Willamette River
TMDL Implementation Plan

City of West Linn, Oregon

March 31, 2008

Prepared for:

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Table 1-1 Acronyms and Abbreviations

1200-C	DEQ Erosion Control Permit for Construction Activities
ACWA	Oregon Association of Clean Water Agencies
BLM	Bureau of Land Management
BMP	Best Management Practice
CFR	Code of Federal Regulations
CS	Construction Site Standards
CWA	Federal Clean Water Act
CWR	Cold Water Refugia
DEQ	Oregon Department of Environmental Quality
DS	Development Standards
ESA	Endangered Species Act
FTE	Full Time Equivalent
ID	Illicit Discharges
IDDE	Illicit Discharge Detection and Elimination
MEP	Maximum Extent Practicable
MOA	Memorandum of Agreement
MOU	Memorandum of Understanding
MS4	Municipal Separate Storm Sewer System
NPDES	National Pollutant Discharge Elimination System
O&M	Operations and Maintenance
OAR	Oregon Administrative Rule
PE	Public Education
PF	Program Funding
PI	Public Involvement
PY	Permit Year
QA/QC	Quality Assurance and Quality Control
ROW	Right of Way
RR	Record Keeping and Reporting
SRF	State Revolving Fund
SWMP	Stormwater Management Program
TMDL	Total Maximum Daily Load
UA	Urbanized Area
UIC	Underground Injection Control
USEPA	United States Environmental Protection Agency
WPCF	Water Pollution Control Facilities

1.0 Introduction and Background

The Oregon Department of Environmental Quality (DEQ) has set Total Maximum Daily Loads (TMDLs) for water bodies located in the Willamette River Basin. Any agency or municipality that has legal authority over activities or areas that are sources of pollutants that impact water quality are known as Designated Management Agencies (DMAs). DMAs that are responsible for areas discharging to a TMDL water body must develop an Implementation Plan describing strategies to be undertaken to address TMDL pollutants (DEQ 2006).

The City of West Linn, located on the border of the Tualatin River Subbasin and the Middle Willamette and Lower Willamette Subbasins of the Willamette River, must comply with this requirement. This requirement specifically pertains to those areas of the City that discharge to the Willamette River. However, areas in the Tualatin River basin are exempt from these requirements for parameters that have already been addressed and covered as part of the Tualatin River TMDL. The TMDL parameters of concern for the Lower and Middle Willamette subbasins include temperature, bacteria, and mercury. This document represents the TMDL Implementation Plan for the City of West Linn, specifically addressing the Willamette River TMDL for temperature. A detailed overview of management strategies for bacteria and mercury is also provided in this plan, although compliance with the TMDL for these parameters is covered by the City's MS4 NPDES stormwater permit.

This document is arranged in five sections. Section 1.0 provides an overview of the TMDL Implementation Plan and provides background on the Willamette River TMDL with respect to West Linn. Section 2.0 provides an overview of how the City's MS4 NPDES permit addresses TMDL compliance with respect to bacteria and mercury. Section 3.0 provides the temperature portion of the TMDL Implementation Plan. Section 4.0 provides evidence of compliance with land use requirements. Section 5.0 discusses additional elements required in the Water Quality Management Plan (WQMP) for the Willamette River TMDL: public involvement, fiscal analysis, legal authority, and cold water refugia.

1.1 Total Maximum Daily Loads Summary

The Federal Clean Water Act (CWA) of 1977 gave authorization to the U.S. Environmental Protection Agency (EPA) to restore and maintain water quality in all water bodies within the United States. In response to the CWA, the EPA designated certain state agencies, DEQ for the State of Oregon, to develop water quality standards, perform water quality monitoring to understand current conditions, determine sources of pollution, and develop TMDLs as a tool to improve water quality and restore the beneficial uses of surface waters. When a water body is found not to meet water quality standards, it is first placed on the 303(d) list as an impaired water body, and the development of a TMDL follows.

A TMDL specifies the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards, and it allocates pollutant loadings among point and non-point sources, background levels, reserves for future growth, and a margin of safety. Point sources are typically defined as those sources that enter surface waters through a pipe or defined conveyance

system (i.e., municipal and industrial stormwater and/or wastewater discharges from wastewater treatment plants). Wasteload allocations (WLAs) are provided in the TMDL for point sources. Nonpoint sources are typically defined as those sources that enter surface waters through more diffuse and dispersed overland flow (e.g., surface runoff from agricultural and forested lands). Load allocations (LAs) are provided in the TMDL for nonpoint sources. Implementation plans are a DMA's response to the TMDL, describing management strategies that they will implement and monitor to mitigate excess loading of TMDL pollutants (DEQ 2006).

In September 2006, DEQ issued a TMDL for nine subbasins within the Willamette River Basin in an effort to protect and restore the beneficial uses of the Willamette River. This TMDL is the largest TMDL undertaken by the DEQ thus far. The Willamette River watershed is divided into 12 subbasins; however, the Tualatin Subbasin is not covered under this TMDL for bacteria and temperature since it already has a TMDL in place for those parameters, and the Molalla/Pudding and Yamhill Subbasins are still under review by DEQ. Mercury, bacteria, and temperature have been identified as problematic constituents for the Willamette River. Additional pollutants have been identified as problematic for specific tributaries and portions of the mainstem Willamette River; these pollutants are dissolved oxygen, turbidity, and toxics and are not covered under the scope of this plan as they are not listed of concern in areas covered by West Linn (DEQ 2006).

Chapter 14 of the Willamette River TMDL provides a Water Quality Management Plan, which presents management measures for jurisdictions discharging to the Willamette River, in order to comply with the TMDL requirements. In addition, a TMDL Implementation Plan Guidance for State and Local DMAs (May 2007) is available to jurisdictions to assist in preparing their individual TMDL Implementation Plans. Both documents are referenced in the preparation of this TMDL Implementation Plan.

1.2 Willamette River and the Middle and Lower Willamette Subbasins

The Willamette River watershed encompasses 11,500 square miles and is home to 70% of Oregon's population, which equates to over two million people (DEQ 2006). The Willamette River and its tributaries are an important resource for residents of the watershed, providing beneficial uses such as private and public drinking water supply, industrial water supply, irrigation, recreation, aesthetic quality, natural habitat, and other functions.

West Linn falls within the boundaries of both the Middle and Lower Willamette Subbasins of the Willamette River (Figure 1-1). Together, these two subbasins include portions of seven counties and 30 cities, encompassing a total of 1,106 square miles.

The Lower Willamette Subbasin is situated in the northern portion of the Willamette Basin. Its boundary extends from the foothills of the Cascades on the east side of the Willamette River to the Tualatin divide on the west, from the City of St. Helens to the northeast, and to the Willamette Falls at river mile (RM) 26.6 to the south. Included in this subbasin is the City of Portland, which is Oregon's largest city. The area in this subbasin is almost completely privately owned, with some scattering of land owned by the U.S. Forest Service and state wildlife refuges in the northwest and lowlands near Sturgeon Lake. Primary land use includes urban, forestry, and agriculture.

