildlife habitat.

Prohibit	***Limit***	***Allow***
• Preserve existing ecological functions	• Existing ecological functions impaired	• Existing ecological functions greatly impaired
• More native plants and animals	• Some increase in non-native species invasions	• Greatly increased non-native species invasions
• More biodiversity	• Some biodiversity loss	• Substantial biodiversity loss
• Retain existing stream network	• Some streams will be lost, but less than allow	• Substantial stream loss continues
• Good restoration potential	• Good restoration potential	• Poor restoration potential
• Flood frequency, magnitude maintained as is possible	• Flooding increased compared to prohibit	• Flooding substantially increased
• Soil loss continues at current level	• Increased soil loss, sedimentation	• Very damaging soil loss, sedimentation
• Possibly retain salmon	• Salmon decline further	• Probable salmon loss
• Possible environmental threat due to greater UGB expansions	• Possible environmental threat due to greater UGB expansions, but to a lesser degree than Prohibit	• Decreased need for future UGB expansions, reducing environmental threats to areas outside the UGB

This chapter addresses the following questions:

- What are the functions and values of the region's fish and wildlife habitat?
- What impacts do conflicting uses have on the region's fish, wildlife, and their habitats?
- What are the potential environmental consequences to fish and wildlife habitat of allowing, limiting, or prohibiting uses that conflict with habitat function?

What are the functions and values of the region's fish and wildlife habitat?

To assess the consequences of allowing, limiting or prohibiting conflicting uses on fish and wildlife habitat, it is important to first identify the ecological characteristics of healthy ecosystems. Metro's science paper characterized the attributes of healthy watersheds and functional values of fish and wildlife habitat (Metro 2002c), as summarized below:

Key ecological attributes that characterize a healthy watershed

- Vegetated uplands dominated by native plant cover.
- Continuous stream corridors, including headwater areas, with healthy, fully functioning riparian corridors. The fewer the disruptions within the riparian corridor, the better.
- Floodplains connected with stream and river channels.
- Relatively unaltered hydrologic regimes.[50]
- Intact hyporheic zones.[51]
- Clean water at temperatures suitable to support native wildlife.
- Natural (or ecologically sustainable) input rates of solar radiation, sediments, organic matter, and nutrients that support healthy, productive and diverse fish and wildlife populations.
- Lateral, longitudinal and vertical connections between ecosystem components.
- Natural (or ecologically sustainable) rates of landscape disturbances.
- Good air quality.[52]
- Healthy, uncompacted soils.
- Diverse biological communities.

Key functions and values of fish and wildlife habitat

- Key habitat functions in riparian corridors can be assigned to five main categories: microclimate and shade; streamflow moderation and water storage; bank stabilization and pollution control; large wood and channel dynamics; and organic material sources.
- Native vegetation plays a critical role in the longitudinal and lateral connectivity of the riparian corridor for fish and wildlife.
- Native vegetation supports more species of native wildlife than non-native vegetation.
- Downed wood and snags (or large woody debris), frequently found in natural ecosystems but often lacking in disturbed environments, are crucial to providing high quality habitat in both

[50] That is, natural drainage systems that route and deliver water in quantities and at rates similar to natural conditions.
[51] Retention of the natural intermixing of ground- and stream water.
[52] See Chapter 7, *Energy Consequences* for further discussion of air quality.

aquatic and terrestrial ecosystems. Large wood also influences natural channel dynamics.

- Conservation of the majority of water areas – wetlands, streams, groundwater, and near surface water areas (hyporheic zone) – is essential to ecosystem health.
- Appropriate buffers to retain key riparian corridor functions should be based on site-specific conditions.
- Upland habitat is important for many wildlife species. The guidelines in developing a conservation plan for upland habitat are: large habitat patches are better than small patches; small patches of unique habitat are worth saving; connectivity to other patches is important; and connectivity or proximity to water resources is valuable.
- Declining and unique habitats are vital to regional biodiversity, and should receive high conservation priority status.
- Habitat fragmentation is detrimental to both wildlife and habitat; buffers and surrounding land use play an important role in maintaining the functions of remaining habitat.
- Tree canopy provides important wildlife habitat and helps maintain air and water quality.

Metro's science paper (Metro 2002c) identifies the fish and wildlife species regularly supported by the region's existing wildlife habitat.

What impacts do conflicting uses have on the region's fish, wildlife, and their habitats?

In water and on land, urban environments share similar ecological problems worldwide, including habitat loss, habitat damage and alteration, modified hydrology, non-native species, and human disturbance. Impacts with negative consequences to fish and wildlife habitat are both site-specific and ultimately, cumulative. For example, stream problems due to pollution may come from either point-source[53] or non-point source polluters.[54] Cumulative impacts provide a way to consider the combined influence of one type of action by many individuals.

Metro's role is to assess and address the cumulative impacts of development and other uses that conflict with fish and wildlife habitat at the regional level. The scientific literature and Metro's fieldwork (Frady et al. 2003) state that certain types of site-specific impacts tend to be associated with certain development types.[55]

In urban areas, cumulative impacts are pervasive and cause great environmental harm. It is often difficult to separate one cumulative impact category from another because they overlap and combine for harmful effects. For example, vegetation loss and increased impervious surfaces combine to alter natural hydrologic regimes. During rainstorms, these impacts cause too much water to enter the streams, too quickly. The result is damaged streambanks and streambeds with increased erosion; erosion adds sediments to the stream, and so forth. Problems such as these quickly become widespread in all urban areas. For the purposes of this analysis it is useful to cluster the primary consequences into eight general categories. Table 6-1 below lists each environmental consequence category and cross-references it with the conflicting uses identified

[53] Industrial or municipal wastewater discharge into a stream or river.
[54] All landowners using pesticides or all non-natural stormwater discharges within a watershed.
[55] This is discussed in more detail in the *Conflicting Use* chapter.

in the *Conflicting Uses* chapter. Following Table 6-1, each environmental consequence category is described more fully and the types of impacts associated with that category identified.[56]

Table 6-1. Cross-reference of the major environmental consequences categories and the conflicting uses associated with each category.

Potential consequences to fish and wildlife habitat	**Disturbance Activities (conflicting uses)**																
	Vegetative clearing	Grading, filling, soil compaction	Installation of impervious surfaces; runoff	Stream modification	Installation and maintenance of utilities	Stormwater piping, water control structures	Road construction, bridges, culverts	Landscaping, introduction of exotic plant species	Introduction of non-native fish and wildlife species	Herbicides, pesticides, fertilizer use	Installation of fences and other wildlife barriers	Introduction of toxics, heavy metals, pollutants	Water useage	Livestock grazing	Trail construction, maintenance and use	Allowing pets, livestock in natural resource areas	Human disturbance (e.g. light, noise)
Altered hydrology, physical stream damage, increased flooding	■	■	■	■	■	■	■	□	□	□		□	■	■	□	□	
Degraded water quality	■	■	■	■	■	■	■	■	□	■		■	■	■	■	■	
Loss/degradation of riparian or upland habitat	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Habitat fragmentation	■	■	■	■	■	■	■	■	□	□	■		□	■	□	□	■
Altered microclimate	■	■	■	■	■	■	■	□		□			■	■	□		■
Reduced woody debris and organic materials	■	□	■	■	■	■	■	■		□			□	■	□		
Erosion, sedimentation and soil loss	■	■	■	■	■	■	■	□		□			□	■	■	□	
Reduced biodiversity; non-native species invasions	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■

■ Conflicting use has potential for direct impact.
□ Conflicting use has potential for impacts, but at a reduced level or through indirect means.

Altered hydrology, physical stream damage, increased flooding

This category is listed first because it is an overarching issue in urban ecology. Activities typically associated with urbanization, especially vegetation removal, installation of impervious surfaces, and stormwater control (Table 6-1), fundamentally alter the patterns of rainwater delivery to streams and other waterbodies: too much water hits the stream too quickly. The result is physical damage to streams and an increase in flooding. Many adverse effects are documented due to hydrologic alterations, and some of these are listed in Table 6-2. Impaired

[56] For more in-depth discussions of these issues and relevant literature citations, see *Metro's Technical Report for Goal 5* (Metro 2002c).

water quality, addressed as a separate environmental consequence category, is also associated with altered hydrology, as are many other urban effects (see Table 6-1 above).

In the Metro region, much of the rainfall naturally seeps into the soil and makes its way to the stream only after much slowing and interception by soils, rocks, plants, and roots. Streams and the animals living there are adapted to these patterns; when the patterns change substantially, streams can no longer support some of these species, such as salmon and certain insects critical to instream food webs (McCarron et al. 1997; May and Horner 2000).

Development activities remove vegetation, add impervious surfaces, and often include intentional widening, deepening, straightening, and sometimes armoring streambanks to confine flows and increase a stream's capacity for localized flood control (although in fact, this practice increases flooding by altering the hydrology). These activities result in moving water more quickly downstream, disconnecting the stream from its floodplain and groundwater sources, degrading riparian habitat, and creating bigger floods and more problems downstream. To illustrate this concept, Figure 6-2 compares two hydrographs, a type of graph that charts the timing of runoff and peak flood stage. The "Q after" line shows a taller flood peak that occurs sooner, with more water being discharged via the stream than under natural conditions (Q before).

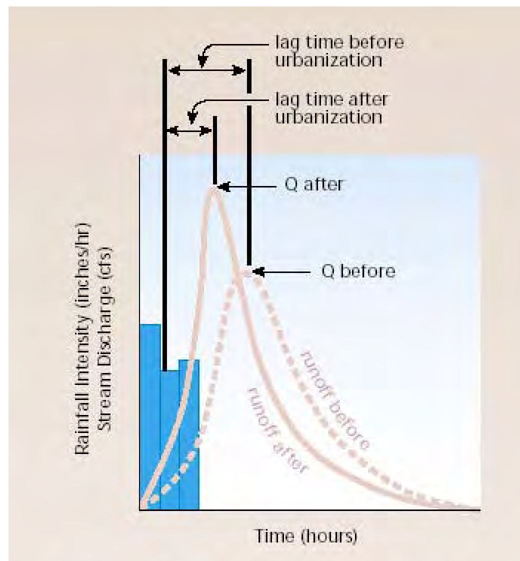

Figure 6-2. A comparison of hydrographs before and after urbanization.
(Source: FIRSWG 1988)

Altered hydrology damages stream channels and streambanks. Fast-moving, high-volume water quickly erodes away streambanks, incises (downcuts) stream channels, and increases sediment loads in the water and streambed. Stream channels widen and straighten, and are often intentionally modified in these ways, to accommodate increased stormwater velocity and volume due to altered hydrology. Large woody debris, ponds, pools, riffles, streambanks, and sandbars are simplified or washed away. The stream's substrate – that is, the particles making up the bottom of the streambed – tend to change from larger rocks to finer particles such as clay and silt; fine substrates are tightly packed, with little room for oxygen pockets or macroinvertebrates. Salmon need larger substrates for spawning, and they also need macroinvertebrates for food. These changes result in a loss of stream complexity and fish and wildlife habitat and degraded water quality downstream due to increased fine sediments in the channel and in the water column.

Altered hydrology causes increased flooding by affecting the frequency, duration and magnitude of flood events, and reducing water infiltration and storage (Booth and Jackson 1997). The frequency is altered in that more floods occur per year. Flood duration and severity tend to be increased. These flood characteristics are typically measured using a hydrograph; Figure 6-2 shows an example of the changes in flood patterns that occur with urbanization. The hydrograph's peak is taller and occurs sooner (a bigger flood that quickly overwhelms water storage) and the shape of the peak is narrower (the water is not retained on the land to replenish groundwater and keep summer streams running).

Altered hydrology complicates restoration efforts in an urban setting. Restoration has some limited ability to counteract these negative effects, but may be rendered ineffective if larger-scale issues such as stormwater, canopy cover, and imperviousness are not addressed. For example, placing large wood in a stream usually helps under more natural conditions, but if the stream is too flashy from altered hydrology it may wash away the wood and continue to widen, deepen, and damage the stream.

Table 6-2. Environmental consequences of altered hydrology, physical stream damage and increased flooding.

- Degraded riparian habitat, ecological function loss
- Decreased channel sinuosity (results in higher water velocity, increased discharge, increased flooding)
- Stream channel scouring, armoring, and changes in channel width and depth
- Streambank erosion and destabilization
- Downstream sedimentation and erosion
- Loss of riparian vegetation due to erosion, downcutting, disconnection with groundwater
- Loss of stream shading; higher water temperatures
- Altered microclimate
- Loss of riparian buffer filtration capacity
- Loss of hyporheic zone, groundwater
- Loss of large woody debris, instream complexity
- Loss of pool/riffle complexes and decreased streambed substrate size harms native fish and invertebrates
- Loss of ecosystem services provided by healthy watersheds: clean water, nutrient cycling, human food (salmon), water storage, flood abatement, summertime inflow/recharge of cool, clean water to streams, etc.
- Loss of critical food web components (macroinvertebrates, salmon, organic materials)
- Loss of sand bars, shorebird, and waterfowl habitat
- Loss of habitat heterogeneity; reduced instream and riparian structural and functional diversity
- Loss of native soil and native soil invertebrates
- Native aquatic and land-dwelling wildlife decline due to cumulative instream and terrestrial habitat degradation
- Reduced biodiversity

Degraded water quality

Urban areas are where human population densities are highest. Humans are the primary source of pollutants and excess nutrients, thus urbanized watersheds typically have elevated pollution levels and impaired water quality. However, many factors contribute to pollution, and some of these factors can be controlled or mitigated. Table 6-3 highlights some of the environmental consequences of degraded water quality.

Excess pollutants, increased temperatures, or excess sediments may degrade water quality. Sediments are addressed in a separate consequences category below (Erosion, sedimentation and soil loss). Pollution can destroy food webs within stream systems. Pollution includes excess fertilizers, pesticides and herbicides, heavy metals, and other toxins. Impervious surfaces collect and concentrate pollutants from different land use activities and deliver these materials to streams during storms, preventing percolation and natural filtering by soil and vegetation. Data collected in the Pacific Northwest suggest that pollution from urban areas is harming salmon, birds and some mammals such as river otters (Lower Columbia River Estuary Program [LCREP] 1999; McCarthy and Gale 1999). Human health is also an issue; eating fish and crayfish from polluted waters can cause serious illness.[57] For example, fish in the Columbia Slough contain PCBs and pesticides; these chemicals may effect human development, reproduction, and immune systems, and may increase the probability of contracting cancer (City of Portland 2003).

[57] See *Social Consequences* chapter for further discussion of public health issues.

Development type influences the pollutants entering stream systems. For example, *E. coli* derives primarily from residential areas (pets, leaking septic tanks, etc.), entering through runoff, stormwater and groundwater; this bacterium is an indicator of fecal pollution from warm-blooded animals (Oregon Department of Environmental Quality 1998). Sediments derive most frequently from industrial and residential streets; construction and agriculture are other major sediment sources.

Phosphorus derives from fertilizer applied to residential lawns, industrial streets, and residential streets, in that order, but also sometimes from natural geological sources and from air deposition (Don Yon, Oregon DEQ, personal communication 2003); elevated phosphorus levels are a common problem in our area. Excess nitrogen is typically associated with agricultural lands, but residential fertilizers are another source. Some of these nutrients are needed in waterways, but excess amounts cause unnaturally increased nutrients, leading to low-oxygen water conditions and other water quality problems.

Heavy metals in excess amounts are toxic to humans, fish and other wildlife. Heavy metals are often contributed by cars and trucks; brake pads, oil and tire wear are major sources (Engberg 1995; Baldwin et al. 2003). Copper is emerging as a major problem for salmon, and in urban areas derives primarily from brake pads (Baldwin et al. 2003). Industrial lands are also a source of heavy metals through both point- and nonpoint-sources, but residential roofs also contribute substantial amounts of copper and zinc.

Pesticides, from both the present and the past (e.g., DDT), are present in many of the region's streams. More pounds of pesticides per acre are applied in urban areas than agricultural areas (Stinson and Bromley 1991). Recent research suggests that pesticides at low levels have an additive harmful effect on stream-dwelling wildlife (Munn and Gilliom 2001). Pesticides harm fish and wildlife through a variety of means, including direct mortality, decreased reproductive capacity, loss of salmon navigation and defense abilities, and loss of macroinvertebrates, a key salmon food source.

Table 6-3. Environmental consequences of degraded water quality.

- Hazardous materials, toxics in waterways and on land
- Groundwater and well water contamination
- Toxic pesticide residuals may remain in soils, plants, groundwater, and surface water for decades
- Human toxicity, direct and indirect (drinking contaminated water, eating contaminated fish)
- Heavy metal contamination harms salmon
- Pesticides entering waterways kill or harm aquatic organisms; unintended kills to non-target organisms
- Loss of pollution-intolerant species; increase in tolerant generalist species, which out-compete sensitive species
- Toxin bioaccumulation; decrease in reproductive success (e.g., Bald Eagles, Osprey, salmon, otters)
- Pollution-associated chemical changes, growth impediments
- Decreased stream and wetland water quality; feeds into larger streams, rivers and degrades downstream quality
- Increased nutrients in streams and wetlands; excess algal growth, low oxygen conditions harm aquatic organisms
- Decrease in life-sustaining capacity of air, water, and land
- Impaired salmon olfactory responses and homing behavior
- E. coli, other bacterial contamination; human health risk
- Water temperature increases result in lower dissolved oxygen; harms temperature-sensitive aquatic organisms (e.g., salmon, macroinvertebrates)
- Reduced biodiversity

Other chemicals found in streams, soil and groundwater create a variety of health problems for humans, fish and wildlife. Oil and other hydrocarbons, PAHs (polycyclic aromatic hydrocarbons), PCBs, dioxins and furans, pesticides, and metals are the most toxic to fish and wildlife, based on both Lower Columbia River and Willamette River studies by DEQ, and these are also most prevalent in the region's waterways (Don Yon, personal communication 2003). These chemicals typically derive from vehicular use and industrial and residential uses, through both point- and nonpoint-sources.

Physical and chemical pollution is not the only important water quality issue; temperature is a key water quality issue in the Metro region (see *Appendix B*). Water temperature is an important indicator of a watershed's vitality because of its controlling influence on the metabolism, development and activity of aquatic organisms (Naiman et al. 1992). Cold water holds more oxygen; cold, well-oxygenated water is needed by many aquatic species. Increased water temperatures may have profound effects on aquatic species, such as salmon, that can tolerate only a limited temperature range natural to Pacific Northwest streams. Air temperature and riparian vegetation play key roles in maintaining lower water temperatures.[58]

Riparian vegetation helps keep stream and river water cool (Budd et al. 1987). Riparian vegetation is more effective in providing shade and moderating stream temperature in smaller streams. Shade also cools shallow groundwater that feeds the stream during dry summer periods. Although shading on larger rivers may have little influence on water temperature, overhanging riparian vegetation along the banks creates cooler microhabitat for fish and aquatic organisms, and shade from smaller tributaries supply cooler water to large rivers (Palone and Todd 1997). Removing vegetation, especially trees and shrubs, results in warmer stream and river water.

As described in Chapter 1, the Oregon DEQ is required by the federal Clean Water Act to maintain a list of steam segments that do not meet water quality standards, called the 303(d) list. Many of the region's stream reaches are 303(d) listed as water-quality impaired due to elevated temperatures (Appendix B). Elevated temperatures are typically due to a combination of riparian forest removal and an increase in pavement and other impervious surfaces, where water flowing across these heat-gathering surfaces is warmed. Fish and other aquatic wildlife are adapted to the naturally cool water conditions in the Metro region, and warmer water harms these animals.

Loss/degradation of fish and wildlife habitat

Vegetation loss through a variety of means harms fish and wildlife and their habitats. Habitat loss has been identified a key factor in the decline of biodiversity worldwide (Kerr and Currie 1995). Within this category, many actions contribute to cumulative impacts. The Metro region, once composed of vast forested expanses, now has only about 12 percent forest canopy cover remaining according to one recent report (American Forests 2001). Substantial losses (25 percent or more) of surface streams reduces riparian habitat, a vitally important habitat type to the region's wildlife (Metro 1999b). Table 6-4 highlights some of the environmental consequences of habitat loss and degradation.

However, substantially more forest canopy cover exists outside the UGB than within it, attesting

[58] See Chapter 7 *Energy Consequences* for more information.

to the success of the UGB in controlling some negative impacts due to urbanization at the macro scale. In addition, many areas within the Metro region are currently undergoing restoration and tree-planting activities that provide widespread benefits to fish, wildlife, and people through improvements to the environment. If this environmentally promising trend continues and accelerates, the region could potentially see ecological improvement over time, perhaps even with increased human population and development.

Table 6-4. Environmental consequences of fish and wildlife habitat loss and degradation.

- Altered watershed hydrology
- Increased flooding
- Erosion and soil loss throughout the watershed
- Increased downstream sedimentation and erosion
- Increased water velocity: stream incision, bank damage, loss of pool/riffle complexes, decreased substrate size
- Soil compaction; reduced water infiltration and storage
- Loss of fish and wildlife habitat
- Loss of habitat connectivity; fragmentation
- Reduction of structural and functional habitat diversity
- Shift in vegetation types or dominant plant species
- Shift to deciduous tree cover, with changes in wildlife, nutrient cycles, and reduced water storage capacity
- Increased adverse edge effects such as predation
- Increased edge-associated non-native species
- Loss of native vegetation in herbaceous, shrub, tree layers
- Loss of large woody debris and its sources
- Loss of native soil and native invertebrates
- Native aquatic wildlife declines due to cumulative instream and terrestrial habitat degradation
- Loss of stream shading
- Increased air temperatures (see Energy section, Urban Heat Island effect)
- Increased water temperatures
- Altered microclimate (warmer, drier air and soils)
- Loss of ecosystem services provided by plants (toxin and CO_2 uptake; O_2 release; water and carbon storage)
- Loss of riparian buffer pollution, sediment filtration capacity
- Loss of at-risk habitats
- Reduced biodiversity

Wildlife habitat is directly lost through development and other land use activities that remove trees and other vegetation. Habitat is degraded through a variety of activities, from site-specific to regional spatial scales. For example, at the site level, construction of a single-family residential home typically involves clearing vegetation, resulting in habitat loss. Lawns and other non-native vegetation replace native forests, resulting in a shift in plant species, leading to a shift in wildlife species. This is often to the detriment of native species and those species that rely on specific native habitat types such as grasslands, coniferous forests, or Oregon white oak habitat. During site preparation, soils are moved and compacted, altering soil profiles, fungus and microorganisms important to the success of native plant communities.

At a larger spatial scale, the effects of changes in vegetative cover can be observed through long-term species trends. For example, at-risk habitats in this region include riparian forests and grasslands, with substantial regional losses documented. Trends over the past three decades for many bird species that specialize in these habitats show precipitous declines.[59]

All other consequence categories interact with this consequence category. For example, altered hydrology results in the loss and degradation of aquatic/riparian areas; so do degraded water quality, habitat fragmentation, altered microclimate, loss of large wood, and erosion and soil

[59] For some examples of species declining in the Metro region, see Table 6 in *Metro's Technical Report for Goal 5* (Metro 2002c).

loss. This is because wildlife depends on natural resources to live, and natural resources rely to some degree on wildlife as well. For example, plants need insects for fertilization; plants provide insects with food and a place to live, hide, and reproduce. Nearly all bird species feed their young insects. Birds disperse the plant seeds pollinated by the insects, and also do some pollinating themselves (for example, hummingbirds).

Habitat fragmentation

As discussed above, large-scale vegetation loss impacts wildlife. What habitat remains typically becomes fragmented, with increased consequences to wildlife and habitat due to negative edge effects and loss of connectivity between habitats. Habitat fragmentation has been identified as a key factor in the decline of biodiversity worldwide (Kerr and Currie 1995). Table 6-5 highlights some of the environmental consequences of habitat fragmentation.

Fragmentation reduces or eliminates the structural and functional diversity of fish and wildlife habitat; it also alters microclimate, discussed below. The predominance of non-native species is a key problem accompanying habitat fragmentation, primarily due to adverse edge effects.[60]

Edge effects are the negative consequences to plant and wildlife communities due to positioning near the edge of a habitat patch. Edge effects include increased predation of birds and bird nests by native and non-native predators; increased non-native plant and animal species; simplified forest structure; and increased human disturbances (physical, light and noise) associated with activities near the edge of the patch (Soulé 1991; Lidicker and Koenig 1996; Bolger et al. 1997; Hennings and Edge 2003). Habitat fragmentation increases edge habitat, and edge effects.

Table 6-5. Environmental consequences of wildlife habitat fragmentation.

- Small remnant patches of habitat not connected to other natural vegetation
- Adverse edge effects due to non-native or invasive plants and animals
- Increased wildlife disturbance and mortality due to pets, humans and predators moving along patch edges
- Increased nest predation
- Degraded habitat quality due to reduction in invertebrate abundance and quality
- Loss of connectivity between habitat patches
- Gradual loss of species richness over time in disconnected habitat patches
- Loss of population gene flow and genetic diversity
- "Edge" species benefit, while forest-interior or area-sensitive species decline or are lost
- Impassable barriers and mortality to wildlife (e.g., roads)
- Increases in roads and pathways (major disturbance and invasive species vectors)
- Vegetation trampling, soil compaction and tree root zone disturbance; increased tree wind-throw and death
- Loss of/harm to those species relying on a specific habitat type to meet their life-history needs
- Loss of/harm to disturbance-sensitive wildlife species (e.g., Neotropical migratory songbirds, bats, shorebirds)
- Noise/light pollution require fish and wildlife habitat quality
- Reduced biodiversity

Fragmentation and habitat isolation is also a problem because some wildlife species, such as amphibians, have small home ranges and cannot travel as freely as birds and mammals (Corn and Bury 1989; Richter and Azous 1995). Once a species disappears from a habitat patch, there may

[60] Non-native species are discussed further under the section below entitled "Reduced biodiversity and non-native species invasions."

be no way for more individuals of that species to move back in and repopulate the patch, causing regional species losses over time. All types of development can cause habitat loss and fragmentation, and fragmentation occurs in all types of habitat – streams, wetlands, riparian, and upland wildlife habitats. When large-scale habitat loss occurs, an ecosystem can no longer support as much wildlife as it once did (Wilcox and Murphy 1985; Bolger et al. 1997).

It is possible to reduce the adverse effects of fragmentation by planning the size, shape, and connectivity of remaining natural areas (Soulé 1991) and Metro built these important characteristics into the wildlife habitat model.[61]

In areas with extensive habitat loss typical of urban areas, it is important to plan for larger habitat patches and connectivity among patches wherever possible. Narrow habitat patches such as those along developed streams are critical to migratory wildlife such as Neotropical migratory birds, known to be at risk in the Metro area (Hennings and Edge 2003). Neotropical migrants are bird species that breed in the Metro region, but migrate south of the U.S./Mexico border to overwinter.[62] A system that contains large and medium sized habitat patches, connected by narrower corridors and nearby smaller patches is desirable.

The amount of human disturbance to wildlife is related to habitat fragmentation. Human disturbance can occur anywhere in urban areas, but within wildlife habitat patches these disturbances are typically concentrated in or near edge habitats. Road, noise, lights, and human activity[63] can all have detrimental effects on fish and wildlife and their habitats.

Noise can disrupt wildlife movement by distracting animals or by causing them to move away from the noise source, which can affect migration, breeding and nesting habits, as well as effectively reducing available habitat. Road noise is an emerging issue for birds, who rely on song to communicate and defend their breeding territories (Reijnen et al. 1995). Road noise may be a key to Neotropical migratory songbird loss in our urban area, where the number of species and individuals is reduced with increasing road density (Hennings and Edge 2003).

Night lighting, which frequently occurs near habitat edges, can alter the life cycles of plants and animals. For example, Moore et al. (2000) found that night lighting caused some wetland algae-grazing invertebrate species to forage deeper in the water; this could cause algal blooms at the water's surface, which can degrade water quality through low dissolved oxygen levels and toxicity. While lighting effects on fish of our area have not been studied, river-dwelling seatrout in Scotland are exposed to greater predation under night lighting (Contor and Griffith 1995). Terrestrial invertebrates (Frank 1988), amphibians (Buchanan 1993), birds (Frey 1993) and mammals (Rydell and Baagoe 1996) are also affected by night lighting.

Large buildings that remain lit overnight are known to attract migrating birds, which are injured or killed when they hit the buildings (Trapp 1998; Manville 2000). The magnitude of kills may

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[61] See *Introduction* chapter for a brief description of Metro's wildlife habitat model. Metro's *Riparian corridor and Wildlife Habitat Inventories* contain a complete description (Metro 2002c).
[62] Typical examples include some of the more colorful species such as most warblers, Rufous Hummingbirds and Western Tanagers.
[63] For example, hiking on trails, children playing in streams.

depend on siting, height, lighting, and cross-sectional area of the obstacle, as well as weather conditions (Weir 1976). Night lighting also affects wildlife habitat itself. Many plant species depend on light and dark cycle lengths to direct their growth and reproduction, thus changing light duration may interfere with germination, flowering, and growth (Campbell 1990; Edwards and El-Kassaby 1996; Environmental Building News 1998).

The mere presence of humans has been shown to be detrimental to some wildlife species. Repeated human disturbance such as approaching large mammals can cause loss of unborn young (Phillips and Alldredge 2000). Bird biologists recognize that repeatedly approaching a bird's nest may cause the parents to abandon eggs or young (Bowman and Stehn 2003). Human disturbance causes energetically costly defensive behavior in animals; for example, bats are particularly sensitive to human disturbance, especially during breeding or hibernation (LaRoe et al. 1995; Tuttle 1997; Montana Chapter, The Wildlife Society 1999). Other negative effects from humans disturbing natural environments include vegetation trampling, tree root zone disturbance, and soil compaction, which reduces water infiltration and capacity for soil to support plants and invertebrates) (Cole and Trull 1992; Cole 1995; Whitecotton et al. 2000).

Altered microclimate

Riparian areas have a unique microclimate differentiated from upland habitat by a diversity of vegetation, leading to complex structure in the forest canopy, which impacts the amount of light, heat, and wind that penetrates the area. Moist soils help to keep temperatures lower than in surrounding areas as well. Stream channel width and riparian area topography influence microclimate extent (Brosofske et al. 1997; Pollock and Kennard 1998). Table 6-6 highlights some of the environmental consequences of altered microclimate.

The microclimate of riparian areas is generally more moist and mild (cooler in summer and warmer in winter) than the surrounding area (Knutson and Naef 1997). This creates diverse habitat characteristics that are desirable to many species, particularly for amphibians year-round and for large mammals during hot, dry summers and severe winters (Knutson and Naef 1997). Widespread microclimate alterations change plant and animal communities, due in part to the edge effects engendered by habitat fragmentation (Saunders et al. 1999; Gehlhausen et al. 2000; Laurance et al. 2000). Forest edges tend to have

Table 6-6. Environmental consequences of altered microclimate.

- Decrease in soil and air moisture
- Increase in soil, air, and water temperatures, with particularly harmful effects to amphibians
- Wider temperature variability in soils and air
- Decrease in soil's carrying capacity for microorganisms (macroinvertebrates, beneficial bacteria and fungi)
- Decrease in soil's ability to support plants, with corresponding habitat loss/degradation and reduction in ecosystem's ability to support wildlife
- Reduction in organic materials and large wood; altered food web, degraded fish and wildlife habitat (especially invertebrates, fish, amphibians, small mammals and snag-dependent species)
- Decrease in terrestrial food sources: leaves and other organic matter, macroinvertebrates
- Decreased stream shading, increased water temperatures
- Shallow groundwater temperature increases due to shading loss and soil warming
- Increased wind causes wind-throw, damaging or killing trees, especially near edges
- Wind-throw causes reduction in patch size and increased edge effects and fragmentation
- Wind-throw exposes soils to erosion
- Altered plant, fish and wildlife communities
- Reduced biodiversity

elevated air temperatures, reduced humidity, and are exposed to more wind than forest interior habitats (Saunders et al. 1999; Gehlhausen et al. 2000; Laurance et al. 2000). In urban areas, this effect is compounded by the urban heat island effect.[64]

Amphibians may be the group most sensitive to microclimate changes and have suffered worldwide declines over the past 20 years, with particularly significant declines in the Pacific Northwest (LaRoe et al. 1995; Richter and Ostergaard 1999; Semlitsch 2000). Unlike other species groups, amphibian skin and eggs are not wind- or waterproof, and exposure to temperature and wind increases may be lethal.

Microclimate includes wind effects. An important consideration with forested riparian buffers is the ability of the forest to withstand the force of high winds (Broderson 1973; Steimblums et al. 1984). For example, in northwest Washington, windthrow (uprooting of trees or tree trunk breakage from wind) averaged 33 percent in riparian forest buffers within one to three years after clearcut harvest of adjacent timber (Grizzel and Wolff 1998). In a review of several studies, Pollock and Kennard (1998) determined that wider forest buffers protected trees from windthrow much more effectively than narrow forests. Thus, microclimate effects also relate to habitat loss and degradation, as well as several other consequence categories.

Shade is an important microclimatic function of riparian vegetation that influences water temperature (discussed in the Degraded Water Quality section above). Riparian vegetation creates an instream microclimate that maintains relatively constant water temperatures; when a riparian forest is removed, the monthly mean maximum temperature along smaller streams may increase 7-8° C (Budd et al. 1987). Water temperature is one of the most crucial environmental factors influencing salmon and other aquatic species.

Reduced woody debris and organic materials

Large woody debris (LWD), such as branches, logs, snags, uprooted trees, and root wads, is an important component of aquatic habitats in the Pacific Northwest, both as a structural element and as cover from predators or protection from high streamflows (Adams 1994; Prichard et al. 1998). Organic matter, such as leaves, twigs, and pine needles, help form the foundation of food webs both in aquatic habitats and on land. When riparian vegetation is removed, the source of large wood and organic matter is removed, with resulting harm to fish and wildlife habitat. Table 6-7

Table 6-7. Environmental consequences of reduced woody debris and organic material.

- Loss of stream and channel complexity (pool-riffle sequences, river island formation)
- Changes in channel bottom topography and substrate
- Increased water velocity in streams and rivers
- Changes in sediment and nutrient storage, transport, and cycling; decreased nutrient retention time
- Increased erosion rates and sedimentation
- Loss of important base components of food web
- Reduced carrying capacity of environment (fewer individuals can be supported when food is reduced)
- Loss of important macroinvertebrate, fish, amphibian, bat and small mammal, and bird refugia and habitat
- Potential loss of wildlife species depending on large wood and snags
- Decreased carbon storage (see Energy section)
- Loss of organic components that make up healthy soil; decreased beneficial bacteria, fungi and soil invertebrates
- Decreased rate of new soil production
- Decreased ability for soil to support plants and animals
- Reduced biodiversity

[64] See *Energy Consequences* chapter.

highlights some of the environmental consequences of reduced woody debris and organic materials.

Large woody debris is a key aquatic habitat structure. As sediment, large woody debris and other organic materials are transported and deposited throughout a watershed, channel characteristics and aquatic and terrestrial habitats are formed. Large woody debris is important because it influences the routing and storage of water and sediments, as well as the development of channel bottom topography, including the formation and distribution of pools (Beschta 1979; Booth et al. 1997).

In addition, LWD helps dissipate energy generated from streamflow, slowing erosion and sediment transport rate and retaining organic debris, making it available to organisms living there (Naiman et al. 1992). Large woody debris is also an important source of aquatic cover and acts as a surface for biological activity by aquatic organisms (Gregory et al. 1991; Naiman et al. 1992).

Large woody debris is often intentionally removed from waterways; for example, between 1867 and 1912, 55 miles of the Willamette River above Albany, Oregon were improved for navigation by removing an average 61 snags per kilometer (Sedell et al. 1990). Large wood may also be removed from streams in an attempt to reduce flooding. In urban streams of the Pacific Northwest, large wood is significantly depleted through washout, downcutting, and direct removal (Booth et al. 1997). In the Puget Sound region, the amount of large woody debris in the channel decreases with increased development (May et al. 1997).

The removal of riparian vegetation also results in loss of terrestrial LWD critical to soil health and wildlife habitat (Maser and Trappe 1984). Large woody debris, both standing (snags) and fallen, is an important source of foraging, cover and nest sites for birds, mammals, reptiles, and amphibians. LWD provides nesting habitat for cavity-nesting birds such as woodpeckers, chickadees, nuthatches and wrens. Woody debris has also been shown to be a key habitat element for amphibians (Bury et al. 1991; Welsh and Lind 1991; Butts and McComb 2000) and small mammals (McComb et al. 1993; Butts and McComb 2000; Wilson and Carey 2000).

Beyond the structural importance of LWD, other, smaller organic debris provides carbon, the basic fuel for aquatic and terrestrial food webs (Allan 1995). Smaller pieces of organic litter (e.g., leaves, needles and twigs) and terrestrial insects, important food sources for aquatic species, enter the stream primarily by direct leaf or debris fall (Spence et al. 1996). Benthic, or stream-bottom, invertebrates rely on a supply of organic litter to maintain healthy communities. Removing riparian vegetation also removes the primary source of these materials, reducing the stream's habitat value to fish and wildlife (Brown and Krygier 1970). In addition, when flow rates increase and channels are simplified, the retention time of organic debris in the system is decreased because it quickly washes downstream (Webster and Meyer 1997). Thus urbanized streams tend to contain less food than undisturbed watersheds.

Erosion, sedimentation and soil loss

Increased erosion and sedimentation results from:

- vegetation removal,
- hydrologic alterations (increased water velocity increases erosion),
- roads and other impervious surfaces, and
- construction.

Upon delivery to streams, these sediments are either suspended in water (creating increased turbidity) or deposited on the streambed (creating sediment build-up and embeddedness), where they can alter sediment transport processes, initiate channel instability and lead to in- and near-stream habitat degradation. Erosion removes topsoil; it takes many years for nature to build only a few inches of good topsoil. Healthy soils are vital in the establishment and nourishment of plants and provide habitat for countless organisms. Construction activities also compact soil, reducing the overall watershed infiltration rate and storage capacity. Table 6-8 highlights some of the environmental consequences of erosion, sedimentation and soil loss.

Table 6-8. Environmental consequences of erosion, sedimentation and soil loss.

- Soil loss; it takes centuries to build a few inches of good soil. Hydric (water-retaining) soil is especially detrimental.
- Stream banks damaged
- Stream bed substrates altered, size reduced (salmon and many macroinvertebrates need larger substrate; fish, amphibians, birds, other animals need macroinvertebrates)
- Sediment buildup in stream channels and subsequent loss of channel topography (infilling of pools and loss of biodiversity in aquatic habitats)
- Water quality impairments; increased sedimentation in downstream streams and wetlands
- Increased sedimentation in estaries due to feeder stream sediment loads
- Loss of soil's ability to support vegetation, with accompanying habitat loss and degradation
- Vegetation is damaged or washed away when soils are eroded; fish and wildlife habitat loss and degradation
- Vegetation loss leads to increased runoff, leading to further erosion
- Loss of organic matter critical to fish and wildlife food webs and habitat
- Toxics bind to sediments, enter streams and wetlands
- Salmon reduction and loss
- Large amounts of land with recently disturbed soils suitable for weedy, invasive species
- Increased water turbidity and/or changes in water chemistry, with negative fish and wildlife consequences
- Reduced biodiversity

Vegetation holds soils in place and captures excess sediments as they wash through during rainstorms (Gregory et al. 1991; Knutson and Naef 1997; Naiman and Decamps 1997). Riparian vegetation removal is especially harmful because it disturbs existing soils, allows sediments from the disturbed area to wash into stream, and removes the last remaining filter between the stream and the land. However, removal of vegetation in upland areas, especially in steeply sloped terrain, also contributes to a higher rate of soil erosion and can result in significant consequences such as landslides, flooding, channel erosion and destruction of aquatic habitat.

Landslides are downslope movement, under gravity, of masses of soil and rock material.[65] In an urban setting, improper drainage most often induces disastrous sliding (Oregon DOGAMI 2003). Landslides and debris flows (rapidly moving landslides that typically move long distances) are natural processes, triggered or accelerated by these factors:

- Intense or prolonged rainfall, or rapid snow melt, causing sharp changes in groundwater levels
- Undercutting of a slope or cliff by erosion or evacuation
- Shocks or vibrations from earthquakes or construction.
- Vegetation removal by fires, timber harvesting, or land clearing.
- Placing fill (weight) on steep slopes
- A combination of these factors

Salmon and other aquatic species need clear water with low concentrations of suspended sediments in the water column (turbidity) and cool water. High turbidity clogs fish gills and can hamper migration. However, deposited sediments generally have a greater impact on aquatic species than suspended sediments because they alter macroinvertebrate communities (salmon food supply) and ruins spawning habitat. Salmon, salamanders and many aquatic insects need relatively sediment-free gravel beds with suitable gravel in which to reproduce.

Roads and other impervious surfaces contribute substantially to erosion and soil loss. Road networks contribute more sediments to streams than any other land management activity, from both surface erosion and landslides (Jones et al. 2000; Gucinski et al. 2001). Not only do these features substantially increase sedimentation in their own right, but they also reduce the capacity of soil to support vegetation and store water. In addition, many toxic substances bind to soil particles and enter waterways via eroded soil; for example, DDT, banned decades ago but still present in soils, washes into streams and wetlands in this manner.

Activities such as grading, filling, hauling and agriculture cause significant erosion and transport of fine sediments to the stream (Trimble 1997; Wood and Armitage 1997). Each year in the U.S. an estimated 80 million tons of sediment are washed from construction sites into water bodies (Goldman et al. 1986). Soil quality is typically degraded along urban stream corridors where development activities include removal of natural riparian vegetation, grading, compaction of soil, and placement of fill that is dissimilar from native topsoil.

Reduced biodiversity, non-native species introductions, and landscaping

As described in the *Introduction* chapter, our area's natural resources have changed dramatically in terms of quantity and quality with human encroachment. Altered plant and animal communities are a hallmark of urban ecosystems. Non-native plant and animal invasions, proliferation of generalist species and loss of specialists (those relying on a specific habitat type or feature) are prevalent. Non-native species are associated with the majority of at-risk species declines worldwide due to competition for resources and outright predation (Wilcove et al. 1998;

[65] As defined by the Oregon Department of Geology and Mineral Industries (DOGAMI; Oregon DOGAMI 2003). Landslide hazard areas have been mapped by DOGAMI and are available on their website www.oregongeology.com/landslide/landslidehome.htm.

Pimentel et al. 2000). Table 6-9 highlights some of the environmental consequences of reduced biodiversity and non-native species invasions.

Manicured lawns and landscaping often replace natural vegetation along stream corridors in developed areas throughout watersheds, and this impacts wildlife communities. By replacing the naturally complex mix of vegetation with lawns, structural complexity is reduced. Structurally complex vegetation supports more native species than simple vegetation (Hennings and Edge 2003). In addition, simplified, non-native habitats favor non-native wildlife species because the non-native species that have established populations are habitat generalists, or species that can survive in a wide variety of circumstances. Native generalists also benefit from habitat simplification, to the detriment of native species with more specific habitat requirements.

Table 6-9. Environmental consequences of reduced biodiversity, non-native species introductions, and landscaping.

- Restricted pool of pollinators and seed dispersers
- Reduced native wildlife gene pools can lead to decreased survival rates
- Human-enhanced dispersal of some species (weeds, rodent pests, starlings, English Sparrows, pigeons)
- Potential reduction, loss of species that control pest species (e.g., woodpeckers control carpenter ants)
- Increased competition for food and habitat resources
- Non-native species invasions; reductions in native fish and wildlife populations; extirpations; species extinctions
- Urbanization often benefits species with small home ranges and high reproductive rates
- Generalists that can thrive in a variety of habitats and situations displace more sensitive habitat specialists
- Loss of balance between predator-prey populations
- Increase in small mammal abundance for certain species; small mammals eat bird eggs
- Simplification and large-scale alteration of plant and animal communities
- Non-native plant invasions reduce functional and structural diversity of wildlife habitat
- Loss of food resources for native wildlife species (native insects and birds prefer native plants)
- Local native species extinctions due to increased competition and predation
- Numerous sources for continuous non-native re-invasions
- Introduction of diseases and parasites to which native organisms are not adapted
- Financial harm to crops and agriculture due to pests
- Wildlife predation by cats, dogs, and other human-introduced predators
- Reduced biodiversity

In the Metro region, non-native birds such as European Starlings, non-native amphibians such as bullfrogs, and non-native fish tend to out-compete or directly kill native species.[66] Non-native plants are an issue because they favor non-native wildlife species. In the Metro region, non-native birds and plants are linked to edge effects.[67]

Domestic animals can have strong impacts on wildlife communities. Domestic animals include livestock, but in urban areas the primary species impacting wildlife are domestic cats and dogs, which kill wildlife and disrupt native wildlife behavior. For example, barking dogs scare wildlife, increasing stress levels and reducing

[66] For example, starlings made up 17 percent of riparian birds surveyed along 54 riparian study sites in the greater Metro region (Hennings 2001); the narrower the forest, the more starlings – sometimes more than half of all breeding birds present.
[67] Discussed in the Fragmentation section above; non-native plants, shrubs, and birds decline with distance to the edge of a forest patch.

their ability to forage and nest.[68] As most pet owners realize, cats kill animals even when they have ample food provided. In addition, dogs and cats can contribute to stream degradation by contributing fecal coliform and disturbing streambanks and vegetation.

Wildlife barriers (including habitat fragmentation) also reduce biological diversity. Development practices such as installing stream crossings[69] and piping and culverting streams destroy habitat and create impassable fish barriers that block entire stream reaches to migratory fish species and isolate remaining species, putting these populations at risk of reduced genetic diversity and/or extinction. Habitat fragmentation creates wildlife barriers by creating space between habitat patches across which some species cannot travel.

What are the potential environmental consequences to fish and wildlife habitat of allowing, limiting, or prohibiting uses that conflict with natural resource function?

All major consequences occur in each zoning type, but the severity depends on prevalent conflicting uses. For example, more imperviousness results in more severe hydrologic alterations; more pesticide use results in increased water quality impairment. More traffic translates to increased human disturbance to wildlife. The consequences also depend on the percent of fish and wildlife habitat falling within each zoning type. For example, single-family residential contains about half of all habitat; consequences may be strong due to amount of land cover. On the other hand, commercial contains only five percent of all habitat; thus potential consequences are reduced because commercial uses do not cover much land. This section includes a summary of the potential environmental tradeoffs of allowing, limiting, or prohibiting conflicting uses. Most of the environmental consequences are similar in all regional zones, the differences are described below. Appendix D contains several matrices that summarize the environmental consequences of a decision to allow, limit, or prohibit by generalized regional zones. Finally, the key points learned from the environmental consequences analysis are highlighted at the end of the chapter.

Summary of potential environmental tradeoffs

The analysis of environmental consequences is general in nature to account for variability within zoning types, and also because consequences depend on the program selected. Environmental consequences can also vary depending on the scale through which they are viewed; for example, at the site level, high-density housing is associated with fairly high levels of imperviousness, but on a larger scale this zoning type reduces the amount of roads and land needed to accommodate housing. Below are some general consequences associated with allow, limit, and prohibit decisions.

Allow conflicting uses

- Extensive loss of ecological functions in riparian areas, especially for Class I riparian corridors

[68] About a third of U.S. households have cats; each year in the U.S. cats kill an unknown, but undeniably large number of wild animals (The Wildlife Society 2002).
[69] For example, roads, sewers, and pipelines.

- Likely to harm salmon
- Degraded water quality
- Extensive loss of valuable wildlife habitat and functional values (size, interior habitat, connectivity, proximity to water)
- Loss of Habitats of Concern
- Continued loss of native species and at-risk species; reduction in migratory songbirds
- Education opportunities
- Reduced need for UGB expansion; protects habitat outside UGB from urban encroachment

Limit conflicting uses

- Depends on type of program: results may range from minimal protection to near-full protection of ecological functions
- Strong potential for restoration, mitigation, and education activities to offset negative impacts
- Implementation of BMPs (best management practices) and low impact development standards could reduce negative impacts
- Less harm to native species and fewer nonnative species invasions than Allow
- Intrusion in some habitat areas will reduce the quality of other habitats, especially if connector habitat is fragmented and interior habitat reduced
- May require UGB expansion, depending on program

Prohibit conflicting uses

- Retention of some of the region's most critical ecological functions and best remaining wildlife habitats
- Most likely to support salmon conservation, retains important aquatic habitat
- Prevents further habitat fragmentation; preserves restoration opportunities
- Minimizes hydrologic alterations, reduces flooding, and preserves water quality
- Provides key breeding habitat for migratory songbirds, aquatic species, habitat interior species, and other native species
- Preserves Habitats of Concern
- May require substantial expansion of the UGB

Environmental consequences by generalized regional zone

The disturbance activities, or conflicting uses, associated with each of Metro's generalized regional zones were described in Chapter 3, *Conflicting Uses.* Disturbance activities (conflicting uses) were cross-referenced with potential consequences to regionally significant fish and wildlife habitat in Table 6-1 at the beginning of this chapter. Many of the negative environmental impacts due to conflicting uses relate to the levels of imperviousness and the amounts of natural land cover associated with those conflicting uses. There are trends in imperviousness and natural land cover associated with Metro's generalized regional zones. These trends are useful in fostering discussion about land use impacts. Table 6-10 lists these general trends, providing a foundation for the consequences discussion.

Table 6-10. Relative levels of imperviousness and natural landcover typically associated with generalized zoning land-use types.*

Generalized regional zone	Typical onsite imperviousness[1]	Typical infrastructure requirements[2]	Typical natural landcover[1]
Commercial	High	Moderate to high	Low
Industrial	High	Variable	Low
Mixed use	Moderate to high	Lower per person	Low
High-density multi-family	Moderate to high	Lower per person	Low to moderate
Medium/low density multi-family	Moderate onsite	Moderate per person	Low to moderate
High density single family	Moderate onsite	Moderate per person	Low to moderate
Medium/low density single family	Low to moderate	Higher per person	Moderate to high
Rural	Low	Higher per person	High
Agricultural	Low	Variable	High
Open space	Low	Low	High

*These general estimates are provided to facilitate discussion.
[1]Relative to other land use types; per unit area.
[2]Infrastructure refers to roads and parking, sewers and stormwater piping, power transmission, etc. needed to support the land use.

Most of the environmental consequences are similar across zones (matrices describing the consequences may be found in Appendix D); the differences are identified below.

- **Single-family residential (SFR):** tends to retain more trees and vegetation, reducing negative impacts. Stormwater piping and imperviousness is a strong factor due to the extent of single family zoning; altered hydrology is a primary consequence. Landscaping, pesticide and fertilizer use, and pets tend to degrade habitat and water quality. Potential to retain existing vegetation and add new vegetation, as well as stormwater solutions such as Low Impact Development, could have positive implications for stormwater runoff and hydrology.
- **Multi-family residential (MFR):** density decreases overall infrastructure and road requirements, but increases onsite imperviousness and vegetation loss. Multi-family residential tends to create more human disturbance because human densities are higher. In general, negative environmental consequences are stronger at the site level compared to less dense forms of housing, but reduced at a larger scale due to compactness and efficiency of form.
- **Commercial (COM):** high onsite imperviousness; increased traffic and human disturbance. Consequences similar to industrial development, but commercial development is more consistently associated with certain disturbances, including installation and maintenance of utilities, stormwater-related modifications, and road construction. Not as strongly associated with toxics, heavy metals and other pollutants as industrial development, although transportation-related toxics are an issue due to heavy traffic and parking requirements.
- **Industrial (IND):** high onsite imperviousness; tends to have low amounts of vegetation; use of toxic chemicals may increase negative impacts to fish and wildlife. Consequences weighted toward altered hydrology, degraded water quality, habitat loss, and alterations to biological communities, including reduced biodiversity. Institutional uses are similar to industrial, except that they are not strongly associated with toxics and can sometimes have more natural land cover.
- **Mixed-use centers (MUC):** may decrease VMT which reduces water quality impacts at the regional scale, but onsite imperviousness and noise and light disturbances may be high. May

include a variety of land uses, therefore conflicting uses and consequences vary. Can offer efficient land use and reduce the amount of land needed, because development types can meet specific local needs. Can provide shared parking and greater efficiency in parking lot layout, thereby reducing imperviousness and the stormwater runoff associated with paved areas.

- **Rural residential (RUR):** Less severe hydrologic alterations compared to areas with more pavement and less vegetation. More roads and other infrastructure required per dwelling unit. Agriculture (not regulated by Metro) may increase pesticides, nutrient inputs, and seasonal disturbances, but also can provide grassland and connector habitat. Leaky septic systems can degrade water quality. Livestock grazing harms riparian areas, compacts soil, and degrades water quality. Human disturbance reduced compared to higher density housing types.
- **Parks and open space (POS):** active parks increase human disturbance and tend to remove natural landcover; landscaping in such parks may degrade water quality and wildlife habitat. In more natural areas parks provide important habitat, connectivity, and improved water qualityIn some jurisdictions (e.g., Portland), other uses such as rail lines, utility corridors, broadcast facilities, mining, agriculture, and institutional uses are allowed, with corresponding consequences.

Summary points

- Tree canopy is invaluable to the functionality of both fish and wildlife habitat habitat. It is important both near streams and throughout the watershed, as affirmed by local studies (Frady et al. 2003). Tree canopy provides habitat, absorbs pollution and excess nutrients, and slows and retains stormwater, reducing hydrologic alterations.
- Hydrologic changes have far-reaching negative consequences. Reducing or mitigating imperviousness and stormwater impacts will be important to address these consequences.
- Consequences to fish habitat depend on habitat value. For example, loss of high-value (Class I) riparian corridors, which retain three to five primary functions, would have a stronger ecological impact than Class II or Class III riparian corridors, which contain two or no primary ecological functions, respectively. Loss of high-value riparian corridors would also result in loss of high-value wildlife habitat, because Class I riparian corridors include some high-value wildlife habitat (including Habitats of Concern) where high value inventory areas overlap. For example, many Class I riparian corridors include bottomland hardwood forest and wetlands in a floodplain setting; this type of area is critical to riparian function and also provides a unique and declining habitat type.
- Consequences to wildlife habitat also depend on habitat value, but with different implications than fish habitat. Because connectivity is important to wildlife, the loss of any component in the system may reduce the value of nearby wildlife habitat patches. For example, preserving two Class A wildlife habitat patches – the largest patches with good water resources and connectivity to other patches, or Habitats of Concern – will be most valuable to wildlife if between-patch connectivity is retained; the connecting patches are typically Class B or C wildlife habitat. If only Class A wildlife habitat is preserved, its value will be reduced due to loss of nearby Class B and C patches. On the other hand, smaller habitat patches tend to have lower quality habitat due to edge effects and reduced interior habitat.
- Homes surrounded by trees can provide very important wildlife habitat. For example, local

studies indicate that resident native birds are most diverse in developed areas with plenty of forest canopy (Hennings and Edge 2003). Single-family residential accounts for a large proportion of fish and wildlife lands, therefore retaining tree canopy within this zoning type is desirable. This would allow some conflicting uses to occur while retaining important natural resources, with important implications for limiting future UGB expansions. Clustered housing is one way to reduce forest canopy loss.

CHAPTER 7: ENERGY CONSEQUENCES

Introduction

Urbanization leads to concentrated areas of energy use, with important implications for fish and wildlife habitat. In turn, fish and wildlife habitat influence energy use. Within the UGB the issue is not whether, but *how* to urbanize, and the extent to which fish and wildlife habitat should be protected. The nature of these relationships can affect energy use and efficiency within the UGB, as well as the boundary's size and shape.

The energy consequences analysis of allowing, limiting or prohibiting conflicting uses in fish and wildlife habitat areas addresses the following questions, from a regional perspective:

- What is energy, and how is it used?
- What are the environmental consequences of energy use?
- How does regional planning relate to energy use?
- What are the energy consequences of allowing, limiting, or prohibiting conflicting uses in or near fish and wildlife habitat?

What is energy, and how is it used?

Energy can be broadly defined as the capability of a system to do work. In the electric power industry, energy is more narrowly defined as the mathematical product of real power and time (Public Power Council 2003). For the purposes of this document, energy is the fossil fuel, hydroelectric, or other resource providing the energy to do work, such as driving, creating roads and buildings, and heating and cooling.

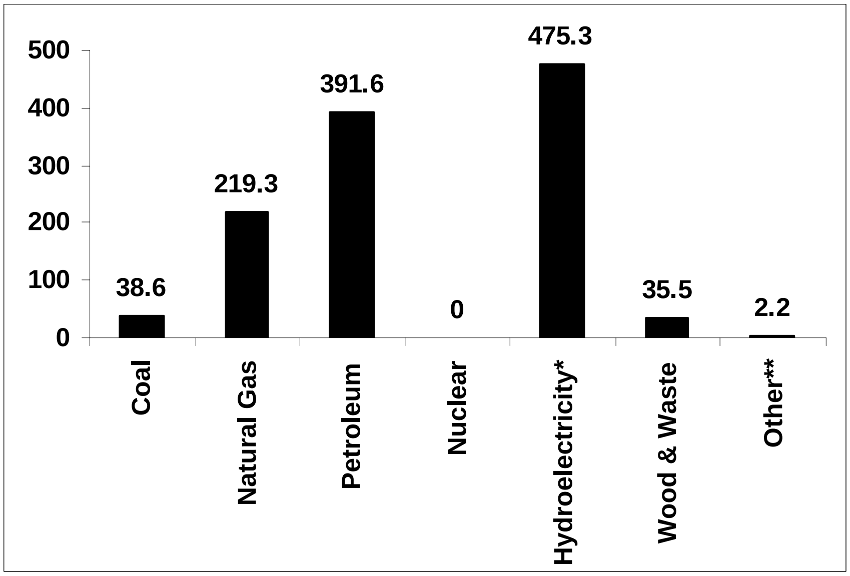
According to the U.S. Department of Energy, Oregonians' primary energy sources are fossil fuels (petroleum products and natural gas) and electricity (Figure 7-1). The proportion of Oregon's energy derived from fossil fuels has risen substantially, whereas the proportion of electricity has held steady since 1980, at about 20 percent (Oregon Office of Energy 2002). Regional planning influences fossil fuel use more than electricity use, because the spatial arrangement of urban infrastructure systems strongly influence fossil fuel use. The factors influencing electricity use tend to be more site-specific.

<u>Fossil fuels</u>

Oregon's fossil fuel use has nearly tripled in the past 40 years. This is due primarily to motor vehicle use, which relies chiefly on petroleum products although interest in alternative fuels is growing. By 1999, petroleum products accounted for nearly half of the energy used in the state (Oregon Office of Energy 2002).

Natural gas is another important fossil fuel resource for industry, electricity generation, residential, and commercial uses, in that order. Natural gas use per capita increased 63 percent between 1990 and 1999, rising to 24 percent of total energy use in the state.

Figure 7-1. Types of energy consumed by Oregonians, 1999 (in trillions of BTUs).



* May include pumped storage and net imports of electricity generated from this resource.
** Geothermal, wind, photovoltaic, and solar.
Source: U.S. Department of Energy, http://www.eia.doe.gov/emeu/sep/or/frame.html

Electricity

Electricity is another important energy source in the region. Portland General Electric (PGE) is the state's largest utility, providing electricity to more than 730,000 customers in Portland, Salem and nearby communities (Hemmingway et al. 2002). The energy sources for PGE's electricity include PGE's hydropower (10 percent), coal (25 percent), gas/oil (26 percent) and purchases on the market which include Mid-Columbia hydropower, wind and other renewable energy sources (39 percent) (PGE 2002). Pacific Power serves another 68,000 customers in the Metro region. Eighty percent of Pacific Power's generation is from thermal plants (Pacificorp 2003).

It takes energy to produce and deliver energy to gas stations, homes, businesses and industry. Of the major energy sources, electricity takes the most energy, on average, for production and delivery to the site (U.S. Department of Energy 1999). However, that depends on how electricity is produced (e.g., via hydropower or fossil fuels). For example, for every unit of fossil fuel-generated electricity produced, it costs three fossil fuel energy units to produce and deliver it to the site, whereas hydropower takes substantially less production and delivery energy (U.S. Department of Energy 1999). Coal is the most energy-intensive source of electricity. Hydropower is a renewable resource, as discussed next, but the region's capacity for generating hydropower is limited.

Renewable energy sources

The Oregon Office of Energy defines renewable energy as energy from any source that can be maintained in a constant supply over time (Oregon Office of Energy 2003). Renewable energy sources represent the most promising future energy supplies because they may be sustainable over the long term; the supply of fossil fuels is limited and therefore non-renewable and non-sustainable. Hydropower (flowing water) is the prevalent renewable energy source used in the Metro region, but alternative sources such as wind and sun power could be further developed. Table 7-1 shows the five predominant renewable energy sources: hydropower, biomass, wind, the sun (solar), and heat from inside the earth (geothermal).

Table 7-1. Types of and uses for renewable sources of energy.

Source of energy	Description	Used for heat?	Used for Electricity?	Used for Vehicle fuel?
Water (hydro-electric)	Like the wind, flowing water is a product of the earth's climate and geography. Snowmelt and runoff from precipitation at higher elevations flow toward sea level in streams and rivers. In an earlier era, water wheels used the power of flowing water to turn grinding stones and to run mechanical equipment. Modern hydro-turbines use water power to generate electricity.		Yes	(electric cars are used, but not on a widespread basis)
Biomass	"Biomass" describes all plants, trees and organic matter on the earth. Biomass is a source of renewable energy because the natural process of photosynthesis constantly produces new organic matter in the growth of trees and plants. Photosynthesis stores the sun's energy in organic matter. That energy is released when biomass is used to make heat, electricity or liquid fuels.	Yes	Yes	Yes
Wind	The wind blows because of natural conditions of climate and geography. Historically, wind power was used to supply mechanical energy, for example to pump water, grind grain or sail a boat. Today, wind power is primarily a source of electricity.		Yes	
Solar	The sun is a constant natural source of heat and light. Sunlight can be converted to electricity. Solar energy is energy that comes directly from the sun.	Yes	Yes	
Geothermal	Heat from deep within the earth is called "geothermal energy." In some locations, geothermal energy is close enough to the surface that, by drilling a well to reach the heat source, the energy can be extracted and used for heating buildings and other purposes. Where the temperatures are hot enough, geothermal energy can be used to generate electricity.	Yes	Yes	

Source: Oregon Department of Energy 2003.

All renewable energy sources can be used to produce electricity. Solar energy and geothermal energy can supply both electricity and heat. Biomass can supply all three forms of useful energy.

Energy cost and availability

Energy cost and availability are important factors influencing the prevailing types of energy used. The Oregon Office of Energy calculated source-specific potential electricity generation and estimated wholesale costs for a variety of renewable energy types (Table 7-2, in order of least to most expensive).

Table 7-2. Potential generation and estimated wholesale costs for renewable energy resources available in the Pacific Northwest.

Renewable energy resource	**Cost** (cents per kilowatt-hour)	**Region-Wide Potential for Generation** (average megawatts)
Hydroelectric	1.1 to 7.0	170
Chemical recovery boilers (used to recycle chemicals, reduce wastewater discharges, and recover energy from pulp wood industry)	2.6	195
Natural gas (can be manufactured rather than extracted; for example, methane from livestock manure)	2.7	7,400
Industrial cogeneration (consumes fuel, usually natural gas, to produce both heat and electricity; captures and uses energy that otherwise would be wasted)	2.7 to 6.4	4,600
Landfill gas	3.1	94
Wood residue	4.3 to 5.4	300
Geothermal	5.2 to 6.5	390 to 1,070
Wind	5.3 to 8.1	700+
Forest biomass	5.5 to 6.6	300 to 1,000
Solar thermal	8.6	------
Solar photovoltaic (large-scale)	19.4	------
Solar photovoltaic (small-scale)	21.5 to 23.6	------

Source: Oregon Office of Energy 2003.

As Table 7-2 shows, hydroelectric power is the cheapest renewable source of electricity in the region, but not necessarily the source with the most energy potential nor the most environmentally sound option. As with any source of energy, there are environmental costs associated with hydroelectric power, including harm to salmon habitat. Some sources such as wind and solar power may be less environmentally harmful, and prices may drop as the technology develops. The environmental consequences of energy use are discussed next.

What are the environmental consequences of energy use?

Energy use can impact the environment in some major and specific ways, and natural resources mitigate these consequences and influence energy use. Therefore, energy consequences are often environmental, but environmental consequences lead to changes in energy use. Some environmental consequences relating directly to energy use include:

- Increased air temperatures
- Increased water temperatures
- Reduced air quality
- Habitat loss and degradation due to infrastructure (transportation and energy)
- Negative effects from hydropower and dams

Increased air temperatures

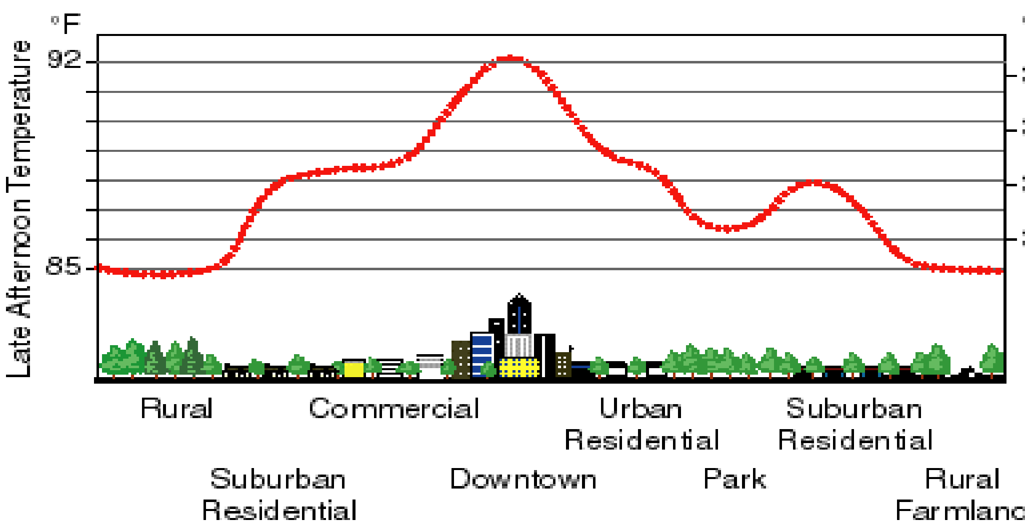
Vegetation helps cool the air, whereas pavement, buildings, and combustion processes such as motor vehicle engines tend to warm the air. This warming may occur both locally (the urban heat island effect) and globally (global warming). Air temperature also influences water temperature and quality, as discussed in the next category.

Air temperature influences energy use; for example, in cities with populations of more than 100,000, peak utility cooling demand increases 1.5 percent to 2 percent for every degree Fahrenheit the temperature rises (U.S. Department of Energy 1999). This increases energy demand and alters forest microclimates by increasing water, soil and air temperature and reducing soil and air humidity.[70]

Urban heat island effect

Cities are warmer than other areas, a phenomenon called the "Urban Heat Island effect" (Figure 7-2; U.S. Department of Energy 1993). The urban heat island effect is not limited to downtown areas, but is also influenced by suburban developments; it is a temperature gradient, increasingly warm from rural to urban areas. The average temperature difference along this gradient varies regionally, with differences in temperature from rural to urban areas ranging from 2º to 8º F (U.S. Department of Energy 1993).

Figure 7-2. Sketch of a typical Urban Heat Island profile (reproduced with permission from Morris 2003).



Plants help reduce the urban heat island effect by cooling the air through several mechanisms. In well-vegetated areas, a substantial portion of solar energy that hits plants is used for plant metabolism (U.S. Department of Energy 1993). Plants provide shade, which keeps other surfaces from storing the sun's heat energy. Plants also use moisture for temperature control; as temperatures rise, excess water is released from leaves it cools the surrounding air.

70 See *Environmental Consequences* chapter for further discussion on microclimate.

Impervious surfaces, especially dark surfaces with low reflectivity, collect and efficiently store the sun's energy as heat, as well as displacing vegetation. The heat energy is released at night, creating areas of warm air. Several hot days in a row can compound this effect, because as the urban or suburban area fails to cool at night, temperatures rise on each successive hot day; ambient air temperature can differ between an urban heat island and a vegetated area by 2-10° F. On a hot day, the air above a paved area may be 25° F hotter than the air in a nearby forest. The U.S. Department of Energy (1993) states that one of the simplest and cheapest strategies for countering the urban heat island effect is to increase the number of trees and other plants.

Global warming

Carbon dioxide in the air is a key contributor to global warming, or the "greenhouse effect" (Rubin et al. 1992). Carbon is stored in trees and other plants, but is released through combustion processes and vegetation removal (Northwest Environment Watch 2003). Although debate continues, most scientists now agree that increasing greenhouse gas emissions from human activities are altering the world's atmosphere, primarily due to the burning of fossil fuels and land use changes such as deforestation (Oregon Progress Board 2000; Price and Root 2001).

In Oregon, electricity production generates 44 percent of the carbon dioxide (CO_2) emissions, and transportation fuels contribute another 35 percent; natural gas contributes 14 percent (Oregon Progress Board 2000). Trees absorb and trap atmospheric CO_2, storing the carbon in solid form for long periods of time (Krieger 2001; Price and Glick 2002). Trees also reduce atmospheric CO_2 by reducing demand for heating and air conditioning (McPherson et al. 2002).

Global warming is expected to change the planet's climate by altering the exchange of water among the oceans, atmosphere, and land; this is expected to shift regional temperatures and patterns of rainfall (Price and Glick 2002). To illustrate, the annual average global temperature has increased by one degree Fahrenheit over the past century; increases have been slightly higher in the Pacific Northwest, at 1.5º F (Price and Root 2001; Northwest Environment Watch 2003). Scientists anticipate that the Pacific Northwest will experience warmer, wetter winters and warmer, drier summers, with an average increase of 4.5˚F by 2050 (Snover et al. 1998).

Global climate change is also likely to influence terrestrial wildlife, such as bird communities (Price 2000; Price and Root 2001). Species' distribution ranges are likely to move northward, and for many species that are already vulnerable, the risk of extinction will increase with global warming (Gitay et al. 2002). For example, Neotropical migratory birds, known to be at-risk in the urban Metro area (Hennings and Edge 2003), are predicted to change in species composition by 32 percent, with a 16 percent net decrease in species richness over the next 75-100 years (Price and Root 2001).

Increased water temperatures

Air temperature strongly influences water temperature. Water temperature is an important indicator of a watershed's vitality because of its controlling influence on the metabolism, development and activity of aquatic organisms (Naiman et al. 1992). Temperature and precipitation are the primary variables that determine the annual water cycle in the Pacific Northwest (Climate Impacts Group, University of Washington 2003). Increased water temperature is a common reason for Metro-area streams appearing on DEQ's 303(d) list of water quality impaired streams, as discussed in the *Environmental Consequences* chapter.

Increased water temperatures reduce the amount of oxygen the water can hold and change the water's chemistry (Pauley et al. 1989). As a result, energy impacts that cause an upward shift in air temperatures result in impaired water quality. This has negative impacts on wildlife living in and near the stream, such as macroinvertebrates, fish and amphibians (Tevis 1966; Pearson and Kramer 1972; Merritt et al. 1982).

Eaton and Scheller (1996) estimated that temperature increases from a doubling of atmospheric carbon dioxide is likely to reduce habitat for cold and cool water fish by approximately 50 percent. Rathert et al. (1999) identified annual air temperature range as a key environmental variable predicting the number of native fish species present in Oregon streams. According to Tyedmers and Ward (2001), the direct impacts to fisheries of water temperature increases due to predicted global warming include the following:

- Rising water temperatures (streams fed by deep groundwater or with riparian shading will be less affected)
- Altered hydrologic regimes (more winter flooding; dryer summers; decreased water supply due to loss of snow pack; shift in some streams from perennial to ephemeral)
- Changes in aquatic productivity (loss of cold-water fish and the macroinvertebrates on which they depend for food; increase in nonnative warm-water species)

Reduced air quality

Although an environmental issue, air pollution is directly related to urban energy use. Vehicular traffic, industry, and heating and cooling are energy-consuming activities that produce air pollutants as products of combustion. Air pollution is also directly related to vegetation; trees and plants clean the air (McPherson et al. 2002).

Air quality is measured and reported in a variety of ways, but Oregon DEQ collects and houses most state and local air quality data. Oregon DEQ uses an Air Pollution Index (API) to integrate carbon monoxide, particulates, ozone, nitrogen oxides, sulfur dioxide, and other pollutants into a single air quality index value (Oregon Department of Environmental Quality 2003b).[71] Figure 7-3 (on page XX) shows the Metro region's major sources of air pollution.

Air temperature is a major factor relating to air pollution. Higher air temperatures accelerate the chemical reactions leading to high ozone concentrations and other pollutants. While ozone high in the earth's atmosphere protects humans from the harmful effect of ultraviolet radiation, it is a pollutant near the earth's surface. Unacceptable levels of smog-forming ozone and other pollutants are frequently reached at 94° F and above, compounding the heat island problem by creating a heat-trapping cloud of pollution over urban areas (McPherson et al. 2002).

Most air pollution is caused by individual actions such as driving cars; using woodstoves, gas-powered lawn mowers and motorboats, paints and aerosol products like hairspray and air

[71] Air quality indices are reported daily via DEQ's website (http://www.deq.state.or.us).

fresheners; and outdoor burning. The Oregon DEQ estimates that industry contributes less than 10 percent of air pollution problems in the state; by far, the largest single source of air pollution is gas-powered vehicles (Oregon Department of Environmental Quality 2001), and this is what can be influenced most at the regional scale.

Habitat loss and degradation due to infrastructure (transportation and energy)

Motor vehicle transportation is the single biggest outlay of energy in the region, and also creates the largest proportion of infrastructure needed to support urban areas. Transportation infrastructure such as road networks requires substantial energy outlays, removes habitat, and negatively impacts wildlife and the environment.[72] Wildlife mortality due to roads is well known. Infrastructure relating directly to the transmission of energy, such as power line corridors and pipelines, may also remove or fragment fish and wildlife habitat, as well as providing corridors for the transmission of undesirable seed sources.[73]

Negative effects from hydropower and dams

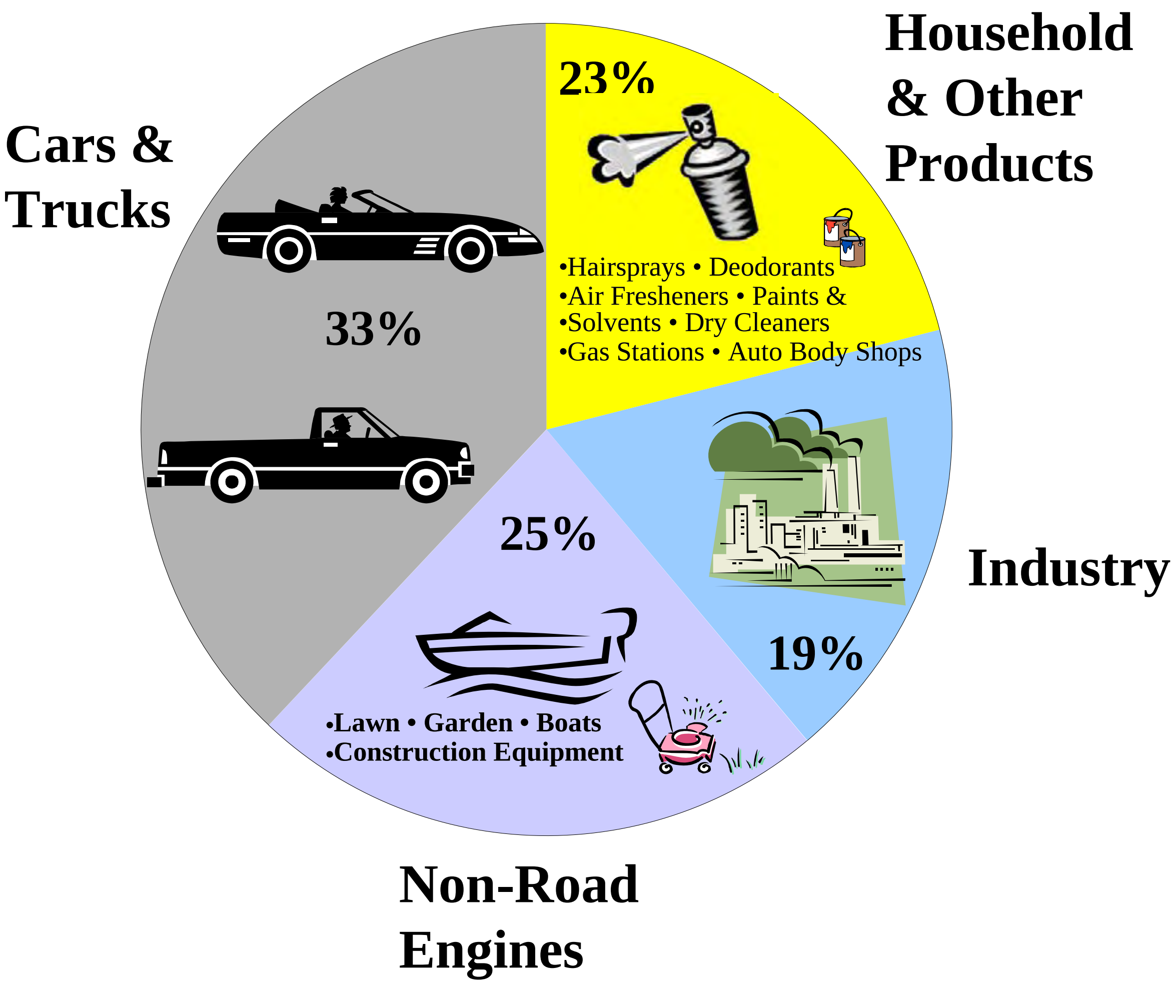
Hydropower is associated with both positive and negative environmental impacts: on the one hand, hydropower is one of the cleanest sources of electricity available on a large scale because it harnesses the movement of water for energy rather than burning fossil fuels. On the other hand, dams affect fish and wildlife and their habitats. Although dams provide many societal benefits including power generation, water storage, flood control, agricultural irrigation, and recreation, they influence watershed functions in fundamental ways (FISRWG 1998). Ecological problems associated with dams include erratic water volume and velocity (altered hydrology), increased streambank erosion, loss and fragmentation of riparian habitat, altered water chemistry, altered instream habitat, and blocked fish and instream wildlife passage.

All salmon and steelhead in the Columbia Basin are affected to some degree by damming activities (Federal Caucus 2000). Fish bypass systems and mitigation strategies are now required as part of Federal Energy Regulatory Commission licensing (Portland General Electric 2003).[74] Recognizing the impacts of energy production on wildlife, regional energy providers such as PGE now offer voluntary “salmon power” or “green power” energy sources, designed to provide more wildlife- and environment-friendly energy at slightly higher short-term costs.

More than 85 percent of the inland waterways within the continental United States are now artificially controlled through dams (National Research Council [NRC] 1992), including all major Metro area rivers. The Columbia and Snake River systems are protected areas, closed to further hydropower development (Oregon Office of Energy 2003). Some of the Metro region’s electricity derives from these sources. Reducing the risk to salmon populations in these river systems may require changes in the management of existing hydroelectric plants. These measures may reduce overall generating capacity, although further development of alternative renewable energy sources could help offset the capacity loss.

[72] See *Environmental Consequences* chapter for further discussion.
[73] Infrastructure is discussed further in the Regional Planning section of this chapter.
[74] The Idaho National Engineering Laboratory administers a federally funded program to develop hydroelectric turbines that will cause less harm to fish (Oregon Office of Energy 2003).

Figure 7-3. Portland/Vancouver metropolitan area airshed ozone* sources, 2001.



* Volatile Organic Compounds and Nitrogen Oxides

Reprinted with permission from Marianne Fitzgerald, Oregon DEQ, Portland, Oregon

How does regional planning relate to energy use?

At the regional scale, energy use is most strongly influenced by the extent and physical arrangement of transportation networks, the built environment, and green infrastructure. These factors are related, and changes in one affect the others and overall energy use patterns. All three factors influence air and water temperature and quality, thus influencing fish and wildlife habitat.

The 2040 Growth Concept and the UGB are important tools for reducing energy use because they define the extent of the urban region and guide the physical arrangement of the built environment and corresponding transportation network. Keeping development inside the UGB protects farm and forest lands from sprawl and reduces vehicle miles traveled (VMT). The 2040 Growth Concept sets forth and implements policies that encourage efficient land use and a balanced transportation system, and guides the physical arrangement of urban centers and the transportation network.

The region's 2040 Growth Concept calls for:

- A compact urban form, including efficient land use that can accommodate a variety of needed zoning types;
- A well-planned transportation system that includes vehicular travel, mass transit, and alternative transportation modes such as bicycling and walking; and
- Protection of natural areas.

The importance of these factors to the region's energy use is discussed below.

Importance of a compact urban form and zoning types

A compact urban form conserves energy by reducing transportation-related energy output and infrastructure needs, and also reduces the spatial extent of vegetation loss and the urban heat island effect.

As the population of an area increases transportation needs increase, and sometimes the number of miles a citizen needs to travel (VMT) also increases. At present, most vehicles are powered by fossil fuels; therefore increased VMT results in increased fossil fuel use. The amount of VMT increase depends on where and how far citizens must drive to meet their daily needs, as well as whether alternative modes of transportation are available.

In the Metro region from 1989 through 1999, about 46 square miles of land were developed, with most construction resulting from development within existing urban and suburban areas in keeping with the region's goals to contain urban sprawl (Northwest Environment Watch 2002a, 2002b). The Metro region's rate of high-density growth (more than 12 people per acre) nearly doubled that of Seattle over the past decade; the region's population increased by about 470,000 during that period.

These statistics indicate two things about the Metro region: first, with more people moving into the area, more city or suburban areas and related infrastructure must be built or expanded, which takes energy and materials.[75] Second, because population density is increasing within the UGB, the infrastructure requirements are reduced compared to the much larger infrastructure investments needed to support development in rural areas. Compact urban forms are more energy and resource efficient than "sprawled" cities.

Transportation and other infrastructure relates to energy because it:

- requires energy to install and maintain;
- can cause loss of trees and natural areas, with resulting energy implications including air temperature and quality and the need to repair damaged stream systems; and
- creates impervious surfaces, with resulting transportation, energy-related air and water quality, and maintenance and repair issues.

Compact urban forms reduce infrastructure requirements. During the 2040 Growth Concept development process Metro modeled water, sewer and stormwater infrastructure requirements under three regional development scenarios (Metro 1994a, b). The option with the most compact urban form incurred the lowest costs for water and sanitary sewer service, although stormwater costs were indistinguishable among the concepts.

There are hidden energy and ecological expenses involved with installing and maintaining infrastructure systems. Stream equilibrium is disturbed when roads, sewer or stormwater pipes are located in stream corridors and under streams, resulting in disturbances that require energy and materials to restore. For example, energy is required to address sediments generated through construction that clog wetlands and stormwater systems; exotic plant invasions; stream channel damage; flood protection and repair, etc.

Substantial dollars in the region are already being invested in restoration. For example, the Metropolitan Greenspaces Program, funded by the U.S. Fish and Wildlife Service and administered in partnership with Metro Regional Parks and Greenspaces, funded 279 restoration and environmental education products totaling more nearly $2.4 million from 1991-2002. With total local matching funds of nearly $7.4 million, the Portland/Vancouver region has spent nearly $9.8 million on restoration through this program alone.

Zoning type influences energy use. Table 7-3 shows the results of a survey Metro conducted to examine the VMT issue. The results indicate that areas combining good transit options (trains and buses) and mixed-use zoning tend to have the lowest VMT, as well as the fewest cars or trucks per household. Mixed-use urban centers are higher density centers of employment and housing that are well served by transit to form compact areas of retail, cultural, and recreational activities in a pedestrian-friendly environment. Mixed-use centers are energy-efficient because they provide efficient access to goods and services and enhance multi-modal transportation. Higher density residential housing is more energy-efficient than low densities due to increased VMT and infrastructure requirements. All zoning types are needed, but a compact urban form can help reduce energy requirements for each.

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[75] Materials also require energy for manufacture and transport.

Table 7-3. Metro Travel Behavior Survey Results for Multnomah County (all trip purposes, all income groups).

	Mode Share					Vehicle Miles per Capita	Auto Ownership per Household
Land Use Type	**% Auto**	**% Walk**	**% Transit**	**% Bike**	**% Other**		
Good Transit/Mixed Use	58.1%	27.0%	11.5%	1.9%	1.5%	9.8	0.9
Good Transit Only	74.4%	15.2%	7.9%	1.4%	1.1%	13.3	1.5
Remainder of Multnomah County	81.5%	9.7%	3.5%	1.6%	3.7%	17.3	1.7
Remainder of Region	87.3%	6.1%	1.2%	0.8%	4.6%	21.8	1.9

Source: Metro 1994 Travel Behavior Survey

Importance of a balanced transportation system

Fossil fuel use is second only to hydroelectric power in regional energy consumption. A large proportion of the region's infrastructure, including roads, parking areas and driveways, supports transportation. Transportation infrastructure creation and maintenance require energy, and so do the vehicles using that infrastructure. However, mass transit and the availability of alternative transportation modes reduce energy consumption and related environmental consequences by reducing VMT, fossil fuel use, and infrastructure needs.

Gasoline use is the principal cause of urban air pollution in the Pacific Northwest, creates the region's largest source of greenhouse gas emissions, and is one of the region's most expensive imports (Northwest Environment Watch 2002a). Overall gas consumption in the Pacific Northwest grew 21 percent from 1993-2002, about in step with the rate of population growth. Oregon consumes 17 percent more gas than it did a decade ago.

Although overall gas consumption also grew in Oregon recent decades, per capita gas consumption in the state actually dropped by about one percent over the last decade; the average Oregonian used 8.5 gallons of gas per week in 2002 (Northwest Environment Watch 2002b). Per capita consumption was expected to drop more substantially with the significant trends in fuel efficiency seen during the 1980s, but Oregonians bought more trucks and sport utility vehicles (SUVs) in the 1990s. SUVs and minivans typically consume about one-fourth more gasoline per mile than cars. Therefore, the expected improvements in per capita fuel use and air quality failed to materialize (Northwest Environment Watch 2002a).

VMT, the number of trips made, driving speed, and driving patterns impact fossil fuel use (Girling et al. 2000). These variables are influenced by the accessibility of uses, and the attractiveness of routes to pedestrian, bicycle, and transit modes of travel. In general, research agrees that higher densities, appropriate mixes of land uses, well designed circulation networks, transit options, and attractive pedestrian and bicycle routes can be associated with less motor vehicle travel.

Importance of “green infrastructure”

As discussed above, trees and other vegetation reduce energy demand and help moderate the air temperature increases and air pollution associated with energy use. Fish and wildlife habitat that provides ecosystem services and that are considered important or necessary to support cities and suburbs, can be considered a type of infrastructure: “green infrastructure.” Recognition and protection of green infrastructure, both inside and outside the urban growth boundary, are reflected in Metro’s 2040 Growth Concept.

Aside from positive environmental and aesthetic effects, green infrastructure can provide access to alternative transportation modes such as walking and bicycling – for example, the Fanno Creek Greenway and Springwater Corridor trail systems provide non-motorized transportation access to many of the region’s citizens.

However, protection of fish and wildlife habitat can also increase energy use by increasing VMT. For example, too many avoided stream crossings may result in the need to drive further around fish and wildlife habitat, increasing VMT. Similarly, utilities such as sewer and water lines may need to be rerouted, requiring energy and materials. Extensive natural areas protection could result in larger UGB expansions.

Those policies that allow the region to maintain a compact urban form and reduce VMT, while at the same time interspersing green infrastructure into and around the built environment, will reduce regional energy demands and the environmental impacts associated with energy use.

What are the energy consequences of allowing, limiting, or prohibiting conflicting uses in or near fish and wildlife habitat?

The analysis of energy consequences is general in nature and deals primarily with the implications of tree and vegetation loss and extent of the urban area. Metro avoided focusing on site-specific energy issues such as household appliance use, because other issues are more relevant to energy use at the regional scale. Below is a general description of the energy impacts of allowing, limiting or prohibiting conflicting uses, a summary of the differences of the consequences by regional zone, and the key points learned from the energy analysis. Several matrices relating the energy impacts to Metro’s generalized regional zones may be found in Appendix D.

Potential energy consequences

Below are some general consequences associated with allow, limit, and prohibit decisions:

Allow conflicting uses

- Compact urban form reduces transportation energy use
- Less vegetation available to conserve energy and mitigate air quality, air and water temperatures

Limit conflicting uses

- Potential to find middle ground, maximizing vegetation and compact urban form
- Most likely to support Region 2040 Growth Concept***Prohibit conflicting uses***

- Potential need for UGB expansions, increased transportation infrastructure, more energy used
- Maximizes retention of forest canopy and vegetation, maximizing vegetation energy benefits

Energy consequences by generalized regional zone

Most of the energy consequences are similar across zones (matrices describing the consequences may be found in Appendix D); the differences are identified below.

- **Single-family residential (SFR):** tends to retain more trees and vegetation than other zoning types, reducing negative air quality and temperature impacts. However, tends to require more infrastructure and creates the need for greater travel distances. In this regard, low-density housing is the most energy inefficient use of all housing types. Clustered housing can reduce this negative consequence.
- **Multi-family residential (MFR):** density decreases overall infrastructure and road requirements, reducing energy use due to reduced transportation and infrastructure needs.
- **Commercial (COM):** high onsite imperviousness, including parking needs, and relatively low tree and vegetation cover can increase temperatures and air pollution consequences.
- **Industrial (IND):** high onsite imperviousness and relatively low amounts of vegetation can increase temperatures and air pollution. Tends to have fewer parking needs than COM.
- **Mixed-use centers (MUC):** this land use is energy efficient because it decreases VMT and overall infrastructure requirements. Can offer efficient land use and reduce the amount of land needed, because development types can meet specific local needs. Can provide shared parking and greater efficiency in parking lot layout, thereby reducing imperviousness and negative energy consequences associated with temperature regulation.
- **Rural residential (RUR):** more roads and other infrastructure required per dwelling unit. Higher VMT due to distances residents need to travel to meet their daily needs. However, tends to retain forest canopy and other vegetation, helping to regulate air and water temperatures and improve air quality.
- **Parks and open space (POS):** varies by the intensity of development within the park. Some parks are very natural, contributing to positive temperature regulation and air quality effects. Other parks, such as those with buildings, parking areas and paved boat landings, may increase negative energy effects related to temperature regulation and air quality.

Summary points

- A compact urban form conserves energy by reducing infrastructure and Vehicle Miles Traveled (VMT), and also conserves fish and wildlife habitat outside UGB.
- Trees and other vegetation are a key variable mitigating negative energy impacts. Plants clean and cool air and water, and also reduce air conditioning demand.
- Transportation infrastructure creation and maintenance require energy, whereas transit and alternative transportation modes reduce energy consumption. Program solutions that reduce infrastructure needs and support alternative modes of transportation are likely to reduce overall energy use.
- At the regional scale, fossil fuel use for transportation constitutes a key use of energy and contributes to warming of air and water, as well as air pollution. Reducing vehicle miles traveled, and the infrastructure required to support such travel, is an important variable in reducing energy use. Clustered housing and MUC and MFR zoning types provide three potential ways to reduce VMT and infrastructure needs.

- Protection of fish and wildlife habitat can increase energy use by increasing VMT, because drivers must travel around the protected areas. However, trees and other vegetation also help mitigate negative energy effects. A strong energy solution would include a balance between compact urban form and retention of green infrastructure within the urban area.

CHAPTER 8: SUMMARY AND CONCLUSIONS

Introduction

Integrating the needs of people with the needs of fish and wildlife in an urban environment is not an easy task. There is debate on the value of protecting habitat in urban and developing areas, considering the difficulty many species have cohabiting with humans and the economic value of developable land in urban areas. However, a large body of evidence, both local and nationwide, indicates that people living in urban areas value fish and wildlife habitat. In addition, properties located adjacent to fish and wildlife habitat can have higher economic and social value.

In keeping with these values, Metro's policies have consistently placed a high level of importance on the protection of the natural environment as a means of maintaining the high quality of life citizens of this region expect. The general economic, social, environmental, and energy tradeoffs of allowing, limiting, and prohibiting conflicting uses are summarized in this chapter. The next step of Metro's planning process is to identify the specific ESEE tradeoffs of several program options, after which the Metro Council will make a decision to allow, limit, or prohibit conflicting uses in fish and wildlife habitat areas.

Tradeoffs of allowing, limiting or prohibiting conflicting uses

The Goal 5 rule describes a process in which the economic, social, environmental, and energy consequences of allowing, limiting, and prohibiting conflicting uses are balanced with the need to preserve fish and wildlife habitat. These tradeoffs are described below by fish and wildlife habitat classification and then the differences by general regional zone are highlighted. Metro considers the tradeoffs from a regional perspective. Some of the tradeoffs are different when considering local priorities and concerns, for example from a regional perspective conflicting uses could be relocated or intensified in one area to account for fish and wildlife habitat protection in another. This solution may not address the needs of a city to provide jobs or housing within its jurisdiction, or to protect locally significant fish and wildlife habitat.

Fish and wildlife habitat class

The consequences of allowing conflicting uses vary by habitat class, with negative impacts greater when conflicting uses are allowed in high value fish and wildlife habitat areas. Impacts on undeveloped land would likely be greater than on developed land, depending on the type of program implemented. However, developed land may be impacted when redevelopment activities occur. Here we focus on the impacts to undeveloped land.

Class I riparian/wildlife corridors and Class A upland wildlife

Allow

The tradeoffs of an allow decision would be substantially greater in Class I riparian/wildlife corridors and Class A upland wildlife habitats than in habitat areas with less functional value. There would not be many positive consequences of allowing conflicting uses in these high quality habitat areas. Only seven percent of the unconstrained, buildable land[76] within the

[76] Unconstrained land has no current environmental regulations; buildable land includes vacant lots and portions of developed lots over a certain size. See *Conflicting Uses* chapter for more detailed definitions.

UGB[77] falls within Class I riparian/wildlife, if more vacant land fell within these areas the tradeoffs would be higher. Less than one-fifth of Class I land is zoned for uses which support employment[78] and none is of high employment value,[79] limiting economic benefits of an allow decision. The largest portion (42 percent) of buildable land in Class I riparian/wildlife is zoned for single family use, so a decision to allow would minimize additional property owner concerns about further regulations on their land. Class A wildlife contains about eight percent of unconstrained, buildable land within the UGB, and of that land 77 percent is zoned for single family use. Single family is likely to retain more natural land cover than other zoning types, providing some wildlife habitat and connectivity within the UGB. Only five percent of Class A wildlife is zoned for uses which support employment, and none is ranked as high employment value.

The negative impacts of an allow decision are particularly striking when considering the environmental consequences. Many primary ecological functions and habitat characteristics would be lost, key habitat for sensitive and endangered species would be fragmented and degraded, and nonnative species would likely be introduced. The loss of trees and vegetation would also lead to higher air temperatures and increased energy demand for temperature regulation. The negative economic impacts of an allow decision in these healthy habitat areas would include the loss of ecosystem services, potential increase in municipal expenditures on water quality and flood control, and a high risk of foregoing future ecosystem benefits. The social impact of losing these high value habitat would be greater than lower value areas, since these places are critical to preserving cultural heritage and protecting public health. A decision to allow would negatively impact the salmon that are so important to Native American culture; and the heritage and economy of the Pacific Northwest may face an irreversible loss through habitat loss and degradation.

Prohibit

A decision to prohibit conflicting uses in Class I riparian/wildlife corridors and Class A upland wildlife would result in the most positive environmental consequences. The amount of buildable land impacted would be fifteen percent of the total buildable land in the UGB, which would reduce competition between habitat conservation and development of these high value habitats (Class I and Class A habitat). Preserving the high value habitats would minimize negative environmental consequences but would focus protection efforts on owners of buildable single family land, especially in upland habitat areas. A decision to prohibit would reduce air temperatures but may increase infrastructure needs and commute distances by preventing road development in high value habitats. Some of the negative economic development impacts of a prohibit decision may be mitigated by the value of ecosystem services provided by high quality habitat. The key social tradeoff is between preserving the public social values of habitat while impacting private property rights. A decision to prohibit conflicting uses in these areas would likely require additional density elsewhere in the UGB or an expansion of the UGB to provide sufficient buildable land.

[77] The UGB prior to December 2002.
[78] Land zoned for employment includes mixed-use, commercial, and industrial zones, and does not include parks.
[79] Employment density is based on employees per acre. See Appendix C.

Limit

A decision to limit conflicting uses in Class I riparian/wildlife corridors and Class A upland wildlife habitat would allow some habitat preservation while mitigating the negative economic, social and energy consequences. The impact of limiting development would depend on the type of program implemented, and the results may range from minimal to almost complete protection of ecological functions. Using best management practices and low impact development standards to mitigate the impacts of development could reduce negative environmental, social, energy and economic consequences. Retention of existing habitat would be much cheaper than restoring it later, and also would require less energy.

Class II riparian/wildlife corridors and Class B upland wildlife

Allow

The tradeoffs of allowing conflicting uses in Class II riparian/wildlife would not be as great as in Class I riparian/wildlife corridors but still have a substantial negative impact on ecological function. However, the potential for losing existing ecological functions is reduced because fewer functions are present. A decision to allow may also result in the loss of restoration opportunities to regain ecological functions. The loss of Class II riparian/wildlife corridors would remove existing water quality filtration capacity and other ecological functions, with resulting negative impacts on ecosystem services, social values, and energy use. It also would have a negative environmental impact on Class I riparian/wildlife corridors by removing areas that contribute both primary and secondary function to the streams and water bodies. Class II riparian/wildlife corridors contains about four percent of the unconstrained buildable land within the UGB; thus allowing development in these areas does not have a significant economic benefit. Most of that buildable land is zoned for single family (47 percent), followed by industrial land (25 percent). The positive social and economic benefits of development would accrue to private landowners with an allow decision, while the public benefits would be diminished. Approximately 28 percent of land in Class II riparian/wildlife corridors supports employment, but only one percent is classified as high employment value.

A decision to allow development in Class B upland wildlife would result in the loss of connectivity between habitat patches as well as extensive loss of migratory stopover habitats and movement corridors. This would impact the value of the Class A upland wildlife areas by reducing connectivity among them, with consequent negative social and economic impacts. Class B upland wildlife contains a little over six percent of the buildable land in the UGB. Over 63 percent of that land is zoned for single family use, followed by rural (16 percent) and industrial (10 percent). Single family uses often retain more habitat value if trees and vegetation are preserved, which would reduce the negative environmental, social and energy consequences of a decision to allow development. Only nine percent of Class B upland wildlife land supports employment, and none is classified as of high employment value.

Prohibit

Prohibiting conflicting uses in Class II riparian/wildlife corridors and Class B upland wildlife would result in a number of positive environmental consequences but at the expense of affecting a large number of residential property owners. Preservation of Class II riparian/wildlife corridors and Class B upland wildlife would increase the quality of Class I riparian/wildlife corridors and Class A upland wildlife, maintaining riparian ecological functions and habitat connectivity. A decision to prohibit may result in the need to increase density within the UGB or to expand the boundary. It also would retain restoration opportunities where ecological functions could be regained by increasing tree canopy or removing nonnative plants.

Limit

The tradeoffs of preserving Class II riparian/wildlife corridors and Class B upland wildlife may be addressed by mitigating the negative consequences with a limit decision. The impact of limiting development would depend on the type of program implemented. Using best management practices and low impact development standards to mitigate the impacts of development could reduce negative environmental, social, energy and economic consequences. Retention of existing habitat would be much cheaper than restoring it later, and also would require less energy. These habitat types that are not currently high quality may benefit from limited development if tied to restoration and mitigation.

Class III riparian/wildlife corridors; Class C upland wildlife

Allow

The tradeoffs of allowing conflicting uses in Class III riparian/wildlife corridors and Class C upland wildlife would not be as great as in the higher value habitat areas. Class III riparian/wildlife corridors include smaller forest patches and developed floodplains. The developed floodplains currently provide little ecological value but may provide opportunities for restoration in the future. Isolated smaller forest patches provide some environmental and energy benefits. These areas make up less than one percent of the buildable land in the UGB. Forty-eight percent of that land is zoned for single family, development of which could retain some of the forest canopy. Forty-nine percent of Class III riparian/wildlife corridors is zoned for uses which support employment, but only two percent is classified as high employment value.

Class C upland wildlife patches are of reduced quality compared to A and B upland wildlife and these isolated patches may be associated with increased wildlife mortality on roads. However, Class C upland wildlife patches may provide important habitat for specific wildlife species as well as connectivity along riparian corridors. Class C upland wildlife comprises only about five percent of the buildable land within the UGB, most of which is zoned for single family (37 percent) and industrial (26 percent). Only 25 percent of Class C upland wildlife land is zoned for uses which support employment, and none is classified as high employment value.

Prohibit

The ecological benefits of prohibiting development in Class III riparian/wildlife corridors and Class C upland wildlife would not be commensurate with the negative economic, social and energy consequences for the property owners in these areas. However, the impact on buildable land would be minimal, reducing the regional impact of preserving these areas.

Limit

A decision to limit conflicting uses in Class III riparian/wildlife corridors and Class C upland wildlife could preserve some habitat value while mitigating the negative consequences of protection. Class III riparian/wildlife corridors and Class C upland wildlife could provide important sites for restoration, improving the overall habitat quality for all habitat classes.

Impact areas

Allow, Limit, Prohibit

The negative consequences of allowing conflicting uses in impact areas would be substantially less for all four ESEE factors than in higher value fish and wildlife habitat categories. Impact areas provide little existing ecological function, so the environmental benefit of limiting or prohibiting conflicting uses is low. However, these areas provide important opportunities for landowner education, stewardship and restoration. With redevelopment a limit decision that directs the use of low impact development standards and best management practices could help the overall ecosystem to regain ecological function over time.

Regional zones

Most of the impacts of allowing conflicting uses would be the same across regional zones and are described in Table 8-1; the differences are described below.

Single family residential (SFR)

For single-family uses, the tradeoffs include many of the most sensitive social issues. Single-family zoning comprises the largest portion (46 percent) of the fish and wildlife habitat inventory, and includes 23 percent of the total unconstrained buildable land within the UGB. A decision to allow conflicting uses minimizes additional restrictions on the development potential of land, reducing possible impacts on personal financial security and regulatory or perceptual takings. Allowing conflicting uses on vacant land may impact established neighborhoods, changing neighborhood character and impacting property owners. With a limit decision, single family uses provide opportunities to balance the competing needs of habitat protection and property development rights. These lands often retain trees and vegetation and also provide opportunities for stewardship and landowner education. However, residential uses may increase offsite roads and infrastructure. Prohibiting conflicting uses completely would adversely affect a large number of residential property owners, but would retain habitat and neighborhood character.

Multi-family residential (MFR)

The most important tradeoff to consider in a decision to allow, limit, or prohibit development on land zoned for multi-family is the impact on capacity within the UGB. However, land zoned for multi-family accounts for only five percent of the total fish and wildlife habitat inventory and only one and a half percent of the total unconstrained buildable land within the UGB. Thus, limiting or prohibiting conflicting uses on multi-family land would have a minimal impact on housing capacity. Multi-family development tends to have fewer infrastructure requirements per dwelling unit as compared to single family, reducing the cost of development (economic and energy) but increasing vegetation loss and impervious surfaces. With a limit decision, this zoning type allows for substantial preservation of the habitat along with development if low impact development standards are applied in conjunction with best management practices.

Mixed-use centers (MUC)

A key tradeoff to consider for mixed-use centers is their importance in supporting the 2040 Growth Concept and providing housing and employment capacity within the UGB. Mixed-use centers comprise only two percent of the fish and wildlife habitat inventory, and almost two percent of the total unconstrained buildable land in the UGB. Mixed-use centers allow residents the opportunity to live near their work, which tends to reduce vehicle miles traveled and the related negative water quality impacts and energy use. Less time spent commuting also allows people time to spend with family, on hobbies or recreational activities. However, the increased levels of impervious surfaces and tree loss add to the urban heat island effect and contribute to global warming. Mixed-use centers may provide some opportunity for habitat preservation along with development, depending on the type of program implemented.

Commercial (COM)

For commercial uses the most important tradeoff to consider is the impact on employment and shopping opportunities. Commercially zoned land accounts for five percent of the fish and wildlife habitat inventory, and only one and a half percent of the total unconstrained buildable land in the UGB. Allowing conflicting uses in commercially zoned areas reduces employment impacts specific to development use and does not affect related income and income tax revenue to municipalities. However, similar to mixed-use centers, the increased levels of on-site impervious surfaces have negative environmental and energy impacts. Commercial land uses tend to be more land extensive than single family or multi-family uses, thus reducing the ability to preserve ecological function while allowing development. However, some ecological functions could be retained with a limit decision by requiring low impact development and best management practices.

Industrial (IND)

Industrial uses provide employment and an income base for the region, a critical tradeoff to consider when protecting fish and wildlife habitat. Land zoned for industrial use comprises 14 percent of the fish and wildlife habitat inventory, but only six percent of the total unconstrained buildable land in the UGB. Additionally, most of the habitat land zoned for industrial use is classified as having a low employment density, minimizing the economic development impacts of a limit or prohibit decision. Industrial development tends to be very land extensive, maximizing vegetation loss; increased toxins may be present. Instituting low impact development standards and best management practices with a limit decision may preserve some of the ecological functions while reducing negative economic impacts.

Rural (RUR)

An important tradeoff to consider in rural areas is the impact of allowing conflicting uses on the regional identity and preservation of land for development in the future. Rural areas serve as visual greenbelts and also maintain land in agricultural uses near the UGB. Rural zoning comprises seven percent of the fish and wildlife habitat inventory and seven percent of the total unconstrained buildable land in the UGB. Outside of the UGB but within Metro’s jurisdiction, rural residential is the predominate use. Rural uses provide important connector habitat, but allowing conflicting uses in rural areas can have negative environmental effects such as livestock degradation of riparian areas and water quality impacts of leaky septic tanks. A limit decision would provide opportunities to preserve habitat while allowing some development to occur.

Parks and open space (POS)

A key consideration for parks and open space uses is the need for active recreation facilities versus using public land to preserve habitat for the public benefit. Land in use as parks and open space makes up 20 percent of the fish and wildlife habitat inventory, but provides a negligible amount of unconstrained buildable land. Publicly owned lands offer the main opportunity to preserve habitat for the public benefit without negatively impacting private property owners.

Key points

Following completion of the ESEE analysis, Metro staff will develop alternatives for implementing programs to protect regionally significant fish and wildlife habitat. These alternatives will be analyzed based on the ESEE tradeoffs identified above, and will be evaluated using criteria developed from the key points described below. This section identifies some of the implications from the analysis that may be relevant to developing and evaluating Goal 5 alternatives.

Economic

1. **Fish and wildlife habitat and the ecosystem services they provide have economic value.** Decisions that protect or enhance ecosystem services have a positive effect on the economy. In some cases it is more cost effective to protect fish and wildlife habitat than it is to undertake restoration or build engineered structures to provide for flood control, water quality, and other ecosystem services.
2. **Development status of fish and wildlife habitat moderates the types, intensity, and distribution of economic consequences.**
   - Most fish and wildlife habitat is in park status, developed with existing uses, or constrained by existing regulatory programs protecting streams, wetlands, floodplains, and steep slopes near streams (34 percent of the habitat is in park status, 22 percent is developed, and 16 percent is vacant constrained). The majority of high value fish and wildlife habitat (71 percent of Class I riparian/wildlife and 59 percent of Class A upland wildlife areas) is already in parks/open space or constrained.
   - While fish and wildlife habitat comprises 41 percent of the unconstrained buildable land supply within the 2002 UGB, the highest value habitat comprises 20 percent of the region's buildable land supply. This reduces the competition between conservation and development of high value fish and wildlife habitat.
   - The degree to which development is limited within fish and wildlife habitat, especially vacant buildable lands, will directly affect the need for compensatory actions such as increasing densities within the UGB and expanding the UGB.
   - Single-family lands deserve special attention given that they account for a large proportion of fish and wildlife habitat (46 percent). How these lands are treated in protection programs will influence the development value and habitat value of these lands.
   - Conflicts are highest on the 14 percent of fish and wildlife habitat lands in industrial zoning. About 61 percent of these lands scored high for at least one measure of development value. How conflicts are resolved in these areas have implications on employment and potentially the need to expand the UGB.
3. **A majority of fish and wildlife habitat occurs outside areas of intensive urban development.** Economic consequences of decisions to limit or prohibit conflicting uses on these lands will affect economic activities with low land value and employment density, relative to the Portland city center. However, these decisions will have a more significant impact on land values than on employment.

- A majority of high value fish and wildlife habitat (83 percent of Class I riparian/wildlife and 95 percent of Class A upland wildlife) is not zoned to support employment, and land that does support employment is mostly of low employment value (no land in these categories is of high employment value).
- Moderate and low value fish and wildlife habitat supports more employment compared to high value habitat, but most employment values remain low.
- A significant proportion of fish and wildlife habitat occurs in areas that have some development value, but compared to the Portland city center, the development values are low.

4. **Limit and prohibit decisions would affect primarily 2040 design types with lower expected levels of urbanization (i.e., inner and outer neighborhoods)**. However, these areas cover a majority of the urban landscape, so the decisions would impact a large number of property owners.
5. **The fact that limit or prohibit decisions would affect land with lower property values and employment density does not mean that the regional consequences of such decisions would be trivial.** The cumulative property value or employment affected could be significant depending on the details of the regional program and the nature of mitigating actions (such as increasing densities within centers or expanding the UGB)
6. **Decisions that result in protection of fish and wildlife habitat may reduce the future costs to municipalities of complying with environmental regulations such as the federal Endangered Species Act and the federal Clean Water Act.** Likewise, degrading fish and wildlife habitat increases the likelihood that future municipal expenditure to comply with environmental laws will increase.
7. **Relocation of conflicting uses within the current UGB, or expanding the UGB, has the potential to mitigate the adverse effects of limit and prohibit decisions on land value and employment.** However, expanding the UGB may increase expenditures associated with vehicle miles traveled, extending or expanding infrastructure, and other urban growth expenditures. At the local scale, relocating conflicting uses to another jurisdiction or expansion of the UGB may not mitigate adverse effects unless the expansion occurs nearby.

Social

1. **Protection of fish and wildlife habitat preserves many important social values.** These include our cultural heritage, regional identity, sense of place, and neighborhood character. Property owners may also benefit from the retention of fish and wildlife habitat through increased property values. Opportunities for education abound in areas with healthy fish and wildlife habitat.
2. **The distribution of the regulatory burden on property owners to protect fish and wildlife habitat for the general public benefit is a critical social concern.** Private property rights are a fundamental cornerstone of American life, and additional regulations reducing development rights may be seen as an attack on personal financial security as well as a possible taking. However, there are public rights to clean air and water, as well as healthy fish and wildlife, which serve as a counterbalance to this view.
3. **Fish and wildlife habitat provide positive benefits to public health and safety, but there are some negative effects.** There are many obvious benefits of recreation, as well as the mental health and stress relief found in nature. Additionally, minimizing the incidence of

flooding and erosion contributes to public safety. However, increased forest canopy and vegetation could lead to wildfire risks and potential damage from windstorms.

4. **People today have a responsibility to provide future generations with some of the same benefits that current residents enjoy.** Sustainable development practices allow for development to occur today while maintaining a certain amount of intergenerational equity.

Environmental

1. **Trees are invaluable to the health of fish and wildlife habitat.** It is important both near streams and throughout the watershed, as affirmed by local studies. Trees provide habitat, absorb pollution and excess nutrients, and slow and retain stormwater, reducing hydrologic alterations.
2. **Hydrologic changes have far-reaching negative consequences.** Reducing or mitigating impervious surfaces and stormwater impacts is necessary to mimic natural water flow patterns.
3. **Consequences to fish habitat depend on habitat value.** For example, loss of high-value Class I riparian/wildlife habitat would have a stronger ecological impact than Class II or Class III habitat. Loss of high-value riparian habitat would also result in loss of high-value wildlife habitat, because Class I riparian/wildlife habitat include some high-value wildlife habitat (including Habitats of Concern).
4. **Consequences to wildlife habitat also depend on habitat value, but with different implications than fish habitat.** Because connectivity is important to wildlife, the loss of any component in the system may reduce the value of nearby wildlife habitat patches. For example, preserving two Class A upland wildlife habitat patches will be most valuable to wildlife if connectivity is retained, and the connecting patches are typically Class B or C upland wildlife. If only Class A upland wildlife is preserved, its value will be reduced due to the loss of nearby Class B and C upland wildlife.
5. **Homes surrounded by trees can provide important wildlife habitat.** Resident native birds are most diverse in developed areas with plenty of forest canopy. A limit decision provides opportunities to preserve important fish and wildlife habitat while allowing for some conflicting uses, especially in residential zones.

Energy

1. **Trees and other vegetation are a key variable mitigating negative energy impacts.** Plants clean and cool air and water, and also reduce air conditioning demand.
2. **Transportation infrastructure creation and maintenance require energy, whereas transit and alternative transportation modes reduce energy consumption.** Program solutions that reduce infrastructure needs and support alternative modes of transportation can reduce overall energy use.
3. **At the regional scale, fossil fuel use for transportation constitutes a key use of energy and contributes to warming of air and water, as well as air pollution.** Reducing vehicle miles traveled, and the infrastructure required to support such travel, is an important variable in reducing energy use. Clustered housing in single family zones, as well as mixed-use centers and multi-family zoning types provide three potential ways to reduce VMT and infrastructure needs.

4. **Protection of fish and wildlife habitat can increase energy use by increasing VMT, because drivers must travel around the protected areas.** However, trees and other vegetation also help mitigate negative energy effects. A limit decision could provide a balance between compact urban form and retention of green infrastructure within the urban area.

Next steps

The right balance between preserving and developing fish and wildlife habitat is not obvious. Allowing 100 percent of the desired development activities or protecting 100 percent of the habitat areas from development will not satisfy the many competing interests, as described above. The ESEE tradeoffs and key points identified in this report create a base of facts as a foundation for the public debate and decision making process. Metro's ESEE analysis shows the difficulty inherent in balancing the goals of protecting fish and wildlife habitat and providing for the development needs of the region.

The next step in Metro's planning process involves defining several program options for protecting fish and wildlife habitat. The tradeoffs associated with each option will be evaluated and compared, providing valuable information to the Metro Council as it considers a final decision to allow, limit, or prohibit conflicting uses in regionally significant fish and wildlife habitat areas.