Insert Figure 1-1

The Middle Willamette Subbasin includes area draining to the Willamette River from Willamette Falls at River Mile 26.6 to River Mile 108. From the East, the Middle Willamette Subbasin drains a portion of the Cascade foothills, and from the west drains a portion of the Coast Range. The subbasin is further divided into the following four smaller watersheds: Abernethy Creek Watershed, Mill Creek Watershed, Rickreal Creek Watershed, and Willamette River/Chehalem Creek Watershed. Although there are small areas of public land located throughout the subbasin, it is comprised primarily of private land. Chief land uses include agriculture, forestry, and urban activities.

1.3 City of West Linn Background

The City of West Linn is located in Clackamas County and covers approximately seven square miles. The City is bounded on the north by the City of Lake Oswego, on the west by unincorporated Clackamas County, and on the east by the Willamette River (Figure 1-1). West Linn has a population of approximately 24,200 (City of West Linn website). The City is primarily a residential community with commercial land use typically isolated to the corridor along Highway 43 (West Linn IER 2006).

There are a number of perennial streams within the City of West Linn that drain to the Willamette and Tualatin Rivers (Figure 1-2). Tanner Creek and other smaller tributaries drain approximately 87% of the city area to the Willamette River. The remainder is routed to the Tualatin River through small tributaries such as Fritchie and Stevens Creek (West Linn IER 2006). The Tualatin River currently has a TMDL in place for phosphorous, dissolved oxygen, , bacteria, and temperature. Major transportation corridors of I-205 and OR-43 run through the City. It should be noted that these highways are under Oregon Department of Transportation (ODOT) jurisdiction and this TMDL Implementation Plan does not cover those areas. In addition, with respect to bacteria and temperature, this TMDL Implementation Plan does not pertain to those areas of the City that drain to the Tualatin River, as a TMDL with separate requirements is already in place for these tributary areas.

West Linn obtained a municipal separate storm sewer system (MS4) National Pollutant Discharge Elimination System (NPDES) permit from DEQ for its municipal stormwater discharges to surface waters as a co-permittee on Clackamas County's Phase 1 MS4 NPDES permit. The City's municipal stormwater discharges are considered to be point sources since they are covered by a permit. West Linn includes some stormwater discharges that flow overland and enter receiving waters directly without first entering the City's stormwater conveyance system or MS4. While these discharges would typically be considered nonpoint sources, they have been included and covered under the City's NPDES permit for ease in management, and therefore the management strategies summarized in Section 2.0 that are listed as occurring under the City's NPDES permit cover these areas as well.

1.4 TMDL and Implementation Plan Goals

The primary goal of the Willamette River TMDL is to ensure that standards for temperature, bacteria, and mercury are not exceeded because waterways that are too warm will not support healthy fish rearing and spawning habitat; bacteria-contaminated water can cause illness in humans; and elevated levels of mercury have resulted in health advisories to limit the amount of

Insert Figure 1-2

fish that can be safely consumed. The goal of this implementation plan is to meet TMDL requirements by developing management strategies and schedules to minimize pollutant loads of heat energy (temperature). Another goal is to provide an overview (for reference purposes only) of management strategies and schedules that are implemented under the City's MS4 NPDES stormwater permit to comply with the bacteria and mercury portions of the TMDL.

1.5 TMDL Implementation Plan Requirements

The Willamette River TMDL addresses bacteria, mercury, and temperature. DEQ created a Water Quality Management Plan (WQMP) for the Willamette Basin TMDL in 2006 meant to provide the framework for the management strategies to attain and maintain water quality standards within the Willamette Basin (OAR 340-042-0040-(4)). Per the WQMP, these strategies are to be submitted by DMAs to the DEQ as a TMDL Implementation Plan. The TMDL Implementation Plans need to identify activities that the City is currently conducting, or planning to implement, to address the TMDL parameters and minimize their effects on receiving water quality.

For the Willamette Basin, specifically, the DMAs are to develop and submit these plans to the DEQ within 18 months after the release of the final TMDLs. The final TMDLs were released on September 21, 2006; consequently the TMDL Implementation Plans developed by the DMAs are due by March 31, 2008.

Oregon Administrative Rule (OAR) 340-042-0080(3), requires the TMDL Implementation Plan to cover the following five components:

1. Management strategies that the DMA or other responsible person will use to achieve load allocations and reduce pollutant loading;

2. A timeline and schedule to achieve measurable milestones;

3. A plan for performance monitoring and periodic review and revision of the implementation plan;

4. Evidence of compliance with applicable statewide land use requirements; and

5. Any other analyses or information as specified in the Water Quality Management Plan.

Note: It should be noted that under the first requirement above, this implementation plan is associated with strategies to achieve load allocations. Waste load allocations are covered through water quality permits for those sources (in this case the City's MS4 NPDES permit).

Section 2.0 provides an overview and reference regarding strategies in the City's MS4 NPDES permit that address TMDL compliance for bacteria and mercury. The first three requirements above are discussed separately for temperature and are covered in Section 3.0. The fourth requirement requires evaluation of the plan's conformance with the City's land use goals and comprehensive plan. This is covered in Section 4.0. The fifth requirement, discussed in Section

5.0, addresses additional items identified in the WQMP that the DMA must address. These items include:

- Determine how best to provide for public involvement;
- Analyze funding to determine what additional resources are necessary to develop, implement, and maintain the management strategies;
- Include citations and brief descriptions of legal authority used to carry out the management strategies; and
- Address areas of cold water refugia.

2.0 Bacteria and Mercury TMDLs

As described in Section 1.0, a TMDL specifies the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards, and it allocates pollutant loadings among point and non-point sources, background levels, reserves for future growth, and a margin of safety. WLAs are provided for point sources (e.g., municipal and industrial stormwater and wastewater) and LAs are provided for nonpoint sources (e.g., surface runoff from agricultural and forested lands). Excess bacteria and mercury in the Willamette River Basin come from both "point" and "nonpoint" sources.

West Linn obtained a MS4 NPDES permit from DEQ for its municipal stormwater discharges to surface waters (i.e., their point sources). The City does not operate its own wastewater treatment plant; therefore, all municipal point sources of bacteria and mercury are represented by stormwater discharges and covered under the City's MS4 NPDES permit. As described in Section 1.0, West Linn includes some stormwater discharges that flow overland and enter receiving waters directly without first entering the City's conveyance system (i.e., nonpoint sources). However, for ease of management, the NPDES permit best management practices (BMPs) have been voluntarily applied to these sources as well, and they have been considered to be subject to waste load allocations for stormwater discharges provided in the TMDL. Therefore, the City does not have any sources of bacteria and mercury that would be subject to load allocations under the TMDL. The City's MS4 NPDES permit serves as the Willamette River TMDL Implementation Plan for bacteria and mercury. The purpose of this section is only to provide an overview of the strategies, schedules, and monitoring activities that address bacteria and mercury that are included as part of the NPDES permit.

2.1 Management Strategies

In order to condense and streamline requirements for multiple management plans that address the same issue, DEQ addresses TMDL requirements within the City's MS4 NPDES permit as they pertain to wasteload allocations for stormwater runoff. With respect to TMDLs, the NPDES permit requires West Linn to develop benchmarks towards meeting TMDL wasteload allocations and requires an adaptive management approach that focuses on refining BMPs over time until wasteload allocations are achieved.

As mentioned above, West Linn's MS4 NPDES permit serves as meeting their Willamette River TMDL requirements for bacteria and mercury. The purpose of this section is only to provide an overview of West Linn's management strategies included in their permit that address bacteria and mercury. These management strategies are listed and summarized in Appendix A. More detail related to each of these practices is provided in the City's Stormwater Management Plan (SWMP) that was included in their Interim Evaluation Report submitted to DEQ in May of 2006. Annual reports are prepared by West Linn and submitted to DEQ by November 1st of each year to summarize annual progress with respect to implementing SWMP best management practices. A summary of the most recent annual report is also provided in the table in Appendix A. This stormwater management plan is an evolving document. Adaptive management may result in changes that are reported in the annual compliance reports. In addition, the City is currently working on an update to the plan for their permit renewal submittal in the fall of 2008.

Therefore, Appendix A only represents the current SWMP through the end of the permit term in 2009.

Since the Willamette River TMDL had not been finalized when the City's NPDES permit was issued in 2004, the requirement to develop benchmarks for the Willamette River TMDL parameters (bacteria and mercury) did not yet apply. However, as mentioned, the City is required to submit an application to renew their permit in the fall of 2008. Benchmarks for bacteria with respect to Willamette River wasteload allocations will be included in the permit renewal application. Mercury is a phased TMDL with monitoring requirements expected for the first phase to support DEQ's development of wasteload allocations for the second phase. A requirement for the development of benchmarks for mercury will apply when DEQ develops wasteload allocations for mercury.

2.2 Timeline and Schedule

The City's NPDES stormwater management plan includes measurable goals for each BMP. These represent the schedule for implementing the TMDL implementation strategies for bacteria and mercury. The table in Appendix A includes the schedules that are currently listed in the City's SWMP for each best management practice. As mentioned, these goals have the potential to change on an annual basis through adaptive management.

2.3 Monitoring

Two types of monitoring are described in this section. Implementation monitoring relates to the tracking of BMP (management strategy) implementation and ensuring that BMP implementation goals are met. Effectiveness monitoring relates to the analysis and evaluation of stormwater and instream concentrations of pollutants with respect to meeting pollutant load reduction benchmarks.

2.3.1 Implementation Monitoring

With respect to implementation monitoring, West Linn is required to submit an annual compliance report that summarizes implementation activities for all BMPs in their NPDES stormwater management plan. Along with each BMP, the table in Appendix A includes a list of measurable goals and also provides an example of what the City's annual stormwater reports include as far as tracking and recording activities associated with those measurable goals (i.e., implementation tracking measures).

2.3.2 Effectiveness Monitoring

The City of West Linn has been conducting effectiveness monitoring in the form of sample collection and analysis at various instream and stormwater outfall sites throughout the City. Stormwater quality related monitoring activities are conducted in conjunction with the monitoring requirements listed in their MS4 NPDES permit. The City of West Linn is currently participating in a coordinated monitoring program with six Clackamas County co-permittees. Under the current permit, West Linn is collecting samples from three instream sites and one

outfall site. Samples collected from these sites are analyzed for a list of parameters including bacteria. The City is awaiting instruction from DEQ related to mercury monitoring. DEQ has been working on a mercury monitoring order for MS4 NPDES permittees for over a year. When the order is received, the monitoring plan will be revised accordingly. See the most current version of the City's stormwater management plan for the City's most current monitoring plan.

3.0 Temperature TMDL

DMAs, including the City of West Linn, must develop temperature TMDL implementation plans in order to address total maximum daily load allocations for temperature, as mandated in the Willamette River TMDL. These plans must describe how each DMA will reduce temperature in order to meet water quality standards. The method most often used for reducing water temperatures is the installation of riparian vegetation where it is lacking along the banks of a stream. As riparian vegetation matures, it produces shade and creates a microclimate around the waterway that regulates and minimizes heating from solar radiation. Although other techniques are available for reducing water temperatures, the installation of native riparian corridors provides a cost-effective and relatively simple (low engineering/earthwork) approach that provides ancillary benefits beyond temperature regulation. Ancillary benefits include primary production of organic materials, source of large woody debris for in-stream channel complexity and habitat features, wildlife corridor connectivity, displacement of noxious vegetation, improved bank stability, and improved visual aesthetics.

Salmonids require cool, well-oxygenated water to survive. Elevated water temperature is a common problem in many tributaries to the Willamette River, resulting in TMDL load allocations and waste load allocations designed to protect and remedy impaired aquatic habitats. Water temperatures in excess of water quality standards make streams unsuitable for coldwater fish and other coldwater aquatic species. Excessively warm streams lead to a variety of ill effects on many salmon and trout species, ranging from decreased spawning success to death (EPA 2003). Given the opportunity, juvenile and adult salmon will occupy water that is 13-18º C (55-64º F), with warmer water selected only if excess food is available. Water temperatures of approximately 23-25º C (73-77º F) are lethal to salmon and steelhead. Colder water is required for spawning, as genetic abnormalities or mortality of salmonid eggs can occur above 11º C (52º F) (WDOE 2000). The maximum temperature that salmonids can tolerate varies with species, life-stage (e.g., fry, fingerling or adult), prior acclimation, oxygen availability, duration of warmer temperature, and the presence of pollutants.

The purpose of this section is to describe West Linn's development of an implementation plan to address temperature. Section 3.1 provides a documented summary of the load allocations and shade curves that are provided in the Willamette TMDL. Section 3.2 provides a summary of an analysis conducted to evaluate existing shade in West Linn's riparian areas. Section 3.3 describes the City's strategies for addressing effective shade given the results of the riparian area analysis. Section 3.4 outlines the timeline and schedule for implementation, and Section 3.5 summarizes proposed monitoring.