Table 8-1. ESEE consequences of allowing, limiting and prohibiting conflicting uses by habitat class

ESEE Consequences of ***ALLOWING*** conflicting uses				
Habitat type	**Economic**	**Social**	**Environment**	**Energy**
CLASS I RIPARIAN *Score: 18-30* *3-5 primary functions, plus secondary functions*	+ Property owners realize full development potential + Supports intrinsic value of built environment + No affect on employment and income related to development activities + Buildable land with habitat accounts for almost half of the total buildable land in UGB, reduces need to expand UGB by allowing development + SFR: No impact on development value on large portion of habitat land + IF a restoration component is included impacts on ecosystem services could be mitigated but at higher cost – Negative impacts on employment and income that depend on quality of riparian and wildlife habitat – Increased municipal spending on flood and water quality management – Cumulative negative impacts on all ecosystem services (e.g., flood management, water-quality) – Increases risk of foregoing future uses and benefits associated with habitat – Increases risk of irreversible outcome (e.g., extinction of salmon) that may have future negative economic consequences – May increase cost of municipal compliance with federal regulations (ESA) – Majority of habitat occurs on land with low development value and employment density, protection of ecosystem values could occur with less economic impact	+ Maintain housing and employment options + No change in property rights + No takings concerns + Equitable impact on property owners + SFR: Maintain personal financial security (equity) + MUC: Does not impact 2040 densities and development in centers + MUC: Allows residents opportunity to live near where they work + POS: Maintain or increase opportunities for active recreation – May lose cultural heritage – May not protect salmon and thus impact Native American culture and regional identity – May change neighborhood character and sense of place – Scenic values may be lost – Incompatible land uses may lose buffers – May degrade environmental quality and impact health – May lose recreational and educational opportunities – Loss of tree canopy and vegetation may increase stress levels and impact mental health – Aggression and violent behavior could increase – May increase risk of landslides and floods if tree canopy and vegetation is removed – Loss of intergenerational equity	+ **Functional consequences:** no positive consequences beyond that provided by existing protection + Reduced need for UGB expansion + SFR: may retain more trees/ vegetation + MFR: Increased density within UGB reduces need for UGB expansions + MFR: Decreased infrastructure requirements per dwelling unit decreases overall infrastructure/roads + MUC: tends to reduce VMT, reducing water quality impacts – **Functional consequences:** loss of 3-5 primary ecological functions – Likely harm to salmon and wildlife through habitat loss and degradation – Increased pesticide and fertilizer use degrades water quality – Landscaping uses water – Continued development in flood areas – Continued wetland conversion – Nonnative species introductions – MFR: tends to retain less vegetation and add more imperviousness – IND: Increased imperviousness and decreased canopy cover increase negative ecological effects – IND: Increased toxins may be associated with this land use – IND: Can be particularly detrimental to water quality – RUR: Livestock degrade riparian area – RUR: Septic tanks are common and may leak, reducing water quality	+ Contributes to efficiencies in provision of services + More compact development may reduce VMT (Vehicle Miles Traveled per person) and fossil fuel use + Reducing VMT and fossil fuel use reduces air pollutants and heat + MUC: High density centers reduce VMT, infrastructure, energy use + RUR: Imperviousness is typically lower and vegetation cover higher, reducing Urban Heat Island effect – Loss of trees and increased imperviousness lead to Urban Heat Island effect and global warming; higher air conditioning (AC) demand – Warmer air warms water; harms salmon – Increased energy consumption to provide engineered solutions to manage stormwater flow, reduce soil erosion, keep water cool, etc. – SFR: associated with increased offsite roads and infrastructure – MFR, COM, IND: Increased onsite imperviousness and tree loss add to Urban Heat Island effect and global warming on a per-acre basis – IND: Placement within the floodplain is common, increasing energy-requiring flood mitigation

ESEE Consequences of ***ALLOWING*** conflicting uses				
Habitat type	**Economic**	**Social**	**Environment**	**Energy**
CLASS II RIPARIAN *Score: 6-17* *1-2 primary functions and some secondary functions*	+ *Same as Class I riparian* − *Same as Class I Riparian, except less risk*	+ *Same as Class I riparian* − *Same as Class I Riparian, except less risk*	+ *Similar to Class I riparian habitat* − *Similar to Class I riparian habitat, except:* − Loss of restoration opportunities to regain ecological functions − Loss of functionality would be less because fewer ecological functions are present; however, loss of Class 2 Riparian removes existing water quality filtration capacity and other ecological services	+ *Same as Class I Riparian* − *Same as Class I Riparian, except less risk*
CLASS III RIPARIAN *Score: 1-5* *No primary functions, no wildlife value: includes small forest patches and developed floodplain*	+ *Same as Class I Riparian* − *Same as Class I Riparian, except less risk*	+ *Same as Class I Riparian* − *Same as Class I Riparian, except less risk*	+ *Similar to Class I riparian habitat, except:* + Class 3 Riparian ecological functions are already reduced, thus allowing conflicting uses does not have a significant impact on overall ecological function − *Similar to Class II riparian habitat, except:* − The potential for losing existing ecological functions is reduced	+ *Same as Class I Riparian* − *Same as Class I Riparian, except less risk*

ESEE Consequences of ***ALLOWING*** conflicting uses				
Habitat type	**Economic**	**Social**	**Environment**	**Energy**
CLASS A WILDLIFE *Score 7-9* *no primary riparian function but may contain secondary riparian functions*	+ *Same as Class I riparian* - *Same as Class I riparian*	+ *Same as Class I riparian* + Less vegetation may reduce risk of wildfires + Less habitat may reduce number of undesirable species - *Same as Class I Riparian*	+ *Similar to Class I riparian habitat* + **Functional consequences:** no positive consequences noted + SFR: may retain more natural land cover than other zoning, providing wildlife habitat and connectivity + MFR, MUC: Increased density in UGB may limit expansion to new areas + RUR: Less habitat fragmentation; tends to retain more connectivity + RUR: agricultural areas can provide important grassland habitat - **Functional consequences:** Loss of key habitat characteristics - Extensive loss of valuable wildlife habitat - Nonnative plant and animal species invasions - Increased adverse edge effects - Pesticides may harm wildlife - Noise and light disturbances - Continued native species loss over time, reduction in migratory songbirds - Decline of at-risk wildlife species; more species imperiled - Continued loss of Habitats of Concern and associated species - Mortality from roadway crossings - MFR: higher onsite imperviousness, increased negative effects on wildlife and migratory songbirds - COM, IND: Increased imperviousness and decreased canopy cover - COM, MUC: Increased human disturbance	+ *Same as Class I Riparian* - *Same as Class I Riparian*

ESEE Consequences of ***ALLOWING*** conflicting uses				
Habitat type	**Economic**	**Social**	**Environment**	**Energy**
CLASS B WILDLIFE *Score 4-6* *no primary riparian function but may contain secondary riparian functions*	+ *Same as Class I Riparian* − *Same as Class I Riparian, except less risk*	+ *Same as Class A Wildlife* − *Same as Class A Wildlife, except less risk*	+ *Similar to Class I Riparian* + *Similar to Class A Wildlife* − *Similar to Class A Wildlife, except:* − Habitat interior loss less extensive than Class A − Loss of connectivity especially pronounced; extensive loss of migratory stopover habitat and movement corridors. Reduces value of Class A patches. − Loss of grassland and low-structure vegetation within 300 ft of streams − Loss of locally rare migratory stopover habitat and locally rare habitat patches with water resources	+ *Same as Class I Riparian* − *Same as Class I Riparian, except less risk*
CLASS C WILDLIFE *Score 2-3* *no primary riparian function but may contain secondary riparian functions*	+ *Same as Class I Riparian* − *Same as Class I Riparian, except less risk*	+ *Same as Class A Wildlife* − *Same as Class A Wildlife, except less risk*	+ *Similar to Class I Riparian and Class A Wildlife* + These patches tend to be relatively small, isolated, and lacking substantial water resources, and are therefore reduced in quality compared to Class A and B + Isolated patches may be associated with increased wildlife mortality on roadways − *Similar to Class B, except:* − Only limited loss of habitat interior − Some loss of connectivity between patches − Important loss of migratory stopover habitat, these patches tend to occur in areas lacking substantial wildlife habitat − Loss of upland patches lacking water resources but providing important habitat to specific wildlife species	+ *Same as Class I Riparian* − *Same as Class I Riparian, except less risk*

ESEE Consequences of ***ALLOWING*** conflicting uses				
Habitat type	**Economic**	**Social**	**Environment**	**Energy**
Riparian impact area	+ Positive consequences depend on the general zone − Negative consequences depend on the general zone	+ Positive consequences depend on the general zone − Negative consequences depend on the general zone	+ Opportunities for landowner education may reduce effects of existing and future environmentally harmful practices near waterways − Potential for increased adverse impacts (e.g., pollution, altered hydrology, pesticide use, bacterial contamination, human disturbance…) to waterways due to existing and new conflicting uses in areas adjacent to waterways − These impacts are greater than in other areas because they are near water and because non-habitat areas tend to lack natural filtration provided by riparian vegetation	
Vegetation impact area	+ Positive consequences depend on the general zone − Negative consequences depend on the general zone	+ Positive consequences depend on the general zone − Negative consequences depend on the general zone	+ Opportunities for landowner education may reduce effects of existing and future environmentally harmful practices − Potential for increased adverse effects adjacent to habitat areas, primarily forested but also low-structure vegetation	

ESEE Consequences of ***LIMITING*** conflicting uses				
Habitat type	**Economic**	**Social**	**Environment**	**Energy**
CLASS I RIPARIAN *Score: 18-30* *3-5 primary functions, plus secondary functions*	+ *Extent of impact depends on program:* + IF a restoration component is included impacts on ecosystem services could be mitigated but at higher cost + Intrinsic value of built environment can be retained if balanced with habitat needs + Positive to neutral impact on employment and income that depend on quality of riparian and wildlife habitat + Reduces municipal spending on flood and water quality management + Reduces risk of foregoing future uses and benefits associated with habitat + Reduces risk of irreversible outcome (e.g., extinction of salmon) that may have future negative economic consequences + May decrease cost of municipal compliance with federal regulations (ESA) + Majority of habitat occurs on land with low development value and employment density, protection of ecosystem values could occur with less economic impact + Primarily affects 2040 design types with lower expected levels of urbanization + Reduces cumulative negative impacts on all ecosystem services (e.g., flood management, water-quality) + SFR: Large portion of habitat, decisions on access/layout influences development and habitat value − Development potential of property is limited − Some effect on employment and income related to development activities − Buildable land with habitat accounts for almost half of the total buildable land in UGB, may impact need to expand UGB by limiting development − SFR: May substantially impact development value	+ Preserve some buffers between uses + Retain some or most cultural heritage + Provide salmon chance for recovery, lessen impacts on Native American culture and regional identity + Retain most neighborhood character and sense of place + Preserve most scenic values + Maintain environmental quality and reduce negative health impacts + Retain most educational and recreational opportunities + Retention of tree canopy/vegetation may reduce stress levels and positively impact mental health + Reduce risk of landslides and floods + Provide some intergenerational equity + SFR, MFR, MUC: Maintain housing options/affordability if development minimally impacts the habitat + COM, MUC, IND: Maintain employment opportunities + POS: Increase active recreation opportunities if habitat minimally impacted − Property rights: owners may not be able to develop land to same extent − Takings concerns − Inequitable to property owners − SFR: May reduce option for large lot single family homes − SFR: May impact property values, decreasing personal financial security − SFR, MFR, MUC: May reduce housing options/affordability if development minimally impacts the habitat − COM, MUC, IND: May reduce employment opportunities − POS: May reduce opportunities for active recreation	+ **Functional consequences:** May conserve some of 3-5 existing primary ecological functions, depending on program, as well as Class A or B wildlife habitat falling within Class I riparian; extent depends on program + Reduced need for UGB expansion + Strong potential for BMP implementation and low impact development and innovative design standards + Hydrology less altered than "allow" + MFR: Increased density within UGB reduces need for expansions + MFR: Decreased infrastructure requirements per dwelling unit reduces negative ecological effects + MUC: reduced VMT, fewer water quality impacts from transportation runoff − **Functional consequences:** Potential for substantial loss of 3-5 primary ecological functions, as described in ALLOW. Class A or B wildlife habitat falling within Class I riparian would also be compromised. Extent of loss depends on program. *See comments under "allow," except:* − Hydrology less altered, less stream damage − Greater flood area/wetland protection − Greater protection of steep slopes − Fish and other aquatic wildlife habitat impaired, but extent of loss reduced − Water quality impacts likely, but degree depends on program − MFR, MUC, COM, IND: Loss of ecological functions greater than SFR due to increased imperviousness and tree loss − IND: Increased toxins may be associated with this land use type − RUR: Septic tanks may leak bacteria into waterways, reducing water quality	+ **May reduce new infrastructure requirements** + **Reducing VMT and fossil fuel use reduces air pollutants and heat** + **Increased forest cover helps remove air pollutants and reduce smog** + **Increased forest cover cools air by shade, evapotranspiration, carbon storage; reduced Urban Heat Island effect, global warming, and AC demand** + **May result in decreased energy consumption to manage stormwater runoff, reduce sedimentation and erosion and keep water cool** + **Tree retention is cheaper, easier, and less energy-consumptive than planting new** + **MFR: Requires less land per unit than SFR, reducing extent of tree loss, infrastructure, UGB expansions** + **MUC: Higher density centers create compact urban form, reducing VMT, infrastructure**, energy use **Negative consequences similar to "ALLOW", but to a lesser degree** − Avoiding sensitive natural areas may increase infrastructure requirements − May lead to increased VMT − May result in need for UGB expansion − Loss of trees increases Urban Heat Island effect, global warming, AC demand − Warmer air warms water; harms salmon and other species − MFR, COM, IND: Increased onsite tree loss and imperviousness add to Urban Heat Island effect and global warming − COM, IND: May increase energy consumption to replace natural systems − IND: Placement within the floodplain is common, increasing energy-requiring flood mitigation

ESEE Consequences of ***LIMITING*** conflicting uses				
Habitat type	**Economic**	**Social**	**Environment**	**Energy**
CLASS II RIPARIAN *Score: 6-17* *1-2 primary functions and some secondary functions*	**+** *Same as Class I riparian* **−** *Same as Class I riparian, except less risk*	**+** *Same as Class I riparian* **−** *Same as Class I riparian, except less risk*	**+** *Similar to Class I riparian habitat* **+** Retains restoration opportunities where ecological functions could be regained through tree canopy increases or other measures **−** *Similar to Class I riparian resources, except:* **−** Some loss of features providing ecological functions (scores 6-17), unless offset by mitigation and restoration activities	**+** *Same as Class I Riparian* **−** *Same as Class I Riparian, except less risk*
CLASS III RIPARIAN *Score: 1-5* *No primary functions, no wildlife value: includes small forest patches and developed floodplain*	**+** *Same as Class I riparian* **−** *Same as Class I riparian, except less risk*	**+** *Same as Class I riparian* **−** *Same as Class I riparian, except less risk*	**+** *Similar to Class II riparian habitat* **−** *Similar to Class II riparian habitat, except:* **−** Loss of opportunities to add forest canopy along streams where low structure currently exists	: *Same as Class I Riparian* **−** *Same as Class I Riparian, except less risk*

ESEE Consequences of ***LIMITING*** conflicting uses				
Habitat type	**Economic**	**Social**	**Environment**	**Energy**
CLASS A WILDLIFE *Score 7-9* *no primary riparian function but may contain secondary riparian functions*	+ *Same as Class I riparian* − *Same as Class I riparian*	+ *Same as Class I riparian* − *Same as Class I riparian* − More vegetation could increase risk of wildfires − Less habitat could increase nuisance species	+ **Functional consequences:** Some retention of key habitat attributes (patch size, habitat interior, connectivity and water resources) for habitat outside Class I riparian + More habitat retained than Allow + Reduced edge effects + Fewer nonnative species invasions + More connectivity retained + Less harm to native species + Reduced need for UGB expansion + Landscaping can provide diverse habitats + Low to moderate levels of development provide good habitat for some species + MFR: Increased density in UGB may limit expansion to new areas, protecting important outlying habitats + RUR: Less habitat fragmentation; tends to retain more connectivity + RUR: agricultural areas can provide important grassland habitat *Similar to "allow," but to a lesser degree depending on program options* − **Functional consequences:** Potential for *reduction* in habitat patch size, connectivity, and amount of interior habitat, reducing ecological function − Wildlife crossings across roadways cause mortality − MFR, COM, MUC, IND: More onsite imperviousness and less forest/vegetation increase negative effects on wildlife and migratory songbirds − MFR, COM, MUC, IND: Higher level of development is less valuable to wildlife − MFR, COM, MUC, IND: Increased human disturbance may negatively impact wildlife, but to a lesser degree than allow − RUR: Increased toxins may be associated with agriculture	+ *Same as Class I riparian* − *Same as Class I riparian, except less risk*

ESEE Consequences of ***LIMITING*** conflicting uses				
Habitat type	**Economic**	**Social**	**Environment**	**Energy**
CLASS B WILDLIFE *Score 4-6 no primary riparian function but may contain secondary riparian functions*	+ *Same as Class I Riparian* – *Same as Class I Riparian, except less risk*	+ *Same as Class A Wildlife* – *Same as Class A Wildlife, except less risk*	*Similar to Class A, except:* + More habitat connectivity between large habitat patches retained + Grassland and low structure habitat within 300 ft of stream may be retained + Low to moderate levels of development provide good habitat for some species, most pronounced in Class A patches *Similar to "ALLOW," but to a lesser degree depending on program options* – To the extent the resource removed, habitat and connectivity will be lost – MFR: More onsite imperviousness and less forest and vegetation increases negative effects on wildlife and migratory songbirds – MFR, COM, IND, MUC: Higher density development less valuable to wildlife – MFR, COM, IND, MUC: Increased human disturbance may negatively impact wildlife	+ *Same as Class I Riparian* – *Same as Class I Riparian, except less risk*
CLASS C WILDLIFE *Score 2-3 no primary riparian function but may contain secondary riparian functions*	+ *Same as Class I Riparian* – *Same as Class I Riparian, except less risk*	+ *Same as Class A Wildlife* – *Same as Class A Wildlife, except less risk*	*Similar to Class B, except:* + Most are small forested patches + Less likely to provide good habitat for some species, because these patches tend to be narrow, disconnected, and surrounded by development + Isolated patches may be associated with increased wildlife crossing mortality on roadways *Similar to "allow," but to a lesser degree depending on program options* – To the extent that conflicting uses remove the resource, habitat and connectivity will be lost	+ *Same as Class I Riparian* – *Same as Class I Riparian, except less risk*

ESEE Consequences of ***LIMITING*** conflicting uses				
Habitat type	**Economic**	**Social**	**Environment**	**Energy**
Riparian impact area	+ Positive consequences depend on the general zone − Negative consequences depend on the general zone	+ Positive consequences depend on the general zone − Negative consequences depend on the general zone	+ Retains restoration opportunities where riparian functions could be regained through planting tree canopy or other measures + May help protect existing water resources from current or future adverse effects due to conflicting uses + Provides mitigation opportunities + Incentives and landowner education could enhance ecological health over time − Similar to “allow,” but to a lesser degree	+ Positive consequences depend on the general zone − Negative consequences depend on the general zone
Vegetation impact area	+ Positive consequences depend on the general zone − Negative consequences depend on the general zone	+ Positive consequences depend on the general zone − Negative consequences depend on the general zone	+ Retains restoration opportunities where habitat patch functions could be regained through planting tree canopy or other measures; for example, potential for decreased edge effects, increased interior habitat and increased connectivity to other patches and to water resources + Provides mitigation opportunities + Incentives and landowner education could enhance ecological health over time − *Similar to “allow,” but to a lesser degree*	+ Positive consequences depend on the general zone − Negative consequences depend on the general zone

ESEE Consequences of ***PROHIBITING*** conflicting uses

Habitat type	Economic	Social	Environment	Energy
CLASS I RIPARIAN *Score: 18-30* *3-5 primary functions, plus secondary functions*	+ Positive impact on employment and income that depend on quality of riparian and wildlife habitat + Minimizes municipal spending on flood and water quality management (as long as takings issues are avoided) + Minimizes risk of foregoing future uses and benefits associated with habitat + Minimizes risk of irreversible outcome (e.g., extinction of salmon) that may have future negative economic consequences + May decrease cost of municipal compliance with federal regulations (ESA) + Majority of habitat occurs on land with low development value and employment density, protection of ecosystem values could occur with less economic impact + Most habitat is on land with 2040 design types with lower expected levels of urbanization + Minimizes cumulative negative impacts on all ecosystem services (e.g., flood management, water-quality) – Does not support intrinsic value of built environment – Development potential of property is impacted substantially – Major affect on employment and income related to development activities if buildable land decreased – Buildable land with habitat accounts for almost half of the total buildable land in UGB, likely to impact need to expand UGB by prohibiting development – SFR: Likely to have substantial impact on development value on large portion of habitat	+ Preserve cultural heritage + Provide salmon a chance to recover and lessen impacts on Native American culture and regional identity + Preserve or increase buffers between incompatible land uses + Retain neighborhood character/sense of place + Preserve scenic values + Maintain and possibly improve environmental quality and reduce negative health impacts + Retain educational and recreational opportunities + Retention of tree canopy and vegetation may reduce stress levels and positively impact mental health + Reduce risk of landslides and floods + Provide intergenerational equity – Inequitable impact on property owners – Property rights: owners may not be able to develop land to same extent – Likely to result in takings concerns – SFR: Possible negative impact on property values, decrease in equity – SFR, MFR, MUC: Reduce housing options and opportunities – SFR, MFR, MUC: May impact housing affordability – MUC: Negative impact to 2040 if development in centers is curtailed – COM, IND, MUC: Reduce employment options and opportunities – POS: Reduce opportunities for active recreation	+ Functional consequences: Preservation of the most ecologically functional riparian areas, as well as some of the most important wildlife habitat remaining in the region, including Habitats of Concern + Helps maintain hydrologic connectivity + Minimizes hydrologic alterations, reduces flooding + Retention of important salmon habitat + IND: Minimize water quality degradation + RUR: Fewer water quality problems associated with leaky septic tanks, livestock + POS: Could help prevent human/pet disturbance to wildlife – **Functional consequences**: no adverse consequences for Class I habitat – Increased need for UGB expansion – Potential for increased infrastructure intrusion into other habitat areas if Class I riparian areas are avoided – MFR, MUC: Opportunity for increased density reduced, thereby increasing need for UGB expansion – RUR: Rural lands are low density and therefore tend to require more infrastructure per dwelling unit, increasing VMT and decreasing water quality	+ **Retention of tree canopy and other vegetation may provide strong protection from warmer air and water from Urban Heat Island effect and global warming** + **Opportunity for pleasant, accessible alternative means of transportation such as walking and bicycling through natural areas, if permitted under program** + **Likely to result in decreased need for future** restoration and flood mitigation – Limits transportation planning options – Limits infrastructure placement options – Increases extent of urban area and VMT – Potential for increased total imperviousness due to increased roads; energy is required to build and maintain roadways and other infrastructure – If utilities are prohibited from being installed along streams, may require pumping or other activities to take non-gravity driven pathways – Increased VMT, fossil fuel use, air pollution, related warming of air and water – Extent of Urban Heat Island effect may increase, potentially increasing AC demand – MUC: Most energy-efficient land use; prohibit decision would reduce energy saving opportunities

ESEE Consequences of ***PROHIBITING*** conflicting uses				
Habitat type	**Economic**	**Social**	**Environment**	**Energy**
CLASS II RIPARIAN *Score: 6-17* *1-2 primary functions and some secondary functions*	+ *Same as Class I riparian* − *Same as Class I riparian, except less risk*	+ *Same as Class I riparian* − *Same as Class I riparian, except less risk*	+ Similar to Class I riparian habitat + Retention of some critical ecological functions and ecosystem services provided by existing natural resources + Retains restoration opportunities where ecological functions could be regained through tree canopy increases or other measures + Provides mitigation opportunities − *Similar to Class I riparian habitat, except:* − Increased need for UGB expansion, but less so than prohibit decision in Class I (scores of 6-18 – at least 1 primary function) −	+ *Same as Class I Riparian* − *Same as Class I Riparian, except less risk*
CLASS III RIPARIAN *Score: 1-5* *No primary functions, no wildlife value: includes small forest patches and developed floodplain*	+ *Same as Class I riparian* − *Same as Class I riparian, except less risk*	+ *Same as Class I riparian* − *Same as Class I riparian, except less risk*	+ Similar to Class I riparian habita, except: + Retention of some ecological functions and ecosystem services provided by existing natural resources + Retains restoration opportunities where ecological functions could be regained through tree canopy increases or other measures + Provides mitigation opportunities − *Similar to Class I riparian habitat, except:* − Increased need for UGB expansion, but less so than Class II	+ **Same** *as Class I Riparian* − *Same as Class I Riparian, except less risk*

ESEE Consequences of ***PROHIBITING*** conflicting uses				
Habitat type	**Economic**	**Social**	**Environment**	**Energy**
CLASS A WILDLIFE *Score 7-9* *no primary riparian function but may contain secondary riparian functions*	+ *Same as Class I Riparian* − *Same as Class I Riparian, except less risk*	+ *Same as Class I Riparian* − *Same as Class I Riparian* − More vegetation increase risk of wildfires − More habitat may increase nuisance species	+ Functional consequences: Retention of key attributes for habitat outside Class I riparian + Retention of some of the best remaining wildlife habitats in the region + Provides key breeding habitat for migratory songbirds, aquatic species and habitat interior specialists + Retains Habitats of Concern + Provides important source habitats for native wildlife and plant species + Reduced wildlife road crossing mortality + RUR: Decrease in agricultural toxins + RUR: Reduced livestock damage − **Functional consequences:** Continuing functionality of Class A habitat patches may depend on connectivity with other, less valuable habitat patches − If conflicting uses are prohibited in all Class A wildlife other habitat may be disproportionately removed or altered, reducing the quality of Class A habitat − Class A patches are typically very large, may result in need for UGB expansions − RUR: Agricultural areas can provide important habitat for grassland and low structure-associated species	+ *Same as Class I Riparian* − *Same as Class I Riparian, except less risk*

ESEE Consequences of ***PROHIBITING*** conflicting uses				
Habitat type	**Economic**	**Social**	**Environment**	**Energy**
CLASS B WILDLIFE *Score 4-6* *no primary riparian function but may contain secondary riparian functions*	+ *Same as Class I Riparian* − *Same as Class I Riparian, except less risk*	+ *Same* as *Class A Wildlife* − *Same as Class A Wildlife, except less risk*	+ Similar to Class A, except: + Retention of some of the most important connectivity elements in the region + Retention of large upland habitat patches important to specific wildlife species + Important for migratory songbirds + May provide important source habitats for native wildlife and plant species + Grassland and low-structure vegetation within 300 ft of streams would be retained − *Similar to Class A Wildlife, except:* − If conflicting uses are prohibited in all Class B wildlife habitat, Class A and C may be disproportionately removed or altered, thereby reducing the quality of Class B habitat through connectivity loss and increasing isolation	+ *Same as Class I Riparian* − *Same as Class I Riparian, except less risk*
CLASS C WILDLIFE *Score 2-3* *no primary riparian function but may contain secondary riparian functions*	+ *Same as Class I Riparian* − *Same as Class I Riparian, except less risk*	+ *Same as Class A Wildlife* − *Same as Class A Wildlife, except less risk*	+ Similar to Class B, except: + Not as important to regional connectivity, may provide important local connectivity + Small, isolated patches provide important and locally rare stopover habitat to migratory birds + RUR: Prohibiting conflicting uses may decrease agricultural toxins + RUR: Reduced livestock damage − *Similar to Class B, except:* − Small isolated habitat patches may limit reproductive success due to edge effects and reduced habitat quality − Isolated patches may be associated with increased roadway mortality − RUR: Agricultural areas can provide important habitat for grassland and low structure-associated species	+ *Same as Class I Riparian* − *Same as Class I Riparian, except less risk*
Riparian impact area	+ Positive consequences depend on the general zone − Negative consequences depend on the general zone	+ Positive consequences depend on the general zone − Negative consequences depend on the general zone	+ *Similar to "limit," but to a greater degree* − Primary negative consequences relate to social, economic and energy	+ Positive consequences depend on the general zone − Negative consequences depend on the general zone

ESEE Consequences of ***PROHIBITING*** conflicting uses				
Habitat type	**Economic**	**Social**	**Environment**	**Energy**
Vegetation impact area	**+** Positive consequences depend on the general zone **−** Negative consequences depend on the general zone	**+** Positive consequences depend on the general zone **−** Negative consequences depend on the general zone	**+** *Similar to "limit," but to a greater degree* **−** Primary negative consequences relate to social, economic and energy	**+** Positive consequences depend on the general zone **−** Negative consequences depend on the general zone

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APPENDICES

Copies of Appendices A, B, C and D are available for review in the Metro Council's files. In addition, copies may be requested from the Metro Planning Department, 600 N.E. Grand Ave., Portland, OR 97232, or by calling 503-797-1555. Copies may also be available via the Metro website: www.metro-region.org/nature.

APPENDIX A

Federal, State, Regional, and Local Policies

APPENDIX A
FEDERAL, STATE, REGIONAL, AND LOCAL POLICIES

Federal, State, Regional, and Local Policies

When the Metro Council adopted the Urban Growth Management Functional Plan in 1996, one of the purposes was to address regional fish and wildlife habitat as a matter that has a "significant impact upon the orderly and responsible development of the metropolitan area." ORS 268.390(1). Regional conservation of identified fish and wildlife habitat is consistent with many other state and federal policies and laws. The Metro Policy Advisory Committee recognized this connection in October 2000, when it adopted the "Purpose, Vision, Goal, Principles and Context" (Vision Statement) for the development of Metro's fish and wildlife program.

The Vision Statement recommended that the Metro Council address these state and federal policies, in particular the Endangered Species Act (ESA). MPAC recommended that Metro develop a program that could satisfy federal agency standards, and comply with the ESA "so that local governments could use it if they choose." Metro's fish and wildlife program will have important connections with many other state and federal programs, and will aid in local compliance with those programs. The discussion below describes relevant federal and state requirements and how Metro's program may be coordinated with those requirements.

Federal Policy

Endangered Species Act (ESA)

The purpose of the ESA is "to provide a means whereby the ecosystems upon which endangered species and threatened species depend may be conserved." 16 USC 1531(b). The act requires federal agencies to identify critical habitat for endangered and threatened species, create a recovery plan for those species and in some circumstances issue regulations that provide for the conservation of such species. Above all, the act prohibits any individual, group of individuals, states, cities and counties from "taking" a listed species.[1]

Twelve species of salmon and steelhead are listed as either threatened or endangered in the Columbia River and Willamette River Basins. (See Table A-1). The federal agency responsible for these species is the National Oceanic and Atmospheric Administration Fisheries unit (NOAA Fisheries). All of these species are present in the Portland metropolitan area at some point in their life cycle. They either migrate through the metropolitan area as adults or juveniles, or may spawn and rear in metropolitan area streams. Most of these salmonids were listed in 1997, 1998 and 1999. NOAA Fisheries is currently undertaking a review of those listed species to determine whether their status should be revised. This review could result in species being reclassified from endangered to threatened or visa versa, or candidate species (those proposed for listing in the past) being listed as endangered or threatened. One such species that exists in the metropolitan area is the lower Columbia River Coho Salmon.

[1] The term "take" means to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to engage in any such conduct. 16 USC 1532(19).

Numerous other fish and wildlife species and species of concern may also be found in the Metro region. These include as listed species: Aleutian Canada goose and Peregrine falcon; species of concern: Pacific western big-eared bat, Northwestern pond turtle, Tricolored blackbird, Olive-sided flycatcher, Little willow flycatcher, Northern red-legged frog, Long-eared myotis (bat), Fringed myotis (bat), Long-legged myotis (bat), Yuma myotis (bat), Green sturgeon and Pacific lamprey.

Table A-1: Endangered Species Act status of West Coast salmon & steelhead

Species	ESU (Date)	Status
Coho Salmon	Lower Columbia River/Southwest WA ESU (7/95)	Proposed
Chinook Salmon	Snake River Fall-run (4/92)	Threatened
	Snake River Spring/Summer-run (4/92)	Threatened
	Lower Columbia River (3/99)	Threatened
	Upper Willamette River (3/99)	Threatened
	Upper Columbia River Spring-run (3/99)	Endangered
Chum Salmon	Columbia River (3/99)	Threatened
Sockeye	Snake River (11/91)	Endangered
Steelhead	Upper Columbia River (8/97)	Endangered
	Snake River Basin (8/97)	Threatened
	Lower Columbia River (3/98)	Threatened
	Upper Willamette (3/99)	Threatened
	Middle Columbia River (3/99)	Threatened

The listing of species as threatened or endangered triggers a requirement for the responsible federal agency to create a recovery plan for that species or their habitat. NOAA Fisheries lists threatened and endangered species by Evolutionarily Significant Units (ESU) which encompass geographic areas that may include multiple river basins. For recovery planning purposes, NOAA Fisheries has combined five ESUs into the Columbia Basin "recovery domain" for listed salmonids. The Willamette River Basin is part of that recovery domain. Recovery planning must address problems at both the ESU scale and the smaller scale of independent populations of fish. For example, NOAA Fisheries has identified independent populations of threatened steelhead in the McKenzie, Calapooia, Santiam and Clackamas river basins.

NOAA Fisheries is currently developing recovery plans for listed salmonid species. As explained in more detail below, much of that work will be accomplished through the Northwest Power Planning Council's subbasin planning process. While it is anticipated that the recovery plans will be detailed and comprehensive, the measures identified by the plans will apply only to federal actions, or actions that have a federal nexus (i.e., federally funded). Strictly speaking, individuals and state and local governments are not bound by these recovery plans. However, the recovery plans are likely to represent the best guidance for conducting local actions that may have an adverse impact on the listed species. It may also be several years before the recovery plans are fully implemented. Until that time, local governments must implement their own measures to avoid taking listed species. These measures can take the form of a section 4(d) limit, a section 10 habitat conservation plan, or modifying regulation of local land development to minimize the risk of take.

Metro's inventory of regionally significant fish and wildlife habitat has identified habitat upon which listed salmonids depend for some part of their life histories. Coordinating Metro's program with NOAA Fisheries recovery plan as it is developed will not only assist in long-term recovery of the species, but also with local compliance with the ESA.

Clean Water Act (CWA)

The Clean Water Act (CWA) sets a national goal to "restore and maintain the chemical, physical and biological integrity of the Nations waters." 33 U.S.C.A. 1251. In Oregon, the CWA is implemented by the Department of Environmental Quality (DEQ) with review and approval by the U.S. Environmental Protection Agency (EPA). The DEQ has the responsibility for protecting the beneficial uses of rivers, streams and lakes of the state. Beneficial uses include drinking water, cold water fisheries, industrial water supply, recreation and agricultural uses. The DEQ carries out this responsibility in part by identifying those water bodies which are not meeting current water quality standards. This inventory is commonly referred to as the section 303(d) list. The 1998 303(d) list included over two hundred miles of rivers and streams in the Metro region which did not meet water quality parameters for one or more pollutants. For the entire state, about 5,000 miles of water quality limited rivers and streams have been added to the 303(d) list since 1998.

For waters identified on the 303(d) list, DEQ must develop total maximum daily loads (TMDL) for those pollutants that exceed water quality standards. These TMDLs apply to both point sources (end of pipe) and nonpoint sources (no specific origin). The daily load allocations become part of plans at the watershed scale intended to meet water quality standards. Depending upon where the watershed is located, different state agencies, local governments and land owners will be responsible for developing the water quality plans. In urban areas, local governments, watershed councils, landowners and stakeholders will likely be the parties responsible for such plans.

In addition to developing water quality plans in connection with TMDLs, some cities and counties are also responsible for stormwater management. Generally, large cities, smaller cities within urbanized areas, and cities outside urbanized areas with populations over 10,000 are required to have permits to operate municipal separate storm sewer systems that discharge into surface waters of the state. These permits require cities to implement water quality protections for their municipal operations and for construction and post construction run-off control from urban development.

Beginning in December 2002, individual projects that disturb one or more acres of land need National Pollutant Discharge Elimination System (NPDES) 1200-C general permit coverage. These permits govern stormwater discharges. One of the requirements of these permits is an erosion and sediment control plan that applies before during and after construction. The plan must demonstrate how erosion will be controlled and limited so that sediment does not have an adverse impact on receiving water bodies.

While Metro does not have responsibility or authority to regulate water quality, the Title 3 water quality land use requirements are already consistent with many DEQ rules. Metro's fish and wildlife program will further assist the region with improving water quality for the beneficial use of supporting cold water fisheries.

Pacific Northwest Electric Power Planning and Conservation Act (Northwest Power Act)

The 1980 Northwest Power Act requires the Bonneville Power Administration ("BPA") to implement a Fish and Wildlife Program that mitigates for the degradation to both fish and wildlife habitat caused by the Columbia Hydropower System. Complying with the Fish and Wildlife Program is achieved primarily through subbasin plans developed with oversight from the Northwest Power Planning Council. The subbasin plans consist of three parts: (1) a subbasin assessment describing existing and historic resource conditions, (2) an inventory if existing activities, and (3) a management plan that addresses the key limiting factors in the subbasin. A "lead entity" is contracted to coordinate the subbasin planning. The BPA provides funding for producing the subbasin plan, technical assistance related to the plan, and ultimately for on-the-ground projects that implement the plan.

The connection between NPPC subbasin planning and NOAA Fisheries recovery planning for listed salmonids has recently been strengthened. The Regional Administrator for NOAA Fisheries envisions that subbasin plans will become components of federal recovery plans. NOAA Fisheries and NPPC collaborated on developing a Technical Guide for Subbasin Planners with the intent of enabling those planners to produce a subbasin plan that would satisfy local recovery plan requirements under the ESA.

The NPPC has contracted with the Willamette Restoration Initiative (WRI) to coordinate the creation of the Willamette Subbasin Plan. The subbasin planning process accommodates and encourages participation by watershed councils, stakeholders, and local governments. The information generated by Metro's Fish and Wildlife Habitat Conservation program will be valuable to that planning process and contribute as a building block of NOAA Fisheries recovery plan. Coordination between Metro and WRI on the subbasin planning will be extremely important because the subbasin plan will prioritize needs and projects in the Lower Willamette and Clackamas River basins that will potentially qualify for federal funding support, and will constitute local components of NOAA Fisheries recovery plan for listed salmonids.

The Magnuson-Stevens Fishery Conservation and Management Act

The Magnuson-Stevens Fishery Conservation and Management Act was originally passed in 1976 and amended by the Sustainable Fisheries Act of 1996. These statutes require federal agencies to consult with NOAA Fisheries on activities that may adversely affect "essential fish habitat" ("EFH"). The Magnuson – Stevens Act defines EFH as "those waters and substrate necessary to fish for spawning, breeding, feeding or growth to maturity."

The Pacific Fishery Management Council has identified EFH for the pacific coast salmon fishery. Those areas generally include "those waters and substrate necessary for salmon production needed to support a long-term sustainable salmon fishery and salmon contributions to a healthy ecosystem."[2] To meet that goal, EFH must include all streams, lakes, ponds, wetlands and the habitat historically accessible to salmon in Washington, Oregon, Idaho and California. The Sandy River, Clackamas River, Tualatin River, and Lower Willamette River basins have all been identified as EFH for chinook and coho salmon. These basins include streams and habitat in urban areas.

The Magnuson – Stevens Act does not contain requirements for state, local or private entities. NOAA Fisheries typically considers EFH at the same time it conducts ESA Section 7 consultations. However, the Pacific Fishery Management Council considers EFH to be a common interest among all parties, and a tool to promote healthy and sustainable coastal fisheries.

State Policy

Oregon Plan for Salmon and Watersheds

The mission of the Oregon Plan for Salmon and Watersheds is "to restore our native fish populations – and the aquatic systems that support them – to productive and sustainable levels that will provide substantial environmental, cultural and economic benefits." It was initiated in 1995 to address restoration of coastal coho salmon. In April 1997, the Oregon Legislature incorporated other related efforts into one overarching framework: "The Oregon Plan for Salmon and Watersheds." It is designed to restore the healthy function of Oregon's natural aquatic systems. It represents commitments on behalf of government, interest groups and private citizens from all sectors of the State.

The local watershed councils are the bedrock of the Oregon Plan. The councils are composed of citizens who are concerned about their rivers and watersheds. They are formed and operate according to two principles adopted by the Legislature: 1) that the watershed council be a voluntary, local group, and 2) the council represents a balance of interested and affected persons within the watershed. The primary tasks of a watershed council are to conduct an assessment of the watershed and create an action plan for improving the watershed.

Six watershed councils are currently operating in the Metro region: Columbia Slough Watershed Council, Sandy River Basin Watershed Council, Clackamas Basin Watershed Council, Tualatin River Watershed Council, Tryon Creek Watershed Council, and Johnson Creek Watershed Council. Each of these groups is funded to some degree by the Oregon Watershed Enhancement Board (OWEB). In addition to doing their assessment and action plans, these watershed councils do a heroic amount of community outreach and education. Close cooperation between Metro and the watershed councils will fulfill the purpose of the Oregon Plan and help identify key restoration opportunities that are important to those communities in the region.

There is a Willamette Chapter to the Oregon Plan for Salmon and Watersheds. In 1998 former Governor John Kitzhaber founded Willamette Restoration Initiative (WRI) by appointing a diverse group of business, government, farming, conservation and community representatives to serve on a board. The group was charged with identifying the means to address the Willamette River's many problems from water quality to lost habitat. In February 2001, the Willamette

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[2] Identification and Description of Essential Fish Habitat, Adverse Impacts and Recommended Conservation Measures for Salmon, Pacific Fishery Management Council, 1999.

Restoration Initiative published its “Willamette Restoration Strategy” which is the Willamette Chapter of the Oregon Plan. The Strategy identifies 27 critical actions that are necessary in the Willamette River Basin to improve the river and its ecosystems. The recommendations from the Strategy will strongly influence local plans that seek to protect natural resources in and along the Willamette River.

Native Fish Conservation Policy

In November 2002, the Oregon Fish and Wildlife Commission adopted the Native Fish Conservation Policy. The purpose of the policy is: “to ensure the conservation and recovery of native fish in Oregon.” OAR 635-007-0502. The policy focuses on “naturally produced native fish” which are those fish species that “reproduce and complete their full life cycle in natural habitats.” OAR 635-007-0501(33). The reason for this focus on naturally produced fish is that those “native fish are the primary basis for Endangered Species Act delisting decisions and the foundation for long-term sustainability of native species and hatchery programs.”

The Oregon Department of Fish and Wildlife is responsible for developing conservation plans for native fish species with priority on those species listed under the state ESA or as state “sensitive species.” OAR 635-007-0505(3). The conservation plans will use the Oregon Plan for Salmon and Watersheds and input from “local and regional forums” as the context for the development, implementation, and coordination of the plans. Although Metro’s fish and wildlife program is not restricted to protecting native fish species, the program will offer some protection to the habitats upon which native fish depend and provide an opportunity to coordinate with ODFW on applicable conservation plans.

Oregon Endangered Species Rules

The Oregon Endangered Species Act is intended to manage the listed “species and their habitats so that the status of the species improves to a point where listing is no longer necessary.” Species are listed under the state act when: (1) they are native, and (2) they are in danger of extinction throughout any significant portion of its range within this state (endangered) or (3) likely to become an endangered species within the foreseeable future throughout any significant portion of its range within this state (threatened). OAR 635-100-0105(3). The state act also lists a species as “sensitive” when the “wildlife species, subspecies, or populations that are subject to a decline in number of sufficient magnitude to qualify their listing as Threatened due to loss in quantity or quality of habitat or other factors.” OAR 635-100-0001(4).

The Oregon Department of Fish and Wildlife (ODFW) is required to develop survival guidelines for certain threatened or endangered species. The survival guidelines include water quality, water quantity and habitat requirements that apply on state property. The state act requires any agency in charge of state owned property to consult with ODFW to ensure that all actions on such property are consistent with the survival guidelines developed for affected species. OAR 635-100-1030. Lower Columbia River Coho salmon are listed as endangered under the state act and ODFW has adopted survival guidelines for the coho. At the time of listing, the species was only found in the Clackamas and Sandy River basins. Lower Columbia River Coho are candidate species for listing under the federal ESA.

Oregon Wetland Regulatory Program

The Oregon Division of State Lands (DSL) administers Oregon's removal/fill law (ORS 196.800-196.990). Using similar definitions as the federal government, DSL determines wetland boundaries and water bodies that meet the definition of "waters of the state." A permit is required for fill equal to or exceeding 50 cubic yards or more of material in any waters of the State at one location. Likewise, a permit is required for removal of more than 50 cubic yards of material in any waters of the state in any calendar year. Waters of the state means natural waterways including all tidal and nontidal bays, intermittent and constantly flowing streams, lakes, wetlands, and other bodies of navigable and non-navigable water.

Oregon Division of State Lands Essential Indigenous Anadromous Salmonid Habitat

In an effort to identify and protect essential habitat for salmon and trout, the Oregon Legislature in 1993 required the DSL to identify essential indigenous anadromous salmon habitat. DSL has defined such habitat as: "habitat that is necessary to prevent the depletion of indigenous anadromous salmonid species during their life history stages of spawning and rearing." OAR 141-102-0020(1). The agency has mapped essential habitat throughout the state. The essential habitat designation carries with it a requirement for a "permit for activities involving the fill or removal of <u>any</u> amount of material in essential habitat, unless the activity is exempt" by state law. OAR 141-102-0000(3).

Regional Policy

Several policies adopted by the Metro Council with the direction of citizens in the region influence the ESEE consequences analysis. These policies provide the framework for protecting natural resources while managing urban growth in the region. Natural resources, including riparian corridors and water quality, play a key role in the livability of the Metro region. Key policies are described below.

Metro Charter

Metro's 1992 Charter requires Metro to address issues of regional significance such as land use and transportation planning as well as regional parks and open spaces. Through its Charter-mandated responsibilities, the Metro Council has provided leadership in addressing growth management issues by working with citizens, elected officials and diverse interest groups to craft a vision of how the region will grow and to adopt policies to achieve that vision. In the course of debating how growth will be managed, the Metro Council identified the protection of natural systems – floodplains, rivers, streams and wetlands – as a cornerstone for these regional policies. Metro has determined in the *Region 2040 Growth Concept* that protecting these systems is essential to maintaining the region's livability and economic well being as well as providing habitat, water quality and flood management benefits.

Metro's role in identifying natural resource protection measures and incentives within its boundary has been established with adoption of the *Regional Urban Growth Goals and Objectives (RUGGOs), Region 2040 Growth Concept* and the *Urban Growth Management Functional Plan*. Natural resources by their very nature cross jurisdictional boundaries and are best managed with regional, watershed-wide protection strategies. Metro has a role in working with local jurisdictions to determine the protection of these important resources, just as it determines parking standards, transportation networks and land use densities for the region. Through extensive public involvement, the Metro Council has identified the need to balance natural resource protection with urban development while the region grows. If coordination with citizens and elected officials outside of the Metro area can be achieved, natural resource protection can be ensured for entire watershed systems.

Future Vision Report

The 1992 Metro Charter required Metro to develop and consider a vision for the region's future development. Metro's 1995 *Future Vision Report* recognizes the region's unique ecosystem and the value of improved air and water quality. It states that the region should manage watersheds to protect, restore and maintain the integrity of streams, wetlands and floodplains, and their multiple biological, physical and social values. It also states that "…We value natural systems for their intrinsic value, and recognize our responsibility to be stewards of the region's natural resources." It identifies the need for "…restored ecosystems protected from future degradation and decline." While not a regulatory document, the *Future Vision Report* has greatly influenced the content of Metro's regional plans.

Regional Urban Growth Goals and Objectives

Metro's Regional Urban Growth Goals and Objectives (RUGGO), amended in 1995, identify goals and planning activities for the Metro region. Several RUGGO chapters relate to watersheds and riparian corridors. Two chapters relate to water resources: Objective 12: Watershed Management and Regional Water Quality and Objective 13: Urban Water Supply. Objective 12.1 states: "Metro will develop a long-term regional strategy for comprehensive water resources management, created in partnership with the jurisdictions and agencies charged with planning and managing water resources and aquatic habitats. The regional strategy shall meet federal and state water quality standards and complement, but not duplicate, local integrated watershed plans."

Objective 15: Natural Areas, Parks, Fish and Wildlife Habitat calls for an open space system capable of sustaining or enhancing native wildlife and plant populations. It recognizes the need for a regionwide system of linked significant wildlife habitats and states that this system should be preserved, restored where appropriate, and managed to maintain the region's biodiversity. The *Region 2040 Growth Concept* included a 200-foot environmental greenway along all streams in the region to ensure connectivity throughout the natural landscape. The Land Conservation and Development Commission (LCDC) acknowledged the RUGGOs for compliance with the statewide planning goals in 1996.

The Stream and Floodplain Protection Plan (Title 3)

Title 3, the *Stream and Floodplain Protection Plan,* (1996 *Urban Growth Management Functional Plan*) establishes regional performance standards to address water quality and floodplain management and recommends actions for the protection of fish and wildlife habitat. In June 1998, the Metro Council adopted revisions to Title 3, including water quality and floodplain maps that show where Title 3 applies. Section 5 of Title 3 (which was essentially unchanged by the 1998 amendments) directed Metro staff to address fish and wildlife habitat. The purpose of Section 5 is to: "conserve, protect and enhance fish and wildlife habitat within the fish and wildlife habitat conservation areas to be identified on the water quality and flood management area map by establishing performance standards and promoting coordination by Metro of regional urban watersheds." The completed sections of Title 3 meet the requirements for Statewide Planning Goal 6 (water quality) and Goal 7 (flood management), while Section 5 relates to Goal 5. LCDC acknowledged the water quality and floodplain protection components of Title 3 for compliance with Goals 5, 6 and 7 in 2000.

Greenspaces Master Plan

The Metro Greenspaces Master Plan, adopted by Metro Council in 1992, articulated the vision for a cooperative, interconnected system of parks, natural areas, trails and greenways for fish, wildlife and people. The Master Plan recommended tools to protect greenspaces such as acquisition, education and restoration. In 1995, voters passed Bond Measure 26-26 directing Metro to purchase regionally significant natural areas. Since then over 9,000 acres of natural areas have been acquired for permanent protection. Metro's Parks and Greenspaces Department also provides education programs and works to restore its properties.

Local Goal 5 programs

Most of the local jurisdictions in the Metro region have adopted Goal 5 programs that have been acknowledged by the Department of Land Conservation and Development as being in compliance with the state rule. Some of these programs were developed prior to Goal 5 rule revisions in 1996, while a few have been done more recently. The rule requires local jurisdictions to balance the need to protect natural resources against other state goals such as housing (Goal 10) and transportation (Goal 12) while providing ample opportunity for citizen involvement (Goal 1). Thus, the state rule allows local jurisdictions' Goal 5 programs to be in compliance with state law while being inconsistent with each other. However, Metro's code required an analysis of the consistency of local natural resource protection prior to conducting a regional ESEE analysis and a regional protection program.

Metro staff conducted an analysis of local Goal 5 programs beginning in 1999 and culminating in a report (*Local Plan Analysis: A Review of Goal 5 Protection in the Metro Region)* to the Metro Council in August 2002. The local plan analysis demonstrated that there are many inconsistencies and inadequacies in natural resource protection in the Metro region. An important reason for the inconsistency in local protection is that the Goal 5 rule does not set a specific standard, rather it lays out a process for jurisdictions to follow. The process described by state law allows jurisdictions to choose which resources to protect and the level of protection received after balancing the consequences of protection with the economic, social, and energy needs within the jurisdiction. Most jurisdictions choose to "limit" conflicting uses in resource areas, the Goal 5 Rule defines this choice as "conflicting uses should be allowed in a limited way that protects the resource to the desired extent." This language gives local governments wide discretion in designing protection programs.

If protecting natural resources is an important piece of maintaining livability within the region, as stated in Metro's Regional Urban Growth Goals and Objectives (RUGGOs), then it is critical to provide a more consistent level of protection throughout the region. This ESEE analysis identifies the tradeoffs of allowing, limiting, or prohibiting development consistently across the region.

Appendix B

Portland Metro Area – DEQ’s 303 (d) Listed Pollutants of TMDLs

APPENDIX B
Portland Metro Area – DEQ's 303 (d) Listed Pollutants of TMDLs as per the 1998 Listing of Water Quality Limited Waterbodies.

TMDL	303 (D) LISTED POLLUTANTS
Lower Columbia River – Tenasillahe Island to Willamette River	Bacteria, Dissolved Oxygen, pH, Temperature, Total Dissolved Gas (from Dams), Arsenic, PCB, DDE, DDT
Lower Columbia River –Willamette River to Bonneville Dam	pH, Temperature, Total Dissolved Gas (from Dams), Arsenic, PCB, DDE, DDT
Lower Columbia – Sandy River	Temperature
Clackamas River -- Mainstem	Temperature
Clackamas River – Fish Creek	Habitat Modification
Lower Willamette -- Blue Lake	Aquatic Weeds or Algae, pH
Lower Willamette -- Bybee Lake	Aquatic Weeds or Algae, Biological Criteria, Flow Modification, Habitat Modification, pH
Lower Willamette -- Columbia Slough	Bacteria, Chlorophyll a, Dissolved Oxygen, Nutrients, pH, Temperature, DDE, DDT, PCBs, 2,3,7,8 TCDD (Dioxin), Lead
Lower Willamette -- Fairview Creek	Bacteria, Nutrients, pH
Lower Willamette -- Fairview Lake	Nutrients
Lower Willamette -- Johnson Creek	Bacteria, Temperature, DDT, Dieldrin
Lower Willamette -- Smith Lake	Aquatic Weeds or Algae, Biological Criteria, Flow Modification, Habitat Modification, pH
Lower Willamette -- Spring Brook Creek	Bacteria
Lower Willamette -- Tryon Creek	Temperature
Willamette River Mainstem – Mouth to Willamette Falls	Bacteria, Biological Criteria, Temperature, Mercury, Pentachlorophenol, Arsenic
Tualatin Basin – Ash Creek	Bacteria, Biological Criteria, Dissolved Oxygen, Temperature
Tualatin Basin – Beaverton Creek	Bacteria, Biological Criteria, Dissolved Oxygen, Temperature
Tualatin Basin – Bronson Creek	Bacteria, Biological Criteria, Chlorophyll a, Dissolved Oxygen, Temperature
Tualatin Basin – Burris Creek	Bacteria, Chlorophyll a, Dissolved Oxygen
Tualatin Basin – Butternut Creek	Bacteria, Biological Criteria, Dissolved Oxygen, Temperature
Tualatin Basin – Carpenter Creek	Bacteria, Dissolved Oxygen
Tualatin Basin – Cedar Creek	Bacteria, Chlorophyll a, Dissolved Oxygen
Tualatin Basin – Cedar Mill Creek	Bacteria, Biological Criteria, Temperature
Tualatin Basin – Chicken Creek	Bacteria, Dissolved Oxygen
Tualatin Basin – Christenson Creek	Bacteria, Dissolved Oxygen
Tualatin Basin – Council Creek	Dissolved Oxygen
Tualatin Basin – Dairy Creek	Bacteria, Dissolved Oxygen, Temperature, pH
Tualatin Basin – Fanno Creek	Bacteria, Chlorophyll a, Dissolved Oxygen, Temperature, Arsenic, Manganese, Iron
Tualatin Basin – Gales Creek	Bacteria, Dissolved Oxygen, Temperature, pH
Tualatin Basin – Hall Creek	Bacteria, Dissolved Oxygen
Tualatin Basin – Heaton Creek	Bacteria
Tualatin Basin – Hedges Creek	Bacteria, Biological Criteria, Dissolved Oxygen, Temperature
Tualatin Basin – Johnson Creek	Bacteria, Biological Criteria, Dissolved Oxygen, Temperature
Tualatin Basin – McFee Creek	Bacteria, Dissolved Oxygen
Tualatin Basin – McKay Creek	Bacteria, Temperature
Tualatin Basin – Nyberg Creek	Bacteria, Chlorophyll a, Dissolved Oxygen, Temperature
Tualatin Basin – Rock Creek	Bacteria, Biological Criteria, Chlorophyll a, Dissolved Oxygen, Temperature
Tualatin Basin – Scoggins Creek	Dissolved Oxygen
Tualatin Basin – Summer Creek	Bacteria, Biological Criteria, Dissolved Oxygen, Temperature
Tualatin Basin – Willow Creek	Bacteria, Dissolved Oxygen, Temperature
Tualatin River – Mainstem	Bacteria, Temperature

Courtesy Don Yon, Oregon DEQ, 2003.

APPENDIX B
Portland Metro Area – DEQ's 303 (d) Listed Pollutants of TMDLs as per the 2002 Listing of Water Quality Limited Waterbodies.

TMDL	**303 (D) LISTED POLLUTANTS**
Clackamas River -- Mainstem	*E. coli*, Temperature
Willamette River -- Mainstem	Aldrin, Biological Criteria, DDT, DDE, Dieldrin, Fecal Coliform, Iron, Manganese, Mercury, PCB, Pentachlorophenol, Polynuclear Aromatic Hydrocarbons (PAHs), Temperature
Lower Columbia – Sandy River	Dissolved Oxygen, *E. coli*, Temperature
Willamette River -- Smith Lake	Aquatic Weeds or Algae, pH
Willamette River -- Blue Lake/Arata Creek and Bybee Lake	Aquatic Weeds or Algae, pH
Willamette River -- Columbia Slough	Iron, Manganese, Temperature
Willamette River -- Fairview Lake/ Osburn Creek	PH
Willamette River -- Johnson Creek	DDT, Dieldrin, Fecal Coliform, PCB, Polynuclear Aromatic Hydrocarbons (PAHs), Temperature
Willamette River -- Spring Brook Creek	Temperature
Willamette River – Kellogg, Mt. Scott, and Phillips Creeks	*E. coli*
Willamette River – Tryon Creek	Temperature
Tualatin Basin – Knoll Wetland	Chromium, Copper, Lead, Silver, Zinc

Courtesy Don Yon, Oregon DEQ, 2003.

Note: This list is shorter than the 1998 list not because water quality has improved, but because TMDLs were developed for many 303(d)-listed reaches.

APPENDIX C

Economic Report and Literature Review

Final Report for the Economic Portion of Metro's Goal 5 ESEE Analysis

October 2004

Prepared for

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SUMMARY

This report is part of Metro's Goal 5 analysis of the economic, social, environmental and energy (ESEE) consequences of developing or protecting riparian and upland-wildlife resources. This final report describes the economic tradeoffs of allowing, limiting or prohibiting development of resources in Metro's service area. Following the conclusion of the ESEE analysis Metro will develop and evaluate the details of Goal 5 program options to protect resources. The appropriate context for considering this report, therefore, is as an interim report about possible methods, *not* as a final report that evaluates proposed policy options. This is not a report on the costs and benefits of protection measures at the local or parcel level. The report describes the economic tradeoffs of allow, limit and prohibit decisions qualitatively and on a regional scale.

Our analysis included the following analytical tasks:

- Rank the lands that contain riparian and upland-wildlife resource using the land's development value. In consultation with Metro staff and Metro's Economic Technical Advisory Council ("ETAC") we develop three methods of ranking the relative importance of land for development: land value, employment, and the 2040 Design Types.
- Compare development importance with Metro's rankings based on the amount and types of ecological functions or wildlife characteristics the lands provide. Comparing the rankings of development importance with rankings for riparian and wildlife importance provides information on the amount and distribution of significant conflicts between development use and resource protection.
- Describe the current land-use status of lands that contain riparian and upland-wildlife resources. Some of these lands have already been developed. Other lands are vacant, but development will be constrained by existing protection measures (e.g., Title 3) or characteristics of the land (e.g., steep slopes). Development status affects the economic analysis because it can influence the type, amount and timing of economic tradeoffs of protection decisions.
- Describe the economic tradeoffs of allow, limit, and prohibit decisions as they relate to the development use of lands and protecting the riparian and wildlife resources.
- Our analysis includes a review of the professional literature on the economic value of land in development and preservation.

The economic principles most relevant to our analysis:

- Market prices for land reflect potential development values. Participants in a market can measure or rank the development importance of land using property values.
- Ecosystem services benefit society and have economic value. Actions that enhance or protect these services also enhance or protect the associated societal benefits and values. Actions that degrade ecosystem services will have the opposite effect.
- Property markets capture some but not all of the value of ecosystem services. Markets typically do not reflect the value of ecosystem services provided by natural resource, such as flood-mitigation or filtering sediment from stormwater runoff.
- Property markets may not capture public-policy or planning goals. For example, public policy may proscribe specific land uses in a specific area (e.g., water-dependent industrial use), that, if left to property markets, would develop into higher-valued land uses (e.g., water-front, large-lot residential developments).
- There's competition for the riparian and upland-wildlife resources at issue in this study. Resources, especially in urban areas, cannot satisfy the complex and competing demands that society places on them. Allocating resources to one use means that competing uses go without, with the associated economic benefits and costs of the allocation decision.
- A static analysis likely will fail to inform decisionmakers adequately of the economic tradeoffs. This approach assumes no changes in factors that could mitigate negative outcomes and encourage positive outcomes. An alternative approach that considers how changes or adjustments—examples in this case include expanding the Urban Growth Boundary (UGB) or restoring degraded riparian areas—affect the economic outcomes will likely provide a more complete descriptions of tradeoffs.

Comparing the different methods of ranking lands and current land uses yields the following interactions:

- Less than 25 percent of the lands that contain Goal 5 resources are vacant and available for development. Goal 5 decisions will have the most immediate impacts on these lands because development is unconstrained by other factors.
- Over 60 percent of resource acres are on lands already maintained as parks or already developed with urban uses. Goal 5 decisions may affect these lands in the future through redevelopment, though impacts on parks lands are expected to be minimal compared to impacts on land in urban development.
- In the short-term, Goal 5 decisions will have the greatest impact on the 22 percent of resource lands that are undeveloped and

unconstrained by Title 3 or other rules. These lands also contain a significant amount, 41 percent, of the total vacant-buildable lands in the UGB.

- Over 80 percent of the land uses that potentially conflict with Goal 5 riparian and upland-wildlife resources occur in three regional zones: single-family residential (SFR), parks and open space (POS), and industrial (IND).

- SFR contains the largest percentage of Goal 5-resource lands, over 46 percent. Goal 5 allow, limit and prohibit decisions likely will fall most heavily on lands in this zoning.

- Lands zoned POS account for approximately 20 percent of Goal 5 natural resources.

- Over 14 percent of the lands with Goal 5 natural resources are zoned IND.

- The majority of lands with Goal 5 resources do not support employment. Less than 22 percent of the lands are zoned for commercial, industrial or mixed-use.

- The zoning for a majority of resource lands, approximately 64 percent, supports development value. The remainder fall into POS zoning or contain water bodies. Of the lands with development value, most fall into the "low" land-value category.

- Approximately 78 percent of the resources lands do not support employment. These lands are zoned SFR, MFR, RUR, and POS. Of the lands that do support employment, most fall into the "low" employment category.

- The distribution of resource lands by 2040 Design Type differs from the distributions described above for land value and employment. In general, categorizing lands using 2040 Design Types yields a distribution with a greater percentage of the lands having development value, and for the lands that have development value, more of the lands rank in the higher-valued design types.

- The large majority of Goal 5 allow, limit and prohibit decisions will impact lands zoned SFR, POS and IND. Impacts on lands zoned SFR and POS will have little or no employment impacts and will affect lands ranked "low" on the land-value scale. The majority of impacts on lands zoned IND will affect lands ranked "high" on at least one measure of development value.

- The fact that Goal 5 decisions would primarily affect acres with lower land values and employment densities does not mean that economic consequences of limit or prohibit decisions would be trivial. The "low" category of land value and employment is relative to values and employment in the Portland city center. The cumulative property value or number of employees affected may be significant depending on the type of decision, the details of the Goal 5 plan that implements the decision, actions that may mitigate the negative impact (e.g., expanding the UGB), and specifics of the individual parcels affected.

- Given the volume or amount of riparian and upland-wildlife resources at issue, and the quality of the resources, the Goal 5 programs that protect these resources may have significantly positive impacts on the values of ecosystem services provided by these resources. These programs may protect services such as flood management, water quality, amenity, and salmon-habitat values across a broad area that may affect residents through out the UGB and downstream from the UGB. Protecting these ecosystem services may also reduce municipal expenditures to provide these same services, especially over the long term.

We describe three categories of economic consequences of Goal 5 decisions:

1. The changes in the values of the goods and services citizens receive. We label these consequences *economic values*. The economic values at issue in this analysis include the impact of Goal 5 decisions on property values and the values of ecosystem goods and services provided by riparian and wildlife areas.

2. The changes in the levels of economic activities within the local economy, in particular, the impact on the level of local employment and income. We label these consequences *economic impacts*.

3. The changes in the distributions of costs and benefits within the economy, especially changes affecting groups of special concern such as property owners that shoulder a disproportionate amount of the negative consequences of a policy decision. We label these consequences *economic equity.*

Allowing conflicting uses means no additional protection of Goal 5 riparian or upland-wildlife resources beyond the baseline protection provided by Title 3, or by local protection measures that exceed Title 3 guidelines. This alternative emphasizes developing lands containing Goal 5 resources. Positive economic tradeoffs of this alternative include:

- No impediments to development or impacts on the development value of land.
- Development-related employment, income and taxes will be unaffected by Goal 5.

- No Goal-5 related increase in Vehicle Miles Traveled (VMT), transportation costs or UGB expansion because Goal 5 protection does not displace development within the UGB.

Negative economic tradeoffs include:

- Amenity-related property values and associated property taxes for undeveloped lands zoned SFR and RUR that are adjacent to Goal 5 resource lands may be less for this scenario relative to limit and prohibit scenarios.
- Flood-mitigation services will decline, flood damage and clean-up costs may increase.
- Erosion and sedimentation will increase, as will concentration of toxins in streams and other water bodies. Water-quality expenditures (e.g., for filtration and treatment) by businesses and municipalities may increase. Municipal expenditures that address water-quality regulations (e.g., the federal Clean Water Act) may increase.
- Summer temperatures and the urban "heat island effect" may increase with an associated increase in cooling costs.
- Developing riparian and upland-wildlife resources will increase the amount of impervious surfaces, which will increase stormwater flows and treatment costs.
- Development that negatively impacts salmon habitat may affect commercial, recreational and cultural harvests. Municipal expenditures that address habitat regulations (e.g., Endangered Species Act) may increase.
- Degrading riparian and upland-wildlife resources may negatively affect recreational opportunities and values that depend on these resources.
- Developing the resources may negatively impact their intrinsic values.
- Developing Goal 5 resources now or in the near-term precludes developing them in the future or protecting them for future generations. This reduces the option values associated with the resources.
- Carbon sequestration and air pollutant removal will decline with an associated decline in air quality and the related values of air-quality services.
- Businesses that rely on riparian and upland-wildlife resources and associated ecosystem services may experience a decline in employment and income. Employment and business-related tax payments may also decline.
- Allowing conflicting uses will negatively affect the 2040 Growth Concept and Design Types that emphasize protecting resources and maintain access to resources.

- The large majority, if not all, of the negative economic tradeoffs of this option affect riparian and upland-wildlife areas, associated ecosystem services and economic factors, e.g., jobs, incomes and values, that depend on these resources. Development interests suffer little or no negative economic tradeoffs.

Limiting conflicting uses strikes a balance between completely developing the Goal 5 riparian and upland-wildlife resources and protecting them. This alternative provides opportunities including: developing lands in ways that minimize negative environmental and economic tradeoffs; supporting the development goals embodied by the 2040 Design Types; and protecting the most important habitats.

The economic tradeoffs for this alternative depend on the degree of limitation on development actions: lightly limit, moderately limit, or strictly limit. Lightly-limit treatments will have more in common with allow treatments than with prohibit treatments. The opposite will be the case for strictly-limit treatments. As the name implies, tradeoffs for the moderately-limit treatment will fall somewhere in between.

This scenario will generate a mix of positive and negative economic tradeoffs for development interests and for the resources and associated ecosystem services. Development will occur, with the associated positive impacts on property values, employment, income, and tax payments. However, these impacts will be less than for the allow scenario. The resources will likely suffer some degradation, but not to the extent generated under the allow scenario. The resource-related economic values and impacts will also increase.

The consequences for the 2040 Design Types will be mixed. Protecting resources to a greater extent, compared with the allow scenario, may increase VMT if protecting resources displaces development and pushes it out toward the UGB or beyond. This may also increase the next UGB expansion and transportation costs. However, protecting riparian and upland-wildlife resources is consistent with the planning goals reflected in the Design Types.

The limit scenario will generate a more equitable distribution of positive and negative economic tradeoffs, compared with either the allow or prohibit scenarios. Development interests and the resources will both experience positive and negative economic tradeoffs.

Prohibiting conflicting uses will prevent development actions that conflict with, or degrade, Goal 5 riparian and upland-wildlife resources. This scenario emphasizes resource protection. Protection measures will exceed the baseline protection provided by Title 3, or by local protection measures that exceed Title 3 guidelines.

Positive economic tradeoffs of this alternative include:

- Amenity-related property values and associated property taxes for lands zoned SFR and RUR that are adjacent to Goal 5 resource lands may be greater for this scenario relative to limit and allow scenarios.
- This alternative will provide the greatest amount of flood-mitigation services and value.
- Erosion and sedimentation will be less than limit or allow alternatives, as will concentration of toxins in streams and other water bodies. Water-quality expenditures (e.g., for filtration and treatment) by businesses and municipalities may be the least under this alternative. Municipal expenditures that address water-quality regulations (e.g., the federal Clean Water Act) may decline, especially over the long term.
- This alternative will have the greatest mitigating effect on summer temperatures, the urban "heat island effect," and associated cooling costs.
- Prohibiting development in Goal 5 riparian and upland-wildlife resources will generate the least amount of impervious surfaces, and will generate the least amount of stormwater flows and treatment costs.
- This scenario will protect the greatest amount of salmon habitat and may positively affect commercial, recreational and cultural harvests. Municipal expenditures that address habitat regulations (e.g., Endangered Species Act) may decline, especially over the long term.
- This alternative will preserve the greatest amount of recreational opportunities, and the associated recreational values.
- The intrinsic and options values for the riparian and upland-wildlife resources will be preserved.
- Maintaining the greatest amount of vegetation will maximize carbon sequestration, air pollutant removal and the related values of air-quality services.
- This alternative will provide the greatest support to businesses that rely on riparian and upland-wildlife resources and associated ecosystem services.
- Prohibiting conflicting uses will support the aspects of the 2040 Growth Concept and Design Types that emphasize protecting resources and maintain access to resources.

Negative economic tradeoffs include:

- This alternative will have the greatest negative impact on the development value of land.
- Development-related employment, income and tax payments will also suffer the greatest under this alternative.

- The large majority, if not all, of the negative economic tradeoffs of this alternative affect development interests. The economic values and activities supported by riparian and upland-wildlife resources suffer little or no negative economic tradeoffs, relative to allow and limit alternatives.

A static description of economic consequences assumes, for the most part, that the consequences are fixed without possibility of mitigating negative impacts or enhancing positive impacts. This view ignores alternatives that may influence the economic tradeoffs of Goal 5 decisions. A more dynamic view of likely consequences accounts for these factors.

These dynamic factors include:

- The substitutability of land use within the UGB. Moving proposed land uses that conflict with riparian and upland-wildlife resources to alternative locations may mitigate negative economic tradeoffs for both the land use and resources.
- Expanding the UGB. Protecting riparian and upland-wildlife resources may reduce the amount of developable land within the UGB. If this is the case, expanding the UGB could mitigate this loss while protecting riparian and upland-resources within the existing UGB.
- Encouraging development practices that minimize conflicts with resources may help mitigate negative economic tradeoffs for both development and resources. These practices include low-impact development projects that minimize impervious surfaces and manage stormwater in ways that more closely mimic natural systems.
- The extent of restoration efforts. Restoring already-degraded riparian and upland-wildlife habitat could offset a portion of the negative impact of new development on habitat elsewhere.

Implications of the economic analysis for developing Goal 5 program options include:

- The economic analysis identifies the major factors and impacts that decisionmakers can use to screen lands at a regional level to get a subset of lands to consider for some level of protection.

- The extreme ends of likely program options include: (1) Adopt no new policy to preserve riparian or upland-wildlife resources inside the UGB, and perhaps even eliminate some existing policies that restrict economic development in specific areas, e.g., water-dependent industrial development; and (2) Allow no new development on any identified resource lands. For political and economic reasons, neither of those options is likely to be the preferred option. Final program options will likely fall somewhere between the extremes.

- A program option that would generate the minimum negative economic impacts on local businesses would continue with and enforce existing regulations. No new Goal 5-related regulations or incentives for preservation would be implemented, but none of the existing ones would be eliminated. With this option, may of the riparian and upland-wildlife resources would eventually get some level of development, though the amount or configuration of the development may be restricted to the benefit of ecosystem services by existing policies, e.g., Title 3.

- A program option that provides some additional protection of significant resources beyond existing regulations would target restrictions on some types development on some types of properties. There's a large number of possible variations of these program options. One option starts with slightly limiting development on lands that ranked low on all three measures of development value that contain the highest quality riparian or wildlife resources. Or, slightly limiting development on these lands in combination with restoring degraded riparian and wildlife resources elsewhere.

- Another example is developing a program option that combines resource protection, as described above, with options that protect specific development values. For example, program options that protect development on lands that ranked high on all three measures of development value, or that protect development that can't be relocated in the UGB to avoid conflicts with significant resources, e.g., water-dependent industrial use.

1. INTRODUCTION

1.1 PURPOSE OF THIS REPORT

State land-use policies, as described by Goal 5: Open Spaces, Scenic and Historic Areas, and Natural Resources, requires that local governments protect important natural resources. Elements of the Goal 5 program include identifying resources, describing their biophysical significance, and evaluating the positive and negative tradeoffs of protecting the resources. Goal 5 lists four categories of potential tradeoffs: economic, social, environmental, and energy (ESEE).

In the Portland region, Metro's responsibilities include identifying significant natural resources and evaluating ESEE consequences of allowing, limiting, or prohibiting development on lands that contain resources. Metro hired ECO to help evaluate the economic consequences. This final report is ECO's product responding to this charge.

1.2 SCOPE OF THIS REPORT

The findings in this report must be interpreted in context. Most importantly, this report is *an interim report about possible methods, <u>not</u> a final report that evaluates proposed policy options.* The rest of this section explains that point.

The analysis described in this report addresses the economic tradeoffs of allowing, limiting, or prohibiting lands uses and other actions that conflict with riparian areas and upland-wildlife habitat[1]. The analysis of tradeoffs addressed how protection actions may impact values and other economic measures including:

- The development value of land.
- The values of ecosystem services provided by riparian and upland-wildlife resources.
- Related economic measures including employment and economic equity.

The format of the Goal 5 process dictates that the ESEE analyses be conducted without the benefit of detailed information on the policies that will protect significant resource. Thus Metro must conduct the analyses:

- Without knowing the *extent* of allow, limit or prohibit decisions. Neither Metro, nor the local jurisdictions with Goal 5-responsibilities have identified the lands on which conflicting uses

[1] See Metro's report on its inventory of significant Goal 5 resources for more information.

will be *allowed*, and the lands on which development activity will be *limited* or *prohibited*.

- Without knowing *how* these decisions will be implemented. Metro's responsibility includes developing management decisions at the *regional* level. As we understand it, *local* jurisdictions have the responsibility of implementing the protection measures at the local level. Local decisions will influence the economic consequences.

- Without a precise *definition* of what limit means for both development value and value of ecosystem services.

Given these constraints and uncertainties, this economic analysis describes the consequences or tradeoffs of allow, limit, and prohibit decisions *qualitatively* and on a *regional scale*. This is *not* a cost-benefit study that:

- Quantifies or measures the complete range of economic costs and benefits of allow, limit and prohibit decisions.
- Describes the economic consequences, tradeoffs or costs and benefits of Goal 5 decisions at the local or parcel level.

- Evaluates the range of management options and identifies, from an economic perspective, the "best" Goal 5 protection policy.

A description of the past and future tasks in Metro's ESEE evaluation helps show where and how this report fits in. Figure 1 summarizes the main parts of Metro's Goal 5 process.[2]

Figure 1: Summary of Metro's Goal 5 Process

Identify and Rank Regionally Significant Riparian and Wildlife Areas. → Identify Conflicting Uses → Analyze ESEE Consequences → Develop Goal 5 Programs

The process began in 2001 with Metro identifying significant riparian and upland wildlife areas and creating an inventory of these natural resources. Based on this information, Metro ranked riparian areas and upland-wildlife habitats. Metro Council adopted these areas as regionally-significant resources in August 2002.

Next Metro identified land uses that conflict with or would adversely affect riparian and upland-wildlife resources. Any development potentially conflicts at some level with the preservation of land in its natural state, but some development types may conflict less than others. Metro described conflicting uses based on the following land-use zonings: single-family

[2] See Metro's Goal 5 report for more information.

residential, multi-family residential, commercial, mixed-use, industrial, rural, and parks-and-open-space.

ECO and Metro completed a preliminary scope of work in March of 2003. In May of 2003, ECO and Metro finalized the scope and ECO completed a preliminary review of the relevant literature. In late May 2003, ECO began work on the economic analysis, while Metro staff evaluated the social, energy, and environmental tradeoffs. ECO completed a draft report in September 2003. ECO reviewed comments on the draft report submitted by Metro's Economic Technical Advisory Committee ("ETAC"), the Independent Economic Analysis Board ("IEAB"), Dr. Art O'Sullivan, stakeholders, and Metro staff and Council. This is ECO's final report.

Based on the results of the analyses of ESEE tradeoffs and on other information, Metro staff will develop and evaluate program options that protect riparian areas and upland-wildlife habitats. Metro Council will make the final determination on protection measures.

1.3 OVERVIEW OF THE ANALYSIS

We started by reviewing Oregon State Land Use Goal 5 and previous Metro work regarding the Goal 5 ESEE analysis. We then searched the professional literature on the economic value of land in development and preservation. In consultation with Metro staff and ETAC we examined the available data that describes the development value of land at issue in the study. We also studied reports on Metro's inventory and ranking of significant riparian and wildlife resources. Working with Metro staff we ranked the relative importance of land in development and preservation and generated maps that depict development value and ecological importance across Metro's jurisdiction. Based on these maps and on the underlying data we examined the interactions between development value and ecological importance of Goal 5 resources. We then described the economic tradeoffs of decisions to allow, limit, or prohibit development of the resource lands.

The analytical constraints and focus of the Goal 5 process require that we depict economic consequences qualitatively rather than quantitatively. We describe the economic factors that can be influenced by an allow, limit, or prohibit decision and the likely direction of change. We do not, however, calculate a quantitative change in development or resource values associated with a Goal 5 decision for the region or for a specific property.

We reviewed the draft reports by Metro staff that describe the energy, social and environmental tradeoffs of allow, limit, and prohibit decisions. To the extent that these studies described energy, social or environmental changes that have economic tradeoffs, we considered this information in our analysis.

1.4 ORGANIZATION OF THIS REPORT

The remainder of this report is divided into two sections:

Economic Principles provides the underlying economic concepts that guide our analysis.

Analysis applies the economic principles to come to conclusions about the economic tradeoffs of allow, limit and prohibit protection measures.

2. ECONOMIC PRINCIPLES

We begin by introducing the economic principles that guide this study. These principles help define our approach to the analysis of economic tradeoffs of developing lands that contain significant riparian or wildlife resources or protecting these resources and the associated ecosystem services that benefit society.

The following are the six economic principles most relevant to our analysis:

1. *Market prices for land can be used as a measure of development value.* Property markets for developable land meet most of the criteria for a well functioning market. Many sellers and buyers participate in the market, there's free entry to and exit from the market, and buyers and sellers have access to information on the attributes of land that provide development value. For these reasons, market prices for land provide a good measure of development value. Participants in a market can measure or rank the development potential or importance of properties based on property value.

2. *Ecosystem services have economic value.* By ecosystem services we mean the benefits to society of well-functioning ecosystems such as riparian areas that mitigate flooding, help filter toxins and sediment from surface runoff and provide recreational and other amenity values. Society also benefits from wildlife habitat that helps support populations of species with commercial, recreational, and cultural value.

3. *Property markets may capture some, but not all, of the values of ecosystem services.* Property markets can provide information on the value of some ecosystem services, such as the value associated with proximity or access to recreational resources or scenic vistas. Property values typically do not reflect the value of other ecosystem services, such as water-quality or wildlife-habitat services.

4. *Property markets may not capture public-policy or planning goals*. Just as property markets fail to reflect the full value to society of ecosystem services, these markets may also fail to capture the value of public-policy or planning goals that affect land use. For example, properties with the highest market value may not necessarily be the most important lands from a public-policy perspective. Specific to this project, the hierarchy of design types as described by the 2040 Growth Concept emphasizes certain development types in certain locations. Public policy consideration drive the design of the hierarchy, not market prices. As a result, a 2040 Growth Concept may emphasize the importance of a relatively low valued land use, such as industrial development, in an area that, if left to property markets, would develop into a higher-valued use, such as a residential development.

5. *There's competition for the riparian and wildlife resources at issue in this study*. In the past, discussions of the competition for natural resources focused on the tradeoffs of developing or using a resource and the associated jobs created or supported versus protecting the resource for its intrinsic or non-use value. This is the 'jobs vs. the environment' argument. Such an approach assumed two competing demands for a resource, that protecting the environment would not generate or support jobs and that development use would not generate negative impacts beyond affecting non-use values.

   Today, the competition for resources is more complex with more demands on a finite amount of natural resources. The dynamics of the competition extend far beyond a choice of jobs or the environment. We distinguish between demands on the resource that have use and non-use values. The range of demands with use values include commercial use of the resource, the ecosystem services provided by the resources, the impacts of the resources and development values on location decisions of retirees, workers and businesses and other quality-of-life impacts and options to use the resources in the future.[3] Demands with non-use values include the intrinsic value of the resources.

6. *A static analysis likely will fail to inform stakeholders or decisionmakers adequately of the economic tradeoffs.* A static analysis is similar to taking a snapshot of analytical conditions. This approach assumes no changes in factors that could influence the outcome of a decision to develop or protect resources. An alternative approach that considers how changes or adjustments affect the economic analysis will likely provide a more complete

[3] See the literature review in the appendix of this report for more information on the competing demands for natural resources.

description of the economic tradeoffs than ignoring these adjustments. In this case, dynamic adjustments may include expanding the Urban Growth Boundary ("UGB") and the substitutability of land within the UGB. Such a dynamic approach also considers the likely restoration efforts that can help mitigate the negative impacts of development on significant resources. A dynamic approach that considers likely changes, adjustments, or possible mitigation efforts will provide decisionmakers with a more complete view of the likely economic impacts than will a static approach.

3. ANALYSIS

The major analytical tasks for our study include:

- *Rank the relative importance of lands that contain significant riparian and wildlife resource for development.* The tradeoffs of protecting riparian and wildlife areas or developing these lands for residential, commercial, industrial, etc. use lies at the heart of Metro's Goal 5 decisions. In this task we worked with Metro staff and ETAC to develop three methods of ranking the relative importance of land for development use: land value, employment, and the 2040 Design Types.

- *Overlay or compare the ranking of development importance with Metro's ranking of significant riparian and wildlife resources.* Metro ranked lands that contain riparian and wildlife resources into six categories depending on the amount and type of ecological functions or wildlife characteristics.[4] In this task we compare the rankings of development importance with rankings for riparian and wildlife importance. This comparison provides decisionmakers with information on the amount and distribution of significant interactions between development use and resource protection.

- *Describe the current land-use status of lands that contain significant riparian and wildlife resources.* We can describe the lands at issue in Metro's Goal 5 process many ways. Metro described and ranked the lands according to the ecological functions they provide. We worked with Metro staff to rank these same lands based on their development value. Current land-use status provides additional information relevant to Goal 5 deliberations. Some of these lands have already been developed. Other lands are vacant, but developing some of these lands will be constrained by existing rules or regulations or characteristics of the land, e.g., too steep. The development status of property relates to the economic analysis because it can influence the

[4] See Metro's report on Riparian Corridor and Wildlife Habitat Inventories and Metro's Conflicting Use report for more information on Metro's ranking of lands.

type, amount and timing of economic tradeoffs of allow, limit and prohibit decisions.

- *Describe the economic tradeoffs of allow, limit, and prohibit decisions as they relate to the development use of lands and protecting the riparian and upland-wildlife resources.* In this task we'll refer back to the previous tasks that describe the context for the analysis of economic tradeoffs. We describe the economic factors, e.g., development value, employment and value of ecosystem services, that may be affected by a Goal 5 decision and the factors that may influence the economic tradeoffs, e.g., expanding the UGB. We summarize our description of economic tradeoffs in a matrix.

3.1. RANK LAND BASED ON THE ECONOMIC IMPORTANCE FOR DEVELOPMENT

We can rank the economic-development importance of land many ways. Methods include ranking land based on property value, distance from city center, the amount of vehicle and pedestrian traffic that passes by, or local economic-development priorities that target specific economic sectors or land uses. Developing an exhaustive list of methods and applying them to the lands that contain Goal 5 riparian and upland-wildlife resources goes beyond the scope of this analysis. We focused instead on a few measures that give stakeholders and decisionmakers a general understanding of the development values at issue in the Goal 5 process and apply to a broad rang of zonings and land uses. In consultation with Metro staff and Metro's ETAC, we selected three measures that describe the current and future development importance of land from different perspectives.

The first measure is property value. Real-estate markets provide a good measure of a property's development value because factors that affect a parcel's development potential are typically widely known and easily measured. The professional literature describes these factors as location and use factors.[5] The location factors that influence property values include availability of urban-infrastructure services, transportation access, and zoning and other regulations. Use factors include a property's amenities, physical terrain and lot size and shape.

Another way of describing the importance of land for development is the employment potential associated with development, which is our second method. We ranked the lands in Metro's inventory of significant riparian and upland-wildlife areas based on the employment associated with zoning and land uses.

[5] See the literature review in the Appendix for more information on these factors.

Property values and employment numbers describe current conditions. For insights into the relative importance of land for development in the future we ranked lands using the planning goals described by the 2040 Design Types[6].

These three measures provide information on development values for the large majority of lands in Metro's Goal 5 analysis. However, these methods have limitations for certain land uses. In subsection 3.1.4 we describe these limitations and provide additional information on the economic importance of the development value for these land uses.

3.1.1. RANK LANDS BASED ON MARKET PRICES FOR LAND

Method and Data

To define categories of development value based on market prices for land we took the following steps:[7]

- Choose the data base. The best (most consistent, broad, and available) data on land price for the Portland metropolitan region are from the county assessors (data compiled by Metro). The reported assessed values probably systematically underestimate at a consistent rate the market value, but the errors should be less than 10%. Also, our ranking of lands among categories of value depends more on the *distribution* of values, and less on a precise measure of value for any one property. This is especially true in our case where we've ranked land value into three categories. The fewer the categories, the less likely that the assessor's data misrepresents a given property's value and that we have assigned the property to the wrong category. Our analysis uses tax-assessor data for year 2003 for lands inside the UGB as of 2002.

- Choose the units of measurement. The two obvious choices for reporting measures of land value that are standardized by land area are dollars per acre and dollars per square foot. The latter is more common in real estate evaluations so we used that.[8]

- Consider natural breaks in the data, market conditions, and study objectives to define categories of land value.

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[6] See Metro's Conflicting Use report for more information on the 2040 Design Types.

[7] See the methodology in the Appendix that describes the details of Metro's ranking of lands that contain significant riparian and wildlife resources.

[8] Conder, S and K. Larson. 1998. *Residential Lot Values and the Capital-Land Substitution Parameter: Some Recent Results from the Portland Metro Area*. Metro. May.

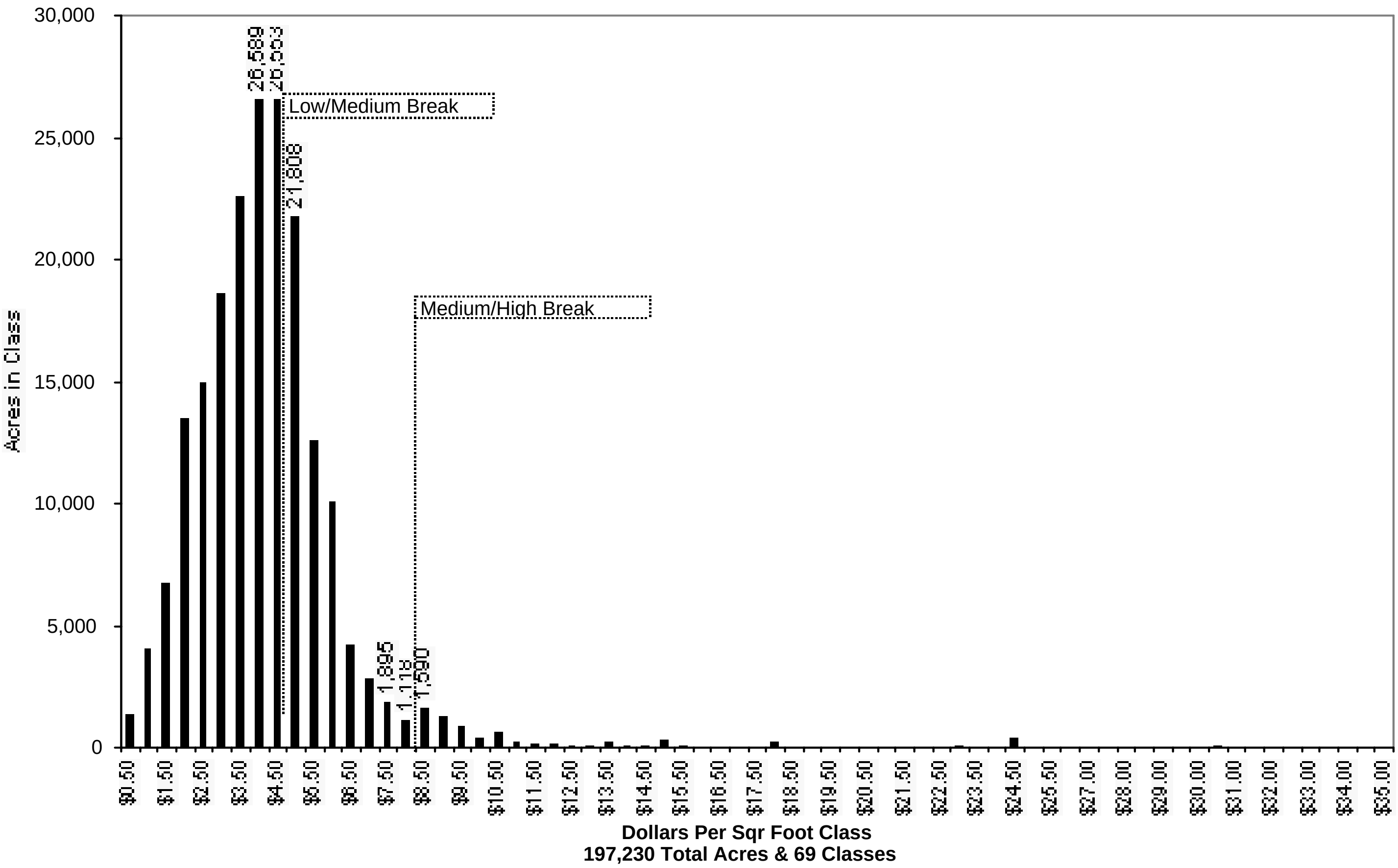
- Regarding market conditions, most unplatted but developable single-family residential parcels in the metropolitan area will be at $4 or $5 a square foot or more. Industrial land is, at the low end, around $5/sqft. Commercial and residential land is higher. Multi-family land, at the lower end (suburban) may be as low as $5/sqft. Land in downtowns outside of Portland will be in the range of $10 to $20 sq. ft. (higher in a few specific locations). Land close-in in Portland can be very much higher than $20/sqft., and can exceed $100/sqft. in the downtown.

- Regarding study objectives, it is more important to discriminate more at the low end of the scale than at the high end. Above $10/sqft., land is clearly "high" value and there is not much of it: showing land in $10- or $20-increments would not provide much value for decisionmaking. At the lower end, below $10/sqft., however, there is a lot of land, and where the line gets drawn between "low" and "medium" value could affect a large number of properties.

Given these considerations we divided "low," "medium," and "high" land values as shown in Figure 2. The acres in Figure 2 represent only those lands in Metro's jurisdiction that contain Goal 5 significant riparian and wildlife resources. Resource lands with assessed values equal to or greater than $8.00 per square foot have "high" development value. Resource lands with values greater than $4.50 and less than $8.00 have "medium" development value. Lands with value below $4.50 per square foot have "low" development value.

Near the breaks between low-medium and medium-high values we list the number of acres for each unit of land value. This information shows how the number of acres in each category increases or decreases by changing the breaks between the categories of land value. For example, *reducing the lower bound of the medium category* by $0.50 per square foot of land value, increases the number of acres with "medium" value and adds 26,553 acres to this category. *Increasing the lower bound of the medium category* by $0.50 per square foot, reduces the number of acres in that category by 21,808 acres.

Figure 2: Distribution of Land Value and Class Breaks



Source: Data analysis by Metro staff and ECONorthwest.

Assumptions and Limitations

Ranking the development value of resource lands as measured by assessed value per square foot reflects the following assumptions and limitations.

- Market prices reflect a parcel's location and use factors.
- The assessor's data on value is a reasonable proxy for market value for purposes of identifying a range of property values from "high" to "low." By reasonable proxy we mean that there's a relatively high correlation between values in the assessor's data and market values. That is, a "high" value in the assessor's database will also have a "high" market value. Given the limitations on assessed value from Measures 5 and 50, we expect assessed values will be less than market values. However, we're using this data to describe a range of property values

from "high" to "low," not as an absolute measure of market value for any one property.

- We used data on land value, not the value of land plus improvements. Land value reflects the expected value of land in the best uses supported by the market and allowed by public policy. Including the value of improvements would bias the analysis against undeveloped land. Property without improvements would likely be constrained to the lower end of the range of values if the range included the value of improvements.

- The database of assessed values excludes land uses that do not pay property taxes, such as public schools and some hospitals, and underestimates the value of other land uses that pay limited property taxes, such as low-income housing. We discuss this issue in subsection 3.1.4 below.

- Land values may reflect the amenity values associated with riparian areas and upland-wildlife habitat, but likely do not capture the value of other ecosystem services such as those associated with water quality and flood management.

Maps

Map 1[9] shows the distribution of land values for all lands in Metro's service area, including lands that do not support riparian and upland-wildlife resources. The "low," "medium," and "high" categories in Map 1 correspond to the break points illustrated in Figure 2. The distribution of land values from "low" to "high" follows the pattern of land-use intensity across Metro's jurisdiction. The highest values occur in the central parts of the city of Portland. Areas of medium value surround the high-valued areas and include urban and suburban population and commercial concentrations. Land with "low" values cover the remaining outlying areas.

Map 1a depicts the distribution of land values for the subset of lands in Metro's jurisdiction that contain riparian and upland-wildlife resources. This map shows the acres at issue in Metro's Goal 5 deliberations. The large majority of these acres fall in the outlying or "low" category.

Map 1b shows only those resource lands that are ranked "high" for the quality of riparian and upland-wildlife habitat characteristics. Another way of describing the lands shown in Map 1b is that they represent the development value of lands that contain the most significant Goal 5 resources.

[9] See the Appendix for the maps discussed throughout the report.

3.1.2. RANK LANDS BASED ON JOBS

Method and Data

To define categories of employment density, we took the following steps:[10]

- Choose the data base. The best data on employment (most consistent, broad, and available, current, disaggregated, and location-specific) for the Portland metropolitan region are from the Oregon Department of Revenue (refereed to as the Employment Security, 202 tapes). These data are available to Metro. Our analysis is based on employment data for year 2002.

- Choose the units of measurement. The two obvious choices for reporting measures of employment that are standardized by land area are employees per acre or per square feet of lot size. The former is more common in Oregon planning practice, and what we chose.[11] Yee and Bradford, 1999. These data represent employees per *gross* acre, which includes land dedicated to roads, sidewalks, and other areas that do not directly support employment.

- Estimate employment density for vacant lands based on the density in surrounding lands with similar zonings.

- Consider natural breaks in the data, market conditions, and study objectives to define categories of the employment value (measured in employees per acre—i.e., the more employees that the land can support, the more valuable it is for development).

- Regarding market conditions, typical density for industrial employment is 5 to 10 employees per acre. Commercial (office and retail) activities typically employ approximately 20 to 25 employees per acre in suburban city centers, shopping centers, and business parks. To get over 25 employees per acre for a large area would probably require a concentration of multi-story buildings.

- Regarding study objectives, it is more important to discriminate more at the low end of the scale than at the high end. Above 20 employees, land is clearly "high value" for employment and there is not much of it. At the lower end, below 20 employees per acre, however, there is a lot of land, and where the line gets drawn between low and medium value may affect many properties.

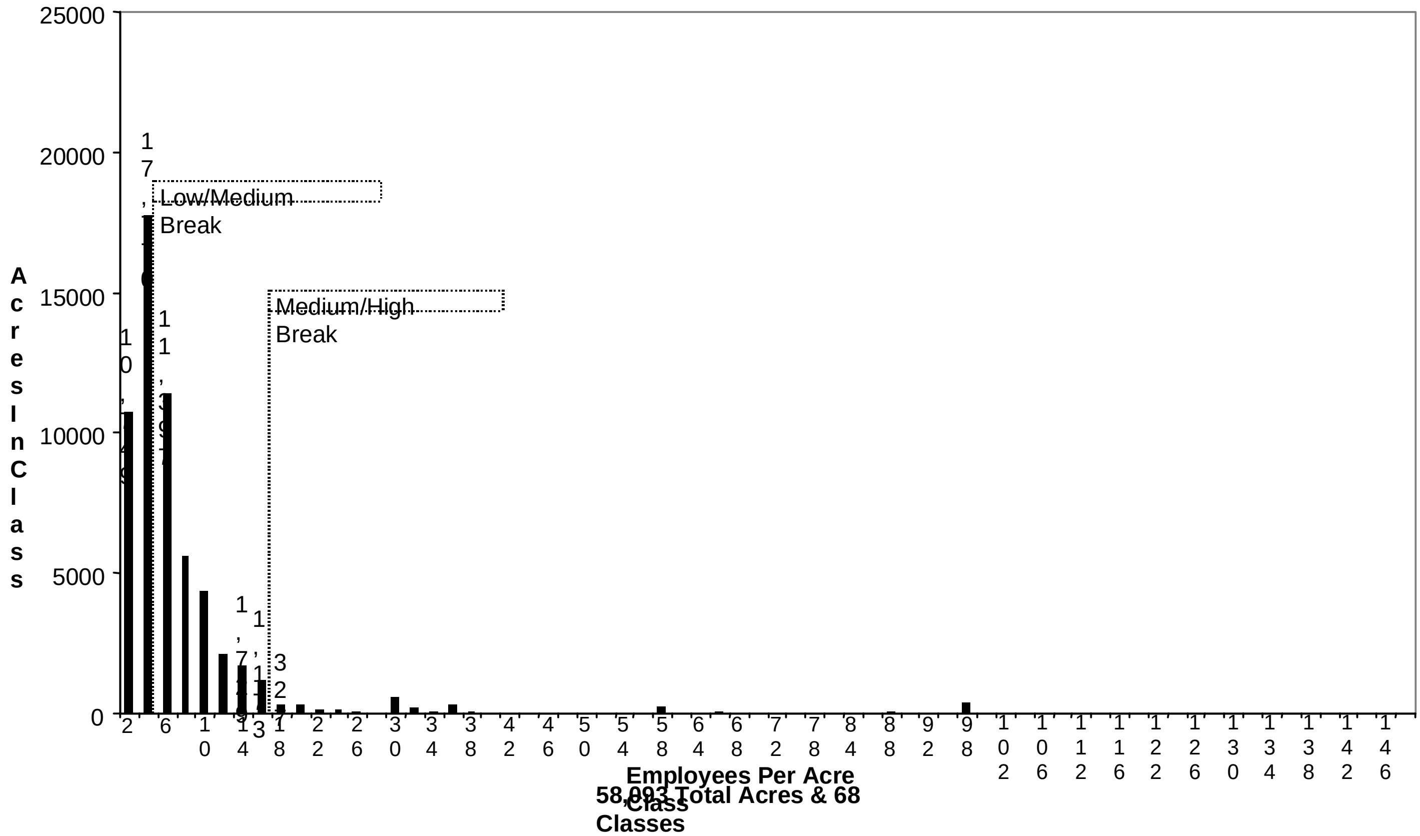
[10] See the methodology in the Appendix that describes the details of Metro's ranking of lands that contain significant riparian and wildlife resources.

[11] Yee, D. and J. Bradford, 1999. *1999 Employment Density Study: Technical Report.* Metro's Growth Management Services Department. Revised May 5.

Given these considerations, we divided “low,” “medium,” and “high” employment as shown in Figure 3. This figure shows the distribution of employment density for lands that contain significant riparian and wildlife resources. Resource lands with employment density equal to or greater than 16 jobs per acre have “high” development value. Resource lands with values greater than 4 and less than 16 jobs per acre have “medium” development value. Lands with employment density of 4 jobs per acre or less have “low” development value.

Near the breaks between low-medium and medium-high values we list the number of acres in each degree of employment density. For example, if we reduce the lower bound of the medium category by one degree of employment density, or 2 jobs per acre, we would add 17,770 acres into the medium category. If we were to increase the lower bound of the medium category by one degree we would reduce the number of total acres in that category by 11,397. This information will help decisionmakers and others conduct sensitivity analyses of the impacts of changing the break points on the number of acres per category.

Figure 3: Distribution of Employment Density and Class Breaks



Source: Data analysis by Metro staff and ECONorthwest.

Assumptions and Limitations

The ranking method described above reflects the following assumptions and limitations:

- This method assumes that jobs are tied to a specific location and cannot move to other locations in the Metro area. This assumption is certainly not strictly correct; in some instances it may not be even approximately correct.

- The measures of employment density do not capture the relative importance of residential developments. However, we expect that ranking land based on land value (as described above) provides a measure of the relative development value of residential areas.

- Employment density for vacant land will be equivalent to employment densities of surrounding lands with similar zonings and land use.

- One of the limitations of our analysis is that we have not distinguished among jobs that are more "important" and those that are less "important," as described by employment income or employment multipliers. The analysis assumes all jobs are equally important. The ranking for an individual parcel using employment income or employment multipliers may differ from the ranking based on employment density. The land uses most affected are smaller parcels that employ large numbers of works at low wages and large parcels that employ few workers at high wages. The former would rank higher on the employment-density scale and lower on the employment-income scale. The latter would rank lower on employment density and higher on employment income. It's not clear from a regional perspective the net effect of this limitation on the overall results. We note also that the 2040 Design Types described in the next subsection account, to some extent, for differences in employment types.

Maps

Map 2 shows the distribution of lands ranked by employment density. The "low," "medium," and "high" categories in Map 2 correspond to the break points illustrated in Figure 3. Compared with the distribution of development values as described by land value (see Map 1), lands that support employment occupy a smaller subset of Metro's service area. That's because Map 2 excludes lands that do not support employment, primarily residential and park lands. Map 2 shows that lands that support employment predominate in the Portland city-center and along transportation routes.

Map 2a depicts the distribution of employment density for the subset of lands in Metro's jurisdiction that contain significant riparian and upland-wildlife resources. This map shows the employment density for the lands at issue in Metro's Goal 5 deliberations. The large majority of these lands fall in the outlying or "low" category.

Map 2b shows the subset of lands from Map 2a that are ranked "high" for the quality of riparian and upland-wildlife habitat characteristics. Map 2b shows the employment density for lands that contain the most significant Goal 5 riparian and wildlife resources. Policy decisions that protect the most significant Goal 5 resources would have the greatest impact on these lands.

3.1.3. Rank Lands According to 2040 Design Types

Method and Data

Land value and employment density measure development importance today under current conditions. For insights into future development patterns and the associated importance of land uses we look to the planning goals as described by the 2040 Design Types. As we understand it, the 2040 Design Types represent a blueprint that helps guide future development and reflect deliberations on what stakeholders and decisionmakers want future development to look like.[12]

For the purposes of Metro's Goal 5 ESEE analysis, Metro developed a hierarchical scheme for the design types as follows.

1. Primary Land Use Components

- *Central City*. Downtown Portland.
- *Regional Centers*. Areas outside the central city that are the focus of compact development, redevelopment, and high-quality transit service, e.g., Hillsboro and Gresham.
- *Industrial Areas, non-water dependent*.
- *Industrial Areas, water dependent*.
- *Intermodal Transportation Facilities*. These facilities include marine terminals, freight facilities for trucking, airports and railroads.

2. Secondary Land Use Components

- *Town Centers*. These areas are smaller and less dense than regional centers, e.g., Forest Grove and Milwaukie.
- *Main Streets*. Main streets are similar to town centers but on a smaller scale.
- *Station Communities*. These developments are centered around light rail or high-capacity transit stations.

[12] For more information on the 2040 Design Types see the Conflicting Uses section of Metro's ESEE report.

3. Tertiary Land Use Components

- *Inner Neighborhoods*. Primarily residential developments with access to employment and shopping.

- *Outer Neighborhoods*. Farther away from employment centers than inner neighborhoods with smaller lot sizes.

- *Employment Centers*. Areas designated to receive various types of employment and may include residential developments that serve the needs of employees.

- *Corridors*. Major streets that serve as key transportation routes for people and goods. Corridors provide a mix of land uses such as higher density residential, office, commercial, and retail.

- *Future Urban Lands*. Areas that have recently been brought into the urban growth boundary ("UGB") and lands that may be brought into the UGB.

4. Other

- *Parks and Open Space*. Not included in other design types.
- *Rural Reserves*. Lands outside the UGB that provide a visual and physical separation between urban areas and farm and forest lands.

Assumptions and Limitations

The ranking method described above reflects the following assumptions and limitations:

- The 2040 Design Types describe future development patterns in Metro's service area.

- The 2040 Design Types consider regional land-use goals and policies in addition to economic factors. For example, non-water dependent industrial areas rank as a primary component, even though some secondary components, e.g., Town Centers, may have higher land values or employment. Industrial areas, however, are more important or valuable from a policy perspective regarding the content and pattern of future development and so rank ahead of Town Centers.

Maps

Metro staff categorized lands in the UGB based on the 2040 Design Types and mapped lands using GIS.[13] Map 3 shows the distribution of the four

[13] See the methodology in the Appendix that describes the details of Metro's ranking of lands that contain significant riparian and wildlife resources.

categories of 2040 Design Types described above for all lands in Metro's service area. Map 3a shows the subset of lands in Map 3 that contain significant Goal 5 riparian or wildlife resources. Metro's Goal 5 decision will affect these lands. Map 3b shows the subset of lands in Map 3a that support the most significant Goal 5 riparian or wildlife resources.

Comparing Maps 1, 2 and 3 we see that the Primary Design Types cover more of Metro's jurisdiction than are areas of "high" land value or employment density, which are concentrated mostly in the downtown Portland area. This is especially true along the Columbia River and the Willamette River outside of downtown Portland. This area has "low" land values and employment densities for the most part, but has a Primary Design-Type designation. For these lands the Design Types reflect public policies that support or enhance the industrial areas along the rivers for future development. Even though these areas have "low" land values and employment densities relative to the Portland city center, public-policy considerations dictate that these industrial lands should be emphasized or enhanced for reasons other than the value of land or employment density.

The preceding paragraph describes differences in distribution among the three measures of development value. There are also similarities. For example, just as most lands in Metro's service area rank "low" for land value and employment density, most lands also rank in the "tertiary" or "other" design type. Another similarity is that, with the exception of lands along the rivers, the distribution of lands with "high" and "medium" employment density has a pattern similar to the distribution of lands ranked "primary" and "secondary" design types.

3.1.4. LIMITATIONS OF THE THREE MEASURES OF THE ECONOMIC IMPORTANCE OF LAND FOR DEVELOPMENT

Some reviewers of the draft economic report felt that the three methods of ranking lands using economic-development values—land value, employment density, and 2040 Design Types—create special concerns for certain land uses. These concerns arise because the three methods either exclude some land uses from the analysis or underestimate their economic importance.

In response to these comments we've added this subsection that describes the limitations of the ranking methods, the affected land uses and their regional significance, and factors to consider regarding the potential impacts of allow, limit, and prohibit decisions for these land uses.

We note that the economic portion of the ESEE analysis describes the relative economic importance of lands that contain significant natural resources from a *regional* perspective. The analysis does not focus on the relative economic importance of *individual parcels*. Such an analysis is beyond the scope of a Goal 5 ESEE analysis. The reviewers' concerns, however, apply to the economic importance of individual parcels. These comments highlight the importance of implementing a Goal 5 program that considers unique or important characteristics at the parcel level when implementing protection guidelines developed at the regional level.

Limitations of the Ranking Methods

Land Value

This method excludes land uses exempt from property taxes or underestimates the economic importance of lands that pay taxes at a diminished rate. Lands exempt from tax assessments—e.g., schools, universities, and some hospitals—do not appear in the data base or analysis for this measure of economic importance.

This method underestimates the economic importance of lands with restricted or diminished tax assessments—e.g., low-income housing, urban-renewal areas, and other land uses that benefit from public policies that subsidize tax payments. The analysis includes these lands in the ranking, but the rankings may not reflect these parcels' full value.

Employment Density

Our analysis calculates the average employment density across all land uses in a given GIS map unit. This method may underestimate or overestimate the employment density for some individual parcels. For example, the employment density for a GIS map unit that includes residential areas surrounding a university or hospital may underestimate the employment ranking for these facilities because of the relatively low employment densities found in the residential areas. We note that the opposite is also true. Because the method calculates the average employment density per map unit, properties with lower-than-average densities will be represented by an average measure for the entire map unit that overestimates the employment density for these parcels.

Employment density does not distinguish between "more" important or "less" important jobs as described by employment income or employment multipliers. In consultation with Metro's ETAC we discussed this issue and considered adding these measures to the analysis or substituting them for employment density. Ultimately we concluded that employment density provides stakeholders and decisionmakers with employment information that exceeds the requirements for a Goal 5 ESEE analysis. Also, we note that Metro uses employment density when addressing other land use issues that have employment consequences[14]. Finally, the 2040 Design Types capture to some degree the economic importance of land as described by employment multipliers.

[14] See the Metro report, *Technical Report: 1999 Employment Density Study*, April 6, 1999, revised May 5, 1999.

2040 Design Type

Some reviewers commented that the 2040 Design Types exclude certain land uses or underestimate the relative importance of a given land use. For example, several educational institutions are not located in designated design-type areas. In other cases, what some consider a regionally-significant land use, such as a regional medical center, are included in a lower-level design type.

Relative Economic Importance of Land Uses

The lands uses of concern—those for which the three methods used in the economic analysis either exclude or underestimate their economic importance—fall predominantly into four general categories: 1) transportation; 2) utilities; 3) education; and, 4) health care. In this subsection we describe the relative economic importance of these land uses.

Transportation Facilities and Utilities: To stay competitive, cities must have modern and efficient physical infrastructure, including roads, bridges, water and sewer systems, airport and cargo facilities, energy systems and telecommunications. The economic literature shows a correlation between economic growth and transportation facilities and utility services. Well-functioning and efficient physical infrastructure helps promote improvements in productivity. The quality of, and access to, transportation facilities and utilities can also directly influence production costs.[15]

Education: The economic literature distinguishes between the economic importance of primary and secondary education, from college, university and post-graduate studies.

Primary and Secondary Education

Many high-skilled or knowledge-based workers can choose where they want to live, they can apply their skills to a variety of industries or have the

[15]Atkinson, Robert D. and Paul D. Gottlieb. 2001. *The Metropolitan New Economy Index: Benchmarking Economic Transformation in the Nation's Metropolitan Areas*. Progressive Policy Institute and the Center for Regional Economic Issues, Case Western Reserve University. April.

Cohen, Natalie. 2000. *Business Location Decision-Making and the Cities: Bringing Companies Back*. Washington, D.C.: The Brookings Institution. April.

Rondinelli, Dennis A. 1998. "The Changing Forces of Urban Economic Development: Globalization and City Competitiveness in the 21st Century." *Cityscape*, 3 (3).

Fisher, R.C. 1997. "The Effects of State and Local Public Services on Economic Development." *New England Economic Review*. March/April, p. 53-82.

Collaborative Economics. 1999. *Innovative Regions: The Importance of Place and Networks in the Innovative Economy*. The Heinz Endowments, Innovation Works, Inc., and The Pittsburg Regional Alliance. October. Collaborative Economics 1999.

ability to telecommute. Because they can pick and choose their locations, they choose those with quality amenities, including good elementary and secondary schools.[16]

College, University, and Post-Graduate Studies

Given the current high demand for skilled labor, economic growth and development depends in part on access to a critical mass of employable persons with the necessary training and education. An educated workforce has become the primary location factor for growing companies.[17]

The most competitive cities recognize that businesses must locate near or have access to knowledge centers. Among the most important knowledge-based organizations are colleges and universities that provide trained personnel and research capacities. Companies also depend on training and continuing education facilities that help them become and remain learning organizations.[18]

Increasing evidence suggests that promoting innovation, creativity, flexibility, and adaptability will be essential to keeping US cities economically vital and internationally competitive. Innovation is particularly important in industries that require an educated workforce. High-tech companies need to have access to new ideas typically associated with a university or research institute.[19]

Medical Services: Medical services contribute to a region's economic growth and development in a number of ways. In many municipalities, hospitals and medical clinics are among the largest employers. For example, in the Portland area, OHSU is the region's top employer. Medical schools and research facilities provided important education-related services that help

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[16] Cohen 2000

Florida, R. 2000. *Competing in the Age of Talent: Environment, Amenities, and the New Economy*. Prepared for the R.K. Mellon Foundation, Heinz Endowments, and Sustainable Pittsburgh.

[17] Cohen 2000

Ady, Robert M. 1997. "Discussion." *New England Economic Review*. March/April, p. 77-82.

Glaeser, E. and J.M. Shapiro. 2001. *Job Sprawl: Employment Location in the U.S. Metropolitan Areas*. The Brookings Institution. May.

[18] Rondinelli 1998

Audretsch, D.B. and M.P. Feldman. 1996. "R&D Spillovers and the Geography of Innovation and Production." *The American Economic Review*. 86 (3), p. 630-640.

Collaborative Economics 1999.

[19]Fulton, William and Paul Shigley. 2001. "Little Chips, Big Dreams." *Governing* (no information on volume number).

support the growth and development of knowledge-based businesses. The availability of high-quality and diverse medical services also contributes to a region's quality of life, which helps attract and retain high skilled, and highly-educated workers.

Factors To Consider Regarding Allow, Limit and Prohibit Decisions

The reviewers' comments highlight the importance of considering unique or important characteristics at the *parcel* level when implementing protection guidelines developed at the *regional* level. The economic factors that may affect deliberations of these issues at the local level include:

Land Value. The fact that municipalities or regional governments grant certain land uses a waiver or reduction of property taxes offers insights into the relative importance of the services provided by these land uses to local or regional residents and businesses. Using this approach for lands excluded from or undervalued in the land-value database, facilities with complete and permanent exemption from property taxes would rank higher than facilities with limited or temporary exemptions.