3.1 TMDL Load Allocations for Temperature

There are several factors that can contribute to elevated instream temperatures such as changes in watershed processes and channel morphology, climate, geographic location, riparian vegetation, dams, reservoirs, and point sources such as industrial waste water discharges (DEQ 2006). DEQ has found that the largest contributor to elevated temperatures is the increased impacts from solar radiation loads due to disturbances of riparian vegetation. In response to this finding, DEQ has defined effective shade targets as a surrogate measure for addressing temperature. Effective

shade is determined through the use of shade curves on a region-specific basis. DEQ has developed region specific shade curves for areas within the Willamette Basin. The shade curves, used along with stream orientation and width, provide a target for percent effective shade and corresponding solar radiation loading (DEQ 2006).

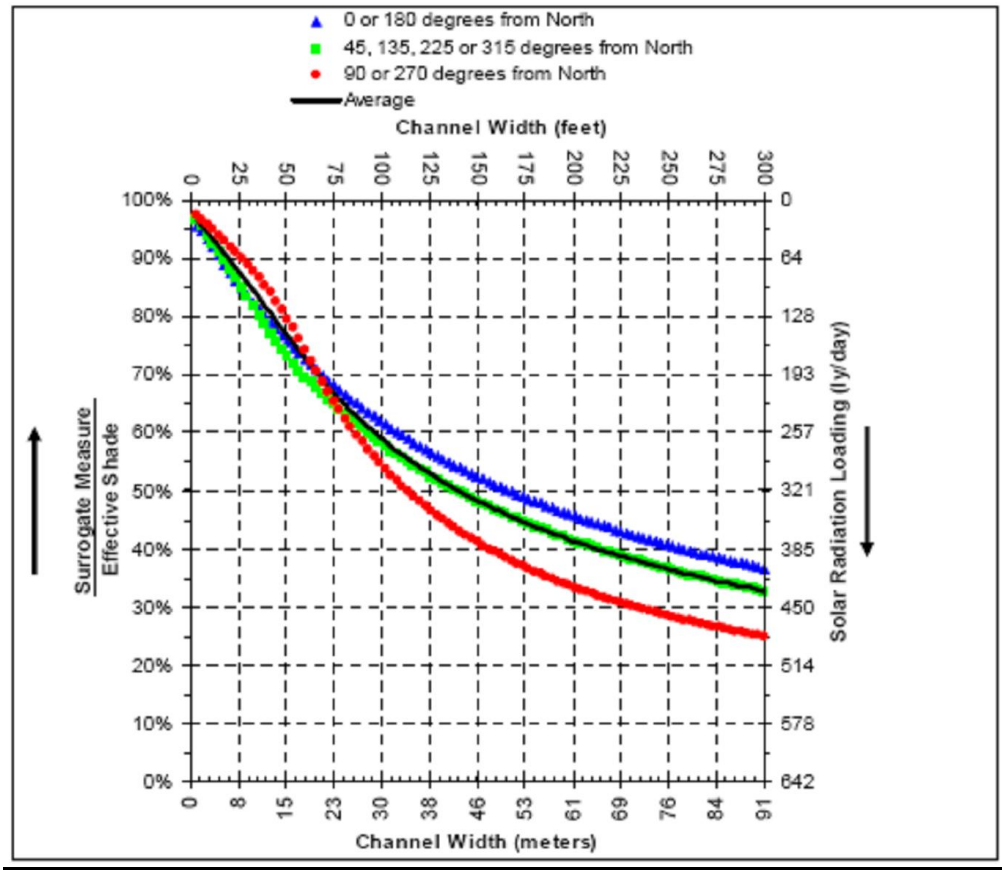
Shade is more effective on narrower streams than wider streams because shadows from trees in the riparian zone will cover a larger percent of water surface. Since the majority of the Willamette River's tributaries within the City of West Linn's urban growth boundary (UGB) are 20 feet wide or less, riparian vegetation casting shade over the streams is expected to be very effective. DEQ developed shade curves to project the effective shade that riparian vegetation would provide at maturity.

Different vegetation types have the capability of providing a different amount a shade. Since vegetation can vary regionally, the shade curves created by DEQ and presented in the Willamette TMDL were created to make certain system potential vegetation characteristics for each geographic area were taken into account appropriately when projecting effective shade goals. For the Lower Willamette Subbasin, shade curves were created based on ecoregions. Ecoregions describe regions with relative likeness of ecological systems and are identified through patterns of soil composition, vegetation, climate, and topography (DEQ 2006). Potential vegetation type, height, canopy overhang, and canopy density were estimated for each identified ecoregion within the Lower Willamette Subbasin, and subsequently used to develop the shade curves. West Linn falls within two ecoregions: 1) Willamette Valley Prairie Terraces, and 2) Willamette Valley Foothills.

As mentioned in Section 1, a portion of West Linn falls within the Middle Willamette Subbasin. Per the Willamette TMDL document, DEQ projected regional potential vegetation for areas within the Middle Willamette Subbasin through the designation of geomorphic units rather than the ecoregion approach taken for the Lower Willamette Subbasin. Generally, geomorphic units can be described as units classified by specific soil characteristics differentiated in terms of surface deposits through processes such as erosion, sediment transport, and deposition (DEQ 2006). These geomorphic units were then used to project potential vegetation for the creation of shade curves. The area of West Linn falls within the Tertiary Columbia River Basalt (Tcr) geomorphic unit.

Once the region-specific shade curve is selected, it is used along with knowledge of the stream channel width and stream aspect to project the effective shade goal at vegetation maturity for the specific location in question. Although portions of West Linn fall within three designated areas for determining effective shade, they all provide approximately the same effective shade percentage for streams 20 feet wide. The majority of the City falls within the Willamette Valley Prairie Terraces ecoregion of the Lower Willamette Subbasin, associated with the shade curve, Figure 5.71 of Chapter 5 of the Willamette River TMDL and is shown below as Figure 3-1. As mentioned above, this curve was generated assuming soils, vegetation, climate, and topography specific to the City of West Linn. This is meant to act as guideline, since site specific conditions could inhibit the vegetation from reaching the height and overhang values used to generate the curves (DEQ 2006).

Figure 3-1: Effective Shade Curve for West Linn



Since most tributaries within the City of West Linn's UGB are less than 20 feet wide, the percent effective shade was taken from Figure 3-1 using a channel width range of 0-20 feet. This resulted in an effective shade goal for the City of between 90% - 98%. This is interpreted to mean historically prevalent riparian vegetation should block the majority (at least 90%) of solar radiation loading from the streams' water surface. It should be noted that based on this curve, percent effective shade decreases significantly as the width of the channel increases. Because of this, the most effective way to manage temperature in the mainstem of the Willamette River is through its smaller, narrower tributaries. To relate these shade goals to West Linn, an analysis was conducted to evaluate the current condition of riparian areas and to identify opportunity areas for shading. The analysis is described in the following section.

3.2 Analysis of Current Riparian Area Conditions With Respect to Shade

The City of Gresham along with Pacific Habitat Services conducted a study on the benefits of effective shade on streams (Majidi 2007). The Gresham study looked at the amount of solar radiation blocked by riparian stream buffers of varying stream widths, aspects, and groupings of streambank plantings (i.e. south only versus south and north streambank plantings). The study made a key determination that the effective shade benefit of riparian plantings is diminished beyond 50 feet from a stream edge for typical regional riparian species. Using this Gresham study, URS developed a simplified method for identifying and prioritizing riparian shade

restoration opportunities for West Linn to assist with the development of their temperature TMDL implementation plan.

The results of the Gresham study are applicable to perennial creeks averaging 20 feet in width or less. These streams receive the most effective shade benefit from riparian plantings. Larger waterways, like the Clackamas and Willamette Rivers, receive less effective shade benefit from riparian vegetation simply due to their width. Tributaries of the Willamette River within the urban growth boundary for West Linn are generally less than 20 feet wide. Therefore, a 50 foot vegetated area on each side of a stream was used as the goal for West Linn tributaries. The following text outlines the steps conducted to identify and prioritize areas for shading.

The first step in identifying opportunity areas was to create a core riparian study area that includes all areas within 50 feet of the ordinary high water mark (OHWM) of a stream. This resulted in a study area that was approximately 120 feet wide in cross section within the West Linn urban growth boundary consisting of a 50^{ft} buffer + stream width (up to 20^{ft}) + 50^{ft} buffer. Where the OHWM wasn't delineated, and only the stream centerline was available, the buffer was increased to ~60 feet to include the width of the stream. This buffer area was created using the City's stormwater geodatabase.

The next step was the identification and elimination of hard and soft planting "constraints" from the study area. Hard constraints included all impervious areas and areas where streams are routed beneath the ground surface (generally through culverts). However, it should be noted that large/ long culverts (such as those under highways) were removed from the study area altogether. Soft constraints included roadway, utility, and/or rail right-of-way (ROW) corridors as these generally have planting restrictions. Some ROW corridors may be planted with shrubs but most do not allow trees to be planted as they reduce aerial visibility, which is required for safety/maintenance flyovers. Soft constraints included wetland areas that are too deeply inundated at various periods of the growing season to support mature woody vegetation and seasonal streams that lack surface water during the summer when temperature standards are most likely to be exceeded. Thus, shade is ineffective in substantially reducing water temperatures in these areas. Where detailed wetland data were available, wetlands capable of being planted with trees (e.g. potential forested wetlands) are not considered to be a constraint. In fact, forested wetlands provide some of the best opportunities for thermoregulation in perennially saturated areas due to the slow movement of water and often spring-fed water sources.

Within the remaining unconstrained portions of the study area, high-resolution aerial photography and other GIS data were used to delineate areas that appeared devoid of mature woody vegetation. Aerial photography data provided to URS by West Linn included 2006 color aerial photography, false infrared photography (same year), and 2005 leaf-off aerial photos. Other GIS data used in this step include digital elevation model datasets, 2-foot topographic contours, local wetlands inventory data, and existing riparian delineation data. These sources further illuminated areas where mature vegetation would be most beneficial. The resulting delineated areas are the identified opportunity areas.

The analysis yielded a total of 540 shade opportunity sites within the City's Willamette River watershed area. Again, these opportunity sites were only identified for the portion of the City within the UGB that discharges to the Willamette River outside of the Tualatin River basin. A

site includes all individual shade opportunity patches within an individual tax parcel. Although some shade opportunity sites are contiguous with other opportunity sites located on an adjacent tax parcel, it was assumed that they would require separate land use and protection agreements, and thus were considered different sites.

The overall riparian study area used to determine the shade opportunity sites is approximately 346 acres, comprising approximately 28.5 lineal stream miles, all within the city limits. Of the 28.5 lineal stream miles, approximately five lineal stream miles were identified as potential opportunity areas for planting to provide shade. The majority of the study area is already shaded by mature vegetation. In addition, many segments of the streams throughout West Linn are constrained from planting as they are buried and flow through underground pipes and culverts. Table 3-1 summarizes the breakdown of the study area by description.

The acreage identified as opportunity area in Table 3-1 is a conservative estimate, as the acreage was determined assuming a planting area of 50 feet on either side of the stream. In many cases, the stream width is significantly smaller than the estimated 20 feet, and therefore a planting area less than 50 feet on either side of the stream would be sufficient to provide shade for the stream.

Table 3-1 Summary of Opportunity Areas for Shading

Description of Area	**Area**	**Approximate Lineal Stream Miles**	**% of Total Study Area**
Currently Shaded	271 Acres	22 miles	78%
Constraints Exist for Planting	18 Acres	1.5 miles	5%
Opportunities Exist for Planting	57 Acres	5 miles	17%
Total Study Area:	**346 acres**	**28.5 miles**	**100%**

Note: One lineal stream mile in this table represents opportunity for shading/ planting on both sides of the stream. One lineal stream mile represents two miles of shoreline streambank. Opportunity areas for planting were estimated in terms of shoreline streambank..

Based on these results, two major strategies emerged for meeting shade targets: the development of a plan to provide shade where opportunities exist, and the implementation of protection measures for areas that are already currently shaded. In addition, measures to promote groundwater recharge may help to reduce elevated stream temperatures. These strategies are all described in Section 3.3.

3.3 Implementation Strategies

This section describes the proposed locations and measures that the City will undertake to plant effective shade along their creeks and streams in areas where opportunities exist and it also describes the measures already in place to protect riparian areas and promote groundwater recharge.

3.3.1 Opportunities for Planting to Provide Additional Shade

The 540 identified shade opportunity sites were further analyzed and prioritized for planting. This section provides the process used to prioritize and select sites.

The prioritization of shade opportunity areas was based on measures of maximum shade benefits, procedural and economic ease of site acquisition/protection, duration of shade (stream aspect), fish use, size, and proximity to potential cold water thermal refugia. Each site was numerically scored as described below for the following factors:

- Ease of Acquisition/Protection: Public site (score =5), private site (score =1).
- Aspect (Duration of Shade): South bank (score =5), west bank and east bank (score =4), west bank only (score =3), east bank only (score =2), or north bank only (score =1).

  Explanation: Where an opportunity for revegetation spans both sides of a creek, that opportunity offers additional microclimate benefits, which additionally regulate solar radiation. Thus, sites having west and east bank shade opportunities were scored slightly higher. For other sites that include multiple bank aspects, these sites were scored based on the highest scoring bank site involved (e.g. a site with both north and south opportunities was scored as a south bank site). Because the hottest part of the day occurs after noon, sites on the west bank of a stream received a higher score than those on the east bank. Vegetation on the south bank of a stream provides the maximum duration of shade for a stream.
- Fish Habitat Support: Opportunity downstream of an ODFW fish passage barrier (score =3) or upstream of a fish passage barrier (score =0). Note that none of the streams in West Linn are mapped as Endangered Species Act-listed fish habitat by Streamnet.
- Size: Of the 540 shade opportunity sites identified, only six were larger than one acre. Thus the size factor was scored as follows: Area $\geq$ 0.5 acre (score =5), between 0.25 acre and 0.49 acre (score =3), and area smaller than 0.24 acre (score =1)
- Protection of Cold Water Refugia (CWR): Within 50 foot buffer of CWR (score =3), within 50ft - 100ft buffer of CWR (score =1), or beyond 100^{ft} from CWR (score =0). The definition of CWR and the methods for its identification are provided in Section 5.0.