Employment Density. Some regionally-significant facilities rank low on the employment scale because they're surrounded by land uses with low employment densities. Others because they occupy relatively large parcels, which diminishes the number of employees per gross acre. This condition is analogous to industrial lands, which occupy relatively large parcels and have relatively low employment densities. Metro recognized that employment density and the other measures of economic importance did not adequately reflect the economic contribution of some industrial lands to the regional economy. As a result of this limitation, it made a policy decision to identify these lands as "regionally-significant" industrial lands and to rank these lands higher on the scale of economic importance than other industrial lands. Metro or local decisionmakers could apply this same policy consideration and decision to the lands that rank lower on the employment measure of development value.

Flexibility of Land Use. The potential economic consequences of Goal 5 protection for the land uses at issue in this part of our analysis depends in part on the details of a given land use including the physical space the use occupies. For example, the economic impacts of limiting the development of a runway extension at Portland airport will be different from the potential impacts of reconfiguring an access road on the airport grounds so that it avoids significant riparian areas.

In another example, a utility right-of-way that extends for miles along a narrow strip of land may pass through riparian or wildlife habitats that vary in importance and value. This land use has limited flexibility in that it would be difficult and expensive to move or reconfigure the right-of-way. The utility services provided via the right-of-way may have regional significance if they affect residences and businesses through out Metro's service area. In a contrasting example, a college or university with ample vacant land on its campus may have multiple options for the site of a new dormitory if the proposed location conflicts with important and valuable riparian or upland-wildlife habitat.

3.2. Rank Land Based on the Economic Importance for Ecosystem Services

Method and Data

Metro conducted an inventory of the significant riparian-wildlife and upland-wildlife resources in its service area and ranked these resources based on the amount and type of ecological functions and wildlife characteristics.[20]

The ecological functions specific to riparian wildlife areas that Metro considered include:

- Microclimate and shade provided by forest or woody vegetation in and along riparian areas.
- Stream flow moderation and water storage capabilities.
- Bank stabilization and sediment and pollution control.
- Channel dynamics.
- Organic inputs.

Metro ranked riparian-wildlife areas into three categories, Class I, II, and III. As we understand it, areas with more ecological functions and/or areas with functions near a stream, wetland or floodplain received a higher ranking than areas with fewer functions or with functions that were further away from water features.

The characteristics that Metro considered for upland-wildlife areas included:

- Habitats of concern and habitats for unique and sensitive species.
- Habitat patch size and interior habitat.
- Connectivity and proximity to water resources and other habitat areas.

Similar to the ranking of riparian areas, Metro staff ranked land with upland-wildlife habitat into three categories, Class A, B, and C, depending on the type and amount of wildlife characteristics.

[20] See Metro's report, *Metro's Riparian Corridor and Wildlife Habitat Inventories* for more information on Metro's inventory and ranking of riparian and wildlife resources.

In Table 1 below, we list the riparian and wildlife classes and the percent of total resources by class.

Table 1: Resource Categories, as a Percentage of Total Resource Lands.

Resource Category	Percent of Total Resource Lands
Riparian & Wildlife Class I	32%
Riparian & Wildlife Class II	14%
Riparian Class III	8%
Upland Wildlife Class A	24%
Upland Wildlife Class B	13%
Upland Wildlife Class C	9%
Total	100%

Source: Conflicting Uses section of Metro's Goal 5 report.

Fifty-six percent of the resource lands are in Riparian & Wildlife Class I and Upland Wildlife Class A, categories with the most important ecological functions and wildlife characteristics. The percentage of total resource lands in a resource category declines from Class I to Class III and from Class A to Class C.

Metro's inventory and ranking focused on the ecological functions and wildlife characteristics that affect the biophysical health and wellbeing of these areas, without concern for how these attributes benefit society. Hueting, et al. (1998), King and Mazzotta (2003) and others,[21] describe the relationship between the biophysical attributes of natural areas and the related benefits to society. These researchers and others use the term "ecosystem services" to describe the services provided by natural areas that benefit society.

Table 2 below lists the ecological functions and wildlife characteristics that Metro considered in its ranking of riparian and wildlife areas and the related ecosystem services that benefit society.[22]

[21] Balmford, A., et al. 2002. "Economic Reasons for Conserving Wild Nature." *Science* 297: 950-953.

Costanza, R., et al. 1997. "The Value of the World's Ecosystem Services and Natural Capital." *Nature* 387 (May 15): 253-260.

Daily, G. and K. Ellison. 2002. *The New Economy of Nature*. Washington, D.C.: Island Press.

[22] See also Metro's analysis of environmental consequences for information on the relationship between ecological functions, wildlife characteristics and benefits to society.

Table 2: Ecological Functions, Wildlife Characteristics and Related Ecosystem Services that Benefit Society

Ecological Function	Ecosystem Service
Microclimate shade and cooling	Moderating summer temperatures, which helps reduces energy demand for cooling.
Stream flow moderation and improved water storage	Reduced flood damage and flood-management costs.
Bank stabilization and sediment and pollution control	Improved water quality. Reduced demand for water filtration and treatment. Reduced landslides and related damage and clean-up costs.
Large woody debris and channel dynamics	Reduced flood damage and flood-management costs.
Well-functioning riparian areas in general	Recreation, amenity and intrinsic values associated with riparian areas.
Wildlife Characteristic	
Habitats of concern and habitats for unique and sensitive species	Increased populations of salmon and other species and associated increases in commercial, recreational, cultural and intrinsic values.
Well-functioning wildlife habitats in general	Recreation, amenity and intrinsic values associated with wildlife habitat.

Source: ECONorthwest and Metro's inventory and ranking of riparian and wildlife resources.

As described in the references noted above, and in the literature review that accompanies this report, the ecological functions and wildlife characteristics in Table 2 provide ecosystem services that benefit society. For example, riparian areas that mitigate flooding help reduce flood-related damages to homes and businesses. In another example, protecting or improving habitat that benefits salmon helps protect the fish's commercial, recreational, and cultural values. See the literature review for more information on ecosystem services and their economic values.

Assumptions and Limitations

The ranking of riparian-wildlife and upland-wildlife resources depends on the following assumptions and characteristics:

- Areas that provide more of the ecological functions and wildlife characteristics illustrated in Table 1 provide more ecosystem services and value to society than do areas that provide fewer functions and characteristics.

- Actions that enhance or protect ecosystem services also enhance or protect the economic values associated with those services. Actions that degrade these services will have the opposite effect.

Maps

Map 4 shows the distribution of the classes of riparian-wildlife and upland-wildlife resources across Metro's service area. With one notable exception—the area between the Willamette and Columbia Rivers—Goal 5 significant natural resources cover much of Metro's service area. The map shows that the most intensively-developed areas of the Portland city center and extending east from the Willamette River retain little or no riparian or wildlife resources.

Map 4a shows the distribution of the highest-valued resource lands, Riparian & Wildlife Class I and Upland Wildlife Class A.

3.3. CURRENT LAND-USE STATUS OF RESOURCE LANDS

The previous subsections describe the lands at issue in Metro's Goal 5 analysis based on their economic importance for development and on the quality of riparian and wildlife habitat. This section describes the current land-use characteristics of the land. These characteristics include development status (vacant or developed, and the type of development) and zoning type (e.g., single-family residential, commercial, etc).

Development status and zoning type influence the type, amount, and timing of the economic consequences of Goal 5 allow, limit and prohibit decisions. For example, the employment impacts of limiting future activities in an already-developed residential area will differ from the impacts of limiting development of vacant area zoned for commercial or industrial use.

3.3.1. DEVELOPMENT STATUS

Metro classified the lands containing significant riparian and wildlife resources using four development categories:

- *Developed Parks*[23]: Park and openspace lands that Metro considers already developed and generally not available for urban development.
- *Developed Urban:* Lands that have been developed in accordance with specific zoning, such as single-family residential or commercial use.
- *Vacant Constrained:* Lands that have not yet been developed but development is constrained by Title 3[24].

[23] This category includes all areas covered by parks or open space and includes park land zoned as single-family residential, commercial, or other zoning.

[24] For information on Title 3, see, "Title 3: Water Quality, Flood Management, and Fish and Wildlife Conservation" described in the Metro Urban Growth Management Functional Plan. Title 3 describes development guidelines that protect water quality, floodplain areas, and fish and wildlife habitat.

- *Vacant Buildable*: Vacant, buildable land that's unconstrained by non-Goal 5 regulations.

Table 3 describes the development status of the Goal 5 resources lands and describes these lands as a percentage of the *total* lands by development category in the UGB. For example, 34 percent of Goal 5 resources lands are in parks and these parklands account for approximately 66 percent of the total parklands in the Portland Metro UGB.

Table 3: Goal 5 Resource Lands by Development Status and As A Percentage of Total Lands in the Development Status in the UGB in 2002

Development Status	% of Total Goal 5 Resource Lands	Goal 5 Resources as a % of Total Lands in the Development Status in the UGB
Developed Parks	34%	66%
Developed Urban	28%	10%
Vacant Constrained	16%	67%
Vacant Buildable	22%	41%
Total	100%	(not applicable)

Source: Data analysis by Metro staff.

Table 3 illustrates that:

- Less than 25 percent of the lands that contain Goal 5 resources are vacant and available for development. Goal 5 decisions will have the most immediate impacts here because development is unconstrained by other factors. Limit and prohibit decisions will affect vacant-buildable lands throughout the Portland metro area because these lands account for over 40 percent of the total inventory of vacant-buildable lands within the UGB.

- Seventy-eight percent of the lands with Goal 5 resources have already been developed or development is constrained on these lands by non-Goal 5 regulations.

- Over 60 percent of Goal 5-resource lands have already been developed as parks/open space or as urban residential, commercial, industrial, etc. developments.

- We expect that future developments on park and open-space lands will have limited negative impacts on the significant riparian and wildlife resources on these lands. As a result, it's unlikely that Goal 5 limit or prohibit decisions will significantly affect future developments on these lands.

- Goal 5 decisions may impact lands in the developed-urban category in the future as these lands are redeveloped.

- Title 3 restricts development on 16 percent of the lands with Goal 5 resources. This percentage underestimates the total amount of land on which development is restricted because Title 3 is a state-wide regulation and does not reflect lands on which development is restricted by local regulations that exceed Title 3 guidelines.

Metro must conduct the Goal 5 ESEE analysis for lands that contain significant natural resources *and* impact areas[25]. Impact areas lie outside, but adjacent to, the lands that contain significant resources. Land-use activities that occur on lands within the impact areas may negatively impact significant resources. Metro identified two types of impact areas. Riparian-impact areas occur within 150 feet of a stream, wetland, or lake that otherwise receives no resource protection. Supplementary impact areas occur in a band 25-feet wide around all resources to protect the tree root-zone areas.

Table 4 describes the development status of impact areas.

Table 4: The Development Status of Impact Areas

	Developed Parks	Developed Urban	Vacant Constrained	Vacant Buildable
Percentage of Impact Areas	9%	73%	5%	13%

Source: Data analysis by Metro staff.

As Table 4 indicates, most impact areas have already been developed.

An analysis of the development value of impact areas, as described by land value, employment density and 2040 Design Types, found that the distribution of development values follows the distributions of land value, employment density and 2040 Design Types described above for the lands containing significant riparian and wildlife resources. That is, most impact areas have "low" land value, employment density, and design types, relative to the values measured for lands in the Portland city center.

3.3.2. GENERALIZED REGIONAL ZONES

As described in the Conflicting Uses section of Metro's Goal 5 report, Metro identified land uses that could potential conflicting with significant riparian-wildlife and upland-wildlife habitat. Metro described these land uses using "generalized regional zones." The generalized regional zones reflect a compilation of zoning designations as implemented by local governments

[25] See the Impact Areas section of Metro's Goal 5 report for more information on impact areas.

within Metro's service area.[26] In this subsection we describe the lands containing significant Goal 5 natural resource by generalized regional zones.

Table 5 below lists the lands with Goal 5 natural resources by the generalized regional zones[27].

Table 5: Significant Riparian Areas and Wildlife Habitat by Generalized Regional Zone, in Acres and Percentage, in the UGB in 2002

Generalized Regional Zone	Acres	Percentage of Total Acres of Significant Resources
Single-Family Residential	24,821	46.2%
Multi-Family Residential	2,610	4.9%
Commercial	2,672	5.0%
Industrial	7,721	14.4%
Mixed Use Centers	1,284	2.4%
Rural	3,923	7.3%
Parks and Open Space	10,468	19.5%
No Zoning	172	0.3%
Total	53,671	100%

Source: Conflicting Uses section of Metro's Goal 5 report.

Table 5 illustrates that:

- Over 80 percent of the land uses that potentially conflict with Goal 5 riparian-wildlife and upland-wildlife resources occur in three regional zones: single-family residential (SFR), parks and open space (POS), and industrial (IND).
- SFR contains the largest percentage of Goal 5-resource lands, over 46 percent. Goal 5 allow, limit and prohibit decisions likely will fall most heavily on lands in this zoning.
- Lands zoned POS account for approximately 20 percent of Goal 5 natural resources.
- Over 14 percent of the lands with Goal 5 natural resource are zoned IND.

[26] See Metro's Goal 5 report for more information on designating conflicting uses.

[27] Table 3 describes the potential conflicting lands uses *within the UGB* in 2000. Lands *outside the UGB* but within Metro's service area are primarily zoned rural residential, agricultural, and forestry lands. Relative to the Portland city center we expect these lands have low employment density and land value. These lands have not yet been categorized by 2040 Design Type.

- The majority of lands with Goal 5 resource do not support employment. Less than 22 percent of the lands are zoned for commercial, industrial or mixed-use.

3.4. INTERACTIONS AMONG MEASURES

Previous subsections describe the lands containing Goal 5 natural resources using measures of development value[28], resource categories[29], and generalized regional zones[30]. In this subsection we describe the overlap and interactions among the measures. Given the number of measures and the large size of the table of interactions, we've appended the table in the Appendix to this report. The Appendix also contains tables that describe interactions between various subsets of measures.

Summary points illustrated in the tables of interactions include:

- *Land Value, Zoning and Resources:* The zoning for a majority of resource lands, approximately 64 percent, support development value. The remainder fall into POS zoning or contain water bodies. Of the lands with development value, most fall into the "low" land-value category. See Table 4 in the Appendix

- *Employment, Zoning and Resources:* Approximately 78 percent of the resources lands do not support employment. These lands are zoned SFR, MFR, RUR, and POS. Of the lands that do support employment, most fall into the "low" employment category. See Table 5 in the Appendix.

- *2040 Design Type and Resources:* The distribution of resource lands by 2040 Design Type differs from the distributions described above for land value and employment. In general, categorizing lands using 2040 Design Types yields a distribution with a greater percentage of the lands having development value, and for the lands that have development value, more of the lands rank in the higher-valued design types. See Table 6 in the Appendix.

- *2040 Design Type, Zoning, and Resources:* Three generalized regional zones, SFR, POS, and IND, account for 80 percent of the resource acres. Ninety-eight percent of the resource lands zoned SFR and POS fall into the lowest design type[31]. In contrast, 33 percent of the lands

[28] Land value, employment density, and 2040 Design Type.

[29] Riparian-wildlife classes I, II, and III, upland-wildlife classes A, B, and C.

[30] Single-family residential, multi-family residential, commercial, industrial, mixed use centers, rural, parks and open space, and no zoning.

[31] This includes lands in the tertiary design type, and lands in the "other" design type that includes parks, open space and rural reserves.

zoned IND fall in the lowest design type and 60 percent is ranked in the primary, or highest, design type. See Table 7 in the Appendix.

- *Land Value, Employment, 2040 Design Type, Zoning and Resources*: Focusing on resource lands zoned SFR, POS, and IND, approximately 98 percent of POS lands, and approximately 78 percent of SFR lands ranked in the lowest category for all three measures of development value (land value, employment and 2040 Design Type). In contrast, 25 percent of lands zoned IND ranked in the lowest categories for all three measures of development value. Over 60 percent of IND lands ranked in the highest category for at least one measure. See Table 8 in the Appendix.

- *Goal 5 Allow, Limit, Prohibit Impacts*: The large majority of Goal 5 allow, limit and prohibit decisions will impact lands zoned SFR, POS and IND. Impacts on lands zoned SFR and POS will have little or no employment impacts and will affect lands ranked "low" on the land-value scale. The majority of impacts on lands zoned IND will affect lands ranked "high" on at least one measure of development value.

The fact that Goal 5 decisions would primarily affect acres with lower land values and employment densities does not mean that limit or prohibit decisions on these acres would generate trivial economic consequences. The "low" category for these development values are relative to land values and employment densities found in the Portland city center and do not represent an absolute measure of land value or employment. The actual impacts of limit or prohibit decisions on property values or employment will depend on the specifics of the decision (e.g., lightly limit, moderately limit, etc.), the details of the Goal 5 plan that implements the decision, actions that may mitigate any negative impacts, and specifics of the individual parcels affected.

Maps

For mapping purposes, Metro summarized the interaction among the measures of development value into three categories, which they refer to as Component Summaries. The lowest category shows lands that ranked "low" on all three measures of development value: property value, employment density and 2040 Design Types. The next category shows lands that ranked "medium" on at least one category, with no "high" rankings. The final category shows lands that ranked "high" on at least one category.

Map 5 shows the Component Summaries for *all* lands in Metro's service area, including lands that do not contain Goal 5 natural resources. Map 5a shows the Component Summaries for the subset of lands within Metro's service area that contain significant Goal 5 natural resources. Goal 5 decisions will affect these lands. Map 5b is similar to Map 5a except that it illustrates the Component Summaries for the subset of resource lands that ranked highest for type and amount of ecological functions and wildlife characteristics (Class I and Class A lands).

Focusing on Maps 5a and b that depict resource lands, the maps show that the majority of resource lands ranked "low" on all three measures of development value.

3.5. Potential Economic Tradeoffs of Goal 5 Allow, Limit, and Prohibit Decisions

3.5.1. Introduction

The economic portion of the Goal 5 ESEE analysis addresses the tradeoffs of developing lands that contain Goal 5 riparian and wildlife resources, or maintaining the resources and their associated ecosystem services that benefit society. Any development potentially conflicts at some level with preserving land in its natural state. Developing the lands with Goal 5 resources will generate a set of economic tradeoffs distinct from the tradeoffs of protecting the resources. We describe these tradeoffs in this subsection.

It's not clear at this time the details of Metro's Goal 5 programs or how they'll be implemented. Both will influence the economic tradeoffs. Economic tradeoffs will also depend on the specifics of the significant resources affected, the conflicting land uses, and parcel size, configuration, and location. As a result of these analytical uncertainties, we depict economic tradeoffs qualitatively rather than quantitatively. We describe—at the regional level—the economic factors that allow, limit, or prohibit decision can influence and the likely directions of change. We do not, however, calculate a quantitative change in the development or resource values associated with a Goal 5 decision on a specific property.

We considered the results from the analyses of energy, social, and environmental tradeoffs in our analysis of economic tradeoffs.

We describe the following categories of economic tradeoffs:

Economic Values. The changes in the values of goods and services.

- Property values.
- The values of ecosystem goods and services provided by riparian and wildlife areas.

Economic Impacts. The changes in the levels of economic activities within the local economy.

- Employment and income tradeoffs.
- Changes in tax payments.
- Transportation impacts.

2040 Design Types. The 2040 Design Types outline development patterns over the coming decades. The analysis considered the economic tradeoffs of how allow, limit and prohibit decisions may impact future development.

Economic Equity. The changes in the distributions of costs and benefits within the economy, especially changes affecting groups of special concern such as property owners that shoulder a disproportionate amount of the negative consequences of a policy decision. Equity tradeoffs in this analysis include:

- Tradeoffs by type of land use, as described by zoning type.
- The geographic distribution of economic tradeoffs.

As an introduction to our discussion of economic tradeoffs we describe the baseline conditions against which the economic tradeoffs of Goal 5 decisions will be compared. We then describe the static economic tradeoffs or the tradeoffs as if the economy or policy makers cannot react to mitigate or avoid negative economic outcomes, or to enhance or promote positive economic outcomes. Following our description of economic tradeoffs we list the major factors that can influence the distribution and magnitude of tradeoffs. These factors provide a somewhat dynamic view of the tradeoffs. In matrices that follow our narrative description we summarize the economic tradeoffs of allow, limit, and prohibit decisions by generalized regional zones.

3.5.2. BASELINE FOR THE ANALYSIS OF ECONOMIC TRADEOFFS

The existing, non-Goal 5, regulatory protection of riparian and wildlife resources provides the baseline for the analysis of economic tradeoffs of Goal 5 allow, limit and prohibit decisions. An allow decision will permit developing significant natural resource to the limits allowed by existing, non-Goal 5 protection measures. Goal 5 limit or prohibit decisions provide a marginal *increase* in protection above and beyond existing protection measures.

For lands in Metro's service area, Title 3 of the Urban Growth Management Function Plan (Title 3) describes existing protection measures and is the baseline against which the Goal 5 management decisions will be measured. Title 3 regulates development that affects water quality, flood management and fish and wildlife conservation. As described by Metro, the goal of Title 3 is to

> "[P]rotect the region's health and public safety by reducing flood and landslide hazards, controlling soil erosion and reducing pollution of the region's waterways. Title 3 specifically implements the Oregon Statewide Land Use Goals 6 and 7 by protecting streams, rivers, wetlands and floodplains by avoiding,

limiting or mitigating the impact on these areas from development."[32]

Because Title 3 implements statewide land-use goals it affects lands in all the local jurisdictions within Metro's service area. Local jurisdictions, however, may adopt protection measures that *exceed* Title 3 regulations. The economic tradeoffs of Goal 5 allow, limit and prohibit decisions in these jurisdictions will differ from the tradeoffs in jurisdictions where Title 3 represents the baseline protection in the following ways.

- Allow decisions will overestimate the negative impacts of development on Goal 5 riparian and wildlife resource and associated ecosystem services. An allow decision will also overestimate the benefits on development values.

- Limit and prohibit decisions will overestimate the benefits of habitat protection and will overestimate the negative impacts on development values.

3.5.3. POTENTIAL ECONOMIC TRADEOFFS OF GOAL 5 ALLOW, LIMIT, AND PROHIBIT DECISIONS

We begin by describing economic values, economic impacts, 2040 Design Types and equity issues and how Goal 5 decisions may impact these factors. Next we summarize the economic tradeoffs for allow, limit and prohibit decisions. Finally, we describe economic tradeoffs by generalized regional zones.

Economic Values

Property Values in Development

The factors that affect the development value for land fall into two general categories: location factors and use factors[33].

Location factors include:

- Availability and quality of public infrastructure, e.g., roads, sewer, water, electric. Land-use decisions that hinder or make more difficult the provision of infrastructure services may negatively impact the values of the affected properties.

- Access to the site. Actions that limit or impede access to a site may negatively impact the site's property value.

[32] www.metro-region.org/article.cfm?ArticleID=274 accessed August 5, 2004.

[33] See the accompanying literature review for more information on location and use factors.

- Agglomerative economies associated with the location. Decisions that promote or allow the development of agglomerative economies, e.g., clustering of commercial or industrial developments, will help maintain or enhance development values of these activities. Decisions that inhibit the development of such agglomerative economies may have the opposite effect.

- Existing zoning or other land-use regulations. Zoning and other regulations can have positive and negative impacts on a property's value. For example, water-front properties zoned for industrial use might have higher property values if they were zoned residential. In another example, a residential zoning may protect property values by excluding incompatible land uses, e.g., a gas station.

Use factors include:

- Amenities of the site, e.g., views, access to parks, water, and other open spaces. Actions that protect or enhance a location's amenities, may also protect or enhance the impact that amenities have on property values.

- Physical terrain, e.g., hilly or flat. Grading hills and other changes to a parcel's physical terrain may increase the parcel's usability and development value. Actions that limit grading hills or other changes to a parcel's physical terrain may negatively impact the parcel's property value.

- Lot size, shape and buildable area. Actions that limit a parcel's usable area may negatively impact the parcel's development value. We expect that the impacts from limiting a parcel's usable area will likely be the most common way that limit or prohibit decisions could influence development values.

Values of Ecosystem Services

Metro's report on Goal 5 environmental tradeoffs describes the consequences of allow, limit and prohibit decisions on riparian and wildlife resources and on the associated ecological functions and wildlife characteristics. As described in Metro's environmental report, and above in Section 3.2 and in the literature review that accompanies this report, the ecological functions and wildlife characteristics at issue in Metro's study provide ecosystem services that benefit society. Actions that protect or enhance these services will also protect and enhance their value. Actions that degrade ecosystem services will have the opposite effect. As services degrade, society either does without the service, restores the degraded habitat, or replaces some lost or degraded services by building engineered projects, e.g., upgrading a water-treatment plant that provide clean water.

Metro's Goal 5 decisions will impact the following ecosystem services:

- *Flood Management*. Riparian and upland-wildlife habitat help mitigate flooding by moderating flow intensities and absorbing runoff. Actions that reduce flood-management services may increase flooding of area homes and businesses, and increase flood-related damages and government expenditures for flood clean up and mitigation.

- *Water Quality*. The habitats at issue in this study help control soil erosion and landslides that cause sedimentation. Riparian and wildlife areas also help filter toxins and sediment from surface runoff before they enter streams and other water bodies. Degrading these services may increase the flow of sediment and contaminants into areas waters. Degraded water quality may increase filtration costs for businesses and municipalities. Increased concentrations of toxins and sedimentation may also increase the costs of projects mandated by regulatory agencies to bring water quality into compliance with federal and state water-quality laws, e.g., the Clean Water Act.

- *Moderating Water and Air Temperatures*. Vegetation in riparian and wildlife habitats provides shade that helps reduce air temperatures and the "heat island effect" in summer. Moderating air temperatures in summer helps reduce electricity costs associated with air conditioning. Actions that remove this vegetation may increase summer air temperatures and cooling costs.

- *Stormwater Services*. Riparian and upland wildlife habitats absorb rainfall that otherwise would flow into stormwater systems. Replacing these habitats with impervious surfaces will increase stormwater flows and management costs. These costs can be substantial. For example, Portland is currently spending approximately $1.4 billion retrofitting its stormwater system[34].

- *Salmon Habitat*. The habitats at issue in this study help support salmon populations and related commercial, recreational and cultural values. Actions that protect salmon habitats also help protect these values. Actions that degrade habitats may have the opposite effect.

- *Amenities*. Riparian and upland-wildlife habitats provide view, open-space, and water-related amenities and associated amenity values for properties in proximity to the resources. Actions that protect these amenities also protect the contribution these resources make toward property values. Actions that degrade the resources have the opposite effect.

- *Recreation*. Riparian and upland-wildlife habitats support recreation activities including wildlife viewing, fishing, and activities associated

[34] Portland Utility Review Board, Issue Paper Recommendation, August 25, 2004. <www.portlandonline.com>

with parks and open space. Degrading these resources may also degrade recreation-related ecosystem services.

- *Intrinsic and Option Values*. Intrinsic values are the values people find inherent in a resource or species for itself, rather from the use or consumption of the resource. These values represent the amounts residents or society would pay to protect a resources, or expect in payment to degrade the resource. Option values represent the value of protecting a resource or species for future use or enjoyment[35]. Actions that degrade riparian and upland-wildlife resources also degrade the intrinsic and option values associated with the resources. Such decisions also increase the risks of an irreversible outcome, e.g., extinction of a salmon species, which may have negative economic consequences in the future.

- *Carbon Sequestration*. Metro's Goal 5 report on energy tradeoffs describes the carbon-sequestration benefits of trees and other vegetation. Removing the vegetation negatively impacts the sequestration benefits and associated economic value[36].

To the extent that riparian and upland-wildlife resources provide multiple ecosystem service, the true or full values of services at risk from actions that degrade resources are the cumulative values of the affected services.

Economic Impacts

Employment

We expect that for lands that support employment, e.g., commercial, industrial and mixed use, the factors that influence land value also influence employment. For example, actions that affect access to a site or a property's developable area will also likely affect the employment potential of the site. In general, however, we expect that Goal 5 decisions will impact land values more than employment (or income) for the following reasons.

- A large percentage of Goal 5 riparian and upland-wildlife resources are zoned for land uses that do not support employment. Of the remaining lands, many have "low" employment densities, relative to densities in the Portland city center.

- A portion of the lands containing resources zoned commercial or industrial have previously been developed and currently support employment. Goal 5 decisions will not affect this employment. A Goal

[35] See the literature review that accompanies this report for more information on intrinsic and option values.

[36] See the literature review for more information on the value of carbon sequestration.

5 decision on these lands may affect future employment through re-development of properties.

Actions that protect or degrade riparian and upland-wildlife resources may impact jobs that depend on these resources. For example, protecting salmon habitat may help support jobs that depend on commercial and recreational salmon harvests. In this example, many of the jobs associated with salmon harvests may be located outside Metro's service area.

Income

We expect the income tradeoffs of protecting or degrading riparian and upland-wildlife resources will follow employment tradeoffs.

Taxes

Property Taxes

We expect impacts of protecting or degrading riparian and upland-wildlife resources will follow impacts on property values. This is especially true for lands zoned commercial and industrial that have not yet been developed. Limiting development on these lands may negatively impact property values and associated property taxes. Limiting development may have the opposite effect on property values and associated tax payments for residential property surrounding or adjacent to properties currently undeveloped. Protecting riparian and upland-wildlife resources on these lands may have a beneficial impact in property taxes, especially over the long term.

Payroll Taxes

We expect that the payroll-tax tradeoffs of protecting or degrading riparian and upland-wildlife resources will follow employment and income tradeoffs.

Business Taxes

We expect that the business-tax tradeoffs of protecting or degrading riparian and upland-wildlife resources will follow the tradeoffs for property value, employment and income for lands zoned commercial, industrial and mixed-use.

Transportation Costs

Transportation costs increase with the number of vehicle miles traveled (VMT). Planning guidelines that address transportation costs, such as the 2040 Design Types, promote more compact development that limits VMT and transportation costs. Actions that push development out towards the UGB boundary or beyond will increase VMT and transportation costs relative to actions that promote more compact development.

2040 Design Types

The 2040 Growth Concept outlines the Portland metropolitan region's plan to accommodate expected population growth over the coming decades, while addressing housing, transportation, open space and employment needs. The 2040 Design Types represent the land-use categories, e.g., central city, main streets, neighborhoods, rural reserves/open space, that embody the Growth Concept's transportation, housing and other land-use goals[37]. The 2040 Growth Concept anticipates expected population growth while:

- Maintaining access to nature.
- Protecting wildlife habitat.
- Promoting efficient use of land.
- Supporting a vibrant economy.
- Providing transportation options.
- Promoting development along transportation corridors.
- Minimizing sprawl and VMT.

Activities that protect or degrade riparian and upland-wildlife resources may have mixed impacts on the 2040 Growth Concept's goals and associated Design Types. Protecting and maintaining access to these resources supports the Growth Concepts and Design Types' emphasis on resource protection. However, if protecting resources displaces development to the extent that it promotes sprawl, expanding the UGB and the number of VMT, protection actions may inhibit or limit the Design Types. Alternatively, developing resource lands may limit UGB expansion and associated consequences, but may also conflict with the Growth Concept's goals that address resource protection and access to natural areas.

The Growth Concept's goals regarding development density and transportation considerations may mitigate the impacts of resource protection on sprawl. Increasing the efficiency of land use by promoting higher development densities along transportation corridors complements the resource-protection goals by accommodating, to some extent, land uses that might otherwise be displaced to outside the UGB.

Economic Equity

Geographic Distribution of Impacts

In general, locations within Metro's service area that have been developed more intensely over longer periods of time have the least amount of riparian

[37] For more information on the 2040 Growth Concept and Design Types see Metro's publication, "The Nature of 2040: The Region's 50-Year Plan for Managing Growth," "2040 Growth Concept and the RTP," and other information on Metro's web site, www.metro-region.org.

and upland-wildlife resources. As a result, Goal 5 protection measures will have limited or no negative impacts on development in these locations. Map 4 shows the distribution of riparian and upland-wildlife resources at issue in Metro's Goal 5 analysis.

As illustrated in Map 4, a triangularly-shaped area that extends southwest from the confluence of the Willamette and Columbia Rivers down to Gladstone, then northeast up to Troutdale, and northwest along the Columbia River to the confluence with the Willamette River has little riparian or upland-wildlife resources, excluding river-front areas. We expect that negative tradeoffs of Goal 5 protection measures on development will predominantly affect properties outside this area.

To the extent that Goal 5 decisions limit development outside this triangular area, properties within the triangle may become more desirable to developers and increase in value relative to conditions that would exist without Goal 5 protection.

Distribution of Impacts by Land Use

Approximately 80 percent of the lands containing riparian and upland-wildlife resources fall into three generalized regional zones: single-family residential (SFR), parks and open space (POS), and industrial (IND). See Table 5. We expect the economic tradeoffs associated with Goal 5 protection will fall primarily on lands in these zoning categories. As a group, lands in other zoning categories will experience limited Goal 5 economic tradeoffs.

SFR lands accounts for approximately 46 percent of Goal 5-resource lands and will experience the large majority of economic tradeoffs. This percentage is disproportionately large, relative to other zonings, and means Goal 5 tradeoffs will impact these lands the most and to a greater extent than lands in other zonings. POS lands account for approximately 20 percent of resource lands, and IND lands 14 percent. Lands in the remaining four zoning categories, multi-family residential, commercial, mixed use centers, and rural, combined account for approximately 20 percent of Goal 5 riparian and upland-wildlife lands. Tradeoffs associated with Goal 5 protection measures will be disproportionately less for these lands.

The current development status of lands that contain Goal 5 riparian and upland wildlife resources shows another aspect of the distribution of Goal 5 economic tradeoffs. As described above in section 3.3, vacant-buildable lands that contain Goal 5 riparian and upland-wildlife resources will likely experience the most immediate effects of Goal 5 protection measures. These lands account for approximately 22 percent of Goal 5 resource lands. See Table 3. However, these lands also represent over 40 percent of the available vacant-buildable land in the UGB. The economic tradeoffs of Goal 5 protection measures will affect a significant portion of vacant-buildable land throughout the UGB.

Distribution of Impacts By Goal 5 Treatment

Of course, the Goal 5 treatments will affect the distribution of positive and negative economic tradeoffs. Allow treatments do not increase resource protection beyond Title 3 or local regulatory measures and place no additional restrictions on land use and development. Developers and property owners will enjoy most, if not all, of the benefits. Riparian and upland-wildlife resources, associated ecosystem services and those that benefit from the resources and services will suffer most, if not all, of the negative economic tradeoffs. Results for prohibit treatments will have the opposite effect. Development interests will suffer most, if not all, of the restrictions. The natural resources, ecosystem services, and those who benefits from the resources and services will experience most, if not all, of the benefits. Limit treatments offer the most equitable distribution of tradeoffs because they generate positive and negative tradeoffs for development and resource interests.

SUMMARY OF ECONOMIC TRADEOFFS

Allow Conflicting Uses

Allowing conflicting uses means no additional protection of Goal 5 riparian or upland-wildlife resources beyond the baseline protection provided by Title 3, or by local protection measures that exceed Title 3 guidelines. This alternative emphasizes developing lands containing Goal 5 resources. Positive economic tradeoffs of this alternative include:

- No impediments to development or negative impacts on the development value of land.
- Development-related employment, income and taxes will be unaffected by Goal 5.
- No Goal-5 related increase in VMT, transportation costs or UGB expansion.

Negative economic tradeoffs include:

- Amenity-related property values and associated property taxes for undeveloped lands zoned SFR and RUR that are adjacent to Goal 5 resource lands may be less for this scenario relative to limit and prohibit scenarios.
- Flood-mitigation services will decline, flood damage and clean-up costs may increase.
- Erosion and sedimentation will increase, as will concentration of toxins in streams and other water bodies. Water-quality expenditures (e.g., for filtration and treatment) by businesses and municipalities may increase. Municipal expenditures that address water-quality regulations (e.g., the federal Clean Water Act) may increase.

- Summer temperatures and the urban "heat island effect" may increase with an associated increase in cooling costs.
- Developing riparian and upland-wildlife resources will increase the amount of impervious surfaces, which will increase stormwater flows and treatment costs.
- Development that negatively impacts salmon habitat may affect commercial, recreational and cultural harvests. Municipal expenditures that address habitat regulations (e.g., Endangered Species Act) may increase.
- Degrading riparian and upland-wildlife resources may negatively affect recreational opportunities and values that depend on these resources.
- Negative impacts on intrinsic values for riparian and upland-wildlife resources.
- Developing Goal 5 resources now or in the near-term precludes developing them in the future or protecting them for future generations. This reduces the option values associated with the resources.
- Carbon sequestration and air-pollution removal will decline with an associated decline in air quality and related values of air-quality services.
- Businesses that rely on riparian and upland-wildlife resources and associated ecosystem services may experience a decline in sales, employment and income relative to the limit or prohibit scenarios. Employment and business-related tax payments may also decline.
- Allowing conflicting uses will negatively affect the 2040 Growth Concept and Design Types that emphasize protecting resources and maintain access to resources.
- The large majority, if not all, of the negative economic tradeoffs of this option affect riparian and upland-wildlife areas, associated ecosystem services and economic factors, e.g., jobs, incomes and values, that depend on these resources. Development interests suffer little or no negative economic tradeoffs.

Limit Conflicting Uses

Limiting conflicting uses strikes a balance between completely developing the Goal 5 riparian and upland-wildlife resources and protecting them. This alternative provides opportunities including: developing lands in ways that minimize negative environmental and economic tradeoffs; supporting the development goals embodied by the 2040 Design Types; and protecting the most important habitats.

The economic tradeoffs for this alternative depend on the degree of limitation on development actions: lightly limit, moderately limit, or strictly limit. Lightly-limit treatments will have more in common with allow treatments than with prohibit treatments. The opposite will be the case for strictly-limit treatments. As the name implies, tradeoffs for the moderately-limit treatment will fall somewhere in between.

This scenario will generate a mix of positive and negative economic tradeoffs for development interests and for the resources and associated ecosystem services. Developing resources will generate positive impacts on development values, employment, income, and tax payments. However, these impacts will be less than for the allow scenario. The resources will likely suffer some degradation, but not to the extent generated under the allow scenario.

The consequences for the 2040 Design Types will be mixed. Protecting resources to a greater extent, compared with the allow scenario, may increase VMT if protecting resources displaces development and pushes it out toward the UGB or beyond. This may also increase the next UGB expansion and transportation costs. However, protecting riparian and upland-wildlife resources is consistent with the planning goals reflected in the Design Types.

The limit scenario will generate a more equitable distribution of positive and negative economic tradeoffs, compared with either the allow or prohibit scenarios. Development interests and the resources will both experience positive and negative economic tradeoffs.

Prohibit Conflicting Uses

Prohibiting conflicting uses will prevent development actions that conflict with, or degrade, Goal 5 riparian and upland-wildlife resources. This scenario emphasizes resource protection. Protection measures will exceed the baseline protection provided by Title 3, or by local protection measures that exceed Title 3 guidelines.

Positive economic tradeoffs of this alternative include:

- Amenity-related property values and associated property taxes for lands zoned SFR and RUR that are adjacent to Goal 5 resource lands may be greater for this scenario relative to limit and allow scenarios.
- This alternative will provide the greatest amount of flood-mitigation services and value.
- Erosion and sedimentation will be less than limit or allow alternatives, as will concentration of toxins in streams and other water bodies. Water-quality expenditures (e.g., for filtration and treatment) by businesses and municipalities may be the least under this alternative. Municipal expenditures that address water-quality regulations (e.g., the federal Clean Water Act) may decline, especially over the long term.

- This alternative will have the greatest mitigating effect on summer temperatures, the urban "heat island effect," and associated cooling costs.
- Prohibiting development in Goal 5 riparian and upland-wildlife resources will generate the least amount of impervious surfaces, and will generate the least amount of stormwater flows and treatment costs.
- This scenario will protect the greatest amount of salmon habitat and may positively affect commercial, recreational and cultural harvests. Municipal expenditures that address habitat regulations (e.g., Endangered Species Act) may decline, especially over the long term.
- This alternative will preserve the greatest amount of recreational opportunities, and the associated recreational values.
- The intrinsic and options values for the riparian and upland-wildlife resources will be preserved.
- Maintaining the greatest amount of vegetation will maximize carbon sequestration, air pollutant removal and the related values of air-quality services.
- This alternative will provide the greatest support to businesses that rely on riparian and upland-wildlife resources and associated ecosystem services.
- Prohibiting conflicting uses will support the aspects of the 2040 Growth Concept and Design Types that emphasize protecting resources and maintain access to resources.

Negative economic tradeoffs include:

- This alternative will have the greatest negative impact on the development value of land.
- Development-related employment, income and tax payments will also suffer the greatest under this alternative.
- Aspects of the 2040 Design Types that minimize VMT and sprawl will be negatively impacted if protection measures displace development within the UGB.
- The large majority, if not all, of the negative economic tradeoffs of this alternative affect development interests. The economic values and activities supported by riparian and upland-wildlife resources suffer little or no negative economic tradeoffs, relative to allow and limit alternatives.

3.5.4. The Dynamic Aspects Of Economic Tradeoffs

The description of economic tradeoffs in the previous section assumes no reaction by stakeholders and decisionmakers that would impact the economic tradeoffs. This static approach ignores, for example, the possibility that restoring riparian and upland-wildlife habitats may mitigate some of the negative economic tradeoffs of development on these resources. A more dynamic view of economic tradeoffs considers alternatives that could help mitigate negative tradeoffs and enhance positive tradeoffs. In this section we describe a number of these dynamic factors.

Substitutability of Land Uses

Moving proposed land uses that conflict with riparian and upland-wildlife resources to alternative locations may mitigate negative economic tradeoffs for both the land use and resources. The previously-conflicting land use can take place without impacting Goal 5 resources. Substituting a non-conflicting or less-conflicting land use in the resource area will protect, to some extent, the property's development value. Such a move will also protect, to some extent, the quality and quantity of the property's riparian and upland-wildlife resources.

The feasibility of substituting land uses depends on the types of land uses at issue and the availability of suitable sites outside the resource areas. The more specific or unique the development requirements, the less likely the development can take place elsewhere. For example, water-dependent industrial development must take place in specific locations—relatively large lots with water access. This limits the extent to which the land use can avoid conflicting with riparian resources by moving elsewhere. By comparison, residential land uses have relatively few development-specific requirements and take place throughout Metro's service area.

Expanding the Urban Growth Boundary

Protecting riparian and upland-wildlife resources may reduce the amount of developable land within the UGB. If this is the case, expanding the UGB could mitigate this loss while protecting riparian and upland-resources within the existing UGB. However, expanding the UGB may promote sprawl and negative sprawl-related impacts including increased VMT and transportation costs, and possibly minimizing the effectiveness of the 2040 Design Types.

As we understand it, Metro Council and staff consider expanding the UGB as an option of last resort. Goal 5 protection options will be developed in ways that emphasize other mitigation options.

Encourage Development Practices That Minimize Conflicts With Resources

Encouraging development practices that minimize conflicts with resources may help mitigate negative economic tradeoffs for both development and the resources. These practices include low-impact development projects that minimize impervious surfaces and manage stormwater in ways that more closely mimic natural systems. Cluster developments for residential lands is another example. This type of development localizes housing sites and associated land-use activities, e.g., roads, while avoiding developing riparian and upland-forest resources. In another example property owners may sell future development rights while retaining ownership without restrictions on existing land uses.

Restoring Degraded Riparian and Upland-Wildlife Resources

Restoring already-degraded riparian and upland-wildlife habitat could offset a portion of the negative impact of new development on habitat elsewhere. In some cases, restoration opportunities may lie outside the existing UGB or Metro's service area.

3.5.5. Economic Tradeoffs By Generalized Regional Zone

Single Family Residential (SFR)

Lands zoned SFR account for almost half, 46 percent, of Goal 5 riparian and upland-wildlife resources. Protection actions on these lands will primarily affect property values and related tax payments with little or no direct impacts on employment and income. Since SFR developments typically retain more vegetation and tree cover than other types of development, this land use will conflict less with resources and retain more ecosystem services and associated economic values than other development uses. Encouraging low-impact developments and cluster development patterns may help mitigate negative economic tradeoffs for development and resources.

Multi-family Residential (MFR)

MFR lands account for approximately 5 percent of Goal 5 riparian and upland-wildlife resources. Economic tradeoffs will be similar to SFR lands except that MFR development typically retains less vegetation cover and fewer ecosystem services and associated values.

Commercial (COM)

Approximately 5 percent of Goal 5 riparian and upland-wildlife resources are on lands zoned COM. Resource-protection actions may negative affect property values, employment, income and related tax payments. COM developments involve extensive landscape modifications that negatively affect ecosystem services and the economic values of services. These negative impacts are comparable to, or greater than, the degradation of ecosystem services and values associated with MFR developments.

Industrial (IND)

IND lands account for approximately 15 percent of lands containing Goal 5 riparian and upland-wildlife resources. Economic tradeoffs will be similar in type and extent to tradeoffs for COM lands.

Mixed-Use Centers (MUC)

Approximately three percent of Goal 5 riparian and upland-wildlife resources are on lands zoned MUC. Economic tradeoffs will be similar to developments on lands zoned MFR and COM. Limiting MUC developments will have mixed impacts on 2040 Design Types and the underlying 2040 Growth Concept. Protecting riparian and upland-wildlife resources supports the Growth Concept's goals of maintaining access to nature and protecting habitat. Limiting MUC developments, however, may negatively impact the Design Type's emphasis on promoting more efficient use of land and minimizing sprawl and VMT.

Rural Residential (RUR)

RUR lands account for approximately 7 percent of Goal 5 riparian and upland-wildlife resources. Economic tradeoffs of developing RUR lands will be similar to SFR except less intensive given the more dispersed nature of RUR developments.

Parks and Open Space (POS)

Approximately 20 percent of the Goal 5 riparian and upland-wildlife resources are on lands zoned POS. Protection measures may limit recreation activities that require facilities, e.g., ball fields and golf courses, and related infrastructure, e.g., parking lots. This limitation may negatively impact property values for private parklands more than parks on public lands. Park and open-space land uses may be the least intrusive on habitats and associated ecosystem services and economic values.

The matrices at the end of this report depict the proceeding descriptions of economic tradeoffs by generalized regional zone in table format.

3.5.6. SUMMARY POINTS

- Allowing development of Goal 5 riparian and upland-wildlife resources protects development values but will degrade riparian and upland wildlife resources and the associated ecosystem services that society values.

- Prohibiting development protects resources and associated values, but will limit development-related economic benefits.

- Limiting development preserves some level of development and resource values.

- Protecting resources within the existing UGB preserves resources in close proximity to current population distributions but increases the probability of expanding the UGB sooner or to a greater extent than otherwise would be the case if protection measures displace developable land.

- Protecting resources on the urban fringe protects development interests close in, but reduces access to resources and associated ecosystem services for the majority of the population within the existing UGB.

- The details of the program options applied at the parcel level will dictate the type and extent of positive and negative economic tradeoffs for Goal 5 resource-protection measures.

- Avoid double-counting environmental consequences when developing Goal 5 programs. For example, environmental consequences were estimated by Metro staff as part of their ESEE analysis. ECONorthwest's analysis of economic consequences considered the impacts on ecosystem services, which are based in large part on Metro's analysis of environmental consequences.

4. MATRICIES OF ECONOMIC CONSEQUENCES

Single Family Residential

	Riparian & Wildlife Classes I, II, III		Upland Wildlife Classes A, B, C	
	Positive	**Negative**	**Positive**	**Negative**
Allow	• Property owners realize full development potential. • Protection of amenity/quality of life values associated with the build environment in urban areas. • Expanding UGB to offset development land lost to resource protection not required.	• Degradation of ecosystem services and values. • Higher loss of ecosystem services and values for resources in Class I compared with Classes II and III. • Municipal expenditures may increase in the future re environmental laws, flood management and water-quality control. • Damages and costs associated with flooding and landslides may increase. • Cooling costs in summer may increase. • Increased risk of foregoing future uses of resources. • Increased risk of irreversible outcome with possible negative economic results. • May increase restoration costs. • May negatively impact jobs and income that depend on quality of ecosystem services.	Similar to Riparian.	Similar to Riparian except: • Degradation of ecosystem services associated with habitat that supports salmon. Negative consequences on related commercial, recreational, spiritual and intrinsic values. • Higher loss of ecosystem services and values for resources in Class A compared with Classes B and C. • Negative impacts on employment that depends on quality of salmon habitat.

Single Family Residential

	Riparian & Wildlife Classes I, II, III		Upland Wildlife Classes A, B, C	
	Positive	**Negative**	**Positive**	**Negative**
Limit	• The economic tradeoffs associated with a limit decision will fall between the tradeoffs of allow and prohibit. Limit tradeoffs will depend on the specifics of the limit decision (severely limit, moderately limit, or slightly limit), the land use and property in question, and the mitigation possibilities. The limit option offers the most equitable distribution of positive and negative economic tradeoffs of Goal 5 protection.			
Prohibit	• Protection of riparian resource and associated ecosystem services and values. • Greater protection of services and values for Class I resource compared with Class II and III. • May reduce future costs re environmental regulations, flood management and water quality controls. • May reduce future damage and costs re flooding and landslides. • May reduce "heat-island" effect and cooling costs in summer. • Lower restoration costs compared with allow or limit. • Reduced risk of foregoing future uses of resources. • Reduced risk of irreversible outcome with possible negative economic results. • May protect jobs and income that depend on quality of ecosystem services.	• Negative consequences on development value of property and associated taxes. • Expanding the UGB to mitigate negative impacts on amount of developable land may increase costs associated with expanding or extending infrastructure and other sprawl-related costs. • SFR accounts for 46% of total resource lands and will experience more negative impacts than other land uses.	Similar to Riparian except: • Protecting wildlife habitat that supports salmon and related commercial, recreational, spiritual, and intrinsic values. • May protect jobs and income that depend on quality of salmon habitat.	Similar to Riparian.

Multi Family Residential

	Riparian & Wildlife Classes I, II, III		Upland Wildlife Classes A, B, C	
	Positive	**Negative**	**Positive**	**Negative**
Allow	Similar to SFR.	Similar to SFR except: • More habitat disturbance will generate greater negative impacts on resources, ecosystem services and associated economic values.	Similar to SFR.	Similar to SFR.
Limit	Similar to SFR.			
Prohibit	Similar to SFR.	Similar to SFR. except: • Pressure to expand UGB will be less than for SFR because of the increased density of MFR developments.	Similar to SFR.	Similar to SFR.

Commercial

	Riparian & Wildlife Classes I, II, III		Upland Wildlife Classes A, B, C	
	Positive	**Negative**	**Positive**	**Negative**
Allow	Similar to MFR except: • No employment impacts specific to development use. • No impacts on related income and income-tax revenue to municipalities.	Similar to MFR.	Similar to MFR.	Similar to MFR.
Limit	Similar to MFR.			
Prohibit	Similar to MFR.	Similar to MFR except: • COM contains 5% of significant resources. • Negative impacts on employment specific to development use. Substitutability or reconfiguration of land use may mitigate this impact. • Negative impacts on related income and income-tax revenue.	Similar to MFR.	Similar to MFR.

Industrial

	Riparian & Wildlife Classes I, II, III		Upland Wildlife Classes A, B, C	
	Positive	**Negative**	**Positive**	**Negative**
Allow	Similar to COM except: • More intensive positive development-related impacts.	Similar to COM except: • Greater negative impacts on ecosystem services.	Similar to COM.	• Similar to COM.
Limit	Similar to COM.			
Prohibit	Similar to COM except: • Greater beneficial impacts on ecosystem services.	Similar to COM except: • More intensive negative development-related impacts.	Similar to COM.	Similar to COM.

Mixed Use Centers

	Riparian & Wildlife Classes I, II, III		Upland Wildlife Classes A, B, C	
	Positive	**Negative**	**Positive**	**Negative**
Allow	Similar to MFR and COM, depending on land use.	Similar to MFR and COM, depending on land use.	Similar to MFR and COM, depending on land use.	Similar to MFR and COM, depending on land use.
Limit	Similar to MFR and COM, depending on land use.			
Prohibit	Similar to MFR and COM, depending on land use.	Similar to MFR and COM, depending on land use.	Similar to MFR and COM, depending on land use.	Similar to MFR and COM, depending on land use.

Rural

	Riparian & Wildlife Classes I, II, III		Upland Wildlife Classes A, B, C	
	Positive	**Negative**	**Positive**	**Negative**
Allow	Similar to SFR except: • Impacts will be more dispersed.	Similar to SFR except: • Impacts will be more dispersed.	Similar to SFR except: • Impacts will be more dispersed.	Similar to SFR except: • Impacts will be more dispersed.
Limit	Similar to SFR except: • Impacts will be more dispersed.			
Prohibit	Similar to SFR except: • Impacts will be more dispersed.	Similar to SFR except: • Impacts will be more dispersed.	Similar to SFR except: • Impacts will be more dispersed.	Similar to SFR except: • Impacts will be more dispersed.

Parks and Open Space

	Riparian & Wildlife Classes I, II, III		Upland Wildlife Classes A, B, C	
	Positive	**Negative**	**Positive**	**Negative**
Allow	Similar to RUR except: • Employment, income and related taxes specific to public and private parklands, e.g., golf courses, will be unaffected.	Similar to RUR.	Similar to RUR.	Similar to RUR.
Limit	Similar to RUR.			
Prohibit	Similar to RUR.	Similar to RUR except: • Negative impacts on development values specific to public and private park lands.	Similar to RUR.	Similar to RUR.

Impact Areas

	Riparian & Wildlife Classes I, II, III		Upland Wildlife Classes A, B, C	
	Positive	**Negative**	**Positive**	**Negative**
Allow	Similar to SFR, COM, IND, POS, depending on land use.	Similar to SFR, COM, IND, POS, depending on land use.	Similar to SFR, COM, IND, POS, depending on land use.	Similar to SFR, COM, IND, POS, depending on land use.
Limit	Similar to SFR, COM, IND, POS, depending on land use.			
Prohibit	Similar to SFR, COM, IND, POS, depending on land use.	Similar to SFR, COM, IND, POS, depending on land use.	Similar to SFR, COM, IND, POS, depending on land use.	Similar to SFR, COM, IND, POS, depending on land use.

5. APPENDIX TABLES

Table 1: Percentage of Goal 5 Resource Lands in Urban Development, in the UGB in 2002

	Riparian & Wildlife Resources			Upland Wildlife Resources		
	Class I	Class II	Class III	Class A	Class B	Class C
% of Goal 5 Lands in Urban Development	16%	33%	85%	16%	38%	34%

Source: Data analysis by Metro staff and ECONorthwest.

Table 2: Percentage of Goal 5 Resource Lands in Parks and Open Space, in the UGB in 2002

	Riparian & Wildlife Resources			Upland Wildlife Resources		
	Class I	Class II	Class III	Class A	Class B	Class C
% of Goal 5 Lands in Parks	41%	23%	4%	56%	18%	18%

Source: Data analysis by Metro staff and ECONorthwest.

Table 3: Percentage of Goal 5 Resource Lands Categorized as Vacant Buildable, in the UGB in 2002

	Riparian & Wildlife Resources			Upland Wildlife Resources		
	Class I	Class II	Class III	Class A	Class B	Class C
% of Goal 5 Lands Vacant Buildable	13%	20%	9%	25%	36%	41%

Source: Data analysis by Metro staff and ECONorthwest.

Table 4: Percentage of Goal 5 Lands In Zonings That Do Not Support Development Values, and for Zonings That Do Support Development Value, the Percentage of Lands Categorized As Low, Medium, and High Land Value, in the UGB in 2002

	Riparian Resources			Wildlife Resources		
	Class I	**Class II**	**Class III**	**Class A**	**Class B**	**Class C**
% of Goal 5 Lands in Zonings that Do Not Support Development Value	43%	25%	7%	57%	19%	19%
% Low Land Value	48%	60%	68%	38%	58%	62%
% Medium Land Value	9%	14%	22%	4%	22%	18%
% High Land Value	0%	1%	3%	1%	1%	1%
Total	100%	100%	100%	100%	100%	100%

Source: Data analysis by Metro staff and ECONorthwest.

Table 5: Percentage of Goal 5 Lands In Zonings That Do Not Support Employment, and for Zonings That Do Support Employment, the Percentage of Lands Categorized Low, Medium, and High Employment Density, in the UGB in 2002

	Riparian & Wildlife Resources			Upland Wildlife Resources		
	Class I	**Class II**	**Class III**	**Class A**	**Class B**	**Class C**
% of Goal 5 Lands in Zonings that Do Not Support Employment	83%	72%	51%	95%	91%	75%
% Low Employment Value	11%	18%	30%	3%	5%	18%
% Medium Employment Value	6%	9%	17%	2%	4%	7%
% High Employment Value	0%	1%	2%	0%	0%	0%
Total	100%	100%	100%	100%	100%	100%

Source: Data analysis by Metro staff and ECONorthwest.

Table 6: Percentage of Goal 5 Lands by 2040 Design Type That Do Not Support Development Values, and for Lands That Do Support Development Value, the Percentage of Lands Categorized as Tertiary, Secondary, and Primary Design Types, in the UGB in 2002

	Riparian Resources			Wildlife Resources		
	Class I	**Class II**	**Class III**	**Class A**	**Class B**	**Class C**
% of Goal 5 Lands By Design Types that Do Not Support Development Value	35%	15%	2%	52%	12%	10%
% Tertiary Design Type	48%	61%	52%	44%	80%	68%
% Secondary Design Type	5%	6%	13%	2%	3%	7%
% Primary Design Type	12%	18%	33%	2%	5%	15%
Total:	100%	100%	100%	100%	100%	100%

Source: Data analysis by Metro staff and ECONorthwest.

Table 7: Interactions Between Resource Acres By Zoning and 2040 Design Types, in the UGB in 2002

Zoning Type Containing Acres of Significant Riparian and Wildlife Resources	Percentage of Acres in Zoning Type Classified as Tertiary + Other 2040 Design Types	Percentage of Acres in Zoning Type Classified as Primary 2040 Design Type
Single Family Residential	98%	1%
Parks and Open Space	98%	0.3%
Industrial	33%	60%

Source: Data analysis by Metro staff and ECONorthwest.

Table 8: Interactions Between Resource Acres By Zoning and Combined Measures of Development Value, in the UGB in 2002

Zoning Type Containing Acres of Significant Riparian and Wildlife Resources	% of Acres In Zoning Type Classified as "Other" Design Type	% of Acres in Zoning Type with All Low Measures	% of Acres in Zoning Type with At Least One Medium Measure, No High Measures	% of Acres in Zoning Type with At Least One High Measure
Single Family Residential	16.7%	60.9%	20.7%	1.7%
Parks and Open Space	81.0%	16.9%	1.7%	0.3%
Industrial	10.3%	14.1%	15.1%	60.5%

Source: Data analysis by Metro staff and ECONorthwest.

APPENDIX D

ESEE Consequences by Generalized Regional Zones

Development scenario	Economic consequences: SINGLE FAMILY RESIDENTIAL (SFR)			
	Class I, II and III Riparian/wildlife		**Class A, B, and C Upland wildlife habitat**	
	Positive	***Negative***	***Positive***	***Negative***
ALLOW	• Property owners realize full development potential. • Protection of amenity/quality of life values associated with the build environment in urban areas. • Expanding UGB not required.	• Degradation of ecosystem services and values. • Higher loss of ecosystem services and values for resources in Class I compared with Classes II and III. • See full table of interactions for tradeoffs of low-, medium, and high-valued SFR with Class I, II, III resources. • Municipal expenditures in the future re environmental laws may increase. • Municipal expenditures in the future re flood management and water quality may increase. • Damages and costs associated with flooding and landslides may increase. • Cooling costs in summer may increase. • Increased risk of foregoing future uses of resources. • Increased risk of irreversible outcome with possible negative economic results. • May include restoration costs. • May negatively impact jobs and income that depend on quality of ecosystem services.	*Similar to Riparian*	*Similar to Riparian except:* • Degradation of ecosystem services associated with habitat that supports salmon. Negative consequences on related commercial, recreational, spiritual and intrinsic values. • Higher loss of ecosystem services and values for resources in Class A compared with Classes B and C. • See full table of interactions for tradeoffs of low-, medium, and high-valued SFR with Class A, B, and C resources. • Negative impacts on employment that depends on quality of salmon habitat.
LIMIT	The economic tradeoffs associated with a limit decision will fall between the tradeoffs of allow and prohibit. Limit tradeoffs will depend on the specifics of the limit decision (severely limit, moderately limit, or slightly limit), the land use and property in question, and the mitigation possibilities.			

Development scenario	Economic consequences: SINGLE FAMILY RESIDENTIAL (SFR)			
	Class I, II and III Riparian/wildlife		**Class A, B, and C Upland wildlife habitat**	
	Positive	***Negative***	***Positive***	***Negative***
PROHIBIT	• Protection of riparian resource and associated ecosystem services and values. • Greater protection of services and values for Class I resource compared with Class II and III. • May reduce future costs re environmental regulations. • May reduce future costs re flood management and water quality. • May reduce future damage and costs re flooding and landslides. • May reduce "heat-island" effect and cooling costs in summer. • No restoration costs. • Reduced risk of foregoing future uses of resources. • Reduced risk of irreversible outcome with possible negative economic results. • May protect jobs and income that depend on quality of ecosystem services.	• Negative consequences on development value of property. Substitutability or reconfiguration of land use may mitigate this consequence. • 1% of SFR has "High" land value. • 98% of SFR ranked "Low" on 2040 Design Types. • 78% of SFR ranked "Low" on all measures of development value. • See full table of interactions for tradeoffs of low-, medium, and high-valued SFR with Class I, II, III resources. • Expanding the UGB to mitigate negative impacts on amount of developable land may increase costs associated with expanding or extending infrastructure and other sprawl-related costs. • SFR accounts for 46% of total resource lands and will experience more negative impacts than other land uses.	*Similar to Riparian except:* • Protection of wildlife habitat that supports salmon and related commercial, recreational, spiritual, and intrinsic values. • May protect jobs and income that depend on quality of salmon habitat. • See full table of interactions for tradeoffs of low-, medium, and high-valued SFR with Class A, B, and C resources.	*Similar to Riparian*

Development scenario	Economic consequences: MULTI-FAMILY RESIDENTIAL (MFR)			
	Class I, II and III Riparian/wildlife		**Class A, B, and C Upland wildlife habitat**	
	Positive	***Negative***	***Positive***	***Negative***
ALLOW	*Similar to SFR except:* • Reduced need for UGB expansion and associated costs.	*Similar to SFR. except:* • Increased negative impacts on economic costs and damage associated with stormwater (flooding) and water quality. • See full table of interactions for tradeoffs of low-, medium, and high-valued MFR with Class I, II, III resources.	*Similar to SFR.*	*Similar to SFR except:* • See full table of interactions for tradeoffs of low-, medium, and high-valued MFR with Class A, B, C resources.
LIMIT	*Similar to SFR.*	*Similar to SFR.*	*Similar to SFR.*	*Similar to SFR.*
PROHIBIT	*Similar to SFR.*	*Similar to SFR. except:* • MFR accounts for 5% of significant resources. • 66% of MFR lands ranked low on land value and 4% ranked high. • 86% of MFR ranked “Low” on 2040 Design Types. • 68% ranked “Low” on all measures of development value. • See full table of interactions for tradeoffs of low-, medium, and high-valued MFR with Class I, II, III resources. • Increased concentration of development means that the marginal demand to expand UGB will be less than for SFR.	*Similar to SFR.*	*Similar to SFR except:* • See full table of interactions for tradeoffs of low-, medium, and high-valued MFR with Class A, B, C resources.

Development scenario	Economic consequences: COMMERCIAL (COM)			
	Class I, II and III Riparian/wildlife		**Class A, B, and C Upland wildlife habitat**	
	Positive	***Negative***	***Positive***	***Negative***
ALLOW	*Similar to MFR except:* • No employment impacts specific to development use. • No impacts on related income and income-tax revenue to municipalities.	*Similar to MFR except:* • Increased costs and damage associated with stormwater (flooding) and water quality. • See full table of interactions for tradeoffs of low-, medium, and high-valued COM with Class I, II, III resources.	*Similar to MFR.*	*Similar to MFR except:* • See full table of interactions for tradeoffs of low-, medium, and high-valued COM with Class A, B, C resources.
LIMIT	*Similar to MFR.*	*Similar to MFR.*	*Similar to MFR.*	*Similar to MFR.*
PROHIBIT	*Similar to MFR.*	*Similar to MFR except:* • COM contains 5% of significant resources. • Negative impacts on employment specific to development use. Substitutability or reconfiguration of land use may mitigate this impact. • Negative impacts on related income and income-tax revenue to municipalities. • 81% COM ranked "Low" land value. • 57% COM ranked "Low" employment and 0.2% ranked "High" employment. • 77% COM ranked "Low" on 2040 Design Type • 63% COM ranked "Low" on all measures of development value. 9% COM ranked high on one measure. • See full table of interactions for tradeoffs of low-, medium, and high-valued COM with Class I, II, III resources.	*Similar to MFR.*	*Similar to MFR except:* • See full table of interactions for tradeoffs of low-, medium, and high-valued COM with Class A, B, and C resources.

Development scenario	Economic consequences: INDUSTRIAL (IND)			
	Class I, II and III Riparian/wildlife		**Class A, B, and C Upland wildlife habitat**	
	Positive	***Negative***	***Positive***	***Negative***
ALLOW	*Similar to MFR except:* • No employment impacts specific to development use. • No impacts on related income and income-tax revenue to municipalities.	*Similar to MFR except:* • Increased costs and damage associated with negative impacts on ecosystem services. • IND accounts for 14% of significant resources. • See full table of interactions for tradeoffs of low-, medium, and high-valued IND with Class I, II, III resources.	*Similar to MFR.*	*Similar to MFR except:* • See full table of interactions for tradeoffs of low-, medium, and high-valued IND with Class A, B, and C resources.
LIMIT	*Similar to MFR.*	*Similar to MFR.*	*Similar to MFR.*	*Similar to MFR.*
PROHIBIT	*Similar to MFR.*	*Similar to MFR except:* • Negative impacts on employment specific to development use. Substitutability or reconfiguration of land use may mitigate this impact. • Negative impacts on related income and income-tax revenue to municipalities. • 93% ranked “Low” land value. • 70% ranked “Low” employment. • 32% ranked “Low” 2040 Design Type and 60% ranked “High.” • 24% ranked “Low” on all measures of development value. 61% ranked “High” on at least one measure.	*Similar to MFR.*	*Similar to MFR.*

Economic consequences:
MIXED-USE CENTERS (MUC)

<table>
<tr><th rowspan="2">Development scenario</th><th colspan="2">Class I, II and III Riparian/wildlife</th><th colspan="2">Class A, B, and C Upland wildlife habitat</th></tr>
<tr><th>Positive</th><th>Negative</th><th>Positive</th><th>Negative</th></tr>
<tr><td>ALLOW</td><td>Similar to MFR and COM, depending on land use.</td><td>Similar to MFR and COM, depending on land use except:
• MUC accounts for 2% of significant resources.
• See full table of interactions for tradeoffs of low-, medium, and high-valued MUC with Class I, II, III resources.</td><td>Similar to MFR and COM, depending on land use.</td><td>Similar to MFR and COM, depending on land use except:
• See full table of interactions for tradeoffs of low-, medium, and high-valued MUC with Class A, B, and C resources.</td></tr>
<tr><td>LIMIT</td><td>Similar to MFR and COM, depending on land use.</td><td>Similar to MFR and COM, depending on land use.</td><td>Similar to MFR and COM, depending on land use.</td><td>Similar to MFR and COM, depending on land use.</td></tr>
<tr><td>PROHIBIT</td><td>Similar to MFR and COM, depending on land use.</td><td>Similar to MFR except:
• Negative impacts on employment specific to development use. Substitutability or reconfiguration of land use may mitigate this impact.
• Negative impacts on related income and income-tax revenue to municipalities.
• 74% ranked “Low” land value.
• 41% ranked “Low”, 49% ranked “Medium,” and 10% ranked “High” employment.
• 24% ranked “Low,” and 19% ranked “High” on 2040 Design Types.
• 17% ranked “Low” on all measures of development value, 64% ranked “Medium” on at least one measure, and 19% ranked “High” on at least one measure.</td><td>Similar to MFR and COM, depending on land use.</td><td>Similar to MFR and COM, depending on land use.</td></tr>
</table>

Development scenario	Economic consequences: RURAL (RUR)			
	Class I, II and III Riparian/wildlife		**Class A, B, and C Upland wildlife habitat**	
	Positive	***Negative***	***Positive***	***Negative***
ALLOW	*Similar to SFR.*	*Similar to SFR except:* • RUR accounts for 7% of significant resources. • See full table of interactions for tradeoffs of low-, medium, and high-valued RUR with Class I, II, III resources.	*Similar to SFR.*	*Similar to SFR except:* • See full table of interactions for tradeoffs of low-, medium, and high-valued RUR with Class A, B, and C resources.
LIMIT	*Similar to SFR.*	*Similar to SFR.*	*Similar to SFR.*	*Similar to SFR.*
PROHIBIT	*Similar to SFR.*	*Similar to SFR except:* • 100% of RUR ranked “Low” on land value. • 84% ranked “Low” and 15% ranked “High” on 2040 Design Types. • 83% ranked “Low” on all measures of development value, 15% ranked “High” on at least one measure.	*Similar to SFR.*	*Similar to SFR.*

Development scenario	Economic consequences: PARKS AND OPEN SPACE (POS)			
	Class I, II and III Riparian/wildlife		**Class A, B, and C Upland wildlife habitat**	
	Positive	***Negative***	***Positive***	***Negative***
ALLOW	*Similar to RUR.*	*Similar to RUR except:* • POS contain approximately 20% of the Goal 5 significant resources. • See full table of interactions for tradeoffs of low-, medium, and high-valued POS with Class I, II, III resources.	*Similar to RUR.*	*Similar to RUR except:* • See full table of interactions for tradeoffs of low-, medium, and high-valued POS with Class A, B, and C resources.
LIMIT	*Similar to RUR.*	*Similar to RUR.*	*Similar to RUR.*	*Similar to RUR.*
PROHIBIT	*Similar to RUR.*	*Similar to RUR except:* • In general, this category has no development value.	*Similar to RUR.*	*Similar to RUR.*

Development scenario	Economic consequences: IMPACT AREAS			
	Class I, II and III Riparian/wildlife		**Class A, B, and C Upland wildlife habitat**	
	Positive	***Negative***	***Positive***	***Negative***
ALLOW	*Depends on land use. May be similar to SFR, COM, IND, POS.*	*Depends on land use. May be similar to SFR, COM, IND, POS.* • See full table of interactions for tradeoffs of low-, medium, and high-valued Impact Areas with Class I, II, III resources.	*Depends on land use. May be similar to SFR, COM, IND, POS.*	*Depends on land use. May be similar to SFR, COM, IND, POS.* • See full table of interactions for tradeoffs of low-, medium, and high-valued Impact Areas with Class A, B, C resources.
LIMIT	*Depends on land use. May be similar to SFR, COM, IND, POS.*	*Depends on land use. May be similar to SFR, COM, IND, POS.*	*Depends on land use. May be similar to SFR, COM, IND, POS.*	*Depends on land use. May be similar to SFR, COM, IND, POS.*
PROHIBIT	*Depends on land use. May be similar to SFR, COM, IND, POS.*	*Depends on land use. May be similar to SFR, COM, IND, POS.*	*Depends on land use. May be similar to SFR, COM, IND, POS.*	*Depends on land use. May be similar to SFR, COM, IND, POS.*

Social consequences:
SINGLE-FAMILY RESIDENTIAL

Riparian and wildlife habitat resources

Development scenario	*Positive*	*Negative*
ALLOW	• Maintain housing options • No change in property rights • No takings concern • Maintain personal financial security (equity) • Equitable impact on property owners *Wildlife habitat same as riparian, except:* • Less vegetation may reduce risk of wildfires • Less habitat may reduce number of undesirable species	• May lose cultural heritage • May not protect salmon and may impact Native American culture and regional identity • May change neighborhood character and sense of place • Scenic values may be lost • Incompatible land uses may lose buffers • May degrade environmental quality and affect health • May lose recreational and educational opportunities • Loss of tree canopy and vegetation may increase stress levels and impact mental health • May increase risk of landslides and floods if tree canopy and vegetation are removed • Loss of intergenerational equity
LIMIT	• Maintain housing options when development can occur with minimal impact to the resource • Preserve some buffering of incompatible uses • Retain some or most of our cultural heritage • Provide salmon more of a chance to recover and lessen impacts on Native American culture and regional identity • Retain most neighborhood character and sense of place • Preserve most scenic values • Maintain environmental quality and reduce negative health impacts • Retain most educational and recreational opportunities • Retention of tree canopy and vegetation may reduce stress levels and positively impact mental health • Reduce risk of landslides and floods • Provide some amount of intergenerational equity	• May reduce option for large-lot single-family homes • Regulations may affect property rights – owners may not be able to develop land to same extent • May result in takings concerns • Could have a negative impact on property values and thus decrease personal financial security • Impact on property owners is not equitable – only those with significant resources are impacted *Wildlife habitat same as riparian, except:* • More vegetation could increase risk of wildfires • More habitat could increase number of undesirable species
PROHIBIT	• Preserve cultural heritage • Provide salmon a chance to recover and lessen impacts on Native American culture and regional identity • Preserve or increase buffers between incompatible land uses • Retain neighborhood character and sense of place • Preserve scenic values • Maintain and possibly improve environmental quality and reduce negative health impacts • Retain educational and recreational opportunities • Retention of tree canopy and vegetation may reduce stress levels and positively impact mental health • Reduce risk of landslides and floods • Provide intergenerational equity	• Reduce housing options and opportunities (Even if residential land is provided outside the UGB it is not equivalent to land in existing neighborhoods) • May impact housing affordability • Regulations would impact property rights – owners may not be able to develop land to same extent • Likely to result in takings concerns • Could have a negative impact on property values and thus decrease personal financial security • Impact on property owners is not equitable – only those with significant resources are impacted *Wildlife habitat same as riparian, except:* • More vegetation could increase risk of wildfires • More habitat could increase number of undesirable species

Development scenario	Social consequences: MULTI-FAMILY RESIDENTIAL	
	Riparian and wildlife habitat resources	
	Positive	***Negative***
ALLOW	• Maintain housing options • No change in property rights • No takings concern • Equitable impact on property owners *Wildlife habitat same as riparian, except:* • Less vegetation may reduce risk of wildfires • Less habitat may reduce number of undesirable species	• May lose cultural heritage • May not protect salmon and thus impact Native American culture and regional identity • May change neighborhood character and sense of place • Scenic values may be lost • Incompatible land uses may lose buffers • May degrade environmental quality and impact health • May lose recreational and educational opportunities • Loss of tree canopy and vegetation may increase stress levels and impact mental health • May increase risk of landslides and floods if tree canopy and vegetation are removed • Loss of intergenerational equity
LIMIT	• Maintain housing options when development can occur with minimal impact to the resource • Preserve some buffering of incompatible uses • Retain some or most of our cultural heritage • Provide salmon more of a chance to recover and lessen impacts on Native American culture and regional identity • Retain most neighborhood character and sense of place • Preserve most scenic values • Maintain environmental quality and reduce negative health impacts • Retain most educational and recreational opportunities • Retention of tree canopy and vegetation may reduce stress levels and positively impact mental health • Reduce risk of landslides and floods • Provide some amount of intergenerational equity	• May reduce opportunities to develop at high density • May impact housing affordability • Regulations may impact property rights – owners may not be able to develop land to same extent • Limit decision may result in takings concerns • Impact on property owners is not equitable – only those with significant resources are impacted *Wildlife habitat same as riparian, except:* • More vegetation could increase risk of wildfires • More habitat could increase number of undesirable species
PROHIBIT	• Preserve cultural heritage • Provide salmon a chance to recover and lessen impacts on Native American culture and regional identity • Preserve or increase buffers between incompatible land uses • Retain neighborhood character and sense of place • Preserve scenic values • Maintain and possibly improve environmental quality and reduce negative health impacts • Retain educational and recreational opportunities • Retention of tree canopy and vegetation may reduce stress levels and positively impact mental health • Reduce risk of landslides and floods • Provide intergenerational equity	• Reduce housing options and opportunities (even if residential land is provided outside the UGB, it is not equivalent to land in existing neighborhoods) • May impact housing affordability • Regulations would impact property rights – owners may not be able to develop land to same extent • Likely to result in takings concerns • Impact on property owners is not equitable – only those with significant resources are impacted *Wildlife habitat same as riparian, except:* • More vegetation could increase risk of wildfires • More habitat could increase number of undesirable species

Development scenario	Social consequences: MIXED-USE CENTERS	
	Riparian and wildlife habitat resources	
	Positive	***Negative***
ALLOW	• Maintain housing options • Maintain employment opportunities • Does not impact 2040 densities and development in centers • Allows residents opportunity to live near where they work • No change in property rights • No takings concern • Equitable impact on property owners *Wildlife habitat same as riparian, except:* • Less vegetation may reduce risk of wildfires • Less habitat may reduce number of undesirable species	• 2040 growth concept emphasizes importance of green corridors, a healthy ecosystem • May lose cultural heritage • May not protect salmon and thus impact Native American culture and regional identity • May change neighborhood character and sense of place • Scenic values may be lost • Incompatible land uses may lose buffers • May degrade environmental quality and impact health • May lose recreational and educational opportunities • Loss of tree canopy and vegetation may increase stress levels and impact mental health • May increase risk of landslides and floods if tree canopy and vegetation are removed • Loss of intergenerational equity
LIMIT	• Maintain housing options when development can occur with minimal impact to the resource • Maintain employment opportunities if development can occur with minimal impact to the resource • Preserve some buffering of incompatible uses • Retain some or most of our cultural heritage • Provide salmon more of a chance to recover and lessen impacts on Native American culture and regional identity • Retain most neighborhood character and sense of place • Preserve most scenic values • Maintain environmental quality and reduce negative health impacts • Retain most educational and recreational opportunities • Retention of tree canopy and vegetation may reduce stress levels and positively impact mental health • Reduce risk of landslides and floods • Provide some amount of intergenerational equity	• May impact 2040 growth concept if development in centers is curtailed • May reduce opportunities to develop at high density • May reduce employment and housing opportunities • May impact housing affordability • Regulations may impact property rights – owners may not be able to develop land to same extent • Limit decision may result in takings concerns • Impact on property owners is not equitable – only those with significant resources are impacted *Wildlife habitat same as riparian, except:* • More vegetation could increase risk of wildfires • More habitat could increase number of undesirable species

Development scenario	Social consequences: MIXED-USE CENTERS	
	Riparian and wildlife habitat resources	
	Positive	***Negative***
PROHIBIT	• Preserve cultural heritage • Provide salmon a chance to recover and lessen impacts on Native American culture and regional identity • Preserve or increase buffers between incompatible land uses • Retain neighborhood character and sense of place • Preserve scenic values • Maintain and possibly improve environmental quality and reduce negative health impacts • Retain educational and recreational opportunities • Retention of tree canopy and vegetation may reduce stress levels and positively impact mental health • Reduce risk of landslides and floods • Provide intergenerational equity	• Negative impact to 2040 growth concept if development in centers is curtailed • Reduce housing and employment options and opportunities. Even if residential and employment land is provided outside the UGB, it is not equivalent to land in existing neighborhoods and centers. • May impact housing affordability • Regulations would impact property rights – owners may not be able to develop land to same extent • Likely to result in takings concerns • Impact on property owners is not equitable – only those with significant resources are impacted *Wildlife habitat same as riparian, except:* • More vegetation could increase risk of wildfires • More habitat could increase number of undesirable species

Social consequences:
COMMERCIAL

Riparian and wildlife habitat resources

Development scenario	Positive	Negative
ALLOW	• Maintain employment opportunities • No change in property rights • No takings concern • Equitable impact on property owners *Wildlife habitat same as riparian, except:* • Less vegetation may reduce risk of wildfires • Less habitat may reduce number of undesirable species	• 2040 growth concept emphasizes the importance of green corridors and a healthy ecosystem • May lose cultural heritage • May not protect salmon and thus impact Native American culture and regional identity • Scenic values may be lost • Incompatible land uses may lose buffers • May degrade environmental quality and impact health • May lose recreational and educational opportunities • Loss of tree canopy and vegetation may increase stress levels and impact mental health • May increase risk of landslides and floods if tree canopy and vegetation are removed • Loss of intergenerational equity
LIMIT	• Maintain employment opportunities if development can occur with minimal impact to the resource • Preserve some buffering of incompatible uses • Retain some or most of our cultural heritage • Provide salmon more of a chance to recover and lessen impacts on Native American culture and regional identity • Preserve most scenic values • Maintain environmental quality and reduce negative health impacts • Retain most educational and recreational opportunities • Retention of tree canopy and vegetation may reduce stress levels and positively impact mental health • Reduce risk of landslides and floods • Provide some amount of intergenerational equity	• May reduce employment opportunities • Regulations may impact property rights – owners may not be able to develop land to same extent • Limit decision may result in takings concerns • Impact on property owners is not equitable – only those with significant resources are impacted *Wildlife habitat same as riparian, except:* • More vegetation could increase risk of wildfires • More habitat could increase number of undesirable species
PROHIBIT	• Preserve cultural heritage • Provide salmon a chance to recover and lessen impacts on Native American culture and regional identity • Preserve or increase buffers between incompatible land uses • Preserve scenic values • Maintain and possibly improve environmental quality and reduce negative health impacts • Retain educational and recreational opportunities • Retention of tree canopy and vegetation may reduce stress levels and positively impact mental health • Reduce risk of landslides and floods • Provide intergenerational equity	• Reduce employment options and opportunities. Even if employment land is provided outside the UGB, it is not equivalent to land in existing neighborhoods and centers. • Regulations would impact property rights – owners may not be able to develop land to same extent • Likely to result in takings concerns • Impact on property owners is not equitable – only those with significant resources are impacted *Wildlife habitat same as riparian, except:* • More vegetation could increase risk of wildfires • More habitat could increase number of undesirable species

<table>
<tr><td rowspan="3">Development scenario</td><td colspan="2">Social consequences:
INDUSTRIAL</td></tr>
<tr><td colspan="2">Riparian and wildlife habitat resources</td></tr>
<tr><td>Positive</td><td>Negative</td></tr>
<tr><td>ALLOW</td><td>• Maintain employment opportunities
• No change in property rights
• No takings concern
• Equitable impact on property owners
Wildlife habitat same as riparian, except:
• Less vegetation may reduce risk of wildfires
• Less habitat may reduce number of undesirable species</td><td>• May lose cultural heritage
• May not protect salmon and thus impact Native American culture and regional identity
• Scenic values may be lost
• Incompatible land uses may lose buffers
• May degrade environmental quality and impact health
• May lose recreational and educational opportunities
• Loss of tree canopy and vegetation may increase stress levels and impact mental health
• May increase risk of landslides and floods if tree canopy and vegetation are removed
• Loss of intergenerational equity</td></tr>
<tr><td>LIMIT</td><td>• Maintain employment opportunities if development can occur with minimal impact to the resource
• Preserve some buffering of incompatible uses
• Retain some or most of our cultural heritage
• Provide salmon more of a chance to recover and lessen impacts on Native American culture and regional identity
• Preserve most scenic values
• Maintain environmental quality and reduce negative health impacts
• Retain most educational and recreational opportunities
• Retention of tree canopy and vegetation may reduce stress levels and positively impact mental health
• Reduce risk of landslides and floods
• Provide some amount of intergenerational equity</td><td>• May reduce employment opportunities
• Regulations may impact property rights – owners may not be able to develop land to same extent
• Limit decision may result in takings concerns
• Impact on property owners is not equitable – only those with significant resources are impacted
Wildlife habitat same as riparian, except:
• More vegetation could increase risk of wildfires
• More habitat could increase number of undesirable species</td></tr>
<tr><td>PROHIBIT</td><td>• Preserve cultural heritage
• Provide salmon a chance to recover and lessen impacts on Native American culture and regional identity
• Preserve or increase buffers between incompatible land uses
• Preserve scenic values
• Maintain and possibly improve environmental quality and reduce negative health impacts
• Retain educational and recreational opportunities
• Retention of tree canopy and vegetation may reduce stress levels and positively impact mental health
• Reduce risk of landslides and floods
• Provide intergenerational equity</td><td>• Reduce employment options and opportunities. Even if employment land is provided outside the UGB, it is not equivalent to land in existing neighborhoods and centers.
• Regulations would impact property rights – owners may not be able to develop land to same extent
• Likely to result in takings concerns
• Impact on property owners is not equitable – only those with significant resources are impacted
Wildlife habitat same as riparian, except:
• More vegetation could increase risk of wildfires
• More habitat could increase number of undesirable species</td></tr>
</table>

<table>
<tr><th rowspan="3">Development scenario</th><th colspan="2">Social consequences:
RURAL</th></tr>
<tr><th colspan="2">Riparian and wildlife habitat resources</th></tr>
<tr><th>Positive</th><th>Negative</th></tr>
<tr><td>ALLOW</td><td>• Metro does not regulate agricultural activities, thus the impacts of allowing, limiting or prohibiting agricultural disturbances to the resource are not described here
• Maintain housing and employment opportunities in the future if land is to be urbanized
• No change in property rights
• No takings concern
• Equitable impact on property owners
Wildlife habitat same as riparian, except:
• Less vegetation may reduce risk of wildfires
• Less habitat may reduce number of undesirable species</td><td>• May lose cultural heritage
• May not protect salmon and thus impact Native American culture and regional identity
• Scenic values may be lost
• Incompatible land uses may lose buffers
• May degrade environmental quality and impact health
• May lose recreational and educational opportunities
• Loss of tree canopy and vegetation may increase stress levels and impact mental health
• May increase risk of landslides and floods if tree canopy and vegetation are removed
• Loss of intergenerational equity</td></tr>
<tr><td>LIMIT</td><td>• Maintain housing and employment opportunities in future if urbanized and development occurs with minimal impact to the resource
• Preserve some buffering of incompatible uses
• Retain some or most of our cultural heritage
• Provide salmon more of a chance to recover and lessen impacts on Native American culture and regional identity
• Preserve most scenic values
• Maintain environmental quality and reduce negative health impacts
• Retain most educational and recreational opportunities
• Retention of tree canopy and vegetation may reduce stress levels and positively impact mental health
• Reduce risk of landslides and floods
• Provide some amount of intergenerational equity</td><td>• May reduce housing and employment opportunities in future if land is to be urbanized
• Regulations may impact property rights – owners may not be able to develop land to same extent
• Limit decision may result in takings concerns
• Impact on property owners is not equitable – only those with significant resources are impacted
Wildlife habitat same as riparian, except:
• More vegetation could increase risk of wildfires
• More habitat could increase number of undesirable species</td></tr>
<tr><td>PROHIBIT</td><td>• Preserve cultural heritage
• Provide salmon a chance to recover and lessen impacts on Native American culture and regional identity
• Preserve or increase buffers between incompatible land uses
• Preserve scenic values
• Maintain and possibly improve environmental quality and reduce negative health impacts
• Retain educational and recreational opportunities
• Retention of tree canopy and vegetation may reduce stress levels and positively impact mental health
• Reduce risk of landslides and floods
• Provide intergenerational equity</td><td>• Reduce housing and employment options and opportunities – if area is to be urbanized in the future will impact land available for housing and employment
• Regulations would impact property rights – owners may not be able to develop land to same extent
• Likely to result in takings concerns
• Impact on property owners is not equitable – only those with significant resources are impacted
Wildlife habitat same as riparian, except:
• More vegetation could increase risk of wildfires
• More habitat could increase number of undesirable species</td></tr>
</table>

Development scenario	Social consequences: PARKS AND OPENSPACE	
	Riparian and wildlife habitat resources	
	Positive	***Negative***
ALLOW	• Maintain or increase opportunities for active recreation if parks are converted to ball fields, boat ramps, or other community structures *Wildlife habitat same as riparian, except:* • Less vegetation may reduce risk of wildfires • Less habitat may reduce number of undesirable species	• May lose cultural heritage • May not protect salmon and thus impact Native American culture and regional identity • Scenic values may be lost • May degrade environmental quality and impact health • May lose recreational and educational opportunities • Loss of tree canopy and vegetation may increase stress levels and impact mental health • May increase risk of landslides and floods if tree canopy and vegetation are removed • Loss of intergenerational equity
LIMIT	• Maintain existing active park use and provide new opportunities if development occurs with minimal impact to the resource • Retain some or most of our cultural heritage • Provide salmon more of a chance to recover and lessen impacts on Native American culture and regional identity • Preserve most scenic values • Maintain environmental quality and reduce negative health impacts • Retain most educational and recreational opportunities • Retention of tree canopy and vegetation may reduce stress levels and positively impact mental health • Reduce risk of landslides and floods • Provide some amount of intergenerational equity	• May reduce opportunities for active recreation *Wildlife habitat same as riparian, except:* • More vegetation could increase risk of wildfires • More habitat could increase number of undesirable species
PROHIBIT	• Preserve cultural heritage • Provide salmon a chance to recover and lessen impacts on Native American culture and regional identity • Preserve scenic values • Maintain and possibly improve environmental quality and reduce negative health impacts • Retain educational and recreational opportunities • Retention of tree canopy and vegetation may reduce stress levels and positively impact mental health • Reduce risk of landslides and floods • Provide intergenerational equity	• Reduce opportunities for active recreation *Wildlife habitat same as riparian, except:* • More vegetation could increase risk of wildfires • More habitat could increase number of undesirable species

Development scenario	Social consequences: IMPACT AREA	
	Riparian and wildlife habitat resources	
	Positive	***Negative***
ALLOW	Same as described above depending on the regional zoning category	Same as described above depending on the regional zoning category
LIMIT	Same as described above depending on the regional zoning category	Same as described above depending on the regional zoning category
PROHIBIT	Same as described above depending on the regional zoning category	Same as described above depending on the regional zoning category

Development scenario	Environmental consequences: SINGLE FAMILY RESIDENTIAL			
	Class I Riparian resources		**Class A Wildlife Habitat resources**	
	Positive	***Negative***	***Positive***	***Negative***
ALLOW	• **Functional consequences**: no positive consequences noted beyond that provided by existing protection (e.g., Title 3) • Reduced need for UGB expansion (protects land outside UGB) • Low to medium density SFR may retain more trees/vegetation than most other zoning types; local studies show that increased forest canopy near streams and throughout the watershed is associated with healthier streams • This zoning type contains the largest amount of Class I Riparian Resources, therefore incentives and education could improve land stewardship, but would require substantial financial investment	• **Functional consequences**: Widespread loss of 3-5 primary ecological functions, including: microclimate and shade; streamflow moderation/water storage; bank stabilization, sediment and pollution control; large wood and channel dynamics; and organic material sources. Class I Riparian resources also contain a substantial portion of high-value wildlife habitat (not included in Class A or B wildlife habitat if falls in Class I riparian), which would also be compromised or removed • Medium to high density housing tends to retain less vegetation and add more imperviousness; these factors are known to harm streams and wetlands • Likely harm to salmon and wildlife through habitat loss and degradation • Increased pesticide and fertilizer use degrades water quality • Landscaping uses water • Continued development in flood areas • Continued wetland conversion • Non-native species introductions • Severity of consequences relates to: o housing density o proximity to water resources o amount of vegetation retained onsite o amount of effective imperviousness o stormwater management practices o landowner/land user outreach and education	*Similar to Class I Riparian Resources* • **Functional consequences**: no positive consequences noted • Low to medium density SFR may retain more natural land cover than most other zoning types, providing wildlife habitat and connectivity	• **Functional consequences**: Loss of key habitat characteristics including large patch size, shape (habitat interior), water resources, connectivity • High density housing may not retain trees and other vegetation; partial or complete loss of largest, most well-connected and water-rich patches • Extensive loss of valuable wildlife habitat • Non-native plant and animal species invasions • Increased adverse edge effects • Reduced wildlife food and cover • Reduced woody debris and snags • Pesticides may harm wildlife • Noise and light disturbances • Continued native species loss over time • Reduction in Neotropical migratory songbirds • Most extensive loss of habitat interior and associated species outside Class I riparian • Further decline of at-risk wildlife species; more species likely to become imperiled • Continued loss of Habitats of Concern and associated species • Wildlife crossings across roadways cause mortality

Environmental consequences: SINGLE FAMILY RESIDENTIAL

Development scenario	Class I Riparian resources		Class A Wildlife Habitat resources	
	Positive	***Negative***	***Positive***	***Negative***
LIMIT	• **Functional consequences:** May conserve some level of 3-5 existing primary ecological functions, depending on program, as well as Class A or B wildlife habitat falling within Class I riparian; extent depends on program • Reduced need for UGB expansion compared to “prohibit” • Strong potential for restoration and mitigation activities to offset negative ecological effects • Strong potential for BMP implementation and low impact development and innovative design standards • Hydrology less altered than “allow” • The large extent of Class I Riparian Resources in SFR represents substantial mitigation, restoration and land stewardship opportunities, but would require investment	• **Functional consequences:** Potential for substantial loss of 3-5 primary ecological functions, as described in Allow. Class A or B wildlife habitat falling within Class I riparian would also be compromised. Extent of loss depends on program. • See comments under “allow,” except: • Hydrology less altered, less stream damage • Greater protection of flood areas and wetlands • Greater protection of steep slope areas • Fish and other aquatic wildlife habitat impaired, but extent of loss reduced • Water quality impacts likely, but degree depends on program effectiveness	• **Functional consequences:** Some retention of key habitat attributes (patch size, habitat interior, connectivity and water resources) for habitat outside Class I riparian • More habitat retained than Allow • Reduced edge effects • Fewer non-native species invasions • More connectivity retained • Less harm to native species • Reduced need for UGB expansion • Landscaping can provide diverse habitats • Low to moderate levels of development provide good habitat for some species • This zoning type contains the largest amount of Class A Wildlife Habitat resources outside of Riparian Class I, therefore represents mitigation, restoration and land stewardship opportunities	*Similar to “allow,” but to a lesser degree depending on program options* • **Functional consequences:** Potential for reduction in habitat patch size, connectivity, and amount of interior habitat, reducing ecological function of habitat
PROHIBIT	• **Functional consequences**: Preservation of the most ecologically functional riparian areas, as well as some of the most important wildlife habitat remaining in the region, including Habitats of Concern (especially wetlands, bottomland hardwood) • Helps maintain hydrologic connectivity • Minimizes hydrologic alterations, reduces flooding • Retention of important salmon habitat	• **Functional consequences:** no adverse consequences noted to Class I resources • Increased need for UGB expansion • Potential for increased infrastructure intrusion into other resource areas due to avoiding Class I riparian areas	• **Functional consequences**: Retention of key habitat attributes (patch size, habitat interior, connectivity and water resources) for habitat outside Class I riparian • Retention of some of the best remaining wildlife habitats in the region • This option will provide key breeding habitat for Neotropical migrants, aquatic species and habitat interior specialists (but see next column) • Retains Habitats of Concern • Provides important source habitats for native wildlife and plant species • Reduced wildlife road crossing mortality	• **Functional consequences:** Continuing functionality of Class A habitat patches may depend on connectivity with other, less valuable habitat patches • If conflicting uses are prohibited in all Class A wildlife habitat patches, other habitat patches may be disproportionately removed or altered, thereby reducing the functionality of Class A habitat patches through connectivity loss • Class A patches are typically very large, therefore may result in a need for UGB expansions

Development scenario	Environmental consequences: SINGLE FAMILY RESIDENTIAL (SFR)			
	Class II Riparian resources		**Class B Wildlife Habitat resources**	
	Positive	***Negative***	***Positive***	***Negative***
ALLOW	*Similar to Class I riparian resources* • This zoning type contains the largest amount of Class II Riparian Resources, therefore represents substantial mitigation, restoration and land stewardship opportunities	*Similar to Class I riparian resources, except:* • Loss of restoration opportunities where ecological functions could be regained through tree canopy increases or other measures • Loss of functionality would be less because less ecological function exists; however, loss of this resource type would remove existing water quality filtration capacity or other ecological services, leaving waterways with little or no protection from conflicting uses	*Similar to Class I Riparian Resources* • SFR contains majority of Class B Wildlife Habitat Resources, therefore represents substantial mitigation, restoration and land stewardship opportunities	*Similar to Class A, except:* • Habitat interior loss less extensive than Class A • Loss of connectivity especially pronounced; extensive loss of migratory stopover habitat and movement corridors. Reduces value of Class A patches. • Loss of grassland and low-structure vegetation within 300 ft of streams; important to specific wildlife groups (e.g., grassland birds) • Loss of locally rare migratory stopover habitat and locally rare habitat patches with water resources
LIMIT	*Similar to Class I riparian resources, except:* • Retains restoration opportunities where ecological functions could be regained through tree canopy increases or other measures • Provides mitigation opportunities	*Similar to Class I riparian resources, except:* • Some loss of the features providing important ecological functions (scores 6-17), unless offset by mitigation and restoration activities	*Similar to Class A, except:* • More habitat connectivity between large habitat patches retained • Grassland and low structure habitat within 300 ft of stream may be retained • Low to moderate levels of development provide good habitat for some species, but this is most pronounced in Class A patches due to forest width	*Similar to "allow," but to a lesser degree depending on program options* • To the extent that conflicting uses remove the resource, habitat and connectivity will be lost
PROHIBIT	*Similar to Class I riparian resources, except:* • Retention of some critical ecological functions and ecosystem services provided by existing natural resources • Retains restoration opportunities where ecological functions could be regained through tree canopy increases or other measures • Provides mitigation opportunities	*Similar to Class I riparian resources, except:* • Increased need for UGB expansion, but less so than prohibit decision in Class I (scores of 6-18 – at least 1 primary function)	*Similar to Class A, except:* • Retention of some of the most important connectivity elements in the region • Retention of large upland habitat patches important to specific wildlife species • This option important for Neotropical migratory birds during migration • May provide important source habitats for native wildlife and plant species • Grassland and low-structure vegetation within 300 ft of streams would be retained	*Similar to Class A*

<table>
<tr><th rowspan="3">Development scenario</th><th colspan="4">Environmental consequences:
SINGLE FAMILY RESIDENTIAL (SFR)</th></tr>
<tr><th colspan="2">Class III Riparian</th><th colspan="2">Class C Wildlife Habitat resources</th></tr>
<tr><th>Positive</th><th>Negative</th><th>Positive</th><th>Negative</th></tr>
<tr><td>ALLOW</td><td>Similar to Class I riparian resources, except:
• Low Value Riparian tends to have less forest or other vegetation than other classes, and includes developed floodplains, where functionality is already reduced
• SFR and IND contain the majority of Low Value Riparian Resources, therefore SFR represents opportunities for improved ecological function through mitigation or restoration</td><td>Similar to Class II riparian resources, except:
• The potential for losing existing ecological functions is reduced</td><td>Similar to Class I, except:
• These patches tend to be relatively small, isolated, and lacking substantial water resources, and are therefore reduced in quality and functionality compared to Class A and B
• Isolated patches may be associated with increased wildlife crossing mortality on roadways</td><td>Similar to Class B, except:
• Only limited loss of habitat interior
• Some loss of connectivity between patches
• Important loss of migratory stopover habitat, because these patches tend to occur in areas lacking substantial wildlife habitat
• Loss of upland patches lacking water resources but providing important habitat to specific wildlife species</td></tr>
<tr><td>LIMIT</td><td>Similar to Class I riparian resources, except:
• Retains restoration opportunities where ecological functions could be regained through tree canopy increases or other measures
• Provides mitigation opportunities</td><td>Similar to Class I riparian resources, except:
• Loss of opportunities to add forest canopy along streams where low structure currently exists</td><td>Similar to Class B, except:
• Most are small forested patches
• Less likely to provide good habitat for some species, because these patches tend to be narrow, disconnected, and surrounded by development
• Isolated patches may be associated with increased wildlife crossing mortality on roadways</td><td>Similar to “allow,” but to a lesser degree depending on program options
• To the extent that conflicting uses remove the resource, habitat and connectivity will be lost</td></tr>
<tr><td>PROHIBIT</td><td>Similar to Class I riparian resources, except:
• Retention of some ecological functions and ecosystem services provided by existing natural resources (scores 1-5)
• Retains restoration opportunities where ecological functions could be regained through tree canopy increases or other measures
• Provides mitigation opportunities</td><td>Similar to Class I riparian resources, except:
• Increased need for UGB expansion, but less so than Class II</td><td>Similar to Class B, except:
• Not as important to regional connectivity, but may provide important local connectivity
• Small, isolated patches provide important and locally rare stopover habitat to migratory birds</td><td>Similar to Class B, except:
• Small isolated habitat patches may limit reproductive success due to edge effects and reduced habitat quality
• Isolated patches may be associated with increased wildlife crossing mortality on roadways</td></tr>
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<table>
<tr><th rowspan="3">Development scenario</th><th colspan="4">Environmental consequences:
SINGLE FAMILY RESIDENTIAL (SFR)</th></tr>
<tr><th colspan="2">Impact areas around waterways (50-150 feet from resource)</th><th colspan="2">Impact areas around habitat (25 feet)</th></tr>
<tr><th>Positive</th><th>Negative</th><th>Positive</th><th>Negative</th></tr>
<tr><td>ALLOW</td><td>• Opportunities for landowner education may reduce effects of existing and future environmentally harmful practices near waterways</td><td>• Potential for increased adverse impacts (e.g., pollution, altered hydrology, pesticide use, bacterial contamination, human disturbance…) to waterways due to existing and new conflicting uses in areas adjacent to waterways
• These impacts are greater than in other areas because they are near water and because non-resource areas tend to lack natural filtration provided by riparian vegetation</td><td>• Opportunities for landowner education may reduce effects of existing and future environmentally harmful practices</td><td>• Potential for increased adverse effects adjacent to habitat areas, primarily forested but also low-structure vegetation, including:
o Soil compaction, causing tree and other vegetation damage and increasing risk of tree falls
o Increased vegetation trampling at edges of habitat patches
o Introduction of trash and pollutants to wildlife habitat
o Increased adverse edge effects
o Increased light and noise disturbance
o Increased potential for non-native plant and animal species invasions</td></tr>
<tr><td>LIMIT</td><td>• Retains restoration opportunities where riparian functions could be regained through planting tree canopy or other measures
• May help protect existing water resources from current or future adverse effects due to conflicting uses
• Provides mitigation opportunities
• Incentives and landowner education could enhance ecological health over time</td><td>Similar to “allow,” but to a lesser degree</td><td>• Retains restoration opportunities where habitat patch functions could be regained through planting tree canopy or other measures; for example, potential for decreased edge effects, increased interior habitat and increased connectivity to other patches and to water resources
• Provides mitigation opportunities
• Incentives and landowner education could enhance ecological health over time</td><td>• Similar to “allow,” but to a lesser degree</td></tr>
<tr><td>PROHIBIT</td><td>Similar to “limit,” but to a greater degree</td><td>• Primary negative consequences relate to social, economic and energy</td><td>Similar to “limit,” but to a greater degree</td><td>• Primary negative consequences relate to social, economic and energy</td></tr>
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Development scenario	Environmental consequences: MULTIFAMILY RESIDENTIAL (MFR)			
	Class I Riparian resources		**Class A Wildlife Habitat resources**	
	Positive	***Negative***	***Positive***	***Negative***
ALLOW	*Similar to Single Family Residential, except:* • Increased density within UGB reduces need for UGB expansions • Decreased infrastructure requirements per dwelling unit decreases overall infrastructure and roads needed, thereby reducing negative ecological effects	*Similar to Single Family Residential, except:* • Associated with higher levels of onsite imperviousness and lower levels of forest and vegetation, with increased negative stormwater and water quality impacts	*Similar to Single Family Residential, except:* • Increased density within UGB may limit expansion to new areas, protecting important outlying habitats	*Similar to Single Family Residential, except:* • Associated with higher levels of onsite imperviousness and lower levels of forest and vegetation, with increased negative effects on riparian wildlife and Neotropical migrants
LIMIT	*Similar to Single Family Residential, except:* • Increased density within UGB reduces need for UGB expansions • Decreased infrastructure requirements per dwelling unit decreases overall infrastructure and roads needed, thereby reducing negative ecological effects	*Similar to Single Family Residential, except:* • Onsite loss of ecological functions and ecosystem services likely to be more severe due to increased imperviousness and tree canopy loss, unless offset by mitigation and restoration activities	*Similar to Single Family Residential, except:* • Increased density within UGB may limit expansion to new areas, protecting important outlying habitats	*Similar to Single Family Residential, except:* • Associated with higher levels of onsite imperviousness and lower levels of forest and vegetation, with increased negative effects on riparian wildlife and Neotropical migrants • Higher level of development less valuable to wildlife
PROHIBIT	*Similar to Single Family Residential*	*Similar to Single Family Residential, except:* • Opportunity for increased density reduced, thereby increasing need for UGB expansion	*Similar to Single Family Residential*	*Similar to Single Family Residential*

Development scenario	Environmental consequences: MULTIFAMILY RESIDENTIAL (MFR)			
	Class II Riparian resources		**Class B Wildlife Habitat resources**	
	Positive	***Negative***	***Positive***	***Negative***
ALLOW	*Similar to Class I riparian resources*	*Similar to Class I riparian resources, except:* • Loss of restoration opportunities where ecological functions could be regained through tree canopy increases or other measures • Loss of functionality would be less because less ecological function exists; however, loss of this resource type would remove any remaining water quality filtration capacity or other ecological services, leaving waterways with little protection or buffering from conflicting uses	*Similar to Class I Riparian Resources*	*Similar to Class A, except:* • Habitat interior loss, but less extensive than Class A • Loss of connectivity especially pronounced; extensive loss of migratory stopover habitat and movement corridors. Reduces value of Class A patches. • In Type 2 habitat patches, loss of grassland and low-structure vegetation important to specific wildlife groups (e.g., grassland birds, meadow voles) • Loss of locally rare migratory stopover habitat and locally rare habitat patches with water resources • Associated with higher levels of onsite imperviousness and lower levels of forest and vegetation, with increased negative effects on riparian wildlife and Neotropical migrants • Higher density development less valuable to wildlife
LIMIT	*Similar to Class I riparian resources, except:* • Retains restoration opportunities where ecological functions could be regained through tree canopy increases or other measures • Provides mitigation opportunities	*Similar to Class I riparian resources, except:* • Loss of opportunities to add forest canopy along streams where low structure currently exists	*Similar to Class A, except:* • More habitat connectivity between large habitat patches retained • More grassland and low structure habitat retained (larger, better connected low structure patches fall in Class B)	*Similar to "allow," but to a lesser degree depending on program options* • To the extent that conflicting uses remove the resource, habitat and connectivity will be lost • Associated with higher levels of onsite imperviousness and lower levels of forest and vegetation, with increased negative effects on riparian wildlife and Neotropical migrants • Higher density development less valuable to wildlife
PROHIBIT	*Similar to Class I riparian resources, except:* • Retention of some critical ecological functions and ecosystem services provided by existing natural resources • Retains restoration opportunities where ecological functions could be regained through tree canopy increases or other measures • Provides mitigation opportunities	*Similar to Class I riparian resources, except:* • Increased need for UGB expansion, but less so than Class II	*Similar to Class A, except:* • Retention of some of the most important connectivity elements in the region • Retention of large upland habitat patches important to specific wildlife species • Preserves areas important for Neotropical migratory birds during migration • May provide important source habitats for native wildlife and plant	*Similar to Class A, except:* • If conflicting uses are prohibited in all Class B wildlife habitat patches, Class A and C may be disproportionately removed or altered, thereby reducing the functionality of Class B habitat patches through connectivity loss and increasing isolation

			species	

Development scenario	Environmental consequences: MULTIFAMILY RESIDENTIAL (MFR)			
	Low Value Riparian		**Class C Wildlife Habitat resources**	
	Positive	***Negative***	***Positive***	***Negative***
ALLOW	*Similar to Class I riparian resources, except:* • This class tends to have less forest or other vegetation than other classes, and includes developed floodplains; functionality already reduced here	*Similar to Class II riparian resources, except:* • The potential for losing existing ecological functions is reduced	*Similar to Class B, except:* • These patches tend to be relatively small, isolated, and lacking substantial water resources, and are therefore reduced in quality and functionality compared to Class A and B	*Similar to Class B, except:* • Only limited loss of habitat interior • Some loss of connectivity between patches • Important loss of migratory stopover habitat, because these patches tend to occur in areas lacking substantial wildlife habitat • Loss of upland patches lacking water resources but providing important habitat to specific wildlife species
LIMIT	*Similar to Class I riparian resources, except:* • Retains restoration opportunities where ecological functions could be regained through tree canopy increases or other measures • Provides mitigation opportunities	*Similar to Class I riparian resources, except:* • Loss of opportunities to add forest canopy along streams where low structure currently exists	*Similar to Class B, except:* • Most are small forested patches • Less likely to provide good habitat for some species, because these patches tend to be narrow, disconnected, and surrounded by development	*Similar to "allow," but to a lesser degree depending on program options* • To the extent that conflicting uses remove the resource, habitat and connectivity will be lost
PROHIBIT	*Similar to Class I riparian resources, except:* • Retention of some ecological functions and ecosystem services provided by existing natural resources • Retains restoration opportunities where ecological functions could be regained through tree canopy increases or other measures • Provides mitigation opportunities	*Similar to Class I riparian resources, except:* • Increased need for UGB expansion, but less so than Class II	*Similar to Class B, except:* • Not as important to regional connectivity, but may provide important local connectivity • Small, isolated patches provide important and locally rare stopover habitat to migratory birds	*Similar to Class B, except:* • Small isolated habitat patches may limit reproductive success due to edge effects and reduced habitat quality

<table>
<tr><th rowspan="3">Development scenario</th><th colspan="4">Environmental consequences:
COMMERCIAL (COM)</th></tr>
<tr><th colspan="2">Class I, II and III Riparian resources</th><th colspan="2">Class A, B, and C Wildlife Habitat resources</th></tr>
<tr><th>Positive</th><th>Negative</th><th>Positive</th><th>Negative</th></tr>
<tr><td>ALLOW</td><td>Similar to MFR</td><td>Similar to MFR, except:
• Increased imperviousness and decreased canopy cover increase negative ecological effects</td><td>Similar to MFR</td><td>Similar to MFR, except:
• Increased imperviousness and decreased canopy cover increase negative ecological effects
• Increased human disturbance may negatively impact wildlife</td></tr>
<tr><td>LIMIT</td><td>Similar to MFR</td><td>Similar to MFR, except:
• Increased imperviousness and decreased canopy cover increase negative ecological effects, to a lesser extent than allow</td><td>Similar to MFR</td><td>Similar to MFR, except:
• Increased imperviousness and decreased canopy cover increase negative ecological effects to a lesser degree than allow
• Increased human disturbance may negatively impact wildlife, but to a lesser degree than allow</td></tr>
<tr><td>PROHIBIT</td><td>Similar to MFR</td><td>• Similar to MFR</td><td>Similar to MFR</td><td>Similar to MFR</td></tr>
</table>

Environmental consequences:
INDUSTRIAL (IND)

Development scenario	Class I, II and III Riparian resources		Class A, B, and C Wildlife Habitat resources	
	Positive	***Negative***	***Positive***	***Negative***
ALLOW	*Similar to MFR, except:* • SFR and IND contain the majority of Low Value Riparian Resources, therefore SFR represents opportunities for improved ecological function through mitigation or restoration	*Similar to MFR, except:* • Increased imperviousness and decreased canopy cover increase negative ecological effects • Increased toxics may be associated with this land use type • IND contains a substantial portion of Class I Riparian Resources and can be particularly detrimental to water quality	*Similar to MFR*	*Similar to MFR, except:* • Increased imperviousness and decreased canopy cover increase negative ecological effects
LIMIT	*Similar to MFR, except:* • IND contains a substantial portion of Class I Riparian Resources, representing opportunities for improved ecological function through mitigation, restoration, or programmatic protection • SFR and IND contain the majority of Low Value Riparian Resources, therefore SFR represents opportunities for improved ecological function through mitigation or restoration	*Similar to MFR, except:* • Increased imperviousness and decreased canopy cover increase negative ecological effects • Increased toxins may be associated with this land use type	*Similar to MFR*	*Similar to MFR, except:* • Increased imperviousness and decreased canopy cover increase negative ecological effects, but to a lesser extent than allow
PROHIBIT	*Similar to MFR* • Prohibiting conflicting uses would minimize water quality degradation • IND contains a substantial portion of Class I Riparian Resources, representing opportunities for improved ecological function through preservation and restoration	*Similar to MFR*	*Similar to MFR*	*Similar to MFR*

Development scenario	Environmental consequences: MIXED USE CENTERS (MUC)			
	Class I, II and III Riparian resources		**Class A, B, and C Wildlife Habitat resources**	
	Positive	***Negative***	***Positive***	***Negative***
ALLOW	• Because MUC zoning allows for a variety of land uses in the same area, it has potential for reducing the amount of land needed; UGB expansions less necessary • MUC tends to reduce VMT, thereby reducing water quality impacts due to transportation runoff • Less use of fertilizers, pesticides and herbicides than residential because less landscaping and vegetation present	• Mixed use development generates similar disturbance activities and consequences as residential and commercial, but to varying degrees depending on uses • MUC typically have high imperviousness and little tree canopy cover • Extensive loss of ecological functions and ecosystem services, with particular concerns regarding altered hydrology, stormwater and water quality • More parking areas and roads add pollutants to water resources	• Because mixed use zoning allows for a variety of land uses, it has potential for reducing the amount of land needed; UGB expansions less necessary • Incentives and education could improve land stewardship, but requires financial investment	*Similar to MFR and COM, depending on mix of land uses, except:* • Noise and light disturbances may be higher • Extent of vegetation loss may be higher
LIMIT	*Similar to MFR and COM, depending on mix of land uses, except:* • MUC tends to reduce VMT, thereby reducing water quality impacts due to transportation runoff	*Similar to MFR and COM, depending on mix of land uses*	*Similar to MFR and COM, depending on mix of land uses*	*Similar to MFR and COM, depending on mix of land uses*
PROHIBIT	*Similar to MFR and COM, depending on mix of land uses*	*Similar to MFR and COM, depending on mix of land uses*	*Similar to MFR and COM, depending on mix of land uses*	*Similar to MFR and COM, depending on mix of land uses*

<table>
<tr><th rowspan="3">Development scenario</th><th colspan="4">Environmental consequences:
RURAL (RUR)</th></tr>
<tr><th colspan="2">Class I, II and III Riparian resources</th><th colspan="2">Class A, B, and C Wildlife Habitat resources</th></tr>
<tr><th>Positive</th><th>Negative</th><th>Positive</th><th>Negative</th></tr>
<tr><td>ALLOW</td><td>Similar to SFR, except:
• Lower imperviousness; more tree canopy and vegetation reduce harm to streams</td><td>Similar to SFR, except:
• Increased pesticide use may be associated with this land use due to agriculture
• Livestock degrade riparian area and water quality
• Septic tanks are common and sometimes leak bacteria into waterways, reducing water quality</td><td>Similar to SFR, except:
• Lower imperviousness; often more tree canopy and vegetation reduce extent of habitat loss and adverse edge effects
• Less habitat fragmentation; tends to retain more connectivity between patches and to water
• RUR lands with agricultural areas can provide important habitat for grassland and low structure-associated species</td><td>Similar to SFR, except:
• Increased toxics may be associated with this land use type due to agriculture
• Livestock degrade riparian area and reduce habitat quality
• Wildlife crossings across roadways cause mortality</td></tr>
<tr><td>LIMIT</td><td>See comments under “allow,” except:
• Programmatic options may reduce loss of ecological functions
• Impervious surface mitigation opportunities
• Hydrology often less altered than other zoning types
• Strong potential for BMPs, restoration and mitigation activities to offset negative ecological effects, but requires financial investment</td><td>Similar to SFR, except:
• Increased pesticide use may be associated with this land use due to agriculture
• Septic tanks are common and sometimes leak bacteria into waterways, reducing water quality</td><td>Similar to SFR, except:
• Lower imperviousness; often more tree canopy and vegetation reduce extent of habitat loss and adverse edge effects
• Less habitat fragmentation; tends to retain more connectivity between patches and to water
• RUR lands with agricultural areas can provide important habitat for grassland and low structure-associated species</td><td>Similar to SFR, except:
• Increased toxics may be associated with this land use type due to agriculture
• Livestock grazing can damage riparian areas and reduce habitat quality
• Wildlife crossings across roadways cause mortality</td></tr>
<tr><td>PROHIBIT</td><td>Similar to SFR, except:
• Fewer water quality problems associated with leaky septic tanks, livestock
• Less need to expand UGB</td><td>Similar to SFR, except:
• Rural lands are low density and therefore tend to require more infrastructure per dwelling unit, increasing VMT and decreasing water quality</td><td>• Similar to SFR, except:
• Prohibiting conflicting uses may decrease toxics associated with agriculture
• Reduced livestock damage to habitat
• Reduced wildlife road kill mortality
•</td><td>Similar to SFR, except:
• RUR lands with agricultural areas can provide important habitat for grassland and low structure-associated species</td></tr>
</table>

Development scenario	Environmental consequences: PARKS AND OPEN SPACE (POS)			
	Class I, II and III Riparian resources		**Class A, B, and C Wildlife Habitat resources**	
	Positive	***Negative***	***Positive***	***Negative***
ALLOW	*Similar to RUR, except:* • May be highly variable in natural land cover and management	*Similar to RUR, except:* • May be highly variable in natural land cover and management • Human disturbance may be higher	*Similar to SFR, except:* • May be highly variable in natural land cover and management	*Similar to RUR, except:* • May be highly variable in natural land cover and management
LIMIT	*Similar to RUR, except:* • May be highly variable in natural land cover and management	*Similar to SFR, except:* • May be highly variable in natural land cover and management • Human disturbance may be higher	*Similar to SFR, except:* • May be highly variable in natural land cover and management	*Similar to RUR, except:* • May be highly variable in natural land cover and management
PROHIBIT	*Similar to RUR, except:* • May be highly variable in natural land cover and management • Could help prevent human / pet disturbance to wildlife	*Similar to RUR, except:* • May be highly variable in natural land cover and management	*Similar to RUR, except:* • May be highly variable in natural land cover and management	*Similar to RUR, except:* • May be highly variable in natural land cover and management

Development scenario	Energy consequences: SINGLE FAMILY RESIDENTIAL *Fish and wildlife habitat* ***Positive***	***Negative***
ALLOW	• More compact form contributes to efficiencies in provision of services and reduction of travel distances • More compact development form may reduce VMT (Vehicle Miles Traveled per person) and fossil fuel use • Reducing VMT and fossil fuel use reduces air pollutants and heat • Represents the majority of buildable resource lands; opportunities for education and incentives	• Loss of trees and increased imperviousness lead to increased Urban Heat Island effect and global warming; increased air conditioning (AC) demand • Extensive loss of ecosystem services related to trees, plants; reduced air quality • Warmer air warms water; harms salmonids and other temperature-sensitive animals • Increased energy consumption to provide engineered solutions to replace natural systems to manage stormwater flow, reduce soil erosion, keep water cool, etc. • This land use type associated with increased offsite roads and infrastructure; large amount of buildable resource acres suggests high energy output for infrastructure creation, maintenance, and increased AC demand due to additional imperviousness • Decreased energy efficiency if housing is not required to use cluster design • Education and incentives, if implemented, would require substantial financial investment
LIMIT	• May reduce infrastructure requirements and enable use of existing infrastructure, thereby saving energy needed to create, install, and maintain all types of infrastructure • May allow energy-saving infrastructure development (e.g., gravity flow sewer or water lines) • Reducing VMT and fossil fuel use reduces air pollutants and heat • Increased forest cover can help remove energy-related air pollutants and reduce smog • Increased forest cover can cool air by shade, evapotranspiration, carbon storage; reduced Urban Heat Island effect, reduced global warming, reduced AC demand • May result in decreased energy consumption to manage stormwater runoff, reduce sedimentation and erosion and keep water cool • Tree retention is cheaper, easier, and less energy-consumptive than planting new trees • Limiting conflicting uses has the greatest potential for mitigation and restoration activities; may result in increased ecological function over time • Represents the majority of buildable resource lands; opportunities for education and incentives	*Negative consequences similar to "allow" option, but to a lesser degree* • Avoiding sensitive natural areas may increase energy-using infrastructure requirements • Increased miles of infrastructure and increased transportation systems lead to increased VMT • Avoiding sensitive natural areas may result in future need for UGB expansion • Loss of trees increases Urban Heat Island effect and global warming; increased air conditioning demand, impacts air quality • Allows greater transportation planning options compared to prohibit, while still retaining green infrastructure • Warmer air warms water; harms salmonids and other temperature-sensitive animals • Possible reduction in access to transportation modes such as bicycling, walking because extensive pathways often run along natural areas (program-dependent) • Education and incentives, if implemented, would require substantial financial investment
PROHIBIT	• Retention of substantial tree canopy and other vegetation may provide the strongest protection against warmer air and water due to Urban Heat Island effect and global warming (CO_2 storage) (although physical extent of Urban Heat Island effect likely to be expanded) • Opportunity for pleasant, accessible alternative means of transportation such as walking and bicycling through natural areas, if permitted under programmatic options • Likely to result in decreased need for future energy-requiring restoration and flood mitigation activities due to retention of tree and vegetation cover	• Limits transportation planning options • Limits infrastructure placement options • Increases extent of urban area and VMT • Potential for increased total imperviousness due to increased roads; energy is required to build and maintain roadways and other infrastructure • If utilities are prohibited from being installed along streams, may require pumping or other energy-requiring activities to take non-gravity driven pathways • Increased travel distance, fossil fuel use, air pollution, related warming of air and water • Extent of Urban Heat Island effect may increase, potentially increasing AC demand

Development scenario	Energy consequences: MULTIFAMILY RESIDENTIAL	
	Fish and wildlife habitat	
	Positive	***Negative***
ALLOW	*Similar to Single Family Residential, except:* • Buildable resource lands are less extensive • Can clear less land per unit to construct dwelling units than SFR, reducing overall extent of tree loss, infrastructure requirements, and need for UGB expansion	*Similar to Single Family Residential, except:* • Buildable resource lands are less extensive • Increased onsite imperviousness and tree loss add to Urban Heat Island effect and global warming on a per-acre basis
LIMIT	*Similar to Single Family Residential, except:* • Buildable resource lands are less extensive • Can clear less land per unit to construct dwelling units than SFR, reducing overall extent of tree loss, infrastructure requirements, and need for UGB expansion	*Similar to Single Family Residential, except*: • Buildable resource lands are less extensive • Increased onsite imperviousness and tree loss add to Urban Heat Island effect and global warming on a per-acre basis
PROHIBIT	*Similar to Single Family Residential*	*Similar to Single Family Residential*

Development scenario	Energy consequences: COMMERCIAL	
	Fish and wildlife habitat	
	Positive	***Negative***
ALLOW	*Similar to Single Family Residential, except:* • Buildable resource lands are less extensive	*Similar to Single Family Residential, except:* • Buildable resource lands are less extensive • High onsite imperviousness and tree loss add to Urban Heat Island effect and global warming on a per-acre basis • Further increases in energy consumption to provide engineered solutions to replace natural systems to manage stormwater flow, reduce soil erosion, keep water cool, etc.
LIMIT	*Similar to Single Family Residential* • Buildable resource lands are less extensive	*Similar to Single Family Residential, except*: • Buildable resource lands are less extensive • High onsite imperviousness and tree loss add to Urban Heat Island effect and global warming on a per-acre basis • Further increases in energy consumption to provide engineered solutions to replace natural systems to manage stormwater flow, reduce soil erosion, keep water cool, etc.
PROHIBIT	*Similar to Single Family Residential*	*Similar to Single Family Residential*

Development scenario	Energy consequences: INDUSTRIAL	
	Fish and wildlife habitat	
	Positive	***Negative***
ALLOW	*Similar to Single Family Residential, except:* • Buildable resource lands are less extensive, although still substantial	*Similar to Single Family Residential, except:* • Buildable resource lands are less extensive, although still substantial • High onsite imperviousness and tree loss add to Urban Heat Island effect and global warming • Further increases in energy consumption to provide engineered solutions to replace natural systems to manage stormwater flow, reduce soil erosion, keep water cool, etc. • Placement within the floodplain is common, increasing energy-requiring flood mitigation
LIMIT	*Similar to Single Family Residential, except:* • Buildable resource lands are less extensive, although still substantial	*Similar to Single Family Residential, except:* • Buildable resource lands are less extensive, although still substantial • High onsite imperviousness and tree loss add to Urban Heat Island effect and global warming • Further increases in energy consumption to provide engineered solutions to replace natural systems to manage stormwater flow, reduce soil erosion, keep water cool, etc. • Placement within the floodplain is common, increasing energy-requiring flood mitigation
PROHIBIT	*Similar to Single Family Residential, except:*	*Similar to Single Family Residential*

Development scenario	Energy consequences: MIXED USE CENTERS	
	Fish and wildlife habitat	
	Positive	**_Negative_**
ALLOW	*Similar to Single Family Residential, except:* • Buildable resource lands are less extensive • Higher density centers of employment and housing create compact urban form, reducing VMT, infrastructure, energy use • Provide efficient access to goods and services, enhance multi-modal transportation	*Similar to Single Family Residential, except:* • Buildable resource lands are less extensive
LIMIT	*Similar to Single Family Residential, except:* • Buildable resource lands are less extensive • Higher density centers of employment and housing create compact urban form, reducing VMT, infrastructure, energy use • Provide efficient access to goods and services, enhance multi-modal transportation	*Similar to Single Family Residential, except:* • Buildable resource lands are less extensive
PROHIBIT	*Similar to Single Family Residential* •	*Similar to Single Family Residential, except:* • This zoning type is the most energy-efficient land use; prohibit decision would reduce energy saving opportunities provided by land use and transportation efficiencies

Development scenario	Energy consequences: RURAL	
	Fish and wildlife habitat	
	Positive	**_Negative_**
ALLOW	*Similar to Single Family Residential, except:* • Buildable resource lands are less extensive • Imperviousness is typically lower and vegetation cover higher, reducing Urban Heat Island effect	*Similar to Single Family Residential, except:* • More infrastructure required per dwelling unit
LIMIT	*Similar toSingle Family Residential, except:* • Buildable resource lands are less extensive • Imperviousness is typically lower and vegetation cover higher, reducing Urban Heat Island effect	*Similar to Single Family Residential* • More infrastructure required per dwelling unit
PROHIBIT	*Similar to Single Family Residential*	*Similar to Single Family Residential* • More infrastructure required per dwelling unit

Development scenario	Energy consequences: PARKS AND OPEN SPACE	
	Fish and wildlife habitat	
	Positive	***Negative***
ALLOW	*Similar to Single Family Residential, except:* • Buildable resource lands are less extensive • Imperviousness is typically lower and vegetation cover higher, reducing Urban Heat Island effect • Less infrastructure required compared to other zoning types	*Similar to Single Family Residential*
LIMIT	*Similar toSingle Family Residential, except:* • Buildable resource lands are less extensive • Imperviousness is typically lower and vegetation cover higher, reducing Urban Heat Island effect • Less infrastructure required compared to other zoning types	*Similar to Single Family Residential*
PROHIBIT	*Similar toSingle Family Residential, except:* • Buildable resource lands are less extensive	*Similar to Single Family Residential*

Assumptions:

- At the regional scale, energy use is most strongly influenced by the extent and physical arrangement of transportation networks, the built environment, and green infrastructure. Options consistent with Region 2040 Growth Concept support energy conservation, especially fossil fuel use.
- Because options consistent with Region 2040 are a primary consideration, energy consequences differ little between:
    - riparian and wildlife habitat resources - tree retention and stream crossing considerations are most important
    - low-value and high value resources
    - types of land use (based on residential because that is most extensive land use; comments on differences among land uses included at end of table)

EXHIBIT F—ORDINANCE NO. 05-1077C

ATTACHMENT 4.