The score for each site was the sum of the five individual scoring criteria. Because there were a wide range of scores (from a low of 3 to a high of 18), the scores were broken into three subjective priority categories for mapping purposes. These priority categories allowed the high-scoring sites to be easily identified on the map (Figure 3-2), whereas using a different color code for each of the 15 different scores would be difficult to readily interpret. Sites that received a score greater than 11 (15 sites) were mapped as "high priority" opportunities. Sites that received a score of 10 or 11 (31 sites) were mapped as "medium priority" opportunities. All sites receiving a score less than 10 were mapped as "lower priority" opportunities (494 sites). These three categories were based on a subjective review of scores and were only meant to be used for highlighting the best opportunities on a map (Figure 3-3). Table 3-2 at the end of this subsection lists only those sites that scored 10 or better. These 46 high and medium priority sites are generally large areas, on public lands, and/or would potentially benefit cold water refugia.

In summary, of the approximately five lineal stream miles of shade opportunity areas or ten total miles of shoreline, approximately 2.5 miles of shoreline are associated with high and medium priority areas. Of those 2.5 miles of shoreline, 1.9 miles are publicly owned. Revegetation efforts will focus on the highest priority, public shoreline areas.

Based on soil survey data and local site knowledge, the species listed in Tables 3-3 and 3-4 are recommended for planting the shade opportunity sites depending on the hydrologic regime of an individual site. In order to estimate the resources necessary to complete a riparian planting project for all of the opportunity area, the following cost estimate was prepared. For all areas, the cost estimate assumes a six foot-on-center planting density. This planting density results in 1,210 trees per acre. Containerized and dormant cuttings should occur in the spring or fall when precipitation is abundant. If bare root plant materials are used, planting should occur in the late winter/early spring only. Summer planting will require irrigation, which is costly and not accounted for in the prices provided by this plan for planning purposes. In addition, cost estimates do not take into account property acquisitions/easements or permitting costs and site preparation costs including weed removal, as this would vary largely between sites. Plant costs are based on 1-gallon, containerized plant stock installed at six foot spacing on-center and estimated at $3/plant. Materials include a 2-day utility vehicle charge ($100/day), plant protectors ($0.50/plant), and mulch ($0.50/plant). Labor includes a crew of 4 laborers at $16/hour each (i.e., $64/hour) plus one supervisor, ($32/hour) assuming a planting rate of 40 trees per hour (i.e., 10 trees per person per hour). Under this scenario, each acre will take approximately 30 hours to install, so the cost estimate below is displayed on a per acre basis.

Table 3-3: Planting Recommendations for Lower Streambanks and Wetlands

Species (Common Name)	Scientific Name	Percentage of Area Planted
Oregon ash	*Fraxinus latifolia*	30
Black cottonwood	*Populus balsamifera* spp. *Trichocarpa*	20
Red alder	*Alnus rubra*	20
Pacific willow	*Salix lucida*	10
Red-osier dogwood	*Cornus sericea*	10
Sitka willow	*Salix sitchensis*	10

Table 3-4: Planting Recommendations for Upper Streambanks and Floodplain

Species (Common Name)	Scientific Name	Percentage of Area Planted
Red cedar	*Thuja plicata*	25
Douglas fir	*Pseudotsuga menziesii*	25
Bigleaf maple	*Acer macrophylum*	25
Red alder	*Alnus rubra*	15
Black cottonwood	*Populus balsamifera* spp. *Trichocarpa*	10

Cost Estimate:

Plants: $3,630/acre
Materials: $1,410/acre
Labor: $2,880/acre
Total per acre: $7,920

As stated above, this cost does not include permitting, summer irrigation, or site preparation costs, which could be a significant addition.

In summary, while a 50 foot buffer is a goal, many of West Linn's streams are very narrow in width (i.e., less than 10 ft.) and even smaller buffer widths will provide significant shade benefits. Therefore, when space is constrained, the City will work to maximize the benefits of the available opportunity.

The City plans to allocate $5,000 per year over the next five years to revegetation activities including planting in the prioritized opportunity areas, ground truthing, existing vegetation maintenance, and public education.

Shade opportunity sites were identified remotely using GIS and ground truthing was not conducted. Conditions may have changed since the aerial photographs were taken. Ground truthing will be conducted as the City works its way through the list of opportunity areas for planting. This will be especially important in the case of wetland areas identified by the local wetland inventory (LWI). These areas, if capable of supporting wetland trees, can potentially offer excellent thermal regulation with forest cover because water is generally moving slowly through these shaded features near the surface.

Table 3-2: Summary and Ranking of Opportunity Areas for Shading (High and Medium Priority Areas only)

Priority Score	Shade Opportunity	Tax Parcel	Acres	Lineal Shoreline Feet	Aspect	Public?	Upstream of Fish Barrier?	Proximity to Potential CWR	Drainage	Map Rank
18	Tann-3	21E36BB03600	1.22	680	S	YES	NO		Tanner Creek	High
18	Heron-1	21E24 00600	1.33	1383	S,E,N	YES	NO		Heron Creek	High
18	Tril-1	21E23DD07900	0.53	675	S,N	YES	NO		Trillium Creek	High
18	Fern-14	21E23CB04900	1.11	435	S,N	YES	NO		Fern Creek	High
18	Tann-60	21E25CC05900	0.93	1130	S	YES	NO		Tanner Creek	High
18	Tann-74	21E26DA07800	0.64	580	S,N	YES	NO		Tanner Creek	High
17	Bern-10	31E02AA00800	0.63	485	S	NO	NO	50ft	Bernert Creek	High
17	Bern-15	21E36 01700	0.59	490	S,N	NO	NO	50ft	Bernert Creek	High
17	Sun-1	22E31 00800	0.20	100	S	YES	NO	50ft	Sunset Creek	High
17	McLn-2	22E30CD04500	1.54	480	W,E	YES	NO		McLean Creek	High
17	Heron-2	21E24 00300	0.01	21	S	YES	NO	50ft	Heron Creek	High
17	Wmmt-37	21E24 00400	0.01	22	S	YES	NO	50ft	Willamette River	High
16	Tann-71	21E26DA08000	0.25	230	S,N	YES	NO		Tanner Creek	High
15	Bern-1	31E02AC00700	0.32	440	W,E	YES	NO		Bernert Creek	High
15	Sal-11	21E35AB03500	0.93	475	E	YES	NO		Salamo Creek	High
14	Bern-2	31E02AC00800	1.05	500	S,N	NO	NO		Bernert Creek	Med
14	Bern-6	31E02AC01205	1.15	460	S,N	NO	NO		Bernert Creek	Med

Priority Score	Shade Opportunity	Tax Parcel	Acres	Lineal Shoreline Feet	Aspect	Public?	Upstream of Fish Barrier?	Proximity to Potential CWR	Drainage	Map Rank
14	Bern-9	31E02AA01000	0.86	257	S,N	NO	NO		Bernert Creek	Med
14	Bern-11	31E02 00100	0.93	340	S,N	NO	NO		Bernert Creek	Med
14	Bern-60	21E35CC01000	0.01	35	S	YES	NO		Bernert Creek	Med
14	Sal-18	21E35AC09400	0.42	265	W	YES	NO		Salamo Creek	Med
14	Wmmt-2	21E36DB01800	0.05	60	S	YES	NO		Willamette River	Med
14	Tann-49	21E36 02000	0.66	150	W,E	NO	NO	100ft	Tanner Creek	Med
14	Sun-2	22E31 00900	0.36	175	W,E	NO	NO	50ft	Sunset Creek	Med
14	Bolt-19	21E25AD02700	0.02	20	S	YES	NO		Bolton Creek	Med
14	Bolt-23	22E30BC02300	0.05	100	S	YES	NO		Bolton Creek	Med
14	Barl-19	21E25AA04505	0.03	68	S	YES	NO		Barlow Creek	Med
14	Barl-31	21E25AC02223	0.12	115	S	YES	NO		Barlow Creek	Med
14	Barl-34	21E25AC02224	0.05	33	S	YES	NO		Barlow Creek	Med
14	Barl-61	21E25BD03900	0.08	120	S	YES	NO		Barlow Creek	Med
14	Tril-15	21E23CD12500	0.17	145	S	YES	NO		Trillium Creek	Med
13	Sun-8	21E36AB12203	0.22	100	W,E	YES	NO		Sunset Creek	Med
13	Sun-10	21E36AB12202	0.23	90	W,E	YES	NO		Sunset Creek	Med
13	Barl-10	21E25AA02400	0.14	80	S	NO	NO	50ft	Barlow Creek	Med
13	Heron-3	21E24AC00900	0.01	14	S	NO	NO	50ft	Heron Creek	Med

Priority Score	Shade Opportunity	Tax Parcel	Acres	Lineal Shoreline Feet	Aspect	Public?	Upstream of Fish Barrier?	Proximity to Potential CWR	Drainage	Map Rank
13	Casc-1	22E30DB00500	0.08	120	S	NO	NO	50ft	Cascade Springs Pond Creek	Med
13	Tann-51	21E36 02100	0.05	80	S	NO	NO	50ft	Tanner Creek	Med
11	Tann-4	21E36BB03800	0.12	460	S	YES	YES		Tanner Creek	Med
11	Tann-46	21E36CA00159	0.05	48	S	YES	YES		Tanner Creek	Med
11	Mary-19	21E26AA01700	0.15	300	S	YES	YES		Mary S. Young Creek	Med
11	Tann-62	21E25CC00545	0.84	660	N	YES	YES		Tanner Creek	Med
11	Tann-78	21E26DA08100	0.21	80	S,N	YES	YES		Tanner Creek	Med
11	Tann-90	21E25CC06000	0.14	152	S	YES	YES		Tanner Creek	Med
11	Tann-114	21E26A 05000	0.41	290	W	YES	YES		Tanner Creek	Med
10	Tann-30	21E36BD07100	0.29	150	E	YES	YES		Tanner Creek	Med
10	Robn-2	21E13CC05700	0.10	95	S	NO	YES	50ft	Robin Creek	Med

Insert Figure 3-2

Insert Figure 3-3 (13 pages – page 23-35)

3.3.2 Measures to Protect Existing Shaded Areas

The Willamette River TMDL defines shade as the surrogate for thermal load allocations. Encouraging the preservation and enhancement of riparian vegetation, especially shade-producing riparian vegetation, is one of the most important methods for reducing stream temperatures. To positively affect stream temperature, the amount and quality of the riparian shading must increase, so it is important to not only plant more shade-producing vegetation, but also preserve what is there. Based on the results of the shade opportunity analysis shown in Table 3-1, over three-quarters of the City of West Linn's riparian areas are already shaded. Therefore, protecting the vegetation that already exists in these areas will be an important implementation strategy.

Related to the preservation and maintenance of riparian shade, Metro developed Title 3 and Title 13, two sections of Metro's Urban Growth Management Plan that address development in the riparian corridor. Specifically, Title 3 prohibits new development within specified established buffers, and provides replanting requirements for unavoidable new development. Title 13 establishes protected areas (habitat conservation areas or HCAs) for both upland and riparian wildlife. Since preserving and restoring shade are important strategies for addressing the temperature TMDL, jurisdictions that currently comply with Title 3 and/or Title 13 are already utilizing strategies for addressing temperature. Section 3.3.2.1 describes Title 3 and Title 13 in more detail. Section 3.3.2.2 describes West Linn's efforts to comply with Metro's Urban Growth Management Plan as related to Titles 3 and 13.

3.3.2.1 Summary of Title 3/Title 13 Requirements

Title 3

Title 3, specifically the Title 3 model ordinance, was created in 1997 by Metro, which is a regional government serving the Portland metropolitan area including 25 cities. The purpose of Title 3 is to implement the Oregon Statewide Land Use Goals 6 and 7 that address protecting streams, rivers, wetlands, and floodplains. Title 3 provides this protection by avoiding, limiting, or mitigating the impact on these areas from development. This Title limits development in identified water quality resource areas (WQRAs) and flood management areas (FMAs) and it limits development that would cause any extent of erosion within the Metro Boundary. Title 3 defines the WQRA as the protected water feature and associated vegetated corridor adjacent to the water feature and provides the method for determining the appropriate width of this vegetated corridor. Native vegetation within the WQRA should be maintained, enhanced or restored, if disturbed. Metro developed the Water Quality and Flood Management Areas map identifying these areas with input from the cities and counties within the Metro region. Table 3.07-3 in Title 3 is shown below and summarizes the vegetated buffer widths for protected water features.