METRO'S PHASE II ECONOMIC, SOCIAL, ENVIRONMENTAL, AND ENERGY (ESEE) ANALYSIS

This report is available for review in the Metro Council's files or on Metro's website: **http://www.metro-region.org/nature**. In addition, copies may be requested from the Metro Planning Department, 600 N.E. Grand Ave., Portland, OR 97232, or by calling 503-797-1555.

Metro's Phase II ESEE Analysis

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METRO
People places • open spaces
Clean air and clean water do not stop at city limits or county lines. Neither does the need for jobs, a thriving economy, and good transportation choices for people and businesses in our region. Voters have asked Metro to help with the challenges that cross those lines and affect the 24 cities and three counties in the Portland metropolitan area.

A regional approach simply makes sense when it comes to protecting open space, caring for parks, planning for the best use of land, managing garbage disposal, and increasing recycling. Metro oversees world-class facilities such as the Oregon Zoo, which contributes to conservation and education, and the Oregon Convention Center, which benefits the region's economy.

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Figure 4-13. Park lands by habitat class and ownership.

CHAPTER ONE: INTRODUCTION

The natural environment is an important aspect of the uniqueness of the Metro region. Metro's policies have consistently placed a high level of importance on the protection of the natural environment as a means of maintaining the high quality of life citizens of this region expect. Healthy streams and upland areas provide habitat for many animals, fish such as salmon, and clean water for people, fish, and wildlife.

Residents of this region consistently say that contact with nature is important, and they value the natural biological diversity that is part of the Willamette Valley.[1] As Oregonians, state symbols are part of the cultural identity of residents in the Metro region. The Western Meadowlark was selected as Oregon's state bird by schoolchildren in 1927 (Marshall et al. 2003). It is currently a state-listed Species of Concern, and has been nearly lost from the Metro region due to loss of native grasslands and urban development. However, some birds still winter over in the region, and bird-watchers often seek them out in areas such as the agricultural lands around the Tualatin River. The state fish, Chinook salmon, has five evolutionary significant units (ESUs) in or near this region, and all five are listed as Threatened or Endangered under the federal Endangered Species Act. Contact with nature and the rich diversity of species and habitats native to this region are important parts of the region's cultural heritage. To the extent that these habitat is lost, so is a part of our culture, heritage, and natural history.

Much work has already been accomplished to protect and restore fish and wildlife habitat in the region. Metro and other organizations have purchased close to 11,000 habitat acres, thousands of volunteers work to restore habitat and remove invasive species, and most cities and counties have existing habitat protection programs. Metro's efforts are not isolated and build on the tremendous work that is going on in the region. However, Metro's habitat inventories and science review, as well as compliance with federal regulations such as the Endangered Species Act and Clean Water Act, demonstrate that additional habitat protection is needed. Metro's goal is to provide more consistent, effective protection to fish and wildlife habitat across the region.

Metro's approach to fish and wildlife habitat protection

The Metro Council and its local partners are conducting a three-step planning process to conserve, protect, and restore urban streams, waterways, and upland areas that provide important fish and wildlife habitat. State land-use planning laws and broad citizen concern about the need to protect and restore habitat guide this work.

The Metro Council identified regionally significant fish and wildlife habitat in August 2002, based on a scientific assessment of functional habitat values, completing the first step of the planning process. Metro is currently completing the second step of the planning process: assessing the Economic, Environmental, Social, and Energy (ESEE) tradeoffs of protecting or not protecting regionally significant fish and wildlife habitat.

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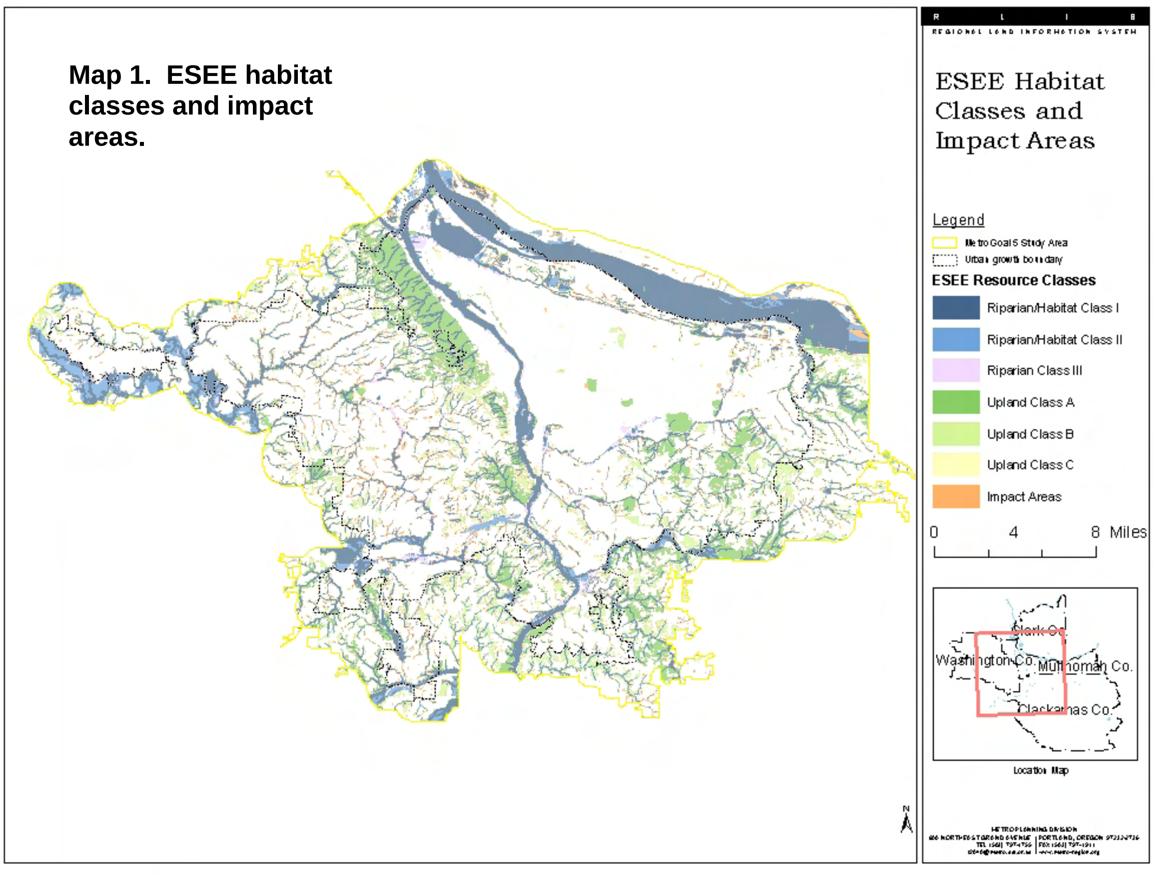
[1] May 2001 Davis and Hibbits phone survey commissioned by Metro, an October 2001 Moore Information survey sponsored by KGW-TV and the Portland Tribune, and an informal "SurveyPoint" poll available by phone and on Metro's website in 2001.

Metro's ESEE analysis is divided into two phases. The first phase was completed in fall 2003 with the release of the discussion draft ESEE Phase I report, which describes the general regional tradeoffs of allowing, limiting, or prohibiting conflicting uses in fish and wildlife habitat areas.[2] Map 1 shows the habitat and impact areas under consideration in the ESEE analysis.



Map 1. ESEE habitat classes and impact areas.

Key points from ESEE Phase I

Metro's approach for conducting a region-wide ESEE consequences analysis focused on achieving the goals of the 2040 Growth Concept. The goals in the Growth Concept, the Future Vision, the Regional Framework Plan (implemented through the Urban Growth Management Functional Plan), and Metro's Vision Statement for Protecting Fish and Wildlife Habitat all specify that the region should manage growth while protecting the natural environment, maintaining a high quality of life, and providing affordable housing options.

A key step in the ESEE analysis is to identify conflicting uses that "exist, or could occur" within regionally significant fish and wildlife habitat sites and identified impact areas. According to the Goal 5 rule, a conflicting use is a "land use, or other activity reasonably and customarily subject to land use regulations that could adversely affect a significant Goal 5 resource." Identifying conflicting uses is important to focus the ESEE analysis on various land uses and related

[2] Metro's Phase I Economic, Social, Environmental, and Energy Analysis (ESEE) April 2005.

disturbance activities that may negatively impact fish and wildlife habitat. In Metro's Phase I ESEE analysis, conflicting uses were identified from a regional perspective by examining generalized regional zones and by considering Metro's 2040 Growth Concept. Metro analyzed the distribution of its fish and wildlife habitat inventory among generalized regional zones, 2040 design type priorities, and impact areas.

The Goal 5 rule describes a process in which the ESEE consequences of allowing, limiting, and prohibiting conflicting uses are weighed with the need to preserve natural resources. These tradeoffs are described below. Metro considered the tradeoffs from a regional perspective. Some of the tradeoffs are different when considering local priorities and concerns; for example, from a regional perspective conflicting uses could be relocated or intensified in one area to account for habitat protection in another. This solution may not address the needs of a city to provide jobs or housing within its jurisdiction, to collect tax revenue, or to protect locally significant resources.

Economic tradeoffs

The key economic tradeoffs identified in the ESEE analysis include:

- Habitat lands have economic value for their urban development potential, which is measured using land value, employment density and 2040 design type designation. Generally, habitat land that is located in a primary 2040 design type designation (i.e., city center, regional center, industrial areas) has the highest value for urban development. Residential, lower density retail, and employment areas have lower value for urban development. Urban development value is not assigned to rural areas and parks.
- Habitat lands also have economic value for the ecosystem services they provide, such as flood control and water quality protection. Lands with the highest fish and wildlife values provide the highest level of ecosystem services.
- Competition between the use of habitat land for ecosystem services and urban development is minimal because the overlap between the highest value habitat and the highest value urban development land is relatively small.
- Much of the vacant, buildable land throughout the region is not part of the highest class of regionally significant fish and wildlife habitat.
- The majority of the highly valued habitat land is outside intensely developed urban areas and, thus, has lower urban development value.
- Lower-value habitat and urban development value areas are important for their cumulative contribution to the region's economy and habitat health.
- Habitat identified as having a low urban development value at the regional level may have high urban development value from a local perspective.
- By concentrating development in defined urban centers, some of the region's development needs can be met. However, accommodating demand for industrial land and single-family residential property will need special attention because these needs cannot be met fully in centers.
- Restricting the development of vacant habitat lands increases the likelihood of expanding the urban growth boundary (UGB).

Social tradeoffs

The key social tradeoffs identified in the ESEE analysis include:

- The social benefits of preserving fish and wildlife habitat areas are diverse and cross-cultural. Habitat areas are an integral part of the area's cultural heritage, regional identity, education, recreation, and public health.
- Public values must be balanced with personal and financial private property interests.
- The needs of future generations must be considered when determining how the land is used today.
- Consideration must be given to the additional time and resources needed for compliance and enforcement of new requirements.
- Preservation of land for habitat use within the urban area may result in the shifting of jobs and housing away from locations where people prefer to live and work.

Environmental tradeoffs

The key environmental tradeoffs identified in the ESEE analysis include:

- Development on highly valued fish and wildlife habitat land has a greater ecological impact than development on less valuable habitat land.
- Protection of both streamside and upland habitat is important to watershed health. Lower-valued upland wildlife areas can play a critical role in connecting habitat areas and supporting biodiversity.
- Trees are very important because they provide habitat, absorb pollution, and reduce water-related impacts by slowing and holding runoff.
- When development activity disturbs streams, the environmental impacts affect the immediate property and also are felt downstream.
- Protection of higher and lower-valued habitat supports healthy watersheds and creates restoration opportunities that, over time, can further improve the watershed.
- Some of the highest value habitat areas are located outside the UGB. If development needs cannot be accommodated within the existing UGB, conflict between habitat protection and urban development will increase as the UGB expands.

Energy tradeoffs

The key energy tradeoffs identified in the ESEE analysis include:

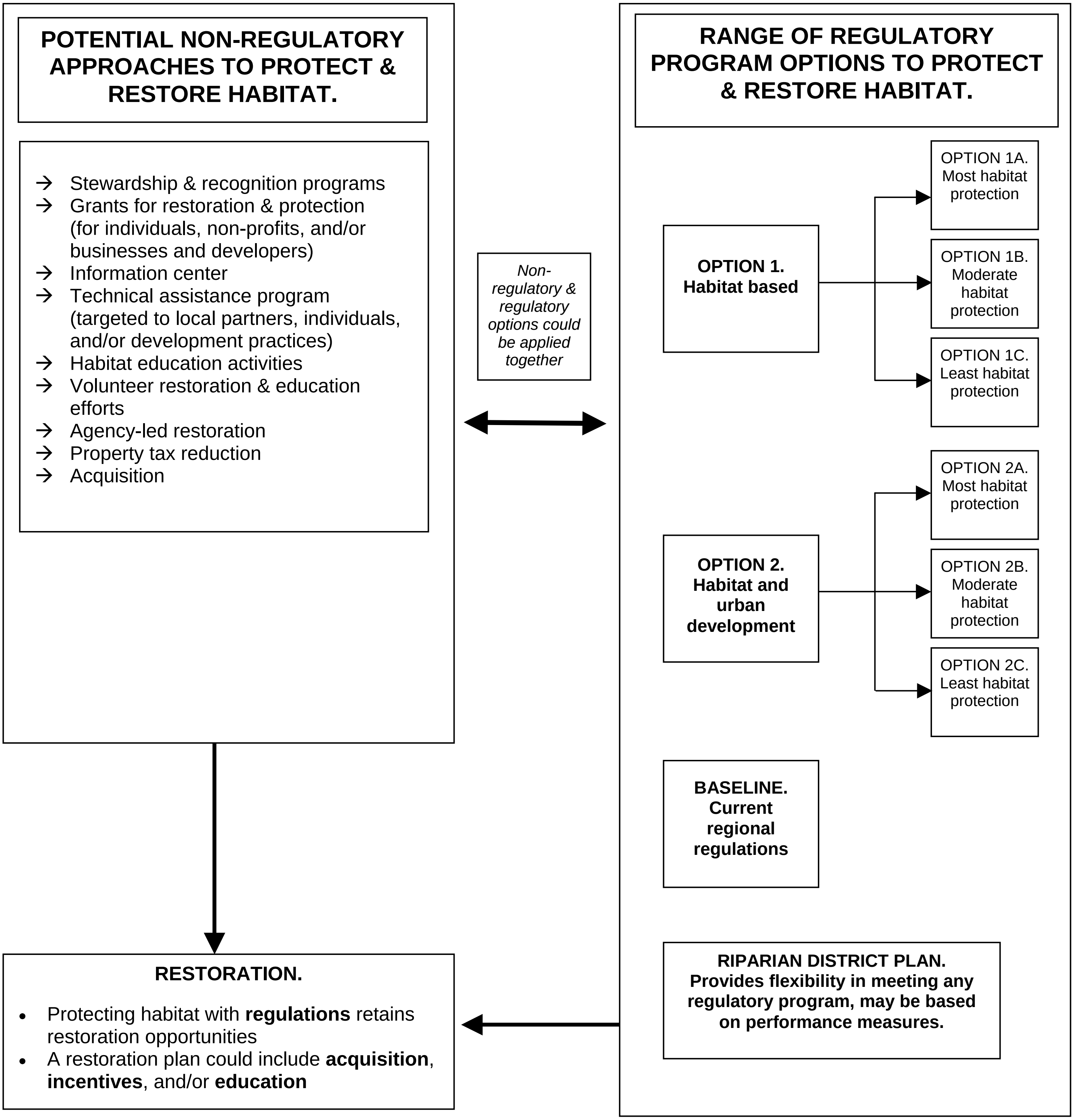
- Trees and other vegetation can reduce energy use because they cool and clean the air and water naturally.
- If protection results in additional expansion of the urban growth boundary to accommodate development needs, increased auto use could result in increased fuel (energy) use.
- Building in urban centers can reduce auto and energy use.

The results of the Phase I analysis showed that neither allowing all habitat land to be developed nor prohibiting development on all habitat land will satisfy the competing land use interests. Metro Council accepted the findings of the Phase I report and directed staff to evaluate six regulatory options that varied habitat protection levels.

Phase II ESEE analysis

This ESEE Phase II report describes several potential non-regulatory approaches to habitat protection and includes Metro's evaluation of the performance of the six program options identified by the Metro Council in October 2003. The Program Option Chart (Figure 1-1) illustrates the six regulatory and various non-regulatory program approaches studied in the Phase II ESEE analysis. Program options are defined by applying a range of hypothetical allow, limit, and prohibit regulatory treatments to regionally significant fish and wildlife habitat and impact areas within Metro's jurisdiction. Non-regulatory approaches are described as possible components to program options. The results identified in this report will provide information to the Metro Council, local partners, and citizens in the region as the Council chooses a direction for program development in May 2004. The Metro Council is scheduled to consider a fish and wildlife program by December 2004 designed to protect the nature of the region for generations to come.

FIGURE 1-1: PROGRAM OPTION CHART



Format of report

This Phase II ESEE analysis includes four major chapters.

Chapter 2 focuses on non-regulatory approaches for protecting and restoring fish and wildlife habitat. A brief summary of existing efforts in the Metro region is included, followed by several potential approaches, most of which could build on existing programs. A cursory estimate of cost and effectiveness of the non-regulatory approaches is included.

Chapter 3 focuses on existing and potential regulations to protect fish and wildlife habitat. A summary of Metro's *Local Plan Analysis* (August 2002) describes the existing local Goal 5 protection plans. Due to inconsistencies of local plans, Metro uses Title 3 Stream and Floodplain Protection as a baseline for comparing the six regulatory program options. The baseline regulations are described, followed by a description of the regulatory options.

Chapter 4 includes the analysis of tradeoffs for the ESEE factors as well as other criteria including meeting federal guidelines and the increment of additional protection.

Chapter 5 summarizes Metro's analysis of the six regulatory program options, describes how the non-regulatory and regulatory tools could complement each other, and identifies the next steps in program development.

CHAPTER TWO: NON-REGULATORY TOOL OPTIONS

Introduction

A program to protect and restore fish and wildlife habitat can protect more habitat if it includes both regulatory and non-regulatory components. These approaches complement each other, as shown in the table below: non-regulatory tools can address habitat issues that are not covered under land use regulations (e.g., pesticide use) as well as decrease the social/economic impact of regulations (e.g., funds for restoration activities, technical assistance for habitat friendly development). An effective regional protection program could use regulations to establish baseline levels of protection and non-regulatory tools to support and in some cases exceed the baseline. Further, regulations could provide jurisdictions flexibility to meet protection standards under a variety of different circumstances. Regulatory and non-regulatory habitat protection tools can offer varying levels of protection, and can be applied to different habitat in the urban area. Choosing the right tool for the right habitat, location and situation is important, and will require additional analysis and the input and recommendations of the public and the Metro Council.

Table 2-1. Comparison of regulatory and non-regulatory approaches to protect and restore habitat.

Non-regulatory approaches	Regulatory approaches
1. Uncertain protection (acquisition provides certainty but requires funding and depends on willing sellers)	1. Certainty of protection (with adequate enforcement capability)
2. Restoration can be achieved with a variety of approaches (incentives are necessary)	2. Preserves restoration opportunities but does not achieve restoration (mitigation may be required but unlikely to increase overall ecological function)
3. Depends on willing landowners and good stewardship	3. Property rights concerns (takings, real or perceived)
4. Can apply to non-land use activities (e.g., gardening, landscaping, remodeling, etc.)	4. Triggered by development (e.g., building permit application)
5. Application is limited by dollars and the number of willing landowners	5. Consistent treatment of similar situations

Metro's Parks and Greenspaces Department, along with other local partners, commissioned a study of incentives for natural area protection in 2002 (*Incentives Report*).[3] The Metro Council has considered the *Incentives Report*, and the information that relates to fish and wildlife habitat protection has been incorporated into the Phase II ESEE analysis. The study included three parts: a study of 18 candidate incentives, landowner interviews, and implementation strategies for three promising programs. Potential non-regulatory approaches for protection and tools for restoration are described and evaluated based on cost and effectiveness. A summary of non-regulatory tools currently being used in the Metro region is also included. Any new or expanded non-regulatory tool would require funding at some level; potential funding sources will be considered when Metro develops a program to protect fish and wildlife habitat.

[3] Local partners include: City of Portland, City of Oregon City, and the Tualatin Hills Parks and Recreation District. *Tools for natural area protection*, February 2002.

Existing non-regulatory tools for habitat protection and restoration

Numerous non-regulatory programs focused on protecting fish and wildlife habitat exist in the Metro region. In 2003, Metro compiled and summarized the efforts of 31 groups[4] that focus habitat protection and restoration efforts within the UGB, providing a snapshot of current efforts.[5] Funding levels fluctuate and organizations come and go, but Metro's survey provides a picture of how much has been accomplished in the current environment with non-regulatory tools. Table 2-2, below, describes a few of the non-regulatory programs in the region.

Since there are so many different types of programs in the region, Metro's study of non-regulatory tools categorized habitat protection and restoration programs in the following ways:

- **Restoration and enhancement.** The watershed councils operating in the Metro area have identified many restoration and enhancement priorities, which have been implemented and funded by several types of government agencies and private organizations. Much of the grant money that flows into the region is used for restoration and enhancement, but the grants are highly competitive and are inadequate to meet the demand. For example, Metro's grant program with the US Fish and Wildlife Service funded only about 35 percent of the grant proposals over the past three years, leaving about $1.7 million of unfunded requests. These grant sources are also volatile and may change due to economic and political forces.
- **Education and outreach.** Some programs are focused on assisting private citizens and businesses in "green" consumer choices.[6] Other education efforts focus on living with wildlife, acquiring skills in watershed protection, and monitoring of fish and wildlife habitat. Outreach tools include articles in newsletters and on websites as well as brochures and books that inform the public and landowners about stewardship issues. In addition to informing the public about fish and wildlife habitat issues, education and outreach are often used to promote restoration and other habitat protection programs.
- **Land acquisition programs.** These programs are very effective in habitat protection and restoration and are usually applied to privately owned lands. Land may be purchased outright or with a conservation easement from willing landowners.

A summary of the known accomplishments from the organizations surveyed is described below.

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[4] The 31 groups investigated included: city governments, environmental services districts, park districts, soil and water conservation districts, watershed councils, federal programs, Metro, and non-profit organizations.
[5] *Accomplishment Report: Non-regulatory fish and wildlife stewardship in the Metro region* (Metro 2003).
[6] Including programs such as: alternatives methods of pest control, "Naturescaping," and "Green Building" construction methods.

Table 2-2. Examples of existing non-regulatory programs in the Metro region.

Focus	Programs
Restoration and enhancement	• *Oregon Watershed Enhancement Board (OWEB) General Grant Program.* Grants to carry out on the ground watershed restoration projects to restore aquatic habitat, improve water quality, and improve biodiversity. Projects include planting, culvert replacement, habitat improvements, wetland restoration, and others. (2002 total of $3,028,000 for Clackamas, Multnomah, and Washington counties; 31 projects). • *Metro/USFWS Greenspaces Grant Program.* Provides funding for urban projects that emphasize environmental education, habitat enhancement and watershed health. • *East Multnomah Soil & Water Conservation District grants*. Provides awards for conservation and restoration projects, ranging from $200-2,500, mostly on rural lands (funding is sponsored by the Fish and Wildlife Foundation). • *Wildlife Habitat Incentives Program (WHIP)*. Implemented through Natural Resources Conservation Service (NRCS) to help landowners develop and improve wildlife habitat on their land. In Oregon approximately $350,000 (for the entire state) is targeted for salmon habitat, riparian habitat, and promotion of biodiversity. • *Environmental Quality Incentives Program (EQIP).* Provides payments through the NRCS to farmers and ranchers for assistance implementing conservation practices on their lands (including filter strips, manure management practices and others). Authorized by the 2002 Farm Bill, pays up to 74% of the costs of the implemented practice.
Education and outreach	• *Metro's Natural Gardening and Landscaping Program.* Metro offers free natural gardening seminars and workshops in spring and fall. Also includes a demonstration garden, summer garden tour, and educational materials. • *Downspout Disconnect Program.* City of Portland program that provides property owners with funds and technical expertise to disconnect downspouts to reduce flow into the stormsewer system. • *Eco Biz Program.* City of Portland program, started to recognize auto repair and service facilities that minimize their environmental impacts. Currently being extended to landscaping business. • *Metro's Green Streets Handbook.* A resource for designing environmentally sound streets that can help protect streams and wildlife habitat. • *Eco-roof Program.* Portland provides sewer rate discounts to developers that build greenroofs minimizing stormwater runoff. Also provides an eco-roof floor area bonus, in which each square foot of eco-roof equals an additional three square feet of building area in the downtown. • *G-Rated Incentive Program.* Portland program that encourages innovations in residential and commercial development and redevelopment for green building design practices. Provides up to $20,000 for commercial projects and $3,000 for residential projects.
Land acquisition programs	• *Metro Openspaces Acquisition Program.* Funded through $135 million bond measure approved by voters in 1995. Focuses on targeted natural areas and regional trails. • *Three Rivers Land Conservancy Acquisition Program.* Works to encourage donation of conservation easements to protect targeted open space in the Metro region. • *Johnson Creek Willing Seller Program.* Portland program allows landowners in Johnson Creek floodplain to sell their property to the City at fair market value. After acquisition, properties are restored to natural floodplain function. Funded largely with dollars from FEMA after the 1996 flood. • *Sherwood program.* Requires system development charge (SDC) for development in floodplains, fee waived if flood area is donated to the city.

Restoration and enhancement

On the ground restoration and enhancement programs and projects were conducted by all of the organizations surveyed, with the exception of the Federal programs that fund many of the efforts. The Americorps program provides much needed labor; the U.S. Fish and Wildlife Service (USFWS) provides $300,000 per year to fund environmental education, conservation and restoration grant projects; and the Natural Resources Conservation Service (NRCS) cost-share program implements restoration projects on rural lands in the region. Environmental service districts[7] conduct much of the revegetation efforts, planting a substantial portion of the trees and plants in the year surveyed. Much of this work is accomplished through Portland's Bureau of Environmental Services (BES) "Watershed Revegetation Program." BES provides their services as a contractor outside of the city projects, contracting with organizations like Metro.

Watershed Councils and Park Districts also carry out projects in restoration and enhancement. Watershed councils frequently work in partnership with environmental service districts and other organizations. City governments and non-profits make extensive use of volunteers to conduct habitat restoration. Over 15,000 volunteers worked on restoration and enhancement efforts in the Metro region in 2002, contributing 49,150 hours of labor to remove 76 tons, 30 truckloads, and 382 cubic yards of debris and restoring 162 acres of land.[8] The Soil and Water Conservation Districts in the Metro region support restoration and enhancement efforts by helping landowners to revise land management practices to reduce erosion and non-point pollution of streams and rivers.

Education and outreach

Education and outreach programs are an important component of fish and wildlife habitat protection. Most of the organizations surveyed by Metro include some type of education and outreach in their work programs. Hands-on education is very popular, and significant amounts of volunteer time and resources are spent on this aspect of fish and wildlife habitat protection and restoration. A majority of habitat education programs included in Metro's study were conducted by non-profits. The Audubon Society of Portland surpassed all other organizations in attendance and number of classes due to the popularity of their bird and animal oriented classes. Also significant was the contribution by the environmental service districts, providing classes for school children and adults.

Park districts also provide educational programs. The Tualatin Hills Nature Park provides many adults and children with a hands-on experience in one of Washington County's oak savannahs. Portland Parks takes many school children to Hoyt Arboretum, Powell Butte, and Forest Park. Metro provides classes at regional parks[9], natural gardening, and recycling programs. Watershed Councils often work to educate residents as well; one example is the Slough School education program conducted by the Columbia Slough Watershed Council (funded by grants from OWEB and the Metropolitan Greenspaces Program).

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[7] Washington County's Clean Water Services (CWS), Clackamas County's Water Environmental Services (WES), and Portland's Bureau of Environmental Services (BES).
[8] *Accomplishment Report: Non-regulatory fish and wildlife stewardship in the Metro region* (Metro 2003).
[9] 10,000 people annually, including 7,000 children.

The organizations reviewed for this study used a number of tools to reach out to the public. More than 406,000 newsletters, 106,000 brochures and other promotional materials were distributed throughout the region in one year about environmental health in the Metro region. As is the case almost everywhere, the Internet is a fast growing outreach tool. A partial sample[10] of web-based outreach organizations reported 120,500 website hits and 15,000 electronically mailed newsletters during the sample year. Technical support to landowners interested in revising management practices on their properties was limited, and is mostly provided by the soil and water conservation districts which focus efforts on rural and agricultural areas.

Land acquisition

Land acquisition programs are used by a select set of organizations. The high cost of land limits the ability of many smaller organizations to purchase land. Primarily city governments, Metro, federal programs, and a few non-profit organizations utilize acquisition programs. Since 1995, all of the programs combined have succeeded in protecting 10,925 acres of land in the Metro region that is explicitly managed for fish and wildlife habitat protection (Table 2-3 below).[11] Close to 80 percent of the land that Metro has purchased is located outside of the urban growth boundary. Much of the restoration and enhancement work, as well as education and outreach activities, occur on these lands.

Table 2-3. Acres of land purchased for fish and wildlife habitat (as of August 2003).

Organization	Outright purchase or donation	Conservation easements	Total
Metro	7,872	81	7,953
Cities/Environmental Service Districts/Parks	2,035	4	2,039
Non-profits	769	164	933
Total	10,757	168	**10,925**

Metro's 1995 Open Spaces Bond Measure provided an impetus for acquisition to other organizations. The Open Spaces land acquisition program has acquired 7,953 acres, of those acres a little over 80 acres are conservation easements. In addition, through their own programs (bond measures or system development charge funds) the cities of Gresham, Portland, and Lake Oswego have acquired 1,254 acres of parks and open spaces. Since 1995 Portland Parks and Tualatin Hills Park and Recreation Districts have acquired 621.3 acres of habitat land, some through land donations and the rest funded by system development charges.

The city of Portland currently operates a willing seller floodplain acquisition program targeted to the Johnson Creek floodplain. The program was established after the floods of 1996, and used funds from the Federal Emergency Management Agency (FEMA) and the Department of Housing and Urban Development (HUD). More than 106 acres of floodplain have been acquired, although the major sources of funding have been used up. The City of Portland Bureau

[10] Not including Metro's website.
[11] As of August 2003.

of Environmental Services (BES) contributes $300,000 of Capital Improvement Project money to the program each year.

The Three Rivers Land Conservancy (TRLC) and the Wetlands Conservancy have acquired 769 acres inside the urban area to protect wetlands, riparian areas, and uplands that meet strict criteria in their value added to fish and wildlife habitat restoration and enhancement. TRLC also has a conservation easement program that has grown to 164 acres in the past decade. These lands are still privately owned but are strictly managed for their natural resource values in perpetuity.

Summary

While there is substantial evidence of non-regulatory approaches accomplishing habitat protection, restoration, and education in the Metro region, these efforts have not been successful in preventing a decline in overall ecosystem health. As described and catalogued in Metro's *Technical Report for Goal 5* and *Riparian Corridor and Wildlife Habitat Inventories*, the amount and quality of fish and wildlife habitat has been in steady decline over time. Most non-regulatory programs are dependent on unsteady sources of grant funding, volunteerism, and good stewardship, often without recognition or reward. Each program conducts important work, but even taken as a whole over the past decade only a small portion of the habitat in the region received the attention needed. There is a much greater need for restoration dollars; technical assistance for landowners, developers, and local jurisdictions; and permanent protection for critical habitats than is currently available.

Potential non-regulatory tools for protection and restoration

Non-regulatory tools are a key component of a strategy to protect fish and wildlife habitat. Incentives, education, and acquisition strategies are popular among landowners and can be used in conjunction with regulations and where regulations do not apply. For example, local land use regulations are generally triggered by a proposal for new development or redevelopment. Non-regulatory strategies can apply to other activities such as landscaping and reducing pesticide and herbicide use. Non-regulatory tools for habitat protection include acquisition (outright purchase and conservation easements), property tax relief, and good stewardship agreements.

Restoration is a critical component of an effective fish and wildlife habitat protection program. Without active restoration efforts, ecological conditions will likely deteriorate further, even if most habitat lands are protected through regulations. Mitigation for the negative environmental impacts of development may be included as part of a regulatory program. However, actions to restore habitat to a condition better than exists today cannot be required as part of a regulatory program; restoration could be included as a major part of a non-regulatory approach. Regulations can protect land that can then be restored through non-regulatory approaches to provide better functioning habitat.

Based on the results of the *Incentives Report* and Metro's analysis of existing non-regulatory tools for habitat protection and restoration, the following potential non-regulatory tools are examined:

- Stewardship and recognition programs
- Financial incentives (grants, incentives for green streets, property tax reduction)
- Education (information center, technical assistance, other education activities)
- Volunteer activities
- Agency-led restoration
- Acquisition (outright purchase, conservation easements, revolving acquisition fund)

A brief examination of potential costs and effectiveness of potential non-regulatory programs is included in Table 2-5 at the end of this chapter.

Stewardship and recognition programs

These programs publicly acknowledge landowners, businesses and other entities for conserving open space, protecting or restoring habitat areas, making financial contributions or carrying out good stewardship practices in general. Public agencies and nonprofit organizations can administer the programs, and the recognition could take the form of media publicity, awards ceremonies, or plaques and certificates. These programs, while not widely applied in the Metro region, have much potential for encouraging conservation behavior when combined with other programs.

A good stewardship agreement between a landowner and an organization interested in protecting or restoring habitat and monitoring success over time can be used to achieve some level of habitat protection. Such a program would recruit landowners to agree to voluntary stewardship agreements that allow residents to make a commitment to care for the land in a manner that promotes habitat value. A stewardship agreement program would be most effective when combined with other incentives such as education, technical assistance, and grants.

Landowner recognition programs on their own generally provide no permanent protection of resources because participation is voluntary. However, administrative costs may be relatively low compared to funding for programs such as acquisition that provide definitive permanent protection. This tool is most likely to be effective when integrated with other tools (e.g., grants and education) as part of an overall conservation strategy.

Potential programs

1. ***Yearly report.*** Develop a report (printed and/or on website) to publicize innovative examples of restoration, protection and habitat friendly development in the Metro region.
2. ***Stewardship recognition program.*** Develop a regional fish and wildlife habitat stewardship program that recognizes landowners for restoring and protecting habitat on their land and habitat friendly development practices. Sponsor a yearly award ceremony, provide certificates, and encourage media coverage.
3. ***Stewardship agreements.*** Develop signed voluntary stewardship agreements between a property owner and Metro or another sponsor for habitat protection. Most likely to be effective when used in conjunction with small grants and long-term monitoring.

Financial incentives

Achieving restoration on private and public lands typically requires some type of financial incentive to induce property owners to conduct activities such as planting of native vegetation, removal of invasive species, and other habitat improvements.

Grants

Grants for restoration can provide the incentive for supportive landowners and other organizations to restore habitat on private and public lands. A small grant program, targeted to watershed councils, non-profit organizations, or local governments, could be created similar to Metro's recent grants for regional and town center planning efforts. Applicants could submit projects one or two times per year, and they could be reviewed and ranked based on established criteria. Small grants given in strategic places could build on existing work and encourage more efforts in targeted areas.

Funding can leverage additional benefits such as education and volunteerism. Private landowners may be interested in the concept of improving the habitat value on a portion of their land, and the availability of dollars can provide the impetus to conduct restoration activities. Many grants are provided with a required match of either dollars or in-kind materials or labor. These incentives provide landowners who contribute a portion of the proposed cost for conservation or restoration activities with additional funding opportunities. There are several programs in place for rural land in agriculture or forestry use, and some for urban lands. A grant program could target specific activities along stream reaches or within watersheds in coordination with watershed action plans to accomplish the most effective restoration. A monitoring component of a restoration plan would be essential to assess effectiveness over time at restoring habitat function.

As part of a regional habitat friendly development program, Metro could develop a *Habitat-oriented Development Program* similar to Metro's Transit-oriented Development (TOD) Program to encourage construction of new developments or redevelopment that protects and restores fish and wildlife habitat. This would require funds to provide the incentives for developers to practice habitat friendly development. For example, 1000 feet of a stream in the Tryon Creek watershed will be daylighted (removed from pipes) through incentives provided to a housing redevelopment project.[12]

Potential programs

A small grant program could be targeted to residential or individual landowners, or targeted towards development and business practices. Grants could also be aimed at watershed councils or other non-profit groups.

1. ***Small grant program for restoration.*** Develop a small grant program to accomplish restoration on private or public property within the identified regionally significant fish and wildlife habitat areas. With larger grants require long-term monitoring.
2. ***Habitat friendly development grants.*** Provide grants to encourage habitat friendly development, similar to Metro's grant programs to encourage and support Transit-Oriented Development (TOD) and regional and town center planning.

[12] *Oregonian*, "Developer keeps at creek crusade" 10/3/2003.

3. ***Wildlife crossing/culvert replacement grants.*** Provide grants to encourage culvert replacement and wildlife crossings around the region.

Incentives for green streets
The Metro Council could establish a priority for funding transportation projects based on their impacts to regionally significant fish and wildlife habitat. This could help to prevent additional damage to habitat in the region and also provide incentives to restore habitat that has been impacted by development. A criterion could be added to the MTIP funding priorities that focuses on habitat issues, such as culvert replacement or removal, wildlife crossing improvements, or implementation of Green Streets design standards. Alternatively, a separate category or bonus points could be assigned to projects that meet habitat criteria to allow for the funding of projects that improve transportation and habitat in the region.

Property tax reduction
Providing landowners with a reduction in property taxes in exchange for habitat protection or restoration is not a new idea. There are many federal programs that encourage landowners to do just that; however, most of these programs are applicable to farm or forest land. There are two state programs that could be applicable within the urban area: the *Riparian Lands Tax Incentive Program* and the *Wildlife Habitat Conservation and Management Program*. Both of these programs would require county or city action to be implemented. The riparian tax incentive program allows for a tax exemption for property within 100 feet of a stream provided the land is protected and managed for habitat value. The program is limited to 200 stream miles per county. The wildlife habitat program allows designated habitat land to be taxed at a special, reduced rate as long as it is protected and managed for habitat value. This program is not limited by acres and can be applied to riparian or upland habitat.

Property tax reduction is a useful tool to provide motivated landowners with an incentive to manage their land for habitat values, and can also serve as a mechanism to achieve some restoration if a habitat management plan includes requirements for enhancement of existing habitat. However, property tax reductions would reduce jurisdictional revenues. Once enrolled in the program, these properties could also be targeted by agencies that conduct restoration activities such as Metro, Portland’s Bureau of Environmental Services, or Clean Water Services in Washington County for greater public benefit. Habitat protection and restoration may be most effective ecologically if this tool is applied strategically, for example, in a specific stream reach or headwater area. This tool could serve as an important incentive to encourage landowners to work in a coordinated fashion to leverage ecological improvements in a specific area. If used on a “first-come, first-served” basis, there may be a scattered approach and less ecological benefit overall. A downside to using property tax relief as a tool for habitat protection is that a landowner can leave the program at any time, the only penalty being payment of back taxes, similar to opting out of a farm or forest tax deferral program.

Education

Information center for fish and wildlife habitat protection
One of the biggest challenges with any incentive/non-regulatory program is getting information into the hands of people who can use it. An “information center” that includes technical assistance, recognition programs, and potentially small grant funds could serve as a “one-stop

shop" providing landowners and others with information and referrals needed to protect and restore fish and wildlife habitat. A center could also include assistance to landowners and others on regulatory compliance and provide coordination between multiple agencies. Metro has some experience providing information to the public – the Recycling Information Center has assisted people with recycling questions since 1981. Other Metro information programs that benefit the environment include Natural Gardening, Soils for Salmon, and Greenspaces education programs and grants. A similar system could be developed to provide landowners and others the information they need to protect fish and wildlife habitat. An alternative to a fully-fledged information center is a permanent hotline residents could call for information on habitat protection and restoration.

Potential programs

1. ***Hotline.*** Provide a permanent hotline for fish and wildlife habitat protection and restoration, include number on all brochures, handbooks, and other educational materials. The hotline could serve as a referral service to other experts in the region.
2. ***Information center.*** Develop an information center, similar to the Recycling Information Center but on a much smaller scale. Citizens could call and talk to a person about habitat protection and restoration or development questions.

Habitat education

Many landowners would like to manage their land in a way that benefits fish and wildlife habitat. However, frequently people do not know if certain activities are detrimental (using herbicides and pesticides), if there are alternatives (natural gardening), what to do to improve habitat (plant native plants, remove invasive species like ivy), and how to connect to agencies and organizations that provide grants and/or volunteers to help improve habitat. A program could be developed to focus efforts to increase people's awareness of the connections between their activities and the health of streams and rivers, similar to fish stencil programs. Landowners in regionally significant habitat areas could be targeted to raise awareness of how individual activities impact fish and wildlife habitat. Education activities would be most effective when used in conjunction with a stewardship certification program, grant programs, and regulatory programs.

Metro currently has several education programs that help fish and wildlife habitat in the Parks and Greenspaces Department and the Solid Waste and Recycling Department. Many other organizations in the region also provide classes about the environment. Several possible programs are described below.

Potential programs

1. ***Brochure.*** Provide an educational brochure about protecting and restoring habitat to be mailed once per year to landowners with significant habitat (also include on website).
2. ***Coordinate with other organizations.*** Distribute information about regionally significant fish and wildlife habitat through education programs provided by other organizations.
3. ***Expand existing education programs.*** Add to existing workshops and classes. Develop a program similar to "Naturescapeing" or "Natural Gardening" on habitat protection and restoration.
4. ***Curriculum for schools.*** Develop a curriculum for schools; work with teachers to implement.

Technical assistance

Technical assistance programs are noted for being responsive to landowner needs, providing practical information, and having knowledgeable resource staff. Such a program would not provide direct protection to habitat, but would offer a means of improving stewardship and enhancement by private landowners. Technical assistance could help supplement cost-sharing programs, such as grants, to further protection and restoration efforts. Technical assistance could be focused on landowners, development practices, and/or local partners. Metro has provided technical assistance to local partners throughout the implementation of the Regional Framework Plan and the Regional Urban Growth Management Functional Plan. This has proved especially important in the implementation of Title 3 (stream and floodplain protection) and planning for 2040 centers.

Metro could work with local partners to develop technical assistance, incentives, recognition programs, and awards for development that helps protect fish and wildlife habitat. Metro, in conjunction with local partners, could develop regional low impact development standards and designs to reduce development impacts on fish and wildlife habitat. The Green Streets Handbook serves as a successful model of technical assistance for transportation infrastructure.

Potential programs

1. ***Local partners.*** Provide assistance to staff from local jurisdictions and other organizations to enable them to assist property owners. If a regulatory program is chosen, provide assistance to local jurisdiction staff to aid in implementation.
2. ***Individual property owners.*** a) Develop and distribute materials focused on habitat protection, restoration and enhancement. b) Dedicate staff to assist property owners in habitat protection and restoration activities on a demand basis. c) Dedicate staff for a one-on-one outreach effort to property owners with high quality habitat, include workshops one to two times per year.
3. ***Development and business practices.*** a) Develop and distribute a manual on habitat-friendly development and green business practices. b) Dedicate staff to assist developers/businesses in habitat protection/restoration on a demand basis. c) Dedicate staff to proactively seek out developers/business owners to achieve habitat friendly development and restoration, include workshops one to two times per year.

Volunteer activities

Much habitat restoration has already been accomplished in the region through the efforts of volunteers. There are many groups that coordinate activities, including SOLV (the statewide Oregon non-profit organization founded in 1969 by Governor Tom McCall), Watershed Councils, Riverkeepers, and Friends' organizations. For example, the Friends of Forest Park organizes major efforts throughout the year to remove English ivy from the park and Friends of Trees organizes more than a dozen native planting events in natural areas each year. Metro currently works with volunteers to both educate (volunteer naturalists) and restore habitat. Involving volunteers in habitat restoration projects both helps to accomplish work and provides a forum for education and awareness of the fish and wildlife in the region. Metro could expand current efforts and partner with non-profit groups and public agencies to coordinate restoration activities to encourage restoration in areas that are designated as regionally significant fish and wildlife habitat.

Potential programs

1. ***Focus existing programs.*** Encourage existing volunteer organizations to focus restoration efforts in regionally significant fish and wildlife habitat areas.
2. ***Provide funding.*** Provide funds to existing volunteer organizations to conduct restoration on public lands with regionally significant fish and wildlife habitat.

Agency-led restoration

Several government agencies currently sponsor and conduct restoration. For example, Metro carries out restoration activities on its own properties to enhance existing habitat value. Metro is currently working with public landowners in the Clackamas River basin on a program to halt the spread of and hopefully eradicate Japanese knotweed – a tenacious non-native plant that overtakes riparian areas. Some agencies, such as the City of Portland's Bureau of Environmental Services, conduct restoration on private lands if they are invited to do so. Agency sponsored restoration could be used in conjunction with other incentive and regulatory programs to accomplish regional restoration goals.

Potential programs

1. ***Provide funding for public lands.*** Provide funds to agencies that conduct restoration to focus efforts in regionally significant habitat areas.
2. ***Provide funding for private lands.*** Provide funds to agencies to conduct restoration for private property owners with regionally significant habitat in exchange for habitat protection.

Acquisition

The most certain way to protect habitat is to acquire it. There are various ways to acquire land such as outright purchase, development rights, and property transfers. These programs address social concerns of fairness as well as real and perceived takings, since they conform to a market-based approach for habitat conservation.

Metro began focusing attention on fish and wildlife habitat protection in the early 1990's, identifying natural areas of regional significance and eventually developing the Greenspaces Master Plan to protect a system of regionally significant natural areas. Metro's $135 million bond measure passed in 1995 to primarily purchase open space and develop regional trails. The bond measure identified 14 target areas and six trail and greenway projects. These came from the Greenspaces Master Plan that identified "regionally significant" natural areas following an exhaustive inventory. Sites were selected based on the following criteria:

- Immediacy or threat of development
- Accessibility to residents of the region
- Protection of large contiguous blocks (patch size)
- Expanding on existing regionally significant areas that are protected

If additional funding to purchase habitat land was secured, an acquisition program could focus on regionally significant fish and wildlife habitat, targeted to achieve specific goals. The goals could include protection of Habitats of Concern, floodplains, regional connector habitat, strategically located, high-value habitat, and key restoration opportunities. Table 2-4 below shows the acres of undeveloped land in Metro's fish and wildlife habitat inventory. This helps to describe the magnitude of land that falls within the habitat inventory. For example, Riparian Class I contains over 11,000 acres of undeveloped habitat land. Based on the cost of land purchased through Metro's 1995 Open Spaces Bond Measure, land costs inside the UGB average about $45,000/acre and outside the UGB average about $8,600/acre. Due to the expense, acquisition clearly is not a tool that could be used alone to protect even this most ecologically valuable habitat.

Table 2-4. Acres of undeveloped habitat land.

Habitat classification	**Total undeveloped habitat land**
Riparian Class I	11,614
Riparian Class II	5,365
Riparian Class III	682
Wildlife Class A	8,643
Wildlife Class B	8,211
Wildlife Class C	4,711
Total	**39,226**

Outright purchase

A fee simple purchase of habitat land provides permanent protection but depends on willing sellers. Property is purchased for market prices and thus an acquisition program must be well funded to be effective on a large scale. For example, Metro's Open Spaces acquisition program was funded through a $135 million bond measure approved by voters in May 1995. As of July 15, 2003, Metro had acquired more than 7,935 acres of land for regional natural areas and regional trails and greenways, in 251 separate property transactions at a cost of $1.2 million.[13] These properties protect 70 miles of stream and river frontage.

Regional Revolving Land Purchase Fund

Sometimes valuable fish and wildlife habitat is located on only a portion of a property, and the rest of the parcel is either already developed (e.g., a house) or could be developed in the future. If these parcels are purchased through an acquisition program two concerns arise. First, if the property has a house or other existing use, Metro or another purchasing agency would then be in the position of either renting the useable portion of the property or retiring it from the marketplace and shouldering high maintenance costs. Second, the overall purchase cost of such a parcel would be high, and would effectively reduce available funds for other targeted habitat acquisitions. A program could be developed to purchase habitat land, place development restrictions or conservation easements to protect the habitat areas, and then sell or exchange (via land swaps) the remainder of the land for development or continued use. Funds from the sale could then be used to protect additional land. Such a program could maximize the use of conservation dollars by protecting only the habitat areas on a parcel of land, rather than the entire parcel.

[13] Part of the $135 million bond measure went to local jurisdictions for local parks and greenspaces purchases.

Conservation easement

A conservation easement is a legal agreement between a landowner and a land trust or government agency that permanently limits use of the land in order to protect its habitat values. It allows landowners to continue to own and use their land and to sell it or pass it on to heirs. Conservation easements offer great flexibility. An easement on a property containing rare wildlife habitat might prohibit any development, for example, while one on a farm might allow continued farming. An easement may apply to a portion of the property and need not require public access.

Conservation easements can be donated or purchased. If the donation benefits the public by permanently protecting important conservation resources and meets other federal tax code requirements, it can qualify as a tax-deductible charitable donation. The amount of the donation is the difference between the land's value with the easement and its value without the easement. Conservation easements could be used effectively to target dollars for protecting critical habitat areas. A few organizations currently use conservation easements in the region. A strategy could be developed to collaborate with groups that currently use this tool to protect portions of the regionally significant fish and wildlife habitat identified in Metro's inventory. In addition, agency-sponsored revegetation could be offered to landowners as an incentive to establish conservation easements.

Metro currently has eight easements acquired through the open spaces program (81.1 acres total). One is a flood easement, the other seven are conservation easements. The flood easement is not included in acreage numbers, but the other seven are included. Three easements were donated (59.11 acres), three were purchased (15.89 acres), and one was acquired through an exchange of a 25-year agricultural lease on one acre of property - easement is on 6.1 acres.

Conservation easements have some drawbacks. The legal agreements are complex and time-consuming, and the level of effort (both time and dollars) is often comparable to an outright purchase. Additionally, some property owners would prefer to sell their land outright rather than be encumbered with a conservation easement. Finally, after a conservation easement is in place, it requires resources and staff time to monitor it to ensure it is being followed, and to enforce in instances where its requirements have been disregarded.

Summary

There are many types of non-regulatory tools that could be used to protect and restore fish and wildlife habitat in the region. All of these tools require some type of funding, whether to pay for staff or provide direct dollars to purchase or restore land. Moreover, the success of non-regulatory tools also relies on the willingness of property owners and businesses to invest time and resources, and often to change historic practices. Many of the non-regulatory tools could be implemented at either the local or regional level. Table 2-5 on the following pages describes some of the implementation issues and costs associated with the non-regulatory tools identified in this analysis.

Acquisition is the most effective non-regulatory tool to achieve definitive habitat protection. Acquisition achieves permanent protection and also preserves land to be restored at a later date. However, the high cost of purchasing land, especially within the urban growth boundary, the dependence of an acquisition program on willing sellers, and the fact that much of the habitat is on partially developed land limits the effectiveness of such a program.

Many of the other non-regulatory habitat protection and restoration tools considered here are most effective when used in combination with each other and/or along with a regulatory program. A regulatory program can provide the incentive and motivation to develop innovative solutions to land development while protecting habitat. Grants and technical assistance are the tools that could be most effective in protecting and restoring habitat, in the absence of an acquisition program. A stewardship recognition program could help promote grants and serve to educate others about innovative practices. Coordinating with existing agencies and volunteer groups that conduct restoration as well as providing funds to focus efforts could be effective in enhancing regionally significant habitat.

Table 2-5. Potential non-regulatory programs for fish and wildlife habitat protection.

What	Effectiveness	Partnerships	Cost*
Stewardship & recognition programs 1. *Accomplishments report* to publicize innovative examples of restoration, protection, and habitat friendly development in region. 2. *Stewardship program* to recognize landowners for restoring and protecting habitat on their land and habitat friendly-development/business practices, include a yearly award ceremony. 3. *Voluntary stewardship agreements* between a property owner and either Metro or another sponsor for habitat protection.	• Limited acreage of total habitat covered • Long-term protection uncertain • Monitoring may increase effectiveness • Relies on willing participants • More effective when used with cost-sharing, grants and technical assistance to encourage more successful projects	Could be implemented by Metro, a local partner, or Watershed Councils.	Low to Medium
Grants for restoration & protection 1. *Residential owner.* Small grant program to accomplish restoration on private or public properties within resource area. 2. *Development activities and business practices.* Provide grants to: • businesses for habitat restoration • developers to encourage habitat friendly development or redevelopment • cities and counties for wildlife crossing and culvert replacement projects	• Effectiveness depends on funding, technical assistance and education, and long-term monitoring • Provides on-the-ground protection and restoration accomplishments • Grants to developers could effectively encourage innovative practices • Limited acreage of total habitat covered • Could increase effectiveness of regulations	A grant program could be implemented at the local or regional level. Partner with Watershed Councils and other groups.	Medium to High
Information center 1. *Hotline* for fish and wildlife habitat protection and restoration. (Calls would be returned periodically). 2. *Call center* for fish and wildlife habitat protection and restoration, referral to other agencies. (Immediate response).	• Effectiveness depends on publicity, technical expertise, and longevity • Depends on extensive marketing campaign and longevity	Could be implemented at the regional level and/or through partnerships.	Low to Medium
Habitat education activities 1. *Educational brochure* on maintaining and enhancing fish and wildlife habitat to be mailed once per year to landowners with significant habitat (also include on website). 2. *Coordinate* with existing organizations that provide habitat-oriented classes, distribute information on regionally significant resources. 3. *Add to Metro's existing workshops and classes* (e.g., Parks Dept. nature classes, tours, and birdwatching events; Solid Waste Dept. "Naturescaping" and "Natural Gardening" classes). 4. *Curriculum* for schools, work with teachers to implement.	• A long-term commitment is required to change behaviors and practices • Over time an education program can reach a large number of people • Could provide consistent message and economy of scale across the region	Could be implemented by Metro, local partners, Watershed Councils, or other non-profits.	Low to Medium
Technical assistance program *Focused on local partners* 1. Assistance to local jurisdiction staff and other organizations to enable them to assist property owners in their jurisdictions 2. Provide assistance to local jurisdiction staff to aid in implementation of a regulatory program (if one is chosen)	• Level of commitment and longevity of program would be key to effectiveness • Technical assistance supports stewardship programs and grants • Technical assistance could increase the effectiveness of a regulatory program	Could be implemented at the regional level and/or through a partnership with other jurisdictions and agencies (e.g.,	Low to Medium

What	Effectiveness	Partnerships	Cost*
Focused on residential, individual owners 3. Develop and distribute materials focused on habitat protection, restoration & enhancement 4. Dedicate staff to assist property owners in habitat protection/ restoration activities on a demand basis 5. Dedicate staff for a one-on-one outreach effort to property owners with high quality habitat, include workshops 1-2 times/year *Focused on development and business activities* 6. Develop and distribute a manual on habitat-friendly development and green business practices 7. Dedicate staff to assist developers/businesses in habitat protection/restoration activities on a demand basis 8. Dedicate staff to proactively seek out developers/business owners to achieve habitat friendly development, restoration; include workshops	• Most effective with high staff to client ratio; no single agency could address needs of so many properties without adequate staff • Knowledgeable staff is critical to providing effective technical assistance	Portland's Office of Sustainable Development).	
Volunteer activities 1. *Partner* with existing volunteer organizations to focus restoration efforts in regionally significant habitat areas. 2. *Provide funds* to existing volunteer organizations (e.g., SOLV) to conduct restoration on public lands with regionally significant habitat.	• Substantial restoration work currently conducted with volunteer efforts • Supports education efforts by training volunteers • Easier access on public lands	Coordinate with existing programs, such as Watershed Councils, friends' groups, SOLV.	Low to High
Agency-led restoration activities 1. *Restoration on public lands.* Provide funds to agencies (e.g., Metro, Portland Bureau of Environmental Services, Clean Water Services) that conduct restoration to focus on regionally significant habitat. 2. *Restoration on private lands.* Provide funds to agencies for restoration on private lands in exchange for habitat protection.	• A trained and experienced staff with monitoring capability could lead to effective restoration work • Maintenance and monitoring of the restoration site over time is necessary to accomplish effective long-term restoration	Implemented at regional and local partner level.	Medium to High
Property tax relief (Programs exist under Oregon state law) 1. Riparian Lands Tax Incentive Program 2. Wildlife Habitat Conservation and Management Program	• Limited landowner enrollment • Requires ongoing management plan with Oregon Department Fish & Wildlife • Landowners can opt out of program with payment of back taxes	Counties implement, Metro could facilitate implementation; encourage application in urban area.	Medium
Acquisition 1. Outright purchase 2. Conservation easement 3. Revolving acquisition fund 4. Donation/bequest program	• Most effective in long-term preservation • Properties may require maintenance • Conservation easements complex to negotiate • Revolving acquisition fund could make effective use of limited dollars	Could be implemented at federal, regional, or local level or by a non-profit.	High

***About cost:** High (grants, restoration, acquisition); Medium (dedicated staff); Low (materials only, some staff)

CHAPTER THREE: EXISTING REGULATORY ENVIRONMENT AND REGULATORY PROGRAM OPTIONS

Existing regional and local environmental regulations already cover a portion of the region's habitat land. Since 1998, cities and counties have implemented Metro's protection standards for flood management and water quality (Title 3) along streams and floodplains. Approximately 30 percent of regionally significant fish and wildlife habitat currently covered by Title 3 regulations achieves some, but not all, of the habitat protection needed in these areas. Very few of the wildlife areas in Metro's habitat inventory are covered by consistent regional standards.

In addition to implementing Title 3, some cities and counties have adopted local regulations to protect habitat. Regulations vary in the amount of habitat area they cover and in the level of protection they provide. None of them regulate all regionally significant fish and wildlife habitat within their jurisdiction. This chapter includes:

- a description of the baseline regulations (Title 3) for purposes of analysis
- a summary of Metro's analysis of local Goal 5 programs, and
- a description of the six regional regulatory program options to protect fish and wildlife habitat.

Baseline for analysis (Title 3)

This section describes the starting point for this Phase II ESEE analysis – a baseline from which to measure ESEE tradeoffs of the increment of additional protection posed by each option.

Metro's Title 3 (Water Quality and Flood Management Plan) provides a level of fish and wildlife habitat protection that is consistent across the region. For this reason, Title 3 serves as a proxy for measuring existing levels of protection and is the baseline for this analysis. Habitat outside of Title 3 management areas receives no additional regionally consistent protection. Although many local jurisdictions do provide protection beyond Title 3, none of them regulate all regionally significant habitat lands within their jurisdictions. A comparison of several local Goal 5 programs is made in the next section.

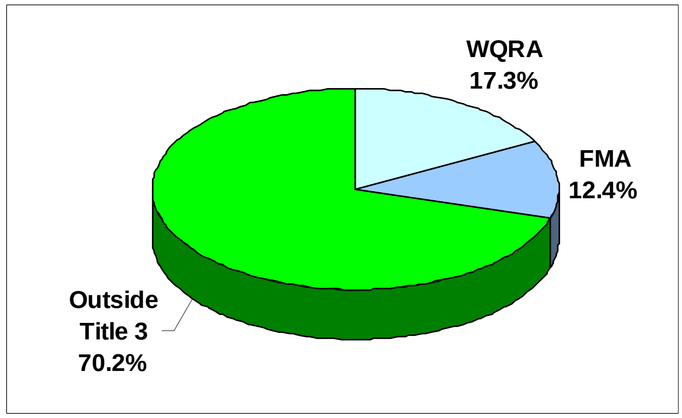
The water quality resource areas (WQRA) and flood management areas (FMA) established in Title 3 protect some of the regionally significant Goal 5 fish and wildlife habitat. Table 3-1 shows Title 3 coverage of fish and wildlife habitat and impact areas. Figures 3-5 and 3-6 graphically illustrate this information.

Table 3-1: Title 3 coverage of fish and wildlife habitat and impact areas (within Metro's jurisdiction)

Fish and wildlife habitat class	Acres within WQRA	Acres within FMA	Total WQRA/ FMA	Acres Outside Title 3	Total Acres	% WQRA/ FMA of Total Acres
Class I RC/WH	13,144	6,803	19,947	7,929	27,876	21%
Class II RC/WH	1,893	1,948	3,841	4,051	7,893	4%
Class III RC/WH	177	2,543	2,720	1,711	4,432	3%
Class A WH	214	108	322	19,359	19,682	0%
Class B WH	69	18	87	12,802	12,889	0%
Class C WH	42	92	134	7,328	7,463	0%
Impact Areas	1,067	419	1,486	14,235	15,721	2%
Total	***16,606***	***11,931***	***28,537***	***67,415***	***95,956***	***30%***

Habitat location (i.e., within WQRAs, within FMAs, outside Title 3), development status (vacant vs. developed), and conflicting land use (e.g., industrial development vs. single-family residential) are important factors for assessing the ESEE tradeoffs of additional protection proposed by the six program options.

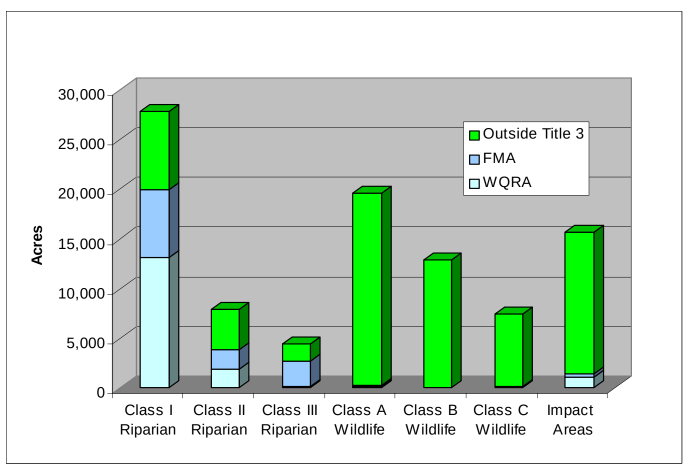
Figure 3-5. Proportion of habitat and impact areas covered by Title 3 (within Metro's jurisdiction).



Habitat location

Figure 3-5 shows that approximately 30 percent of habitat and impact areas are currently covered by Title 3 (28,537 acres). Title 3 achieves some, but not all, of the habitat protection needed in these areas. Most of the protection occurs in Class I-III riparian/wildlife corridors (see Figure 3-6); almost none of the upland wildlife habitat is covered by Title 3.

Figure 3-6. Title 3 coverage of habitat classes and impact areas (within Metro's jurisdiction).



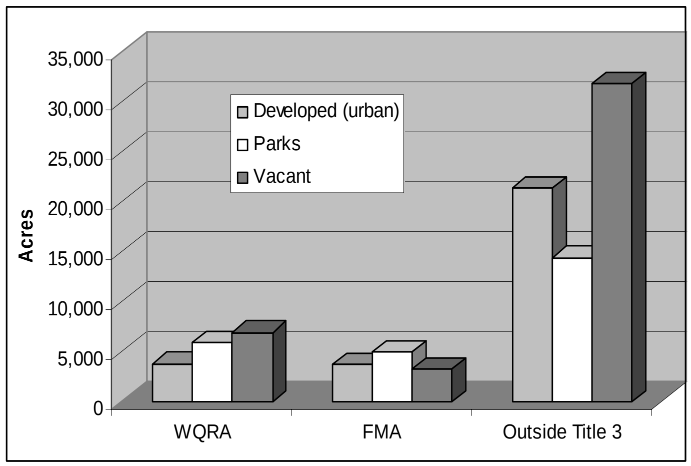
Title 3 performance standards differ in WQRAs and FMAs. Water quality resource areas vary in width from 15 feet to 50 feet from the water feature, and up to 200 feet in steeply sloped areas. New development is ***not allowed*** in these areas unless there is no practical alternative for locating it. In flood management areas, however, new development is ***allowed*** subject to the base zone or existing flood hazard overlay zones and Title 3 development standards (e.g., balance cut and fill). FMAs include the 100-year floodplain, flood area and floodway, and the 1996 flood inundation area.

The increment of additional protection would be greater in the FMAs than in the WQRAs if disturbance areas are limited by a Goal 5 program because Title 3 does not currently limit disturbance area size in FMAs. The increment of additional protection would be greatest in habitat and impact areas outside Title 3, where it is assumed for this analysis that habitat is not currently protected.

Development status

Development status also plays a part in assessing the increment of additional protection. As described in the Phase I ESEE analysis, development status refers to whether habitat land is developed or vacant. Figure 3-7 shows development status of habitat land and impact areas inside Metro's jurisdiction.

Figure 3-7. Development status of habitat and impact areas (within Metro's jurisdiction).



Developed habitat is land with improvements (e.g., buildings, roads) and specific land uses (e.g., residential, industrial). Two subsets are included in this category: developed urban and parks. An example of habitat categorized as developed urban is dense forest canopy over a developed residential subdivision. Thirty percent of habitat and impact areas (28,734 acres) is developed with urban uses. Parks are categorized as developed land because they generally are not available for urban development. Approximately 28 percent (26,841 acres) of the habitat and impact areas are in park status or zoned parks and open spaces (POS). Generally, the impact of additional protection would be less in developed habitat land than in vacant habitat land, at least in the short term because the regulations would apply to new land use development and would not affect existing development. Over time as redevelopment occurs, however, new Goal 5 regulations would apply.

Vacant land is defined as land without buildings, improvements or identifiable land use. Metro's vacant lands inventory includes vacant portions of developed tax lots that are one-half acre or larger. Vacant land also has two subsets: constrained (by Title 3 WQRA and FMA) and buildable (vacant land outside Title 3). Forty-four percent of habitat and impact areas is vacant (41,965 acres). The impact of additional protection will be greatest on vacant habitat land outside Title 3 areas. Factors other than Title 3 can affect the ability to develop vacant land, such as utility corridors.

Conflicting land uses

Phase I of the ESEE analysis examined conflicting uses; that is, a land use that could adversely affect regionally significant fish and wildlife habitat. Conflicting uses were identified using

Metro's seven regional zones – a compilation of local jurisdictions' zones (see Chapter 3 of the Phase I ESEE Analysis for a full discussion of conflicting uses). Zoning plays a part in assessing ESEE tradeoffs. For example, the increment of additional protection on land zoned for parks would likely be less than habitat land zoned for urban uses (e.g., industrial). Some uses that would conflict with habitat protection may occur in a variety zones such as roads, public utilities, and regionally significant public facilities (major medical facilities and educational institutions). These special uses will be considered in the program development phase.

In summary, the ESEE analysis considers current regulations, development status and regional zoning in assessing the consequences of limiting, allowing or prohibiting development in fish and wildlife habitat areas. Thirty percent of the fish and wildlife habitat inventory overlaps with Title 3 water quality and flood management areas; 70 percent is outside Title 3. The increment of additional protection is influenced by where the habitat is located (in WQRA/FMA vs. outside Title 3), development status of the habitat (developed vs. vacant), and conflicting land uses (regional zones). Title 3 standards focus on streams, floodplains and wetlands; upland wildlife habitat is not covered for the most part. Developed land will experience the impacts of program options through the eventual redevelopment and expansion of existing land uses. Vacant land not covered by Title 3 will experience the most immediate impact of regulatory program options. The extent of the effects varies further by the nature of the land use. The next section describes local Goal 5 programs.

Local Goal 5 programs

Metro conducted a review of local jurisdiction's plans for habitat protection from 1999 to 2002, resulting in the *Local Plan Analysis: A review of Goal 5 protection in the Metro region (August 2002).* Most of the local jurisdictions in the Metro region have adopted Goal 5 programs that have been acknowledged by the Department of Land Conservation and Development as being in compliance with the state rule. Some of these programs were developed prior to the Goal 5 rule revisions in 1996, while a few have been completed more recently.

The Goal 5 rule requires a three-step process, as described in the introduction to this report. However, local governments may also choose to utilize the State "safe harbor" approach rather than conduct an inventory using the standard methodology described above (OAR 660-23-020). A safe harbor approach may be used for riparian corridors and wildlife habitat. Using the safe harbor approach, a local government may determine the boundaries of significant riparian corridors within its jurisdiction using a standard setback distance from all fish-bearing lakes and streams (OAR 660-23-090(5)). This setback distance is determined as follows:

(a) for streams with average annual stream flow greater than 1,000 cubic feet per second (cfs), the riparian corridor boundary is 75 feet upland from the top of each bank
(b) for lakes and fish-bearing streams with average annual stream flow less than 1,000 cfs, the riparian corridor boundary is 50 feet upland from the top of each bank

Goal 5 is a process goal – the state does not prescribe a specific outcome as it does in other land use planning goals. The rule requires local jurisdictions to balance the need to protect natural resources against other state goals such as housing (Goal 10) and transportation (Goal 12) while providing ample opportunity for citizen involvement (Goal 1). Thus, the state rule allows local jurisdictions' Goal 5 programs to be in compliance with state law while being inconsistent with each other. However, Metro's code required an analysis of the consistency and/or adequacy of local natural resource protection prior to conducting a regional ESEE analysis and a regional protection program. The key findings from the *Local Plan Analysis* are reviewed below.

The Goal 5 process begins with the inventory of Goal 5 resource sites, providing information to locate and evaluate resources and to develop programs to protect such resources (OAR 660-023-0030(1)). The standard inventory process involves four steps. However, depending on the type of Goal 5 resource, not every step must be applied in the inventory stage.

Inconsistencies

Fish and wildlife habitat in the Metro region receive inconsistent treatment and protection across jurisdictions, considering the pervasive inconsistencies in Goal 5 inventory methodologies, data layer formats, ESEE analyses, and program decisions of local jurisdictions. Outside of the State safe harbor for riparian areas and wetlands, the Goal 5 rule provides little guidance to local governments on methods of protection, except the requirement that a protection program include clear and objective standards. The Goal 5 protection programs of local jurisdictions within the Metro region are inconsistent with each other on a number of levels. Some programs offer exclusive protection for riparian and wetland areas, prohibiting development unless exceptional circumstances apply, whereas other jurisdictions offer limited development within their most significant resource areas. Furthermore, protection levels for limited development range anywhere from five percent development to at least fifty percent development on significant natural resource land. Finally, there is no consistency between local jurisdictions' review processes, mitigation and enhancement procedures, or their monitoring and enforcement mechanisms.

Inadequacies

It is often difficult to determine what specific protection will be applied to resources by local governments when implementing Goal 5 programs. This not only leads to inconsistent protection around the region, but also may result in inadequate protection of natural resources. The most consistent protection is Metro's Title 3 regulations for protecting water quality and floodplain function.[14] In addition, several jurisdictions in the region have adopted the State's Safe Harbor provisions under Goal 5, which provide protection specific to fish-bearing streams based on stream size. Local jurisdictions' riparian corridor protection programs that do vary from either Title 3 or the State Safe Harbor range from 30 feet on a class I stream (Lake Oswego) to as much as 150 feet on a principal river (Clackamas County).[15]

Figure 1 compares the minimum widths recommended in the scientific literature[16] to the riparian corridor protection provided by Metro's Title 3 regulations and the State Safe Harbor. As the figure illustrates, even the maximum protection provided by Title 3 on steep slopes (200 ft.)

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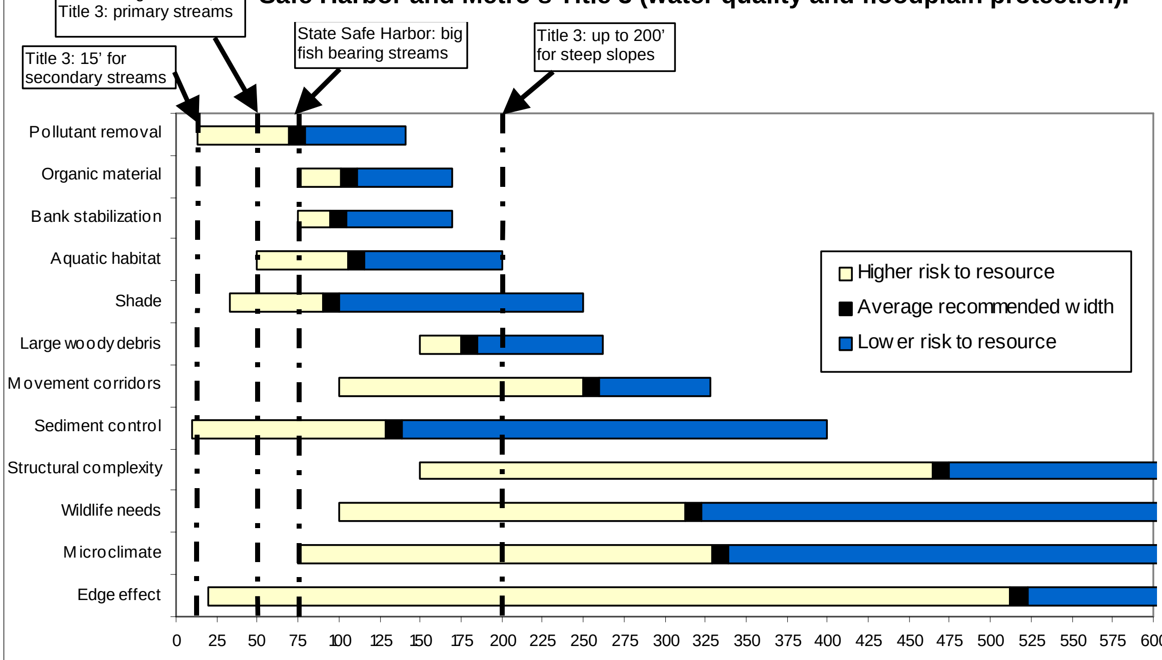
[14] This is why Metro is using Title 3 protection as a baseline for analysis purposes in the evaluation of the six program options, described later in this report.
[15] *(See Local Plan Analysis* section on inconsistencies – program decisions for more detail on local jurisdictions' programs.*)*
[16] See Metro's *Technical Report for Goal 5* (2002).

meets the average recommended width for only seven of the twelve functions included on the chart. However, the 200-foot vegetated corridor provides some protection for all twelve functions.[17] Furthermore, the State Safe Harbor, when applied to larger fish-bearing streams (75 ft), only meets the average recommended minimum width for one function, pollutant removal. The 75-foot buffer does not even meet the minimum recommendations for four functions, including one of the most important for listed salmon – large woody debris[18]. The 50-foot buffer provided by the State Safe Harbor on smaller fish-bearing streams and by Metro's Title 3 on primary streams only provides minimal protection for five functions. For smaller streams, those draining less than 50 acres, Title 3 provides for a 15-foot buffer that barely meets the most minimal scientific recommendations for two functions.

In effect, there is not a regulatory program in the region that provides sufficient protection for riparian corridors based on consideration of all the functions necessary for fish and wildlife habitat. While it is unlikely that any regulatory program could be implemented that would fully protect all of the functions depicted in Figure 3-1, habitat protection in the Metro region does not comport with the scientific knowledge of what is needed for full fish and wildlife habitat protection.

Figure 3-1. Recommended minimum buffer widths compared to State Safe Harbor and Metro's Title 3 (water quality and floodplain protection).



Source: Metro 2001.

[17] These 12 functions were identified in Metro's *Technical Report for Goal 5* that included a review of the scientific literature related to fish and wildlife habitat.

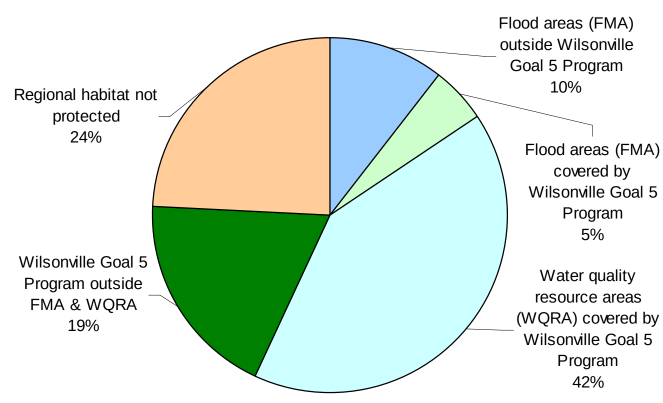
[18] Obviously, large woody debris does reach the stream at distances of less than 75 feet, providing some level of function to instream habitat. However, several studies have shown that larger buffer widths are necessary to provide adequate levels of large woody debris to both instream and riparian (terrestrial) habitats. Thus, any distance that is less than one site potential tree height (average in Metro region determined to be 150 ft) allows for a very high risk to the resource.

As described in the *Local Plan Analysis*, local protection of upland wildlife habitat is limited throughout the region. Only eight jurisdictions[19] have identified upland areas not associated with streams or wetlands for regulatory protection. By default, some steeply sloped areas are regulated due to natural hazards, such as earthquakes and landslides. The planning guidelines for upland habitats[20] recommend protection of large areas and retention of native vegetation. However, based on Metro's review of local regulations, protection of these areas in the region does not meet the scientific recommendations. Tree protection ordinances occur most frequently. However, ordinances that specifically protect upland habitat by limiting development are more effective but less common. For example, Lake Oswego requires protection of significant tree groves, but allows for up to 50 percent of the trees on a site to be removed for development purposes. Other jurisdictions such as Sherwood and Tigard require a tree inventory and provide incentives for retention of trees through the permit process. The city of Portland limits disturbance in upland areas and has established an ordinance for land divisions that requires preservation of existing tree canopy.

Comparison of three local programs with Metro's baseline regulations

For purposes of the Phase II ESEE Analysis, Metro chose three local Goal 5 programs as examples to compare the extent of the regional fish and wildlife habitat inventory covered by local environmental zones. These local zones also overlap, in many cases, with Title 3 water quality resource areas and flood management areas (see Figure 3-1 above). The extent of this overlap, as well as additional habitat areas covered by local environmental zones, is shown in Figures 3-2 to 3-4 for the cities of Wilsonville, Lake Oswego, and Portland.

Figure 3-2. How existing habitat protection in Wilsonville addresses 1,222 acres of regionally significant habitat

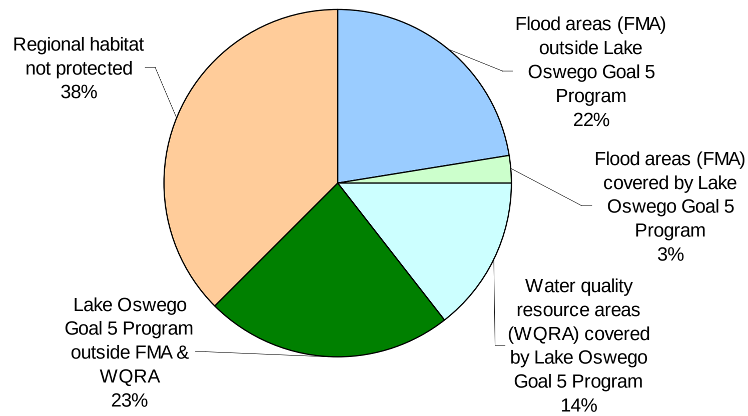


The City of Wilsonville's Significant Resource Overlay Zone (SROZ) Ordinance as well as other ordinance requirements[21] exceed Metro's Title 3 baseline for water quality resource areas and flood management areas. Wilsonville's SROZ ordinance, combined with additional lands covered by Title 3 flood management restrictions, applies to 76 percent (927 acres) of regionally significant habitat. Twenty-four percent (296 acres) of regionally significant habitat is not covered by the SROZ ordinance or the Title 3 baseline (Figure 3-2). Wilsonville's SROZ ordinance

[19] Beaverton, Hillsboro, Lake Oswego, Milwaukie, Portland, Wilsonville, Clackamas County, Multnomah County, and Washington County have specifically mentioned wildlife habitat not associated with riparian corridors in local code.
[20] See Metro's *Technical Report for Goal 5* (2002).
[21] Significant Resource Overlay Zone Section 4.139 of the Zoning Ordinance; see also Planning and Development Ordinance Section 4.172 (Floodplain Regulations), Section 4.171.06 (Protection of Natural Features and other resources); Section 4.6 (Tree Preservation and Protection).

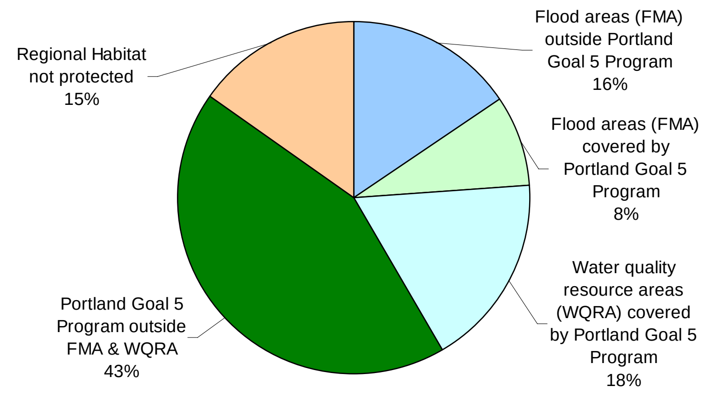
prohibits development within the overlay zone and impact area unless an applicant submits a significant resource impact report and mitigates for habitat loss. The City of Lake Oswego's Sensitive Lands Overlay District as well as other ordinance requirements exceed Metro's Title 3 baseline for water quality resource areas and flood management areas.[22] Lake Oswego's Sensitive Lands Overlay District, combined with additional lands covered by Title 3 flood management areas, applies to 1,627 acres (62 percent) of regionally significant habitat. There are 976 acres comprising 38 percent of regionally significant habitat that are not covered by the Sensitive Lands Overlay District or Title 3 flood management restrictions. (Figure 3-3). The Sensitive Lands Overlay District includes resource protection and conservation overlay zones to protect stream corridors, wetlands, and tree groves, and establishes mitigation requirements for habitat loss. Significant isolated tree groves and tree groves associated with wetlands or streams receive additional protection.

Figure 3-3. How existing habitat protection in Lake Oswego addresses 2,603 acres of regionally significant habitat



The City of Portland's Environmental Overlay Zone Regulations as well as other ordinance requirements exceed Metro's Title 3 baseline for water quality resource areas and flood management areas.[23] Portland's Environmental Overlay zones, combined with additional lands covered by Title 3 water quality and flood management restrictions, applies to 24,296 acres (85 percent) of regionally significant habitat. There are 4,374 acres comprising 15 percent of regionally significant habitat that are not covered by Portland's environmental overlay zones or Title 3 flood management restrictions (Figure 3-4). Portland's environmental overlay zones include the protection zone and the conservation zone. The protection zone applies to the most significant habitat, and strictly limits development in

Figure 3-4. How existing habitat protection in Portland addresses 28,659 acres of regionally significant habitat



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[22] Sensitive Lands Overlay District (Section 48.17 of the Development Code); see also Section 17 (Floodplain Standards), Section 55 (Tree Ordinance), Section 48.17.600 (Mitigation)

[23] Environmental Zones (Section 33.430 of the Zoning Code); see also Greenway Zone (Section 33.440 of the Zoning Code), Open Space Zone (Section 33.100 of the Zoning Code), Flood Hazard Areas (Section 24.50 of the Building Code).

these areas; the conservation zone applies to significant habitat and allows development as long as adverse impacts are avoided, minimized, and mitigated.

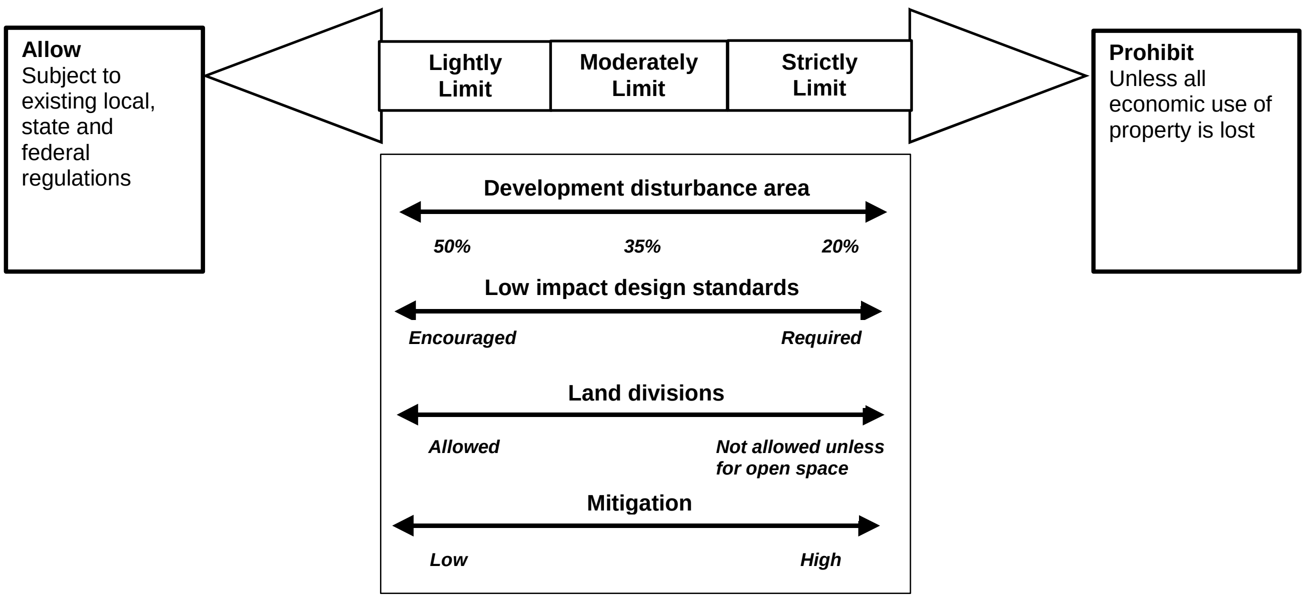
In summary, this comparison shows that at least some local programs currently exceed the minimum standards of Title 3 water quality resource areas and flood management areas. As a result, a portion of regionally significant habitat not covered by the Title 3 baseline receives protection by local programs. While it would be helpful to know the increment of local protection beyond the Title 3 baseline, the difficulties of measuring the extent of this coverage and the level of protection provided under all local government plans is well established in Metro's *Local Plan Analysis*.

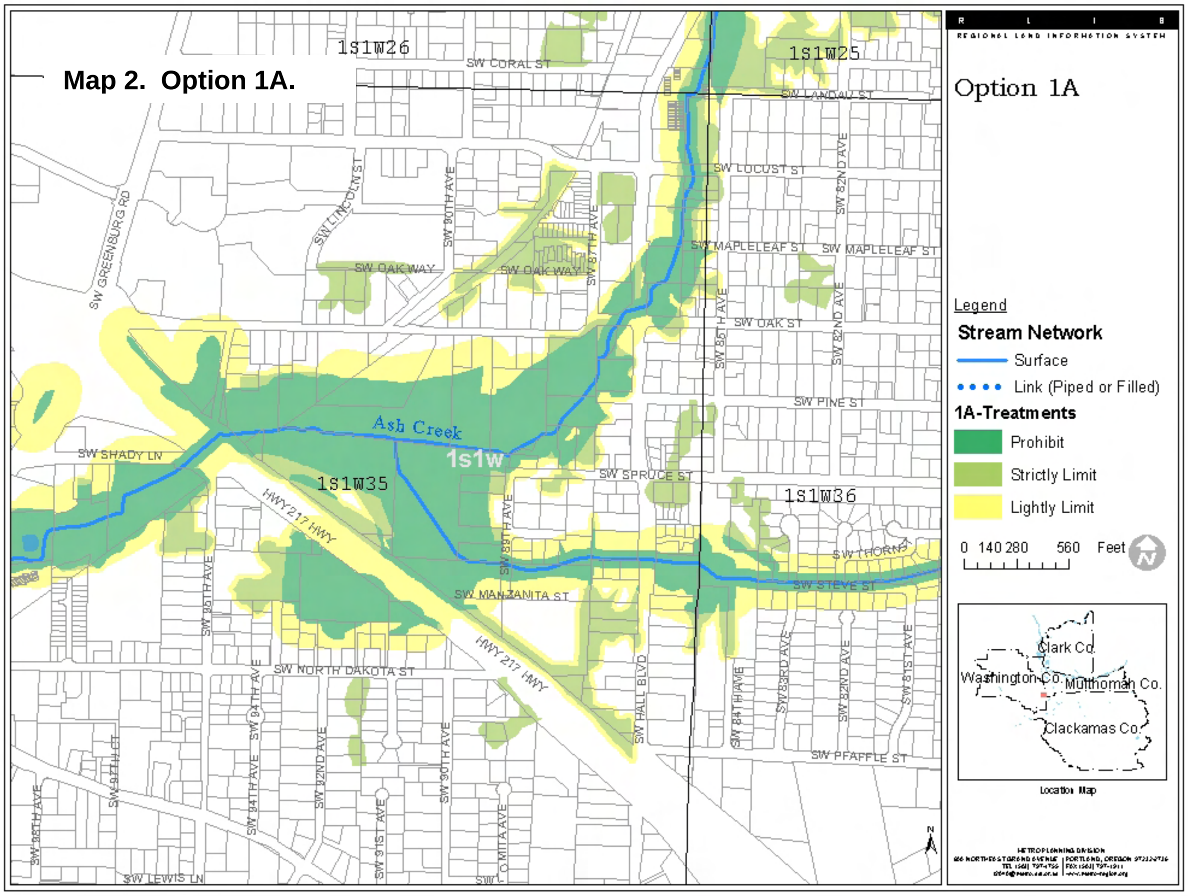
Regulatory program options

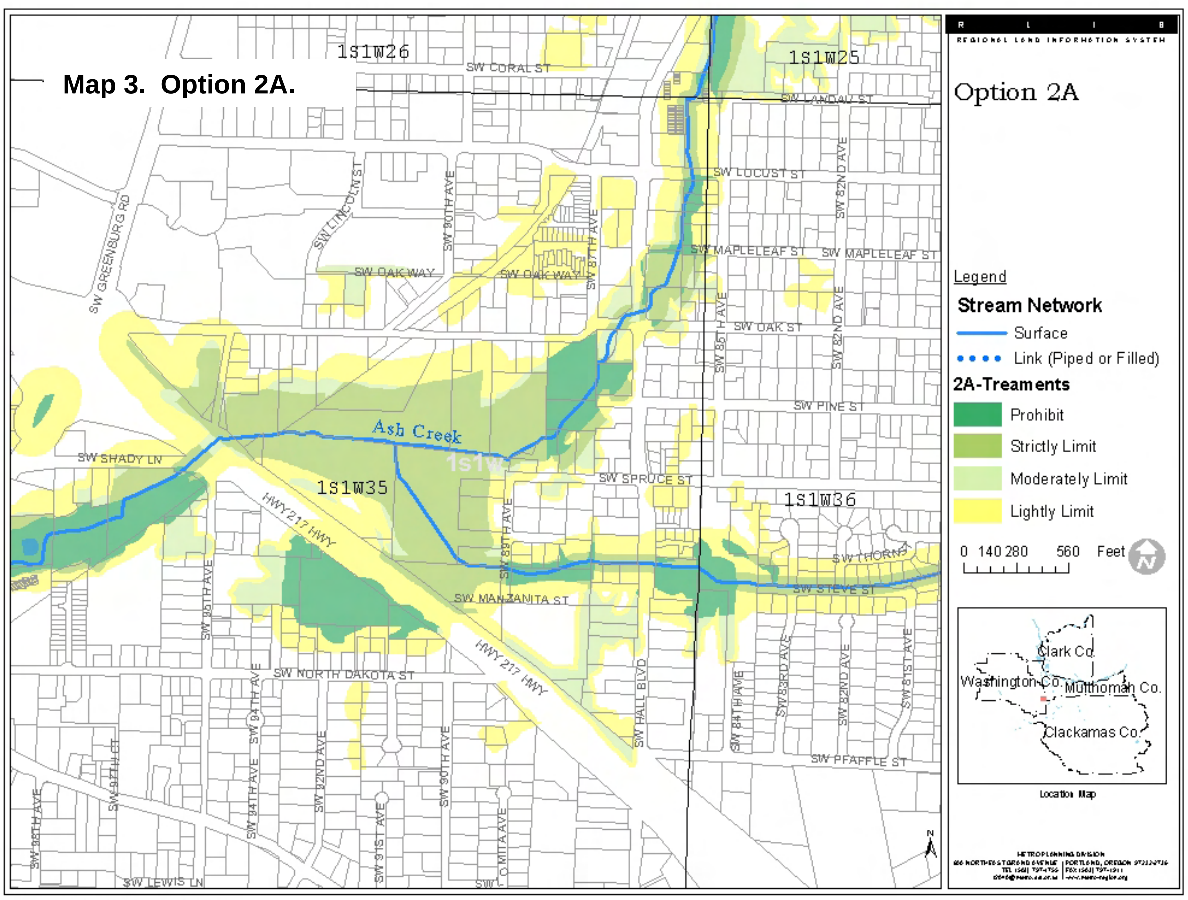
The Goal 5 rule requires Metro and local governments to develop a program to protect regionally significant fish and wildlife habitat based on ESEE decisions to allow, limit, or prohibit conflicting uses in significant resource sites. The six regulatory program options described in this section were developed to support Metro Council's decision. Maps 2-7 on the following pages depict the regulatory options for a specific geographic area that includes a regional center and several habitat types. These maps profile the differences among the options due to habitat types and urban development values.

In each of the six options, allow, limit or prohibit "treatments" are assigned to each of the fish and wildlife habitat classes and impact areas. This results in a range of scenarios that provide varying levels of habitat protection. Figure 3-8 below shows the range of treatments (from least to most). In this analysis, the limit category has been expanded to three levels (lightly limit, moderately limit, strictly limit) to provide a continuum of protection approaches. The information in Figure 3-8 represents ***potential targets*** for protecting fish and wildlife habitat while allowing some level of development to occur. These potential targets are preliminary and are subject to revision during the third step of the Goal 5 process – the program development phase.

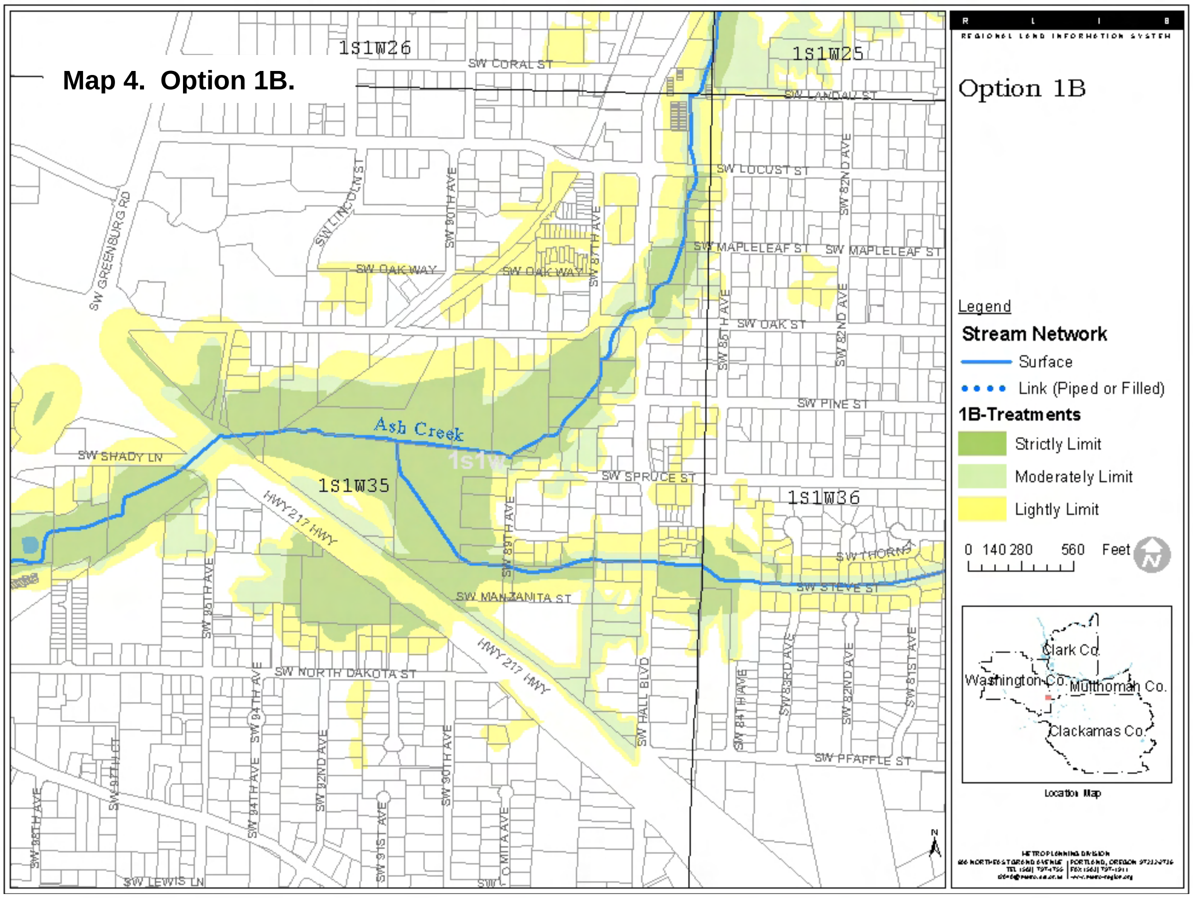
Figure 3-8. Allow, limit and prohibit treatments.
Range of Limit Treatments



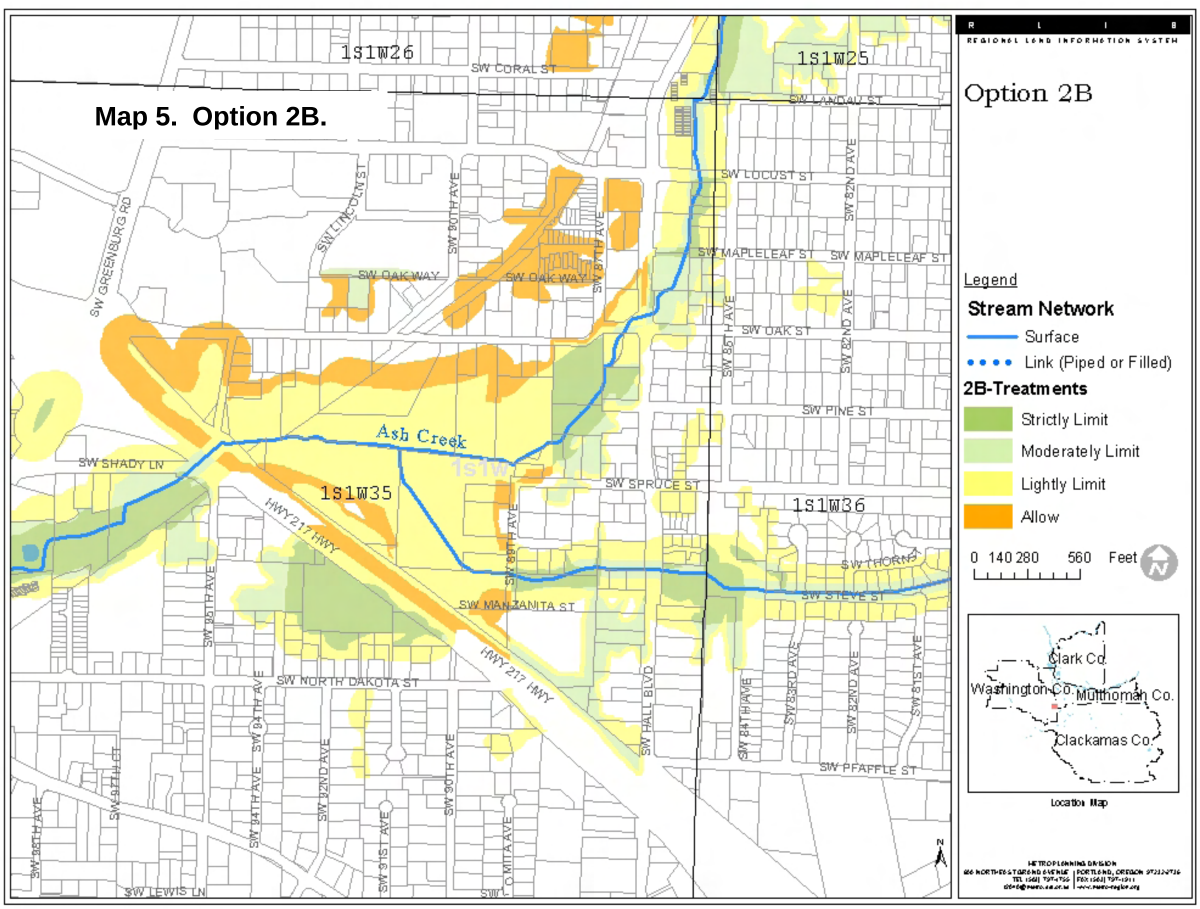

Map 2. Option 1A.
1S1W26
1S1W25
1S1W35
1S1W36
1s1w
Ash Creek
SW CORAL ST
SW LANDAU ST
SW LOCUST ST
SW MAPLELEAF ST
SW OAK WAY
SW OAK ST
SW PINE ST
SW SPRUCE ST
SW SHADY LN
SW THORN ST
SW STEVE ST
SW MANZANITA ST
SW NORTH DAKOTA ST
SW PFAFFLE ST
SW LEWIS LN
SW GREENBURG RD
SW LINCOLN ST
HWY 217 HWY
SW HALL BLVD
Option 1A
Legend
Stream Network
Surface
Link (Piped or Filled)
1A-Treatments
Prohibit
Strictly Limit
Lightly Limit
0 140 280 560 Feet
Clark Co.
Washington Co.
Multnomah Co.
Clackamas Co.
Location Map

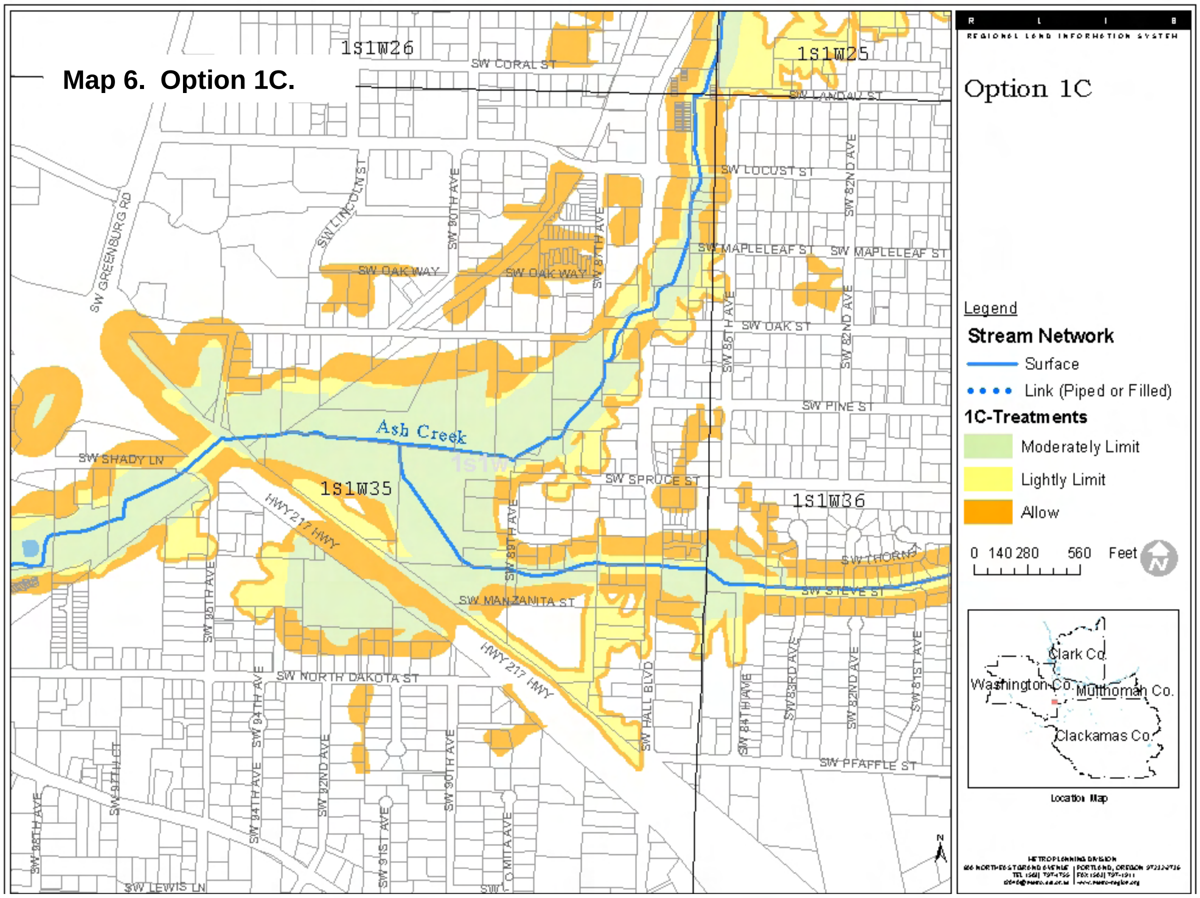

Map 3. Option 2A.
1S1W26
1S1W25
1S1W35
1S1W36
Ash Creek
SW CORAL ST
SW LANDAU ST
SW LOCUST ST
SW MAPLELEAF ST
SW OAK WAY
SW OAK ST
SW PINE ST
SW SPRUCE ST
SW SHADY LN
SW THORN ST
SW STEVE ST
SW MANZANITA ST
SW NORTH DAKOTA ST
SW PFAFFLE ST
SW LEWIS LN
HWY 217 HWY
SW HALL BLVD
Option 2A
Legend
Stream Network
Surface
Link (Piped or Filled)
2A-Treaments
Prohibit
Strictly Limit
Moderately Limit
Lightly Limit
0 140 280 560 Feet
Clark Co.
Washington Co.
Multnomah Co.
Clackamas Co.
Location Map

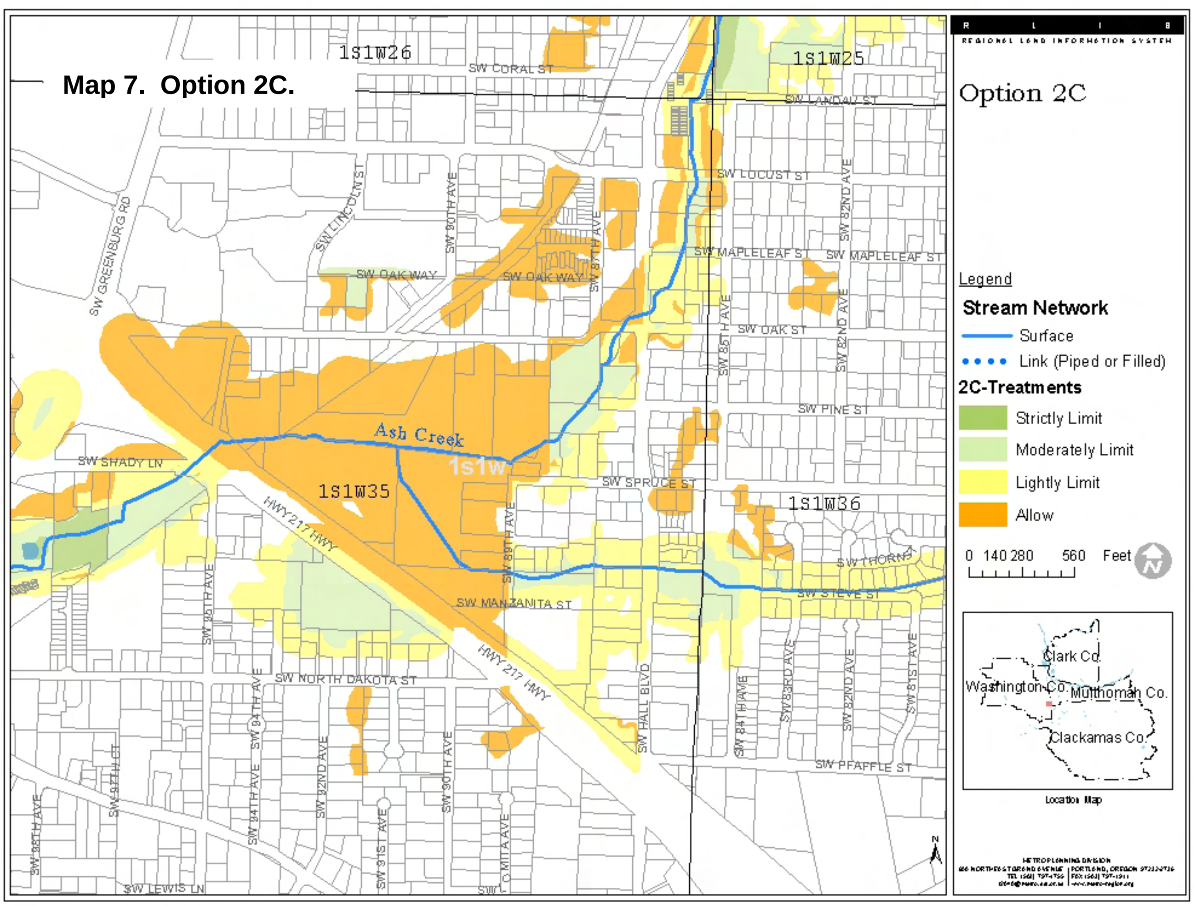
Map 4. Option 1B.



Map 5. Option 2B.




Map 6. Option 1C.
Option 1C
Legend
Stream Network
Surface
Link (Piped or Filled)
1C-Treatments
Moderately Limit
Lightly Limit
Allow
0 140 280 560 Feet
Clark Co.
Washington Co.
Multnomah Co.
Clackamas Co.
Location Map
Ash Creek
1S1W26
1S1W25
1S1W35
1S1W36
SW CORAL ST
SW LANDAU ST
SW LOCUST ST
SW MAPLELEAF ST
SW OAK WAY
SW OAK ST
SW PINE ST
SW SHADY LN
SW SPRUCE ST
SW THORN ST
SW STEVE ST
SW MANZANITA ST
SW NORTH DAKOTA ST
SW PFAFFLE ST
SW LEWIS LN
SW GREENBURG RD
SW LINCOLN ST
HWY 217 HWY
SW HALL BLVD


Map 7. Option 2C.
Option 2C
Legend
Stream Network
Surface
Link (Piped or Filled)
2C-Treatments
Strictly Limit
Moderately Limit
Lightly Limit
Allow
0 140 280 560 Feet
Clark Co.
Washington Co.
Multnomah Co.
Clackamas Co.
Location Map
Ash Creek
1S1W26
1S1W25
1S1W35
1S1W36
SW CORAL ST
SW LANDAU ST
SW LOCUST ST
SW MAPLELEAF ST
SW OAK WAY
SW OAK ST
SW PINE ST
SW SHADY LN
SW SPRUCE ST
SW THORN ST
SW STEVE ST
SW MANZANITA ST
SW NORTH DAKOTA ST
SW PFAFFLE ST
SW LEWIS LN
SW GREENBURG RD
SW LINCOLN ST
HWY 217 HWY
SW HALL BLVD

Habitat-based options (1A, 1B, 1C)

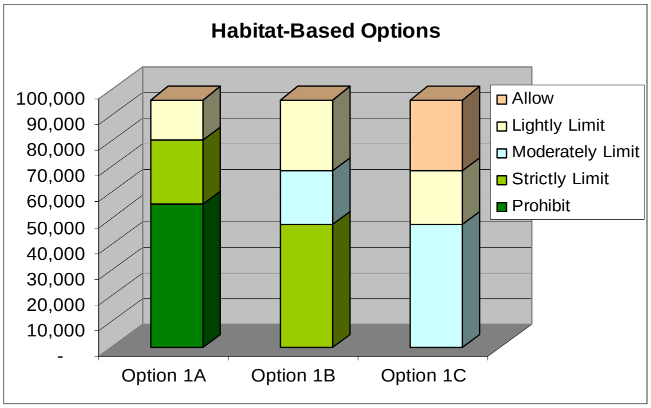
The three habitat-based options (Options 1A, 1B, and 1C) use habitat quality as the basis for varying protection regardless of land uses or urban development values. This approach recognizes fish and wildlife habitat as fixed assets in the urban landscape and orients urban development patterns around habitat areas based on the ecological values present. Ecological values were measured during Metro's Goal 5 inventory process and were based on landscape features (e.g., trees, woody vegetation, wetlands, etc.) and the ecological functions they provide (e.g., shade, streamflow moderation, wildlife migration, nesting and roosting sites, etc.). The inventory was then classified into six categories for the ESEE analysis (Class I-III riparian/wildlife corridors and Class A-C upland wildlife habitat) to distinguish higher value habitat from lower value habitat. Class I riparian/wildlife corridors and Class A upland wildlife habitat are the highest valued habitats.

Table 3-2: Habitat-based options (1A, 1B, 1C)

Fish & Wildlife Habitat Classification	Option 1A	Option 1B	Option 1C
	Treatment	*Treatment*	*Treatment*
Class I Riparian/Wildlife	P	SL	ML
Class II Riparian/Wildlife	P	ML	LL
Class III Riparian/Wildlife	SL	LL	A
Class A Upland Wildlife	P	SL	ML
Class B Upland Wildlife	SL	ML	LL
Class C Upland Wildlife	SL	LL	A
Impact Areas	LL	LL	A

Note: P = Prohibit; SL = Strictly Limit; ML = Moderately Limit; LL = Lightly Limit; A = Allow

Figure 3-9: Habitat-based program options



This approach assumes that all habitat lands have development value. As the ecological value decreases, the recommended treatment becomes less restrictive of development. In these options, the two high value habitat types (Class I riparian and Class A wildlife) would receive the same level of regulatory protection in industrial areas as they would in residential areas. In other words, these options establish a more equal shared responsibility for habitat protection across land uses.

Table 3-2 shows allow, limit and prohibit (ALP) treatments for each option. Figure 3-9 shows habitat and impact area acreage affected by ALP treatments under the three options. In Option 1A, the highest value habitat (Class I and II riparian and Class A wildlife) receives the highest level of protection, while lower valued habitat (Class III riparian and Class B and C wildlife) receives lower levels of protection. In Options 1B and 1C, habitats receive decreasingly lower levels of protection. In Option 1C, the lowest value habitat areas do not receive any protection other than existing local, state and federal regulations. Impact areas would face little or no regulatory requirements.

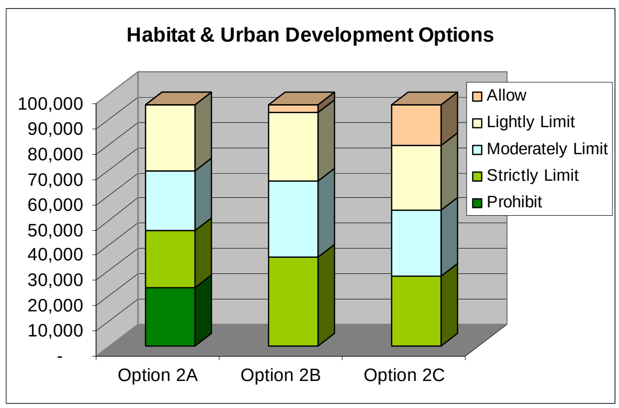
Habitat and urban development-based options (2A, 2B, 2C)

The three habitat and urban development-based options (2A, 2B, and 2C) use habitat values and urban development values as the basis for varying protection. Urban development values were categorized as high, medium or low in the Phase I ESEE analysis based on three measures: land value, employment density and 2040 design type hierarchy (based on Metro's 2040 Growth Concept). Areas receiving a high score in any of the three measures are called "high urban development value"; areas receiving no high scores but at least one medium score are called "medium urban development value"; and areas receiving all low scores are called "low urban development value." Areas without urban development value – parks and open space (both inside and outside the UGB) and rural areas outside the UGB – were not assigned development value.

High priority 2040 Growth Concept design types include the central city, regional centers and regionally significant industrial areas. Medium priority 2040 Growth Concept design types include town centers, main streets, station communities, other industrial areas and employment centers. Inner and outer neighborhoods and corridors are considered low priority 2040 Growth Concept design types. In the recent expansion areas, interim design types were used to determine urban development value.

Tables 3-3, 3-4 and 3-5 show the allow, limit and prohibit (ALP) treatments for each option. Habitat protection levels are adjusted based on urban development value in these options. For example, a Class I riparian corridor located within a regional center or industrial area (high urban development value) would receive less protection than one that passes through an inner or outer neighborhood (low urban development value) in all three tables. Figure 3-10 shows habitat and impact area acreage affected by ALP treatments under the three options.

Figure 3-10: Habitat and urban development-based program options



Option 2A provides the highest level of protection for high valued riparian habitat and less protection for wildlife and other habitat areas. Commercial and industrial areas, which are important to the region, have less protection than other areas in Option 2A. In Options 2B and 2C, the level of protection on the most highly valued habitat decreases, while the levels of protection in the high value urban development areas decrease even more. In Option 2C,the most highly valued urban development areas have no habitat protection, regardless of habitat quality. In all three habitat and urban development-based options, rural areas and parks and open spaces receive more protection than other areas due to their relatively low urban development value. Impact areas would face little or no regulatory requirements in these options.

Table 3-3. Habitat and urban development-based program option (2A) and ALP treatments.

Fish & Wildlife Habitat Classification	HIGH Urban Development Value	MEDIUM Urban Development Value	LOW Urban Development Value	Other Areas*
	Treatment	***Treatment***	***Treatment***	***Treatment***
Class I Riparian/Wildlife	SL	SL	P	P
Class II Riparian/Wildlife	ML	ML	SL	SL
Class III Riparian/Wildlife	LL	LL	LL	ML
Class A Upland Wildlife	LL	ML	ML	SL
Class B Upland Wildlife	LL	LL	ML	ML
Class C Upland Wildlife	LL	LL	LL	ML
Impact Areas	LL	LL	LL	LL

*Other areas include parks and open space within Metro's jurisdiction and areas outside the UGB with no design type.

Table 3-4: Habitat and urban development-based program option (2B) and ALP treatments.

Fish & Wildlife Habitat Classification	HIGH Urban Development Value	MEDIUM Urban Development Value	LOW Urban Development Value	Other Areas*
	Treatment	***Treatment***	***Treatment***	***Treatment***
Class I Riparian/Wildlife	LL	ML	SL	SL
Class II Riparian/Wildlife	LL	LL	ML	ML
Class III Riparian/Wildlife	A	LL	LL	ML
Class A Upland Wildlife	LL	ML	ML	SL
Class B Upland Wildlife	LL	LL	ML	ML
Class C Upland Wildlife	A	LL	LL	ML
Impact Areas	A	LL	LL	LL

*Other areas include parks and open space within Metro's jurisdiction and areas outside the UGB with no design type.

Table 3-5: Habitat and urban development-based program option (2C) and ALP treatments

Fish & Wildlife Habitat Classification	HIGH Urban Development Value	MEDIUM Urban Development Value	LOW Urban Development Value	Other Areas*
	Treatment	***Treatment***	***Treatment***	***Treatment***
Class I Riparian/Wildlife	A	LL	ML	SL
Class II Riparian/Wildlife	A	LL	LL	ML
Class III Riparian/Wildlife	A	A	A	ML
Class A Upland Wildlife	A	LL	ML	SL
Class B Upland Wildlife	A	LL	LL	ML
Class C Upland Wildlife	A	A	A	ML
Impact Areas	A	A	LL	LL

*Other areas include parks and open space within Metro's jurisdiction and areas outside the UGB with no design type.

Habitat acreage by allow, limit and prohibit treatments in program options

Table 3-6 below compares all six options and shows the number of acres that would be covered by each option and treatment type. For example, in Option 1A, 55,450 habitat acres would receive a prohibit treatment (almost 70 percent of habitat acres), whereas 23,084 acres in Option 2A (27 percent of habitat acres) would receive a prohibit treatment. The acreage in this table is for habitat areas and impact areas within Metro's jurisdictional boundary. Approximately 80,200 acres are fish and wildlife habitat; impact areas cover approximately 15,720 acres.

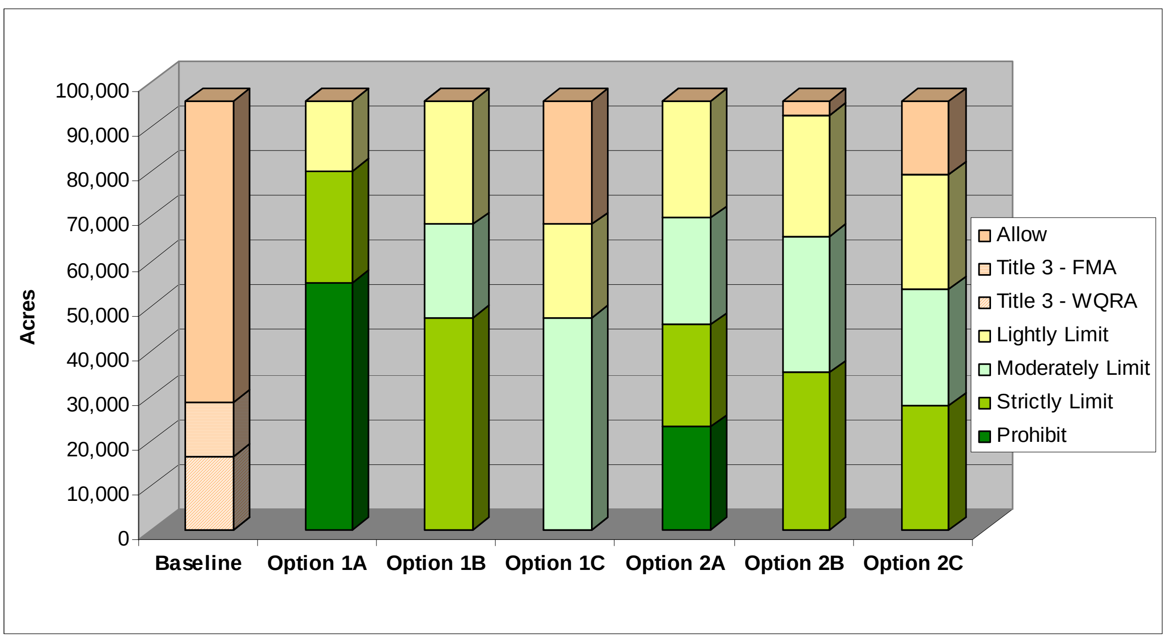
Table 3-6: Habitat and impact area acreage within Metro's jurisdictional boundary by allow, limit and prohibit treatments

Treatment	Option1A	Option 1B	Option 1C	Option 2A	Option 2B	Option 2C
Prohibit	55,450	0	0	23,084	0	0
Strictly Limit	24,784	47,557	0	22,775	35,212	27,872
Moderately Limit	0	20,782	47,557	23,965	30,352	25,983
Lightly Limit	15,721	27,616	20,782	26,131	27,323	25,727
Allow	0	0	27,616	0	3,069	16,374
Total	*95,956*	*95,956*	*95,956*	*95,956*	*95,956*	*95,956*

Figure 3-11 graphically illustrates the information in Table 3-6. The bar on the far left represents Title 3 protection of fish and wildlife habitat. Title 3 acreage is distributed within each of the bars representing the six options. However, these bars do not show in which treatment category this acreage occurs. For example, the 28,540 acres of Title 3 management areas may fall into any one of the treatment categories depending on the program option.

A comparison of the option bars shows that Option 1A provides the greatest habitat protection among the options with a total of 55,450 acres (Class I and II riparian/wildlife, Class A wildlife) covered by a prohibit treatment, and 15,721 acres (Class III riparian/wildlife, Class A and B wildlife) covered by a strictly limit treatment. The bars representing Option 2A-C show more variation in treatment than the habitat-based options, which is a result of considering urban development values. Option 1C provides the least habitat protection among these three options, considering the larger acreage in allow and lightly limit and lack of any habitat in strictly limit.

Figure 3-11: Comparison of options by allow, limit and prohibit treatments



These six program options are evaluated based on their economic, social, environmental and energy consequences in Chapter 4. Most of the data used in this analysis is shown in Table 3-7 (on the following two pages).

Table 3-7: Fish and wildlife habitat classes and impact areas by development status and development value (inside Metro's jurisdiction)

Fish & Wildlife Habitat Class & Urban Development Value	Option 1A	Option 1B	Option 1C	Option 2A	Option 2B	Option 2C	Developed (urban)			Developed (parks)			Total Devel. Habitat Acres	Vacant			Total Vacant Habitat Acres	Total Devel. & Vacant Habitat Acres
							Inside Title 3 WQRA	*Inside Title 3 FMA*	*Outside WQRA/ FMA*	*Inside Title 3 WQRA*	*Inside Title 3 FMA*	*Outside WQRA/ FMA*		*Inside Title 3 WQRA*	*Inside Title 3 FMA*	*Outside WQRA/ FMA*		
Class I Riparian/Wildlife Corridors																		
High	P	SL	ML	SL	LL	A	175	71	36	0	0	0	282	592	516	833	1,942	2,224
Medium	P	SL	ML	SL	ML	LL	254	66	140	0	0	0	460	1,274	288	545	2,107	2,567
Low	P	SL	ML	P	SL	ML	968	272	1,003	0	0	0	2,243	2,281	796	2,020	5,097	7,340
Other Areas	P	SL	ML	P	SL	SL	432	239	179	5,449	3,999	2,045	12,342	1,718	556	1,128	3,402	15,744
Total Acres							***1,829***	***648***	***1,357***	***5,449***	***3,999***	***2,045***	***15,327***	***5,866***	***2,156***	***4,527***	***12,549***	***27,876***
Class II Riparian/Wildlife Corridors																		
High	P	ML	LL	ML	LL	A	104	99	70	0	0	0	273	42	310	316	668	941
Medium	P	ML	LL	ML	LL	LL	184	39	186	0	0	0	409	123	128	434	686	1,095
Low	P	ML	LL	SL	ML	LL	607	102	793	0	0	0	1,502	227	262	875	1,364	2,866
Other Areas	P	ML	LL	SL	ML	ML	126	46	140	266	708	515	1,801	213	254	721	1,188	2,990
Total Acres							***1,021***	***286***	***1,189***	***266***	***708***	***515***	***3,986***	***606***	***954***	***2,347***	***3,907***	***7,893***
Class III Riparian/Wildlife Corridors																		
High	SL	LL	A	LL	A	A	22	918	127	0	0	0	1,066	0	6	41	48	1,114
Medium	SL	LL	A	LL	LL	A	42	487	321	0	0	0	851	2	4	125	131	982
Low	SL	LL	A	LL	LL	A	78	914	452	0	0	0	1,444	4	14	333	351	1,795
Other Areas	SL	LL	A	ML	ML	ML	25	152	57	3	45	123	405	1	3	133	137	541
Total Acres							***167***	***2,471***	***956***	***3***	***45***	***123***	***3,766***	***7***	***27***	***632***	***666***	***4,432***
Class A Wildlife Habitat																		
High	P	SL	ML	LL	LL	A	11	7	50	0	0	0	67	5	17	185	207	275
Medium	P	SL	ML	ML	ML	LL	12	0	88	0	0	0	101	6	0	365	372	473
Low	P	SL	ML	ML	ML	ML	20	2	2,031	0	0	0	2,054	25	2	4,726	4,753	6,807
Other Areas	P	SL	ML	SL	SL	SL	17	36	468	80	42	8,307	8,952	38	1	3,138	3,176	12,127
Total Acres							***60***	***45***	***2,637***	***80***	***42***	***8,308***	***11,173***	***74***	***21***	***8,414***	***8,508***	***19,682***
Class B Wildlife Habitat																		
High	SL	ML	LL	LL	LL	A	1	2	56	0	0	0	58	1	1	357	359	417
Medium	SL	ML	LL	LL	LL	LL	1	0	206	0	0	0	208	7	1	801	809	1,016
Low	SL	ML	LL	ML	ML	LL	15	2	2,674	0	0	0	2,690	15	3	3,094	3,112	5,802
Other Areas	SL	ML	LL	ML	ML	ML	2	1	640	16	4	1,481	2,144	11	4	3,494	3,509	5,653
Total Acres							***19***	***4***	***3,576***	***16***	***4***	***1,481***	***5,100***	***34***	***10***	***7,746***	***7,789***	***12,889***
Class C Wildlife Habitat																		
High	SL	LL	A	LL	A	A	3	6	109	0	0	0	118	4	38	421	462	580
Medium	SL	LL	A	LL	LL	A	2	1	313	0	0	0	317	10	4	809	822	1,139
Low	SL	LL	A	LL	LL	A	4	2	1,348	0	0	0	1,354	7	15	1,715	1,737	3,091
Other Areas	SL	LL	A	ML	ML	ML	1	5	256	9	21	892	1,184	3	0	1,465	1,468	2,653
Total Acres							***10***	***15***	***2,026***	***9***	***21***	***892***	***2,973***	***23***	***56***	***4,410***	***4,489***	***7,463***

Note: WQRA/FMA = Water Quality Resource Area/Flood Management Areas
P = Prohibit; SL = Strictly Limit; ML = Moderately Limit; LL = Lightly Limit; A = allow
Source: Metro 2003

Table 3-7 (cont.): Fish and wildlife habitat classes and impact areas by development status and development value (inside Metro's jurisdiction)

Fish & Wildlife Habitat Class & Development Value	Option 1A	Option 1B	Option 1C	Option 2A	Option 2B	Option 2C	Developed (urban)			Developed (parks)			Total Devel. Habitat Acres	Vacant			Total Vacant Habitat Acres	Total Devel. & Vacant Habitat Acres
							Inside Title 3 WQRA	*Inside Title FMA*	*Outside WQRA/ FMA*	*Inside Title 3 WQRA*	*Inside Title 3 FMA*	*Outside WQRA/ FMA*		*Inside Title 3 WQRA*	*Inside Title 3 FMA*	*Outside WQRA/ FMA*		
Impact Areas																		
High	LL	LL	A	LL	A	A	76	123	698	0	0	0	897	39	48	391	478	1,375
Medium	LL	LL	A	LL	LL	A	154	34	1,429	0	0	0	1,617	109	5	709	824	2,440
Low	LL	LL	A	LL	LL	LL	402	45	6,596	0	0	0	7,043	96	12	1,524	1,631	8,674
Other Areas	LL	LL	A	LL	LL	LL	52	6	801	103	143	1,005	2,109	37	2	1,084	1,123	3,232
Total Acres							***684***	***208***	***9,523***	***103***	***143***	***1,005***	***11,665***	***280***	***68***	***3,708***	***4,056***	***15,721***
Grand Total							***3,792***	***3,678***	***21,265***	***5,926***	***4,962***	***14,368***	***53,990***	***6,890***	***3,293***	***31,783***	***41,965***	***95,956***

Note: WQRA/FMA = Water Quality Resource Area/Flood Management Areas
RC/WH = riparian corridor, wildlife habitat; WH = upland wildlife habitat
P = Prohibit; SL = Strictly Limit; ML = Moderately Limit; LL = Lightly Limit; A = allow
Source: Metro 2002

CHAPTER FOUR: ANALYSIS OF REGULATORY PROGRAM OPTIONS

Six regulatory options are under consideration for land classified as regionally significant fish and wildlife habitat, as described in Chapter Three. Five potential regulatory treatments are applied in each of the options, ranging from allowing conflicting uses to prohibiting conflicting uses in habitat areas. The potential consequences of applying these treatments to fish and wildlife habitat are considered and evaluated with 19 criteria identified by the Metro Council in October 2003; 17 criteria are derived from the economic, social, environmental, and energy tradeoffs and two additional criteria consider how well the six regulatory options would assist in meeting the requirements of the federal Endangered Species Act and the Clean Water Act.

The criteria are based on the tradeoffs identified in the Phase I ESEE analysis of protecting or not protecting regionally significant fish and wildlife habitat. For example, the economic analysis identified the tradeoffs related to development opportunities and the regional economy. The economic analysis also identified the economic values associated with ecosystem services provided by fish and wildlife habitat. The criteria are assumed to have equal weight in the evaluation of program options. Table 4-1 below describes the evaluation criteria.

Table 4-1. Evaluation criteria.

Economic factors	**Description**
1. Supports the regional economy by providing development opportunities (such as residential, commercial, industrial)	The regional economy depends on urban development. Metro identified priorities for urban development based on land value, employment potential and regional growth management priorities (2040 Growth Concept).
2. Supports economic values associated with ecosystem services (such as flood control, clean water, recreation and amenity values).	Stream corridors and upland wildlife habitat provide economic value (e.g.,habitat provides services that can significantly reduce public and private costs over the long term). Higher value habitat provides more ecosystem services.
3. Promotes recreational use and amenities	Focuses on the recreational benefits – both active and passive – of retaining habitat. Options that protect more high quality habitat will help protect the recreational amenity values.
4. Distribution of economic tradeoffs	Highlights land uses (regional zoning) and ownership classes (public vs. private) that would bear a disproportional share of impacts.
5. Minimizes need to expand the urban growth boundary (UGB) and increase development costs.	Describes the effects of program options on the need to expand the urban growth boundary (UGB).
Social factors	
6. Minimizes impact on property owners	Potential regulations have different impacts on residential, business and rural property owners. Options that provide more habitat protection have more impact on property owners.
7. Minimizes impact on location and choices for housing and jobs	Applying regulations to protect habitat may affect the urban land supply and relates to people's basic needs for housing and jobs.
8. Preserves habitat for future generations	Species diversity, environmental quality and the potential economic benefits derived from fish and wildlife habitat are important for people today as well as future generations.
9. Maintains cultural heritage and sense of place	Fish and wildlife habitat provides important values such as cultural heritage (salmon) and regional identity (people move here to enjoy the proximity to the natural environment).

10. Preserves amenity value of resources (quality of life, property values, views)	Fish and wildlife habitat provides amenity values such as quality of life, increased property values and regional attractiveness.
Environmental factors	
11. Conserves existing watershed health and restoration opportunities	Preserving habitat protects existing ecosystem functions (such as clean, cold, reliable water sources) that promote a healthy watershed and retains lower quality habitat for future restoration opportunities.
12. Retains multiple habitat functions provided by forest areas	Forest cover is important to maintain healthy fish and wildlife habitat and a diversity of species in the region. Forested areas may be found in developed areas (such as neighborhoods) and on vacant land. Trees are more likely to be lost in vacant areas than in existing neighborhoods.
13. Promotes riparian corridor connectivity and overall habitat connectivity	Habitat connectivity is important to fish and wildlife. Stream corridor connectivity allows fish to travel safely to upstream areas. Many fish and wildlife species must make seasonal journeys to meet basic needs for food, shelter and breeding.
14. Conserves habitat quality and biodiversity provided by large habitat areas	Large habitats are more valuable to native wildlife than smaller ones because more wildlife species are retained over time. Animals sensitive to human disturbance still have a place to live.
15. Supports biodiversity through conservation of sensitive habitats and species	Some habitats once common are now scarce (such as wetlands, native meadows, white oaks, healthy urban streams). Sensitive species depend on these rare habitats; their loss could significantly impact biodiversity.
Energy Factors	
16. Promotes compact urban form	A compact urban form conserves energy by reducing auto travel times and need for roads.
17. Promotes green infrastructure	Trees and other vegetation reduce energy demand by decreasing water and air temperature, flooding, and air pollution associated with energy use.
Other criteria	
18. Assists in protecting fish and wildlife protected by the federal Endangered Species Act	The Endangered Species Act's ultimate goal is to recover species and conserve the ecosystems upon which they depend so they no longer need regulatory protection. Protecting slopes, wetlands, riparian functions, hydrologic conditions and areas of high habitat value may help species recover and prevent future listings.
19. Assists in meeting water quality standards required by the federal Clean Water Act	Protecting slopes and wetlands, habitat near streams, hydrologic conditions, and forested areas can assist local jurisdictions in meeting the standards of the federal Clean Water Act.

This chapter includes detailed analysis of the performance of the six regulatory program options against the criteria. It includes a ranking of the options for each criterion.

Evaluation of economic criteria

This section of the Phase II ESEE analysis compares the potential economic tradeoffs of the six regulatory programs. Based on the analysis of economic consequences in Phase I, Metro developed five criteria to measure the performance of program options in addressing the potential economic impacts. These criteria are:

1. Supports urban development priorities.
2. Supports economic values of ecosystem services.
3. Supports recreational access and amenities.
4. Distributes economic tradeoffs.
5. Minimizes need to expand the urban growth boundary (UGB).

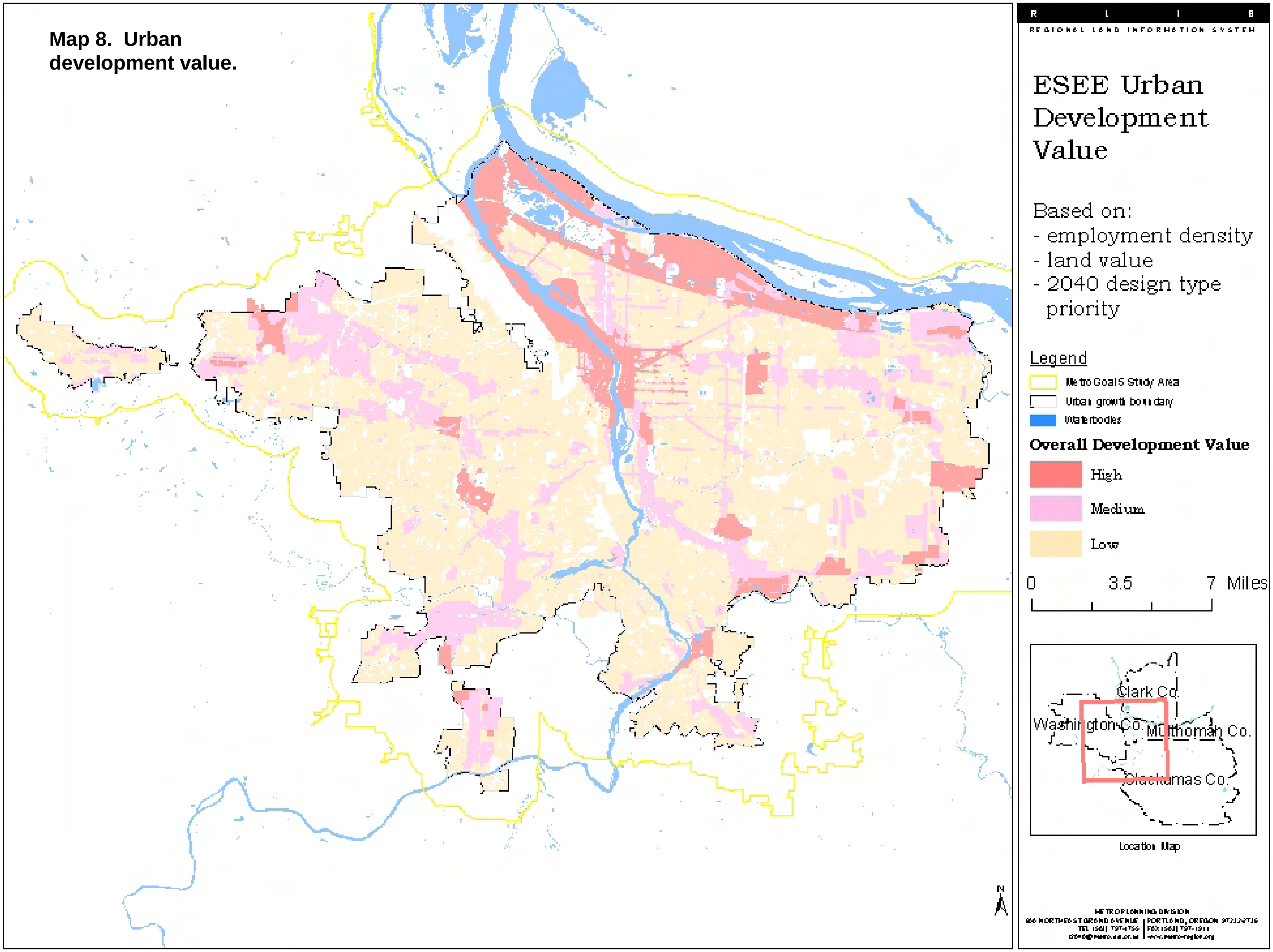
1. Supports urban development priorities.

This criterion uses the land rankings developed in Phase I of the ESEE analysis as a tool to identify where lands with high, medium or low development value are affected by allow, limit, or prohibit treatments under the six regulatory program options.

Not all land has the same economic importance for development. For example, land zoned for parks is assumed to have less economic importance than land zoned for industrial uses. In Phase I of the ESEE analysis, a method was developed to rank the relative economic importance of land for development, or "development value." Urban lands were ranked into three categories – "high," "medium" and "low" – using three measures: land value, employment density and 2040 design types (based on Metro's 2040 Growth Concept). Land value and employment density describe relative economic importance based on the current land use and labor demands. The 2040 design type hierarchy ranks land using development priorities as described by Metro's regional goals for future land use and development.

Lands that ranked high scored high on at least one of the three measures. Lands that ranked medium scored medium on at least one of the three measures, and lands that ranked low scored low on each of the three measures. A fourth category of lands, "other lands," describes primarily non-urban lands that are not ranked for development value. Approximately half of these lands are inside the UGB, half are outside. These lands include parks and open space and agricultural and forestry land. Describing the economic consequences of program options using these measures provides information on current and future economic tradeoffs of protecting fish and wildlife habitat. Map 8 shows the urban development values.

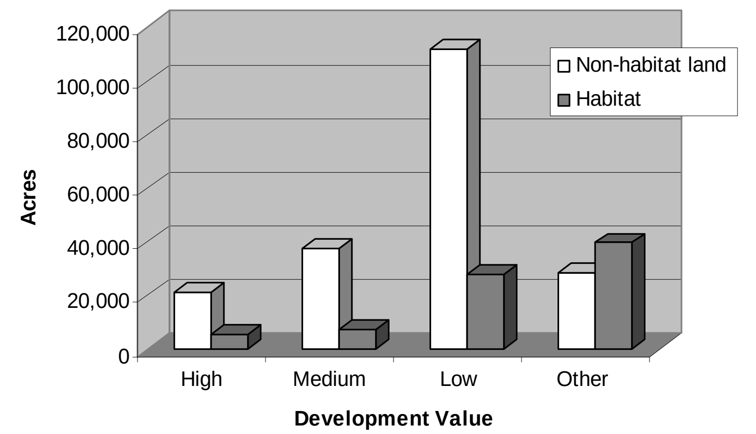
Map 8. Urban development value.



Potential impacts on urban development priorities

The economic analysis for this criterion evaluates urban development values on land containing fish and wildlife habitat. Comparing the acres of land that contain habitat with the total acres of land in Metro's jurisdiction provides insight into the relative magnitude of land affected by the six regulatory program options. Figure 4-1 illustrates the distribution of lands in Metro's jurisdiction (approximately 280,000 acres) by habitat status (non-habitat vs. habitat) and development value (high, medium, low).

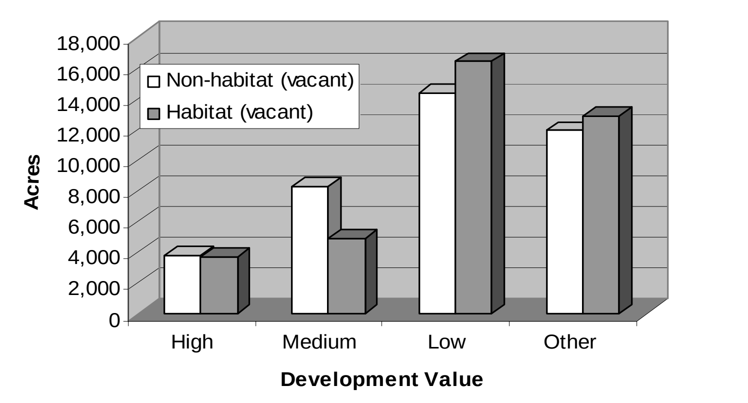
Figure 4-1: Non-habitat and habitat land by urban development value in Metro's jurisdiction.



This analysis assumes that Goal 5 treatments that protect habitat (i.e., prohibit or limit) could restrict urban use and development of these lands and/or increase development costs. About a quarter of the lands in Metro's jurisdiction with high, medium and low development values could potentially be affected by Goal 5 treatments and may have considerable negative consequences for the regional economy. Sixty-three percent of "other" lands in Metro's jurisdiction also contain fish and wildlife habitat. To the extent that program options protect habitat on these lands rather than on urban lands, negative impacts on urban development priorities may be limited.

Goal 5 treatments could impact half of all vacant land in Metro's jurisdiction. Figure 4-2 shows the breakdown of vacant lands in Metro's jurisdiction with and without fish and wildlife habitat. It describes a significant impact because in general, developing vacant land costs less and takes less time than redeveloping land, which makes this land more desirable for expanding urban development priorities. Also, because these lands are currently vacant and more easily developed, the negative impacts of reduced property value, increased development costs, and reduced employment associated with limit and prohibit treatments may begin in the short term.

Figure 4-2: Vacant non-habitat and habitat land by urban development value in Metro's jurisdiction.



Comparing Figure 4-1 with Figure 4-2 shows that a larger proportion of vacant land ranked high and low contain habitat compared with the average for all lands in Metro's jurisdiction.

Figure 4-3 Developed non-habitat and habitat by urban development value in Metro's jurisdiction.

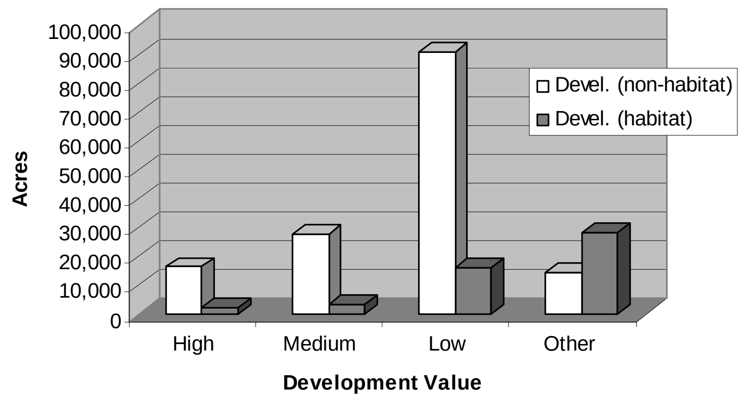


Figure 4-3 illustrates that most developed land in Metro's jurisdiction does not contain fish and wildlife habitat. Limit and prohibit treatments would affect development values on approximately 15 percent of the developed land in Metro's jurisdiction. Negative impacts on property value, development costs, and employment would accrue over the long term as redevelopment takes place on these lands.

Protecting habitat acres that otherwise could be developed under current regulations may reduce the developable area of a parcel, which could also reduce the parcel's market value. This result is more likely with strictly limit and prohibit treatments and less likely with lightly limit and moderately limit treatments.

Protection may also require modifying development plans, such as changing access routes or altering a development's configuration. Such changes may increase development costs, which may also negatively impact property values. Limiting developable area or increasing development costs for commercial or industrial sites may also negatively impact the site's employment potential. To the extent that protection limits or prevents developing land uses consistent with the 2040 Growth Concept, these actions may negatively impact the region's long-term planning goals.

Program options with the greatest support for use and development of land would rank highest for this criterion. These options have the greatest number of acres affected by allow, lightly limit and moderately limit treatments. Program options that least support use and development of land would rank lowest. These options have the greatest number of acres affected by strictly limit and prohibit treatments.

Measuring the criterion

Table 4-2 shows the number of acres of habitat land and impact areas in the four urban development categories (high, medium, low, and other) affected by allow, limit, and prohibit treatments for the six program options. Habitat acres considered developed, but in park status, are excluded from this table because they generally are not available for urban development.

Table 4-2: Acres of fish and wildlife habitat & impact areas by urban development priorities affected by program options (parks not included).

Treat-ment	Program Options	*HIGH* Urban Development Value			MEDIUM Urban Development Value			LOW Urban Development Value			Other Areas		
		Dev. urban	*Vacant inside Title 3*	*Vacant outside Title 3*	*Dev. urban*	*Vacant inside Title 3*	*Vacant outside Title 3*	*Dev. urban*	*Vacant inside Title 3*	*Vacant outside Title 3*	*Dev. urban*	*Vacant inside Title 3*	*Vacant outside Title 3*
Allow	Option 1A	0	0	0	0	0	0	0	0	0	0	0	0
	Option 1B	0	0	0	0	0	0	0	0	0	0	0	0
	Option 1C	2,081	135	853	2,785	134	1,643	9,841	148	3,572	1,354	45	2,683
	Option 2A	0	0	0	0	0	0	0	0	0	0	0	0
	Option 2B	2,081	135	853	0	0	0	0	0	0	0	0	0
	Option 2C	2,762	1,621	2,544	2,785	134	1,643	2,798	40	2,048	0	0	0
Lightly limit	Option 1A	897	87	391	1,617	114	709	7,043	108	1,524	859	39	1,084
	Option 1B	2,081	135	853	2,785	134	1,643	9,841	148	3,572	1,354	45	2,683
	Option 1C	331	355	673	617	260	1,235	4,192	507	3,970	955	483	4,215
	Option 2A	2,207	160	1,394	2,992	142	2,444	9,841	148	3,572	859	39	1,084
	Option 2B	681	1,486	1,691	3,402	394	2,878	9,841	148	3,572	859	39	1,084
	Option 2C	0	0	0	1,178	1,828	2,146	11,235	614	5,493	859	39	1,084
Moderately limit	Option 1A	0	0	0	0	0	0	0	0	0	0	0	0
	Option 1B	331	355	673	617	260	1,235	4,192	507	3,970	955	483	4,215
	Option 1C	349	1,132	1,018	561	1,568	911	4,296	3,104	6,746	1,372	2,312	4,266
	Option 2A	273	352	316	510	258	799	4,744	45	7,821	1,138	22	5,092
	Option 2B	0	0	0	561	1,568	911	6,246	534	8,696	1,450	489	5,814
	Option 2C	0	0	0	0	0	0	4,296	3,104	6,746	1,450	489	5,814
Strictly limit	Option 1A	1,243	50	819	1,375	28	1,734	5,488	58	5,143	1,138	22	5,092
	Option 1B	349	1,132	1,018	561	1,568	911	4,296	3,104	6,746	1,372	2,312	4,266
	Option 1C	0	0	0	0	0	0	0	0	0	0	0	0
	Option 2A	282	1,109	833	460	1,562	545	1,502	489	875	834	505	3,859
	Option 2B	0	0	0	0	0	0	2,243	3,077	2,020	1,372	2,312	4,266
	Option 2C	0	0	0	0	0	0	0	0	0	1,372	2,312	4,266
Prohibit	Option 1A	622	1,484	1,334	970	1,820	1,345	5,798	3,593	7,621	1,684	2,779	4,987
	Option 1B	0	0	0	0	0	0	0	0	0	0	0	0
	Option 1C	0	0	0	0	0	0	0	0	0	0	0	0
	Option 2A	0	0	0	0	0	0	2,243	3,077	2,020	850	2,274	1,128
	Option 2B	0	0	0	0	0	0	0	0	0	0	0	0
	Option 2C	0	0	0	0	0	0	0	0	0	0	0	0

Results

Figures 4-5 through 4-8 (at the end of this section) illustrate the findings in Table 4-2 for the four categories of urban development value: high, medium, low, and other lands. Program options that emphasize allow, lightly limit and moderately limit treatments rank higher for this criterion because, for the range of Goal 5 treatments, these would likely have the least negative impact on property values, employment and 2040 design types. Program options that rank higher for high and medium lands are not the same program options that rank higher for low and other lands. Low and other lands, however, account for more acres of land than high and medium lands.

Basic statistics

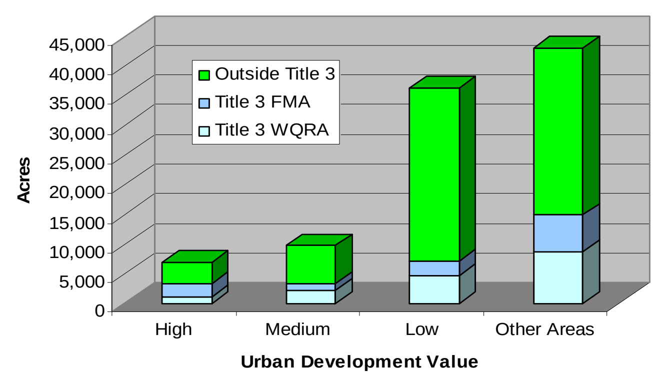
In total the analysis includes 95,956 acres of urban and non-urban fish and wildlife habitat and impact areas. This criterion would affect 53,015 acres of urban lands (ranked for development priority).

- 6,925 acres of land ranked high (habitat land – 5,550 acres; impact areas – 1,375 acres)
- 9,713 acres of land ranked medium (habitat land – 7,273 acres; impact areas – 2,440 acres)
- 36,376 acres of land ranked low (habitat land – 27,702 acres; impact areas – 8,674 acres)
- 42,940 acres of other areas, the non-urban lands that have not been ranked by high, medium, or low development value (habitat land – 39,708; impact areas – 3,232 acres)

Baseline protection (Title 3)

- Title 3 Water Quality and Flood Management Plan currently limits development in Water Quality Resource Areas, and requires specific design standards for development in Flood Management Areas. Any negative impacts of Goal 5 treatments on these lands represent marginal changes in development conditions rather than absolute changes compared with development conditions on the lands without Title 3 regulations. Some local regulations exceed Title 3 protection levels; therefore, the actual marginal changes in development conditions are less than if only Title 3 regulations were considered. However, for reasons stated in Chapter 3, it is not possible to measure the additional increment of land protection beyond the Title 3 baseline for all jurisdictions within the region.

Figure 4-4: Title 3 coverage of habitat & impact areas by urban development value.



- Figure 4-4 shows that Title 3 currently covers almost half of habitat lands with high development values.
- Approximately one-third of habitat lands with medium development values and one-fifth of lands with low urban development values currently receive Title 3 protection.

Potential economic tradeoffs vary by Goal 5 treatments

The extent to which the six program options support urban development priorities depends in part on the mix of allow, limit, and prohibit (ALP) treatments that comprise each program option. The ALP treatments will affect the amount of land protected, prescribe mitigating habitat damage, and identify guidelines on development design and land division. To the extent that land outside Title 3 WQRAs are covered by local programs, they would not necessarily be affected by regional program options.

- *Protecting habitat*. The proposed definition of Goal 5 treatments for protecting habitat range from no additional protection under allow treatments, to limiting conflicting uses to varying degrees (lightly limit, moderately limit, strictly limit), to prohibiting conflicting uses in habitat areas.

- *Mitigation.* In addition to protecting significant amounts of habitat from development the potential ALP treatments also call for mitigating negative ecological impact of developing habitat lands. Mitigation requirements may increase with increasing protection.

  Mitigation requirements may increase the cost of developing lands that contain habitat, which could negatively impact the urban development priorities. The actual impacts on development costs would depend on the percentage of habitat cover, the negative impacts of development on habitat, and the specifics of the mitigation requirements.

- *Design guidelines and land divisions*. The potential ALP treatments may include locating development as far away as possible from water features and minimizing fragmentation of wildlife habitat. Lightly limit and moderately limit treatments may encourage using low impact development techniques. These treatments may also encourage land divisions that designate habitat as open space. Planned densities will most likely not be affected under lightly and moderately limit treatments. Strictly limit treatments may require low impact development practices and require land divisions for dedicated open space. Prohibit treatments may not allow development.

  Potential ALP treatments that include design standards and land division restrictions may increase development costs. The actual impacts on development costs would depend on the details specific to the parcel and land use.

- *Allow Treatment*. The allow treatment would have no impact on development priorities beyond existing federal, state, or local regulations. Goal 5 would have no incremental or additional impact on lands affected by an allow treatment.
- *Impact Areas*. A majority lands categorized as impact areas are already developed (66 percent). (See Phase I ESEE report for information on impact areas.) These lands would receive allow or lightly limit treatments upon redevelopment.

Potential economic tradeoffs of treatments vary by the development status of lands
The development status of lands would influence the timing of the economic impacts of program options on urban development priorities.
- *Vacant lands outside Title 3*. These lands are currently vacant and are unconstrained by Title 3 (water quality and flood management). However, these lands could be constrained by federal, state, and local regulations, which apply beyond Title 3 boundaries. These lands would likely be developed first and experience the most immediate impacts of program options.

- *Vacant lands inside Title 3*. Development on these lands is constrained by current regulations aimed at protecting water quality and flood areas. Similar to vacant lands outside Title 3, vacant lands inside Title 3 would likely experience economic impacts of program options in the short run. The magnitude of Goal 5 impacts on these lands, however, would likely be less (depending on the strictness of Goal 5 treatments applied) because existing regulations limit development on these lands.
- *Developed urban lands*. Lands classified as developed urban would experience economic impacts of program options through redevelopment or expanding existing land uses. Current Title 3 regulations apply to redevelopment actions, so Goal 5 treatments could result in a marginal increase in development constraints depending on the treatment applied. These impacts would likely occur farther into the future compared with impacts on vacant lands inside and outside Title 3.

Comparison of program options

Lands with high urban development value (See Figure 4-5)

- Option 2C provides the greatest support for lands with high urban development value among the six program options. This result holds for developed lands, vacant lands outside Title 3 and vacant lands inside Title 3.
- In descending order of support for urban development priorities the remaining options rank: 2B, 1C, 2A, 1B, and 1A. Option 1C, which emphasizes habitat protection, performs better under this criterion than does Option 2A, which emphasizes urban development values.
- The ranking of the program options described above applies to developed urban lands and vacant lands outside Title 3. This ranking also reflects the outcome for vacant lands inside Title 3 except that Options 2A and 1B perform similarly rather than 2A dominating 1B.

Lands with medium urban development value (See Figure 4-6)

- Option 2C also performs best for lands with medium urban development value. This result also holds for the three development categories of land.
- The order of the remaining program options for medium value lands under this criterion reflects the order for high value lands except that Option 1C performs better than remaining options in the following order: 1C, 2B, 2A, 1B, 1A.
- The above ranking holds for developed urban and vacant lands outside Title 3. For vacant land inside Title 3 Options 2A and 1B perform comparably rather than 2A performing better than 1B as indicated above.

Lands with low urban development value (See Figure 4-7)

- Option 1C, which was designed to emphasize habitat protection, performs better than the other options under this criterion for lands with low urban development value. This result holds for the three development categories.
- In descending order of support for urban development priorities the remaining options rank: 2C, 2B, 1B, 2A, 1A.
- This ranking holds for developed urban and vacant lands outside Title 3. For vacant land inside Title 3, Options 2B and 1B perform comparably rather than Option 2B performing better 1B as indicated above.

Other lands (See Figure 4-8)

- As with lands ranked low, Option 1C also provides the greatest support for urban development values for other lands. This result holds for the three development categories.
- In descending order of support for urban development priorities, the remaining options rank: 1B, 2C and 2B are comparable, 2A and 1A.
- This ranking holds for developed urban and vacant lands outside Title 3. For vacant land inside Title 3, Option 1B performs similarly to Options 2C and 2B rather than Option 1B performing better than the other two.

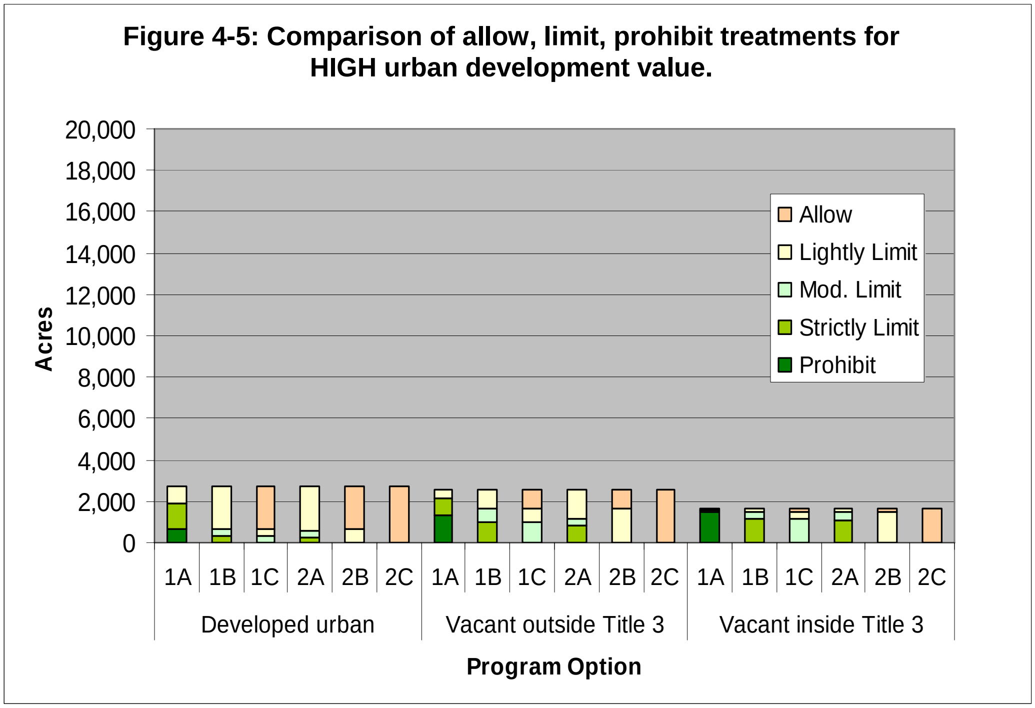


Figure 4-5: Comparison of allow, limit, prohibit treatments for HIGH urban development value.
Acres
20,000
18,000
16,000
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
Allow
Lightly Limit
Mod. Limit
Strictly Limit
Prohibit
1A 1B 1C 2A 2B 2C 1A 1B 1C 2A 2B 2C 1A 1B 1C 2A 2B 2C
Developed urban
Vacant outside Title 3
Vacant inside Title 3
Program Option

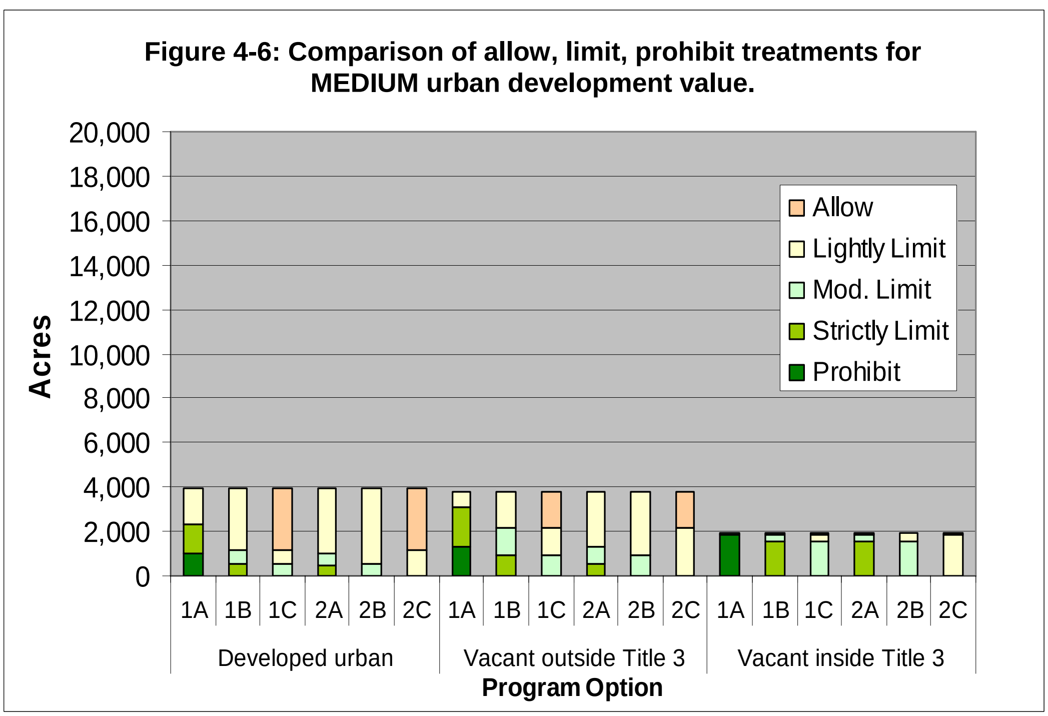


Figure 4-6: Comparison of allow, limit, prohibit treatments for MEDIUM urban development value.
Acres
20,000
18,000
16,000
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
Allow
Lightly Limit
Mod. Limit
Strictly Limit
Prohibit
1A 1B 1C 2A 2B 2C 1A 1B 1C 2A 2B 2C 1A 1B 1C 2A 2B 2C
Developed urban
Vacant outside Title 3
Vacant inside Title 3
Program Option

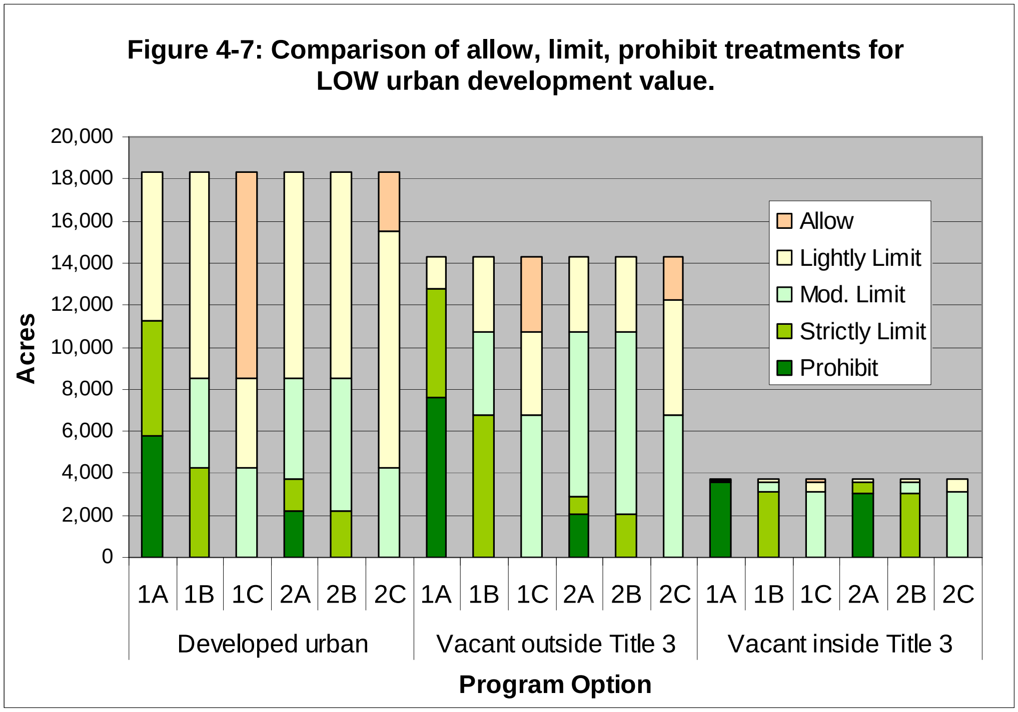


Figure 4-7: Comparison of allow, limit, prohibit treatments for LOW urban development value.
Acres
20,000
18,000
16,000
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
Allow
Lightly Limit
Mod. Limit
Strictly Limit
Prohibit
1A 1B 1C 2A 2B 2C 1A 1B 1C 2A 2B 2C 1A 1B 1C 2A 2B 2C
Developed urban
Vacant outside Title 3
Vacant inside Title 3
Program Option

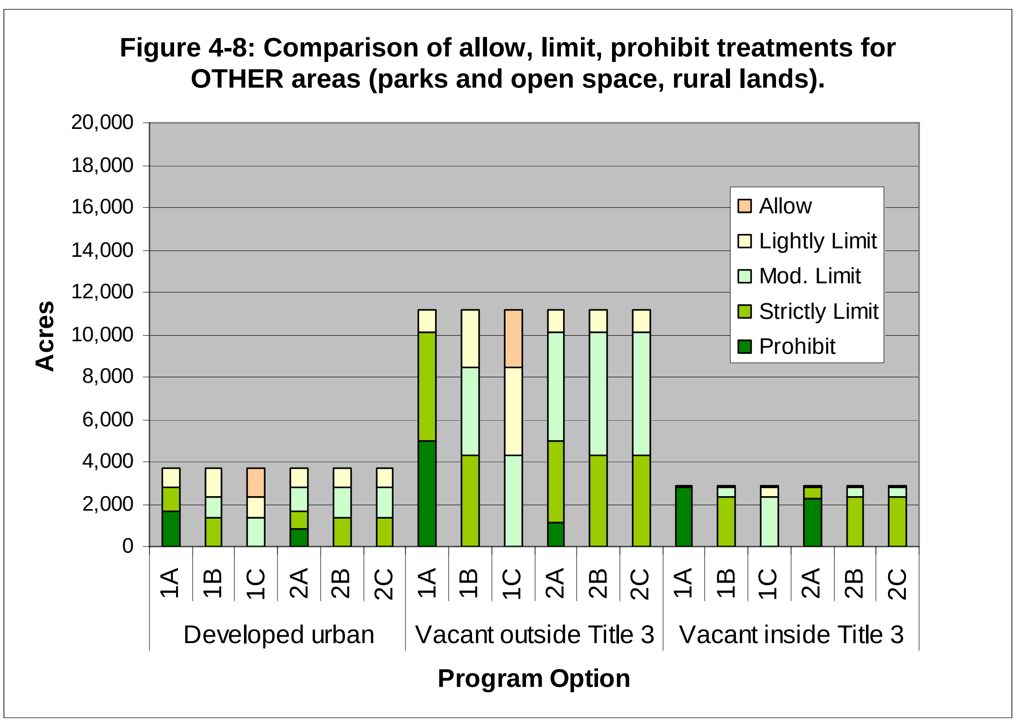


Figure 4-8: Comparison of allow, limit, prohibit treatments for OTHER areas (parks and open space, rural lands).
Acres
20,000
18,000
16,000
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
Allow
Lightly Limit
Mod. Limit
Strictly Limit
Prohibit
1A 1B 1C 2A 2B 2C 1A 1B 1C 2A 2B 2C 1A 1B 1C 2A 2B 2C
Developed urban
Vacant outside Title 3
Vacant inside Title 3
Program Option

Summary

Table 4-3 summarizes the ranking of program options based on the outcome for lands with high urban development value. These lands contain the greatest concentration of high valued lands and lands with the highest employment density.

Table 4-3: Performance of options in meeting Economic Criterion 1: supports urban development priorities.

Rank	Option	Performance
1	2C	Option 2C provides the greatest support for urban development priorities among the six options, as described by the impacts on lands ranked "high." It has the greatest number of acres affected by allow treatments, which have no negative impacts on development, and no acres affected by strictly limit or prohibit treatments.
2	2B	Options 2B and 1C are second to Option 2C in the number of allow acres. 2B has more acres affected by lightly limit than 1C. 2B has zero acres affected by moderately limit, 1C has the most acres affected by moderately limit of any option. For these reasons 2B dominates 1C.
3	1C	Option 1C dominates option 2A because 1C has acres affected by allow treatments. 2A has no allow acres.
4	2A	Option 2A has more lightly limit acres than 1B or 1A. Option 1B has more acres affected by moderately limit and strictly limit than 2A. Option 1A is the only option with acres affected by prohibit treatments.
5	1B	Option 1B dominates 1A because it has more acres affected by lightly limit treatments and no acres affected by prohibit treatments.
6	1A	Option 1A has the greatest negative impact from prohibit treatments and the greatest negative impact overall on urban-development priorities of the six options.

Note that the ranking of program options based on the *average* outcome for the *total acres* in the analysis differs from the ranking in Table 4-3. A summary based on the average for all acres weighs more heavily the impacts on lands ranked low and other lands, because these rankings contain more acres than do lands with high or medium rankings. The ranking of program options based on the average for all acres is: 1C, 2C, 2B, 1B, 2A, 1A.

2. Supports economic values of ecosystem service

The acres of habitat protected by program options help determine the extent to which the options retain ecosystem services and related economic values. Regionally significant fish and wildlife habitat is ranked into six classes based on the amounts and types of ecological functions and wildlife characteristics: Class I-III riparian/wildlife corridors and Class A-C upland wildlife habitat. Areas with more ecological functions and/or areas with functions closer to streams, wetlands, or floodplains rank higher than areas with fewer functions or with functions further away from water features (see Chapter 4 of Metro's Phase I ESEE analysis for full discussion of ecosystem services).

Potential impacts on the value of ecosystem services

Metro's inventory and ranking focused on the ecological functions and wildlife characteristics that affect a habitat's biophysical health and wellbeing. Well-functioning habitats also produce ecosystem services that benefit society. Table 4-4 below lists the ecological functions and wildlife characteristics that were considered in ranking of fish and wildlife habitat, the related ecosystem services that benefit society, and where these ecosystem services occur in the inventory classes.

Table 4-4: Ecological functions, wildlife characteristics and related ecosystem services that benefit society.

Ecological function	Ecosystem service	Where ecosystem services occur in Metro's habitat classes
Microclimate, shade, and cooling of water temperature	Decreased summer temperatures, which helps reduce energy demand for cooling.	All habitat classes
Moderated stream flow and improved water storage	Reduced flood damage and flood management costs.	All habitat classes
Bank stabilization and sediment and pollution control	Improved water quality. Reduced demand for water filtration and treatment. Reduced landslides and related damage and clean-up costs.	All habitat classes
Large woody debris and channel dynamics	Reduced flood damage and flood-management costs.	Class I or II riparian/wildlife corridors
Well-functioning riparian areas in general	Increased amenity and intrinsic values associated with riparian areas.	All habitat classes
Habitats of concern and habitats for unique and sensitive species	Increased populations of salmon and other species and associated increases in commercial, recreational, spiritual and intrinsic values.	Class I riparian/wildlife corridors, Class A upland wildlife habitat
Well-functioning wildlife habitats in general	Increased amenity and intrinsic values associated with wildlife habitat.	All upland wildlife classes and Class I-II riparian/wildlife corridors

Source: ECONorthwest and Metro's inventory and ranking of riparian and wildlife resources.

The analysis of program options and their associated impacts on ecosystem services and related economic values assumes:

- Areas that provide more of the ecological functions and wildlife characteristics illustrated in Table 4-4 provide more ecosystem services and value to society than do areas that provide fewer functions and characteristics.
- Actions that enhance or protect ecosystem services also enhance or protect the economic values associated with those services. Actions that degrade these services will have the opposite effect.

This criterion emphasizes protecting habitats and associated ecosystem services. Criterion 1 emphasizes just the opposite, developing habitat in support of urban development priorities. In general, options that performed well under the Criterion 1, emphasizing urban development priorities, perform poorly under Criterion 2, because they degrade ecosystem functions, wildlife habitat, and the associated ecosystem services listed in Table 4-4. The resulting negative economic consequences over the long term may include:

- Higher summer temperatures with associated increased cooling costs in summer.
- Increased air pollution and associated impacts and costs.
- Increased flooding with related property damage, and disruption of commercial, business, and industrial activity, and increased transportation disruptions and costs.
- Increased landslides that may threaten residential, commercial and industrial properties, transportation routes and water quality.
- Decreased water quality and associated increased treatment costs.
- Reduced amenity and intrinsic values associated with habitat and species.

Degrading habitat on a regional scale, such as the lands in Metro's jurisdiction, may generate significant negative economic consequences, especially over the long term. Protecting these resources over the long term may yield economic benefits throughout the region. (See Metro's Phase 1 ESEE Report for information on methods of estimating the value of the affected ecosystem services and the magnitudes of the values.)

Environmental Criterion 1 (conserves existing watershed health and restoration opportunities) describes the impact of program options on the amount and quality of ecosystem functions for fish and wildlife habitat. It is assumed that program options that promote or protect these functions also promote or protect the related ecosystem services and values to society. It is also assumed that options that rank high on this environmental criterion will also rank high for related ecosystem services and economic values.

The analysis of program options and their impacts on the value of ecosystem services builds upon the biophysical analysis of ecosystem functions. The ecosystem functions provide the ecosystem services that society values. This criterion describes the impacts of program options on related ecosystem services and values to society. Not incidentally, to assign values to the ecosystem services derived from the biophysical analysis of ecosystem functions does not double count the economic importance of ecosystem functions or ecosystem services. The two analyses— biophysical and economic—are separate, with the economic analysis converting the findings of the biophysical analysis to different units of measurement.

Measuring the criterion

Table 4-5 shows the number of acres of habitat, by habitat class, affected by allow, limit, and prohibit treatments for the six program options. The habitat classes are subdivided for developed and vacant acres. As described in Economic Criterion 1, vacant acres will experience the most immediate impacts of program options. Developed lands will experience impacts of program options through the eventual redevelopment and expansion of existing land uses.

Table 4-5: Retention of ecosystem services by program option (in number of acres of habitat).

Program treatment		Option 1A		Option 1B		Option 1C		Option 2A		Option 2B		Option 2C	
		Developed	Vacant	Developed	Vacant	Developed	Vacant	Developed	Vacant	Developed	Vacant	Developed	Vacant
Class I	A	0	0	0	0	0	0	0	0	0	0	282	1,942
	LL	0	0	0	0	0	0	0	0	282	1,942	460	2,107
	ML	0	0	0	0	15,327	12,549	0	0	460	2,107	2,243	5,097
	SL	0	0	15,327	12,549	0	0	742	4,050	14,585	8,499	12,342	3,402
	P	15,327	12,549	0	0	0	0	14,585	8,499	0	0	0	0
Class A	A	0	0	0	0	0	0	0	0	0	0	67	207
	LL	0	0	0	0	0	0	67	207	67	207	101	372
	ML	0	0	0	0	11,173	8,508	2,154	5,125	2,154	5,125	2,054	4,753
	SL	0	0	11,173	8,508	0	0	8,952	3,176	8,952	3,176	8,952	3,176
	P	11,173	8,508	0	0	0	0	0	0	0	0	0	0
Class II	A	0	0	0	0	0	0	0	0	0	0	273	668
	LL	0	0	0	0	3,986	3,907	0	0	682	1,354	1,911	2,050
	ML	0	0	3,986	3,907	0	0	682	1,354	3,303	2,553	1,801	1,188
	SL	0	0	0	0	0	0	3,303	2,553	0	0	0	0
	P	3,986	3,907	0	0	0	0	0	0	0	0	0	0
Class B	A	0	0	0	0	0	0	0	0	0	0	58	359
	LL	0	0	0	0	5,100	7,789	266	1,168	266	1,168	2,898	3,921
	ML	0	0	5,100	7,789			4,834	6,622	4,834	6,622	2,144	3,509
	SL	5,100	7,789					0	0	0	0	0	0
	P	0	0	0	0	0	0	0	0	0	0	0	0
Class III	A	0	0	0	0	3,766	666	0	0	1,066	48	3,361	530
	LL	0	0	3,766	666	0	0	3,361	530	2,295	482	0	0
	ML	0	0	0	0	0	0	405	137	405	137	405	137
	SL	3,766	666	0	0	0	0	0	0	0	0	0	0
	P	0	0	0	0	0	0	0	0	0	0	0	0
Class C	A	0	0	0	0	2,973	4,489	0	0	118	462	1,789	3,021
	LL	0	0	2,973	4,489	0	0	1,789	3,021	1,671	2,559	0	0
	ML	0	0	0	0	0	0	1,184	1,468	1,184	1,468	1,184	1,468
	SL	2,973	4,489	0	0	0	0	0	0	0	0	0	0
	P	0	0	0	0	0	0	0	0	0	0	0	0

Notes for table 4-5:
Developed: sums parks and urban acres because the focus of this criterion is the retention of habitat irrespective of development status
Vacant: sums constrained and unconstrained acres (by Title 3 baseline regulations) for the same reason above.

Results

Figures 4-9 through 4-11 illustrate the findings in Table 4-5. Program options that protect more fish and wildlife habitat overall, as well as more of the most valuable habitat, rank higher for this criterion.

Figure 4-9: Performance of program options for Class I and Class A habitat.

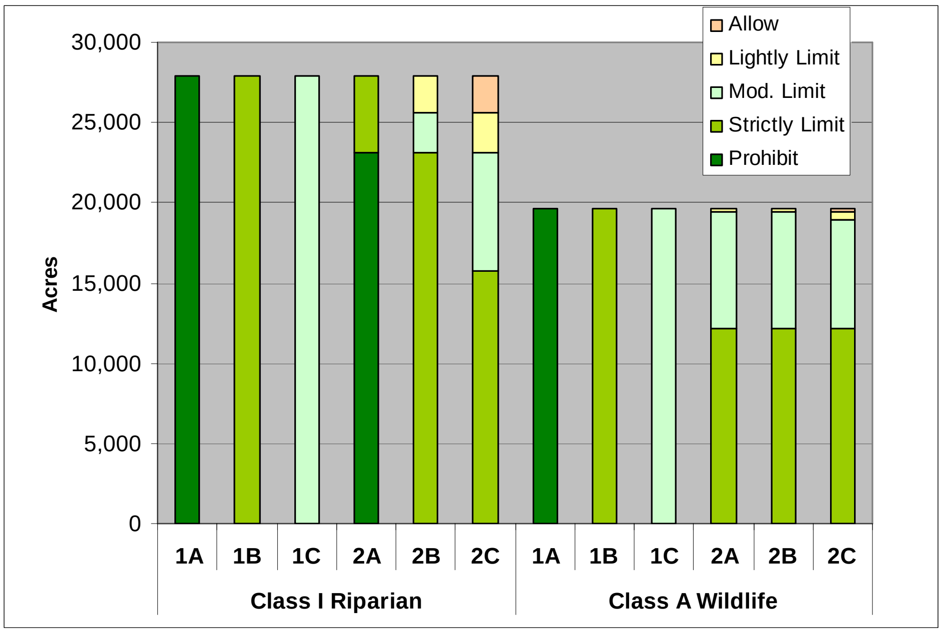


Figure 4-10: Performance of program options for Class II and Class B habitat.

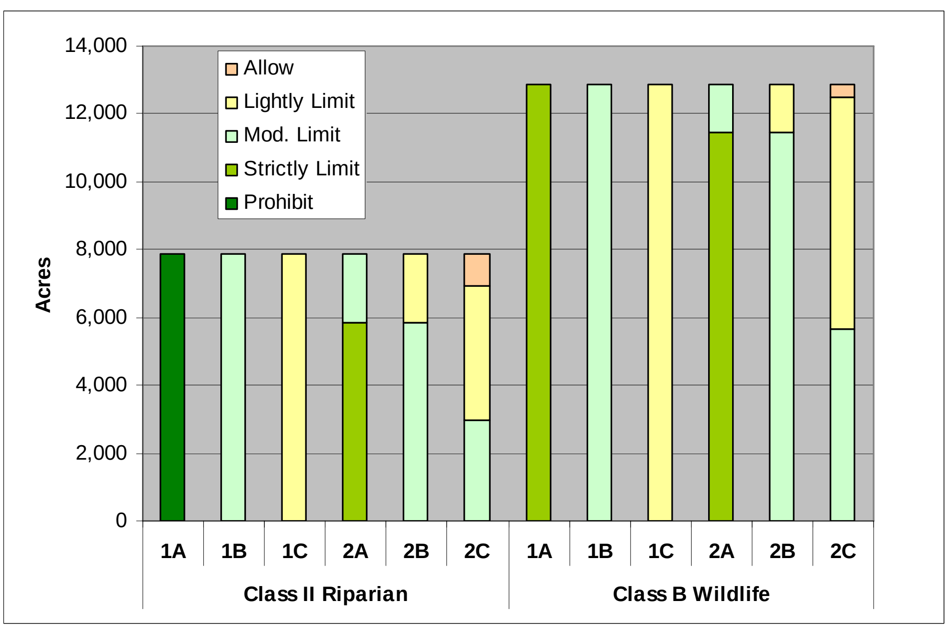
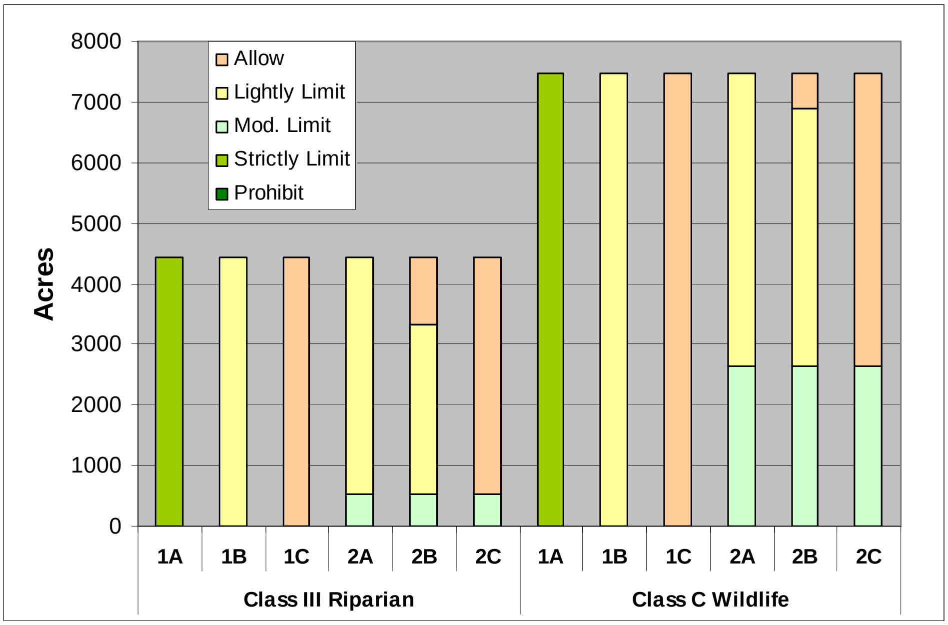


Figure 4-11: Performance of program options for Class III and Class C habitat.



Basic statistics

- This analysis includes 40,201 acres of Class I, II, and III riparian/wildlife corridors and 40,032 acres of Class A, B, and C wildlife habitat.
- The highest quality riparian/wildlife corridors (Class I) account for 69 percent of the total number of acres of riparian habitat.
- The highest quality wildlife habitat (Class A) account for 49 percent of the total number of acres of wildlife habitat.

Baseline protection (Title 3)

- Program options that provide the least protection to habitat lands will, in general, have more negative impacts on Class A, B, and C lands over the long term compared to the impacts on Class I, II, and III lands, because the lands in the latter group receive more baseline protection from Title 3. For example, nearly half of Class I and a quarter of Class II riparian/wildlife corridors are included in Title 3 Water Quality Resource Areas.
- Title 3 Water Quality Resource Areas (WQRA) and Flood Management Areas (FMA) protect 72, 49, and 61 percent of Class I, II, and III lands, respectively (See Chapter 3, *Baseline for Analysis*).
- To the extent that the WQRAs and FMAs also protect the ecosystem services specific to Class I through III habitat lands, they also protect the associated economic values.
- Title 3 provides almost no protection for Class A, B, and C lands or the associated ecosystem services and values. Inside Title 3 protection, Class A lands account for two percent, Class B lands for one percent, and Class C lands for two percent.

Comparison of program options

Class I, II, and III riparian/wildlife corridors

- Option 1A promotes the greatest retention of ecosystem services and associated economic values among the six options for Class I, II, and III lands. This result holds for developed and vacant land in Metro's jurisdiction.
- In descending order of retaining ecosystem services and associated values, the remaining options rank: 2A, 1B, 2B, 2C, 1C.

Class A, B, and C upland wildlife

- The six program options perform similarly for Class A and B lands but not for Class C lands.
- Similar to Class I, II, and III lands, Option 1A promotes the greatest retention of ecosystem services and associated economic values among the six options for Class A and B lands.
- In descending order for lands in Class A and B, the remaining options rank: 1B, 2A = 2B, 2C, and 1C. This ranking applies to developed and vacant land.
- Option 1A also promotes the greatest retention of ecosystem services and associated economic values among the six options for Class C lands.
- In descending order for lands in Class C, the remaining options rank: 2A, 2B, 2C, 1B, 1C. This ranking applies to developed and vacant land.

Summary

Table 4-6 summarizes the performance ranking of the program options based on the average outcome for the total acres in the analysis. As a group, Class I, II and III lands cover approximately the same number of acres as the lands in Class A, B and C. Thus, the outcomes for these two groups receive approximately the same weight. The outcomes for the individual classes, however, do not receive equal weights because the number of acres in each class differs. The classes rank in the following descending order based on the acres of lands in the class expressed as a percentage of the total acres in the analysis: Class I (35 percent of total acres), Class A (25 percent), Class B (16 percent), Class II (9 percent), Class C (9 percent), and Class III (6 percent). The results in Table 4-6 reflect the weighting of the results for the individual classes based on these percentages.

Table 4-6: Performance of options in meeting Economic Criterion 2: promotes retention of ecosystem services

Rank	Option	Performance
1	1A	This option provides the greatest retention of ecosystem services and related economic values among the six options. This is true for all classes of habitat and for developed and vacant lands.
2	2A	Comparable to Option 1B in overall retention of ecosystem services and related values. Option 2A retains more higher quality riparian services, while Option 1B retains more higher quality wildlife habitat services.
3	1B	See the description for Option 2A.
4	2B	Performs comparable to Option 2A for Class A and B lands. For all other lands, Option 1B performs better.
5	2C	Performs consistently behind Options 2B, and consistently dominates Option 1C.
6	1C	This option provides the least retention of ecosystem services and related economic values of the six options. This ranking applies for all classes of habitat and for developed and vacant lands.

The proposed Goal 5 guidelines include mitigating adverse impacts of development on habitat. Detailed mitigation guidelines have not yet been developed. The site-specific nature of habitat and the impacts of development on the habitat will also influence the type and amount of Goal 5 mitigation that may be required. Given these uncertainties, and the conclusions from Metro's Technical Report for Goal 5 that mitigating habitat damage in urban areas faces considerable challenges, the ranking of program options in Table 4-6 does not reflect the outcome of potential Goal 5 mitigation.

3. Promotes recreational access and amenities.

This criterion ranks program options based on the extent to which they promote recreational access and amenities. The analysis of this criterion uses data similar to that for the analysis of Environmental Criterion 1 and Economic Criterion 2 – acres of habitat protected. The criterion, however, focuses on the subset of total habitat acres that support recreational opportunities. Metro classifies these lands as parks and open space.

The analysis of this criterion distinguishes between public and private recreational lands because ownership may influence the impacts of program options on recreational access. For example, public ownership implies more open access to recreational opportunities. Private ownership implies that access requires membership or has other restrictions. Public park and open space lands include parks, schools and rights-of-way. Private park and open space lands includes golf courses and cemeteries.

Potential impacts on recreational opportunities

In general, the program options would have a limited impact on the number of acres of recreational and open space lands. This is true for two reasons. First, existing land uses either support recreational use and open space directly (e.g., public parks or golf courses) or support recreation related uses indirectly (e.g., schools). The options would have more limited impacts on the number of acres of these types of land uses compared with the more intensive urban development uses described in Criterion 1. The second reason is that the large majority of the lands in this analysis are publicly owned. Public ownership makes it unlikely (though not impossible) that recreational and open space uses will change significantly in the future.

The options may impact the *quality* of recreational and open space experiences on the lands at issue in this analysis. Options that protect more habitat, and more higher quality habitat, will help protect the recreational related amenity values associated with the habitat. The analysis of program options and their associated impacts on recreational access and amenities assumes:

- Fish and wildlife habitat provide recreation and open space related ecosystem services and values to society. Higher quality habitat provides higher quality ecosystem services and values compared with lower quality habitat.
- Actions that enhance or protect habitat also enhance or protect the recreation and open space related amenities that influence the quality of recreational experiences. Actions that degrade these services will have the opposite effect.
- Program options that protect habitat lands with more restrictive treatments will also promote greater access to recreational opportunities and higher quality recreational experiences. Options that provide less protection will have the opposite effect.

Other lands outside park and open space can contribute to recreational experiences and amenities. For example, bird and fish habitat on non-parklands contribute to the amenity value of bird watching and fishing on parklands. The analysis of Criterion 3 focuses only on parks and open spaces; thus, it likely underestimates the true scope and values of recreational amenities affected by Goal 5 program options.

Measuring the criterion

Table 4-7 below shows the habitat acres that support recreation (25,265 acres) by ownership (public vs. private) and by allow, limit, and prohibit treatments for the six program options.

Table 4-7: Acres in parks and open space lands by ownership and by program treatment

Program Options	Program treatments	Publicly owned	Privately owned	Total acres	Public: % of total	Private: % of total
Option 1A	Prohibit	19,046	2,372	21,418	89%	11%
	Strictly limit	2,076	521	2,596	80%	20%
	Moderately limit	0	0	0	0%	0%
	Lightly limit	950	302	1,252	76%	24%
	Allow	0	0	0	0%	0%
Option 1B	Prohibit	0	0	0	0%	0%
	Strictly limit	17,967	1,959	19,926	90%	10%
	Moderately limit	2,301	692	2,993	77%	23%
	Lightly limit	1,804	542	2,346	77%	23%
	Allow	0	0	0	0%	0%
Option 1C	Prohibit	0	0	0	0%	0%
	Strictly limit	0	0	0	0%	0%
	Moderately limit	17,967	1,959	19,926	90%	10%
	Lightly limit	2,301	692	2,993	77%	23%
	Allow	1,804	542	2,346	77%	23%
Option 2A	Prohibit	10,311	1,185	11,495	90%	10%
	Strictly limit	8,736	1,187	9,923	88%	12%
	Moderately limit	2,076	521	2,596	80%	20%
	Lightly limit	950	302	1,252	76%	24%
	Allow	0	0	0	0%	0%
Option 2B	Prohibit	0	0	0	0%	0%
	Strictly limit	17,967	1,959	19,926	90%	10%
	Moderately limit	3,155	933	4,088	77%	23%
	Lightly limit	950	302	1,252	76%	24%
	Allow	0	0	0	0%	0%
Option 2C	Prohibit	0	0	0	0%	0%
	Strictly limit	17,967	1,959	19,926	90%	10%
	Moderately limit	3,155	933	4,088	77%	23%
	Lightly limit	0	0	0	0%	0%
	Allow	950	302	1,252	76%	24%

Results

Figure 4-12 displays the information from Table 4-7. It shows that the large majority of land at issue in this case is in public ownership. Figure 4-13 shows park lands by quality of habitat and by ownership. The large majority of park lands in this analysis also contains the highest quality fish and wildlife habitat.

Figure 4-12: Performance of program options for parks and open space lands, by ownership.

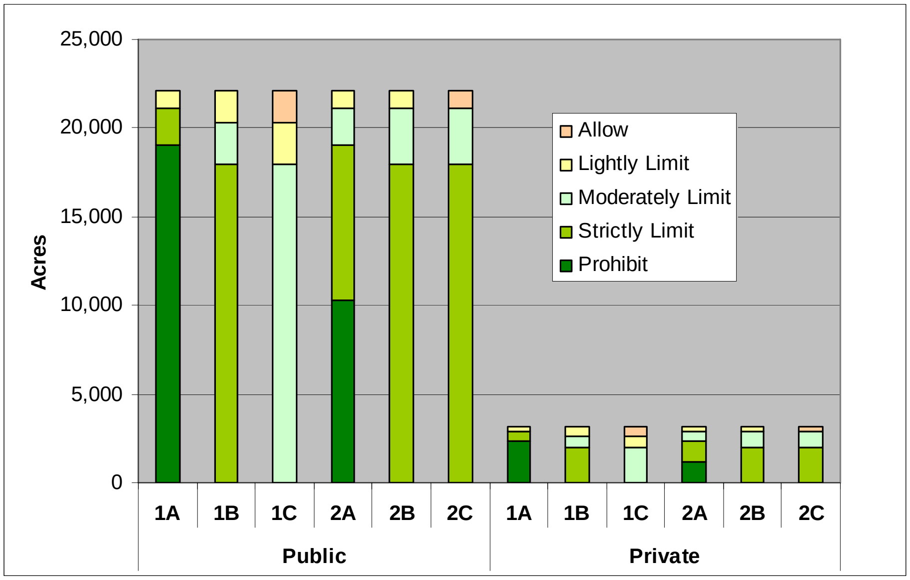
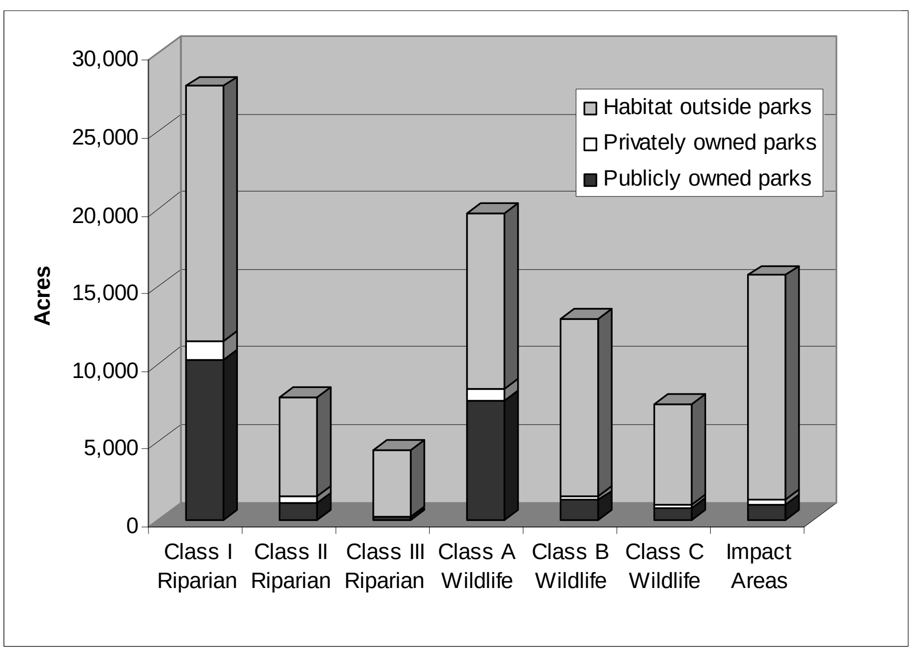


Figure 4-13: Park lands by habitat class and ownership.



Program options that protect more park and open space lands overall will more likely promote recreational access, higher quality recreational experiences and score higher for this criterion. Program options that protect more *public* park and open space lands will more likely promote recreational access with fewer restrictions compared with protecting *private* park and open space lands. The quality of remaining habitat land will also affect the quality of recreational experiences.

Basic statistics

- The analysis for this criterion includes 25,265 acres of park and open space lands.
- 22,071 acres, or 87 percent, are publicly owned; 3,194 acres, or 13 percent, are privately owned.

Comparison of Program Options

Park and open space lands in public ownership

- Option 1A promotes recreational access to the greatest extent of the six program options by protecting over 21,000 acres of public and private park and open space lands with prohibit treatments. Given that the large majority of these lands also contains Class I and Class A habitat, this option also protects habitat lands that provide the highest quality recreational and open space amenities.
- In descending order of promoting recreational access and the quality of recreational amenities, the options rank: 2A, 2B, 1B, 2C, 1C.
- Two of the options that take into account urban development values rather than quality of habitat, 2A and 2B, perform better under this criterion than do options 1B and 1C, which were designed with greater habitat protection in mind.

Park and open space lands in private ownership

- The program options rank the same for privately owned park lands as they do for lands in public ownership.
- Ownership does influence the performance of the less protective treatments of the program options. In general, private lands account for a higher proportion of the less protective treatments compared with their portion of the total park and open space acres. For example, under option 1B, private park land accounts for 23 percent of the lands with moderately and lightly limit treatments. But these lands account for 13 percent of the total park lands. In general, private lands receive a larger percentage of the less protective treatments and a smaller percentage of the more protective treatments relative to public lands.

Summary

Table 4-8 summarizes the ranking of the performance of the program options based on the average outcome for the total acres in the analysis.

Table 4-8. Performance of options in meeting Economic Criterion 3: promotes recreational access and amenities.

Rank	Option	Performance
1	1A	This option promotes the greatest access to recreational opportunities, and highest quality recreational experiences among the six options. This holds for both public and private park lands. This option protects over 21,000 acres with prohibit treatments, the most of any option.
2	2A	This option relies on a mix of prohibit and strictly limit treatments. It performs better than options 1B and 1C, which take habitat protection into account.
3	2B	This option relies on a mix of limit treatments, without allow or prohibit treatments. This option also performs better than options 1B and 1C.
4	1B	This option relies on a mix of limit treatments, without allow or prohibit treatments. Option 2B dominates this option even though both rely on a mix of limit treatments.
5	2C	This option relies on a mix of limit and allow treatments.
6	1C	This option provides the least support for recreational opportunities and quality of recreational experiences among the six options. This holds for both public and private park lands.

4. Distributes economic tradeoffs

This discussion of Criterion 4 has two parts. The first part considers the distributional impacts of program options on property owners as described by public and private land. The second considers the distributional impacts on land use as described by regional zoning types.

The other economic criteria (1, 2, 3 and 5) in this analysis rank program options on a scale, for example, from least to most supportive of urban development priorities. The analysis for this criterion does not emphasize ranking program options because they do not vary significantly by land ownership or regional zone. It focuses instead on describing the extent to which the strictness of program options (e.g., allow vs. lightly limit, or lightly limit vs. moderately limit, etc.) varies by ownership or by regional zone. This criterion highlights property owners or regional zones that would bear a greater burden of the land use impacts that may stem from the more restrictive Goal 5 treatments.

Distribution of impacts by property ownership

This portion of the analysis describes the impact of program options on land ownership as measured by acres of public and private land. Economic Criterion 1 describes the impacts of program options on urban development values. In this criterion, the *distribution* of the impacts of program options on public and private lands that support the urban development values (described in Criterion 1) are examined. Similar to the analysis of Economic Criterion 1, the analysis for this criterion also assumes that the Goal 5 program options that protect habitat would restrict use and development of public and private land. Restrictions are assumed to be more likely with prohibit and strictly limit treatments and less likely with lightly limit or allow treatments.

Measuring the criterion

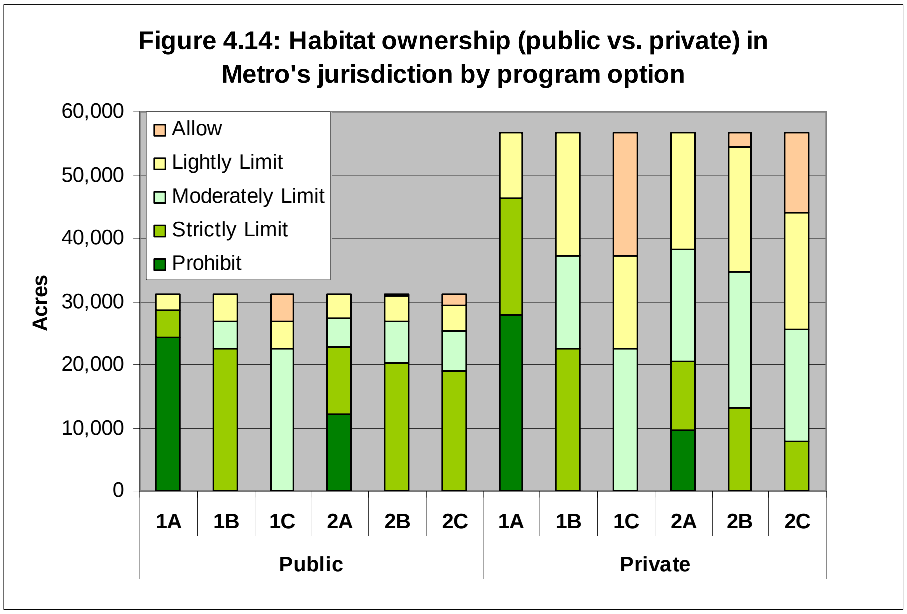
Table 4-9 shows the breakdown of Goal 5 allow, limit, and prohibit treatments by public and private lands for each program option.

Table 4-9: Habitat and impact area acres by land ownership and program options.

Program Option	Program Treatment	Acres of Resource in Taxlots			% of Resource in Taxlots			% of Treament in Taxlots			% of Ownership in Taxlots		
		Private	Public	Total*	Private	Public	Total*	Private	Public	Total*	Private	Public	Total*
	P	27,840	24,341	52,182	32%	28%	59%	53%	47%	100%	49%	78%	59%
	SL	18,423	4,156	22,579	21%	5%	26%	82%	18%	100%	32%	13%	26%
	ML	0	0	0	0%	0%	0%	0%	0%	0%	0%	0%	0%
	LL	10,491	2,534	13,025	12%	3%	15%	81%	19%	100%	18%	8%	15%
	AL	0	0	0	0%	0%	0%	0%	0%	0%	0%	0%	0%
Option 1A	Total*	56,754	31,032	87,786	65%	35%	100%	65%	35%	100%	100%	100%	100%
	P	0	0	0	0%	0%	0%	0%	0%	0%	0%	0%	0%
	SL	22,527	22,507	45,034	26%	26%	51%	50%	50%	100%	40%	73%	51%
	ML	14,797	4,245	19,042	17%	5%	22%	78%	22%	100%	26%	14%	22%
	LL	19,431	4,280	23,710	22%	5%	27%	82%	18%	100%	34%	14%	27%
	AL	0	0	0	0%	0%	0%	0%	0%	0%	0%	0%	0%
Option 1B	Total*	56,754	31,032	87,786	65%	35%	100%	65%	35%	100%	100%	100%	100%
	P	0	0	0	0%	0%	0%	0%	0%	0%	0%	0%	0%
	SL	0	0	0	0%	0%	0%	0%	0%	0%	0%	0%	0%
	ML	22,527	22,507	45,034	26%	26%	51%	50%	50%	100%	40%	73%	51%
	LL	14,797	4,245	19,042	17%	5%	22%	78%	22%	100%	26%	14%	22%
	AL	19,431	4,280	23,710	22%	5%	27%	82%	18%	100%	34%	14%	27%
Option 1C	Total*	56,754	31,032	87,786	65%	35%	100%	65%	35%	100%	100%	100%	100%
	P	9,658	12,197	21,855	11%	14%	25%	44%	56%	100%	17%	39%	25%
	SL	10,972	10,525	21,497	12%	12%	24%	51%	49%	100%	19%	34%	24%
	ML	17,495	4,629	22,124	20%	5%	25%	79%	21%	100%	31%	15%	25%
	LL	18,630	3,680	22,310	21%	4%	25%	84%	16%	100%	33%	12%	25%
	AL	0	0	0	0%	0%	0%	0%	0%	0%	0%	0%	0%
Option 2A	Total*	56,754	31,032	87,786	65%	35%	100%	65%	35%	100%	100%	100%	100%
	P	0	0	0	0%	0%	0%	0%	0%	0%	0%	0%	0%
	SL	13,230	20,256	33,486	15%	23%	38%	40%	60%	100%	23%	65%	38%
	ML	21,456	6,550	28,006	24%	7%	32%	77%	23%	100%	38%	21%	32%
	LL	19,639	3,974	23,613	22%	5%	27%	83%	17%	100%	35%	13%	27%
	AL	2,430	251	2,681	3%	0%	3%	91%	9%	100%	4%	1%	3%
Option 2B	Total*	56,754	31,032	87,786	65%	35%	100%	65%	35%	100%	100%	100%	100%
	P	0	0	0	0%	0%	0%	0%	0%	0%	0%	0%	0%
	SL	7,740	18,953	26,693	9%	22%	30%	29%	71%	100%	14%	61%	30%
	ML	17,923	6,319	24,241	20%	7%	28%	74%	26%	100%	32%	20%	28%
	LL	18,291	3,997	22,288	21%	5%	25%	82%	18%	100%	32%	13%	25%
	AL	12,801	1,763	14,564	15%	2%	17%	88%	12%	100%	23%	6%	17%
Option 2C	Total*	56,754	31,032	87,786	65%	35%	100%	65%	35%	100%	100%	100%	100%

* Total habitat acres differ from original number (95,955 acres) because some areas do not have tax lots (e.g., roads).

Results
Figure 4-14 illustrates the findings from Table 4-9.



Basic Statistics

- Privately owned land accounts for 56,745 acres, or 65 percent of the total acres in this analysis.
- Publicly owned land accounts for 31,031 acres, or 35 percent of the total acres in this analysis.

Comparison of program options

- The ranking of program options from least to most restrictive does not vary by property ownership. The program options rank, from least to most restrictive: 1C, 2C, 2B, 1B, 2A, and 1A.
- Even though the rank of program options does not vary by ownership, the degree of restriction does vary by public or private ownership. In general, publicly owned lands bear a higher proportion of the most restrictive Goal 5 treatments than do privately owned lands, relative to the distribution of public and private acres in the analysis. For example, Option 1C, which is the least restrictive option, splits the number of acres affected by the most restrictive treatment (moderately limit) evenly between public and private land (see Table 4.11 below). However, private land accounts for 65 percent, and public land accounts for 35 percent of total acres. If the impacts of the most restrictive treatment were distributed proportionally based on the number of acres of private and public lands in the analysis, private lands would receive approximately 65 percent of the most restrictive treatment and public lands 35 percent.

Table 4-10: Distribution of Allow, Limit and Prohibit Treatments between Private and Public Land for Option 1C.

Treatment	Private Lands (65% of total acres)	Public Lands (35% of total acres)	Total
Prohibit	0%	0%	
Strictly Limit	0%	0%	
Moderately Limit	50%	50%	100%
Lightly Limit	78%	22%	100%
Allow	82%	18%	100%

- The reverse is true for the less restrictive treatments. The less restrictive Goal 5 treatments affect private lands in a proportion greater than their percentage of total acres in the analysis. Public lands receive less-than-proportional impacts from the less restrictive treatments.
- For example, private lands account for 65 percent of the acres in the analysis but account for 78 percent of the acres affected by lightly limit treatments and 82 percent of the acres affected by allow treatments. Public lands, in contrast, account for 35 percent of the acres but 22 percent of the lightly limit treatments and 18 percent of allow treatments.

Distribution of impacts by regional zoning type

In this portion of the analysis, the impacts of program options on land uses in Metro's jurisdiction are described. There are seven regional zones (see Metro's Phase I ESEE report for a description of regional zoning types).

- Single-family residential (SFR)
- Multi-family residential (MFR)
- Mixed-use centers (MUC)
- Commercial (COM)
- Industrial (IND)
- Parks and open space (POS)
- Rural (RUR)

Potential impacts on zoning types

In this part of the analysis, it is assumed that program options that protect habitat would restrict land uses as described by regional zoning types. Land use restrictions are assumed to be more likely with prohibit and strictly limit treatments and less likely with moderately or lightly limit treatments.

The extent to which any one zoning type bears a disproportional share of acres affected by program options, relative to the zoning type's share of total acres in Metro's jurisdiction, are considered. Also described for a given program option are the land uses that receive less restrictive treatments (e.g., moderately limit and lightly limit) and those that receive more (e.g., strictly limit and prohibit).

Measuring the criterion

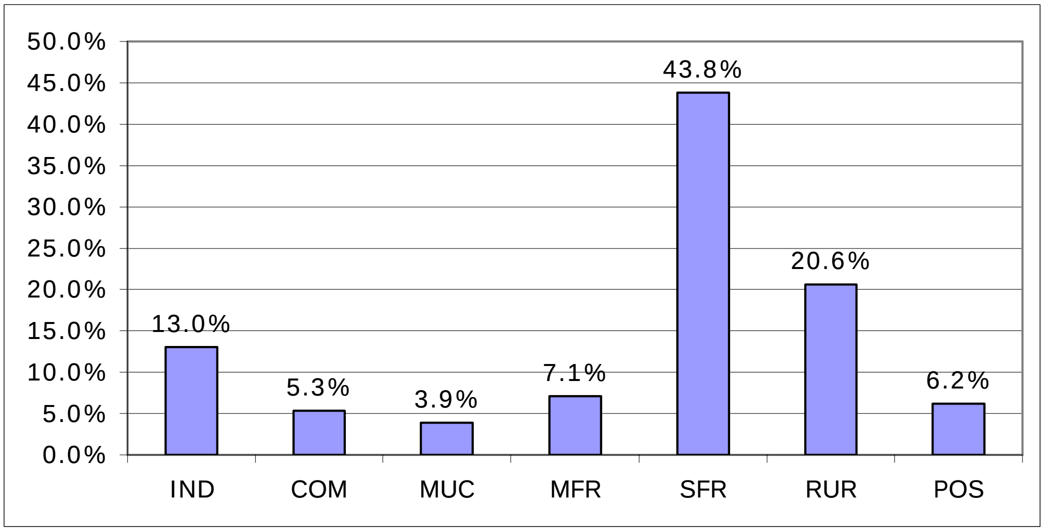
This criterion is measured by evaluating the number of acres in each zoning type affected by allow, limit and prohibit treatments.

Results

As background to the analysis of the distributional impacts of program options on land uses, Metro considered the extent to which any one zoning type bears a disproportional share of impacts from Goal 5 treatments relative to the zoning type's share of total acres in Metro's jurisdiction. Such an outcome would occur if a zoning type accounts for a larger proportion of the acres affected by a program option relative to the zoning type's proportion of total acres in Metro's jurisdiction.

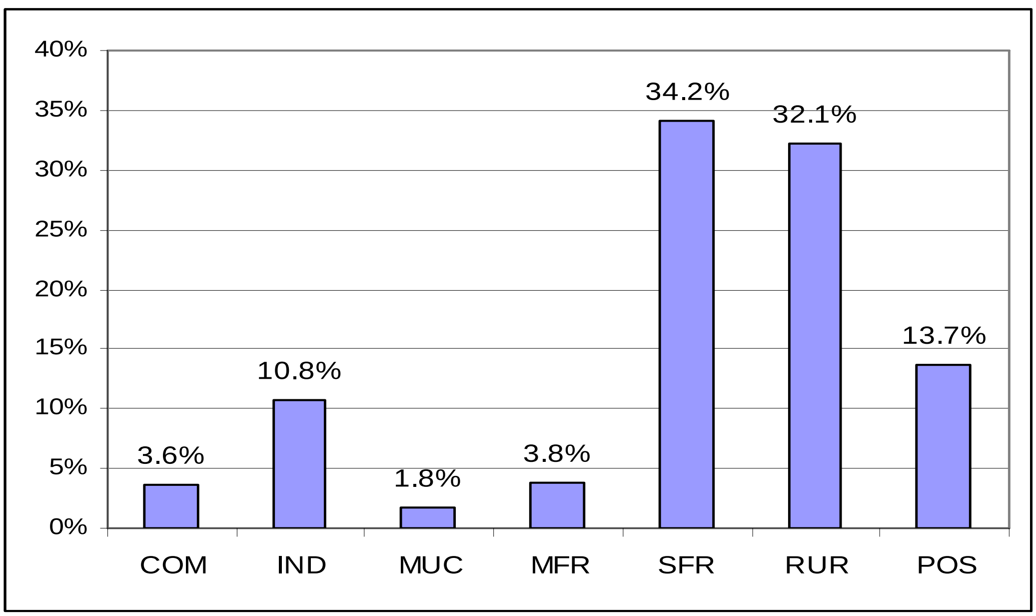
Figures 4-15 and 4-16 illustrate the relevant distributions. Figure 4-15 shows the percentage of total acres in Metro's jurisdiction by zoning type. For example, industrial lands (IND) account for 13 percent of the total acres in Metro's jurisdiction. Figure 4-16 shows the distribution of acres affected by program options, by zoning type. Industrial lands, for example, account for approximately 11 percent of the total acres affected by program options.

Figure 4-15: Percentage of total acres in Metro's jurisdiction by zoning type.



Source: ECONorthwest with data provided by Metro.

Figure 4-16: Percentage of total acres of habitat, by zoning type.



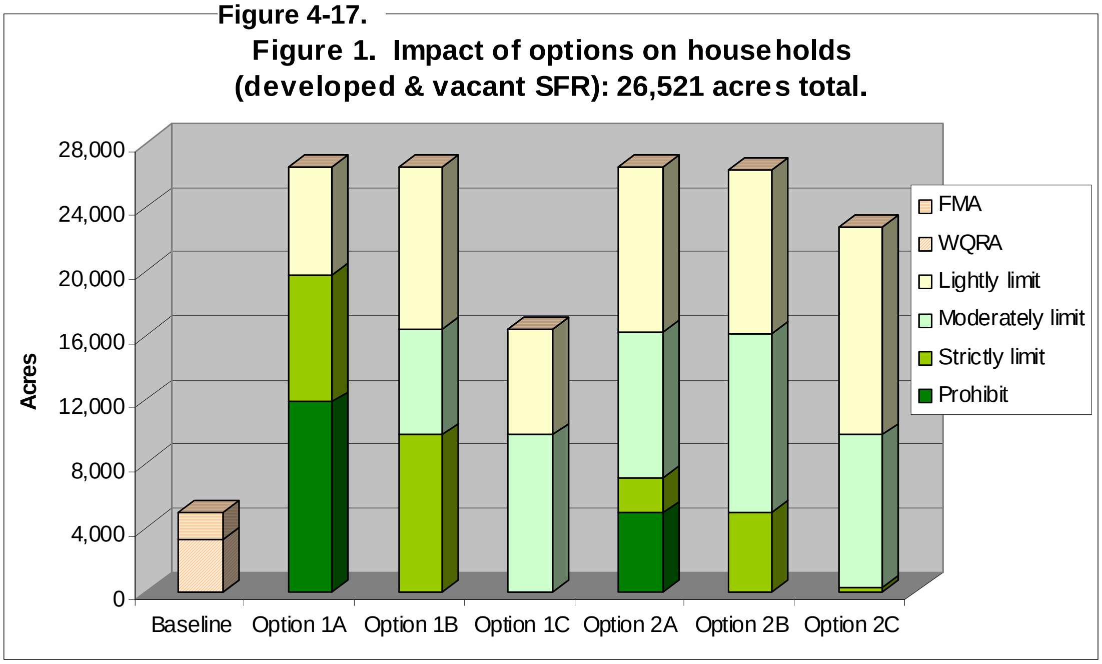
Source: ECONorthwest with data provided by Metro.

Comparing Figures 4-15 and 4-16:

- RUR and POS land uses would carry a disproportional share of the burden of Goal 5 treatments, relative to their share of total acres in Metro's jurisdiction. RUR lands account for approximately 21 percent of land but 32 percent of Goal 5 treatments. POS account for approximately 6 percent of land but 16 percent of Goal 5 treatments.
- Land uses with urban residential and business applications would shoulder a smaller share of the burden of Goal 5 treatments, relative to their proportion of total acres in Metro's jurisdiction. For example, SFR lands account for approximately 44 percent of land but only 32 percent of Goal 5 treatments. IND lands account for 13 percent of land but 11 percent of Goal 5 treatments.
- These results illustrate the interaction between the existing distributions of land uses and riparian and wildlife habitat and describe the *amount* and *type* of acres that would be affected by Goal 5 treatments. The *degree* to which any one program option would restrict land uses depends on the mix of allow, limit and prohibit treatments for that option. The following figures illustrate these impacts.

Figures 4-17, 4-18 and 4-19 illustrate the findings from Metro's analysis of social criteria based on the number of acres affected by allow, limit, and prohibit treatments for residential, business-related and rural land uses. Figure 4-17 illustrates the impacts of program options on SFR lands. Figure 4-18 shows the impacts on lands with business uses (MFR, MUC, COM, and IND). Figure 4-19 shows the impacts on RUR lands. Figure 4-20, which comes from the analysis of Economic Criterion 3, shows the impacts of Goal 5 treatments on park lands.

Figure 4-17.



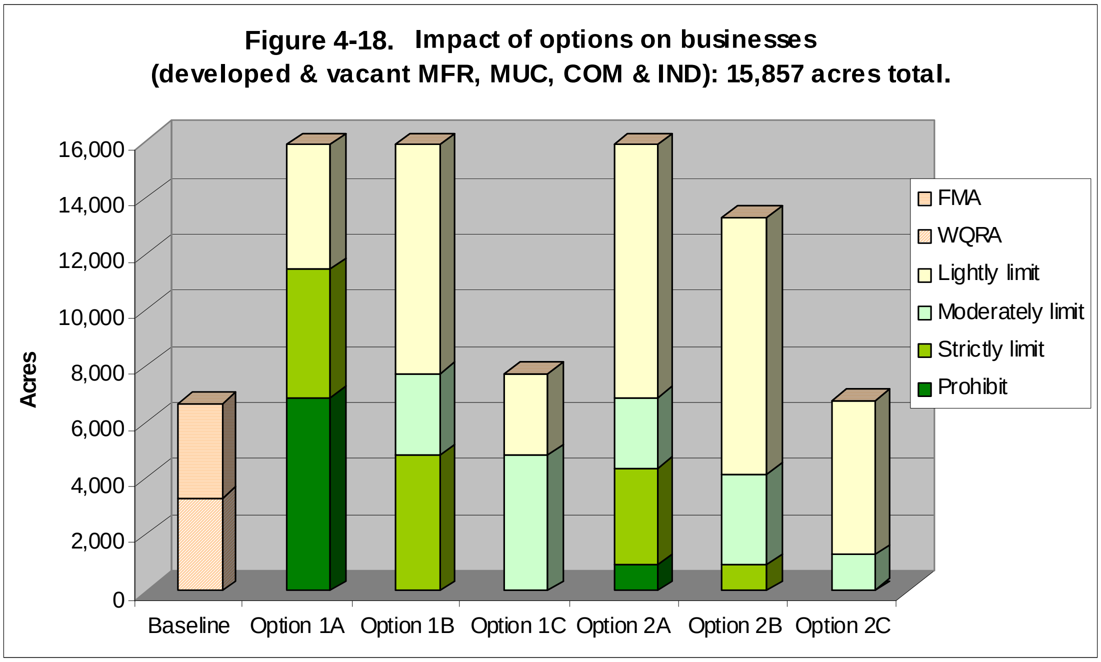


Figure 4-18. Impact of options on businesses
(developed & vacant MFR, MUC, COM & IND): 15,857 acres total.
Acres
16,000
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
Baseline
Option 1A
Option 1B
Option 1C
Option 2A
Option 2B
Option 2C
FMA
WQRA
Lightly limit
Moderately limit
Strictly limit
Prohibit

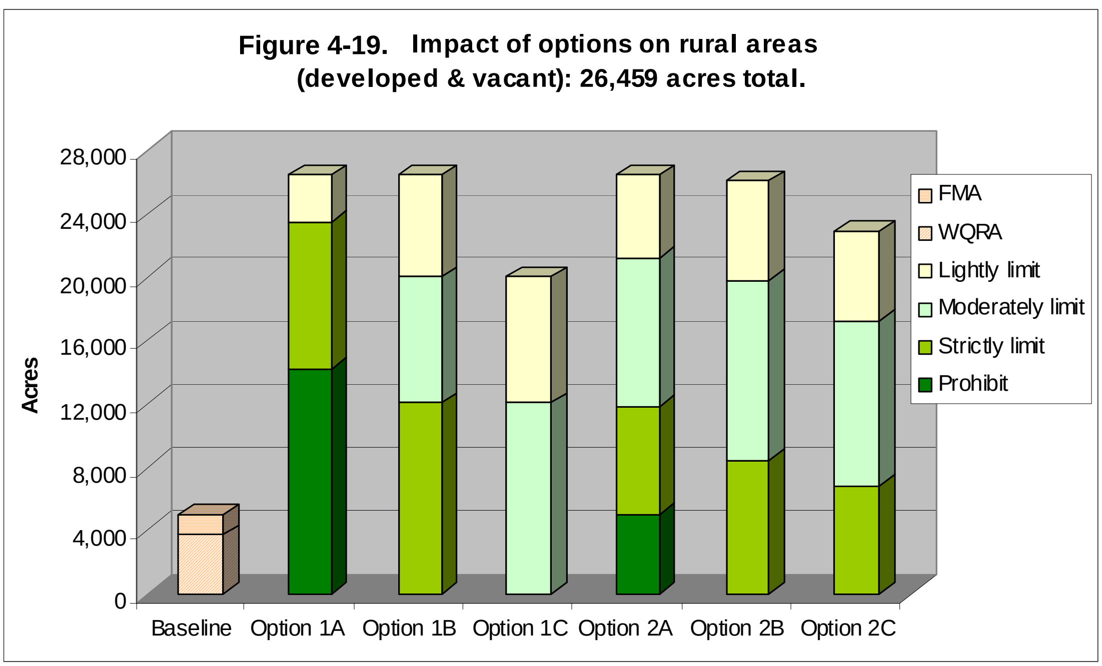
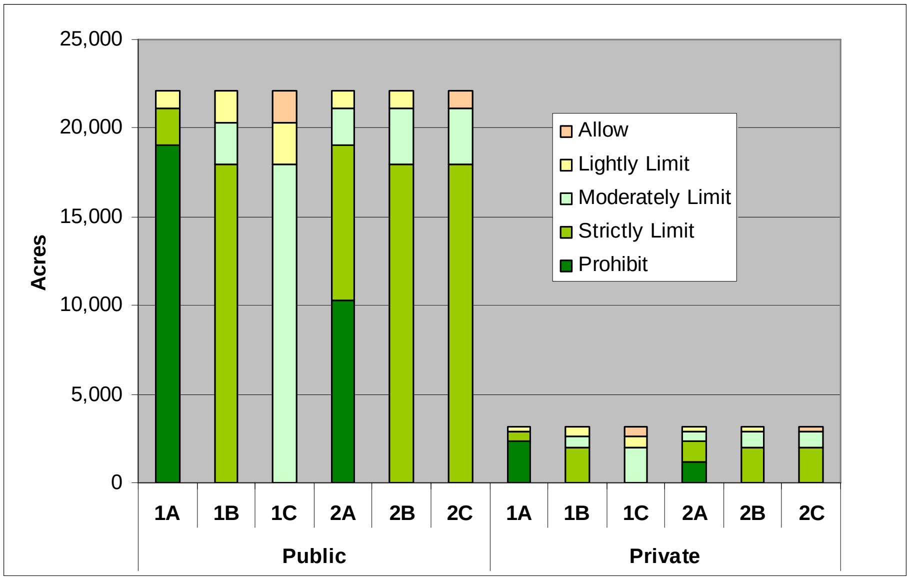


Figure 4-19. Impact of options on rural areas
(developed & vacant): 26,459 acres total.
Acres
28,000
24,000
20,000
16,000
12,000
8,000
4,000
0
Baseline
Option 1A
Option 1B
Option 1C
Option 2A
Option 2B
Option 2C
FMA
WQRA
Lightly limit
Moderately limit
Strictly limit
Prohibit

Figure 4-20: Performance of program options for parks and open space lands, by ownership



Basic Statistics
The number of acres that Goal 5 treatments would affect, by regional zone:

- SFR 26,521 acres
- MFR 2,886 acres
- MUC 1,625 acres
- COM 2,124 acres
- IND 9221 acres
- POS 13,118 acres
- RUR 26,460 acres.

Comparison of program options

- The ranking of program options, from least to most restrictive, varies little for residential, business-related, or rural land uses. In general, the program options that would restrict SFR lands the most would also restrict business-related (MFR, MUC, COM, IND) and rural (RUR) land uses the most.
- The ranking of program options for residential, business-related and rural land uses, from least to most restrictive, is 1C, 2C, 2B, 1B, 2A, and 1A. The only exception to this ranking is that for MUC and IND, 2C dominates 1C as the least restrictive option.
- The ranking of program options varies slightly for parks (POS) relative to the other regional zones. The ranking for POS, from least to most restrictive, is 1C, 1B, 2B, 2C, 2A, and 1A.
- Even though the rankings of program options would vary little among the regional zones, the limitations the program options would place on land uses would vary by regional zone. In general, the Goal 5 treatments under Criterion 4 would favor business-related land uses over POS, RUR, and SFR land uses. The non-business related land uses (POS, RUR, and SFR) would typically receive more restrictive Goal 5 treatments than would business-related land uses (MFR, MUC, COM, IND), for a given program option. For example, for option 1C,

approximately 38 percent of SFR lands would receive an allow treatment. For COM lands, 52 percent would receive an allow treatment. Option 1C ranks as the least restrictive option for both SFR and COM. See Table 4-11.

Table 4-11: Distribution of allow, limit and prohibit treatments for Option 1C by regional zone.

Treatment	SFR	MFR	MUC	COM	IND	POS	RUR
Allow	38%	52%	47%	52%	52%	9%	24%
Lightly Limit	25%	18%	19%	21%	17%	8%	30%
Moderately Limit	37%	29%	33%	27%	31%	83%	45%
Strictly Limit	0%	0%	0%	0%	0%	0%	0%
Prohibit	0%	0%	0%	0%	0%	0%	0%
Total	100%	100%[1]	100%[1]	100%	100%	100%	100%[1]

1: Total reflects rounding for the percentage by treatment.

- Among the non-business-related land uses, the ranking of regional zones from most restricted to least restricted is POS, RUR, and SFR. This ranking applies for all options.
- IND lands receive the least restrictive Goal 5 treatments of any of the regional zones.
- Among the business-related land uses, the ranking from most to least restricted is (in general) MFR, MUC, COM, and IND. This ranking applies primarily for options 2A, 2B and 2C. For example, for option 2C, approximately 71 percent of IND lands would receive an allow treatment. The comparable figures for the other business-related land uses are 25 percent for MFR, 49 percent for MUC, and 46 percent for COM. See Table 4-12.

Table 4-12: Distribution of allow, limit and prohibit treatments for Option 2C, by Regional Zone.

	SFR	MFR	MUC	COM	IND	POS	RUR
Allow	14%	25%	49%	46%	71%	0%	13%
Lightly Limit	49%	50%	47%	42%	26%	5%	21%
Moderately Limit	36%	25%	4%	12%	2%	12%	40%
Strictly Limit	1%	0%	0%	0%	0%	83%	26%
Prohibit	0%	0%	0%	0%	0%	0%	0%
Total	100%	100%	100%	100%	100%[1]	100%	100%

1: Total reflects rounding for the percentage by treatmen

t.

5. Minimizes need to expand the urban growth boundary (UGB).

In this discussion of Criterion 5, the effects of the program options on the need to expand Metro's urban growth boundary (UGB) are described. The program options that would have the least impact on the need to expand the UGB rank higher for this criterion.

Potential impacts on the need to expand the UGB

State land use laws require that Metro's UGB accommodate anticipated population and employment growth over the next twenty years. As the area's population grows and urban development intensifies, pressure to expand the UGB increases. By how much and where to expand the UGB depends on a variety of factors including population distribution, the suitability of land on the urban fringe, and the intensity of in-fill development within the existing UGB. The program options that protect fish and wildlife habitat to a greater extent may also decrease the amount of developable land available inside the UGB. As the amount of developable land inside the UGB decreases, the likelihood that the UGB will expand in response to population and development growth increases.

Previous expansions of the UGB and related developments provide a context for the analysis of the impacts of program options on the need to expand the UGB. Metro's UGB expansions and related developments include:

- In 1995, the Metro Council adopted the 2040 Growth Concept, which anticipated adding 15,000 to 19,000 acres to the UGB over 50 years.
- In 1998-99, Metro added 4,000 acres to the UGB.
- In May of 2002, voters approved ballot measure 26-29, which prohibits higher densities in existing neighborhoods. Increasing urban densities as a means of avoiding or minimizing UGB expansions cannot target existing neighborhoods and will focus instead on downtown city centers and transportation corridors.

- In December of 2002, Metro Council added 18,638 acres to the UGB, with 2,851 of these acres dedicated to employment needs.
- Metro's current deliberations on UGB expansion include a proposal to add 2,000 acres targeting industrial use.

The assumption is made in this criterion that the program options which would restrict to a greater extent the development of vacant lands would increase the likelihood of expanding the UGB. Impacts on vacant land would have the most immediate impact on vacant land because these lands provide the greatest development opportunities.

Program options that increase the likelihood of expanding the UGB may also contribute to sprawl related economic consequences, such as increased travel times, increased vehicle miles traveled with associated increased concentrations of air pollutants, and increased costs of extending or expanding roads, water and sewer infrastructure. Program options that minimize UGB expansions by promoting development within the existing UGB may minimize sprawl related costs but may generate other economic consequences. For example, developing lands within the existing UGB, at the expense of riparian and wildlife habitat, would reduce the concentrations or availability of habitat related ecosystem services near population centers. In effect, development would push these resources and associated ecosystem services further out to the urban fringe away from employment and population concentrations.

Measuring the criterion

Table 4-2 in Criterion 1 (supports urban development priorities) shows the number of acres of lands in the four urban development categories (high, medium, low, and other) affected by allow, limit, and prohibit treatments for the six program options. It also shows impacts by development status including vacant lands inside and outside Title 3 protection. The analysis for this criterion uses the data in Table 4-2.

Results

Comparison of program options

Lands with high urban development value

- Option 2C provides the least restrictive impact on vacant lands inside and outside Title 3 and would have the least likelihood of promoting UGB expansions of the six program options.
- In ascending order of increasing restrictions on vacant lands outside Title 3 and increasing the likelihood of UGB expansions—the remaining options rank: 2B, 1C, 2A, 1B, and 1A. This ranking also reflects the outcome for lands inside Title 3 except that Options 2A and 1B perform comparably rather than 2A performing better 1B.

Lands with medium urban development value

- The results for lands with medium urban development value reflect the outcome for lands with high value.

Lands with low urban development value

- Option 1C performs better than the other options under this criterion in that it would have the least restrictive impact on vacant lands inside and outside Title 3, and would be the least likely to promote UGB expansions of the six program options.

- In ascending order of increasing restrictions on vacant lands outside Title 3, and increasing likelihood of promoting UGB expansions, the remaining options rank: 2C, 2B, 1B, 2A, and 1A. This ranking also reflects the outcome for lands inside Title 3 except that Options 2B and 1B have about the same effect rather than 2B dominating 1B.

Other lands

- Option 1C also performs better under this criterion for park land and rural inside and outside Title 3.
- In ascending order of increasing restrictions on vacant lands outside Title 3, and increasing likelihood of promoting UGB expansions, the remaining options rank: 1B, 2C and 2B are comparable, 2A, and 1A. This ranking also reflects the outcome for lands inside Title 3 except that Option 1B performs similarly to Options 2C and 2B rather than dominating these options.

Summary

Table 4-13 summarizes the ranking of the performance of the program options based on the average outcomes for the total acres in the analysis. This summary weighs more heavily the impacts on vacant lands ranked low and other lands because these rankings contain more acres of land than do vacant lands with high or medium rankings.

Table 4-13: Performance of options in meeting Economic Criterion 5: minimizes the need to expand the UGB.

Rank	Option	Performance
1	1C	Option 1C provides the greatest support for developing vacant land among the six options and will least likely promote UGB expansions. It has the greatest number of acres affected by allow treatments, which have no negative impacts on development, and no acres affected by strictly limit or prohibit treatments.
2	2C	Option 2C is second only to Option 1C in supporting the development of vacant lands and in the number of acres affected by allow treatments. No acres affected by prohibit treatments.
3	2B	Option 2B supports developing vacant land to a greater extent than does Option 1B because the allow treatments in this option generate no negative development impacts and there are no negative impacts from prohibit treatments.
4	1B	All Goal 5 treatments for Option 1B would have some negative impact on developing vacant land. Option 2B dominates 1B because it has allow treatments for high-valued vacant land. 1B has no allow treatments. This option supports developing vacant land to a greater extent than do Options 2A and 1A primarily because it has no negative impacts from prohibit treatments.
5	2A	Option 2A would have a slightly more negative impact on developing vacant lands, and thus promote UGB expansions to a greater extent, than Option 1B because of the negative impacts associated with prohibit treatments.
6	1A	Option 1A has the greatest negative impact from prohibit and strictly limit treatments and the greatest negative impact overall on developing vacant land of the six options. This option would likely promote UGB expansions to a greater extent than the other options.

Evaluation of social criteria

The Goal 5 process requires local governments to make a decision to allow, limit, or prohibit conflicting uses to protect fish and wildlife habitat based on balancing the consequences of the four ESEE factors. Based on the analysis of social consequences in Phase I, Metro developed five criteria to measure the performance of the six regulatory program options in addressing the potential social impacts. These criteria are:

1. Minimizes impact on property owners,
2. Minimizes impact on location and choices for housing and jobs,
3. Preserves habitat for future generations,
4. Maintains cultural heritage and sense of place, and
5. Preserves amenity value of habitat.

Some of the key questions considered in the analysis were:

- How much of the habitat and impact areas are affected?
- How much of the habitat land is already protected to some extent by the baseline?
- Do the effects differ by habitat class?
- Do the effects differ by urban development values?
- What would be affected by a decision to "allow" or 'lightly limit" the impact areas?

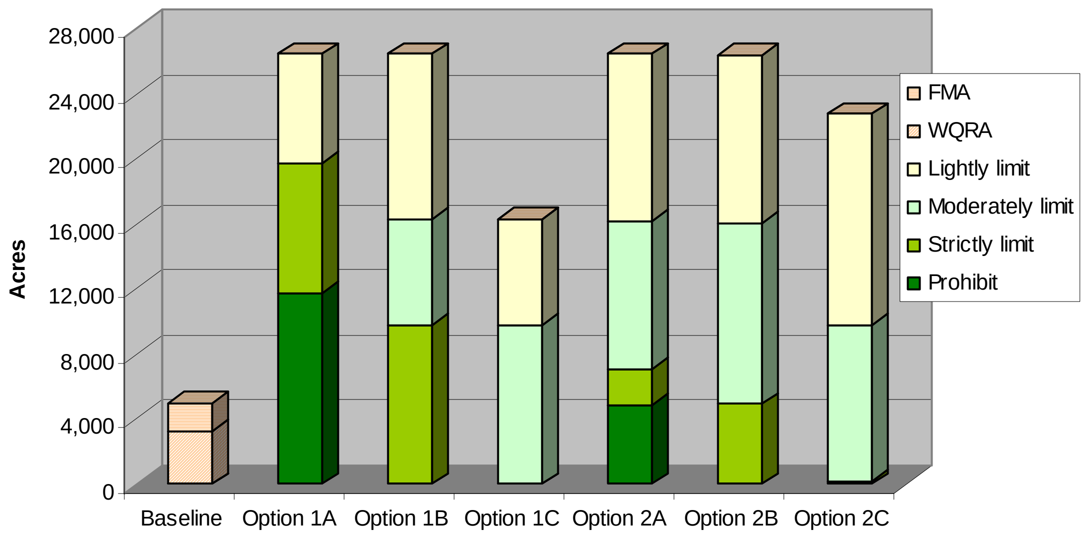
1. Minimizes impact on property owners

Property ownership and land use regulations are sensitive issues central to habitat protection. Landowners may be concerned about impacts to property rights, takings issues, and the distribution of the burden of protecting habitat. Other landowners may be supportive of protection programs despite being personally affected for several reasons including an appreciation of habitat and the wish to see it remain in addition to the increased property values that can result from trees and proximity to water. For this criterion the data is analyzed by three main groups: households, businesses, and rural areas. It should be noted that, because treatments may be applied to only a portion of a lot, and several treatments could apply to the same lot, considering the acres affected by each treatment might produce statistics that tend to magnify potential impacts greater than they likely would be felt. Metro has already stated that potential regulations will not be imposed on particular, buildable lots if the result would be to render such lots unbuildable.

Potential impact on households

For residential land in particular, personal financial security or the expectation to maintain, develop or redevelop land within the existing regulatory framework could be impacted by a program option. A decision to allow, limit, or prohibit conflicting uses in fish and wildlife habitat has an impact on individual landowners. Thirty-four percent of the habitat lands are located in areas zoned for single-family residential uses, a third of which is in impact areas. Many residential properties are on small lots, thus options impacting more residential land could affect a large number of property owners, when compared to business and rural properties that have large lots. Figure 4-21 shows the distribution of the treatments on residential land (developed and undeveloped) for each option.

Figure 4-21. Impact of options on households (developed & vacant SFR): 26,521 acres total.



Results

The following observations are made from Figure 4-21 above.

Basic statistics & baseline protection

- 34 percent (26,521 acres) of habitat and impact areas are SFR.
- A third of the 26,521 acres of SFR land in Figure 4-21 is in impact areas, two-thirds has habitat value.
- SFR lands are distributed across all habitat classes.
- Most SFR lands fall in the low urban development value category.
- Baseline protection only covers a small portion of single-family land, with WQRA restrictions applied to about 10 percent and an additional five percent covered by FMA design guidelines.

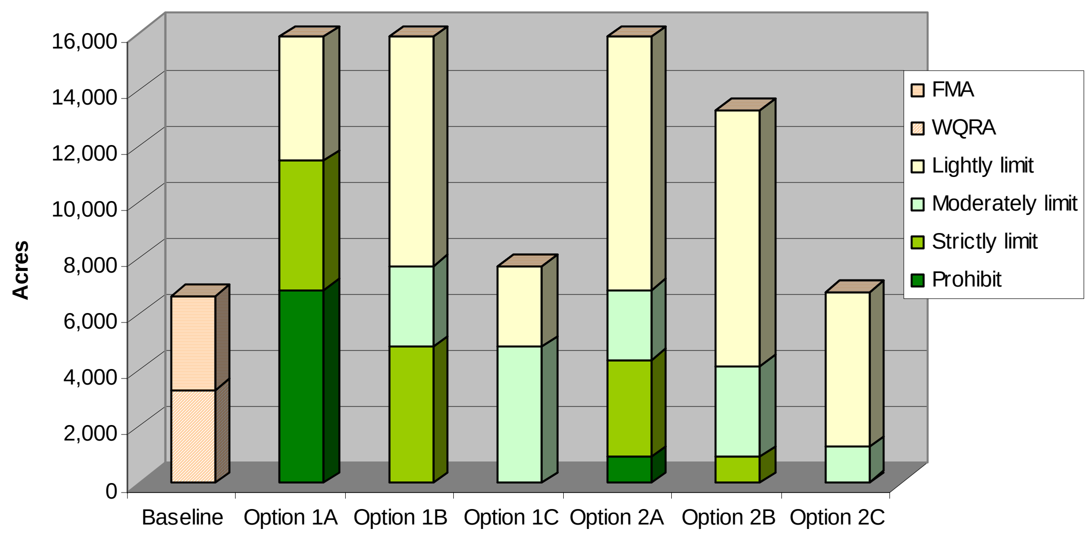
Comparison of options

- The urban development value options (2A-C) apply more stringent treatments to SFR lands than most other zoning types; while the habitat based options (1A-C) apply treatments to zoning types depending on habitat value.
- Option 1C, followed closely by 2C, has the least stringent treatments applied to the largest acreage of land zoned for single-family uses.
- Options 1A, 1B, 2A, and 2B each would apply some type of limit or prohibit decision to ***all*** land zoned for single-family with significant habitat.
- Option 1A would have the most impact on households, applying a prohibit treatment to 40 percent of the land, a strictly limit treatment to about 30 percent, and lightly limit to the remaining 30 percent (the impact areas).

Potential impact on businesses

Land used for business purposes, whether developed or vacant, would also be impacted by any of the regulatory program options. For developed land, the impact would be in the future if a property owner chose to redevelop and was required to follow new Goal 5 regulations. Reducing development opportunities and/or requiring specific habitat friendly development practices could impact vacant land. Restrictions on development could have an overall impact on the regional economy, (see economic criteria). Most business land includes commercial and industrial properties and apartment complexes located on large lots. This reduces the number of property owners potentially impacted. Figure 4-22 below shows the distribution of the treatments on land used for businesses (developed and undeveloped) for each option. Land used for businesses includes multi-family (MFR), mixed-use centers (MUC), commercial (COM), and industrial (IND).

Figure 4-22. Impact of options on businesses (developed & vacant MFR, MUC, COM & IND): 15,857 acres total.



Observations

The following observations are made from Figure 4-22 above.

Basic statistics & baseline protection

- Seventeen percent (15,857 acres) of total habitat and impact areas are zoned for business purposes.
- A third of the 15,857 acres of business land is in impact areas, two-thirds have habitat value.
- Baseline protection covers almost 40 percent of land used for business purposes, with WQRA restrictions applied to close to 20 percent and an additional 20 percent covered by FMA design guidelines.
- About 25 percent of business land contains the highest value riparian and wildlife habitat.

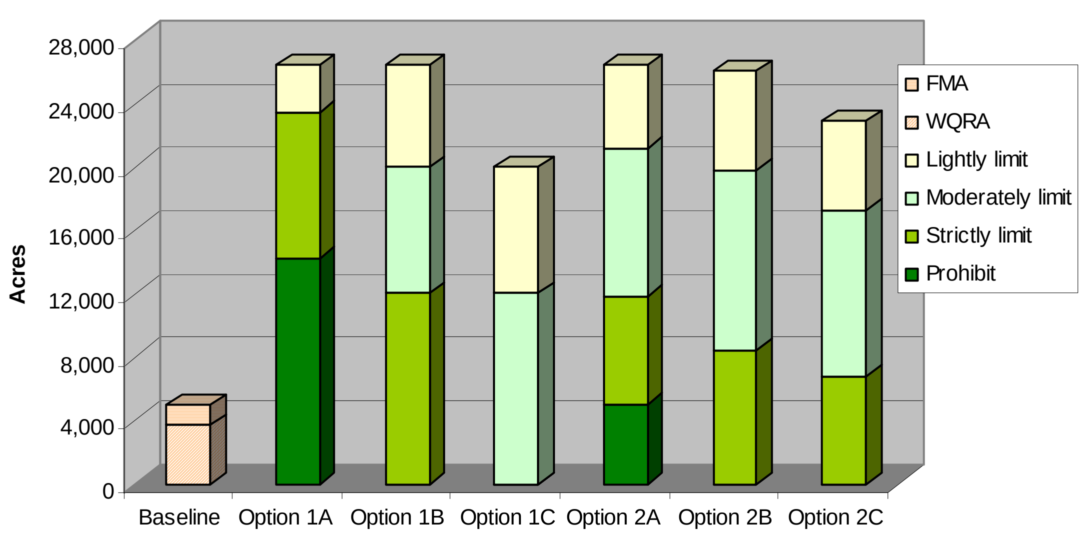
Comparison of options

- The urban development value options (2A-C) apply less stringent treatment to most business land; while the habitat based options (1A-C) apply treatments to zoning types depending on the habitat value.
- Option 2C, followed by 1C, has the least stringent treatments applied to the largest acreage of land zoned for businesses. Over 50 percent of business land receives an allow treatment in 2C.
- Option 2B provides substantially more protection than 1C and 2C, but less than 1A, 1B and 2A since about 20 percent of the land would receive an allow treatment.
- Options 1A, 1B and 2A each would apply some type of limit or prohibit decision to ***all*** land zoned for businesses with significant habitat.
- Option 1A would have the most impact on businesses with significant habitat, applying a prohibit treatment to over 40 percent of the land, strictly limit to about 30 percent, and lightly limit to the remaining 30 percent (impact areas).

Potential impact on rural areas

Much of the regionally significant fish and wildlife habitat falls on rural land, over 26,000 acres. Rural properties tend to be larger than those in other zones, impacting a smaller number of property owners but a large number of acres. Land uses include some residential and a substantial amount of farming and timber production. Farm and forestry practices have special regulations under Senate Bill 1010 and are not regulated by Metro. However, if these properties were urbanized in the future they would be subject to a regional fish and wildlife habitat protection program if those areas were to eventually become urbanized. Figure 4-23 shows how rural areas might be impacted by the six regulatory program options and how much of the rural landscape is covered by the baseline regulations.

Figure 4-23. Impact of options on rural areas (developed & vacant): 26,459 acres total.



Results

The following observations are made from Figure 4-23 above.

Basic statistics & baseline protection

- Twenty-eight percent (26,459 acres) of total habitat and impact areas are in rural areas.
- About 15 percent of the 26,459 acres of rural land is in the impact area, 85 percent has habitat value.
- Baseline protection only covers about 15 percent of rural land, with WQRA restrictions applied to about 10 percent and close to five percent covered by FMA design guidelines.
- Over 40 percent of rural land contains the highest value riparian and wildlife habitat.
- Urban development values apply to rural zoning with design types that fall inside Metro's urban growth boundary.

Comparison of options

- The urban development value options (2A-C) apply the most stringent treatments to rural areas that do not have a design type; while the habitat based options (1A-C) apply treatments to zoning types depending on the habitat value.
- Option 1C, followed by 2C, has the least stringent treatments applied to the largest acreage of rural land.
- Option 2B would apply an allow treatment to about two percent of rural lands, otherwise it is similar to 1B in the treatments applied.
- Options 1A, 1B and 2A each would apply some type of limit or prohibit decision to ***all*** rural land with significant habitat.
- Option 1A would have the most impact on rural land with significant habitat, applying a prohibit treatment to about 50 percent of the land, strictly limit to about 35 percent, and lightly limit to the remaining 15 percent.

Performance of options

All six regulatory options have some impact on landowners. The options that apply more stringent treatments to a larger part of the landscape have more of an impact than the options that apply lightly limit or allow treatments. The affect of applying the urban development values in Options 2A-C benefits business land substantially more than single-family residential and rural areas. In addition, the Metro Council's commitment not to adopt a program that would render currently buildable lots as unbuildable also moderates, to some degree, the impact that any option would have on property owners.

Table 4-14. Performance of options in meeting Social Criterion 1: minimizes impact on property owners.

Rank	Option	Performance
1	Option 1C	This option affects the fewest property owners with stringent treatments.
2	Option 2C	Most business land receives an allow treatment under this option but a substantial number of residential and rural property owners are affected.
3	Option 2B	Urban development values reduce amount of business land receiving strict treatments but residential and rural areas receive strictly and moderately limit treatments.
4	Option 1B	This option affects the same number of property owners as Options 1A and 2A, but none would receive a prohibit treatment and a larger number would receive lightly limit.
5	Option 2A	Despite applying urban development values, this option affects a large number of property owners with stringent treatments, especially in residential and rural areas.
6	Option 1A	This option affects the most property owners with the highest level of restrictions.

2. Reduces impact on types/locations of jobs and housing

The urban land supply is a social issue because it relates to people's basic needs for housing, jobs and urban services. A constriction of the existing land supply could negatively affect the social needs these lands serve (e.g., housing and employment). An urban growth boundary (UGB) expansion could offset the impacts, but urbanizing rural land spreads the development pattern towards the periphery of the region. This could increase travel times and congestion and could encroach further on fish and wildlife habitat in rural areas.

Potential impact on housing location and choices

Residential zones (SFR and MFR) make up the largest component of buildable land in the fish and wildlife habitat inventory. The types of housing opportunities available may change depending on habitat protection. Rather than reduce the number of housing units allowed on a lot, regulations may allow for the same units in a denser configuration, such as rowhouses, condominiums, or apartments. Clustering units on smaller lots in a subdivision may allow fish and wildlife habitat to be preserved. However, these potential changes have social impacts. Many people who might choose to purchase or rent a single-family home with a yard may not view these other housing options as equivalent. The location of the housing is important as well. Housing opportunities closer to existing employment, shopping, and entertainment will not be replaced by residentially zoned land in areas on the urban fringe. Housing affordability may also be affected if protecting fish and wildlife habitat results in changes to the land supply. Figures 4-24 and 4-25 show how the options treat vacant single and multi-family land as compared to the baseline.

Figure 4-24. Treatment of vacant single family habitat land: (11,250 vacant, 15,271 developed acres)

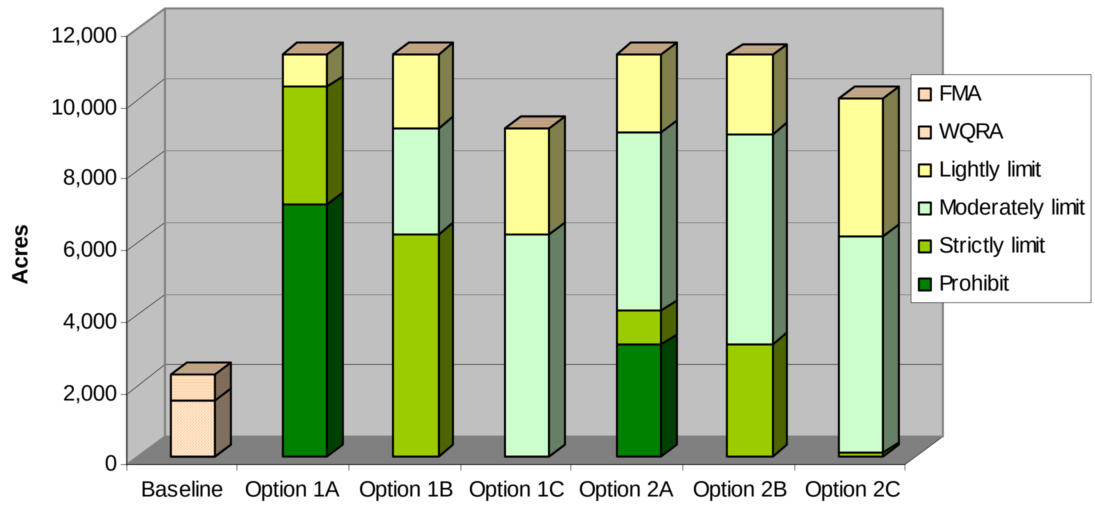


Figure 4-25. Treatment of vacant multi-family habitat land: (1,060 vacant, 2,886 developed acres).

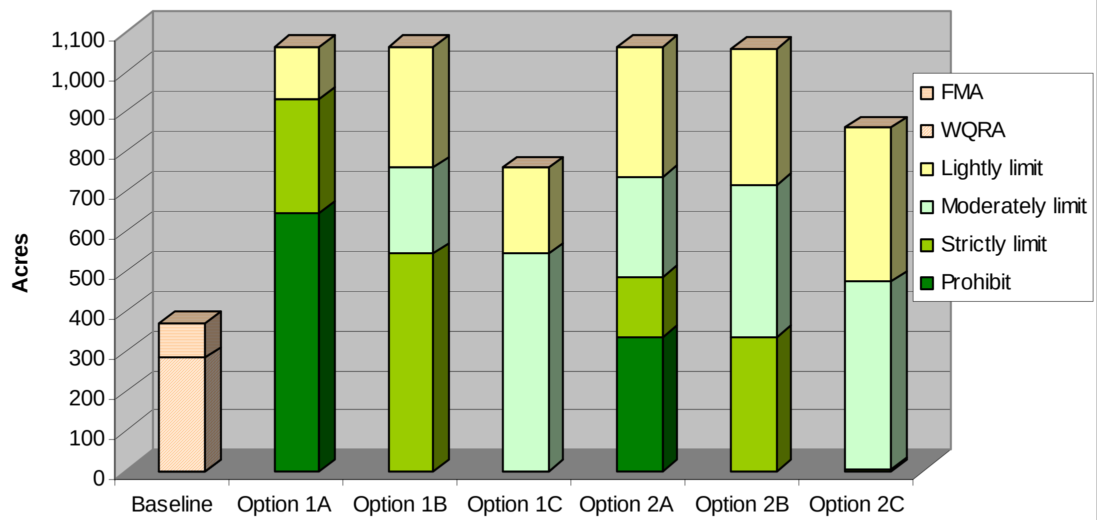


Table 4-15. Vacant residential land: acres potentially affected.

	Status of vacant land	Allow		Lightly limit		Moderately limit		Strictly limit		Prohibit	
		SFR	MFR	SFR	MFR	SFR	MFR	SFR	MFR	SFR	MFR
Option 1A	**Inside Title 3**	0	0	63	16	0	0	33	7	2,214	348
	Outside Title 3	0	0	851	114	0	0	3,256	278	4,833	297
	% covered by baseline	*0.0%*	*0.0%*	*6.9%*	*12.3%*	*0.0%*	*0.0%*	*1.0%*	*2.5%*	*31.4%*	*54.0%*
Option 1B	**Inside Title 3**	0	0	85	19	297	47	1,927	304	0	0
	Outside Title 3	0	0	1,960	282	2,676	168	4,304	238	0	0
	% covered by baseline	*0.0%*	*0.0%*	*4.2%*	*6.3%*	*10.0%*	*21.9%*	*30.9%*	*56.1%*	*0.0%*	*0.0%*
Option 1C	**Inside Title 3**	85	19	297	47	1,927	304	0	0	0	0
	Outside Title 3	1,960	282	2,676	168	4,304	238	0	0	0	0
	% covered by baseline	*4.2%*	*6.3%*	*10.0%*	*21.9%*	*30.9%*	*56.1%*	*0.0%*	*0.0%*	*0.0%*	*0.0%*
Option 2A	**Inside Title 3**	0	0	88	20	39	16	386	86	1,797	249
	Outside Title 3	0	0	2,071	305	4,980	236	572	62	1,318	86
	% covered by baseline	*0.0%*	*0.0%*	*4.1%*	*6.2%*	*0.8%*	*6.3%*	*40.3%*	*58.1%*	*57.7%*	*74.3%*
Option 2B	**Inside Title 3**	5	1	145	29	362	92	1,797	249	0	0
	Outside Title 3	9	2	2,080	315	5,499	286	1,352	86	0	0
	% covered by baseline	*35.7%*	*33.3%*	*6.5%*	*8.4%*	*6.2%*	*24.3%*	*57.1%*	*74.3%*	*0.0%*	*0.0%*
Option 2C	**Inside Title 3**	84	8	409	110	1,762	248	55	5	0	0
	Outside Title 3	1,138	193	3,442	276	4,319	219	41	0	0	0
	% covered by baseline	*6.9%*	*4.0%*	*10.6%*	*28.5%*	*29.0%*	*53.1%*	*57.3%*	*100.0%*	*0.0%*	*0.0%*

Results

The following observations are made from Figures 4-24 and 4-25, and Table 4-15.

Basic statistics and baseline protection

- Thirteen percent of habitat and impact areas comprise vacant residential land (SFR and MFR).
- Baseline protection only covers about 17 percent of vacant single-family land and about 30 percent of multi-family land. More restrictive WQRA restrictions are applied to about 10 percent of SFR land and a little over 20 percent of MFR land. An additional seven percent of SFR and eight percent of MFR are covered by FMA design guidelines.

Comparison of options

- Applying urban development values (options 2A-C) does not substantially change treatments applied to residential land.
- *Minimum impact:* Option 1C, followed by 2C, would apply the least stringent treatments to the largest acreage of residential land (both SFR and MFR). 2,346 acres (SFR & MFR) in option 1C and 1,423 acres in 2C would receive an allow treatment.
- *Maximum impact:* a prohibit designation would affect 7,700 acres in 1A and 3,450 acres in 2A of vacant SFR & MFR.
- Options 1A, 1B and 2A each would apply some type of limit or prohibit decision to ***all*** residential land with significant habitat.
- Option 1A would have the most impact on residential land with significant habitat, applying a prohibit treatment to almost 60 percent of SFR and over 55 percent of MFR,

strictly limit to about 30 percent (both SFR and MFR), and the remaining acres would receive a lightly limit treatment.

- Option 2A is more restrictive on MFR than SFR: about 40 percent of MFR is covered by prohibit and strictly limit treatments compared to about 30 percent of SFR.
- As described above, some of the vacant residential land is already covered by baseline regulations that limit housing location and development options. Limit and prohibit treatments would have less impact in those areas.
- All options apply a lightly limit treatment to some portion of the vacant residential land. A small percentage is already covered by baseline regulations in all options, but in options 1C and 2C over 20 percent of MFR land that receives a lightly limit treatment is covered by baseline, reducing the impact.
- All options except for 1A apply a moderately limit treatment to some portion of the vacant residential land with significant habitat. In options 1C and 2C over 50 percent of land receiving a moderately limit treatment is covered by baseline regulations, reducing the impact.
- All options except for 1C apply a strictly limit treatment to some portion of the vacant residential land with significant habitat. In 1A only a small percentage of land receiving strictly limit is covered by baseline, but in all other options the area covered by baseline that receives strictly limit ranges from 31 percent to 100 percent, reducing the impact.
- Only options 1A and 2A apply a prohibit treatment to vacant residential land with significant habitat. A significant portion of the habitat that would receive a prohibit treatment is covered by baseline, especially in 2A with 58 percent of SFR and 74 percent of MFR, reducing the impact.

Jobs

Employment opportunities typically occur on land that is zoned for commercial, industrial, or institutional uses. Vacant land zoned for commercial, industrial, or mixed-use development makes up 28 percent of the land within the fish and wildlife habitat inventory, and almost half is not constrained by Title 3. The location of these lands is an important factor in determining the social impact of allowing, limiting, or prohibiting use in these areas. Metro is able to add land to the UGB if employment capacities are reduced due to habitat protection.

However, it is important to consider the social impacts of adding employment land on the urban fringe. Will job opportunities located in newly developed areas be equivalent to lost opportunities located near existing concentrations of housing? Residents choosing to work in locations further from their homes will incur additional travel expenses as well as a reduction in quality of life due to more time spent commuting and away from home. Additionally, the types of jobs may be different, as a company that might choose to locate in an existing commercial or industrial area may not choose to move to a new location. Figure 4-26 graphically depicts the treatments for vacant employment land by option as compared to the baseline. Table 4-16 provides additional information on the existing environmental constraints on vacant employment land and the increment of regulations added by option.

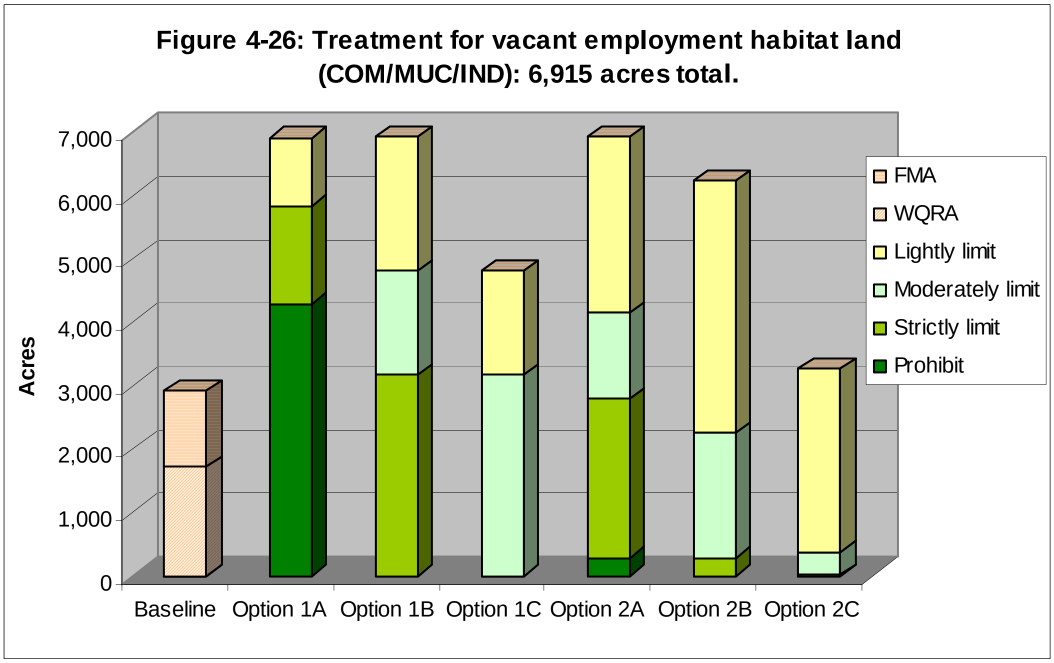


Table 4-16. Vacant employment land: acres potentially affected.

	Status of vacant land	Allow		Lightly limit		Moderately limit		Strictly limit		Prohibit	
		COM/ MUC	IND	COM/ MUC	IND	COM/ MUC	IND	COM/ MUC	IND	COM/ MUC	IND
Option 1A	**Inside Title 3**	0	0	21	162	0	0	7	78	572	2,077
	Outside Title 3	0	0	229	671	0	0	486	964	599	1,046
	% covered by baseline	*0.0%*	*0.0%*	*8.4%*	*19.4%*	*0.0%*	*0.0%*	*1.4%*	*7.5%*	*48.8%*	*66.5%*
Option 1B	**Inside Title 3**	0	0	26	235	133	458	442	1,624	0	0
	Outside Title 3	0	0	511	1,328	370	678	433	676	0	0
	% covered by baseline	*0.0%*	*0.0%*	*4.8%*	*15.0%*	*26.4%*	*40.3%*	*50.5%*	*70.6%*	*0.0%*	*0.0%*
Option 1C	**Inside Title 3**	26	235	133	458	442	1,624	0	0	0	0
	Outside Title 3	512	1,328	370	678	433	676	0	0	0	0
	% covered by baseline	*4.8%*	*15.0%*	*26.4%*	*40.3%*	*50.5%*	*70.6%*	*0.0%*	*0.0%*	*0.0%*	*0.0%*
Option 2A	**Inside Title 3**	0	0	28	259	85	442	366	1,514	121	101
	Outside Title 3	0	0	690	1,783	364	479	215	403	46	18
	% covered by baseline	*0.0%*	*0.0%*	*3.9%*	*12.7%*	*18.9%*	*48.0%*	*63.0%*	*79.0%*	*72.5%*	*84.9%*
Option 2B	**Inside Title 3**	2	120	141	1,224	337	872	121	101	0	0
	Outside Title 3	66	491	799	1,814	405	359	46	18	0	0
	% covered by baseline	*2.9%*	*19.6%*	*15.0%*	*40.3%*	*45.4%*	*70.8%*	*72.5%*	*84.9%*	*0.0%*	*0.0%*
Option 2C	**Inside Title 3**	86	1,187	393	1,021	120	104	2	4	0	0
	Outside Title 3	561	1,812	650	827	105	41	1	3	0	0
	% covered by baseline	*13.3%*	*39.6%*	*37.7%*	*55.2%*	*53.3%*	*71.7%*	*66.7%*	*57.1%*	*0.0%*	*0.0%*

Results

The following observations are made from Figure 4-26 and Table 4-16.

Basic statistics and baseline protection

- Seven percent of habitat and impact areas are vacant and zoned for employment (MUC, COM, IND).
- Baseline protection covers about 40 percent of the vacant employment land in the habitat inventory. More restrictive WQRA restrictions are applied to about 20 percent of employment land; about 18 percent is covered by FMA design guidelines.

Comparison of options

- Applying urban development values (options 2A-C) substantially changes treatments applied to employment land.
- *Minimum impact:* Option 2C has the least impact on job location and choices, as it applies an allow treatment to 3,646 acres of vacant employment land.
- *Maximum impact:* Applying urban development values reduces the number of vacant acres that would receive a prohibit treatment from 4,300 in 1A to 286 in 2A.
- Options 1A, 1B and 2A each would apply some type of limit or prohibit decision to ***all*** employment land.
- Option 1A would have the most impact on employment land, applying a prohibit treatment to almost 60 percent, strictly limit to a little over 20 percent, and lightly limit to the remaining 20 percent (impact areas).
- As described above, some of the vacant employment land is already covered by baseline regulations that limit job location and development options. Limit and prohibit treatments would have less impact in those areas
- The urban development value options (2A-C) apply stricter treatments to more land that is already covered by baseline than the habitat-based options (1A-C), reducing the potential impact on jobs.
- Most of the vacant employment land that would receive a prohibit treatment in Option 2A is already covered by baseline regulations. Similarly, in Option 1A a substantial portion of the land that would receive a prohibit treatment is covered by baseline.

Performance of options

All six regulatory options have some impact on housing and job location and choices. The options that apply more stringent treatments to a larger part of the landscape are likely to have more of an impact than the options that apply lightly limit or allow treatments. Applying the urban development values in Options 2A-C benefits employment land more than residential land.

Table 4-17. Performance of options in meeting Social Criterion 2: Jobs and housing location and choices.

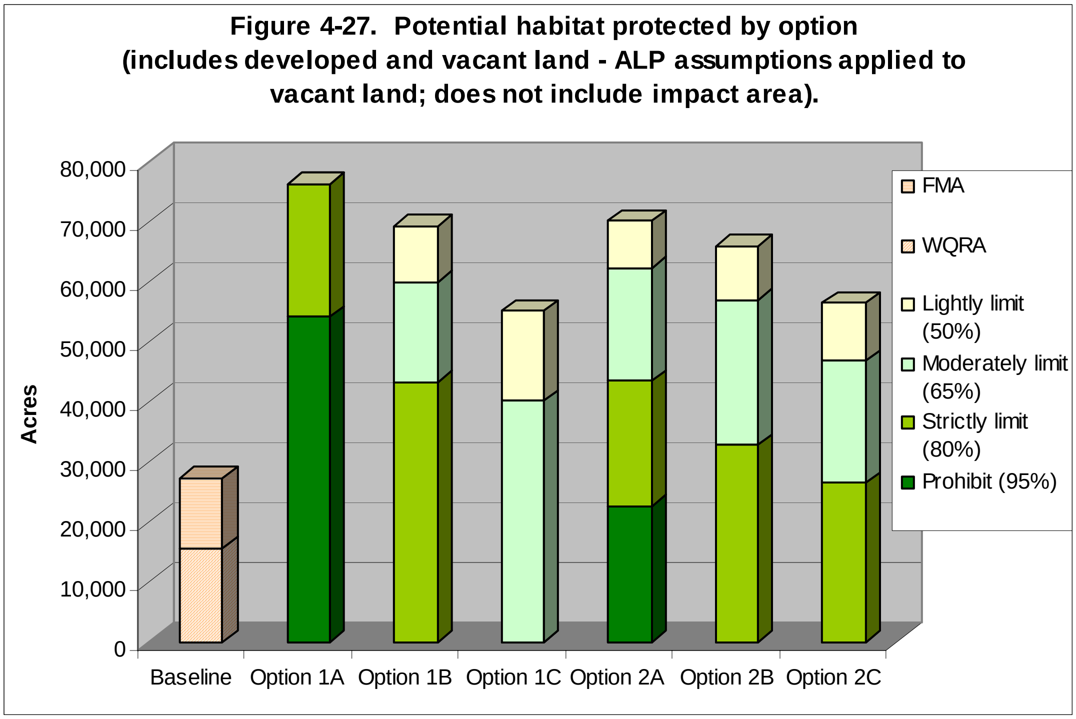
Rank	Option	Performance
1	Option 2C	Employment land benefits the most from the application of the urban development values, however residential land would receive almost as the same treatments as in Option 1C.
2	Option 1C	Residential land fares better under this option but employment land is substantially more impacted than in Option 2C.
3	Option 2B	Urban development values affect the amount of employment land receiving stringent treatments; residential land receives some benefit as well.
4	Option 1B	This option applies a similar level of protection to residential and employment land.
5	Option 2A	Employment land fares substantially better than residential land under this option.
6	Option 1A	This option has a significant effect on the location and choices available for jobs and housing.

3. Preserves resources for future generations

An important social responsibility for people today is to preserve resources for future generations. The Iroquois Confederacy stated: "In every deliberation, we must consider the impact of our decisions on the next seven generations." This criterion is based on the concept that our children and grandchildren should be able to enjoy the resources we do now, from the perspective of species diversity and environmental quality as well as the potential economic benefits derived from fish and wildlife habitat. An example is the plethora of pharmaceutical applications found in the natural world, from the Amazon jungle to the cancer fighting agents found in the yew tree.

One way to assess the performance of each option in addressing this criterion is the total number of habitat acres protected. An allow treatment can be assumed to protect zero acres and therefore is not shown in Figure 4-27 on the following page, while a prohibit treatment can be assumed to do a substantial job of protecting habitat where applied. The three types of limit protect the habitat to varying degrees.

While the role of restoration is important for the environmental health of the future, Environmental Criterion 1 addresses this. Opportunities for restoration are best addressed by options that protect existing habitat.



Results

The following observations are made from Figure 4-27.

Basic statistics and baseline protection

- All habitat land is included in this criterion, 80,234 acres.
- Baseline protection covers about 30 percent of the habitat inventory (not including impact areas), or 27,300 acres. More restrictive WQRA restrictions are applied to about 15 percent of habitat land; about 15 percent is covered by FMA design guidelines.

Comparison of options

- Applying ALP disturbance area assumptions to the base of 80,234 acres results in varying levels of habitat protection. This ranges from a minimum of 41,000 acres protected in Option 1C to a maximum of 72,000 acres in Option 1A.
- Options 1A and 2A would apply the stringent treatments to the most acres, preserving the most habitat for future generations.
- Option 1C leaves the most habitat at risk for loss to future generations.

Performance of options

All six regulatory options protect some habitat for future generations. The options that apply more stringent treatments to a larger part of the landscape would preserve more habitat and potential for restoration.

Table 4-18. Performance of options in meeting Social Criterion 3: Preserves habitat for future generations.

Rank	Option	Performance
1	Option 1A	Preserves the most habitat for future generations by applying strict treatments to all habitat types.
2	Option 2A	Applying urban development values reduces the amount of habitat preserved but this option still protects a substantial amount of habitat.
3	Option 1B	A moderate level of protection is applied across the landscape, focused on high value habitat.
4	Option 2B	Close to the same level of protection as 1B, but more habitat is left unprotected in areas of high urban development value.
5	Option 2C	Habitat in areas of high urban development value is not preserved, more protection than Option 1C.
6	Option 1C	Leaves the most habitat at risk for loss to future generations, also reduces potential for restoration.

4. Maintains cultural heritage and sense of place

Protection of fish and wildlife habitat preserves many important social values. These include our cultural heritage, regional identity, sense of place, and neighborhood character. Opportunities for education abound in areas with healthy fish and wildlife habitat. Part of the region’s cultural heritage is the retention of the salmon and other endangered species. The salmon are a ubiquitous symbol for the Pacific Northwest, and a key aspect of Native American culture. It is difficult to measure how well these more ambiguous values are retained by the application of the six potential program options. As a proxy for a more specific quantitative measure, retention of Habitats of Concern and Riparian/wildlife Class I habitat is used to assess how well each option addresses this criterion (the same measurements are used in Environmental Criterion 5). Habitats of Concern are places that have been identified by local field biologists and other experts as providing habitat for critical species, while Class I riparian areas are essential to providing habitat for threatened and endangered salmon, as well as birds, deer and other wildlife that are of cultural importance in the region.

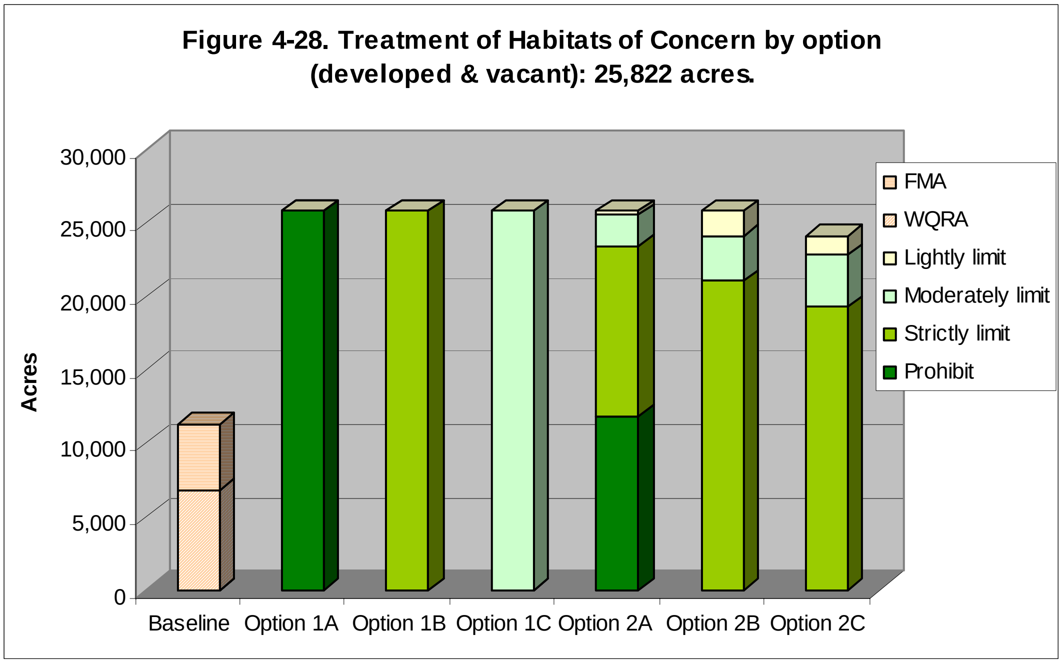


Figure 4-28. Treatment of Habitats of Concern by option (developed & vacant): 25,822 acres.
Acres
30,000
25,000
20,000
15,000
10,000
5,000
0
Baseline
Option 1A
Option 1B
Option 1C
Option 2A
Option 2B
Option 2C
FMA
WQRA
Lightly limit
Moderately limit
Strictly limit
Prohibit

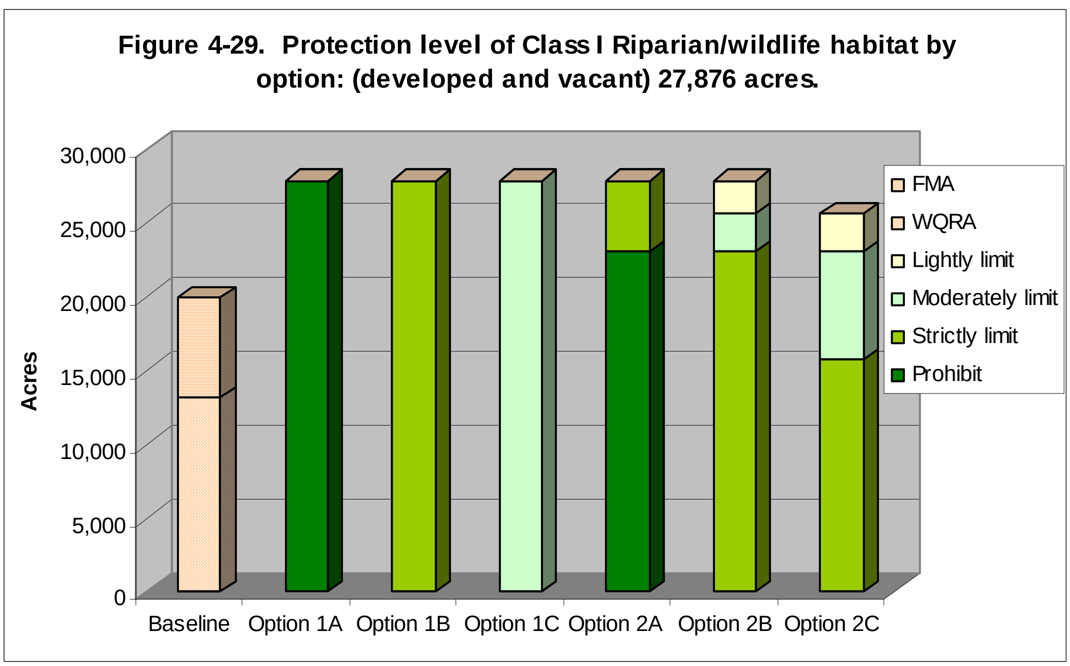


Figure 4-29. Protection level of Class I Riparian/wildlife habitat by option: (developed and vacant) 27,876 acres.
Acres
30,000
25,000
20,000
15,000
10,000
5,000
0
Baseline
Option 1A
Option 1B
Option 1C
Option 2A
Option 2B
Option 2C
FMA
WQRA
Lightly limit
Moderately limit
Strictly limit
Prohibit

Results

The following observations are made from Figures 4-28 and 4-29.

Basic statistics and baseline protection

- Class I riparian includes 27,872 acres, Habitats of Concern (HOCs) encompass 25,822 acres. Some of the HOCs are included in the Class I riparian, but it is useful to consider them as a group due to their importance.
- Baseline protection covers about 65 percent of the Class I habitat and about 40 percent of HOCs. More restrictive WQRA restrictions are applied to about 42 percent of Class I and 22 percent of HOCs; FMA design guidelines cover a little over 20 percent of Class I and about 18 percent of HOCs.

Comparison of options

- Option 1A, 1B, and 2A would apply a strictly limit or prohibit treatment to all Class I habitat.
- Applying urban development values leads to loss of a small amount of HOCs and Class I habitat with allow and lightly limit treatments.
- Option 1C would apply the least stringent treatments to the largest amount of HOCs and Class I habitat.

Performance of options

All six regulatory options help to preserve cultural heritage and sense of place. The options that apply more stringent treatments to a larger part of the landscape have more of a positive impact than the options that apply lightly limit or allow treatments.

Table 4-19. Performance of options in meeting Social Criterion 4: Cultural heritage and sense of place.

Rank	Option	Performance
1	Option 1A	Does the best job of preserving cultural heritage and sense of place when measuring the effect on Class I habitat and Habitats of Concern. However, if a prohibit treatment resulted in an expansion of the urban growth boundary the resulting environmental effects could negatively impact cultural heritage and the salmon.
2	Option 2A	Comparable to 1A, however the application of urban development values would result in slightly less protection of cultural heritage and sense of place in areas with high urban development value.
3	Option 1B	Applies a strictly limit treatment to all Class I habitat and Habitats of Concern, providing substantial benefit to salmon and other endangered species but without as much potential for expansion of the UGB.
4	Option 2B	A large amount of Class I and Habitats of Concern receive stringent treatments in this option, with lightly limit applied to areas of high urban development value.
5	Option 2C	Similar to 2B, however a small amount of these highest value habitat areas would be lost due to the application of an allow treatment in high urban development value areas.
6	Option 1C	Applies the lowest level of protection to the highest value habitat, putting some of the social values contained in cultural heritage and sense of place at risk of loss.

5. Preserves amenity value of resources

The amenity value of habitat land on quality of life, property values, and regional attractiveness is an important consideration. For example, proximity to some types of natural areas actually increases property values, thus preservation of these habitats could positively impact nearby property owners. Private individuals and firms can capture the value of location, such as nearby parks, open space or schools, or good accessibility to services or transportation infrastructure. This results in higher demand and higher dollar valuation of these properties. On the other hand, public parks, schools, highways, and other perceived amenities capture individual or commercial value by the usage, time, and willingness of people to pay for them.

One way to assess the effectiveness of each option in addressing this criterion is the reliability of protection provided to the fish and wildlife habitat. An option that relies more on regulations and applies strict treatments to habitat land is more likely to produce reliable protection. Options that rely less on regulations and more on voluntary actions or incentives that are dependent on funding sources may be less likely to provide certainty of habitat protection. Thus, the amenity value that attracted landowners to purchase particular properties in the first place may be lost due to the absence or ineffectiveness of protection measures on adjacent lands. Figures 4-30 to 4-33) on the following page graphically depict the treatments to vacant land in the highest four habitat classes as a proxy for retaining amenity value.

Figure 4-30. Treatment of vacant Class I Riparian/wildlife land by option: 12,549 acres total.

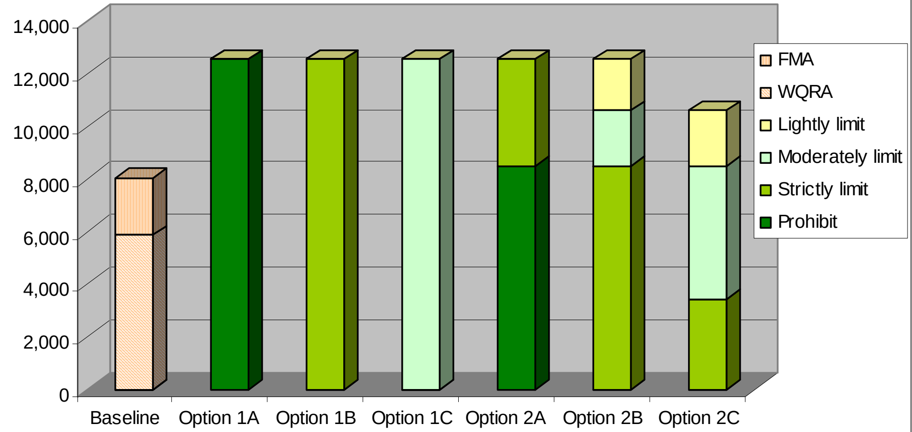


Figure 4-31. Treatment of vacant Class II Riparian/wildlife land by option: 3,907 acres total.

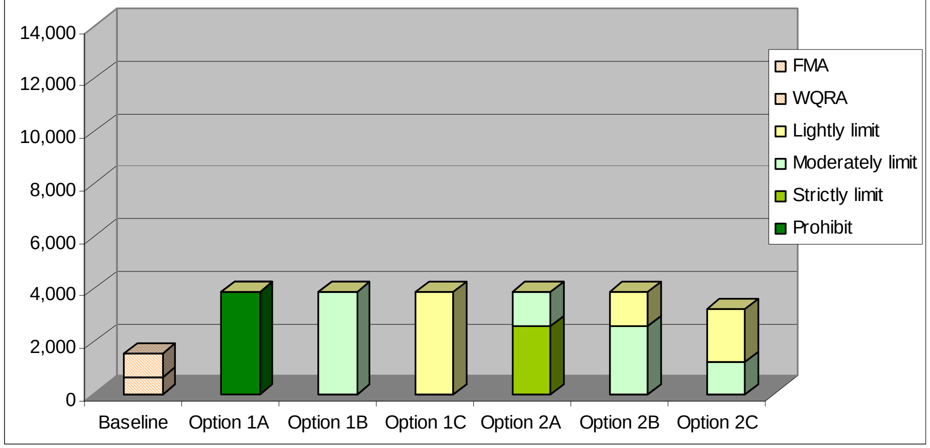


Figure 4-32. Treatment of vacant Class A Wildlife land by option: 8,508 acres total.

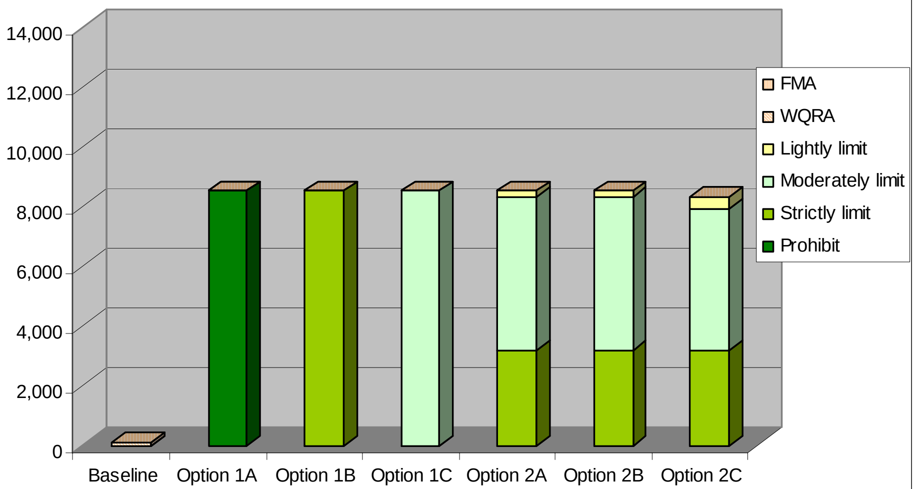
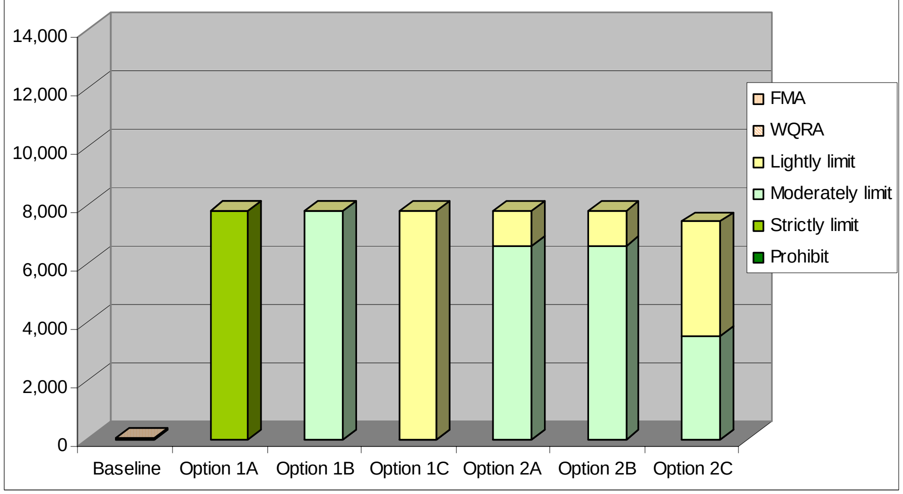


Figure 4-33. Treatment of vacant Class B Wildlife land by option: 7,789 acres total.



Results

The following observations are made from Figures 4-30 to 4-33.

Basic statistics and baseline protection

- Vacant Class I riparian includes 12,549 acres, vacant Class II riparian includes 3,907 acres, vacant Class A wildlife includes 8,508 acres, and vacant Class B wildlife includes 7,789 acres.
- Baseline protection covers about 65 percent of the Class I riparian, 40 percent of Class II riparian, and only one percent of Class A and B wildlife. More restrictive WQRA restrictions are applied to about 47 percent of Class I, 16 percent of Class II, about one percent of Class A and B wildlife; FMA design guidelines cover 17 percent of Class I, 24 percent of Class II, and a negligible amount of Class A and B wildlife.

Comparison of options

- Options 1A, 1B, and 2A would apply a strictly limit or prohibit treatment to all Class I habitat.
- Option 1A is the only option that would apply a prohibit treatment to Class A wildlife habitat and Class II riparian habitat, treatments for these habitat types range from strictly limit to allow in the other options.
- Applying urban development values does not substantially effect the treatment of Class A wildlife habitat, due to the fact that very little of this habitat type is in the high urban development category.
- Option 1C would apply the least stringent treatments to Class II and Class B habitats.

Performance of options

All six regulatory options help to preserve amenity value. The options that apply more stringent treatments to a larger part of the landscape have more of a positive impact than the options that apply lightly limit or allow treatments.

Table 4-20. Performance of options in meeting Social Criterion 5: Amenity value.

Rank	Option	Performance
1	Option 1A	Preserves amenity value consistently in all four of the highest habitat classes.
2	Option 2A	Applying the urban development values results in a small loss of amenity value in areas with high urban development value; preserves more amenity value in riparian habitat than wildlife habitat.
3	Option 1B	Applies consistent level of protection to all four habitat types, but riparian habitats are not as well preserved as in 2A.
4	Option 2B	Urban development values result in very similar protection for wildlife habitat as 2A, but riparian protection would be less than in 1B.
5	Option 2C	Amenity value provided by the highest value wildlife habitat receives similar protection to 2A, but the other three habitat categories receive less stringent treatment.
6	Option 1C	Retains the least amount of amenity value in wildlife habitat areas, provides a bit more protection for riparian habitat.

Evaluation of environmental criteria

The environmental portion of this phase of the ESEE analysis is intended to compare the potential effects of the six program options on fish and wildlife habitat. Five criteria will assist in this process:

1. Conserves existing watershed health and restoration opportunities;
2. Retains multiple functions provided by forest canopy cover;
3. Promotes riparian corridor continuity and overall habitat connectivity;
4. Conserves habitat quality and biodiversity provided by large habitat patches; and
5. Promotes biodiversity through conservation of sensitive habitats and species.

Criteria were selected based on the findings in Metro's Technical Report for Goal 5 and Phase I ESEE analysis (Metro 2002, Metro 2003). Charts depicting program performance for the most vulnerable habitat are embedded in the text. Habitat lands in parks and Title 3 WQRA are typically omitted from the graphs because they are currently afforded some protection. Habitat lands in Title 3 FMA are included in charts that illustrate vulnerability of the fish and wildlife habitat under the options because FMA areas do not protect vegetation.

The summary of each criterion includes a table ranking the programs in order of performance, from most to least protective. The criteria provide important new information about how each program performs relative to the others, and will aid Metro, its partners, and the public in designing a fish and wildlife habitat protection program appropriate to the region.

1. Conserves existing watershed health and restoration opportunities

The amount of fish and wildlife habitat protected or partially protected by each regulatory program option will help determine whether the option preserves habitat, existing ecosystem functions, and restoration opportunities for the future.

Potential impacts on fish and wildlife habitat

Partial or full loss of natural habitat impairs ecological functioning. The type and extent of impairment depends on the habitat class and, within each habitat class, the attributes that make each area valuable to fish and wildlife habitat. Metro's Phase I ESEE analysis (Metro 2003) describes the impacts on ecological systems when such functions are removed, and the Technical Report for Goal 5 (Metro 2002) describes how the region's natural habitats have been altered over time.

In riparian areas, highest value habitats provide the most functions. Class I riparian habitats provide at least three of the five key, or "primary," ecological functions mapped in the inventory. These areas are typically near streams and wetlands and often include forests or undeveloped floodplain areas; they are critical to maintaining aquatic habitat and water quality. Class II habitats provide one or two primary functions, and often also several secondary functions. Class III areas are lower value areas that still provide some degree of ecological function, such as small forest patches that are disassociated from the stream. Thus, protection of Class I is most important, followed by Class II, then Class III.

Wildlife habitat is similarly valued in a tiered approach; Class A is more valuable to wildlife than Class B, and Class B is more important than Class C. Metro mapped wildlife habitat based on spatial ecology principles, where large patches that are well connected to other patches, contain less edge habitat, and contain good water resources are considered most valuable. However, in the case of wildlife habitat, removal of lower valued habitats (Class C) can negatively impact the remaining habitats to a higher degree than for riparian due to connectivity issues (see criterion 3, Connectivity).[24]

Potential impacts on restoration opportunities

Restoration potential is preserved where habitat areas still exist (e.g., not paved); therefore, the level of protection provided by each program option illustrates the relative amount of potential restoration opportunities retained. This analysis does not identify the precise location or quality of restoration opportunities; however, because as habitats differ between classes, so do restoration opportunities. For example, areas of low-structure vegetation along streams may provide excellent opportunities to control non-native species and increase native tree and shrub cover; this would increase habitat to support diverse native wildlife communities. Native tree and shrub cover provide many vital ecological functions, including valuable riparian wildlife habitat, shading streams for cooler water, etc. Low-structure areas near streams are most typically found in Class II riparian and Class B wildlife.

Restoration opportunities are also found in high-value habitat areas; for example, Forest Park contains substantial amounts of non-native, invasive English Ivy. Efforts to control such invasions are ongoing. Because Forest Park is currently protected from development, the habitat and the restoration opportunities continue to exist. In upland areas, restoration is often needed to enhance wildlife habitat or control non-native species, particularly near forest edges. Thus, small habitat patches or long, narrow patches that contain a high proportion of edge habitat also provide restoration opportunities. Streams, wetlands, lakes and rivers can often be rehabilitated to create channel meanders, enhance water filtration capacity, or re-connect to natural floodplain areas. [25]

Metro’s habitat inventories focused on the most important remaining habitats, and did not include every potential restoration opportunity due to the large scale nature of the regional inventory and because the Goal 5 rule applies to existing habitat.

Measuring the criterion

For each habitat class and each program option, the acreage that falls under various ALP designations is the measure for this criterion. The data is broken down between developed and vacant lands, because the time frame for habitat risk is different. Redevelopment will presumably occur over a longer time frame than new development. Additionally, habitats on

[24] It is important to consider the interactions between the riparian and wildlife inventories. The two inventories were conducted separately then reconciled so that a program could be developed for a single inventory map. As a result, some of each inventory was allocated to the other. For example, when Class I riparian coincided with any wildlife class, the wildlife portion became Class I riparian. Thus the loss of one habitat type may also include loss of another due to the extensive spatial overlap of the two inventories.
[25] Metro’s Technical Report for Goal 5 (Metro 2002) includes a chapter describing how to go about watershed planning and prioritizing opportunities for restoration and other ecologically important activities.

vacant lands unconstrained by existing protection are more likely to be subjected to new conflicting uses. Title 3 WQRA acreage is excluded from this criterion because it is already partially protected (see introductory chapter). Similarly, Criterion 1 does not include parks, but focuses on habitat areas that may be placed at risk through development or redevelopment.

Results
Figures 4-34 through 4-37 illustrate the findings. Program options that are likely to protect more fish and wildlife habitat overall, as well as more of the most valuable habitat, are assumed to perform better than other options.

Basic statistics

- This criterion includes 80,143 acres of fish and wildlife habitat. Of that:
  - 27,851 acres are in class I riparian (34 percent of total)
  - 7,901 acres are in class II riparian (10 percent of total)
  - 4,434 acres are in class III riparian (6 percent of total)
  - 19,662 acres are in class A wildlife (25 percent of total)
  - 12,828 acres are in Class B wildlife (16 percent of total)
  - 7,468 acres are in Class C wildlife (9 percent of total)
- Riparian habitat comprises 17,500 acres (38 percent), while wildlife habitat comprises 28,960 acres (62 percent).

Baseline protection (Title 3)

- This analysis removed WQRA because it provides a degree of habitat protection.
- Of total habitat lands, 19 percent is in WQRA (7 percent parks, 4 percent in developed urban, and 8 percent in vacant).
- Of total habitat lands, 17 percent is in parks.
- If WQRA are included in the acreage figures, nearly half of Class I habitat and one-fourth of Class II habitat are WQRA, with all other habitat classes containing less than 5 percent WQRA.
- Fifteen percent of developed urban and vacant habitats are in Title 3 FMA, but vegetation is not protected in FMA and wetlands may be filled with proper DSL permission. Thus FMA does not protect habitat, and only partially protects the water storage function in riparian habitats. FMA are included as vulnerable to conflicting uses in Figures 4-34 through 4-37.
- The acres included under this criterion are outside WQRA and are subject to conflicting uses if no increase in protection level is applied; therefore, any program option that is not allow will provide incrementally more protection on the lands considered in Figures 4-34 through 4-37.

Potential effects of treatments vary by development status and habitat class

- Two-thirds of these habitat lands are vacant and one-third is developed urban. Treatments applied to vacant lands may have disproportionately high impacts compared to the same treatments applied to developed urban.
- Of vacant habitats, riparian comprises 34 percent, while wildlife comprises the remaining 66 percent. Of developed urban habitats, riparian only comprises 15 percent, with the remaining 85 percent in wildlife. These opposing trends indicate that treatments applied to vacant lands may disproportionately influence riparian habitats, whereas treatments applied to developed

urban lands may more strongly influence wildlife habitat.

- Class I dominates vacant riparian, comprising 63 percent of the acreage, but only 29 percent of developed urban riparian (Class III comprises half of the riparian acreage in developed urban). Treatments applied to vacant Class I riparian will profoundly influence the future ecological conditions of aquatic and riparian habitats.
- Class A comprises 41 percent of vacant wildlife and 32 percent of developed urban wildlife. Treatments applied to both vacant and developed urban wildlife will be important determinants of future wildlife conditions.
- Average riparian and wildlife habitat values tend to be lower in developed urban compared to vacant, because conflicting uses tend to degrade habitats. For example, developed floodplains do not retain the same ecological functions as the original floodplain, and riparian and wildlife habitat is more fragmented in developed areas.

Impact Areas

- Impact areas are designated where adjacent land use may harm the habitat.
- An allow decision in impact areas may harm remaining habitat over time, whereas a lightly limit decision may help protect habitat.
- Lightly limit program definitions may need to differ between habitats and impact areas, because impact areas, by definition, are not habitat. For example, impact areas to protect streams may require low impact development standards upon redevelopment.
- If a program option is selected that includes an allow decision for certain habitats, it would be sensible to administer an allow decision for adjacent impact areas, because impact areas are designed to address where adjacent land use might adversely affect *existing* resources.

Program Option performance

- In options 2A-2C, the urban development value plays a role in what may happen to the habitat because treatments change based on both habitat class and by urban development value. Options 1A-1C are based solely on habitat value.
- For wildlife habitat, options 1A and 1B are most protective.
- For riparian habitat, options 1A and 2A are most protective.
- Options 1C and 2C are the least protective for both riparian and wildlife habitat.
- Potential effects of program options depend in part on the amount of land falling within each habitat class; Class I, Class A and Class B contain the most acreage, whereas Class III and Class C hold the least. For example, options affording less protection to Class B (1C, 2B, 2C) will have greater adverse effects on overall wildlife habitat protection.
- Class C wildlife is most vulnerable to loss under all options (least protective treatments applied). Class II and III are also vulnerable under certain program options (e.g., 1C, 2C).

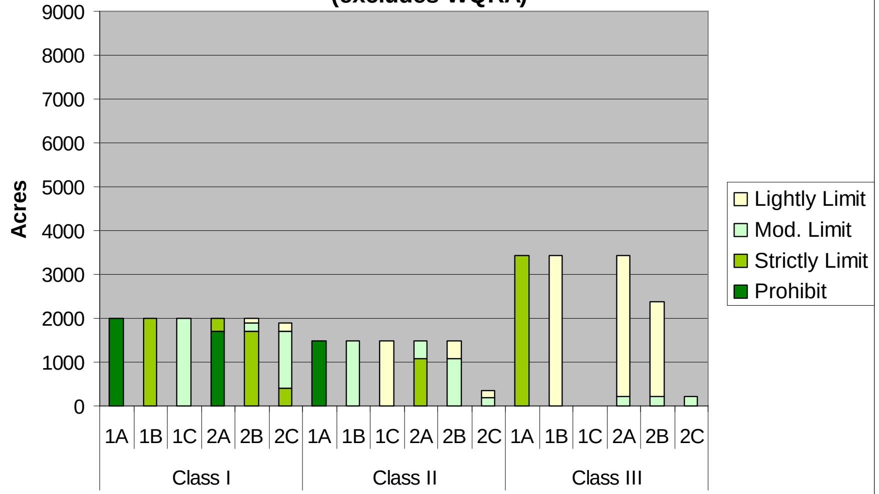
Summary

Program options show a marked decline in protection levels, as indicated in Table 4-21 below. The options that apply more stringent treatments to a larger portion of resources, particularly high value resources, will protect a larger proportion of regionally significant resources in the long term. Table 4-21 provides a ranking of program options for this criterion.

Table 4-21. Performance of options in meeting Environmental Criterion 1: Conserves existing watershed health and restoration opportunities.

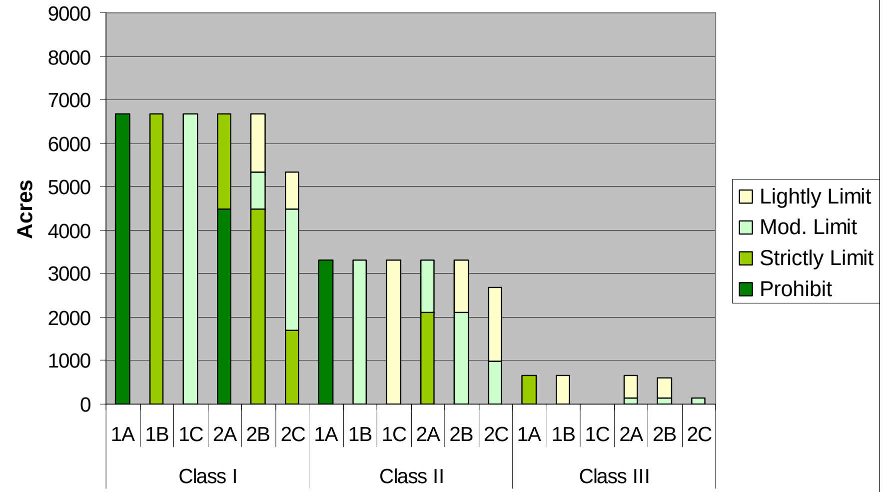
Rank	Option	Performance
1	1A	Charts 1a-1d indicate that this option will provide the most effective protection for the highest value resources (class I and class A habitat). This option also provides the highest protection levels for the remaining resource categories.
2	2A	This option still provides excellent protection for the majority of class I resources, and good protection for other riparian classes. The protection level is diminished, but still good for wildlife resources; however, option 1B provides better protection for wildlife habitat than 2A.
3	1B	Protection for all classes of riparian habitat is substantially reduced in this option compared to 1A and 2A. Class III riparian in appears to be particularly vulnerable. For wildlife habitat, this option performs at a higher level than 2A, but the importance of riparian habitat was considered first in this criterion.
4	2B	Performs moderately well for the higher classes in both riparian and wildlife habitat. This is the point at which protection levels drop off significantly for lower value resources. Poses substantial risk to habitat in classes III and C, due to lower protection levels and because some acreage is in the allow category.
5	2C	Lower protection levels for all resources. In particular, classes III and C are predominantly allow. Likely to result in substantial loss of riparian function unless extensive non-regulatory programs are put in place.
6	1C	Low protection levels for all habitat classes. Likely to result in significant habitat loss and ecosystem function over time in both developed and vacant lands.

Figure 4-34. Criterion 1a: Comparison of allow, limit, prohibit treatments by riparian class in developed urban lands (excludes WQRA)



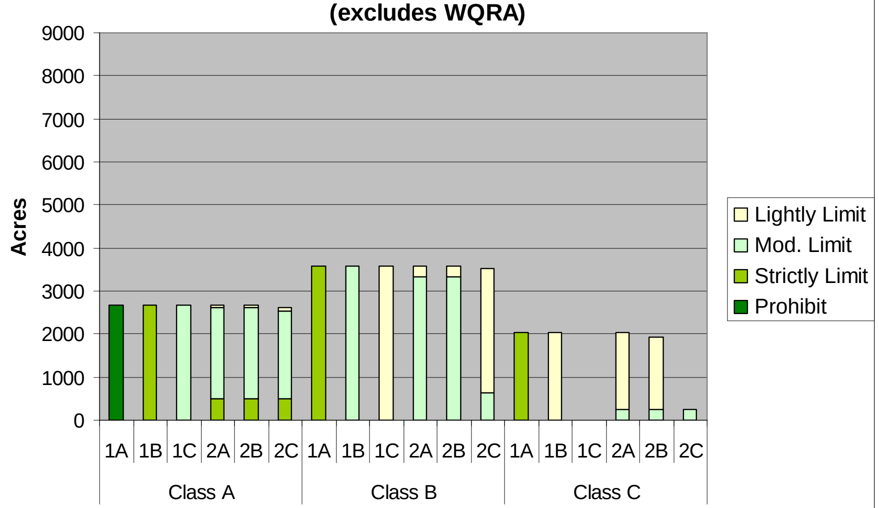
Program Option and Riparian Class
WQRA = 3,023 acres, non-WQRA = 6,909 acres

Figure 4-35. Criterion 1b: Comparison of allow, limit, prohibit treatments by riparian class in vacant lands (excludes WQRA)



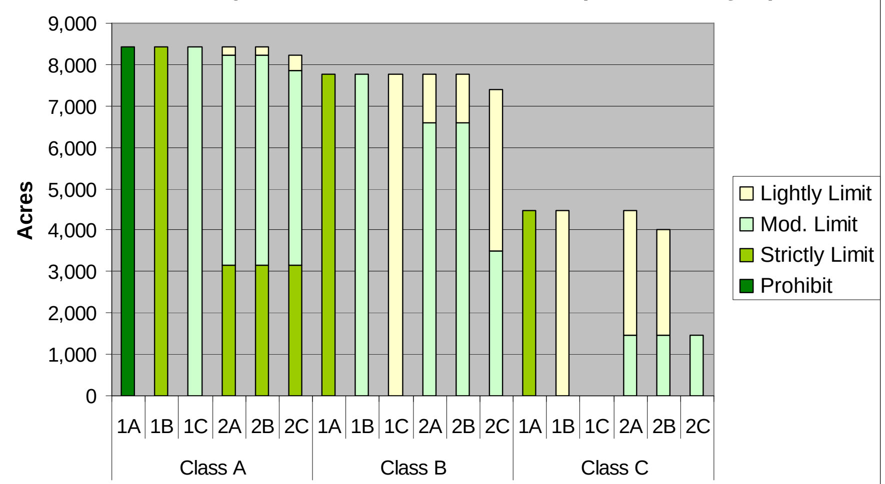
Program Option and Riparian Class
WQRA = 6,466 acres, non-WQRA = 10,636 acres

Figure 4-36. Criterion 1c: Comparison of allow, limit, prohibit treatments by wildlife class in developed urban lands (excludes WQRA)



Program Option and Wildlife Class
WQRA = 89 acres, non-WQRA = 8,286 acres

Figure 4-37. Criterion 1d: Comparison of allow, limit, prohibit treatments by wildlife class in vacant lands (excludes WQRA)



Program Option and Wildlife Class
WQRA = 133 acres, non-WQRA = 20,638 acres

2. Retains multiple functions provided by forest canopy cover

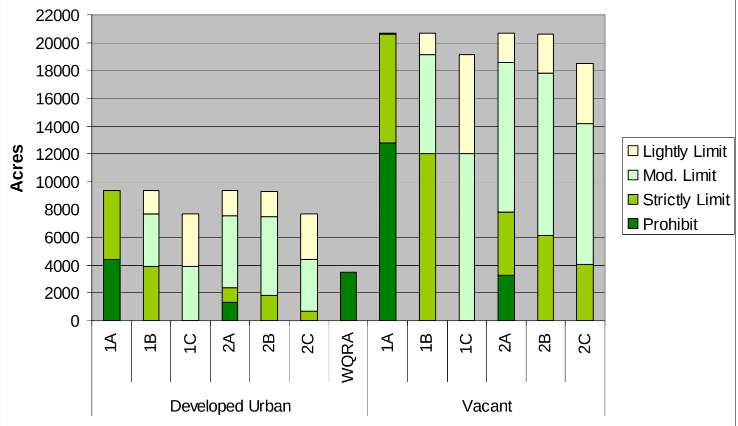
The Metro region is naturally forested, and trees play a pivotal role in maintaining healthy fish and wildlife habitat and regional biological diversity. Local studies affirm the importance of trees to stream health both near streams and throughout the watershed. Forest canopy plays a major role in all five ecological functions mapped in Metro's riparian habitat inventory, and forest habitat comprise the majority of the wildlife inventory.

Trees are also directly linked to each of the eight major ecological impact categories described in the ESEE Phase I discussion draft (Metro 2003). For example, trees help prevent altered hydrology and physical stream damage, and mitigate flooding caused by altered hydrology. They maintain water quality by taking up excess nutrients, heavy metals and other toxins, and provide shade over streams to cool water. Trees provide a primary source of wildlife habitat, and salmon and other aquatic wildlife frequently linger in shaded stream areas for thermal and predator protection.

Measuring the criterion

This criterion is measured by calculating the acreage of forest associated with each ALP category by program option. Forest canopy is a component of every habitat class, therefore this analysis does not differentiate by habitat class (for analysis by habitat classes, see criterion 1). The analysis does differentiate between vacant and developed status, because developed lands are less likely to experience much further tree loss, whereas vacant lands may be developed with substantial tree loss. However, forest loss can be an issue when redevelopment occurs, particularly when redevelopment occurs at higher densities. Program options that are likely to protect more acres of trees overall will receive a better rating in this criterion.

Figure 4-38. Criterion 2: Comparison of allow, limit, prohibit treatments for forest canopy (excludes WQRA)



WQRA = 4,679 acres, non-WQRA = 29,980 acres

Results

Figure 4-38 illustrates the findings from acreage calculations. Program options that are more likely to protect forest canopy cover are assumed to perform better than options providing less protection.

Basic statistics

- This criterion considers 50,134 acres of forested fish and wildlife habitat.
- Parks comprise 15,475 acres (31 percent of total forested acres), developed urban comprises 10,504 acres (21 percent of total forested acres), and vacant comprises 24,155 acres (48 percent of total forested acres).
- The bar chart for this criterion considers the most at-risk categories (developed urban and vacant, both outside WQRA).

Baseline protection (Title 3)

- WQRA comprise 2,916 forested park acres, 1,165 forested urban developed acres, and 3,514 forested vacant acres, or 15 percent of total forest habitat.
- Comprising about a third of forested lands, parks provide important protection to trees.
- The graph for criterion 2 excludes WQRA for the same reasons as stated in criterion 1.

Potential effects of treatment vary by development status

- Nearly half of forested habitat is in vacant lands. Of this, only 15 percent is protected as WQRA, while the remaining 85 percent is unprotected. Many of these lands are in rural zoning in new Urban Growth Boundary expansion areas.
- Of developed lands, two thirds receive some level of protection through parks or WQRA.
- Eleven percent of developed urban lands with forest are in WQRA. The remaining 9,339 acres are vulnerable to conflicting uses, particularly if redevelopment occurs at higher densities.
- Treatments applied to vacant lands may have disproportionately high impacts to forest habitat compared to the same treatments applied to developed urban lands.

Program option performance

- Options 1A and 1B are most protective of forest canopy in both developed urban and vacant lands. Options 2C and 1C are least protective.
- Options 2A and 2B fall in the mid-range in terms of protecting forest canopy.
- Option 1A is substantially more protective than option 1B. The difference between options 1B and 2A are less clear.
- The program options do not vary much between developed urban and vacant in terms of the proportions falling within allow, limit, prohibit designations.

Summary

Program options vary considerably in terms of forest canopy protection. The options that apply more stringent treatments to a larger part of the forested landscape will protect more forest canopy over the long term. Table 4-22 below provides a ranking of program options for this criterion, based on the most at-risk acres illustrated in Figure 4-38.

Table 4-22. Performance of options in meeting Environmental Criterion 2: Retains multiple functions provided by forest canopy.

Rank	Option	Performance
1	1A	Protects by far the most canopy cover of any other program option for vulnerable forested lands in both vacant and developed.
2	1B	Substantially less protection than option 1A, but still performs better than the remaining options. However, options 1B and 2A appear relatively close in terms of potential effects on the region's forest canopy. No Allow designations mean that all forest habitat would be afforded at least some level of protection.
3	2A	Similar to 1B.
4	2B	Little Allow (76 acres), but overall protection levels lower than options 1B and 2A.
5	2C	Low protection levels for forest canopy, with 38 percent of vacant and developed urban in Lightly Limit or Allow. Likely to result in significant habitat loss over time in both developed and vacant lands.
6	1C	Low protection levels for forest canopy, with 47 percent of vacant and developed urban in Lightly Limit or Allow. Likely to result in significant forest habitat loss over time.

3. Promotes riparian corridor continuity and overall habitat connectivity

Habitat connectivity is important to fish and wildlife for several reasons. Riparian, or longitudinal, connectivity ensures continued ecological functioning of streams and helps enable fish passage to areas upstream. Many fish and wildlife species must migrate seasonally to meet basic needs for food, shelter and breeding, and connections between habitat patches, including aquatic habitat, allow this migration to occur.

Fish and wildlife populations that are connected to each other are more likely to survive over the long term than an isolated population. In addition, when connectivity is lost between habitats the remaining habitat tends to become less native, attracting non-native and generalist wildlife species that can out-compete more sensitive native species, thereby reducing biodiversity. Metro's Phase I ESEE report describes the importance of connectivity to regional fish and wildlife habitat and populations (Metro 2003).

Measuring the criterion

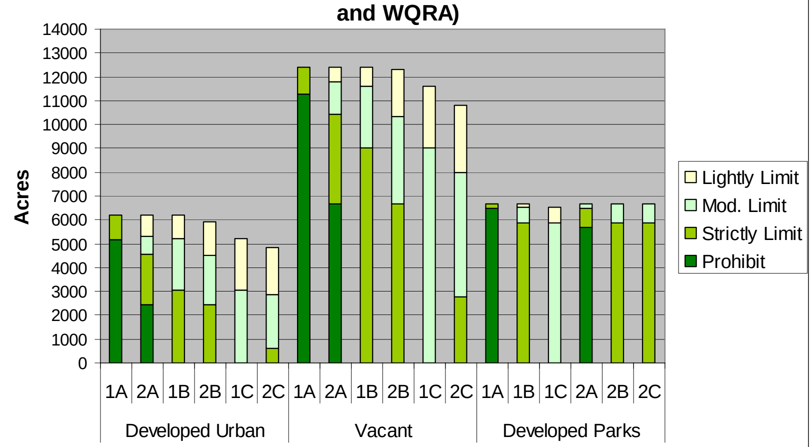
Connectivity is an important indicator of habitat fragmentation. It is also very difficult to accurately measure, and prohibitively time-intensive to measure for six different program options. As a proxy for connectivity this criterion examines the following indicators:

- Criterion 3a: Riparian corridor continuity. Measures the amount of habitat within 150 feet of streams that falls within each allow, limit, prohibit designation for each program.
- Criterion 3b: The relative risk to all fish and wildlife habitat by program option.
- Criterion 3c: Discussion of the potential for disproportionate impacts by Metro's 27 subwatersheds.

Results: Criterion 3a - Riparian corridor continuity

The figure below illustrates the findings. Program options that protect more habitat within 150 feet of streams are more likely to retain existing riparian corridor continuity.

Figure 4-39. Criterion 3a: Comparison of allow, limit, prohibit treatments for habitat within 150' of streams (includes parks and WQRA)



Program Option
Total acres =25,261

Basic statistics

- This criterion includes 25,260 acres of fish and wildlife habitat near streams.
  - 6,186 acres are in developed urban (24 percent of total).
  - 12,395 are in vacant (49 percent of total).
  - 6,680 acres are in parks (26 percent of total).

Baseline protection (Title 3)

- Of developed urban, 2,579 acres (40 percent) are in WQRA.
- Of vacant, 4,936 acres (40 percent) are in WQRA.
- Of parks, 3,221 acres (48 percent) are in WQRA.

This analysis included WQRA and parks because it constitutes a significant portion of riparian corridor continuity. The bar chart does not specifically delineate WQRA due to graph complexity.

Potential effects of treatments vary by development status

- About half of the acreage is vacant, with another quarter each in parks and developed urban. Parks are afforded some degree of protection, and so are WQRA.
- Excluding parks and WQRA, 7,459 acres are at risk in vacant. Less than half that amount, 3,607 acres, is in developed urban. Treatments applied to vacant habitat may have disproportionately high impacts on riparian corridor continuity.
- Parks are assumed to have some existing level of protection, but conflicting uses could impact these resources as well. However, nearly half of park acres are in WQRA.

Program option performance

- For all development statuses, Option 1A is most protective of habitat within 150 feet of streams, followed closely by Option 2A. Option 1B provides the next best protection, followed by 2B.
- Options 1C and 2C are least protective for these resources, and could negatively influence riparian corridor continuity.

Results: Criterion 3b – Relative risk to all fish and wildlife habitat

This sub-criterion is derived from Criterion 1. Figures 4-34 through 4-37 illustrate the findings. Program options that are likely to protect more fish and wildlife habitat overall, as well as more of the most valuable habitat, are assumed to perform better than other options. Here the findings from Criterion 1 are summarized as they related to Criterion 3b:

Basic statistics

- This criterion includes 80,143 acres of fish and wildlife habitat:
  - 27,851 acres are in Class I riparian (34 percent of total); of that, 2,005 developed acres are vulnerable (outside of parks or WQRA) and 6,683 vacant acres are vulnerable.
  - 7,901 acres are in Class II riparian (10 percent of total); of that, 1,475 developed acres are vulnerable and 3,301 vacant acres are vulnerable.
  - 4,434 acres are in Class III riparian (6 percent of total); of that, 3,427 developed acres are vulnerable and 659 vacant acres are vulnerable.
  - 19,662 acres are in Class A wildlife (25 percent of total); of that, 2,682 developed acres are vulnerable and 8,435 vacant acres are vulnerable.
  - 12,828 acres are in Class B wildlife (16 percent of total); of that, 3,580 developed acres re vulnerable and 7,756 vacant acres are vulnerable.
  - 7,468 acres are in Class C wildlife (9 percent of total); of that, 2,041 developed acres are vulnerable and 4,466 vacant acres are vulnerable.

Baseline protection (Title 3)
- See criterion 1 for baseline statistics.
- Nearly half of Class I habitat and one-fourth of Class II habitat are WQRA, with all other habitat classes containing less than 5 percent WQRA. This leaves lower habitat classes more vulnerable than the top two riparian classes.

Potential effects of treatments vary by development status and habitat class
- Class B and C wildlife habitat, in terms of acreage, provide disproportionately important connectivity links, such as stepping-stones between larger patches for migratory stopover and other wildlife movement.
- Class B and C wildlife habitat comprise 39 percent of vulnerable resources outlined above. Because these habitat patches are small, this equates to an high number of connector patches.
- Class B and C wildlife habitat tend to receive lower protective treatments in the program options compared to other habitat classes.
- The majority (68 percent) of vulnerable Class B and C acres are vacant, therefore program treatments applied to vulnerable vacant lands may have a disproportionate negative impact on regional connectivity.

Program Option performance
- Option 1A afford highest protection to Class B and C wildlife habitat, with strictly limit designations assigned to all acres.
- Option 1B provides less protection, but still provides protection to Class B and C habitat at the moderately and lightly limit levels, respectively.
- Options 2A and 2B provide less protection, but are generally similar to one another.
- Option 2C performs poorly, placing an allow designation on the majority of Class C habitat.
- Option 1C completely fails to protect vulnerable Class C habitat. Class C wildlife is most vulnerable to loss under all options (least protective treatments applied).

Results: Criterion 3c – Potential for disproportionate impacts by subwatershed
The findings for Criterion 3a are illustrated in the two figures below.

Basic statistics
- This criterion includes all 80,143 acres of regionally significant fish and wildlife habitat in Metro's 27 subwatersheds, plus 15,730 acres of impact areas (see context chapter for more information on distribution of impact areas by development status).
- Impact areas are addressed in this subcriterion because conflicting uses in impact areas may adversely impact fish and wildlife habitat.
- Resources sites with a lower percentage of fish and wildlife habitat typically contain proportionally more impact areas. These subwatersheds are also typically more developed.
- Of the total, 53,939 acres are in developed, while 41,934 are in vacant.
- The criterion discerns between the most vulnerable habitats and those with some existing protection.

Baseline protection (Title 3)

- Of developed urban habitat and impact areas, 3,795 acres (seven percent of developed urban; four percent of all acres) are in WQRA.
- Of vacant habitat and impact areas, 6,881 acres (16 percent of vacant; seven percent of all acres) are in WQRA.
- Of all acres, 25,212 acres (26 percent) are in parks, shown in black in Figure 4-40.

Potential effects of treatments vary by subwatershed

- Variability exists between subwatersheds; some subwatersheds contain more habitat/impact areas overall, while others contain varying proportions of habitat within the subwatershed.
- In all subwatersheds, WQRA comprises a relatively small proportion of acreage, whether considering vacant or developed urban habitat.
- The bar chart illustrates that some subwatersheds contain more vulnerable lands than others. For example, subwatersheds #8, 26, and 27 contain relatively high amounts of vulnerable developed habitat and impact areas; these areas would be most vulnerable under redevelopment. Subwatersheds #11, 18, and 27 contain relatively high amounts of vulnerable vacant habitat and impact areas; these habitat acres are more immediately vulnerable.
- Some subwatersheds contain low proportions of habitat and impact areas. Examples include subwatersheds #6, 20 and 24, containing from 20-22 percent of acres in habitat or impact areas. Because these subwatersheds contain relatively little existing habitat, program treatments could have disproportionately high impacts on existing connectivity.

Figure 4-40. Criterion 3c: Developed lands - Habitat and impact areas in Metro's 27 subwatersheds

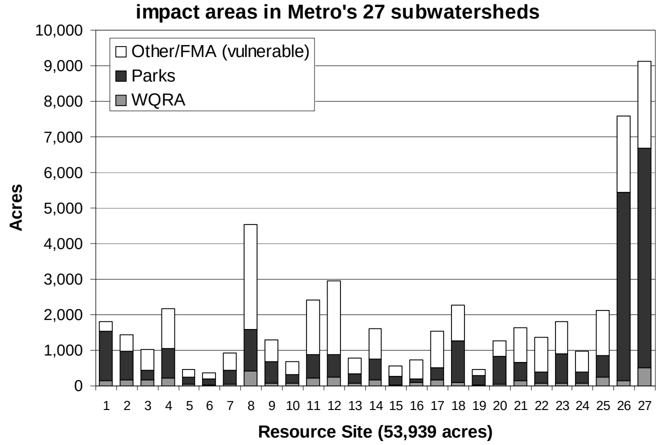
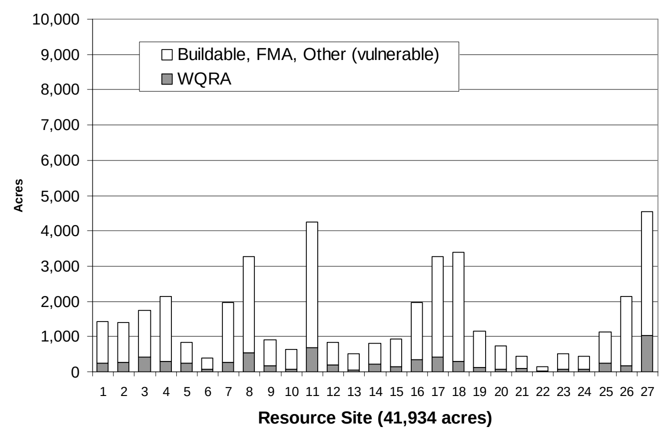


Figure 4-41. Criterion 3c: Vacant lands - Habitat and impact areas in Metro's 27 subwatersheds



Program option performance

- Some subwatersheds contain more habitat and impact areas than others.
- Criterion 1 describes how the six options perform in terms of protecting various habitat classes. More protective options are more likely to retain existing connectivity.
- Large habitat patches (see criterion 4), while vulnerable to fragmentation, may not be as important to systemic connectivity as smaller patches or more linear habitats.
- Program options providing more protection to lower value habitat areas, which tend to be small but important connectors or stepping stones, are more likely to promote connectivity,

particularly in subwatersheds with lower proportions of habitat.

- Options 1A, 2A, and to a lesser extent, 1B are likely to best protect the region's existing connectivity.
- Options 2B, 2C and 1C are likely to significantly reduce connectivity in the region.

Summary

Program options show a marked decline in protection levels, as indicated in Table 4-23 below. The options that apply more stringent treatments to a larger portion of habitat, particularly high value habitat, will protect a larger proportion of regionally significant habitat in the long term. Table 4-23 provides a ranking of program options for this criterion.

Table 4-23. Performance of options in meeting Environmental Criterion 3: Promotes riparian corridor continuity and overall habitat connectivity.

Rank	Option	Performance
1	1A	Program option 1A perform best for all three sub-criteria. This option is most likely to promote riparian corridor continuity and overall habitat connectivity.
2	2A	For riparian corridor continuity (sub-criterion 3a) and protecting subwatersheds from disproportionate impacts (sub-criterion 3c), program option 2A performs best. However, for risk to smaller connector habitats (sub-criterion 3b), 1B is the best performer.
3	1B	This option performs better for protecting small connector habitats than 2A, but does not perform as well for riparian corridor continuity and protecting subwatersheds from disproportionate impacts.
4	2B	This program option performs at a reduced, but fairly consistent, level for all three sub-criteria.
5	2C	This option greatly reduces protection levels for all three sub-criteria, and is likely to result in significantly reduced regional connectivity.
6	1C	This option greatly reduces protection levels for all three sub-criteria, and is likely to result in significantly reduced regional connectivity. In particular, class C wildlife habitat is 100% allow under this option.

4. Conserves habitat quality and biodiversity provided by large habitat patches

The extent to which large habitat patches are disrupted by conflicting uses will help determine habitat quality. Program options that perform better in this regard are more likely to retain the region's biological diversity.

Potential impacts on fish and wildlife habitat

Large habitat patches are primarily forested areas, but also include wetlands. Larger habitat patches are more valuable to native wildlife than smaller patches because more species are retained over time, and species sensitive to human disturbance still have a place to live. Long-term trends in wildlife populations are directly related to the area of habitat available – the larger the patch size, the longer a population can sustain itself. Larger habitat patches also retain more natural predators to keep rodent populations in check[26].

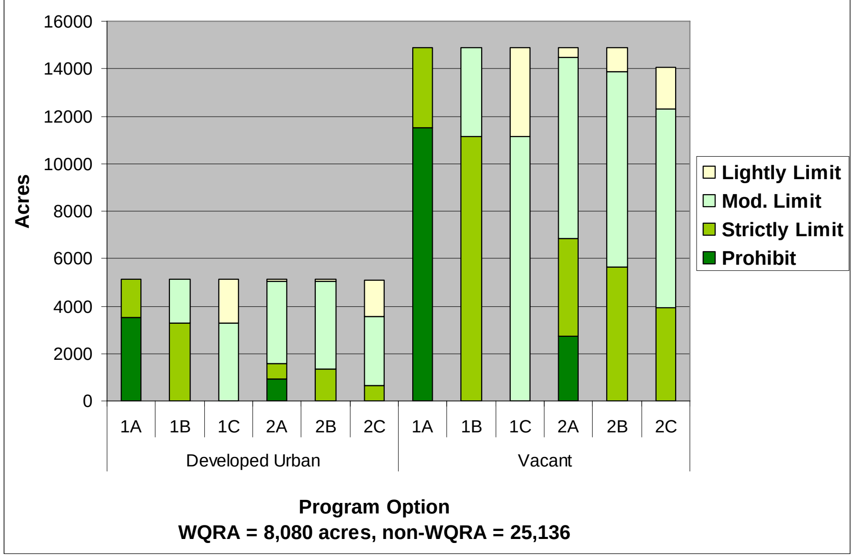
Habitat quality tends to be higher in large patches because negative edge effects, such as invasive species introductions and increased nest predation, are reduced. Local studies show that the complex multi-layered forest and shrub structure important to birds, small mammals and other wildlife is enhanced in larger habitat patches. Large patches also typically contain more woody debris.

Certain sensitive species and groups of species, such as Neotropical migratory songbirds and area-sensitive species, are likely to be negatively affected by less protective options. Large habitat patches are also linked, directly or indirectly, to each of the eight major ecological impact categories described in the ESEE Phase I discussion draft (Metro 2003). Thus, large habitat patches are a key component to retaining the region's biodiversity.

Measuring the criterion

Habitat patch size was a criterion in Metro's wildlife habitat inventory. Because the wildlife and riparian inventories were subsequently combined, portions of large habitat patches near waterways were incorporated into riparian Classes I and II. As a result, large patches were typically split into Class I and II riparian or Class A and B wildlife. For this criterion the wildlife model score prior to reconciling the two inventories, including patches scoring 6-9 points, was used in an effort to gauge the potential programmatic results on large habitat patches.

Figure 4-42. Criterion 4: Comparison of allow, limit, prohibit treatments for large habitat patches (excludes WQRA)



[26] See Metro's Technical Report for Goal 5, Metro 2002.

Results

For each program option, the acreage of large habitat patches that fall under various ALP designations was calculated. The data is reported separately for vacant and developed lands, for the reasons described under criterion 1; similarly, WQRA and parks are excluded in Figure 4-42. Figure 4-42 illustrates the most at-risk acres.

Basic statistics

- The total amount of large habitat patches, as defined in this criterion, is 38,360 acres.

Baseline protection (Title 3)

- Parks comprise 14,155 acres, or 37 percent of the total.
- WQRA comprise 8,090 acres (including 3,899 in parks) for 21 percent of the total.
- Six percent of the total habitat is in Title 3 FMA, but vegetation is not protected in FMA, therefore FMA areas do not protect large habitat patches.
- Excluding parks and WQRA, there are 20,014 acres of at-risk fish and wildlife habitat illustrated in Figure 4-42.
- The acres included in Figure 4-42 are subject to conflicting uses if no increase in protection level is applied; therefore, any program option that is not allow will provide incrementally more protection on these lands.

Potential effects of treatments vary by development status

- Excluding parks and WQRA, developed urban contains 26 percent of this habitat type, while 74 percent falls under vacant.
- The high percentage in vacant suggests that vacant habitat may be disproportionately affected by program choices.
- Developed urban is vulnerable as redevelopment occurs.
- The majority of habitat lands fall in single family residential zoning.
- Current trends for smaller lot sizes render large patches in both developed urban and vacant vulnerable to loss or fragmentation over time.

Program Option performance

- Urban development values in options 2A-2C substantially reduce protection of large habitat patches.
- For both vacant and developed urban habitat, Program Option 1A and to a lesser extent, Option 1B are most likely to keep large patches intact.
- Options 2A and 2B are marginal and may result in significant large patch encroachment.
- Options 2C and 1C are unlikely to retain large patches within the system.

Summary

Program options show a marked decline in protection levels, as indicated in Table 4-24 below. Options that apply stronger protection levels to large patches have a much greater chance of retaining the integrity of these important wildlife resources over time, and thus retaining good habitat quality and biodiversity. Incremental drops in protection may have more severe consequences in this criterion than in most other environmental criteria, because each drop in protection level raises the potential for large patch fragmentation.

Table 4-24. Performance of options in meeting Environmental Criterion 4: Conserves habitat quality and biodiversity provided by large habitat patches.

Rank	Option	Performance
1	1A	Figure 4-42 indicates that this option will provide the most effective protection for large habitat patches, with protection levels of Prohibit or Strictly Limit for all habitat.
2	1B	Protection level diminished, but still good, with Strictly or Moderately Limit for all habitat. However, any reduction in protection level will increase fragmentation of large patches, particularly with trends toward higher density development.
3	2A	Protection levels slightly lower than Option 1B. Three percent of vacant, unprotected habitat would fall under Lightly Limit in this option, with the remainder in Moderately Limit (51 percent), Strictly Limit (28 percent), or Prohibit (18 percent). No Allow.
4	2B	An incremental drop in protection levels compared to 2A. Seven percent of vacant, unprotected habitat would fall under Lightly Limit in this option, with the remainder in or Moderately Limit (55 percent) or Strictly Limit (38 percent).
5	2C	Substantially lower protection levels, with six percent of vacant, unprotected habitat in Allow, 12 percent in Lightly Limit, 56 percent in Moderately Limit, and 26 percent in Strictly Limit. No Prohibit. Likely to result in significant fragmentation of large patches.
6	1C	2C and 1C are fairly similar. 1C has decreased protection levels for all habitat classes, with 25 percent of vacant, unprotected habitat in Lightly Limit and 75 percent in Moderately Limit. Likely to result in significant fragmentation of large patches.

5. Promotes biodiversity through conservation of sensitive habitats and species

The amount and configuration of fish and wildlife habitat play important roles in the region's biodiversity, and these are addressed in Criteria 1 through 4. Also important, but not implicit in the first four criteria, are species and habitats that may be disproportionately at risk due to natural scarcity, habitat loss, or other factors.

Potential impacts on fish and wildlife habitat

For the purposes of this criterion both Habitats of Concern and Class I riparian habitat are included, because high-value riparian areas are widely acknowledged to be at-risk and because these habitats are mapped comprehensively for the region. In addition, known Species of Concern sightings are included to provide a relative measure of risk to wildlife. For these already-depleted habitats and species, a small habitat reduction could deal a major blow to regional biodiversity.

Criterion 5a: Habitats of Concern.

Habitats of Concern are specific areas known to provide a unique and at-risk habitat type, a unique and vital wildlife function, or both. Examples include wetlands, Oregon white oak habitat, riverine delta and island habitat, and critical migratory pathways. Habitats of Concern are premier wildlife areas that are elevated in importance and status within the inventory; all Habitats of Concern fall in either Class I riparian or Class A wildlife. Many of these areas, such as small wetlands, are less than the two-acre minimum established for the wildlife inventory but are included as Habitats of Concern due to their regional importance to biological diversity.[27] Program options providing more protection to these habitats will do a better job of retaining Habitats of Concern throughout the region.

Criterion 5b: Class I riparian.

The Habitats of Concern data is incomplete because it relies on local knowledge rather than comprehensive surveys. Therefore, for the purposes of this criterion Class I riparian habitat is also included because it is a widely acknowledged at-risk habitat and is mapped comprehensively for the region. Some of the implications of Class I habitat loss are described in Criterion 1. In addition to the ecological functions described there, high value riparian habitat contains more species than most other habitats; for example, the region's riparian areas are known to support approximately 93 percent of native bird species at some point in their lives. They also support more sensitive species, such as those found in Criterion 5c. Riparian areas provide vital fish and wildlife habitat connectivity throughout the region. The more a program option places Class I habitat at risk, the more negatively it will affect regional biological diversity.

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[27] Metro collected information on Species of Concern and Habitats of Concern for the Goal 5 wildlife habitat inventory from a variety of sources with site-specific knowledge of the region. ODFW, USFWS, the Oregon Biodiversity Project, and the Oregon-Washington chapter of Partners in Flight identify wetlands, native grasslands, Oregon white oak habitat, and riparian forests as the top four Willamette Valley habitats at risk. ODFW also lists urban natural area corridors as important at-risk habitats. Metro used these habitat types, plus other key contributors to diversity such as riverine islands and deltas and key migratory bird stopover habitats, to map Habitats of Concern.

Measuring the criterion
For each program option, acreage of Habitats of Concern (Criterion 5a) and Class I riparian (Criterion 5b) falling under various ALP designations was calculated. The two are reported separately and are not mutually exclusive.

The data are reported separately for vacant and developed urban habitats, for the reasons described under Criterion 1. Similarly, Title 3 Water Quality Resource Areas (WQRA) and parks are excluded from Figures 4-43 and 4-44 in order to focus on the habitats most at risk of development or other conflicting uses.

Figure 4-43. Criterion 5a: Comparison of allow, limit, prohibit treatments for Habitats of Concern (excludes WQRA)

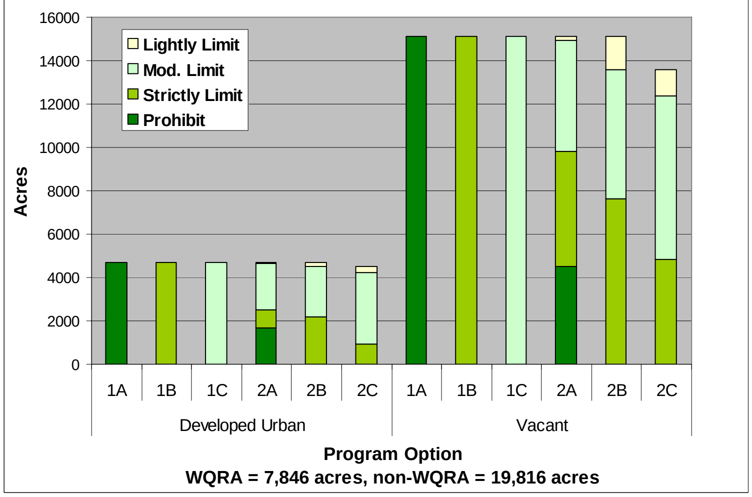
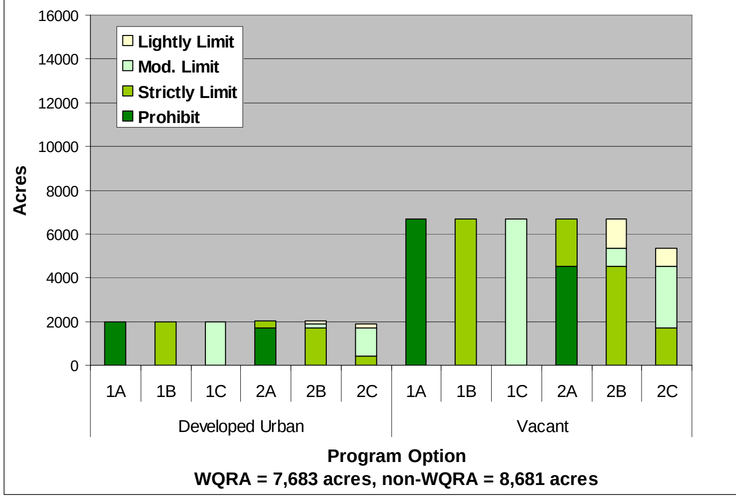


Figure 4-44. Criterion 5b: Comparison of allow, limit, prohibit treatments for Class I (excludes WQRA)



Results
Figures 4-43 and 4-44 illustrate Habitats of Concern, Class I riparian habitat, and Species of Concern, respectively. Program options that are likely to protect more at-risk habitats and species are assumed to perform better than other options.

Basic statistics: Habitats of Concern and Class I riparian

- The data illustrated by Figures 4-43 and 4-44 represent the portion of the habitat expected to be most at risk through development or redevelopment.
- The bar charts include 19,616 acres of Habitats of Concern and 8,688 acres of Class I riparian.
- Figures 4-43 and 4-44 exclude WQRA and parks from analysis for the same reasons stated in criterion 1.

Potential effects of treatments vary by habitat class, development status, and urban development value

- There are many more acres of vacant Habitats of Concern and Class I riparian than there are in developed urban. Therefore, the degree of protection afforded by each program option will have a stronger influence on vacant than on developed urban habitat.
- Where Habitats of Concern fall within Class I riparian, they are treated similarly under the various program options but where they are Class A wildlife, they receive lower protection

levels than Class I under options 2A-2C.
- This places non-riparian Habitats of Concern more at risk than riparian Habitats of Concern.

Program Option performance
- Options 1A and 1B are most protective of Habitats of Concern.
- Options 1A and 2A are most protective of riparian Class I.
- There is a larger discrepancy in protection levels between the two most protective options for Habitats of Concern than for Class I riparian.
- Options 1C and 2C are least protective for Habitats of Concern and are likely to result in substantial further loss of these depleted habitats.
- Options 2B and 2C are least protective of Class I riparian and are likely to result in substantial further loss of these depleted habitats. Option 1C is not much better.

Summary
Habitats of Concern and Class I riparian habitat are closely associated with declining or sensitive species in the region, and these habitats have declined greatly in extent and quality. It will be important to consider the relative rarity of the remaining habitats addressed in this criterion, because substantial further loss may result in regional species extirpations or potential Endangered Species Act listings. More protective options are more likely to prevent or minimize these undesirable results.

Table 4-25. Performance of options in meeting Environmental Criterion 5: Promotes biodiversity through conservation of sensitive habitats and species.

Rank	Option	Performance
1	1A	This option provides the highest protection levels for both Habitats of Concern and Class I riparian by assigning a Prohibit designation to all acres.
2 / 3	1B / 2A	Option 1B is important for Habitats of Concern, which includes more than twice as many acres as Class I riparian. However, Option 2A performs best for Class I riparian, and at a higher protection level than 1B provides Habitats of Concern.
4	2B	This option performs better than 1C or 2C for all Habitats of Concern, and for developed urban Class I riparian. However, for vacant Class I riparian it is difficult to discern whether Option 2B or 1C is more protective.
5	1C	Substantially lower protection levels, but consistent among development status and resource type, with all acres falling within Moderately Limit.
6	2C	Protection levels lowest of all options, with nine percent Allow in unprotected Habitats of Concern and 17 percent Allow in unprotected Class I riparian. Likely to result in substantial loss of sensitive habitats and sensitive species.

Evaluation of energy criteria

The analysis of energy criteria is intended to compare the potential effects of the six program options on energy use in the region. Two criteria will assist in this process:

1. Promotes compact urban form, and
2. Promotes green infrastructure.

Criteria were selected based on the findings in Metro's Technical Report for Goal 5 and Phase I ESEE analysis (Metro 2002, Metro 2003). The energy criteria discussed here are applied using data already collected in the Social, Environmental, and Economic Phase II ESEE analyses.

The summary of each criterion includes a table ranking the programs in order of performance, from most to least energy efficient as relates to each criterion. The criteria provide important new information about how each program performs relative to the others, and will aid Metro, its partners, and the public in designing an energy-efficient fish and wildlife habitat protection program.

1. Promotes compact urban form

A compact urban form conserves energy by reducing transportation related energy output and infrastructure needs, reduces the spatial extent of vegetation loss, and reduces the spatial extent of the urban heat island effect.[28] The amount of fish and wildlife habitat protected or partially protected by each regulatory program option and the zoning type and development status influence whether the option increases the need for Urban Growth Boundary expansions.

Importance of urban development priorities

The region's 2040 Growth Concept is designed to provide a compact urban form through efficient land use, a well-planned transportation system, and protection of natural areas. The second energy criterion below addresses natural area protection.

The extent to which a program option supports development priorities influences the ability to maintain a compact urban form, thus conserving energy by reducing transportation and infrastructure energy output. While program options 1A-1C consider only habitat value, program options 2A-2C incorporate the importance of land value, employment density, and the 2040 Design Types.

Importance of substitutability of lands

The Goal 5 rule requires Metro to consider the effect a Goal 5 program may have on the inventory of buildable lands. Any changes in density requirements may be difficult to reallocate within the current Urban Growth Boundary.

Some land uses can be more easily re-allocated, or substituted, to other parts of the region than other land uses. This can relate to a number of factors such as scarcity, lot size requirements, and the physical characteristics needed for certain land use types. For example, residential land

[28] See Metro's Economic, Social, Environmental and Energy Analysis (ESEE), September 2003.

comprises a majority of the region's vacant zoning and housing can be built on relatively small parcels in a variety of landscapes. As a result, residential lands to a certain extent can be flexible in how they are located on a site, and more sites may be available compared to other land use types. However, Metro cannot force existing residential neighborhoods to accommodate density increases.[29]

Conversely, industrial lands are much more difficult to relocate, and there is a regional shortage of industrial sites to meet our needs over the next 20 years. Industrial sites typically require flat terrain, access to transportation facilities, and some industrial sites need large contiguous parcels. Mixed use zoning, a highly energy efficient land use, can also be difficult to place in alternative sites if it doesn't meet market needs. Commercial land placement affects driving distance and infrastructure requirements.

Thus these land uses may be less substitutable within the existing Urban Growth Boundary than other land use types. New restrictions imposed by a program may limit the capacity for meeting housing and employment needs, and may increase energy use associated with the need for Urban Growth Boundary expansions and related transportation and infrastructure needs.

Measuring the criterion and results

As outlined above, urban development priorities and the substitutability of lands are both important to maintaining a compact urban form. Each of these is addressed in other ESEE criteria. Therefore no new data was collected for this criterion, and the results are available through other ESEE criteria:

- "Supports urban development priorities" (economic criterion 1), and
- "Reduces impact on types/location of jobs and housing" (social criterion 2).

Economic criterion 1, "Supports urban development priorities," assessed program performance for supporting urban development priorities. In descending order of performance, the program options for economic criterion 1 were ranked as follow: 1C, 2C, 2B, 1B, 2A and 1A.

Social criterion 2, "Reduces impact on types/locations of jobs and housing," assessed program performance for limiting new restrictions on vacant industrial, mixed use, and commercial lands (see figure xx in social section, "Treatment of vacant employment habitat land"). In descending order of performance, the program options for social criterion 1 ranked as follow: 2C, 1C, 2B, 1B, 2A and 1A.

Summary

Information pertaining to maintaining a compact urban form has already been assessed under economic criterion 1 and social criterion 2. The program performance for both criteria is similar but not identical, as summarized in the table below. For the energy criterion, emphasis was given to urban development priorities when program rankings differed (i.e., 2C and 1C), due to the importance of the 2040 Growth concept in regional planning.

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[29] See Metro Ordinance #xxx.

Table 4-26. Performance of options in meeting Energy Criterion 1: Promotes compact urban growth form.

Rank	Option	Performance
1	1C	Provides the most support (lack of development restrictions) for lands with high urban development priorities and the second-best support for allowing development on existing vacant industrial, mixed use, and commercial lands.
2	2C	Substantial support for lands with high urban development value, and excellent support for lands with medium urban development value. Provides the best support for allowing development on existing vacant industrial, mixed use, and commercial lands.
3	2B	Good support for urban development priorities and allowing development on existing vacant industrial, mixed use, and commercial lands.
4	1B	Moderate support for maintaining a compact urban growth form. No prohibit treatments for urban development priorities, but significantly stronger impact than 2A or 1A. For vacant industrial, mixed use, and commercial lands, performs at a slightly reduced level compared to option 2A.
5	2A	Slightly less support for urban development priorities than 1B due to a small proportion of prohibit treatment. For vacant industrial, mixed use, and commercial lands, provides slightly more support than option 1B.
6	1A	Promotes compact urban form the least. Substantial restrictions possible on high urban development priorities and on development potential for existing vacant industrial, mixed use, and commercial lands.

2. Promotes green infrastructure

Trees and other vegetation reduce energy demand by moderating stream and air temperature increases, flooding, and air pollution associated with energy use.[30] Fish and wildlife habitat that are considered important or necessary to support cities and suburbs can be considered a type of infrastructure: "green infrastructure." The energy benefits provided by green infrastructure are a type of ecosystem service.

Ecosystem services may be defined as the processes and functions of natural ecosystems that sustain life and are critical to human welfare (see Evaluation of Energy, Criterion 2 for more detail). For example, trees help clean air and water, and wetlands and floodplains store water and help avert flooding. When ecosystem services are removed or diminished, a common alternative is to implement technological surrogates such as stormwater piping or water purification systems. Such solutions tend to require more energy than preserving existing green infrastructure and ecosystem functions.

Measuring the criterion and results

The amount of fish and wildlife habitat protected or partially protected by each program option, as well as the value of that habitat, help determine whether the option protects the energy-related green infrastructure and ecosystem services provided by trees, other vegetation, wetlands and floodplains. Green infrastructure and ecosystem services are strongly related.

This criterion is best assessed using a combination of three criteria from the environmental and economic ESEE:

- "Promotes retention of ecosystem services" (economic criterion 2);

[30] See Metro's Economic, Social, Environmental and Energy Analysis (ESEE), September 2003.

- “Conserves existing watershed health and restoration opportunities (environmental criterion 1); and
- “Retains multiple functions provided by forest canopy cover (environmental criterion 2).

This combination of criteria appropriately addresses energy concerns. No new data was collected, and the detailed results are available through the relevant criteria in the environmental and economic sections.

Ecosystem services are addressed in economic criterion 2, “Promotes retention of ecosystem services.” In that criterion, areas with more ecological functions and/or areas with functions closer to streams, wetlands, or floodplains ranked higher than areas with fewer functions or with functions further away from water features. Economic criterion 2 ranked identically to environmental criterion 1: 1A, 2A, 1B, 2B, 2C, and 1C.

Although green infrastructure is addressed in all environmental criteria environmental criterion 1, “Conserves existing watershed health and restoration opportunities” and criterion 2, “Retains multiple functions provided by forest canopy cover,” are particularly relevant to energy use. These are the resources that protect existing ecosystem functions.

Environmental criterion 1 assesses the performance of program options in conserving existing watershed health and restoration opportunities based on protection levels for fish and wildlife habitat. In descending order of performance, the program options for environmental criterion 1 were ranked as follow: 1A, 2A, 1B, 2B, 2C, and 1C.

Environmental criterion 2 estimates how well each program option would protect existing forest canopy cover, identified in the Phase I ESEE analysis as a key energy-related feature. This is an important separate measure because although all forest is ecologically important to the region, not all forest ranks as high-value fish and wildlife habitat. In descending order of performance, the program options for environmental criterion 2 ranked as follow: 1A, 1B, 2A, 2B, 2C, and 1C.

Summary

Information pertaining to retaining green infrastructure and ecosystem services has already been assessed under economic criterion 1 and environmental criteria 1 and 2. The program performance for all three criteria is similar but not identical, as summarized in the table below.

Table 4-27. Performance of options in meeting Energy Criterion 2: Promotes green infrastructure.

Rank	Option	Performance
1	1A	Provides the most protection for all habitats and best protection to forest canopy cover and ecosystem services.
2	2A	Protection level substantial for high-value riparian habitat, and good for other habitat classes. Ecosystem services also reflect this ranking. However, 1B provides better protection for upland wildlife habitat. Options 2A and 1B fairly similar for forest canopy.
3	1B	Substantially reduced protection for all riparian habitat compared to 1A and 2A. Ecosystem services also reflect this ranking. For wildlife habitat, performs better than 2A. For forest canopy, fairly similar to option 2A.
4	2B	Options 2B, 2C and 1C ranked identically for habitat, tree canopy, and ecosystem service protection. Moderate performance for higher riparian and wildlife classes, but protection drops significantly for lower habitat classes. Similar findings for forest canopy and ecosystem services.
5	2C	Places nearly 40 percent of all forest canopy at risk through low or no protection levels. Low protection levels for all resources. May result in substantial loss of riparian and upland habitat functions, ecosystem services, and forest canopy over time.
6	1C	Places nearly half of all forest canopy at risk through low or no protection levels. Low protection levels for all resources. Most likely to result in substantial loss of riparian and upland habitat functions, ecosystem services, and forest canopy over time.

Evaluation of federal Endangered Species Act

The Endangered Species Act's (ESA's) ultimate goal is to recover species and conserve the ecosystems upon which they depend so they no longer need regulatory protection. Twelve salmon species or runs are listed as either threatened or endangered in the Columbia River and Willamette River basins. The National Oceanic and Atmospheric Administration (NOAA) Fisheries is the federal agency responsible for these species.

The U.S. Fish and Wildlife Service (FWS) has jurisdiction over terrestrial species and aquatic species that spend the majority of their life cycle in fresh water. Listed species under their jurisdiction that currently or historically occurred in the Metro region include bald eagle, bull trout, golden Indian paintbrush, Willamette daisy, water howellia, Bradshaw's lomatium, Kincaid's lupine, and Nelson's checker-mallow. The FWS was petitioned to list pacific lamprey, western brook lamprey and river lamprey in January 2003; processing of the petition has not yet been completed and is currently on hold. Additionally, several candidate species and species of concern are also known to occur in the Metro region. Although these species do not currently receive ESA regulatory protection, efforts to conserve these species may help to sustain existing populations and preclude the need for future listings.

Will a Metro fish and wildlife habitat protection program meet the ESA? There is no clear answer, because program details are not yet developed and it is not possible to fully predict the outcome of any program. It is also worth noting that the full suite of factors that affect the habitats upon which these species depend will not all be addressed in Metro's Goal 5 program. For example, stormwater runoff can have significant impacts on stream health and channel complexity, but Goal 5 is not designed to explicitly or comprehensively address stormwater management.

However, the Goal 5 program will help to define the types of land uses that will be allowed within and near regionally significant habitats, ultimately determining the degree to which these habitats and their ecological functions are conserved over time. The program's non-regulatory components, particularly the degree of investment in restoration, will also play a key role. An effective Metro program that provides adequate species protection could provide a template that could serve as a model for local jurisdictions to come into ESA compliance, and may also contribute to efforts designed to prevent future ESA species listings.

The federal ESA portion of this phase of the ESEE analysis is intended to compare the potential effects of the six program options on listed fish and wildlife and related species of conservation interest such as the three species of lamprey that have been petitioned for listing. Three criteria will assist this process:

1. Protects slopes, wetlands, and areas of high habitat value;
2. Maintains hydrologic conditions; and
3. Protects riparian functions.

These criteria provide important information about how each program performs relative to the others in protecting habitats and watershed health, and will aid Metro, its partners, and the public determine the general consequences to fish and wildlife species under each program.

1. Protects slopes, wetlands and areas of high habitat value

Steep slopes are vulnerable to erosion and landslides that can negatively affect aquatic resources, particularly when trees and other vegetation are removed.[31] Wetlands provide important off-channel rearing habitat for young salmon and functions important to stream health. They also provide key habitat for many of the region's other known at-risk species – for example, bald eagles, northern red-legged frogs, northwestern pond turtles, and numerous neotropical migratory bird species[32]. At-risk species relate to the ESA because if they continue to decline, they may become future candidates for ESA listings. Habitats of Concern include wetlands, riparian bottomland forest, stands of Oregon white oak, native grassland, important migratory pathways, and other critical habitats that potentially support listed plants and animals, as well as numerous other at-risk species. Large habitat patches retain higher habitat quality than smaller patches and provide homes to species most sensitive to human disturbance, such as neotropical migratory songbirds[33], and maintaining the connections between these valuable habitats is vital to supporting the region's sensitive species over time.

Measuring the criterion

Steep slopes are addressed in Metro's riparian GIS model as a primary and secondary functional contributor to Bank Stabilization, Sediment and Pollution Control. Wetlands receive primary functional value in the riparian model under the Streamflow Moderation and Water Storage and Bank Stabilization, Sediment and Pollution Control criteria, and are also captured under Class I riparian as Habitats of Concern. Areas of highest habitat value, including all Habitats of Concern and most large habitat patches, are captured under Class I riparian and Class A wildlife habitat. In addition, large habitat patches were specifically addressed in environmental criterion 2. Thus, this criterion is best assessed using a combination of criteria from the Environmental ESEE:

- Class I riparian and Class A wildlife habitat derived from the criterion entitled "Conserves existing watershed health and restoration opportunities" (environmental criterion 1);
- Promotes riparian corridor continuity and overall habitat connectivity (environmental criterion 3);
- Conserves habitat quality and biodiversity provided by large habitat patches (environmental criterion 2); and
- Promotes biodiversity through conservation of sensitive habitats and species (environmental criterion 5).

Results

The data tables and graphs associated with this criterion are available in the Environmental ESEE section. Option 1A provides the most protection for this criterion, but Options 2A and 1B

[31] The ecological damage associated with excess sediments entering streams is described in Metro's Technical Report for Goal 5 (Metro 2002) and Phase I ESEE report (Metro 2003).
[32] See Metro's species list for at-risk species and their general habitat associations.
[33] Neotropical migratory songbirds have been identified by ODFW as an at-risk group of species. Local studies (Hennings and Edge 2003) confirm that Neotropical migrants are negatively associated with urbanization.

also provide substantial protection. Option 2B provides a moderate level of protection. Options 2C and 1C are least likely to protect sensitive species over time, because substantial habitat and connectivity may be lost.

Table 4-28. Performance of options in meeting ESA criterion 1: Protects slopes, wetlands, and areas of high habitat value.

Rank	Option	Performance
1	1A	Most protective of all variables assessed. Best option for protecting slopes, wetlands, and areas of high habitat value; most likely to reduce need for future ESA listings.
2 / 3	2A / 1B	Option 2A is second-most protective for Class I habitat, promoting overall connectivity. Option 1B is second-most protective for Class A habitat and large patches. Options 2A and 1B are similar in terms of protecting sensitive habitats and species.
4	2B	Incrementally less protection for all variables assessed. Options 2A and 2B are similar in terms of protecting Class A habitat.
5	2C	Ranks fifth for Class A, overall connectivity, and large patches. Ranks sixth for Class I and sensitive habitats. More likely to result in species depletion or loss over time, and may increase future ESA listings.
6	1C	Minimal protection for Class A, overall connectivity, and large patches. Ranks fifth for Class I and sensitive habitats. Most likely to result in species depletion or loss over time, and may increase future ESA listings.

2. Maintains hydrologic conditions

Hydrology, in part, refers to how water is delivered to streams and rivers during storms. Under natural hydrologic conditions in the Pacific Northwest, rainwater movement to streams is slowed and retained by trees, plants, wetlands, floodplains and soils. When these natural features are altered or removed and hard (impervious) surfaces are installed, rainwater is delivered quickly, in high volumes, to streams and rivers. This causes channel damage, excessive flooding, groundwater depletion, and alters habitat such that animals adapted to natural conditions are sometimes no longer able to survive there. Altered hydrology has strongly, negatively impacted the region's threatened salmon and other native aquatic species including lamprey.

All habitat in Metro's inventory is important to maintaining hydrologic conditions. In this naturally forested region, trees are particularly important to hydrology because they slow and store large quantities of stormwater.[34]

Measuring the criterion

This criterion is best assessed using a combination of criteria from the Environmental ESEE:

- "Conserves existing watershed health and restoration opportunities" (environmental criterion 1), and
- Retains multiple functions provided by forest canopy cover (environmental criterion 2).

[34] Metro's field studies showed that the amount of tree cover, both near streams and throughout watersheds, is positively associated with stream health (Frady et al. 2002).

Results

The data tables and graphs associated with this criterion are available in the Environmental ESEE section. Option 1A provides the most protection for this criterion, but Options 2A and 1B also provide substantial protection. Options 2C and 1C are least likely to protect sensitive species over time, because substantial habitat and connectivity may be lost. Less protective options may lead to an increase in future ESA species listings.

Table 4-29. Performance of options in meeting ESA criterion 2: Maintains hydrologic conditions.

Rank	Option	Performance
1	1A	This option provides the most protection and restoration opportunities for existing fish and wildlife habitat, and therefore provides the strongest regulatory approach to maintain current hydrologic conditions.
2 / 3	2A / 1B	Option 2A ranks second for conserving existing watershed health and restoration opportunities, but ranks third for retaining forest canopy cover. Both options could aid in maintaining hydrologic conditions, depending on the amount of habitat retained and whether new trees and habitat are added over time.
4	2B	Ranks fourth for conserving watershed health and restoration opportunities, as well as for conserving forest canopy. Unlikely to maintain hydrologic conditions over time without substantial non-regulatory investments.
5	2C	Ranks fifth for conserving watershed health and restoration opportunities, as well as for conserving forest canopy. Unlikely to maintain hydrologic conditions over time, even with substantial non-regulatory investments. Strong likelihood for increased harm to salmon habitat and increased potential for future ESA species listings.
6	1C	Ranks last for conserving watershed health and restoration opportunities, as well as for conserving forest canopy. Unlikely to maintain hydrologic conditions over time due to extensive loss of existing resources and loss of restoration opportunities. Strong likelihood for increased harm to salmon habitat and increased potential for future ESA species listings.

3. Protects riparian functions

Metro's extensive review of the scientific literature revealed that ecological functions are not limited to the areas nearest the stream. Existing riparian habitat areas protect water quality and provide key habitat to many of the region's at-risk species, including those living on the land or in water. Due to the extent of riparian habitat loss over time, all remaining riparian areas are important to stream health. Lower value areas not only contribute to watershed function, but also provide key restoration opportunities that may help improve watershed health and offset detrimental effects from future development elsewhere in the watershed.

Measuring the criterion

This criterion is derived from the riparian corridor portion of the criterion entitled "Conserves existing watershed health and restoration opportunities" (environmental criterion 1). It measures the amount of riparian habitat affected by allow, limit, prohibit treatments under each program option. Class I riparian receives special consideration in Table 4-29 due to the multiple ecological functions provided in these high-value areas.

Results

The data tables and graphs associated with this criterion are available in the Environmental ESEE section. It is important to note that no matter which option is selected, riparian habitat may be lost and remaining habitat degraded over time due to continued development within the UGB and the urban effects associated with development, such as increased runoff and decreased water quality. The extent to which a program protects riparian function depends, in part, on non-regulatory program elements such as restoration in existing resources and new habitat creation in key areas of importance.

Option 1A provides the most protection for all riparian habitat. Option 2A provides less protection for habitat within one site potential tree height, and Option 1B is a substantial step downward in protection levels. Option 2B is slightly less protective of riparian habitat than Option 1B. Option 2C provides a substantially reduced level of protection for Class I and II habitat, and very little protection for Class III. Option 1C provides low level protection for Class I and II, and no protection at all for Class III riparian; this option is least likely to protect riparian functions. Options 1C and 2C are unlikely to protect existing sensitive species, and will likely result in future ESA listings over time as riparian habitat is lost or damaged.

Table 4-30. Performance of options in meeting ESA criterion 3: Protects riparian corridors

Rank	Option	Performance
1	1A	Most likely to retain existing riparian function and watershed health. Class I and II habitat in prohibit designation, and Class III in strictly limit. Most likely to help conserve sensitive species and aid in preventing future ESA listings.
2	2A	Incrementally less protection for riparian habitat, but generally still good protection levels for Class I and II. Protection drops significantly for Class III, with the majority in lightly limit designation.
3	1B	Substantially less protection compared to Options 1A and 2A. Class III riparian in appears to be particularly vulnerable, with lightly limit designations.
4	2B	Incrementally less protection than previous options. Moderate loss of high-value riparian habitat likely, with potential for negative effects on sensitive species. Protection levels drop off significantly for Class III habitat, with primarily lightly limit designation, similar to option 2A. May increase potential for future ESA listings.
5	1C	Class I receives moderately limit, Class II lightly limit, and Class III receives allow designations. Less likely to protect existing sensitive species than options above. May result in substantial loss of riparian habitat and increases potential for future additional ESA listings.
6	2C	Poor protection for riparian habitat. Least likely to protect existing sensitive species. Most likely to lead to future ESA listings.

Evaluation of federal Clean Water Act

The federal Clean Water Act (CWA) sets a national goal to "restore and maintain the chemical, physical and biological integrity of the Nation's waters." In Oregon, the Department of Environmental Quality (DEQ) implements the CWA, with review and approval by the U.S. Environmental Protection Agency.

The DEQ is responsible for protecting the beneficial uses of rivers, streams and lakes of the state. The DEQ carries out this responsibility in part by identifying those water bodies that are not meeting current water quality standards. This inventory is known as the 303(d) list. For waters identified on the 303(d) list, DEQ must develop total maximum daily loads (TMDLs) for those pollutants that exceed water quality standards. The TMDLs become part of implementation plans at the watershed scale intended to meet water quality standards. In urban areas, local governments are often the parties responsible for such plans, with input from watershed councils, landowners and other stakeholders.

The DEQ recently informed Metro Council that a Goal 5 program that provides shading, pollutant removal, and infiltration could protect and restore fish and wildlife habitat and help meet water quality standards in the Willamette and Tualatin Basins. Retaining fish and wildlife habitat, and the ecological functions these areas provide, is less expensive than constructing water quality treatment facilities. Potentially, the amount of Goal 5 resources preserved for protection and restoration may be an important management measure in a watershed's TMDL implementation plan.

The federal CWA criterion compares the potential effects of the six program options on the importance of fish and wildlife habitat to the region's water quality. Four criteria will assist this process:

1. Protects steep slopes and wetlands;
2. Protects resources within 150 feet of streams;
3. Maintains hydrologic conditions (see ESA criterion 2); and
4. Protects forested areas throughout the watershed.

Some of the criteria used to assess program performance related to the CWA are similar to those assessed for the federal ESA, because existing fish and wildlife habitat also protects water quality. These criteria provide important information about how each program performs relative to the others, and will aid Metro, its partners, and the public in determining the relative consequences to water quality under each program.

1. Protects slopes and wetlands

Steep slopes are vulnerable to erosion and landslides, particularly when trees and other vegetation are removed.[35] Wetlands collect and treat soil runoff and help control stream bank erosion to help meet turbidity, sedimentation, and nutrient TMDLs. Wetlands collect and treat

[35] The ecological damage associated with excess sediments entering streams is described in Metro's Technical Report for Goal 5 (Metro 2002) and Phase I ESEE report (Metro 2003).

pesticides, heavy metals, and other toxic pollutants to help meet TMDLs for these pollutants. Wetlands also collect and store water to provide base flow in streams during summer low-flow months, which helps meet temperature TMDLs.

Measuring the criterion

Steep slopes are addressed in Metro's riparian GIS model as a primary and secondary functional contributor to Bank Stabilization, Sediment and Pollution Control. Wetlands receive primary functional value in the riparian model under the Streamflow Moderation and Water Storage, Bank Stabilization, Sediment and Pollution Control, and are also captured as Class I riparian as a Habitat of Concern.

This criterion is best assessed using a subset of one of the criteria from the Environmental ESEE. Class I and Class II riparian habitat derived from the criterion entitled "Conserves existing watershed health and restoration opportunities" (environmental criterion 1) captures all wetlands and the majority of vegetated steep slopes near streams. As in the ESA criteria, the extent to which restoration is included as part of any Goal 5 program will help determine its effectiveness in protecting water quality.

Results

The data tables and graphs associated with this criterion are available in the Environmental ESEE section and associated appendices. Option 1A provides the most protection for Class I and II riparian habitat. Option 2A provides incrementally less. Options 1B and 2B fall in the middle. Options 1C and 2C perform poorly in protecting these habitat areas, and are likely to result in future 303(d) listings and TMDL requirements due to unprotected steep slopes and wetland areas.

Table 4-31. Performance of options in meeting CWA criterion 1: Protects slopes and wetlands.

Rank	Option	Performance
1	1A	Highest protection level for all Class I and Class II riparian habitat; most likely to protect steep slopes and wetlands. **For every program option, restoration will still be needed to meet temperature and other standards.**
2	2A	Excellent protection for Class I habitat. Good protection for Class II habitat, but definitely a step downward from 1A, with about two thirds of Class II in moderately limit designations and the remainder in Lightly Limit. Where steep slopes occur in Class II, may increase erosion and sedimentation and degrade water quality.
3	1B	Incrementally less protection for Class I and Class II habitat.
4	2B	Somewhat less protection for Class I and II habitat compared to Option 1B, but most habitat areas still receive strictly or moderately limit designations.
5	1C	Substantially reduced protection for steep slope areas and wetlands. Likely to result in non-compliance for existing TMDLs and future 303(d) listings and TMDL requirements.
6	2C	Poor protection for Class I resources (particularly in Developed Urban areas), and dismal protection for Class II. Highly likely to result in degraded water quality, non-compliance for existing TMDLs, and increased future 303(d) listings and TMDL requirements.

2. Protects resources within 150 feet of streams

The importance of riparian areas in maintaining water quality is well documented.[36] These areas provide shading to help meet temperature TMDLs, collect and treat soil runoff, and control stream bank erosion to help meet turbidity, sedimentation, and nutrient TMDLs. Riparian areas collect and treat bacteria in runoff to help meet bacteria TMDLs and collect and treat pesticides, heavy metals, and other toxic pollutants to help meet TMDLs for these pollutants. Like wetlands (and generally including wetlands), riparian areas collect and store water to provide base flow in streams during summer low-flow months, helping to meet temperature TMDLs.

Measuring the criterion

This criterion is assessed using the riparian corridor continuity portion of the criterion entitled "Promotes riparian corridor continuity and overall habitat connectivity" (environmental criterion 3a). It measures the amount of habitat within 150 feet of streams affected by allow, limit, prohibit treatments under each program option.

Results

The data tables and graphs associated with this criterion are available in the Environmental ESEE section. Option 1A provides the most protection for Class I and II riparian habitat. Option 2A, 1B and 2C provide incrementally less protection for areas within one site potential tree height, respectively. Options 1C and 2C perform very poorly in protecting these habitat areas, and are likely to result in future 303(d) listings and TMDL requirements due to habitat loss closest to streams, as well as non-compliance with existing TMDLs.

Table 4-32. Performance of options in meeting CWA criterion 2: Conserves habitat within 150 feet of streams.

Rank	Option	Performance
1	1A	Excellent performance for conserving existing habitat within 150 feet of streams, with primarily Prohibit plus some Strictly Limit designations. This option is most likely to assist in meeting current TMDLs and preventing future non-compliance issues. **For every program option, restoration will still be needed to meet temperature and other standards.**
2	2A	Substantial step downward from 1A, but still good protection levels. About half of the habitat within 150 feet of streams receives Prohibit treatment, with the remainder falling within the three degrees of limit. Loss of any habitat within this zone, particularly without restoring key areas, is likely to decrease water quality and increase CWA non-compliance issues.
3	1B	Incremental step downward from Option 2A. Increases likelihood of water quality issues and CWA non-compliance.
4	2B	Relatively small step downward from Option 1B, with similar repercussions possible.
5	1C	Very poor protection for near-stream habitat. Unlikely to conserve existing resources or retain restoration opportunities within 150 feet of streams. Highly likely to degrade water quality, resulting in non-compliance with current TMDLs and necessitating future 303(d) and TMDL listings.
6	2C	Similar to Option 1C, but slightly worse.

[36] See Metro's Technical Report for Goal 5 (Metro 2002) and Phase I ESEE Report (Metro 2003).

3. Maintains hydrologic conditions

This criterion is described and measured in ESA criterion 2. Altered hydrology is a leading cause of degraded water quality. The key negative effects associated with altered hydrology are described in Metro's Technical Report for Goal 5 and Phase I ESEE documents (Metro 2002, 2003). Program options for this criterion rank as follow, from best to worst in terms of maintaining hydrologic conditions: 1A, 2A/1B, 2B, 2C, and 1C.

4. Protects forested areas throughout the watershed

Trees are vitally important to the region's water quality, as demonstrated through local studies and as recognized by DEQ.[37] Trees provide infiltration to recharge both groundwater and down gradient streams, providing base flow for streams during summer low-flow months and helping to meet temperature TMDLs. Trees are especially effective in reducing sedimentation and erosion, runoff speed and volume, excess nutrients, and water temperature, thereby helping to meet nutrient, sediment, turbidity, and temperature TMDLs.

Measuring the criterion

This criterion is measured using Environmental criterion 2, "Retains multiple functions provided by forest canopy cover."

Results

The data tables and graphs associated with this criterion are available in the Environmental ESEE section. Option 1A provides the most protection for the region's upland and riparian forests. Option 1B provides substantially less protection, with Option 2A close behind. Options 1B and 2B fall in the middle. Option 2C performs very poorly in protecting forest canopy, and is likely to result in future 303(d) listings and TMDL requirements due to unprotected steep slopes and wetland areas.

[37] Metro's field studies showed that the amount of tree cover, both near streams and throughout watersheds, is positively associated with stream health (Frady et al. 2002).

Table 4-33. Performance of options in meeting CWA criterion 4: Protects forest canopy throughout the watershed.

Rank	Option	Performance
1	1A	Protects by far the most canopy cover of any other program option for vulnerable forested lands in both vacant and developed lands. This option is most likely to aid in current Clean Water Act compliance and help prevent future 303(d) listings and TMDL requirements. **For every program option, restoration will still be needed to meet temperature and other standards.**
2	1B	Substantially less protection than option 1A, but still performs better than the remaining options. However, options 1B and 2A appear relatively close in terms of potential effects on the region's forest canopy, and therefore, water quality. No Allow designations mean that all forested habitat would be afforded at least some level of protection.
3	2A	Similar to 1B, with slightly less protection.
4	2B	Little Allow, but overall protection levels lower than options 1B and 2A. Potential for significant forest loss and increased water quality issues.
5	2C	Low protection levels for forest canopy, with 38 percent of vacant and developed urban in Lightly Limit or Allow. Likely to result in significant forest canopy loss over time. Highly likely to degrade water quality, resulting in non-compliance with current TMDLs and likely necessitating future 303(d) and TMDL listings.
6	1C	Low protection levels for forest canopy, with 47 percent of vacant and developed urban in Lightly Limit or Allow. Likely to result in significant forest habitat loss over time. Highly likely to degrade water quality, resulting in non-compliance with current TMDLs and likely necessitating future 303(d) and TMDL listings.

Summary of analysis of regulatory options

Metro's analysis of the six regulatory program options against the 19 criteria provides a substantial amount of information for the Metro Council to use in their consideration of a program direction for protecting fish and wildlife habitat. Generally, the options that protect more habitat (Options 1A and 2A) perform similarly across criteria. The option that least protects the highest value habitat (Option 1C) and the option with the lowest level of protection for habitat in industrial areas and centers (Option 2C) also perform similarly. However, Option 2C favors factors important for urban development by focusing on the economic concerns, while Option 1C reduces protection equally for all land uses. Table 4-34 summarizes the analysis.

Table 4-34. Summary of program option analysis.

Criteria	Option 1A: Most habitat protection	Option 1B: Moderate habitat protection	Option 1C: Least habitat protection	Option 2A: Most habitat protection	Option 2B: Moderate habitat protection	Option 2C: Least habitat protection
	Highest level of protection for all habitats	*High level of protection for highest value habitat, moderate protection for other habitats*	*Moderate level of protection for higher value habitats, no protection for lowest value habitat*	*Moderate level of protection in high urban development value areas, high level of protection in other areas*	*Low level of protection in high urban development value areas, moderate level of protection in other areas*	*No protection in high urban development value areas, moderate level of habitat protection in other areas*
Economic factors						
1. Supports the regional economy by providing development opportunities (such as residential, commercial, industrial)	**Ranks 6th**: Provides least development opportunities due to highest levels of habitat protection on residential, commercial and industrial lands.	**Ranks 4th:** Provides some development opportunities for residential, commercial and industrial.	**Ranks 2nd:** Provides substantial development opportunities for all types of development.	**Ranks 5th:** Provides minimal development opportunities because residential development in some high value habitat is prohibited.	**Ranks 3rd:** Provides moderate development opportunities due to less habitat protection in all commercial and industrial areas and some residential land.	**Ranks 1st:** Provides most development opportunities due to relaxed habitat protection; provides more development opportunities in commercial and industrial areas than in residential areas.
2. Supports economic values associated with ecosystem services (such as flood control, clean water, recreation, amenity values)	**Ranks 1st**: Retains most existing ecosystem services across all habitat classes. Highest protection for habitat.	**Ranks 3rd**: Retains moderate ecosystem services with moderate protection to high value habitat.	**Ranks 6th**: Retains least ecosystem services overall for all habitat classes.	**Ranks 2nd**: Retains substantial ecosystem services with strict protection to high and medium value stream corridors.	**Ranks 4th**: Retains some ecosystem services. Applies moderate protection to stream corridors but higher protection to upland wildlife habitat.	**Ranks 5th**: Retains minimal ecosystem services due to relaxed protection in areas with high and medium development value.
3. Promotes recreational use and amenities	**Ranks 1st**: Promotes the most recreational benefits by prohibiting development in highest quality habitat lands.	**Ranks 3rd**: Provides moderate recreational benefits by applying relatively strong protection to the highest value habitats.	**Ranks 6th**: Provides least recreational benefits because it applies only moderate protection to highest value habitat.	**Ranks 2nd**: Promotes substantial recreational benefits of stream corridors, does not apply same protection to wildlife habitat.	**Ranks 4th**: Promotes some recreational benefits, mostly on park land.	**Ranks 5th**: Promotes minimal recreational benefits mostly on park land.
4. Distribution of economic tradeoffs	**No rank:** Privately-owned habitat land bears greater proportion of highest protection than publicly-owned habitat.	**No rank**: Privately-owned and publicly-owned land bears equal proportion of highest protection.	**No rank:** Privately-owned and publicly-owned land bears equal proportion of highest protection.	**No rank:** Publicly-owned habitat land bears greater proportion of highest protection than privately-owned habitat land.	**No rank:** Publicly-owned habitat land bears greater proportion of highest protection than privately-owned habitat land.	**No rank:** Publicly-owned habitat land bears greatest proportion of highest protection.
5. Minimizes need to expand the urban growth boundary (UGB) and increase development costs.	**Ranks 6th**: Affects the need to expand the UGB the most; highest level of protection restricts development.	**Ranks 4th**: Moderately affects the need to expand the UGB because of restrictive protection levels.	**Ranks 1st**: Least need to expand UGB; lowest protection levels provide most development opportunity.	**Ranks 5th**: Substantially affects need to expand the UGB because of restrictive protection levels.	**Ranks 3rd**: Some need to expand UGB but less restrictive protection.	**Ranks 2nd**: Minimal need to expand the UGB because low level of protection provides development opportunity.
Social factors						
6. Minimizes impact on property owners	**Ranks 6th:** Affects the most property owners with the highest level of habitat protection regardless of zoning.	**Ranks 4th:** Moderately affects all property owners, but does not apply highest habitat protection anywhere.	**Ranks 1st:** Affects the least number of property owners and applies lower levels of habitat protection.	**Ranks 5th:** Substantially affects large number of property owners with strong protection, especially in residential and rural areas.	**Ranks 3rd:** Affects some business landowners with moderate protection, but high protection is applied to residential and rural owners.	**Ranks 2nd:** Minimally affects business landowners, but many residential and rural property owners are affected with lower levels of protection.
7. Minimizes impact on location and choices for housing and jobs	**Ranks 6th:** Most effect on the location and choices available for jobs and housing by	**Ranks 4th:** Moderate effect on the location and choices available for jobs and housing,	**Ranks 2nd:** Minimal effect on housing location and choices, some effect on job location	**Ranks 5th:** Substantial effect on housing location and choices, moderate effect on	**Ranks 3rd:** Some effect on job location and choices, moderate effect on housing	**Ranks 1st:** Least effect on job location and choices, minimal effect on housing location and

Criteria	Option 1A: Most habitat protection *Highest level of protection for all habitats*	Option 1B: Moderate habitat protection *High level of protection for highest value habitat, moderate protection for other habitats*	Option 1C: Least habitat protection *Moderate level of protection for higher value habitats, no protection for lowest value habitat*	Option 2A: Most habitat protection *Moderate level of protection in high urban development value areas, high level of protection in other areas*	Option 2B: Moderate habitat protection *Low level of protection in high urban development value areas, moderate level of protection in other areas*	Option 2C: Least habitat protection *No protection in high urban development value areas, moderate level of habitat protection in other areas*
	applying high protection levels to all habitats.	applies a medium protection level to residential and employment land.	and choices. Applies lower protection levels to all land regardless of zoning.	job location and choices. Applies high protection levels to residential land, medium protection levels to most employment land.	location and choices. Applies lower protection levels to employment land, moderate protection levels to residential land.	choices. Applies lowest protection levels to employment land, moderate protection levels to residential land.
8. Preserves habitat for future generations	**Ranks 1st:** Preserves the most habitat for future generations by applying high levels of protection to all habitats.	**Ranks 3rd:** Preserves a moderate amount of habitat for future generations, focuses protection on higher value habitats.	**Ranks 6th:** Preserves the least amount of habitat for future generations, applies lower level of protection to higher value habitats.	**Ranks 2nd:** Preserves a substantial amount of habitat for future generations. Higher protection levels applied to highest value stream corridors, moderate and high protection applied to other habitats.	**Ranks 4th:** Preserves some habitat for future generations. Applies some protection to highest value habitats and moderate protection to other habitats.	**Ranks 5th:** Preserves a minimal amount of habitat for future generations. Habitat in areas of high urban development value is not preserved, habitat in other areas receives low and moderate protection.
9. Maintains cultural heritage and sense of place	**Ranks 1st:** Provides the most protection for the highest value habitat, highest level of protection may result in need for expanding the UGB.	**Ranks 3rd:** Provides moderate protection for highest value habitat, less potential for expanding the UGB.	**Ranks 6th:** Provides the least protection to highest value habitat, habitat outside UGB at less risk.	**Ranks 2nd:** Provides substantial protection to highest value habitat, a small portion in high urban development value areas receive moderate protection.	**Ranks 4th:** Provides some protection to highest value habitat; applies low protection to habitat in high urban development value areas.	**Ranks 5th:** Provides minimal protection to highest value habitat, habitat in high urban development values receives no protection.
10. Preserves amenity value of resources (quality of life, property values, views)	**Ranks 1st:** Retains the most amenity value in the highest value habitats.	**Ranks 3rd:** Retains moderate level of amenity value in the highest value habitats.	**Ranks 6th:** Retains least level of amenity value in wildlife habitat, slightly more in stream corridors.	**Ranks 2nd:** Retains substantial amenity value in highest value habitats, more protection for streams than upland habitat.	**Ranks 4th:** Retains some level of amenity value in highest value habitat, more protection for streams than upland habitat.	**Ranks 5th:** Retains a minimal level of amenity value, highest value wildlife habitat receives more protection.
Environmental factors						
11. Conserves existing watershed health and restoration opportunities	**Ranks 1st**: Preserves most high value habitat; provides substantial protection to other habitats.	**Ranks 3rd**: Preserves moderate amount of all habitats; higher protection for highest value habitat.	**Ranks 6th**: Preserves least amount of habitat; moderate protection for higher value habitat; no protection for lowest value habitat.	**Ranks 2nd**: Preserves substantial amount of habitat. Highest protection levels for most high value habitat, moderate protection for other habitats.	**Ranks 4th**: Preserves some amount of habitat. Higher value habitats receive moderate protection levels; other habitats receive lower protection.	**Ranks 5th**: Preserves minimal amount of habitat. Provides low protection levels for all habitat classes, no protection for highest value habitat in some circumstances.
12. Retains multiple habitat functions provided by forest areas	**Ranks 1st**: Retains the most forest cover in both vacant and developed habitat lands.	**Ranks 2nd**: Retains substantial amount of forest cover in both vacant and developed habitat lands.	**Ranks 6th**: Retains least amount of forest cover, likely to result in significant forest habitat loss over time.	**Ranks 3rd**: Retains moderate amount of forest cover, some protection for all forested habitat areas and highest protection for forested habitat in stream corridors.	**Ranks 4th**: Retains some amount of forest cover, some protection for almost all forested habitat areas.	**Ranks 5th**: Retains minimal amount of forest cover, low protection levels for most forested habitat areas.
13. Promotes riparian corridor connectivity and overall habitat	**Ranks 1st**: Promotes most stream corridor continuity and overall habitat connectivity.	**Ranks 3rd**: Promotes moderate retention of connectivity. Provides small	**Ranks 6th**: Promotes least retention of connectivity and likely to result in most	**Ranks 2nd**: Promotes substantial retention of stream corridor continuity; moderate	**Ranks 4th**: Promotes some retention of connectivity in stream corridors and between	**Ranks 5th**: Promotes minimal retention of connectivity, likely to result in significantly

Criteria	Option 1A: Most habitat protection *Highest level of protection for all habitats*	Option 1B: Moderate habitat protection *High level of protection for highest value habitat, moderate protection for other habitats*	Option 1C: Least habitat protection *Moderate level of protection for higher value habitats, no protection for lowest value habitat*	Option 2A: Most habitat protection *Moderate level of protection in high urban development value areas, high level of protection in other areas*	Option 2B: Moderate habitat protection *Low level of protection in high urban development value areas, moderate level of protection in other areas*	Option 2C: Least habitat protection *No protection in high urban development value areas, moderate level of habitat protection in other areas*
connectivity		connector habitats with higher protection, does not preserve as much stream corridor continuity.	reduction of regional connectivity. No protection for small connector habitats.	protection for small connector habitats.	upland habitats.	reduced regional connectivity.
14. Conserves habitat quality and biodiversity provided by large habitat areas	**Ranks 1st**: Conserves the most large habitat areas.	**Ranks 2nd:** Conserves a substantial amount of large habitat areas, moderate risk for urban development fragmenting large habitats.	**Ranks 6th**: Conserves least amount of large habitat areas, likely to result in significant fragmentation.	**Ranks 3rd:** Conserves moderate amount of large habitat areas, small amount of low protection applied to portions of some large habitats.	**Ranks 4th:** Conserves some amount of large habitat areas, lower protection levels applied to all large habitats.	**Ranks 5th:** Conserves minimal amount of large habitat areas, likely to result in significant fragmentation of large habitats.
15. Supports biodiversity through conservation of sensitive habitats and species	**Ranks 1st**: Supports the most biodiversity by applying highest levels of protection to sensitive habitats and stream corridors.	**Ranks 2nd/3rd:** Supports a substantial amount of biodiversity, applies more protection to sensitive habitats than stream corridors.	**Ranks 5th:** Supports a minimal amount of biodiversity, applies moderate protection level to sensitive habitats and stream corridors.	**Ranks 2nd/3rd:** Supports a substantial amount of biodiversity, applies more protection to stream corridors than sensitive habitats.	**Ranks 4th:** Supports some biodiversity, applies higher protection to stream corridors than sensitive habitats.	**Ranks 6th:** Supports the least amount of biodiversity, likely to result in substantial loss of sensitive habitats and sensitive species.
Energy Factors						
16. Promotes compact urban form	**Ranks 6th**: Promotes compact urban form the least. Highest protection levels applied to vacant land intended for urban uses (housing & jobs).	**Ranks 4th:** Moderately promotes compact urban form. Some reduction in development potential on all habitat land.	**Ranks 1st**: Promotes compact urban form the most. Development allowed in lowest habitats, moderate protection to other habitat lands.	**Ranks 5th:** Minimally promotes compact urban form. Development opportunities reduced in all habitat areas.	**Ranks 3rd:** Promotes some amount of compact urban form. Development opportunities reduced in most habitat areas.	**Ranks 2nd:** Substantially promotes compact urban form. Development opportunities on business land less impacted than residential land.
17. Promotes green infrastructure	**Ranks 1st:** Conserves the most vegetation and forested areas.	**Ranks 3rd:** Conserves a moderate amount of vegetation and forested areas.	**Ranks 6th:** Conserves the least amount of vegetation and forested areas.	**Ranks 2nd:** Conserves a substantial amount of vegetation and forested areas.	**Ranks 4th:** Conserves some vegetation and forested areas.	**Ranks 5th:** Conserves a minimal amount of vegetation and forested areas.
Other criteria						
18. Assists in protecting fish and wildlife protected by the federal Endangered Species Act	**Ranks 1st:** Provides most protection to sensitive habitats; most protection for hydrology and riparian functions; most likely to protect sensitive species.	**Ranks 3rd**: Provides substantial protection to sensitive habitats and species. Similar to 2A, but provides less protection for hydrologic conditions.	**Ranks 6th:** Provides least protection to sensitive habitats and species, hydrology. Minimal protection for riparian functions.	**Ranks 2nd:** Provides substantial protection to sensitive habitats and species. Similar to 1B, but provides more protection for hydrologic conditions.	**Ranks 4th:** Provides some protection to sensitive habitats; less likely to maintain hydrologic conditions or riparian functions.	**Ranks 5th:** Provides minimal protection to sensitive habitats and species and hydrology. Provides least protection for riparian functions.
19. Assists in meeting water quality standards required by the federal Clean Water Act	**Ranks 1st:** Provides most protection for clean water. Most protective of forest canopy, habitat near streams and on steep slopes; most protection for hydrology.	**Ranks 3rd**: Provides moderate protection for clean water. Moderate protection for for slopes, wetlands, and resources near streams. Substantial protection for forested areas.	**Ranks 5th:** Provides minimal protection for the natural resources important to protecting water quality. Least protection for forested areas.	**Ranks 2nd:** Provides substantial protection for clean water, with strict protection for slopes, wetlands, and resources near streams. Moderate protection for forested areas.	**Ranks 4th:** Some protection for slopes and wetlands, hydrologic conditions, habitat near streams, hydrologic conditions and forest. Potential for decreased water quality.	**Ranks 6th:** Provides least protection for slopes and wetlands, habitat near streams, and hydrology; minimal protection for forested areas. Most potential for poor water quality.

CHAPTER FIVE: SUMMARY AND CONCLUSIONS

Protecting fish and wildlife habitat in the urban area is complex, and there are many important tradeoffs to balance. Metro's consideration of several non-regulatory tools for habitat protection describes several approaches that could be developed further, building on the restoration, education, and acquisition work that Metro currently does. Metro's analysis of the six regulatory program options identifies the number of affected acres of land in each habitat and urban development class, and describes the economic, social, environmental, and energy consequences associated with various protection levels. Evaluating the performance of each option against the 19 criteria provides the Metro Council with valuable information necessary to choose which type of regulatory approach makes the most sense for the region. Non-regulatory and regulatory tools can be complementary, increasing the effectiveness of each approach. This chapter includes:

- a brief summary of the potential non-regulatory tools,
- results of the analysis of the six regulatory options,
- a discussion of the interaction between non-regulatory and regulatory tools,
- potential funding sources, and
- the next steps in the development of a regional fish and wildlife habitat protection program.

Potential non-regulatory tools for habitat protection

While there is substantial evidence of current non-regulatory efforts accomplishing habitat protection, restoration, and education in the Metro region, they have not been successful in preventing the decline in overall ecosystem health. Most non-regulatory programs are dependent on unsteady sources of grant funding, volunteerism, and good stewardship, often without recognition or reward. Each program conducts important work, but even taken as a whole over the past decade only a small portion of the habitat in the region received the attention needed. There is a much greater need for restoration dollars; technical assistance for landowners, developers, and local jurisdictions; and permanent protection for critical habitats than is currently available.

There are many types of non-regulatory tools that could be used to protect and restore fish and wildlife habitat in the region. All of these tools require some type of funding, whether to pay for staff or provide direct dollars to purchase or restore land. Many of the non-regulatory tools could be implemented at either the local or regional level. Below is a list of tools identified in this report:

- Stewardship and recognition programs
- Grants for restoration and protection
- Information resources
- Technical assistance program
- Habitat education activities
- Volunteer activities
- Agency-led restoration activities
- Acquisition

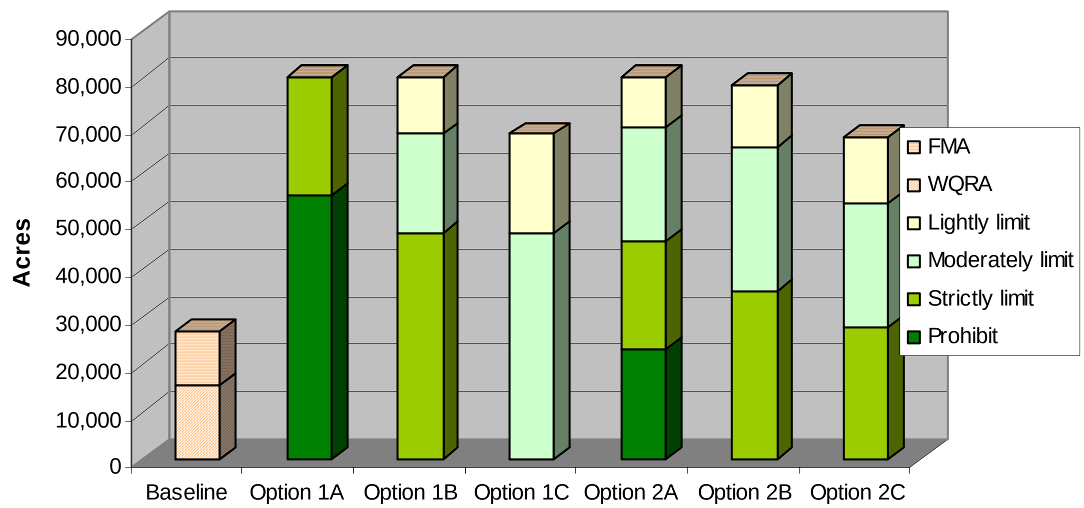
Acquisition is the most effective non-regulatory tool to achieve habitat protection. Acquisition achieves permanent protection and also preserves land to be restored at a later date. However, the high cost of purchasing land, especially within the urban growth boundary, and the dependence of an acquisition program on willing sellers limits the effectiveness of such a program.

Many of the other non-regulatory habitat protection and restoration tools considered in this report are most effective when used in combination with each other and/or along with a regulatory program. A regulatory program can provide the incentive and motivation to develop innovative solutions to land development while protecting habitat. Grants and technical assistance are the tools that could be most effective in protecting and restoring habitat, in the absence of an acquisition program. A stewardship recognition program could help promote grants and serve to educate others about innovative practices. Coordinating with existing agencies and volunteer groups that conduct restoration as well as providing funds to focus efforts could be effective in enhancing regionally significant habitat.

Comparison of regulatory options

Metro developed six regulatory options to protect land classified as regionally significant fish and wildlife habitat. Three of the options consider habitat quality (1A, 1B, and 1C) and three options (2A, 2B, and 2C) consider habitat quality and urban development value. Five possible treatments are applied in the options, identifying whether development would be allowed, lightly limited, moderately limited, strictly limited, or prohibited. The six options were evaluated based on how they met 19 criteria. Most of the criteria were based on the issues identified in Metro's general evaluation of the economic, social, environmental, and energy tradeoffs, two criteria were based on how well the options met the federal Endangered Species Act and Clean Water Act. Figure 5-1 graphically illustrates how the five treatment levels are applied in the six options as compared to the baseline regulations (Title 3).

Figure 5-1. Habitat protected by option (vacant & developed land; does not include impact area)



Overall, the options that protect the highest-value habitat (Options 1A and 2A) perform similarly. The option that provides the least protection for the highest-value habitat (Option 1C) and the option with the lowest level of protection in the industrial and commercial areas (Option 2C) also perform similarly. However, Option 2C favors factors important for urban development while Option 1C reduces protection levels equally for all land uses. Table 5-1 compares the tradeoffs of applying the six regulatory options.

Table 5-1. Comparing the regulatory options.

Options 1A, 2A	Options 1B, 2B	Options 1C, 2C
• Reduces development opportunities within the existing urban growth boundary • Increases possibility of expanding the urban growth boundary, potentially increasing development costs (such as streets and utility connections) • Potentially adds to the cost of urban development (such as environmental review process, low impact development standards) • Protects the most habitat and restoration opportunities • Preserves the most ecosystem services (such as flood management and water quality) • Promotes conservation of sensitive species (such as Pileated woodpeckers and painted turtles) and at risk habitats (such as white oak forests and wetlands) • Supports cultural heritage (such as salmon), regional identity (such as proximity to open spaces), and amenity values (such as property values) • Greatest affect on the location and choices for jobs and housing • Increases property owner concerns about limiting use of land, especially single family residential	These options provide the middle ground between the most restrictive and least restrictive options.	• Provides the most development opportunities within the current urban growth boundary • Minimizes need to expand the urban growth boundary by allowing compact urban development • Supports urban centers and industrial areas by not applying new regulations (Option 2C) • Minimizes habitat protection and preserves the fewest restoration opportunities (but may increase future cost to restore ecosystem services such as flood control) • Increases habitat fragmentation along streams and between streams and upland habitats • Reduces variety of plants and animals that make up a healthy ecosystem • Increases energy demand for cooling air and water temperatures by removing trees and vegetation • Reduces opportunity for future generations to enjoy fish and wildlife habitat and their associated benefits • Minimizes property owner concerns about limiting use of land, especially residential and business land

Interaction of non-regulatory and regulatory tools

A program to protect fish and wildlife habitat may be most effective if it includes a variety of tools and approaches, both non-regulatory and regulatory. Both approaches have strengths and weaknesses, for example non-regulatory tools rely heavily on funding and willing landowners, while regulations only apply when triggered by a land use action. While regulatory and quasi-regulatory tools can offer some flexibility, regulations can and often are used to achieve a baseline level of protection. Protection can be greatly enhanced by supplementing a regulatory component with non-regulatory tools for fish and wildlife habitat protection. If a program option is chosen that includes less regulatory protection then it may be necessary to apply more non-regulatory approaches and a higher level of funding if the same level of habitat protection is desired. The following constitutes a brief summary of how acquisition and incentives can interact with and increase the effectiveness of regulatory tools.

Incentives and regulations

When used in conjunction with regulations, the opportunity of incentives to encourage fish and wildlife habitat protection on private lands cannot be overstated. Through tax benefits, regulatory certainty, public recognition, cost sharing, and other incentives, landowners can be encouraged and rewarded for protecting valuable fish and wildlife habitat on their property. Takings issues, whether actual or perceived, are important to many property owners, thus regulatory programs may be unpopular. The application of incentives, however, can provide willing landowners some kind of compensation for conserving habitat on their land. Incentives can thus be used to support compliance with regulations or to fill in protection gaps for regionally significant habitat where regulations are not applied.

The Riparian Lands Tax Incentive Program (RLTIP), for example, can potentially apply in already urbanized areas to protect regionally significant riparian corridors adjacent to private property where the standards of buffer programs may be difficult to implement. Inside the UGB, where most of the significant riparian corridor habitat is developed rather than vacant, incentives can offer a tremendous opportunity to encourage voluntary protection and restoration. Other incentives[38] can apply to new development or redevelopment where habitat-friendly development is a feasible option for stormwater management and erosion and sediment control.

Acquisition and regulations

Just as incentive programs and regulatory tools can work together to protect significant habitat, combining acquisition with regulatory and quasi-regulatory approaches can create a more comprehensive protection strategy for fish and wildlife habitat. Further, where regulatory tools and incentive programs fail to provide adequate protection, acquisition of land from willing sellers offers a last line of defense for the habitat. Acquisition, by willing sellers, can be applied to conserve some of the remaining significant habitat.

Regulatory flexibility

Regulations to protect fish and wildlife habitat limit development options on land with habitat value. Some ways in which regulations could limit development include lowered density, minimum disturbance areas, and setbacks from significant resources. Incentives can work with regulations to allow development to occur in a manner that reduces the impact on the habitat. For example, cluster development, streamside buffers, and habitat-friendly development

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[38] Such as: the City of Portland's Bureau of Environmental Services (BES) Ecobiz and Ecoroof Programs, the city's Office of Sustainable Development's (OSD) G-Rated Program, and Oregon Department of Environmental Quality's (DEQ) Nonpoint Source Pollution Control Facility Tax Credit Program (NSPCFTC). BES's Ecoroof Program, for example, provides developers with sewer rate discounts for building greenroofs on new buildings or for retrofits, while the DEQ's NSPCFTC program provides cost share opportunities for other innovative LID stormwater management designs. The soon-to-be-implemented Ecobiz program will serve to further encourage the use of LID for new and redevelopment by publicly recognizing landscapers who use these designs.

techniques can all provide some level of regulatory flexibility that allows development to occur while protecting habitat.

Cluster development

Clustering and open space development are land division and development tools used to conserve land on one portion of a site in exchange for concentrated development on another portion of the site. Typically, road frontages, lot sizes and setbacks are relaxed to allow the preservation of open space areas. Clustering has the potential for regulatory flexibility because ordinances implementing these tools can be designed to establish performance standards with objective evaluation criteria for protecting resources from development.

Riparian buffer performance standards

Riparian buffers frequently establish predominantly fixed-width setback standards to protect habitat in and around streams, wetlands and riparian areas. Buffer programs tend to regulate actions rather than establish standards to achieve a specific outcome or performance. However, the potential exists to establish performance standards when implementing buffer programs and to protect fish and wildlife habitat. Some of these standards can include, but are not limited to: variable-width provisions that allow a buffer to expand and contract with the landscape; maintaining or enhancing percentages of native forest cover within buffer areas; and reducing impervious surfaces and road crossings through buffer areas.

Low impact, habitat-friendly development

Low Impact Development (LID) tools, especially those for reducing impervious surfaces and controlling stormwater, contain the most flexible standards from a performance-based perspective. Since the primary objectives of LID are to improve hydrologic conditions and increase water quality in urban watersheds, many LID ordinances, whether mandatory or voluntary, provide flexibility in the types of practices that can be used to meet these objectives. Since LID tools also focus on improving water quality, many jurisdictions specify objective criteria that can be used to evaluate the outcome or performance. Such criteria include, but are not limited to: the number and lengths of roads and other impervious surfaces reduced; percentages of tree canopy maintained or created; maintenance or reduction of stream temperatures; amount of sediment, nutrient, and pollutant loading to water reduced; and the minimization of runoff volumes.

Funding

Protecting and restoring fish and wildlife habitat costs money, with either a non-regulatory focus, regulatory approach, or a combination of the two. All non-regulatory programs would require some type of funding, either to purchase land, restore habitat, provide grants for habitat-friendly development, or to retain staff to develop a technical assistance or stewardship recognition program. Nor are regulations without cost. Staff time (regional and local) is used to develop ordinances and implement new laws and changes in development capacity may result in a reduced property tax base for local partners.

Funding for habitat protection programs could be provided by a non-specific mechanism such as a bond measure or Metro’s excise tax on solid waste, or a funding source could be tied to specific activities that impact fish and wildlife habitat. Below are several ideas for raising funds for protecting and restoring fish and wildlife habitat that could be implemented at the regional or local level.

Increase Metro's excise tax

Metro collects an excise tax on each ton of solid waste produced within the region. An additional per ton fee could be added that would be dedicated to funding the protection and restoration of fish and wildlife habitat. Such a decision would require an action of the Metro Council.

Urban area inclusion fee

Metro manages the region's urban growth boundary (UGB), expanding it according to development needs as the region grows. Land outside the UGB is not allowed to develop at urban capacities. When the boundary expands the new lands increase in value due to the increased ability to develop. An urban area inclusion fee would capture a portion of this increase in the value of property due to inclusion within the UGB. Funds raised could be used to purchase or restore habitat land within Metro's jurisdiction. It could be targeted to lands in the expansion areas as they are developed.

The *Incentives Report* included substantial review of this tool. Based on that study, a partition fee seemed to have the best potential for successful implementation as a method of collecting revenue. A partition fee could be imposed as a flat fee uniformly applied across all land parcels on a per lot or per acre basis. Since the fee would be collected when land is partitioned (typically a one-time event), it would not be assessed multiple times on the same property. Revenue would depend on the amount of developable land brought inside the UGB, the pace of development in the expansion areas, and the proposed fee rate.

Systems development charge (SDC) program

Local jurisdictions, typically municipalities, across the state regularly apply SDCs to new development in an attempt to pay for the cost of new infrastructure. SDCs can only be charged for specified purposes, *water supply, treatment and distribution, drainage and flood control*, and *parks and recreation* all could be construed to relate to the protection and restoration of fish and wildlife habitat. SDCs are a major cost for new development, and the imposition of any additional charge is likely to be challenged in a court of law.

An SDC could be collected to fund mitigation of the environmental impacts of development on fish and wildlife habitat. Fees would be collected by the permitting agency. However, fees generated through an SDC must be used on "capacity increasing capital improvements " that "increase the level of performance or service provided by existing facilities or provides new facilities" (ORS § 223.307(2)). It may be difficult to tie protection or restoration of habitat to a capacity increasing improvement. A more legally viable argument could be made if a regional SDC was collected for stormwater management.

Stormwater management fee

Water providers (e.g., Clean Water Services, Portland Bureau of Environmental Services) collect fees for stormwater management purposes. Some of these funds are currently used for restoration activities, but Metro could encourage these agencies to devote more dollars to habitat protection and restoration. Metro could also impose a regional fee to be used for restoration and protection of significant fish and wildlife habitat to be collected by the water providers.

Bond measure

Metro could put forth a regional bond measure to raise funds to purchase or restore habitat lands from willing sellers. The 1995 Parks and Openspaces bond measure was very successful and allowed the creation of a system of regional parks and trails that will be appreciated for generations. A similar approach could be taken focused on Metro's fish and wildlife habitat inventory. The voters would need to pass a bond measure, and polling has shown that a targeted approach is most likely to be successful. Fish and wildlife habitat targets could include purchasing and restoring Habitats of Concern and floodplains. Funds could also be used to purchase properties that are significantly affected by new regulations.

Funds from outside sources

There are funds to protect fish and wildlife habitat that could be raised from other sources such as national non-profits and federal agencies. Land conservancy organizations could be contacted to encourage the purchase of targeted habitat types (e.g., Nature Conservancy, Trust for Public Land). The US Fish and Wildlife Service has funds available for restoration in urban areas, and has worked in partnership with Metro's Parks Department to provide grants to property owners and organizations to conduct restoration activities. The city of Portland received a grant from the Federal Emergency Management Agency (FEMA) to acquire lands in the Johnson Creek floodplain after the floods of 1996. Additional partnerships with federal agencies could be pursued. Such an effort would require staff time to develop and implement programs for protection or restoration.

Next steps

The Metro Council is scheduled to consider a program direction, including non-regulatory and regulatory components, in May 2004 after a rigorous review process during which the public, local partners, and interested stakeholder groups will have the opportunity to provide input on the best approach for protecting fish and wildlife habitat in the region. Metro will then develop a program to protect fish and wildlife habitat to be considered by the Council in December 2004. Metro's program would include a standard ordinance and may include provisions for a riparian or wildlife district plan as a means of substantial compliance.

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EXHIBIT F -- ORD. NO. 05-1077C
ATTACHMENT 5. SEPT. 2004 HABITAT INVENTORY UPDATE

Habitat Class & Habitat Conservation Area (HCA)	Developed			Parks			Total Devel. & Park Habitat	Vacant				Total Vacant Habitat	Total Devel., Park, & Vacant Habitat
								Constrained			Unconstrained Outside Title 3		
	Inside Title 3 FMA	Inside Title 3 WQRA	Outside WQRA/FMA	Inside Title 3 FMA	Inside Title 3 WQRA	Outside WQRA/FMA		Inside Title 3 FMA	Inside Title 3 WQRA	Outside WQRA/FMA			
Class I Riparian Corridors													
HIGH HCA	624	1,499	1,654	3,729	5,041	3,509	16,056	1,517	4,425	1,002	4,127	11,070	27,126
MODERATE HCA	85	227	81	168	123	22	707	537	687	227	633	2,084	2,790
LOW HCA	0	0	0	0	0	0	0	0	0	0	0	0	0
ALLOW	1	0	1	0	0	0	3	2	0	0	0	2	5
Total acres	*711*	*1,726*	*1,736*	*3,897*	*5,164*	*3,532*	*16,765*	*2,056*	*5,112*	*1,229*	*4,760*	*13,156*	*29,921*
Class II Riparian Corridors													
HIGH HCA	1	2	2	1	1	4	11	1	1	0	1	4	14
MODERATE HCA	163	742	1,121	667	350	602	3,645	480	778	253	1,742	3,254	6,899
LOW HCA	142	303	325	17	7	5	799	378	312	162	795	1,646	2,445
ALLOW	6	1	6	0	0	1	14	4	0	1	2	6	20
Total acres	*311*	*1,048*	*1,453*	*685*	*359*	*612*	*4,468*	*862*	*1,092*	*416*	*2,540*	*4,910*	*9,378*
Class III Riparian Corridors													
HIGH HCA	0	0	0	0	0	0	0	0	0	0	0	0	0
MODERATE HCA	0	0	0	0	0	0	0	0	0	0	0	0	0
LOW HCA	0	0	0	0	0	0	0	0	0	0	0	0	0
ALLOW	2,165	156	1,000	62	7	134	3,523	61	23	99	482	665	4,188
Total acres	*2,166*	*156*	*1,000*	*62*	*7*	*134*	*3,524*	*61*	*23*	*99*	*482*	*665*	*4,189*
Class A Wildlife Habitat													
HIGH HCA	0	0	0	0	0	0	0	0	0	0	0	0	0
MODERATE HCA	0	0	0	0	0	0	0	0	0	0	0	0	0
LOW HCA	0	0	0	0	0	0	0	0	0	0	0	0	0
ALLOW	34	63	2,536	51	107	6,858	9,649	32	201	891	6,254	7,379	17,027
Total acres	*34*	*63*	*2,536*	*51*	*107*	*6,858*	*9,649*	*32*	*201*	*891*	*6,254*	*7,379*	*17,028*
Class B Wildlife Habitat													
HIGH HCA	0	0	0	0	0	0	0	0	0	0	0	0	0
MODERATE HCA	0	0	0	0	0	0	0	0	0	0	0	0	0
LOW HCA	0	0	0	0	0	0	0	0	0	0	0	0	0
ALLOW	7	27	3,343	8	16	1,323	4,724	25	97	716	7,312	8,150	12,874
Total acres	*7*	*27*	*3,343*	*8*	*16*	*1,323*	*4,724*	*25*	*97*	*716*	*7,312*	*8,150*	*12,874*
Class C Wildlife Habitat													
HIGH HCA	0	0	0	0	0	0	0	0	0	0	0	0	0
MODERATE HCA	0	0	0	0	0	0	0	0	0	0	0	0	0
LOW HCA	0	0	0	0	0	0	0	0	0	0	0	0	0
ALLOW	16	14	1,901	13	16	805	2,766	70	81	459	3,776	4,386	7,152
Total acres	*17*	*14*	*1,901*	*13*	*16*	*805*	*2,766*	*70*	*81*	*459*	*3,776*	*4,386*	*7,152*
Total Habitat	*3,246*	*3,035*	*11,969*	*4,715*	*5,668*	*13,263*	*41,897*	*3,105*	*6,607*	*3,810*	*25,124*	*38,646*	*80,542*
Impact Areas													
HIGH HCA	0	0	0	0	0	0	0	0	0	0	0	0	0
MODERATE HCA	0	0	2	0	0	0	2	0	0	0	0	0	2
LOW HCA	0	0	0	0	0	0	0	0	0	0	0	0	0
ALLOW	361	763	9,809	166	131	968	12,197	103	326	608	3,327	4,364	16,561
Total acres	*361*	*763*	*9,810*	*166*	*131*	*968*	*12,199*	*103*	*327*	*608*	*3,327*	*4,365*	*16,564*

EXHIBIT F—ORDINANCE NO. 05-1077C

ATTACHMENT 6.

TUALATIN BASIN ESEE REPORT

This report is available for review in the Metro Council's files (see copy referenced in Technical Amendment No. 19, approved by the Council on September 22, 2005). In addition, copies may be requested from the Metro Planning Department, 600 N.E. Grand Ave., Portland, OR 97232, or by calling 503-797-1555. It is also available on the Washington County website: **http://www.co.washington.or.us/deptmts/lut/planning/tb_esee.htm** .

Ordinance No. 05-1077C - Exhibit G
MAP Revisions MATRIX
PROPOSED MAP CHANGES AND STAFF RECOMMENDATIONS

2005							
Project No./ Location/ Status	**Init.**	**Party/Contact/Address**	**Type of change(s)**	**Documentation provided**	**Adequate?**	**Questions / Documentation needed**	**Staff Recommendation**
021-11	PK/JH	City of Troutdale Contact: Elizabeth McCallum	Surface stream change to piped streams	5/5/05 letter and attached maps	Yes	Arata Creek changes appear to already have been made.	Change already made 9/22/05 PK
025-02	PK	Julie O'Dell Assistant to the City Administrator 2055 NE 238th Drive Wood Village, OR	Wetland changes—additions and removals	Hand-drawn maps provided by City	Yes	Documentation sufficient to use to refine the boundary of existing wetlands and locate mitigation wetlands to recognize development since NWI performed.	Make wetland changes as recommended by City of Wood Village (7 maps with changes in red and cover letter) 9/21/05 PK
PDX/PIC/ Cascade Station		Port of Portland Greg Theisen or Tom Bouillion Box 3529 Portland, OR 97208 503-944-7522 or 944-7615					
2/2001 1N2E06 - **(031-14)**	JH	Port of Portland	Two wetlands do not exist	Map dated 9-12-01	Yes		Amend the wetlands inventory to remove the filled areas. Also Amend the Streams inventory to remove any stream that's coterminous with the wetlands. CHANGE MADE
PIC Sub-district B Site Fill 1N2E15, 1N2E16 **(031-15)**	JH	Port of Portland	Stream segments filled. Much of area east of light rail tracks has been filled.	Approved drainage plan maps	Yes-	Status as of 5/17 was that wetlands had been removed, but additional wetlands and streams need to be removed as per drainage plan left with Justin.	Remove all drainage and wetland features that fall within the shaded areas on the drainage plan. JH CHANGE PENDING
PDX 1N2E09 ESEE **(031-16)**	JH	Port of Portland	Wetlands north of Airport Way no longer exist	Air Photo maps showing fill	Yes		Amend the wetlands inventory to remove the filled areas. CHANGE MADE

2005							
Project No./ Location/ Status	**Init.**	**Party/Contact/Address**	**Type of change(s)**	**Documentation provided**	**Adequate?**	**Questions / Documentation needed**	**Staff Recommendation**
PDX 1N2E05 ESEE **(031-17)**	JH	Port of Portland	Riparian Class III habitat does not exist as anything more than a drainage ditch	Confirmed by on-site inspection - PDX Natural Resource staff	No	Class III Resource is present because of open soil/grassy land cover near the Columbia River. Would need information about a change in land cover. JH	No change can be made because the base features are correct and meet the criteria. Agree that the resource has very low value to the riparian system. JH RECOMMEND NO CHANGE
PDX 1N2E08 ESEE **(031-18)**	JH	Port of Portland	E-zone inside airfield fence subject to federal hazard regulation - exempt from Portland and Metro regulation	GIS layer for the Airport fence line	No (See Comment)	Were the resource features inside the fence line at PDX are correct, they meet the current criteria and are regionally significant. The port contends that federal regulations render them exempt from any local regulations. JH	Recommend raising this issue as a possible ESEE adjustment or program exemption. JH ADDRESSED THROUGH ORDINANCE 05-1077B (WHMP)
PDX 1N2E06 **(031-19) see 031-14 and 031-18**	JH	Port of Portland	Both riparian habitat areas inside fence are subject to federal hazard regulation - exempt from Portland and Metro regulation	GIS layer for the Airport fence line	No- (See Comment)	If the resource features were correct they would meet the current criteria, however, the features have been filled. The idea that federal regulations render them exempt isn't relevant. JH	See 031-14 for the feature corrections. CHANGE MADE Recommend raising the federal regulation issue as a possible ESEE adjustment or program exemption (see 031-18). JH ADDRESSED THROUGH ORD. 05-1077b (WHMP)
PDX 1N1E01 ESEE **(031-20)**	JH	Port of Portland	Ditch south and west of taxiway has been filled - see accompanied maps and data files. Wetland West of Sunderland is much smaller than mapped	Confirmed by on-site inspection - PDX Natural Resource staff, Air Photo	Yes	Confirm stream removal.	Amend wetlands and stream inventory to reflect the changes. JH CHANGES PENDING
PDX 1N1E12 ESEE **(031-21)**	JH	Port of Portland	Stream corridor in NE corner has been filled as part of the SW Quad Safety Fill project	See attached Safety fill maps	Yes	Added flood plain fill as well. JH	Amend stream inventory to reflect the changes. Amend Forest Canopy layer to reflect the removal of vegetation. Amend flood plain to reflect fill. CHANGE MADE
PDX 1N2E18	JH	Port of Portland	Small riparian feature north of		No	Class III Resource is present because of open soil/grassy land	No change can be made because the base features are correct and meet the criteria.

2005							
Project No./ Location/ Status	**Init.**	**Party/Contact/Address**	**Type of change(s)**	**Documentation provided**	**Adequate?**	**Questions / Documentation needed**	**Staff Recommendation**
ESEE **(031-33)**			slough is a holding pond for runway de-icing material - not a natural feature			cover within 300 feet of the Columbia Slough. Would need information about a change in land cover. JH	Agree that the resource has very low value to the riparian system. JH RECOMMEND NO CHANGE
PDX 1N2E07 **(031-22)**	JH	Port of Portland	Wetland at end of cross runway was filled in 2001. Nearby detention pond is not a natural feature, nor is storage collection pond (as mentioned above). SW Quad Safety Fill altered habitat in NW corner of map	See attached maps detailing changes	Yes	Ponds, man made or natural, perform water storage functions and meet the criteria for regional resources. So far the only water quality drainage features removed have been related to sanitary and drinking water facilities. JH	Change the Wetlands inventory to reflect fills. Possibly change the flood and streams layer if needed to reflect fills. Recommend no change on ponds that have not been filled since they are water storage features and meet the criteria. JH CHANGES MADE
Rivergate							
2/2001 #2 Leadbetter Peninsula **(031-23)**	JH	Port of Portland	Remove all of Riparian Class 2 habitat bracketing N. Leadbetter Rd and all class 3 on road and under building footprints.	See map and grading information	Yes	Need to remove finger of floodplain that sticks out to NE. Cut back to pink line	Remove flood areas that have been recently filled. Remove flood areas that were re-graded as a result of recent development. JH CHANGE PENDING
Marine Terminals/Rivergate							
2N1W25 & 26 Rivergate Vestas Site **(031-25)**	JH	Port of Portland	Flood plain area adjacent to Ramsey Lakes has been filled. Remove all Class II and Class III habitat along N. Unnamed Rd.	Areas have been filled/regraded or developed since 96 flood inundation above minimum flood elevation.	Yes		Amend 1996 and or 100 year flood layer to reflect fills. CHANGE MADE
2N1W23 T5	JH	Port of Portland	Remove wetland	Detention pond -	Yes (See	Ponds, man made or natural,	Recommend removing wetland features

2005							
Project No./ Location/ Status	**Init.**	**Party/Contact/Address**	**Type of change(s)**	**Documentation provided**	**Adequate?**	**Questions / Documentation needed**	**Staff Recommendation**
(031-27)			designation at T5. Wetland under TrammelCrow development no longer exists.	not a natural resource area and not a wetland.	Comment)	perform water storage functions and meet the criteria for regional resources. So far the only water quality drainage features removed have been related to sanitary and drinking water facilities.	from inventory. Add pond to open water layer since it is performs water storage functions and meets the criteria for a regional resource. JH CHANGES MADE
2N1W24 - T6 **(031-28)**	JH	Port of Portland	Remove Class II and Class III designations from dock face.		No	The docks are in the 100 year flood plain and or the 1996 flood inundation and perform a secondary water storage function. JH	Recommend no change since the features are accurate and meet the criteria for regionally significant resources. Agree that the level of functionality is very low. JH RECOMMEND NO CHANGE
2N1E30 **(031-29)**	JH	Port of Portland	Remove class II and III habitat designation from flood areas along N. Marine Drive	Built, filled.	No	The area flooded in 1996. At least some of the area still performs secondary water storage functions. Some areas have been graded. Waiting for information on marine drive road improvements to see if they may constitute a flood barrier.	Remove areas that have been graded and built on since 1996. CHANGES MADE Confirmed Marine drive road improvements brought it up above 1996 flood inundation elevation. CHANGE PENDING
2N1E32 **(031-30)**	JH	Port of Portland	Remove Class II habitat designation. Wetland input is incorrect (N. of Suttle Rd facility). Site was delineated in 2004 - not a wetland.	Site was delineated in 2004 - not a wetland	Yes		Remove area covered by 2004 wetland delineation. CHANGES MADE
1N1W02 **(031-31)**	JH	Port of Portland	Remove Class III habitat from T4	Working dock face, RSIA.	No	the docks have value for bank stabilization, and water storage due to the 1996 flood inundation	Recommend no change since the features are accurate and meet the criteria for regionally significant resources. Agree that the level of functionality is very low in flood plain areas. RECOMMEND NO CHANGE
31-34	JH	Port of Portland	Remove class II & B/C habitat from Hyundai site	Air Photo	Yes		Remove vegetation were cleared and wetlands were filled CHANGES MADE
Troutdale							

2005							
Project No./ Location/ Status	**Init.**	**Party/Contact/Address**	**Type of change(s)**	**Documentation provided**	**Adequate?**	**Questions / Documentation needed**	**Staff Recommendation**
Airport							
1n3e22-4-LCSL **(031-32)**	JH	Port of Portland	Forested patch south of Salmon Creek does not exist	Aerial Photo	Yes	Port provided copy of map showing detail of change area.	change tree canopy to open soils CHANGE PENDING
065-001 6/04 – NO INDICATION OF STATUS	**PK**	**Edith Coulter** **3320 SE Westview Avenue** **Portland, OR 97267**	Change stream segments to stream links.	Phone call, aerial photos	Yes	4/27/05 letter from Gary R. Floyd, Technical Services Specialist, Oak Lodge Sanitary District with map showing surface and piped stream location	Recommend stream changes as indicated on map.
078-002	**LH**	**Steve Edelman** **PO Box 91519** **Portland, OR 97291**	Adjust the forest canopy to account for a gap 1N1W22D700, 600 Site address: 3980 NW North Rd. (2 lots, that's the south one)	Aerial photo 2004	Yes	None; please correct	09/14/05 – Recommend adjusting canopy layer to correct for gap in trees (LH). This is a further correction from 078-001. This correction will be submitted with the set of corrections for Council on Sept. 22.
084-005	**PK**	**Christie Galen** **Fishman Environmental Services, on behalf of Lewis & Clark College**	1s1e27 Lewis and Clark College Corrections to forest canopy layer, streams, and wildlife habitat classifications.	Aerial photos and other documentation PK met with Michael Sestric, Campus Planner, on 9/21/05 to review each map revision request and staff recommendations.	Yes	1. South campus and vicinity: a. woodland area SW of Palatine rd: asked for reclassification to Class B and exclusion of roads. b. Forest canopy changes requested, plus stream change request (says its mapped 350 ft too far west of true location). c. Request to reclassify upland wildlife habitat (declined); request to remove roads and parking areas from forest canopy. Review with Michael Sestric confirmed forest canopy	1a: Staff recommends declining request. Metro's inventory is based on the principles of spatial ecology, and the inventory applied the ecological criteria. Criteria change constitutes a policy issue. Metro's mapping only excludes roads that are 4 lanes or wider. 1b: Recommend minor forest canopy changes. Metro incorporated City of Portland streams in 9/04 Inventory Update; it does look from the interactive mapping tool that the stream has already been corrected. Confirmed with Michael Sestric that current Metro map appears accurate. 1c: Confirmed with Michael Sestric that

2005							
Project No./ Location/ Status	**Init.**	**Party/Contact/Address**	**Type of change(s)**	**Documentation provided**	**Adequate?**	**Questions / Documentation needed**	**Staff Recommendation**
						d. 2. Templeton Student Center a. Stream alignment off based on Campus data. b. Why is area north of Templeton Student Center in Class B wildlife? c. Metro observation: Estate Garden is appropriate as low structure vegetation 3. Olin Fields – stream correction 4. Stadium area a. two woodlands on either side of stadium are mapped too extensively. b. Requests reclassification of resources. Evans Hall forest patch. c. Pamplin Center woodland – requests redelineating forest canopy; buildings, etc. under tree. 5a. Entry near Terwilliger – clean up resource mapping. b. Second stream corridor located SE of Law School is not really a stream corridor but an intermittent storm water discharge area; requests reclassification to other than Class I.	forest canopy in this location is accurately delineated. Recommend no change. 2a. Recommend stream alignment changes be processed through City of Portland. b. Recommend no change to Class B habitat patch. It is forest canopy continuous with adjacent Class I and II riparian corridor. c. Recommend no change to low structure vegetation in area in Estate Garden area. 3. Recommend no change as stream alignment and origin has already been corrected by using City of Portland data. 4a. Forest canopy revised previously in June 2004 to show correct boundary. 4b. Recommend no change. Metro included a measure for edge effects in the ecological function criteria, based on regionally-specific field research. 4c. Pamplin Center woodland – Recommend no change. This habitat patch is delineated based on Metro's existing forest canopy rules. 5a. Staff recommends minor changes to forest canopy. 5b. Metro's criteria includes the streams provided by the City of Portland. Confirmed with Michael Sestric that stream exists in location as mapped.
090-007	PK	**Group Mackenzie** **Fazio Property**	New steam channel appearing on	Aerials, July 13, 2004 Group	Yes	Stream correction – must be accomplished through City of	Stream channel appears to exist based on aerial photo review and 5/12/05 letter from

2005							
Project No./ Location/ Status	**Init.**	**Party/Contact/Address**	**Type of change(s)**	**Documentation provided**	**Adequate?**	**Questions / Documentation needed**	**Staff Recommendation**
		NE Fazio Way **1n1e11b 00902** **owner: Jack Fazio**	September 2004 Inventory update that was not present in June, 2004 Inventory. Stream mapping correction requested.	MacKenzie letter, and May 12, 2005 Stark Ackerman letter		Portland. The June, 2004 Metro Inventory was based on Metro regional stream layer; that layer was amended in September 2004 by incorporating City of Portland stream layer. 5/12/05 letter from Stark Ackerman refers to the stream in question as a "small ditch that drains the subject site and adjoining property."	Stark Ackerman. Recommend forwarding to City of Portland to review stream correction request – must be accomplished through City of Portland. 9/23/05 PK
123-001	PK 9/1/05	Crawford Street Corporation Attn: Mat Cusma PO Box 10047 Portland, OR 97296-0047 Submitted by: Geraldine Moyle, Group Mackenzie 0690 SW Bancroft St. Portland, OR 97239-0039	Location: N. Bradford St. at N. Burlington Ave 1n1w12 CA tl 200 and 300 Site size: 10.5 acres Remove Low HCA designation from portion of site (0.68 acres) within the flood area covered in gravel and asphalt as it qualifies as developed floodplain	Group Mackenzie submitted letter and site maps showing current HCA designations, an aerial photo, and on-site photos showing asphalt (of various structural integrity) and bank vegetation.	Yes	The HCA designations are well within 300 feet of bank of the Willamette River. The boundary of Metro's vegetation mapping appears accurate and follows the edge of the paved area. The 0.67 acre in question is not mapped as low structure/open soils but does appear on Metro's vacant land inventory. Metro uses vacant land status as one criterion for identifying undeveloped floodplains. As such, the subject area is identified as Class II riparian (2 primary functions). Notwithstanding the vacant land status, the 0.67 acre area does not support primary riparian ecological functions.	9/1/05—recommend removing the HCA designation from the 0.67 acre area depicted on the Goup Mackenzie map Attachment B of their 7/29/05 letter. DRC (Carol Hall) confirmed its interpretation that the 0.67 acre area qualifies as vacant land per the vacant lands inventory. However, with asphalt pavement, although appearing in deteriorated condition along outward edges, the subject area thus qualifies as developed floodplain. Due to the lack of vegetative cover and presence of asphalt paving material, the subject area is not providing primary ecological riparian functions, and would be classified as Class III riparian and the current HCA designation removed from the 0.67 acre area.
124-001	PK	**Bevins and Bill Stockings** **1248 Arnold St.** **Portland, OR 97219** **Dorothy Cofield, Attorney** **4248 Galewood STE 9** **Lake Oswego, OR 97035** **503-675-4320**	Requests stream alignment correction. City of Portland's jurisdiction.	Stream Survey maps by Welkin Engineering, P.C. and Schott & Asscociates. Portland 5/24/05 BES memo on	Yes	None; adequate documentation. Survey location is different from Metro's map (and Portland's current streams).	Recommend correction of City's stream data and mapping based on documentation provided. Recommend Metro work with City to accomplish this change and communicate with Cofield Law Office or their clients, the Stockings, to process the change through

2005							
Project No./ Location/ Status	**Init.**	**Party/Contact/Address**	**Type of change(s)**	**Documentation provided**	**Adequate?**	**Questions / Documentation needed**	**Staff Recommendation**
				driveway alignment.			the City.
125-001	LH	**Peter & Kandis Morita 17936 SW Frederick Ln Sherwood, OR 97140-7818**	Valid forest canopy correction.	8/27/05 letter to Metro with Interactive map of forest canopy	Yes	Forest canopy boundary can be revised to more accurately show tree line.	Recommend making canopy revision as indicated on map.
126-001	LH	**Alexey Byrgazov 5724 SW Orchid Ct. Portland, OR 97219 503-452-4477**	Requests stream realignment and forest canopy revision.	Aerial photos	Yes	Citizen needs to contact City of Portland to make stream correction.	Please make forest canopy correction as indicated.
127-001	LH	**Brian Hanson 3623 SE Naef Rd. Milwaukie, OR 503-794-9268**	Stream realignment – valid correction	Met with him. Aerial photos.	Yes	Documentation appears adequate.	Please make changes indicated on stream layer. Part is now piped under swimming pools; part is simply mis-placed, and visibly so on the aerials.
128-001	PK	**Steve Mason, Manager Boeing Company P.O. Box 20487 MC5P-91 Portland, OR 97294-0487 Property address: 19000 NE Sandy Blvd. Portland, OR 97294-0487**	Removal of low structure on Boeing property	7/6/05 email describing mapped vegetation as 20 foot deciduous trees along parking facilitylot	Yes	Review of Boeing facility and adjacent land to the north across Sandy Blvd revealed larger issue of low structure mapping unit further than 300 feet from nearest surface stream (Stormwater Creek).	Recommend removing low structure vegetative cover mapping unit as indicated on map and associated Class A wildlife unit. Nearby forest canopy units correctly mapped.
129-001	PK	**Pete Kirby 15400 SW Millikan Way Beaverton, OR 97006 Property address: 10100 SW Herman Rd. Tualatin, OR**	Refine Class 2 riparian unit undeveloped flood area to recognize building site	7/19/04 Sensitive Area Certification letter from CWS	Yes	Review of aerial photos and September 2004 Inventory update indicates some revisions to Class 2 riparian unit on property are justified.	Recommend revising boundary of Class 2 Riparian unit to recognize building site as indicated on map (and removal of building site from Low HCA designation).
130-001	PK	**Michael Lehne 7915 SE 162nd Ave. Portland, OR 97236**	Forest canopy correction.	Aerial photo	Yes	None	Please correct as indicated. 09/15/05 LH
131-001	PK	**Drew Prell Tax Lot 5400 of T2S R1E Section 10DB 722 Maple St.**	Stream correction request	City of Lake Oswego detailed sensitive lands map dated	Yes	None	Please correct stream layer as indicated on sensitive lands map. 09/15/05 LH

2005							
Project No./ Location/ Status	**Init.**	**Party/Contact/Address**	**Type of change(s)**	**Documentation provided**	**Adequate?**	**Questions / Documentation needed**	**Staff Recommendation**
		Lake Oswego, OR Requested by: Joseph S. Schaefer Land Use Planner Schwabe, Williamson Wyatt 1211 SW Fifth Ave. Pacwest Center Suites 1600-1900 Portland, OR		09/04/01 (T2SR1E Section 10D, page 38)			
132-001	PK	**Bill Cordano 19300 NW Green Lane**	Request for stream correction – will need to be done through Tualatin Basin. PK spoke to Bill Cordano on 5/20/05.	11/8/04 handwritten note from Bill Cordano	No	Recommend Mr. Cordano request stream verification from Clean Water Services; and that Metro make appropriate changes to stream layer based on CWS review.	Recommend no change. 9/22/05 PK
133-001	PK	**John Koby 11795 SW Koby Dr. Beaverton, OR 97007**	Stream alignment and forest canopy corrections requested.	1/10/05 letter from John Kobbe, aerial photos, on-site photos	No	Mr. Koby does not dispute existence of streams, but their ecological value. States recent logging has removed substantial forest canopy, but this is not indicated on Metro aerial photos.	Recommend no changes to streams, forest canopy or low structure/shrub vegetative cover mapping based on most recent aerial photos.
134-001	PK	**Ed Bartholemy 18485 SW Scholls Fy Rd. Beaverton, OR 97007**	Removal of pond requested.	11/1/04 map correction form	No	No documentation provided to warrant removal of pond. Metro data shows pond is a wetland resource (NWI data)	Recommend no change. Communicated staff recommendation via 1/26/05 email to Ed Bartholemy. 9/22/05 PK
135-001	PK/LH	**John Cooper 18375 SW Horse Tail Dr. Beaverton, OR 97007**	Remove upland and HOC classifications.	1/3/05 letter from John Cooper, narrative explanation, site photos and logging notice form	Yes	2005 aerial photos of property document significant removal of forest canopy.	Recommend removing forest canopy as indicated on map and remapping low structure and shrub vegetative cover within 300 feet of surface streams. Recommend removing HOC designation over former forest canopy. 9/22/05 PK
136-001	LH	**Suze Hammond 6810 SE 106th, Portland**	Slight corrections to forest canopy.	Aerial photos	Yes	None	Process requested change.
137-001	LH	**Jim and Judith Emerson**	2 types:	Aerial photos, topo	Uncertain		Lori to check with DRC to determine

2005							
Project No./ Location/ Status	**Init.**	**Party/Contact/Address**	**Type of change(s)**	**Documentation provided**	**Adequate?**	**Questions / Documentation needed**	**Staff Recommendation**
		13900 NW Old Germantown Rd. Portland, OR 97231	• Floodplain • Steep slopes	map			whether 1996 area of inundation and steep slopes can be changed. Needs followup.
138-001	LH	**Margaret Stone 11019 SW 32nd Ave. Portland, OR 503-977-3484**	Requests forest canopy adjustment.	Aerial photo	Yes	None	Please clean up forest canopy as indicated.
139-001	LH	**Rowan and Maribeth C Hollitz P.O. Box 755 Gresham, OR 97030 503-492-2066 Property address: 710 SE Butler Rd. Gresham, OR 97080**	Requests removal of stream from property; comments that she sees no sign of stream.	Aerial photo	No	More documentation will be needed because the stream is not visible. Contact landowner and talk to her.	Declined due to insufficient information. Contact landowner to discuss options.
140-001	LH	**Fred Whitfield 12462 SE Winston Rd. Boring, OR 97009 503-658-3281**	Requests change in stream designation – an area is piped.	Aerial photo	Yes	None	Please make indicated changes in stream layer.
141-001	LH	**Rob Clarizio Representing landowner at 23733 SE Hoffmeister Rd. Boring, OR Rob: 503-781-9791**	Stream corrections	Yes – worked with him on aerials	Yes	None; this map change was also provided for the Damascus-Boring concept planning.	Please make changes as indicated.
142-001	PK/LH	**Brad Kilby OTAK 17355 SW Boones Fy Rd Lake Oswego, OR 97035 503-644-2495 Venetia Subdivision, Tualatin SW 57th Terrace and south of SW Lee St.**	New development; resource has been removed.	Aerials, subdivision plats, etc.	Yes	Map change appears to already have been accomplished – likely submitted to Metro by City of Tualatin summer 2004.	09-15-05 - No change needed to forest canopy mapping. Recommend removing Wildlife Class A unit and "allow" unit as indicated on maps.
143-001	PK/LH	**Todd M. VanDomelen Norris & Stevens, Inc. 621 SW Morrison, Ste 800 Portland, OR 97205**	Stream corrections. City of Portland's jurisdiction.	Old Metro interactive tool map. Compared with current	Yes	Map change already accomplished via City of Portland's updated streams layer.	09/15/05 – no correction necessary.

2005							
Project No./ Location/ Status	**Init.**	**Party/Contact/Address**	**Type of change(s)**	**Documentation provided**	**Adequate?**	**Questions / Documentation needed**	**Staff Recommendation**
		503-223-3171 **Property: 8923 NW Mills St., Portland, 97231**		interactive tool map.			
144-001	PK	**Lacamas Laboratories** **P.O. Box 17659** **Portland OR 97217** **Contact: Jennifer M. Powell** **Environmental Manager** **Property location:** **3625 N. Suttle Road**	Undeveloped flood area change to developed flood area	9/19/05 letter from Jennifer Powell, Facility Report documenting recent building 8 and NFIP Elevation Certificate	Yes	Entire property was inundated in 1996 flood, and subsequent filling remains below FEMA flood level of 32 feet. New building #8 completed in mid-2004 (5,500 sq. ft). Remaining undeveloped flood area is estimated to be slightly less than one-half acre, thereby not meeting the Metro minimum mapping unit size for vacant lands or vegetative cover.	Recommend reclassifying the Class 2 riparian area from undeveloped flood area to Class 3 developed flood area, and removing the HCA designation from the polygon area indicated on the map.
145-001	PK/ MW	**Terrell Garrett** **4135 NW St. Helens Road** **Dry Waste Transfer Facility**	Requests removal of stream across property and revision to forest canopy layer	10/18/04 phone conversation with Chris Deffebach, further contacts with Chris in Nov. and Dec. 2004.	Yes	Faxed information on 10/19/04; 11/8/04 reply from Chris. Review of Metro stream data (based on City of Portland streams) clearly shows no stream channel located on subject properties. Forest canopy also requires revision.	Recommend removal of surface stream across subject properties (change to stream link) and coordinate with City of Portland in making this change to the stream data; also recommend revision to forest canopy as indicated on map.
147-001	PK	**Arbor School of Arts and Sciences** **4201 SW Borland Road** **Tualatin, OR 97062** **Contact:** **Kit Abel Hawkins, Director**	Several requested stream alignment changes; forest canopy boundary changes, disagreement over mapping of riparian and wildlife units.	9/9/05 letter; Land Tech, Inc. land survey dated 4/18/05 by Richard Able for Arbor School; on-site photos at various property locations.	Yes for vegetative cover; No for streams and wetlands	Forest canopy and low structure appears mostly accurate. Some clean-up of the vegetative cover is warranted. Insufficient information submitted to justify changes to stream alignment and wetland location for Saum Creek.	Recommend minor revisions to forest canopy and low structure vegetative cover mapping as indicated on map. Recommend stream alignment and wetland location changes be verified by Clean Water Services. 9/22/05 PK
148-001	MW	**Mike & Debbi Malet** **22300 SW Oak Hill Ln** **Tualatin, OR 97062**	Requests removal of stream that does not exist on subject property	None	No		Stream is indicated on CWS database. Aerial photo shows possible stream alignment issue, recommend CWS review stream alignment and location.
149-001	MW	**Richard Piacentini**	Requests change	Reference to	Yes		Recommend revision to forest canopy as

2005							
Project No./ Location/ Status	**Init.**	**Party/Contact/Address**	**Type of change(s)**	**Documentation provided**	**Adequate?**	**Questions / Documentation needed**	**Staff Recommendation**
		13541 Redland Road S. Oregon City, OR **Contact phone/address: 2001 Sixth Ave #2300 Seattle, WA 98121 (206) 448-1975**	to forest canopy; map shows it running over existing building.	interactive map			indicated on map.
150-001	MW	**Robert Randall Jr. 2 Centerpointe Drive, Ste 210 Lake Oswego, OR 97035** **Subject property: 9100 (Block) on West Side of SW 26th Ave, Portland, OR 97219**	Re-align stream and remove forest canopy	Plat map and stream centerline from city of Portland, black and white photo	Yes	City of Portland will have to review stream alignment.	Revise forest canopy as shown on map, recommend City of Portland review stream alignment.
151-001	MW	**Patrick Becker, Jr. 6223 SW Meridian Way Tualatin, OR 97062**	Requests changes to stream location and forest canopy	None.	No	Metro stream data and Clean Water Services stream data both indicate surface stream in same location.	No change recommended. Changes to surface stream feature must be verified by Clean Water Services. 9/22/05 PK

EXHIBIT G—ORDINANCE NO. 05-1077C

REVISION MAPS

Copies of the individual maps depicting the revisions noted in the preceding table are available for review in the Metro Council's files (these revisions were part of the Map Revisions Amendment approved by the Council on September 22, 2005). In addition, copies may be requested from the Metro Planning Department, 600 N.E. Grand Ave., Portland, OR 97232, or by calling 503-797-1555.

STAFF REPORT

IN CONSIDERATION OF ORDINANCE NO. 05-1077 AMENDING THE REGIONAL FRAMEWORK PLAN AND THE URBAN GROWTH MANAGEMENT FUNCTIONAL PLAN RELATING TO NATURE IN NEIGHBORHOODS.

Date: April 14, 2005 Prepared by: Andy Cotugno and Chris Deffebach

Residents of the Metro region value having nature near where they live, work, and play and have expressed the desire to keep nature in neighborhoods as a legacy to future generations. The Metro Council has expressed, as one of four central goals for the region, the aspiration that "(t)he region's wildlife and people thrive in a healthy urban ecosystem." Nature in Neighborhoods is a regional habitat protection, restoration and greenspaces initiative that inspires, strengthens, coordinates, and focuses the activities of individuals and organizations that share an interest in the region's fish and wildlife habitat, natural beauty, clean air and water, and outdoor recreation. Metro plays a leadership role in Nature in Neighborhoods, but recognizes that the protection and restoration of fish and wildlife habitat and the integration of greenspaces into the urban environment is a task of scope and magnitude beyond the reach of any one organization; it will take the coordinated and strategic action of many. This Ordinance addresses one component of the Nature in Neighborhoods initiative, establishing a consistent regional standard for fish and wildlife habitat protection that provides additional support for improving water quality.

CONTEXT AND BACKGROUND

Metro's authority to plan for fish and wildlife habitat protection in the region derives from State Land Use Planning Goal 5: Natural Resources, Scenic and Historic Areas, and Open Spaces. The Goal 5 administrative rule (OAR 660-023) recognizes Metro's unique planning role and gives Metro the option to develop a functional plan to protect regionally significant fish and wildlife habitat (OAR 660-023-080(3)). In 1996 the Metro Council voted to recognize the regional significance of fish and wildlife habitat and include protection in the functional plan.

The region's 2040 Growth Concept and other policies call for protection of natural areas while managing housing and employment growth. In 1998 the Metro Council adopted Title 3 of the Urban Growth Management Functional Plan to protect water quality and for flood management. Title 3 also included a commitment to develop a regional fish and wildlife habitat protection plan. As defined in a Vision Statement (Attachment 1) that was developed in cooperation with local governments through the Metro Policy Advisory Committee (MPAC) in 2000, the overall goal of the protection program is: "…to conserve, protect and restore a continuous ecologically viable streamside corridor... that is integrated with the urban environment." The Vision Statement also refers to the importance that "…stream and river corridors maintain connections with adjacent upland habitats, form an interconnected mosaic of urban forest and other fish and wildlife habitat…"

Metro's program is part of an agency-wide effort called "Nature in Neighborhoods," which is described in Metro Resolution No. 05-3574. The Nature in Neighborhoods initiative includes voluntary, incentive-based components that complement the development standards proposed in this ordinance.

The development standards proposed in this ordinance are consistent with one of the goals described in the Vision Statement to ensure contribution towards compliance with the federal Clean Water Act (CWA) and Endangered Species Act (ESA). Despite the adoption of Title 3 in 1998, the region's waterways are nevertheless still not in compliance with the water quality requirements of the CWA, and are soon to be the subject of a Total Maximum Daily Load rule promulgated by the Oregon Department of Environmental Quality. More needs to be done to improve the quality of the region's waterways and prevent future listings of species as threatened or endangered, and this program will take additional steps toward doing so.

Metro has completed development of a program to protect and restore fish and wildlife habitat, following the 3-step process established by the State Land Use Planning Goal 5 administrative rule (OAR 660-023). In the first step, Metro conducted a scientific analysis and inventory of the following Goal 5 resources: riparian corridors, associated wetlands, and wildlife habitat. A regional approach to inventorying natural resources required a consistent level of data and analysis across the entire Metro region. Metro's Fish and Wildlife Habitat Inventory is based on the best available information that can be applied consistently at a regional scale. Metro took an ecological functions approach to define and identify riparian corridors and wildlife habitat, based on its extensive scientific literature review. This approach combined geographic information system (GIS) mapping technology, scientific recommendations, and fieldwork. The methodology assigned values to resource features that allowed comparison of their cumulative importance. The upland wildlife habitat was evaluated separately from the riparian wildlife habitat areas. In 2002, after review by independent committees, local governments and residents, Metro Council endorsed the inventory of regionally significant fish and wildlife habitat lands (Resolution No. 02-3176 – riparian corridors, Resolution No. 02-3177A – upland habitat). The inventory includes about 80,000 acres of habitat land inside Metro's jurisdictional boundary. The habitat inventory is included in Exhibit F of this ordinance.

Upon completion of the habitat inventory, staff reviewed the habitat protection in each city and county within Metro's jurisdiction. The *Local Plan Analysis* (approved by Metro Council in Resolution No. 02-3218A, available in Metro Council office and on the internet at http://www.metro-region.org/article.cfm?ArticleID=1047) concluded that the standards to protect habitat varied from city to city, and that the most regionally consistent standards were those adopted by cities and counties to comply with Metro's water quality standards. The Metro Council directed staff to complete the second step of the Goal 5 planning process based on the conclusion that, while some cities and counties may provide adequate protection to regionally significant habitat, the level of protection varied substantially.

As described in Metro's *Local Plan Analysis*, cities and counties in the region currently have varying levels of protection for fish and wildlife habitat. As a result, cities and counties approach similar quality streams or upland areas in different parts of the region with inconsistent levels of protection. In addition, one ecological watershed can cross several different political jurisdictions – each with different approaches to habitat protection. With the adoption of the regional habitat protection program, cities and counties will adjust their protection levels to establish a consistent minimum level of habitat protection. For some, this will mean minor modifications to their plans, for others more substantive changes will be necessary.

The second step of the Goal 5 review process is to evaluate the Economic, Social, Environmental and Energy (ESEE) consequences of a decision to allow, limit or prohibit conflicting uses on these regionally significant habitat lands and on impact areas adjacent to the habitat areas. As defined in the ESEE process, the impact areas added about 16,000 acres to the inventory. For the ESEE analysis, Metro classified fish and wildlife habitat based on the ecological function scores into six classes, under two main categories: Riparian/wildlife and Upland wildlife. Each class covers a geographically discrete portion of the inventory, and may include riparian and/or wildlife functions and also may be a Habitat of Concern. Class I Riparian/wildlife and Class A Upland wildlife are the highest value habitat. Metro Council endorsed combining the inventories for the ESEE analysis in Resolution No. 02-3218A. The September 2004 update of the fish and wildlife habitat inventory by habitat class and development status provides the most current acreage information on the habitat inventory (Exhibit F, Attachment 5).

As Metro began its work on the ESEE analysis, several local governments and special districts in the Tualatin Basin approached Metro with a proposal to conduct their own separate ESEE analysis and develop their own habitat protection program using Metro's habitat inventory. In January 2002 Metro entered into an intergovernmental agreement ("IGA") with these local governments and special districts in the Tualatin Basin setting forth a cooperative planning process to address regional fish and wildlife habitat within the basin. The IGA provided that the Tualatin Basin partners would submit their program and analysis to Metro for review and, if it met standards for habitat protection described in the IGA, then Metro would include it as part of the regional habitat protection program. Approximately 16,650 acres of Metro's habitat inventory are located within the jurisdiction of the local governments participating in the Tualatin Basin partnership and within the Metro boundary. Thus, as Metro began its ESEE analysis, the Tualatin Basin partners began their own analysis on a separate track, but closely coordinated with Metro's work.

Metro conducted the ESEE analysis in two phases. The first phase was to evaluate the ESEE consequences at a regional level. This work was completed and endorsed by the Metro Council in October 2003 (Resolution No. 03-3376B). The resolution directed staff to evaluate six regulatory program options and non-regulatory tools for fish and wildlife habitat protection in Phase II of the ESEE analysis.

The Phase II ESEE analysis, endorsed by Metro Resolution No. 04-3440A in May 2004, evaluated the ESEE consequences of possible protection and restoration options that included a mix of regulatory and non-regulatory components. Five potential regulatory treatments were applied in each of the six regulatory options, ranging from allowing conflicting uses to prohibiting conflicting uses in habitat and impact areas. The consequences identified the effects on key ESEE issues identified in the Phase I analysis, including:

- Economic implications of urban development and ecosystem values;
- Environmental effects including ecological function loss, fragmentation and connectivity;

- Social values ranging from property owner concerns about limitations on development to concerns about loss of aesthetic and cultural values; and
- Energy trade-offs such as temperature moderating effects of tree canopy and potential fuel use associated with different urban forms.

In addition, the analysis considered how well the six regulatory options would assist in meeting the requirements of the federal Endangered Species Act and the Clean Water Act. Phases I and II of the ESEE Analysis are as attachments to Exhibit F of this ordinance.

The third and final step of the Goal 5 review process is to develop a program that implements the habitat protection plan by ordinance through Metro's Urban Growth Management Functional Plan (UGMFP or Functional Plan) and Regional Framework Plan policies. After acknowledgment by the State Land Conservation and Development Commission, cities and counties within the Metro jurisdiction will be required to amend their comprehensive plans to be in compliance with the regional habitat protection program.

To develop a program that includes the development standards proposed in this ordinance, Metro reviewed local plans that protect fish and wildlife habitat, researched innovative habitat protection approaches in the Pacific Northwest and throughout the country, and consulted with local practitioners. This research, contained in the *Habitat Protection Tools Summary* (Attachment 3), informed the proposed development standards in the Functional Plan and the Model Ordinance.

Based on the Metro Council's review and consideration of the ESEE analysis and public comment, the Council further informed the direction of the habitat protection program. In August 2004, Council clarified that the regulatory program would not restrict currently allowed uses of residential properties in Resolution No. 04-3489A. In December 2004, the Metro Council approved Resolution No. 04-3506A, which directed staff to develop a fish and wildlife habitat protection program to reflect the following principles:

- Focus the regulatory element of the program on the most valuable Class I and II Riparian Habitat. This significantly reduced the area subject to new regulations. Thirty-six percent of the Class I and II habitat is covered by Title 3 Water Quality Resource Area standards, 21 percent is covered by Title 3 Flood Management Area balanced cut and fill requirements;
- Develop a strong voluntary, incentive-based approach to protect and restore regionally significant habitat, including Class III Riparian, and Class A and B upland habitat (described in *Nature in Neighborhoods Initiative*, Resolution No. 05-3574); and
- Apply regulations to limit development in Class III Riparian, and Class A and B upland habitat in future urban growth boundary expansion areas.

The Tualatin Basin partners completed their ESEE analysis and approved a program proposal on April 4, 2005, and forwarded it to the Metro Council for consideration (Resolution No. 05-3577). If approved by the Metro Council, the Tualatin Basin's final program will be incorporated into this ordinance. About 9,600 acres of Class I and II Riparian habitat on Metro's inventory are located within the Tualatin Basin partner jurisdictions and within the Metro boundary.

Current Action
Based on substantial committee review and outreach to stakeholders, Ordinance No. 05-1077 presents the staff recommendation for public comment and Metro Council consideration on an important component of the Nature in Neighborhoods program, the development standards for Class I and II riparian fish and wildlife habitat within the urban growth boundary, with the inclusion of additional protection for Class A and B upland habitats in future urban growth boundary expansion areas. These recommendations and the key issues for Council consideration are highlighted below.

REVIEW PROCESS

Public comment
The development standards in the proposed new Title 13 of the Urban Growth Management Functional Plan, Model Ordinance, and amendments to the Regional Framework Plan policies are being proposed for public review. It is intended that the public will review this proposal in late April and May, with more opportunity for public comment in late summer/early fall 2005 prior to final consideration by the Metro Council. A summary of public comments will be provided prior to final Council consideration.

Staff has met with numerous stakeholder groups on an on-demand basis throughout the program development phase.

Policy Review
The Metro Policy Advisory Committee reviewed the items proposed in this ordinance at several meetings. MPAC comments on larger policy issues have been incorporated into the proposal. Additionally, staff met with city and county councils upon request to provide further information on the proposal as it was developed.

The Water Resources Policy Advisory Committee (WRPAC) reviewed the development standards proposed in Title 13. Policy comments to date have been conveyed to the Metro Council and have been incorporated into the current proposal.

Technical Review
Several committees reviewed Metro's proposed amendments to the Functional Plan, and many of their comments and suggestions have been included in the proposal.

- The Fish and Wildlife Habitat Program Implementation Work Group was charged with providing advice to staff on the workability of proposed requirements to be included in the Functional Plan or a Model Ordinance. Members included developers, property owners, and local government planners who shared experiences and tools with staff as the program was developed.
- The Metro Technical Advisory Committee reviewed the Functional Plan and Model Ordinance.
- The Goal 5 Technical Advisory Committee reviewed the Functional Plan.

1. RECOMMENDATION ON DEVELOPMENT STANDARDS FOR CLASS I AND II RIPARIAN HABITAT AND CLASS A AND B UPLAND HABITAT IN NEW URBAN AREAS

Resolution No. 04-3506A, adopted by the Metro Council, supports developing flexible development standards that will protect streamside habitat (Class I and II Riparian) within the urban growth boundary and within the current Metro jurisdictional boundary, as well as upland habitat (Class A and B) in future urban growth boundary expansion areas. Of the 80,000 acres in Metro's regionally significant habitat inventory, about 44,000 are in Class I and II riparian habitats that are designated as Habitat Conservation Areas. Streamside habitat areas have the highest functional values in Metro's habitat inventory. Key facts about the streamside habitat areas include:

- ***Much of the area is covered by some standards.*** 36% of Class I and II is covered by Title 3 WQRA (subject to avoid-minimize-mitigate standard), an additional 21% is covered by FMA balanced cut and fill standard, for a total 57% covered by existing regional standards.
- ***Impact on vacant unconstrained land.*** 8,460 acres of vacant unconstrained land, most of which is located in the unincorporated portions of Clackamas, Multnomah and Washington counties and the City of Portland.
- ***Much of the Class I and II habitats are in parks.*** 35% of Class I and II habitat is in park use.

Expectations for urban-style development are different in areas that are brought inside the urban growth boundary in the future. Resolution No. 04-3506A supports protecting more types of habitat in these areas where it is easier to plan for a system of natural habitats integrated with the built environment. The proposed amendments to the Functional Plan and Framework Plan will guide how to plan for growth in new urban areas to account for the most valuable streamside (Class I and II) and upland (Class A and B) habitats.

The development standards included in proposed Title 13 of the Functional Plan would require changes in the way development occurs within Habitat Conservation Areas (HCAs) to ensure that impacts on fish and wildlife habitat are minimized while allowing urban-style development to occur. As proposed, Title 13 includes the following elements:

- Expansion of the water quality protection approach currently in place to encompass all of the most valuable streamside habitats (Class I and II Riparian) identified in Metro's inventory. The approach includes a requirement to first try to avoid habitat, then to minimize development impacts, and last to mitigate for lost habitat function. Metro includes a clear and objective approach (in the Model Ordinance – Exhibit E) and discretionary approach (in Model Ordinance – Exhibit E, and Functional Plan – Exhibit C), consistent with the Goal 5 rule.
- Under Title 3, certain geographic areas were exempted from the requirements to establish Water Quality Resource Areas and Flood Management Areas. These areas include portions of lower Willamette River (Portland Harbor), portions of the Rivergate industrial area in the Columbia Corridor, downtown Beaverton and Tualatin, and other areas determined to support water-dependent industrial uses. The Title 3 exemptions were given for a variety of reasons, a central one being to account

for the economic issues on these sites. Title 3 was carried out for flood management and water quality protection, and did not address fish and wildlife habitat protection. Additionally, Title 3 did not include an examination of the ESEE tradeoffs for fish and wildlife habitat. Substantial consideration to the economic concerns and unique role marine terminals play was included in Metro's ESEE analysis for this program. Therefore, the Title 3 exemptions have not been carried forward in Title 13.

- Habitat-friendly development practices such as clustering, density relaxation, and on-site stormwater management would be required where technically feasible in Habitat Conservation Areas.
- Development standards for Class A and B Upland Habitat in addition to streamside habitats in urban growth boundary expansion areas.
- Several options for city and county compliance, providing flexibility, but also development of a ready-to-implement Model Ordinance. Many cities could use or expand on existing programs to meet regional standards.
- Monitoring and reporting on regional progress.

Each section of Title 13 is described briefly below.

Section 1. Intent.

This section describes that the purpose of the program is two-fold, to achieve the goals described in the Vision Statement and to maintain and improve water quality. It states that the program will include an integrated approach combining voluntary, incentive-based and regulatory tools.

Section 2. Inventory and Habitat Conservation Areas.

This section describes the maps that form the basis of Metro's fish and wildlife habitat protection program. The maps include the inventory map and the Habitat Conservation Area (HCA) map. The HCA map identifies the areas subject to regulatory protection.

A limited few properties that would otherwise have been mapped as HCAs do not appear on the map, as they have been identified as so unique that their economic importance outweighed their fish and wildlife habitat values. Four properties are listed (International Terminal and Port of Portland Marine Terminals 4, 5 and 6), and the following criteria are included for the identification of other, similarly situated sites:

- Property is developed for use as an international marine terminal capable of mooring ocean-going ships, and
- The property is without substantial vegetative cover.

This section also provides that, for properties outside the Metro urban growth boundary but inside the Metro jurisdictional boundary, agricultural and forest activities may continue without new restrictions.

Section 3. Implementation Alternatives for Cities and Counties.

Consistent with Metro's goal of providing regional consistency and local opportunity for flexibility when implementing regional policies, Title 13 as proposed includes several options for a city or county to comply. Compliance with regional habitat protection requirements will also satisfy state requirements, reducing duplicative efforts. A Model Ordinance is included that serves as one example of how cities and counties could comply with the Functional Plan. Options for compliance include:

- Adopt Metro's Model Code and habitat maps;
- Describe how an existing plan substantially complies with the provisions of the Functional Plan;
- Develop an innovative combination of regulatory and incentive-based programs that meet the habitat protection and restoration objectives; or
- Conduct a special planning process for an area (district) that comprises unique circumstances or challenges for a portion of a city or county (and apply one of the approaches in the previous three items across the rest of the city or county).

Metro's Intergovernmental Agreement with the cities, counties and special districts in the Tualatin Basin is recognized in this section. The Tualatin Basin Partners include Washington County, the cities of Beaverton, Cornelius, Durham, Forest Grove, Hillsboro, King City, Sherwood, Tigard, and Tualatin, as well as Clean Water Services and the Tualatin Hills Parks and Recreation Department. Cities and counties who have partaken in this agreement must amend their comprehensive plans and implementing ordinances to be in compliance with the provisions of the Tualatin Basin approach, which is under consideration by the Metro Council (Resolution No. 05-3577).

This section also includes additional items cities and counties must comply with, including:

- Providing a clear and objective standard as well as a discretionary option for property owners, consistent with the Goal 5 rule.
- Removing barriers in comprehensive plans and implementing ordinances to habitat-friendly development practices in all regionally significant fish and wildlife habitat areas.
- Including a reasonable, timely, and fair process for property owners to verify the location of habitat.
- Provisions to allow for the reduction of density requirements to protect all regionally fish and wildlife significant habitat.

Section 4. Performance Standards and Best Management Practices for Habitat Conservation Areas.

This section describes the performance standards and best management practices that allow development to occur in Habitat Conservation Areas while protecting habitat. Several general standards include:

- Title 3 Water Quality Resource Areas and Flood Management Areas standards still apply.
- Any activity on a property with a single-family home constructed prior to the effective date of the ordinance that would not have required a building, grading, or tree removal permit would be exempt from these standards. If a permit were required the standards would apply.
- Habitat-friendly development practices are required where technically feasible and appropriate to reduce the impacts on the habitat and water quality.

- Publicly-owned parks and open spaces that have been designated as natural areas must be provided with extra protection and special management practices to maintain habitat functions and values.
- Planting of native vegetation is encouraged, planting of invasive non-native species is prohibited, and removal of invasive non-native species is allowed.
- Routine repair, maintenance and replacement of existing structures, roads, utilities and other development are allowed, consistent with other applicable rules.
- Intensification of uses and/or upzoning on sites with HCAs is conditioned upon the restoration of habitat on the site.
- *Federal Aviation Administration Wildlife Hazard Management Plan.* Any activity that is undertaken on Port of Portland property within 10,000 feet of an Aircraft Operating Area that is necessary to comply with the Wildlife Hazard Management Plan is exempt from the requirements to avoid if practicable and to minimize intrusion into a Habitat Conservation Area. Any such intrusion must be mitigated, and the mitigation may occur off-site anywhere within the Metro region.
- *Multnomah County Drainage District No. 1, Peninsula Drainage Districts 1 & 2, and the area managed by the Sandy Drainage Improvement Company.* All of the activities undertaken to manage these flood areas are exempt from the development standards, subject to other applicable laws and the requirement to maintain native vegetation where practicable.

City and county comprehensive plans and implementing ordinances must contain development review standards that include a clear and objective approach and a discretionary approach. Metro has provided an example of a clear and objective approach in the Title 13 Model Ordinance (Exhibit E). The discretionary approval standards include a requirement for all development to first avoid the Habitat Conservation Areas, if practicable, then to minimize intrusion into them, and finally to mitigate to restore the habitat functions and values that were impacted. When implementing the avoid, minimize, and mitigate standard cities and counties are directed to consider the level of Habitat Conservation Area (high, medium, or low) to determine the "practicability" of avoiding habitat and the level of mitigation required. High Habitat Conservation Areas have high habitat value and medium or low urban development value, while Low Habitat Conservation Areas have lower-valued habitat and higher urban development value.

This section also describes the requirements to administer the Habitat Conservation Areas Map and provides a method for site-level verification of the habitat. The city or county is responsible for administering the Habitat Conservation Areas map, or a map that has been deemed by Metro to be in substantial compliance. A process for site-level verification must be included that is consistent with general requirements described in Title 13. The process described includes:

- Locating the habitat boundaries based on site-specific information and Metro's maps.
- Determining the urban development value. There are two ways for the urban development value to change: 1) a change in the 2040 design type designation and 2) the property is owned by a regionally significant educational or medical facility.
- Cross-referencing the habitat class with the urban development value to determine the location of the high, moderate and low Habitat Conservation Areas on a property.

Section 5. Program Objectives, Monitoring, and Reporting.
As part of the Nature in Neighborhoods Initiative, Metro will lead the monitoring of the region's progress towards regional habitat objectives and also coordinate data collection throughout the region. As part of the monitoring and reporting element, Metro will track progress in habitat acquisition and restoration efforts and will continue to map the streams, wetlands, floodplains, vegetation and habitats of concern to monitor habitat quality and quantity by watershed. By coordinating with other agencies and jurisdictions that track stream and upland health Metro will present a regional scorecard of progress in achieving performance objectives. Keeping track of regional progress towards the objectives and targets for habitat protection and restoration will enable policy makers to evaluate the effectiveness of the Nature in Neighborhoods Program and consider altering course if necessary. This section describes the responsibilities of Metro, cities, counties, and special districts in regional data coordination and inventory maintenance, monitoring, reporting, and program evaluation.

Four performance objectives are established to measure the quantity and quality of the region's fish and wildlife habitat. Aspirational targets are included for a ten-year timeframe that are based on existing conditions, a successful protection and restoration commitment, and public ownership patterns. Two implementation objectives are included that help describe the actions to look for as the region moves towards achieving the habitat performance objectives. These include efforts made to increase and allow habitat-friendly development practices and increase restoration and mitigation efforts.

2. POLICY ISSUES

Since January, staff has been soliciting comments on draft versions of proposed Title 13 Functional Plan amendments from the Metro Council, Program Working Group, MTAC, MPAC, Goal 5/WRPAC, private business representatives, non-profit groups, and city and county commissioners throughout the region. These discussions helped to refine the proposal from a technical and policy perspective. Below is a summary of the main policy issues, including potential choices and the direction taken in the proposed Title 13.

A. Measure 37

Voters passed Ballot Measure 37 in November 2004, which required governments to either provide compensation or waive regulations that reduced the fair market value (FMV) of properties. The measure includes exemptions for regulations intended to address public health and safety concerns and that are required to meet federal laws, such as the Clean Water Act and the Endangered Species Act. In response to M37's passage, Council directed staff in their December 2004 resolution (No. 03-3506A) to ensure that the habitat protection program did not result in reductions in FMV of properties unless it provided a source of funds for compensation.

Alternatives staff considered for addressing M37 were:

- Include an explicit statement that the program goal would be to increase fair market value of each property affected (by using flexible development approaches such as clustered development; reducing density requirements, etc.)
- Provide a procedure to allow a property owner to obtain a variance if the rules resulted in a loss in FMV of a property; process is a land use decision (i.e. appeals to

LUBA—bringing these claims “within” the land use system, unlike M37 claims); only minimum variance necessary may be granted; includes waiver of future M37 claims based on functional plan; one incentive for property owners to use the variance procedure is that the variance could be transferred to future property owner (unlike M37 waiver).

Some of the main reasons for not recommending this approach include:

- The intent to increase fair market value went beyond Measure 37’s requirements to compensate for losses in fair market values;
- Forcing jurisdictions to establish a separate variance procedure parallel to the Measure 37 procedure and separate from the jurisdictions’ other variance procedures would be unnecessarily duplicative, and having the variance process “within” the land use decision arena (i.e. decisions can be appealed to LUBA, unlike Measure 37 decisions) could result in confusing and inequitable results for property owners;
- Early drafts of Title 13 would institutionalize Measure 37 and did not take into account the possibility that the measure could be amended in the future; and
- The approach did not seek to take advantage of any of the exceptions provided in Measure 37, such as an argument that these new rules are necessary to implement the soon to be finalized TMDL rule issued pursuant to the federal Clean Water Act.

Staff has addressed the issue of whether this ordinance will create additional M37 claims by including provisions that give local governments discretion to implement the program in a way that will not result in the reduction in fair market value of any property.

It is also important to note that the flexible development standards in the functional plan will not prevent development on any property, but will simply require a change in the way development occurs within Habitat Conservation Areas. In some cases, a requirement for cities and counties to remove barriers to habitat-friendly development practices may, in fact, increase property values by allowing more innovation and a potential reduction in storm water impact fees.

B. Appropriate level of regional requirements

Title 13 establishes a set of development standards to provide regional consistency for conserving habitat in Class I and II Riparian areas. The primary issue that has been raised is whether the avoid-minimize-mitigate standard (required in Title 3 Water Quality Resource Areas, which covers about 36% of the HCAs) should be applied to development in High, Moderate, and Low Habitat Conservation Areas.

Council’s December 2004 Resolution (No. 04-3506A) directed staff to vary the level of protection in accordance with the ESEE analysis. Accordingly, staff considered applying avoid-minimize-mitigate to High HCAs, minimize and mitigate to Moderate HCAs, and only mitigate in Low HCAs. The different levels of protection carried out the intent of the ESEE decision to apply less restrictive standards in 2040 mixed-use areas and regionally significant industrial areas.

However, further discussion among a number of review groups led to reconsideration of the application of the avoid-minimize-mitigate standard. The avoid test as defined in Title 3 includes a “practicability” requirement. The definition of practicable includes an economic test, in effect accounting for the need to apply different levels of protection to High, Moderate, and Low HCAs. Generally, the economic practicability of protecting more habitat in a Low HCA with high urban development value would be greater, resulting in less protection.

Therefore, the proposed development standards in Title 13 apply the avoid-minimize-mitigate standard to all three types of HCA. When implementing the “avoid if practicable” test and mitigate requirements, cities and counties are directed to consider the type of HCA. For example, High Habitat Conservation Areas have been designated as such because they have lower urban development value and the highest value habitat, while Low Habitat Conservation Areas have higher urban development value and lower-valued habitat. In addition, this ordinance would refine the definition of “practicable” for purposes of Title 13 requirements to include a provision that any requirement that would result in a decrease in the fair market value of a property would not be considered practicable. This is how the program is designed to avoid the creation of new M37 claims.

The application of avoid-minimize-mitigate requires discretion. The Goal 5 rule requires a city or county to include a clear and objective approach in its land use ordinances, and the option of adopting a discretionary approach. The proposed ordinance would pass this requirement through to the cities and counties upon implementation, providing the Title 13 Model Ordinance as an option to meet the Goal 5 rule requirements.

C. Habitat-friendly development practices

Using habitat-friendly development practices, or low impact development (LID), can help a community better protect its streams, fish and wildlife habitat, wetlands, and drinking water supplies as it grows. Several cities in the region are already encouraging the use of these practices, and some developers are making a point of reducing the impacts of the built environment by meeting environmental standards.

The use of these habitat-friendly practices can serve to increase the value of developments both at the outset and over time. Studies have shown that residential and commercial uses near open space and water features are more valuable and desirable. Additionally, innovative storm water management practices that use natural processes to retain and detain storm water runoff on-site may be less expensive to construct and maintain.

The difficulties in using these habitat friendly practices today range from concerns about capital and maintenance cost, barriers in local codes that make the practices difficult to apply, and lack of up to date familiarity or knowledge on the part of all parties involved on how to apply the quickly evolving technologies. The advantages of using these practices are their benefits to water quality and channel conditions as well as opportunities to retain green infrastructure on the site.

Title 13 would require revision of city and county codes to require the use of these practices in Habitat Conservation Areas. Since there is not a set menu of practices that can be consistently required, the requirements would apply only when technically feasible and appropriate. Cities and counties would also be required to remove barriers to these practices in all other regionally significant habitat areas. Alternatives considered included requiring cities and counties to remove barriers in all areas and not requiring habitat-friendly development practices in Habitat Conservation Areas.

D. New UGB expansion areas

Council direction in the December 2004 resolution (No. 04-3506A) was to extend the regulatory requirements that would apply inside the urban growth boundary (UGB) to Class I and II Riparian Habitat to Class III Riparian, Class A and B Upland Habitat in future UGB expansion areas.

The proposed Title 13 requirements, and associated amendments to other Functional Plan, Framework Plan, and Metro Code amendments related to new urban area planning, would extend regulatory protection to the four highest value habitat classes, Class I and II Riparian and Class A and B Upland Habitat. Class III Riparian encompasses areas providing two habitat functions. First, developed floodplains are included that are providing the water storage function. Second, forest canopy within 780 feet of a stream is included that is providing microclimate to reduce stream temperatures. The large search area for the microclimate habitat function is important when considering ecological values for the habitat inventory, but the arbitrary cutoff at 780 feet results in slivers of forest patches falling within the riparian inventory. Staff has concluded that developing map verification and program elements for these slivers of habitat would be too burdensome and costly for local governments and citizens as compared with the benefits of protecting such habitat. For this reason staff has recommended not including Class III habitat in the HCAs for new urban areas.

The same avoid-minimize-mitigate standard developed for riparian areas inside the current UGB would be applied to upland areas in new urban areas. However, new urban areas also offer opportunities to avoid the habitat in the initial concept planning in ways not possible inside the UGB. Several tools may be more useful in new urban areas prior to upzoning, such as transfer of development rights to address equity concerns of “windfalls and wipeouts.” This is addressed by including the following policy statements in the Regional Framework Plan Chapter 1 and Titles 10 and 11 of the Functional Plan:

- Explicitly stating the intent to protect habitat and limit development in new urban areas;
- Metro will assume lower housing and employment capacity and capture rates for habitat areas when calculating the size of future UGB expansions; and
- Future UGB expansions will be conditioned in such a way to ensure that habitat areas are protected without giving rise to Measure 37 claims.

E. Residential densities

Metro Council has indicated, in multiple Resolutions, its intent to reduce density targets for residential capacity if necessary to protect natural resources. Title 8 allows a process for a city or county to apply to Metro, in March of each year, for approval of a density requirement reduction to support protection of natural resource areas. To date, no local jurisdiction has made a request under these provisions.

Title 13 proposes a process that would not require further approval by Metro. Approval would occur automatically if the decision was documented as necessary to protect regionally significant habitat from development and offered permanent protection of the habitat. The loss of housing units would be taken into consideration when sizing the next UGB expansion. Cities and counties are encouraged to consider transferring development rights to minimize the effect on land supply.

This ability to reduce density would apply only to areas on Metro's Habitat Inventory Map and to local Goal 5 inventories if they were on a map prior to the adoption of Metro's program. This would apply to all habitat areas, both upland and riparian.

The reduction in residential density offers the ability to build larger lots at a lower density than currently allowed within the UGB. Minimum density requirements would be calculated after subtracting out the regionally significant habitat that would be protected. There are about 11,730 acres of vacant unconstrained residential regionally significant habitat (including all habitat classes) land inside the UGB to which this density relaxation could apply. This density reduction would not apply to land brought in the UGB after January 2002, such as the area that is now the City of Damascus, since these areas have not yet been upzoned and there are more opportunities to plan around the habitat.

F. Restoration requirements upon redevelopment

Past development practices have had a significant detrimental impact on fish and wildlife habitat and water quality in this region, adversely affecting the habitat of several fish and wildlife species listed as threatened or endangered. While existing development is not affected by the development standards described in Title 13, over time many of the properties near and next to streams and wetlands may be redeveloped. Upon redevelopment, some mitigation can be conducted to help restore habitat functions and values. For example, the intensive redevelopment that is underway in the South Waterfront area of Portland is including habitat restoration and improvement, and the redevelopment will likely result in significantly increased property values in that area.

The developed areas in which restoration opportunities may exist include both areas that have been mapped as Class I and II riparian habitat, as well as some areas identified as Class III riparian habitat and riparian impact areas. This includes:

- Developed areas that have been mapped as Class I and II resources, such as fully developed areas near streams and underneath tree canopy and all areas within 50 feet of streams (with or without vegetation);
- Developed floodplains (3,460 acres), which are included within Class III riparian areas; and
- Riparian impact areas—those areas within 150 ft. of the stream that would have qualified as riparian habitat but for the fact that they are developed.

The proposed functional plan addresses only those areas that are identified as Habitat Conservation Areas through regulations, leaving cities and counties the option of working with developers in Class III and Riparian Impact Areas to restore habitat function to those areas upon redevelopment. In Habitat Conservation Areas, the following standards are described for redevelopment:

- All redevelopment would be allowed provided that it does not encroach further into undeveloped habitat areas or closer to the relevant water feature. If it would encroach into such areas, then the program's general development rules would apply (e.g. avoid-minimize-mitigate standard). Title 3 currently applies the avoid-minimize-mitigate standard to redevelopment within the WQRA (typically within 50 feet of streams).
- Mitigation would be required upon redevelopment that required upzoning or significantly increased the intensity of the development on a site. For example, if a site had heavy industrial use and was redeveloped as mixed-use residential it would require mitigation to reflect the new, additional impacts that the new development would have on the habitat areas.

G. Similarly situated sites to receive an "allow" decision

Council, in Resolution No. 04-3440A, adopted May 20, 2004, determined that the economic importance of the International Terminal Site on the Willamette Harbor outweighed the identified habitat values and directed staff to identify any other "similarly situated" sites that would be subject to an "allow" decision in the ESEE analysis. The "allow" decision means no further requirements under Metro's Goal 5 program. Since then, staff has worked with several stakeholder groups to identify other sites that might qualify as similarly situated.

Title 13 addresses these unique facilities and the sites where they are located by allowing all conflicting uses, unless a change of zoning occurs (i.e., heavy industrial to mixed-use residential). The functional plan names four sites by name (the International Terminal site, and Port of Portland Marine Terminals 4, 5 and 6) and includes criteria to identify future sites that are similarly situated. The criteria state that a site must be in use as an international marine terminal and must be substantially without vegetative cover.

H. Adjustment in Urban Development Value for Regionally Significant Educational and Medical Facilities

The economic model Metro used to determine urban development value underwent significant peer review, and was developed with the guidance of an Economic Technical Advisory Committee. The model incorporated potential job density, land value (except for residential land), and 2040 design types to determine the urban development value of land within the UGB. Generally, the model worked well, but it did not account for certain unique circumstances. Regionally significant educational and medical facilities typically locate in residential areas to better serve their users. This frequently results in their location in a low-priority 2040 design type, inner and outer neighborhoods, potentially undervaluing the economic importance of these facilities. In May 2004, Council directed staff (Resolution No. 04-3440A) to develop a proposal to consider the urban development value of regionally significant major institutions.

One of the major reasons for this adjustment process was the inclusion of upland habitats in the proposed regulatory treatments under Council Resolutions Nos. 03-3376B and 04-3440. Some medical and educational facilities may have Class A and B upland habitat areas on their campuses that are also identified as future facility expansion areas. Since the Council is applying a regulatory approach for Class I and II riparian areas only, and not upland habitat areas, this lowers the degree of conflict between habitat protection and facility expansion plans.

Title 13 includes the following approach to recognize the economic importance of regionally significant educational and medical facilities:

- Identifies by name ten existing regionally significant educational and medical facilities that have Class I and II Habitat on their properties.
- Adjusts the urban development value for these facilities to high, resulting in either moderate or low Habitat Conservation Areas depending on the habitat value.
- Describes criteria to identify future regionally significant educational and medical facilities to be determined by the Metro Council (not at the city or county level).

I. Program objectives, monitoring and reporting

Resolution No. 04-3506A, adopted by the Metro Council on December 9, 2004, directed staff to develop regional outcome measures to evaluate the region's progress toward meeting the vision of conserving, protecting, and restoring fish and wildlife habitat in the region. The resolution also called for an annual assessment of progress including, but not limited to, an evaluation of the habitat inventory. Title 13 proposes to assess progress every two years, since more frequent reporting is unlikely to detect measurable changes, and to tie it to Metro's overall Performance Measures Report.

As part of the monitoring and reporting element, the functional plan proposes to track progress in habitat acquisition and restoration efforts and changes in streams, wetlands, floodplains, vegetation and habitats of concern to monitor habitat quality and quantity by watershed. This will require substantial coordination with cities, counties, agencies, and special districts, which are required to update Metro with new data when it is available. Keeping track of regional progress towards the objectives and targets for habitat protection and restoration will enable policy makers to evaluate the effectiveness of the Nature in Neighborhoods initiative and consider altering course if necessary.

Title 13 includes four performance objectives to measure the quantity and quality of the region's fish and wildlife habitat. The aspirational targets for each of the performance objectives are included as part of the monitoring section, and are not tied to any city or county compliance alternative. These targets, 2004 baseline, considerations that played a role in determining the targets, and a numeric description of what it would require to meet the target within a ten-year period is included in Table 1 below.

Table 1. Targets, 2004 Baseline, and Considerations in setting targets.

<table>
<tr><th>Targets</th><th>2004 Baseline and Targeted Condition</th><th>Considerations in setting the target</th></tr>
<tr><td rowspan="2">1a. <u>10% increase in forest and other vegetated acres within 50 feet</u> of streams (on each side) and wetlands in each subwatershed over the next 10 years (2015).</td><td>1a. 2004 Baseline Condition (regional data):
• 64% vegetated
• 14,000 vegetated acres</td><td rowspan="2">• Most local and regional riparian regulatory programs are focused within the first 50 feet of streams and wetlands.
• Mitigation, enhancement and restoration projects typically occur in this area.
• A higher target for increasing vegetation cover within 50 feet of streams and wetlands will help achieve DEQ established Total Maximum Daily loads for stream temperature.
• As redevelopment occurs, habitat within 50 of streams and wetlands can be restored.</td></tr>
<tr><td>10% increase:
• 70% vegetated
• 1,400 acre increase in vegetation over 10 years</td></tr>
<tr><td rowspan="2">1b. <u>5% increase in forest and other vegetated acres within 50 to 150 feet of streams</u> (on each side) and wetlands in each subwatershed over the next 10 years (2015).</td><td>1b. 2004 Baseline Condition (regional data):
• 59% vegetated
• 15,250 vegetated acres</td><td rowspan="2">• Some local regulatory programs protect land between 50 and 150 of streams and wetlands, especially in steep slope areas.
• The 150-foot distance includes the outer distance of all primary (most important) ecological functions for riparian areas (with the exception of large undeveloped floodplains).
• Reducing regional residential capacity requirements can help to preserve habitat within 150 feet of streams inside the 2002 UGB.
• As redevelopment occurs, habitat within 150 of streams and wetlands can be restored</td></tr>
<tr><td>5% increase:
• 62% vegetated
• 760 acre increase in vegetation over 10 years</td></tr>
<tr><td rowspan="2">1c. <u>No more than 20% increase in developed floodplain acreage</u> in each subwatershed over the next 10 years (2015).</td><td>1c. 2004 Baseline Condition (regional data):
• 10% of all floodplain acres are developed
• 3,450 acres of developed floodplains</td><td rowspan="2">• Applying the “avoid, minimize, and mitigate” tests to undeveloped floodplains would increase protection levels compared to existing Title 3 “cut and fill” requirements.
• Loss of undeveloped floodplains in industrial and mixed-use areas is expected to continue to occur but at reduced amounts compared to current trends.</td></tr>
<tr><td>20% increase:
• 4,200 acres of developed floodplains</td></tr>
<tr><td rowspan="2">2a. <u>Preserve 75% of vacant Class A and B</u> upland wildlife habitat in each subwatershed over the next 10 years (2015).</td><td>2a. 2004 Baseline Condition:
• 15,500 acres of vacant Class A and B upland</td><td rowspan="4">• Vacant Class A and B upland wildlife habitat within the UGB is most vulnerable to loss over time compared to other upland wildlife habitat located in developed areas or in parks.
• Regional development standards focused on Riparian Class I and II habitats will place development pressure on upland habitats.
• Acquisition programs and habitat friendly development practices can help preserve some upland wildlife habitat.
• Reforestation programs can help restore upland wildlife habitat.
• Reducing regional residential capacity requirements can help preserve upland habitat.
• New urban area planning (e.g., Damascus area) offers opportunities to better protect upland habitat.
• Council’s decision to protect Class A and B habitats in future UGB annexations will increase retention of upland habitats.</td></tr>
<tr><td>75% retention:
• 11,600 acres of vacant Class A and B upland remaining</td></tr>
<tr><td rowspan="2">2b. Of the upland habitat preserved, <u>retain 80% of the number of patches 30 acres or larger</u> in each subwatershed over the next 10 years (2015).</td><td>2b. 2004 Baseline Condition:
• 23,400 acres of upland habitat in 133 patches that contain 30 acres or more of upland wildlife habitat</td></tr>
<tr><td>80% retention:
• 106 upland habitat patches that contain 30 acres or more of upland habitat</td></tr>
</table>

3a. *Preserve 90% of forested wildlife habitat acres located within 300 feet of surface streams* in each subwatershed over the next 10 years (2015).	**3a. 2004 Baseline Condition:** • 28,300 acres within 1,453 patches of forested wildlife habitat located within 300 feet of surface streams	• Vacant upland wildlife habitat is vulnerable to loss, and connectivity between riparian corridors and adjacent upland wildlife habitat can be expected to decline, especially within the 2002 UGB. • Non-forested wildlife habitat within 300 feet of surface streams is more vulnerable to loss compared to forested habitat. • Forested wildlife habitat located within parks and developed residential areas is more stable and will support higher connectivity for wildlife between riparian corridors and upland wildlife habitat. • Acquisition and habitat friendly development practices (cluster development, on and off site density transfers) can help slow the loss of habitat connectivity. • Reducing regional residential capacity requirements can help preserve connectivity between riparian corridors and upland wildlife habitat.
	90% retention: • 25,500 acres of forested wildlife habitat located within 300 feet of surface streams	
3b. *Preserve 80% of non-forested wildlife habitat acres located within 300 feet of surface streams* in each subwatershed over the next 10 years (2015).	**3b. 2004 Baseline Condition:** • 14,400 acres within 1,633 patches of non-forested wildlife habitat located within 300 feet of surface streams	
	80% retention: • 11,500 acres of non-forested wildlife habitat located within 300 feet of surface streams	
4a. *Preserve 95% of habitats of concern acres* in each subwatershed over the next 10 years (2015).	**4a. 2004 Baseline Condition:** • 33% of all habitat designated as HOCs • 26,700 total acres of HOCs	• Habitats of concern are located in Class I riparian areas and Class A upland wildlife habitat, a majority of which are located in parks, riverine islands and deltas, wetlands, floodplains, and riparian corridors. These areas are less vulnerable to loss due to development constraints and public park ownership. • Acquisition, habitat friendly development practices, and reducing regional residential capacity requirements can help slow the loss of Habitats of Concern.
	95% retention: • 25,400 total acres of HOCs	

Two implementation objectives are included that help describe the actions to look for as the region moves towards achieving the habitat performance objectives. These would measure how well cities and counties are allowing and encouraging habitat-friendly development practices and the number of mitigation and restoration projects conducted.

J. Tree protection and vegetative clearing

Tree canopy located in vacant Class I and II riparian habitat areas (19,230 acres including constrained and unconstrained) is vulnerable to loss outside the development review process. For example, a landowner could remove trees on a vacant parcel unless doing so required a tree removal permit from the city or county. Some cities and counties already have tree protection ordinances in place while others do not. Including language in the Functional Plan to protect trees would help address this situation. The tree protection would apply to forested land within Class A and B upland habitats coming into the UGB.

Policy options include:

- Establish mandatory tree protection requirements in the functional plan to address tree removal outside the development process;

- Rely on regional education efforts to increase awareness of the value of trees and to inform property owners about the new regulations in a way that reduces interest in cutting trees before applying for a development permit.
- Expand existing Title 3 approach to development, which is defined to include "removal of more than 10 percent of the vegetation on the lot," to Habitat Conservation Areas.

The proposed Title 13 extends the current Title 3 approach to vegetation removal and tree protection beyond the WQRA to include all HCAs. Removal of more than 10% of the vegetation within an HCA is considered development, and will thereby be subject to the requirements established pursuant to Title 13 (except for excepted activities as noted above, such as for currently developed residential properties).

3. TITLE 13 MODEL ORDINANCE

Metro's Title 13 Model Ordinance serves two purposes: as an example for cities and counties to guide substantial compliance and as an alternative for cities and counties to adopt and be in substantial compliance without further efforts. The model ordinance is written to be consistent with the Goal 5 rule, including a clear and objective standards approach and a discretionary review approach. The main components of the model ordinance are described below.

A. Section 3. Applicability and map administration

This section describes when the ordinance applies, upon development and redevelopment, and includes a site-specific habitat verification process. There are three basic approaches for verification:

1. Basic approach, property owner must use clear and objective development standards
    - Property owner believes map is accurate,
    - Lot lines do not match with HCA boundaries, or
    - Property was developed before Title 13 came into effect
2. Intermediate approach, property owner must use clear and objective development standards
    - HCA map is inaccurate due to incorrect location of a landscape feature
3. Detailed approach, required for all property owners using the discretionary review standards
    - Application must be completed by qualified professional
    - Detailed criteria must be completed

B. Section 4. Uses and activities that are exempt

This section carries forward the activities that were identified in Title 13 and adds to the list other items that can be exempted from further review in this ordinance. Emergency procedures, routine maintenance and repair, existing developed residential properties, replacement to structures within the existing building footprint, and minor expansions to structures are included. Other key exemptions include:

- Development on a site that will remain at least 100 feet away from the boundary of the HCA (i.e. sufficient distance to ensure habitat protection even if there were any mapping errors).

- Sites with a phased development plan, once they have followed the procedures for the initial permit and site plan, are exempt from further review so long as building sites and coverages remain consistent with the original permit.
- Removal of nuisance plants and planting of native plants.
- Restoration projects that are part of an approved plan.
- Low-impact outdoor recreation facilities outside of Title 3 WQRAs, so long as they contain less than 500 sq. ft. of new impervious surface.

C. Section 5. Uses Allowed Under Prescribed Conditions

In this section two specific areas are called out for special attention.

- The Port of Portland has developed a Wildlife Hazard Management Plan to minimize the wildlife hazards, primarily from birds, to jets arriving and departing from international airports in the region. Port of Portland activities required to comply with a Federal Aviation Administration wildlife hazard management plan are exempted from all standards except mitigation, and mitigation is allowed off-site anywhere within the region.
- Within Multnomah County Drainage District No. 1, Peninsula Drainage District No. 1, Peninsula Drainage District No. 2, and the area managed by the Sandy Drainage Improvement Company, activities required to maintain the managed floodplain are allowed so long as native vegetation is maintained or enhanced, further disturbance to the waterways is minimized, and all applicable laws are followed.

D. Section 7. Development Standards

This section describes the clear and objective development standards, if an applicant proposes development that complies with these standards then there is no additional process required. The intent of Title 13, which directs all development within Habitat Conservation Areas to follow the avoid-minimize-mitigate standard, is carried out in this section through incentives for avoiding habitat, disturbance area limitations for High and Moderate HCAs, and mitigation requirements for all development within an HCA.

Flexible development standards are a critical component of this section, providing incentives to avoid and minimize Habitat Conservation Areas. Flexible development standards include:

- *Building setback flexibility*, reducing or eliminating front, side, and back-yard setbacks to allow placement of the building site as far from the HCA as possible.
- *Flexible landscaping requirements* to allow these to be met by preserving the HCA in a natural condition, and allowing certain on-site stormwater management facilities in the HCA. This incentive may be particularly helpful for commercial and industrial developments.
- *Flexible site design, or clustering,* to allow smaller lot sizes and creative configurations to cluster development away from or to minimize disturbance within the HCA.
- *Density bonus for habitat protection,* specifically for multi-family zones.
- *Density reduction for habitat protection,* which allows all habitat that will be permanently protected to be subtracted from calculations to determine minimum density.

- *Transfer of development rights,* an optional provision to transfer density from sites with over 50% in an HCA to 2040 mixed-use areas.

When development does occur within the Habitat Conservation Area there are certain standards that apply.

- *Disturbance area limitations,* to minimize impact to High and Moderate HCAs. There is one calculation method for single-family and another for all other zones.
- *Construction standards* to protect habitat during site development.
- *Utility standards* to minimize disturbance of habitat for utility connections.
- *Subdivision standards* that require new subdivision plats to show a percentage of the High and Moderate HCA as a separate non-buildable tract.

All disturbance within the Habitat Conservation Area must be mitigated. The amount of mitigation is calculated based on the size and number of trees removed or the area disturbed, whichever results in more vegetation planting.

E. Section 8. Discretionary Review

The discretionary review approach closely follows the performance standards and best management practices described in Title 13. An applicant who cannot or chooses not to meet the clear and objective standards may use this approach for development on a site with a Habitat Conservation Area.

All applications for development using these standards must conduct an impact evaluation that includes identification of the ecological functional values on the site, an evaluation of alternative locations, designs, or methods of development to minimize negative impacts, and determination of the development alternative that best meets the approval criteria. The approval criteria include:

- *Avoid.* Applicant must first avoid intrusion into the HCA to the extent practicable. The economic considerations are greater in a Low HCA than in a High HCA. Again, any requirement that would result in a decrease in the fair market value of a property is considered not practicable.
- *Minimize.* All development must minimize, to the extent practicable, detrimental impacts to ecological functions.
- *Mitigate.* An applicant must mitigate for adverse impacts to the HCA. Mitigation must occur on-site to the extent possible, second within the subwatershed, and outside the subwatershed only when the purpose can be better provided elsewhere. Two mitigation options are included; both include requirements to use habitat-friendly development practices. Option 1 allows the applicant to choose from a menu of habitat-friendly development practices and use a set mitigation ratio. Option 2 allows the applicant to reduce the mitigation ratio by achieving a lower percentage of effective impervious area through habitat-friendly development practices.

The other sections of the model ordinance are standard to address:

- Section 1. Intent
- Section 2. Relationship to Water Quality Resource Area and Flood Management Area, Consistency with Other Regulations

- Section 5. Prohibitions – nuisance plants, unauthorized clearing or grading
- Section 9. Variances
- Section 10. Severability
- Section 11. Definitions

4. REGIONAL FRAMEWORK PLAN AMENDMENTS

Several of the policies identified by the Council to implement a fish and wildlife habitat protection program as part of the Nature in Neighborhoods Initiative would be implemented through amendments to the Regional Framework Plan. These amendments are described below.

A. Summary of Growth Concept

This section would be amended to more accurately describe the functional plan requirements related to fish and wildlife habitat.

B. Chapter 1 – Land Use

A new section would be added, 1.9.4 "Protection of Regionally Significant Fish and Wildlife Habitat," to describe the Council's policies to protect habitat in new urban growth boundary expansion areas. It includes direction to conduct an inventory and provides direction to limit future conflicts between habitat protection and urbanization.

C. Chapter 3

The Council is currently considering Resolution No. 05-3574 that would direct the regional fish and wildlife protection, restoration and greenspaces initiative to be named "Nature In Neighborhoods." Chapter 3 of the Regional Framework Plan is currently entitled "Parks, Natural Areas, Open Spaces and Recreational Facilities," yet describes most of the programs that are proposed to be included within the Nature in Neighborhoods Initiative. Based on this, a key proposed amendment is to change the title of Chapter 3 to "Nature in Neighborhoods." Other amendments to this chapter include:

- Section 3.2.2 – states that the fish and wildlife habitat program shall be developed to achieve four performance objectives and two implementation objectives
- Several sections through the chapter – minor wording changes to incorporate references to fish and wildlife habitat and Nature in Neighborhoods Initiative

D. Chapter 4

This chapter focuses on water quality issues, but also specifically relates to fish and wildlife habitat protection. The chapter is currently named "Water Management," but is proposed to be renamed "Watershed Health and Water Quality" to more aptly describe the policies in the chapter. Section 4.18 would be renamed "Water Quality and Riparian Fish and Wildlife Habitat Corridors" and would describe how healthy fish and wildlife habitat and water quality are related. This language explicitly acknowledges as a matter of RFP policy the link between water quality and fish and wildlife habitat, enhancing future ties between Title 13 and federal water quality requirements.

E. RFP Policies and Implementation Recommendations or Requirements Table

Amendments to this table simply reference the appropriate Titles in the Functional Plan, and are purely technical in nature.

5. AMENDMENTS TO TITLES 3, 8, 10 AND 11 OF THE URBAN GROWTH MANAGEMENT FUNCTIONAL PLAN

Implementing Title 13 of the Functional Plan has a cascading effect of simple amendments that are required to several other titles. These amendments are described below.

A. Title 3 – Water Quality and Flood Management

Title 3 addresses water quality and flood management, but also included direction to Metro to conduct planning that would protect fish and wildlife habitat. All references to fish and wildlife habitat have been removed, since these requirements are now placed in Title 13 of the Functional Plan. Two other amendments to Title 3 are included:

- Change to Section B(2)(d) requiring native vegetation to be planted in the Water Quality Resource Area. This amendment loosens the restriction by continuing to allow the removal of non-native or noxious vegetation but removing the requirement to replace it with native vegetation. The amendment encourages the planting of native vegetation but only requires replacement if native vegetation is removed.
- Repeal the variances section, since it applied only to fish and wildlife habitat areas and those provisions are now in Title 13.

B. Title 8 – Compliance with the Functional Plan

Title 8 describes how cities and counties must comply with the Functional Plan. Cities and counties will have to have amended their comprehensive plans and land use regulations to comply with Title 13 within two years of its acknowledgement by LCDC, and will have to make land use decisions compliant with Title 13 at that time (rather than one year after acknowledgement, with is the limit of Metro's authority under state law). In addition, beginning one year after acknowledgement, any other amendments that cities and counties make to other parts of their comprehensive plans or other land use regulations will have to be consistent with Title 13.

C. Title 10 – Definitions

This title provides the definitions critical for effective implementation of the Functional Plan. Several definitions have been added to further clarify the intent of Title 13. The most important changes, already discussed above, are to the definitions of "Development," and "Practicable."

D. Title 11 – Planning for New Urban Areas

This title describes the key items to consider when developing plans for new urban areas. It has been amended to consider Habitat Conservation Areas when developing such plans, and to make efforts to minimize conflicts between protecting Habitat Conservation Areas and urban development of new urban areas.

ANALYSIS/INFORMATION

1. **Known Opposition.** No known opposition to the specific elements in the proposed ordinance, however there has been a substantial public process throughout the course of this project. It is projected that there will be opposition from both sides of the spectrum during the public comment period for this ordinance. Some parties are likely to assert the difficulty of introducing new regulations after the passage of Measure 37, stating the uncertain legal climate and general political environment leading to the measure's success. Other parties will likely convey disappointment in a regulatory program that does not completely protect any regionally significant habitat and has been reduced in geographic scope by half from the time the Council made a preliminary ESEE determination in May 2004.

2. **Legal Antecedents.** Statewide Planning Goal 5, OAR 660-015-0000(5), and the Goal 5 Rule, OAR 660-023, and specifically OAR 660-023-0080. ORS chapter 197, and specifically ORS 197.274. ORS chapter 268, and specifically ORS 268.380, ORS 268.390, and ORS 268.393. The Metro Charter, Regional Framework Plan, and Metro Code sections 3.07.310 to 3.07.370. Metro Resolutions Nos. 02-3176, 02-3177A, 02-3195, 02-3218A, 03-3332, 03-3376B, 04-3440A, 04-3488, 04-3489A, 04-3506A, 05-3574 and 05-3577.

3. **Anticipated Effects.** Approval of this ordinance will allow Metro to complete the three-step process for complying with Statewide Land Use Planning Goal 5 by amending portions of the Regional Framework Plan and Urban Growth Management Functional Plan. This allows Metro to submit a complete package to the Department of Land Conservation and Development for acknowledgement review pursuant to ORS 197.274. Cities and counties would then be required to bring comprehensive plans and implementing ordinances in compliance with Metro's Functional Plan within two years.

4. **Budget Impacts.** Adoption of this ordinance commits Metro to the long-term monitoring and reporting of regional progress in habitat protection and restoration. It also commits staff resources to providing technical assistance to cities and counties in the review of codes for barriers to habitat-friendly development practices. Staff resources will also be necessary to review city and county compliance reports after acknowledgement by DLCD. The Council President's proposed budget for FY 05-06 includes 2 FTE for monitoring and technical assistance.

RECOMMENDED ACTION

Staff requests that Metro Council adopt the proposed amendments to the Regional Framework Plan and Urban Growth Management Functional Plan to implement new development standards in regionally significant fish and wildlife habitat areas identified as Habitat Conservation Areas.

ATTACHMENTS TO THE STAFF REPORT
Attachment 1. Vision Statement.
Attachment 2. Habitat Protection Tools Summary.

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Staff Report for Ordinance #05-1077
Attachment #1

Final DRAFT

October 4, 2000

Streamside CPR*
Program Outline

Purpose, Vision, Goal, Principles and Context

Metro Regional Services
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*CPR = Conserve, Protect and Restore

Purpose, Vision, Goal, Principles and Context

I. INTRODUCTION

A. PURPOSE

This document provides the organizational, definitional and policy approach that will apply to the creation and implementation of Metro's Goal 5 – Fish and Wildlife Program decision. This Purpose, Vision, Goal and Principles document is intended to guide, inform, and be the philosophical underpinnings of the Goal 5 Streamside CPR program. It is not a regulatory document.

The purpose is to develop a streamside conservation, protection and restoration program that balances the goals of:

- building livable, Region 2040 communities and implementing the Regional Urban Growth Goals and Objectives (RUGGO);
- protecting and enhancing fish and wildlife habitat as required by the Metro Urban Growth Management Function Plan;[1]
- supporting a strong economy;
- meeting State Land Use Planning Goal 5 standards and procedures;
- addressing Federal Endangered Species Act (ESA) requirements;
- adding to the progress already made by the implementation of Title 3, regional water quality and flood protection requirements; and
- providing the organizational, definitional and policy approach that will apply to the creation and implementation of Metro's Goal 5 – Streamside Fish and Wildlife Program decision.

Cities and counties, as general-purpose governments, are responsible for comprehensive planning including completion of a generalized coordinated land use map and policy statements that interrelate all functional and natural systems and activities relating to the use of land. Cities and counties also are responsible for implementing ordinances, especially zoning ordinances, to regulate land uses. Metro, a regional government, is responsible for addressing issues of metropolitan concern and the Metro Council may determine such issues and adopt regulations directing local governments to change their comprehensive plans and implementing ordinances to address identified regional issues. The Vision Statement, Regional Goal and Program Principles contained in this document provide overall direction to preparation and implementation of the regional safe harbor, local discretionary and riparian district plan option approaches to Metro Goal 5 compliance that will be available to local governments.

B. VISION STATEMENT

Our region places a high priority on the protection of its streams, wetlands and floodplains to maintain access to nature; sustain and enhance native fish and wildlife species and their habitats; mitigate high storm flows and maintain adequate summer flows; provide clean water; and create communities that fully integrate the built and natural environment. As ribbons of green, stream and river corridors maintain connections with adjacent upland habitats, form an interconnected mosaic of urban forest and other fish and wildlife habitat, and contribute significantly to our region's livability.

The RUGGO state that the region should "Manage watersheds to protect and ensure to the maximum extent practicable the integrity of streams, wetlands and floodplains, and their multiple biological, physical, and social values," as well as that "A region-wide system of linked significant wildlife habitats should be developed. This system should be preserved, restored where appropriate, and managed to maintain the region's biodiversity." The streamside program will contribute to these objectives by balancing, economic, social, environmental and energy considerations as will future efforts to address watershed and upland habitats.

C. Overall Goal

The overall goal is to conserve, protect and restore a continuous ecologically viable streamside corridor system, from the streams' headwaters to their confluence with others streams and rivers, and with their floodplains in a manner that is integrated with the surrounding urban landscape. This system will be achieved through conservation, protection and appropriate restoration of streamside corridors through time.

D. Program Principles

The program will be designed to achieve the following future conditions:

Areas of existing forest cover or areas where it is appropriate to restore forest cover. Conserve, protect and restore the biological, physical and social values of streams, wetlands, riparian areas and floodplains, by encouraging the growth and management of mature forest conditions composed of native forest tree species, appropriate for specific site conditions, mixed with native shrubs and herbaceous species, and containing ample standing snags and downed woody debris. Forest conditions will be managed, where appropriate to address public safety concerns.

Areas where forest cover did not exist historically or where non-forest cover is appropriate, based on a natural resources plan. Conserve, protect and restore the biological, physical and social values of streams, wetlands, riparian areas and floodplains through management of native vegetation appropriate to non-forested conditions.

Developed 2040 Centers and areas where floodplain function is artificially controlled. Contribute to the conservation, protection and restoration of the biological, physical and social values of streams, wetlands, riparian areas and floodplains.

The program will be designed to achieve these future conditions using the following principles:

1. ***Ecological Function***. The ecological function of the streamside corridor system will be restored and maintained to the maximum extent practicable given the opportunities and constraints of the urban landscape.

2. ***Economically Sound***. Economic vitality and a healthy natural environment are necessary components of sustainable development in the metropolitan area. Investments in protection and restoration of our natural areas contribute significantly to the region's economic health.

3. ***Protection and Restoration***.[2] Given the currently degraded condition of a majority of urban streams, wetlands, riparian areas and floodplains, protection and restoration are of equal importance in order to achieve the region's goals. Both protection and restoration are important in moving toward recovery of threatened and endangered salmonids, and avoiding future endangered or threatened listings of both aquatic and terrestrial species.

4. ***Flexible Regulatory Approaches***. Protective regulations shall be based on the best available natural science balanced with economic, environmental, social and energy considerations, and shall provide local governments with flexibility in meeting the overall goals of this program. This

program is also intended to help local governments address the Federal ESA by preventing the need for additional ESA listings and avoiding legal restrictions that may result from current and potential future listings. Implementation of the Federal ESA program for endangered salmonids will need a wide range of actions to be taken by local, state and Federal agencies to recover the species. Metro's requirements are not intended to meet all ESA regulations, but are intended to address recovery obstacles within and along stream corridors. The objective is to obtain Federal approval of this program, so that local governments can use it if they choose. The program is not intended to be the exclusive means available to local governments in the region to address ESA requirements. Local governments can independently seek certification as an alternative.

5. ***Incentives Education and Acquisition***. Regulatory efforts to conserve, protect and restore natural resources are most effective when combined with incentives, education and acquisition programs that encourage full community participation, therefore, such programs will be an element of the overall program.

6. ***Stewardship Responsibilities***. All landowners and land users throughout each watershed have an important stewardship responsibility to contribute to the protection and restoration of streams, wetlands, riparian areas and floodplains.

7. ***Urban Form***. Realization of the region's 2040 Growth Concept requires a compact urban form while protecting natural resources and water quality. This is accomplished in three primary ways:

    a. Protecting natural areas outside the Urban Growth Boundary (UGB). Accommodate compact development within the UGB in order to minimize land extensive expansion that adversely impacts farm and forest lands and natural areas outside the boundary;
    b. Accommodating urban growth in a compact form while protecting and enhancing key fish and wildlife habitat, natural areas, and water quality and quantity within the current UGB;
    c. Protecting and restoring urban stream corridors to provide people with an effective means to access nature, providing ecological linkage to other important fish and wildlife habitats, and compact urban form through integration of the built and natural environments.[3]

8. ***Measure and Monitor***. A measuring and monitoring system should be established and should include:
    - Assessment of existing conditions;
    - Use of "properly functioning conditions"[4] as the description of desired future conditions; and
    - Assessment and regular monitoring over time of streamside conditions to determine progress in achieving the goals of properly functioning conditions.

9. ***Coordination and Cooperation***. Effective management of the regional streamside resource cannot be achieved without a collaborative approach throughout the region. The Streamside CPR Program will provide local jurisdictions with the flexibility to pursue alternative collaborative management approaches that meet the standards of this programs, such as watershed planning, and will emphasize efforts that ensure coordination and cooperation between and among the region's partners including local governments, business, nonprofits and citizens.

E. CONTEXT

The preamble of Metro's voter-approved 1992 Charter declares that Metro's most important service is to "preserve and enhance the quality of life and the environment for ourselves and future generations."[5] Through its Charter-mandated responsibilities, Metro Council has provided leadership in addressing growth management issues by working with citizens, elected officials and diverse interest groups to craft a vision of how the region will grow. Through adoption of policies to achieve that vision, Metro Council has identified the need to balance natural resource protection with urban development while the region grows.

How this balancing will take place, and in what form it will be expressed across the urban landscape, is a key question addressed in various documents. For example, the region's 2040 Growth Concept map includes an environmental greenway along streams in the region to ensure connectivity throughout the urban landscape.[6] The goal of the Greenspaces Master Plan is to create a cooperative regional system of natural areas, open space, trails and greenways for wildlife and people in the four-county metropolitan area.[7] Other planning documents which speak to urban natural areas and water resources include the Future Vision[8], the RUGGO, the Regional Framework Plan[9], and the Urban Growth Management Functional Plan. A unifying feature of all of these documents is to achieve compact urban form and efficient delivery of urban services while at the same time preserving citizen access to nature and community livability.

A cornerstone of these regional policies is protection of natural systems—regionally significant fish and wildlife habitat, streams, rivers, wetlands and floodplains—because their protection and restoration is essential to maintaining and improving the region's livability, economic well-being and environmental health.

In addition to the regionwide policies, there are State and Federal policies which are also important considerations. The purpose of the State's Land Use Planning Goal 5 is "To protect natural resources and conserve scenic and historic areas and open spaces".[10] At the Federal level, for a large part of the Pacific Northwest Coast and associated inland rivers and streams, the National Marine Fisheries Service (NMFS), is acting under the requirements of the Federal ESA. At this time, NMFS has designated four species of Steelhead and eight other species of salmon as either threatened or endangered in the Columbia River Basin. Local governments, through their comprehensive plans, will be implementing requirements to address natural resource protection. In order to address this status, our region will need to take actions that are consistent with the recovery needs of these species. In doing so, the region, its local government partners and the citizens of the metropolitan area can help ensure that one of the defining symbols of our region once again thrives.

To accomplish the planning work described in these policies, Metro is pursuing adoption and implementation of programs to:

- protect the beneficial uses associated with the region's streams and rivers, including water quality and protect life and property from dangers associated with flooding[11]
- Protect, conserve and enhance fish and wildlife habitat within regionally significant riparian corridors under Statewide Planning Goal 5[12]
- Protect, conserve and enhance regionally significant upland wildlife habitat under Statewide Planning Goal 5;[13] and
- Implement the Greenspaces Master Plan.

All of these programs, taken in concert and with full implementation by local governments, will realize the vision for growth enunciated in Metro's Charter, Future Vision and subsequent planning documents described above.

To complete this work effort Metro shall:

1. Establish criteria to define and identify regionally significant fish and wildlife habitat areas;
2. Examine existing Goal 5 data;
3. Identify inadequate or inconsistent data;
4. After considering items 1-3, and after holding public hearings, adopt a map of regionally significant fish and wildlife areas.

II. PROGRAM DESCRIPTIONS (TO BE ADDED)

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[1] The focus of the Purpose, Vision, Goal, Principles and Context Statement is on native species of fish and wildlife whose historic ranges include the metropolitan area and whose habitats are or can be provided for in urban streamside corridors. The Purpose Statement does not intend to include native species such as bear, cougar, lynx and deer, which may be conducive in specific areas such as Portland's Forest Park, but may not be conducive in urban stream corridors elsewhere in the metropolitan area.

[2] Proposed definition of restoration:

Restoration, in the context of the streamside CPR program, means action taken to return natural riparian functions and values for fish and wildlife. Restoration would be applied where riparian functions are in a degraded condition and are intended to return the riparian functions to good or excellent condition. While there may be instances where restoration to pre-development, natural conditions is possible, in general, restoration should not mean the end-state of re-establishing a totally pristine condition. It should address the improvements or re-introduction of functional values.

Conditions Under Which Restoration Would Occur:

Conditions under which restoration will occur will be established when the program is defined. The current draft of the Goal 5 program does not contemplate that homeowners and other property owners would be required to undertake restoration unless there was a development activity that required a permit for new development, significant modifications to structures, or redevelopment. In the absence of a development permit it is assumed that restoration would be achieved through incentive-based, voluntary, and community-based restoration and enhancement activities. Public education and the promotion of voluntary naturescaping and restoration would be part of the regionwide cooperative effort to improve the existing degraded conditions of our urban waterways.

[3] "to provide people with an effective means to access nature" means to help people enjoy, approach or be near to nature. It is not intended to imply the right of any person to enter or make use of private property unless the property owner grants that right of public access.

[4] Defined by Federal natural resource programs.

[5] The preamble of Metro's Charter states the following: "We, the people of the Portland area metropolitan service district, [establish an elected regional government] that undertakes, as its most important service, planning and policy making to preserve and enhance the quality of life and the environment for ourselves and future generations." 1992 Metro Charter, page 1.

[6] The Metro 2040 Growth Concept, acknowledged by the Land Conservation and Development Commission in 1995, states the following: "The basic philosophy of the Growth Concept is: preserve access to nature and build better communities." December 8, 1994, Page 1.

[7] Other goals of the July 1992 Metropolitan Greenspaces Master Plan include preserving "diversity of plant and animal life in the urban environment, using watersheds as the basis for ecological planning." The Greenspaces Master Plan is guided by the following ecological principles: "Maintain biological diversity by restoring and enhancing a variety of habitats, including wetlands, riparian corridors, forests and agricultural lands." And " Protect, restore and recreate stream corridor vegetation by replacing riparian vegetation where it is lacking or dominated by exotic species and removing barriers, where possible, to maintain connections with adjacent upland habitats."

[8] The Future Vision states the following: "We value natural systems for their intrinsic value, and recognize our responsibility to be stewards of the region's natural resources." March 1995, page 1. In 2045, the region should be characterized by "Improved water quality, and increased biodiversity," and "restored ecosystems protected from future degradation and decline." Page 12. Specific actions identified: "Manage watersheds to protect, restore, and maintain the integrity of streams, wetlands and floodplains, and their multiple biological, physical, and social values." Page 12.

[9] Chapter 3 of the December 31, 1997 Regional Framework Plan establishes polices for parks, natural areas and open spaces, and identifies the important environmental benefits of maintaining and improving air and water resources, providing flood control, and protecting fish and wildlife habitat. It commits Metro to "develop a strategy and action plan to address inadequacies in the protection of regional Goal 5 resources. This plan will be carried out by Metro." Page 108, see also page 190.

[10] Goal 5 further states that "Local governments shall adopt programs that will protect natural resources and conserve scenic, historic, and open space resources for present and future generations. These resources promote a healthy environment and natural landscape that contributes to Oregon's livability." Procedures and requirements for complying with Goal 5 call for an inventory, a determination of significance, an analysis of the economic, social, environmental and energy consequences of a decision that could allow, limit or prohibit a conflicting use.

[11] From Title 3, Sections 1-4 of the 1996 Urban Growth Management Functional Plan

[12] From Title 3, Sections 1, 2 and 5 of the 1996 Urban Growth Management Functional Plan.

[13] From Title 3, Sections 1, 2 and 5 of the 1996 Urban Growth Management Functional Plan.

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Staff Report for Ordinance #05-1077
Attachment #2

Fish and Wildlife Habitat Protection and Restoration Tools

Summary Descriptions and Recommended Best Management Practices

April 2005

Fish and Wildlife Habitat Protection and Restoration Tools

Tool Categories (See attached document for summary descriptions)		**Program Objectives**					
		Avoid				***Minimize***	***Mitigate***
		1: Streamside Connectivity	**2**: Large habitat patches	**3:** Wildlife Corridors	**4:** Habitat of Concern	**5:** Minimize Impacts	**6:** Mitigate & Restore
AVOID	1) Acquisition	●	●	●	●	○	○
	2) Tree protection standards	●	●	●	●	●	●
	3) Cluster development	●	●	●	●	●	○
	4) Transfer of development rights (TDRs)	●	●	●	●	●	○
	5) Riparian setbacks	●	○	○	●	○	○
MINIMIZE	6) Flexible site design	○	○	○	○	●	○
	7) Impervious surface reduction	○	○	○	○	●	○
	8) On-site stormwater management and erosion control	○	○	○	○	●	○
	9) Greenstreets standards	○	○	○	○	●	○

Tool Categories (See attached document for summary descriptions)		**Program Objectives**					
		Avoid				***Minimize***	***Mitigate***
		1: Streamside Connectivity	**2**: Large habitat patches	**3:** Wildlife Corridors	**4:** Habitat of Concern	**5:** Minimize Impacts	**6:** Mitigate & Restore
MINIMIZE (cont.)	10) Education and awareness	○	○	○	○	○	○
	11) Technical assistance	○	○	○	○	●	○
	12) Incentives	○	○	○	○	○	○
MITIGATE	13) Mitigation	○	○	○	○	●	●
	14) Restoration	●	●	●	●	○	●
	15) Ongoing monitoring	○	○	○	○	○	○

● = directly supports achieving goal; ○ = indirectly supports achieving goal; √ = area most applicable
SL = strictly limit; ML = moderately limit; LL = lightly limit

Summary Description of Tools

1. Acquisition and conservation easements

Acquisition programs are very effective in habitat protection and restoration and are usually applied to privately-owned lands. Land may be purchased outright or with a conservation easement from willing landowners. Land acquisition programs are used by a select set of organizations. The high cost of land limits the ability of many smaller organizations to purchase land. Primarily city governments, Metro, federal programs, and a few non-profit organizations utilize acquisition programs. Since 1995, all of the programs combined have succeeded in protecting approximately 11,000 acres of land in the Metro region that is explicitly managed for fish and wildlife habitat protection.

Issues to consider for implementation in Metro region

Opportunities	**Constraints**
Acquisition	
• Habitat that is acquired for purposes of conservation may be considered protected in perpetuity. • Land can be donated to non-profits or governments for habitat conservation, property owners receive a tax deduction. • Once acquired, land can be restored and maintained to provide better quality habitat.	• Cost of land in the urban area is very high and an acquisition program depends on willing sellers, limiting the potential for an expansive acquisition program. • Managing donated land is time and labor intensive. • Restoring and maintaining land is expensive. An endowment at the time of purchase can offset these expenses. • Difficult to achieve continuity of habitat.
Conservation Easements/Deed Restrictions	
• Conservation easements can be donated to non-profits or governments for habitat conservation; property owners receive a tax deduction. • Easements can be less expensive and allow private ownership of the land to continue.	• Working with landowners with conservation easements is time and labor intensive. • Long-term maintenance and management of habitat land with easements can be expensive and difficult to manage. • While the deed restriction continues when a property is sold, there may need to be education for the new owner.

RECOMMENDED BEST MANAGEMENT PRACTICES
Class I and II Riparian and other habitat:
Metro should consider using existing resources and a variety of additional funding sources to carry out some or all of the following activities:

a. Coordinate with non-profit agencies and others who are involved in acquisition to help identify prime fish and wildlife habitat for consideration of their acquisition programs.
b. Apply for grants that can lead to targeted acquisition for prime areas, such as opportunities in Damascus and other new urban area planning.
c. Use funds to leverage other purchases and target small areas for purchase outright or in easements.
d. Launch a major acquisition effort tied to the fish and wildlife habitat area preservation and restoration focusing on:
    - Parcels that are so valuable they should not be lost when volunteer efforts and local regulations are not able to protect habitat.

- Key connector habitat areas and other low quality areas that offer important restoration opportunities.

Local jurisdictions should consider acquiring habitat lands through the following programs:

a. Purchasing floodplains and/or other special habitats through SDC (system development charges) programs.
b. Applying for FEMA grants to purchase floodplains.

2. Forest canopy (tree) protection standards

Tree protection ordinances often stipulate tree and forest retention and/or reforestation standards, and require developers to obtain permits before certain trees or percentages of forest cover can be removed, encroached upon, or in some cases pruned. Tree ordinances can also govern the planting and removal of trees within public rights-of-way, and can resolve conflicts between property owners that result when trees block views or sunlight. Some jurisdictions limit the cutting of trees through site design standards (e.g., cluster development) in their environmental or sensitive area overlay zones. Types of tree ordinances[1] include:

- Street Tree Ordinances
- Tree Protection Ordinances
- Forest Conservation Ordinances
- View Ordinances

Of the ordinance types listed above, the most applicable for the creation and protection of habitat are tree protection and forest/woodland conservation ordinances. The former (tree protection) ordinances typically set protection standards for individual trees, whereas the latter (forest conservation) require the protection of forest patches and/or canopy.

Issues to consider for implementation in Metro region

Opportunities:	**Constraints:**
• Tree protection and forest conservation ordinances can be an effective means for protecting fish and wildlife habitat. • Tree protection has additional benefits such as increase in property values, stormwater reduction, energy savings, air pollution reduction. • Many local jurisdictions already have some form of tree ordinances; effective local ordinances could serve as a model for jurisdictions that do not have them. • Undeveloped forest areas coming into the urban growth boundary (UGB) could be preserved.	• Tree ordinances can be administratively and financially cumbersome to developers and existing property owners. • Tree ordinances may require extended permit processing time. • There may be a perceived loss of developable land as a result of forest protection and other costs. • Non-enforcement of tree ordinances can lead to ineffective protection. • There is a potential high cost to landowners/ developers if in-lieu-of fee approach is used. • Preservation of individual trees may be costly and potentially dangerous; sometimes replacement may be more effective than retention of trees. • Forest management is an important concern (e.g., removing competing vegetation to preserve certain habitat types such as White Oak woodlands).

[1] See appendix for a summary of tree ordinances in the Tualatin Basin.

RECOMMENDED BEST MANAGEMENT PRACTICES
Class I and II Riparian:
Local jurisdictions should protect trees in Class I and II Riparian habitat by adopting tree ordinances or other tools that effectively protect trees. Some provisions of an effective tree ordinance include:

a. Prioritize tree canopy protection; e.g., natural stands or groups of trees given priority over individual specimens, largest trees with greatest environmental benefit.
b. Establish minimum standards for tree canopy retention and reforestation standards such as number of trees over 6” dbh per acre; percentage (e.g., 50%) of tree canopy retained; 1:1 replacement according to total DBH; tree planting on site, off site, or in lieu payment.
c. Promote retention of individual tree specimens within Habitats of Concern (such as white oak woodlands).
d. Maintain or enhance understory of shrub and herbaceous layers within forest canopy habitat; require planting of native species and removal of noxious plants.
e. Require a project arborist to oversee construction activities; protect critical root zone during all phases of construction including excavation around trees, grading and filling, placement of impervious surfaces, construction equipment and storage, etc.
f. Include costs for maintenance of trees, or allow developers to contribute to a fund for maintenance rather than replace trees.
g. Include provisions for enforcement of tree protection standards; incentive enforcement of tree code should be considered (see Appendix for description; city of Tigard).

Other habitat areas:
Local jurisdictions are encouraged to protect trees in other regionally significant habitat areas by adopting tree ordinances or other tools that effectively protect trees. In addition to the provisions listed above, effective tree ordinance for other habitat areas include:

a. Retain upland wildlife habitat in as large of units as possible; minimize activities that fragment forest canopy into small units (below 28 acres).
b. Maintain or enhance forest canopy connectivity between upland habitat patches and between riparian corridors and upland habitat.

3. Cluster development/on-site density transfer

Cluster development is a compact form of development that conserves land on one portion of a site in exchange for concentrated development on another portion of the site.[2] Typically, road frontages, lot sizes and setbacks are relaxed to allow the preservation of open space areas.

[2] See Appendix for an example of a proposed cluster development in SE Portland that preserves 17.5 aces of 26.9 acre site and achieves maximum allowed density (65 lots).

Issues to consider for implementation in Metro region

Opportunities	**Constraints**
• Cluster development is most likely to work well in habitat areas with a larger overall site size. • Reducing minimum lot sizes and densities in habitat areas could allow clustering to be more effective. Metro currently has an exemption for density requirements if natural resources are preserved. • Education to developers and public may increase use of clustering. • If the resource covers a small portion of a parcel clustering has more potential.	• Many habitat areas have high minimum densities in place. Clustering would not be possible in these areas without changing the housing type (e.g., from detached single family to attached single family or multi-family). Changing housing types in existing neighborhoods may change neighborhood character, which is contrary to Metro policy (Title 12of the Functional Plan, protection of residential neighborhoods). • Long-term management of habitat preserved through subdivision platting can be an issue.

RECOMMENDED BEST MANAGEMENT PRACTICES

High minimum required densities to meet 2040 goals may reduce the potential for cluster development in some habitat areas.

a. Metro should review and amend, if necessary, current density target exemptions for natural resource protection to ensure workability.

Class I and II Riparian:

Local jurisdictions are required to allow cluster development in Class I and II streamside areas to preserve habitat. Some or all of the following actions could be taken to promote cluster development:

a. Reduce minimum density requirements (zoning) in habitat areas to allow for clustering and larger lots that preserve habitat consistent with Metro direction.
b. Allow cluster development (on-site density transfer) in habitat areas as a by-right method of development, reducing the level of review necessary and therefore minimizing costs.
c. Allow for flexible lot design to reduce impervious cover and preserve the most amount of habitat.
d. Include legal requirements for the long-term maintenance and management of preserved habitat.

Other habitat areas:

Local jurisdictions are encouraged to allow cluster development in all regionally significant habitat areas to preserve habitat.

4. Transfer of Development Rights

Transfer of Development Rights (TDR) is a tool used in many communities to preserve natural features, farmland, and historic landmarks. TDRs encourage a voluntary shift of development from places a community wants to save (sending areas, e.g., Class I riparian corridors) to the places where growth is wanted (receiving areas – e.g., in centers). The owners of the sending areas receive compensation for protecting their land by selling their development rights to another party to be used in a receiving area. Developers in a receiving area may build to a certain extent without using a TDR, but more units or floor space may be allowed with the purchase of a TDR (some jurisdictions have base density, minimum density, and maximum density that can only be reached with the purchase of a TDR). Such a program preserves important places, encourages growth where the community wants it, does not require a substantial public expenditure, and provides compensation to property owners.

Issues to consider for implementation in Metro region

Opportunities	Constraints
• A banking system could be developed for development rights, purchasing the rights from affected landowners who wish to sell and reserving them for sale until needed by jurisdictions for upzoning or in UGB expansion areas. This bank could function at the regional scale or within a specific jurisdiction or planning area, and could be managed by a government or a foundation. • TDRs are particularly useful in UGB expansion areas where a program could be put in place prior to upzoning. This allows all property owners to benefit more equally from inclusion in the UGB and also preserves significant habitat. (Pleasant Valley includes an approach.) • As an alternative to a more traditional TDR program, a density transfer charge imposes a fee any time a developer wishes to build more than allowed on a site, or for any upzoning. Allows for the collection of money to be spent to preserve habitat lands by purchasing them. May not be much application in built out communities, but could apply to growing areas.	• TDR programs have mostly been successful in areas without urban growth boundaries. In Oregon, development is restricted outside of the UGB, and in the Metro region densities have been increased substantially to achieve the 2040 Growth Concept and to focus development in centers. While it would be a relatively simple task to identify sending areas (Class I riparian, Class A upland for example), it is more difficult to identify receiving areas if a market for more density does not exist. • In the Metro region it may be difficult to implement a TDR program due to the existing high densities and the fact that many developers currently build at the minimum density. There does not appear to be much demand for increased densities to be transferred from habitat areas. • Portland has TDRs available for use to preserve habitat in two planning areas; however, they have never been used. • Expansion areas may not have a large capacity for density since there is a substantial amount of existing habitat.

RECOMMENDED BEST MANAGEMENT PRACTICES

a. Metro <u>should</u> explore the potential of requiring any future upzoning throughout the region to require the purchase of a TDR or a density transfer fee to be used for habitat protection.
b. Metro <u>should</u> work with local jurisdictions in urban growth boundary expansion areas to implement a TDR program prior to implementing urban zoning (e.g., in areas like Pleasant Valley and Damascus).
c. Local jurisdictions <u>should</u> consider implementing a transfer of development rights program to preserve habitat.

5. Riparian setbacks

Setbacks are protective corridors of land along shorelines, lakes, streams, and wetlands where development is limited or prohibited. Setbacks provide important ecological and water quality benefits by providing a transition between upland development and adjoining surface waters. In short, they serve as barriers between development and waterways, and are an important resource in themselves. The majority of the region's wildlife species depends on riparian areas. Setbacks can have either fixed or variable widths depending on a jurisdiction's needs and the intended purpose of the setback regulations.

Issues to consider for implementation in the Metro region

Opportunities	Constraints
• Riparian areas are critical to water quality, fish and wildlife, yet many streams lack setbacks of any kind. Providing even minimal setbacks on all streams can help protect the region's water quality and biological diversity. • Because of their ecological importance, riparian areas represent some of the region's best restoration opportunities. Setbacks and current conditions can help define the target areas for riparian restoration. • Setbacks can create clear and objective standards, which are relatively easy to administer and can minimize map error issues. • A strong nexus may be made between riparian setbacks and compliance with federal laws (CWA, ESA); setbacks may help local jurisdictions meet TMDL and ESA requirements.	• Limited benefit where riparian vegetation has already been replaced with development, but setback enhancements could be negotiated under redevelopment. • Setbacks may result in perceived or actual private property rights infringement; some development likely to occur within setback areas to avoid or minimize this issue. • Setbacks should be based on existing resources, which may require site-specific delineation such as those required by Clean Water Services. Site-specific delineation may be expensive.

RECOMMENDED BEST MANAGEMENT PRACTICES

Class I and II Riparian:

Local jurisdictions <u>should</u> expand the area to which Title 3 Water Quality Resource Area performance standards apply.

a. Extend Title 3 WQRA performance standards longitudinally to all inventoried streams, including those draining less than 50 acres. Apply the 15-50 foot standard to the smaller streams.
b. Extend Title 3 WQRA performance standards laterally to Class I and II streamside habitat, consistent with the ESEE treatments.

Local jurisdictions <u>should</u> also consider incorporating the following items in protection regulations for Class I and II habitat:

a. Maintain or enhance forest cover in setback areas to improve stormwater management, habitat protection, and other benefits.
b. Maintain or enhance native vegetation in setbacks areas to provide better wildlife habitat.
c. Minimize stream crossings to promote continuity of riparian corridors.
d. Delineate setback boundary so that it is visible before, during, and after site construction. Developers should be familiar with the limits of disturbance throughout construction.

6. Green development practices, or low impact development (LID) – impervious surface reduction and stormwater management

Low impact development (LID) is an innovative, ecosystem approach to site development and stormwater management. LID design requires careful evaluation of the physical and ecological characteristics of the site and consideration of how to minimize development impacts. LID design techniques typically serve to conserve native vegetation and soils, minimize impervious surfaces, slow down surface water runoff, detain and retain water on-site, maximize infiltration and remove pollutants in stormwater.

In urban and developing areas where impervious cover can be significant, the objective is to reduce imperviousness in the development process and increase natural areas. Reducing the amount of impervious surfaces reduces the amount of stormwater runoff generated in the first place. Conventional stormwater management practices collect and convey stormwater runoff in costly end-of-pipe facilities to one location. In contrast, LID addresses stormwater through small-scale landscape features located at the lot level. These landscape features, known as Integrated Management Practices (IMP), help to maintain natural flow patterns, filter pollutants and recreate or maintain the hydrology of a site.

Impervious surface reduction standards focus on some of the following areas:

- Native soils and soil amendments
- Driveway, street and sidewalk widths
- Flexible lot setbacks and shape standards
- Smaller building footprints
- Alternative foundations
- Permeable pavement options
- Reduced parking lot area
- Parking ratio requirements

Some of the practices used to manage stormwater include[3]:

- Bioretention/rain gardens
- Dry Wells
- Filter Strips
- Swales (wet and dry)
- Rain Barrels
- Infiltration Trenches
- Soil Amendments
- Greenroofs
- Greenstreets

[3] See appendix for examples of low impact development and other green development practices.

Issues to consider for implementation in Metro region

Opportunities:	Constraints:
• Careful site design and stormwater management can allow for urban economic growth while contributing to the protection of sensitive habitat areas. • With better site design, individual developments and road projects can reduce impervious cover and increase natural areas conserved. • Reducing effective impervious surfaces can significantly cut infrastructure costs that developers pay for the construction of roads, sidewalks and stormwater infrastructure. • Permeable pavement can easily be integrated into new construction where soil, slope and traffic conditions are suitable. • Reducing stormwater drainage infrastructure (e.g., pipes, ponds, other structures) can lower infrastructure costs. • Developers using LID practices can potentially increase developable land by reducing size requirements for stormwater ponds. • Using low impact development design techniques assists in meeting Clean Water Act requirements. LID practices have been found to improve hydrologic conditions in a watershed and to remove various urban pollutants from stormwater runoff. • Metro has developed greenstreet standards[4] to reduce impervious surfaces and manage stormwater that could be either required or encouraged throughout the region. • There are many more case studies in the region that provide working examples.	• Most local jurisdictions' development codes do not allow for many LID practices (e.g., narrower roads or open road sections without curbs and gutters).[5] • Many engineers and developers are not familiar with LID stormwater techniques and continue to rely on better known conventional practices. • Permeable pavement costs more (however, more materials are becoming available and prices are coming down). • The use of low impact stormwater management techniques is highly dependent on site conditions and is generally not applicable where soils are impermeable or where water soluble pollutants may contaminate an underlying aquifer. • Other barriers may include higher cost for development review, longer permitting process and additional permit requirements.

RECOMMENDED BEST MANAGEMENT PRACTICES
Class I and II Riparian and other habitats:

Metro should:

a. Help identify barriers to employing the practices listed below,
b. Determine an appropriate goal(s) for on-site stormwater retention for different sites throughout the region, and

[4] *Green Streets: Innovative Solutions for Stormwater and Stream Crossings* (Metro, June 2002).
[5] *Stormwater/Pavement Impact Reduction (SPIR) Project* (Audubon Society of Portland, November 2003) identifies barriers in existing codes for jurisdictions in Washington County. *Economic Growth and Fish & Wildlife Habitat Protection: The Promise of Low-Impact Stormwater Management in the Portland, Oregon Metropolitan Region* (J. Sherman, Master Thesis, University of Washington) analyzes benefits, costs, methods of LID implementation throughout the Northwest, and provides some recommendations and considerations for incorporating low impact development into a fish and wildlife habitat program.

c. Provide education and technical assistance to local jurisdictions and developers.

Class I and II Riparian:

Local jurisdictions should be required to reduce impervious surfaces in Class I and II habitat areas by removing barriers to allowing some or all of the following actions:

a. Minimize grading and lot disturbance; use erosion and sediment control practices to protect soil surface and to retain sediment on site.
b. Amend retained topsoil to regain some of the absorption, infiltration, retention and pollutant removal capabilities of the soil.
c. Relax residential lot sizes, setbacks and shape standard to minimize extent of impervious surfaces.
d. Encourage smaller building footprint through building design.
e. Encourage use of alternative foundations, such as pier, post or piling foundation, that reduce impacts on soils and trees (see Appendix for example of alternative foundation).
f. Use pervious paving materials in place of traditional impervious materials where appropriate.
g. Reduce impervious impacts of residential driveways by narrowing widths, moving access to the rear of the site, using more pervious paving materials and promoting the use of shared driveways.
h. Reduce width of residential streets, depending on traffic and parking needs.
i. Reduce street length, primarily in residential areas, by encouraging clustering and using curvilinear designs.
j. Reduce cul-de-sac radii and use pervious vegetated islands in center to minimize impervious effects.
k. Reduce sidewalks width, place on one side of the street, and graded such that they drain to the front yard of a residential lot or retention area.
l. Reduce impervious surfaces in parking lots by minimizing car spaces and stall dimensions, using shared parking facilities and structured parking, and using pervious paving materials where appropriate.
m. Reduce parking ratios to limit excess parking space construction.

Local jurisdictions should be required to remove barriers in their development codes to allow for low impact development stormwater management in Class I and II habitat areas. Some or all of the following actions could be taken to manage stormwater on-site:

a. Amend retained topsoil to regain some of the absorption, infiltration, retention and pollutant removal capabilities of the soil.
b. Landscape with rain gardens to provide on-lot detention, filtering of rainwater, and groundwater recharge.
c. Disconnect downspouts from roofs and direct the flow to vegetated infiltration/filtration areas such as rain gardens.
d. Retain rooftop runoff in a rain barrel for later on-lot use in lawn and garden watering.
e. Combine the rain gardens with grassed swales to replace a curb-and-gutter system.
f. Use permeable pavers for walkways and parking areas.
g. Design roads to incorporate stormwater management in right-of-ways where appropriate.
h. Use multi-functional open drainage systems in lieu of more conventional curb-and-gutter systems.
i. Use bioretention cells as rain gardens in landscaped parking lot islands to reduce runoff volume and filter pollutants.

j. Use green roofs for runoff reduction, energy savings, improved air quality, and enhanced aesthetics.
k. Apply a treatment train approach to provide multiple opportunities for stormwater treatment and reduce the possibility of system failure.

Other habitats:
Local jurisdictions are encouraged to remove barriers to reducing effective impervious surface and allowing for low impact development stormwater management practices in other habitats and throughout their jurisdiction to address overall watershed health.

7. Design standards for fish passage and wildlife crossings

Design standards and best management practices can be used in road building and stream crossings that promote fish and wildlife continuity in the region. These include structural design provisions to allow wildlife to cross roads and better fish passage schemes at road crossing to aid in salmon and other fish migration.

Wildlife crossings:
- Bridges and overpasses – grade separation structures designed to allow wildlife to cross over an intersecting highway
- Culverts and underpasses – structures designed to convey wildlife under an existing roadway (bottomless culvert, arch culvert)
- Roadside escape structures – structures designed to allow an animal trapped on a roadway by a diversion fence to exit.

Fish passages
- Bridges (preferred over other structures)
- Culverts (bottomless arch culverts, embedded round culverts, concrete box culverts)

Issues to consider for implementation in Metro region

Opportunities:	Constraints:
• Use of wildlife crossing and fish passage facilities in the Metro region presents unique opportunity for promoting continuity of habitat and for minimizing loss of wildlife in urban areas. • Language in Regional Transportation Plan and local plans could be positive and proactive to minimize number of stream crossings. • Wildlife crossings can reduce property damage from accidents and reduced accident cleanup and disposal costs. • ODFW has detailed design specifications for stream crossings on fish bearing streams. • There are many existing culverts that need to be retrofitted to ensure safe fish and wildlife passage. • Local codes and transportation plan updates are opportunities to address conflicts with stream crossing objectives to minimize number of stream crossings.	• Bridges tend to be more expensive than culverts. • Lack of experience in Metro region with habitat-friendly structures could pose significant challenge to effective implementation. • Many fish passage culverts or structures need to be custom made, are expensive, and tend to be oversized. • Some jurisdictions' transportation plans have not been reconciled with natural resource concerns, and result in conflicts with stream crossing objectives.

RECOMMENDED BEST MANAGEMENT PRACTICES
Class I and II Riparian:
Metro should:
a. Maintain list of problem culverts and prioritize for retrofitting to ensure safe fish and wildlife passage.
b. Review language in Regional Transportation Plan and consider changing language to require stream crossing standards from a positive perspective, such as: "where streams must be crossed, space crossings at intervals of 1,200 feet where practicable."

Local jurisdictions should be required to incorporate fish and wildlife friendly passages in road design by addressing some of the following:
a. Minimize the number of stream crossings and place crossing perpendicular to stream channel if possible.
b. Use bridge crossings rather than culverts wherever possible.
c. Design stream crossings for fish passage with shelves and other design features to facilitate terrestrial wildlife passage.
d. Allow narrow street right-of-ways through stream corridors whenever possible to reduce adverse impacts of transportation corridors.
e. Consider using simple ways to help wildlife such as building rock ledges along one side of culverts for wildlife passage, plugging bridge-deck drains, using "lampshades" on bridge lights and creating small animal habitat from logs and brush.

Other habitats:
Local jurisdictions are encouraged to incorporate wildlife friendly passages in road design addressing some of the following:
a. Consider regional wildlife migration patterns for locating transportation facilities in upland areas.
b. Extend vegetative cover through the wildlife crossing in the migratory route, along with sheltering areas.
c. Carefully integrate fencing into the landscape to guide animals toward the crossings.
d. Consider using simple ways to help wildlife such as building rock ledges along one side of culverts for wildlife passage, plugging bridge-deck drains, using "lampshades" on bridge lights and creating small animal habitat from logs and brush.

8. Education and awareness

Many landowners would like to manage their land in a way that benefits fish and wildlife habitat. However, frequently people do not know if certain activities are detrimental (using herbicides and pesticides), if there are alternatives (natural gardening), what to do to improve habitat (plant native plants, remove invasive species like ivy), and how to connect to agencies and organizations that provide grants and/or volunteers to help improve habitat. A program could be developed to focus efforts to increase people's awareness of the connections between their activities and the health of streams and rivers, similar to fish stencil programs. Landowners in regionally significant habitat areas could be targeted to raise awareness of how individual activities impact fish and wildlife habitat. Education activities would be most effective when used in conjunction with a stewardship certification program, grant programs, and regulatory programs.

Metro currently has several education programs that help fish and wildlife habitat in the Parks and Greenspaces Department and the Solid Waste and Recycling Department. Many other organizations in the region also provide classes about the environment.

Issues to consider for implementation in Metro region

Opportunities	Constraints
• There are a number of strong education programs operated by Metro and other organizations that focus on fish and wildlife habitat protection and restoration. • Education oriented towards children may be most effective in long-term behavior change (e.g., recycling).	• Focusing efforts on education and awareness is expensive. • Results are long-term and are unlikely to immediately protect or restore habitat.

RECOMMENDED BEST MANAGEMENT PRACTICES
Class I and II Riparian and other habitats:
Metro should consider using existing resources and a variety of additional funding sources to carry out the following activities:

a. Coordinate fish and wildlife education messages into ongoing Metro program areas, including Parks and Open Spaces planning and outreach, Zoo exhibits such as a display on Metro urban fish and wildlife habitat and enhancement of Solid Waste and Recycling programs to target homeowners and developers of residential properties.
b. Develop seminars, recognition and speaker programs and other special efforts to increase awareness of green development practices.
c. Develop a list of all education programs in the region and determine which are most effective.
d. Coordinate regional messages on fish and wildlife habitat, watershed function, and water quality to encourage people to think on a more broad and time-sensitive scale. Encourage the placement of signs in habitat areas as an important component of an educational program.
e. Organize and prioritize a regional education campaign and provide a clearinghouse for education materials and referrals.

9. Technical assistance

Technical assistance programs are noted for being responsive to landowner or developer needs, providing practical information, and having knowledgeable resource staff. Such a program would not provide direct protection to resources, but would offer a means of improving stewardship and enhancement by private landowners. Technical assistance could help supplement cost-sharing programs, such as grants, to further protection and restoration efforts. Technical assistance could be focused on landowners, development practices, and/or local partners. Metro has provided technical assistance to local partners throughout the implementation of the Regional Framework Plan and the Regional Urban Growth Management Functional Plan. This has proved especially important in the implementation of Title 3 (stream and floodplain protection) and planning for 2040 centers.

Metro could work with local partners to develop technical assistance, incentives, recognition programs, and awards for development that helps protect fish and wildlife habitat. Metro, in conjunction with local partners, could develop regional low impact development standards and designs to reduce development impacts on fish and wildlife habitat. The Green Streets Handbook serves as a successful model of technical assistance for transportation infrastructure.

Issues to consider for implementation in Metro region

Opportunities:	Constraints:
• A technical assistance program can effectively change practices by working with interested parties • There are existing technical assistance programs (e.g., through soil and water conservation services, etc.) that could be supported and enhanced	• Technical assistance can be very labor intensive • Technical assistance can only reach willing participants

RECOMMENDED BEST MANAGEMENT PRACTICES
Class I and II Riparian and other habitats:
Metro should consider using existing resources and a variety of additional funding sources to carry out the following activities:

a. Provide technical assistance to jurisdictions to implement fish and wildlife habitat program recommendations, such as a Handbook of Green Development Practices. Also consider developing a certification process for city officials to help them integrate natural resource needs and development.
b. Work with local jurisdictions to identify barriers in codes that limit green development practices, for example, flexible site design and on-site stormwater management practices.
c. Provide technical assistance to the development community, primarily targeting new residential development to incorporate green development practices. For example, native landscaping, tree planting, and site design.

10. Incentives

Stewardship recognition programs
These programs publicly acknowledge landowners, businesses and other entities for conserving open space, protecting or restoring habitat areas, making financial contributions or carrying out good stewardship practices in general. Public agencies and nonprofit organizations can administer the programs, and the recognition could take the form of media publicity, awards ceremonies, or plaques and certificates. These programs, while not widely applied in the Metro region, have much potential for encouraging conservation behavior when combined with other programs.

A good stewardship agreement between a landowner and an organization interested in protecting or restoring habitat and monitoring success over time can be used to achieve some level of habitat protection. The Wetlands Conservancy uses stewardship agreements to enhance wetlands protected through their efforts. Such a program would recruit landowners to agree to voluntary stewardship agreements that allow residents to make a commitment to care for the land in a manner that promotes habitat value. A stewardship agreement program would be most effective when combined with other incentives such as education, technical assistance, and grants.

Landowner recognition programs on their own generally provide no permanent protection of resources because participation is voluntary. However, administrative costs may be relatively low compared to funding for programs such as acquisition that provide definitive permanent protection. This tool is most likely to be effective when integrated with other tools (e.g., grants and education) as part of an overall conservation strategy. Perhaps the greatest benefit is to provide publicity to developers and landowners, and thus encourage others to take similar actions.

Grants

Grants for restoration can provide the incentive for supportive landowners and other organizations to restore habitat on private and public lands. A small grant program, targeted to watershed councils, non-profit organizations, or local governments, could be created similar to Metro's recent grants for Regional and Town Center planning efforts. Small grants given in strategic places could build on existing work and encourage more efforts in targeted areas.

Funding can leverage additional benefits such as education and volunteerism. Private landowners may be interested in the concept of improving the habitat value on a portion of their land, and the availability of dollars can provide the impetus to conduct restoration activities. Many grants are provided with a required match of either dollars or in-kind materials or labor. These incentives provide landowners who contribute a portion of the proposed cost for conservation or restoration activities with additional funding opportunities. There are several programs in place for rural land in agriculture or forestry use, and some for urban lands. A grant program could target specific activities along stream reaches or within watersheds in coordination with Watershed Action Plans to accomplish the most effective restoration. A monitoring component of a restoration plan would be essential to assess effectiveness over time at restoring habitat function.

As part of a regional habitat friendly development program, Metro could develop a *Habitat-oriented Development Program* similar to Metro's Transit-oriented Development (TOD) Program to encourage construction of new developments or redevelopment that protects and restores fish and wildlife habitat. This would require funds to provide the incentives for developers to practice habitat friendly development.

Incentives for green streets

The Metro Council could establish a priority for funding transportation projects based on their impacts to regionally significant fish and wildlife habitat. A criterion could be added to the MTIP funding priorities that focuses on habitat issues, such as culvert replacement or removal, wildlife crossing improvements, or implementation of Green Streets design standards. Alternatively, a separate category or bonus points could be assigned to projects that meet habitat criteria to allow for the funding of projects that improve transportation and habitat in the region.

Property tax reduction

There are two state programs that could be applicable within the urban area: the *Riparian Lands Tax Incentive Program* and the *Wildlife Habitat Conservation and Management Program*. Both programs would require county or city action to be implemented. The riparian tax incentive program allows for a tax exemption for property within 100 feet of a stream provided the land is protected and managed for habitat value. The program is limited to 200 stream miles per county. The wildlife habitat program allows designated habitat land to be taxed at a special, reduced rate as long as it is protected and managed for habitat value. This program is not limited by acres and can be applied to riparian or upland habitat.

Habitat protection and restoration may be most effective ecologically if applied strategically, for example, in a specific stream reach or headwater area. This tool could serve as an important incentive to encourage landowners to work in a coordinated fashion to leverage ecological improvements in a specific area. If used on a "first-come, first-served" basis there may be a scattered approach and less ecological benefit overall. A downside to using property tax relief as a tool for habitat protection is that a landowner can leave the program at any time, the only penalty being payment of back taxes, similar to opting out of a farm or forest tax deferral program.

Issues to consider for implementation in Metro region

Opportunities	Constraints
• Incentives can provide the necessary encouragement for people who already want to protect and restore fish and wildlife habitat. • An incentive allows for more people to be reached, providing more opportunities for technical assistance and education. • Willing participants. • Incentives can be incorporated with regulations to achieve better results. • Can achieve restoration of degraded habitat.	• Incentives require an investment of both money and staff time. • Habitat is protected on a haphazard basis. • Voluntary protection can result in impermanent protection over time

RECOMMENDED BEST MANAGEMENT PRACTICES
Class I and II Riparian and other habitats:

Metro should consider using existing resources and a variety of additional funding sources to carry out the following activities:

a. Coordinate with Centers Program to offer financial incentives for specific building projects that incorporate green development practices, especially those improving habitat conditions.
b. Provide resources to watershed councils and friends organizations to increase their stability and productivity.
c. Seek interagency and non-profit support for increased federal and state grant funding directed at watershed-based restoration activities (such as National Fish and Wildlife Foundation, USFWS Conservation and Restoration funds, EPA Smart Growth funds, etc).
d. Develop an award program to foster and recognize green development practices, similar to the now defunct Stormwater Management Design Awards Program. Sponsor a yearly award ceremony, provide certificates, and encourage media coverage.
e. Develop a Regional Fish and Wildlife Habitat Stewardship program that recognizes landowners for restoring and protecting habitat on their land. Sponsor a yearly award ceremony, provide certificates, and encourage media coverage.

f. Develop signed voluntary stewardship agreements between a property owner and Metro or another sponsor for habitat protection. Most likely to be effective when used in conjunction with small grants and long-term monitoring.
g. Provide financial incentives for green development practices in habitat areas.
h. Encourage cities and counties to implement existing property tax incentive programs within the Metro region (WHCMP and RLTIP).

Local jurisdictions should get extra points if they incorporate incentive programs for protection and restoration of regionally significant habitat.

11. Mitigation

Mitigation is the attempt to offset potential adverse effects of human activity on the environment[6]. Mitigation can be divided into two general categories: resources for which the state and federal governments control mitigation (wetlands, waters of the state), and habitats where there is no existing state or federal requirement for mitigation.

Title 3 serves as a building block for mitigation for habitat loss in areas not covered by state or federal regulations. Title 3 defines mitigation requirements for development within Title 3 Water Quality Resource Areas (WQRA) and requires "balanced cut and fill" for floodplain areas. Title 3 WQRA extend 50 feet from many of the region's year-round streams, and can extend up to 200 feet in steep slope areas.

The Title 3 Model Ordinance contains a detailed description of mitigation requirements for development in WQRA depending on the existing condition of the vegetated corridor. These requirements could be extended to currently unprotected, high-value riparian habitat in Metro's inventory. Essentially, this would mean an enhanced Title 3 program.

Local government plans also contain mitigation requirements for areas covered in their local Goal 5 programs (City of Portland's E-zones, Wilsonville's Significant Resources Overlay Zone, Hillsboro's Sensitive Lands Overlay District, etc.). Mitigation requirements under Metro's program would be most relevant for Class I and Class II riparian habitat not covered in local programs or where local programs lack mitigation requirements. However, local jurisdictions are encouraged to work closely with same-watershed jurisdictions to plan enhancement activities, and with Metro and other stakeholders to address upland habitat through voluntary measures.

[6] See appendix for local examples of habitat degradation and loss from urban development.

Issues to consider for implementation in the Metro region

Opportunities	Constraints
• Mitigation can help offset the impacts of development on water quality, fish and wildlife by requiring compensatory enhancement of riparian habitat. • Mitigation can help maintain ecosystem services. • Title 3 provides a baseline of regulatory mitigation, has already been implemented by local jurisdictions, and contains specific mitigation instructions. • In the urban area, where habitats may be altered or degraded, out-of-kind mitigation (replacing one resource type with a different type) provides an opportunity to replace low-value riparian habitat with higher-value habitat.	• Existing constraints limit the extent of new regulations (takings issues). • The urban growth boundary is space-limited. Setting high mitigation ratios would limit development opportunities in the UGB, and would create the need for mitigation lands when onsite mitigation is not an option. • The success of mitigation over time and space is uncertain. • Monitoring and enforcement are keys to success, but are often overlooked in mitigation programs. • Mitigation requirements would add to development costs.

RECOMMENDED BEST MANAGEMENT PRACTICES
Class I and II Riparian habitat:

Metro should:

a. Use mitigation efforts to support watershed plans, regional restoration program and performance measures, and create a regional tracking system.
b. Develop a regional restoration program that can support mitigation efforts locally.
c. Continue to explore potential role for regional parklands as mitigation recipients.

Local jurisdictions should be required to preserve and enhance habitat by requiring developers or others disturbing the habitat to:

a. Use strong avoid-minimize-mitigate principle, as in Title 3.
b. When mitigation is necessary, mitigate for all habitat loss/damage where Allow-Limit-Prohibit (ALP) decision is other than Allow.
c. Establish higher mitigation ratios for higher degrees of limit. Set realistic mitigation ratios (e.g., 0.5:1 for lightly limit, 1.5:1 for strictly limit) designed to offset damage from new activities.
d. Discount stormwater fees or offer other incentives to encourage onsite retention of existing riparian habitat.
e. Direct mitigation actions to strategize efforts that enhance ecological functions in habitat areas, create new habitat in strategic locations (connective habitat), restore habitat in redevelopment areas, and to preserve/restore Habitats of Concern or rare biological communities located on the site. Rare habitats may, in some cases, be offered for permanent conservation in lieu of enhancing existing habitat.
f. Permanently protect mitigated lands.
g. Include code language that facilitates restoration and removal of non-native or invasive vegetation.
h. Typically, onsite mitigation is preferred when possible. However, off-site mitigation may be encouraged when appropriate – for example, when offsite mitigation would clearly provide a stronger benefit for fish or wildlife than onsite. Except in special cases, mitigate in the same watershed where the impacts occur.

i. Allow out-of-kind enhancement/replacement when appropriate, but focus on healthy riparian systems and near-stream shade provided by Class I and Class II habitat.
j. Ensure mitigation program includes long-term monitoring ($\geq$5 years) and an adaptive management strategy that provides remedies if monitoring reveals mitigation efforts fail.
k. Coordinate with Metro to document restoration sites, activities and success.
l. To mitigate for riparian impacts, mitigation activities will need to stay primarily within existing or newly created Class I and Class II riparian.

12. Restoration

The Society for Ecological Restoration (SER) defines ecological restoration as the process of assisting the recovery and management of ecological integrity. In the urban region, where restoration of true native conditions may not be possible, the term "enhancement" is often used and is used interchangeably here with restoration.

Restoration of degraded habitat is an important component of a fish and wildlife habitat protection program. Restoration generally involves habitat improvement beyond that required through regulations to offset development impacts (mitigation). Restoration can assist the recovery of functions necessary for watershed health; in turn, healthy watersheds can support people, fish and wildlife. Efforts to protect and restore habitat can, in many instances, also benefit humans by reducing flood damage and protecting water quality[7].

Metro is a logical choice for coordinating regional watershed planning. The impacts of urbanization cannot be realistically addressed through site-specific or small-scale restoration approaches; virtually all recent restoration literature suggests that watersheds are the *minimum* spatial unit for which restoration master planning should occur. Impacts in one watershed may influence adjacent or downstream watersheds, thus all watersheds within the urban area, plus all adjacent watersheds, should be considered in a master restoration plan. NOAA Fisheries (formerly the National Marine Fisheries Service) commented on the importance of considering restoration projects in a large-scale context (2000):

> Projects planned and carried out based on at least a watershed-scale analysis and conservation plan and, where practicable, a sub-basin or basin-scale analysis and plan, are likely to be the most beneficial. NMFS strongly encourages those involved in watershed restoration to conduct assessments that identify the factors impairing watershed function, and to plan watershed restoration and conservation activities based on those assessments. Without the overview a watershed-level approach provides, habitat efforts are likely to focus on "fixes" that may prove short-lived (or even detrimental) because the underlying processes causing a particular problem may not be addressed.

Successful restoration depends on addressing the causes of environmental degradation, rather than the symptoms. Goodwin et al. (1997) suggest asking several questions related to the causes of degradation: Is the disturbance local to the riparian area or does it originate outside in the adjacent upland or watershed? Is the disturbance ongoing, and if so, can it be eliminated? And finally, will recovery occur naturally if the disturbance is removed? The answers to these questions can help guide a restoration plan.

[7] See Appendix for examples of Port of Portland restoration projects.

Issues to consider for implementation in the Metro region

Opportunities	Constraints
• Restoration master planning is more effective than piecemeal efforts. • Restoration can help offset the impacts of development on water quality, fish and wildlife by improving degraded habitat, recovering ecological function(s), and building new habitat where none currently exists. • Regional and watershed-based master planning increases the spatial scale and therefore improves potential effectiveness of restoration planning. • Large-scale master planning builds partnerships, increasing knowledge and funding opportunities. • Potential for shared database of the region's watershed conditions and restoration activities could benefit many partners and increase effectiveness.	• Complete recovery of urban ecosystems is not likely possible. • The success of in- and near-stream restoration activities can be impacted by watershed conditions – for example, imperviousness, forest cover and altered hydrologic conditions. Restoration planning will need to take such factors into account. • Restoration is expensive and funding sources need to be identified. • Monitoring restoration success is critical and will require funding.

RECOMMENDED BEST MANAGEMENT PRACTICES
Class I and II Riparian and other habitats:

Metro should:

a. Convene the experts:
  - form a multi-disciplinary group to support watershed-based restoration activities and identify technical, financial, and institutional barriers to restoration efforts
  - coordinate with Soil and Water Conservation Districts, watershed councils, local, state and federal agencies

b. Develop a regional restoration plan:
  - based on past, current, and projected future conditions
  - consider effects to and from adjacent watersheds (e.g., hydrologic alterations)
  - define regional restoration targets by watershed
  - create a regional geographic information system database drawing on watershed action plans, existing mitigation and restoration sites, Metro's regional habitat inventory and other sources of information to help identify watershed restoration priorities and track implementation and success of restoration and mitigation projects over time
  - work with partners to develop regional plan for strategic, ongoing invasive species removal

c. Increase partnerships for funding and effectiveness:
  - provide resources to watershed councils and friends organizations to increase their stability and productivity
  - consider contributing funds directly to SOLV for specific restoration projects
  - increase funds available in the NFWF restoration bank and solicit corporate donations
  - support leveraged restoration projects with partnerships similar to Americorp Japanese Knotweed and Tualatin River Keepers Gotter's Bottom projects

- seek interagency and non-profit support for increased federal and state grant funding directed at watershed-based restoration activities (such as National Fish and Wildlife Foundation, EPA Smart Growth funds, etc).

d. Prepare for initiating and managing a bond measure program:
   - coordinate with non-profit groups, local governments, citizens and others to identify regional target areas
   - identify local share funds as part of the bond measure proposal
   - create a challenge grant program to local governments and non-profit organizations to leverage the use of public bond measure funds in acquisition and restoration efforts
   - create a short-term revolving fund to purchase land in targeted areas, implement conservation easements and use surplus funds (resale revenue) to create a funding source for land management purposes

Local jurisdictions <u>should</u> promote effective fish and wildlife habitat restoration by:

a. Removing barriers to common and effective restoration practices (e.g., no onerous permitting process for non-native blackberry removal).
b. Participating in watershed planning activities across jurisdictional boundaries.

13. On-going monitoring

Long-term monitoring is important to determine whether various tools are achieving the overall goals for habitat protection. If monitoring shows that goals are not being met, adaptive management strategies may be employed to correct the problem(s).

Monitoring should be based on sound science, and be structured to allow comparisons with other data and over time to determine whether biological goals are being achieved. Some common monitoring targets include vegetative growth, presence of invasive species, biological indicators such as macroinvertebrates, water quality, and ESA-listed species presence. Some monitoring, such as water quality and invasive species, must be conducted in the field. Other monitoring efforts can be conducted using Geographic Information Systems (GIS) – for example, mapping existing near-stream vegetation and monitoring changes over time.

There are many monitoring efforts going on around the region. Agencies such as DEQ, certain local jurisdictions, Oregon Department of Agriculture, ODFW, USGS, and others have collected a variety of data through a variety of methods. There is no comprehensive survey of regional data pertaining to watershed health.

Issues to consider for implementation in the Metro region

Opportunities	Constraints
• Long-term monitoring can help determine whether regional habitat goals are being met. • Helps identify key water quality issues as well as preservation, restoration and enhancement opportunities. • Substantial baseline data exists in the region and only needs to be gathered and mapped. • GIS can be used as a relatively inexpensive, but effective, monitoring tool.	• Funds will need to be located for field-based monitoring efforts. • Existing data may not be compatible/ consistent with Metro's data needs. • Methods will need to comply with other agencies' standards (e.g., DEQ). • Monitoring certain aspects of fish and wildlife habitat – for example, connectivity – may not be possible without best

• A regional monitoring program provides an excellent partnership opportunity. • Mitigation and restoration efforts can be mapped, adding important new information to the fish and wildlife habitat inventory and enabling broad effectiveness monitoring. • Regional monitoring framework can produce a consistent and rich dataset, and considers an ecologically appropriately spatial scale. • Helps lay scientific foundation for future natural resources work. • Provides key data to other agencies and organizations, at no cost to them. • Volunteers may be recruited for certain monitoring efforts, lowering costs and increasing public interest in natural resources.	professional judgment, and will need to be repeatable. • Certain GIS constraints must be considered; for example, when streams not previously mapped are added to the streams data layer, care must be taken not to confuse new information with improved ecological conditions. • Distinguishing cumulative effects (e.g., non-point source pollution) with site-specific effects may be difficult in the urban area. • As certain watersheds increase urban land cover, cumulative effects may obscure improvements from activities such as near-stream enhancement.

RECOMMENDED BEST MANAGEMENT PRACTICES

Class I and II Riparian and other habitats:

To establish and effective regional monitoring framework, Metro should:

a. Establish a watershed-based, ongoing monitoring program for habitat quality, including restoration and mitigation accomplishments.
b. Improve baseline data on existing habitat conditions to enable monitoring of the region's progress in achieving fish and wildlife habitat targets.
c. Use existing data when available and appropriate.
d. Coordinate with other departments and agencies collecting data to improve exchange of information and consistency.
e. Participate on state and local task forces to share information on restoration and monitoring methods and results.
f. Seek partnerships to monitor long-term health of mitigation and restoration projects.
g. Work with partners to gain additional grant funding to support monitoring programs.
h. Work with stakeholders to set watershed-based targets and a series of straightforward, ecologically relevant, repeatable measurements/indicators of success.
i. Use GIS tools to map and measure changes in habitat location, quality and quantity (e.g., changes in each habitat class; changes in near-stream or overall canopy cover). Include some field-based monitoring components, such as macroinvertebrate communities, basic water quality, and temperature. Base monitoring components on Metro's fish and wildlife habitat objectives, targets and indicators.
j. Include an adaptive management component that responds to regional monitoring findings. Adaptive management incorporates research into conservation action. Specifically, it is the integration of design, management, and monitoring to systematically test assumptions in order to adapt and learn.
k. Incorporate a citizen or student volunteer monitoring effort element (for example, temperature monitoring).
l. Require jurisdictions to update data layers (e.g., streams, wetlands) and provide the data to Metro's Data Resources Center in a standardized form.
m. Publish monitoring results reports and make data freely available to others.

Acknowledgement:

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