Table 3-5: Title 3–Required Width of Vegetated Corridor

Table 3.07-3 - Protected Water Features
(Section 3.07.340(B(2)(a))

Protected Water Feature Type (see definitions)	Slope Adjacent to Protected Water Feature	Starting Point for Measurements from Water Feature	Width of Vegetated Corridor
Primary Protected Water Features[1]	< 25%	• Edge of bankfull flow or 2-year storm level; • Delineated edge of Title 3 wetland	50 feet
Primary Protected Water Features[1]	≥ 25% for 150 feet or more[5]	• Edge of bankfull flow or 2-year storm level; • Delineated edge of Title 3 wetland	200 feet
Primary Protected Water Features[1]	≥ 25% for less than 150 feet[5]	• Edge of bankfull flow or 2-year storm level; • Delineated edge of Title 3 wetland	Distance from starting point of measurement to top of ravine (break in ≥25% slope)[3], plus 50 feet.[4]
Secondary Protected Water Features[2]	< 25%	• Edge of bankfull flow or 2-year storm level; • Delineated edge of Title 3 wetland	15 feet
Secondary Protected Water Features[2]	≥ 25%[5]	• Edge of bankfull flow or 2-year storm level; • Delineated edge of Title 3 wetland	50 feet

[1] **Primary Protected Water Features** include: all perennial streams and streams draining greater than 100 acres, Title 3 wetlands, natural lakes and springs

[2] **Secondary Protected Water Features** include intermittent streams draining 50-100 acres.

[3] Where the Protected Water Feature is confined by a ravine or gully, the top of ravine is the break in the ≥ 25% slope (see slope measurement in Appendix).

[4] A maximum reduction of 25 feet may be permitted in the width of vegetated corridor beyond the slope break if a geotechnical report demonstrates that slope is stable. To establish the width of the vegetated corridor, slope should be measured in 25-foot increments away from the water feature until slope is less than 25% (top of ravine).

[5] Vegetated corridors in excess of 50-feet for primary protected features, or in excess of 15-feet for secondary protected features, apply on steep slopes only in the *uphill* direction from the protected water feature.

The cities and counties within the Metro region were given three alternatives for implementing Title 3:

1. Amend comprehensive plans and ordinances to adopt all or part of the Title 3 model ordinance or language that substantially complies with the Title, and adopt either the Metro Water Quality and Flood Management Area map or a map that substantially complies with the Metro map;
2. Demonstrate that existing city and county comprehensive plans and ordinances already substantially comply with the performance standards and the intent of Title 3; or

3. A combination of the first two alternatives that substantially complies with all performance standards of Title 3.

To implement Title 3, many cities have adopted Table 3.07-3, along with a portion of the Title 3 model ordinance into their city code. Several exemptions are allowed for various reasons and are outlined specifically in Title 3 (Metro 1998).

Title 13

Title 13 model ordinance was created by Metro in 2006. It was created to provide clear objective standards and a discretionary review process for implementation of Oregon Statewide Land Use Goal 5. Goal 5 is focused on the protection of natural resources and open space. The purpose of Title 13 is to provide guidelines in order for local jurisdictions to 1) conserve, protect, and restore a continuous ecologically viable streamside corridor that is integrated with upland wildlife habitat and 2) control and prevent water pollution in order to protect public health and improve the region's water quality.

Title 13 focuses on regulating development that would affect riparian or upland wildlife habitat, as documented on the Habitat Conservation Area (HCA) map that Metro has produced. The HCA map was created by Metro and should be adopted by local jurisdictions in the same manner as the Water Quality and Flood Management Areas map developed for Title 3 compliance. HCA priority levels (high, medium, and low) were assigned to areas by cross-referencing habitat classifications (e.g. Class I and Class II Riparian and Class A and Class B Upland Wildlife) and urban development values.

New development restrictions differ depending on the HCA priority level as well as zoning type.

Cities and counties are given three alternatives for implementation of Title 13:

1. Adopt Title 13 model ordinance and map;
2. Demonstrate that the existing or amended comprehensive plan and ordinances "substantially" comply with the title, and existing or adopted maps also comply with Metro's HCA map; or
3. Demonstrate that an alternative program with comparable protection and restoration results has been implemented.

Several exemptions are allowed for various reasons and are outlined specifically in the title. In essence, Title 13 promotes vegetative buffers around water bodies for protection of wildlife habitat through the preservation and improvement of designated habitat conservation areas. Title 13 and its corresponding model ordinance describe specific design and construction practices to minimize impacts on wildlife corridors and fish passage. Performance and implementation objectives and measurable targets are outlined in the title, specifically related to design and construction practices that would be employed.

Metro is developing a process to monitor the region's progress toward implementation of Title 13, and cities and counties are required to submit progress reports on their efforts (Metro 2005).

Title 3 and Title 13 Comparison

Both Title 3 and Title 13 promote the protection of vegetative buffers around water bodies. In addition, both titles contain language that promotes the maintenance and restoration of native vegetation. The goal for Title 3 is to protect water quality and flood areas while Title 13 aims to protect and improve riparian and wildlife habitat. Because Title 3 and Title 13 have different goals, the methods for implementation and performance standards are not identical. Title 13 is more specific than Title 3 in that it has specific numerical targets. However, Title 13 also enables the cities to use their own discretion when defining the protective buffer areas by evaluating the economic effects (urban development values), which is not a component of Title 3 (Metro 1998 and Metro 2005).

3.3.2.2 West Linn Compliance with Title 3/13 Requirements

Chapter 32.000, Water Resource Area Protection, of West Linn's development code implements the intent of Title 3 as developed by Metro. This chapter establishes objectives to protect water resource areas, which are defined by the chapter as water features and their associated vegetated corridors. This chapter establishes a vegetative corridor protected from development with goals of "maintaining or reducing stream temperatures; maintaining natural stream corridors; minimizing erosion, nutrient and pollutant loading into water." This chapter of the City's development code specifically defines the protection and improvement of microclimate and shade in streamside areas as well as mitigation requirements for replacement of water quality and ecological values as objectives.

Chapter 32.000 also includes an adopted version of Table 3.07-3 from Title 3 (Section 3.3.2.1). The chapter also prohibits non-native or invasive species to be planted in new lawn or garden areas; prohibits uncontained areas of hazardous materials; prohibits the planting of nuisance or prohibited plants; and prohibits trimming or removing existing native vegetation unless it is meant to reestablish native vegetation in place of non-native or invasive vegetation within the water resource area. Any construction, including fill, strip, or pipe installation, is prohibited in the delineated water resource area without a permit.

Permits submitted for construction within a water resource area must fulfill numerous provisions. Examples of such provisions are that water resource areas must be identified; natural drainageways shall be maintained; and impacts on water resource areas must be minimized and alternatives avoiding negative impacts to water resource areas must be considered first. Roads, driveways, and utilities should only cross water resource areas when no practical alternatives exist. Consistent with the Title 3 model ordinance, Chapter 32.000 of West Linn's development code also provides specific mitigation requirements when it has been demonstrated that no practicable alternatives to development in the water quality resource area exists.

West Linn is currently implementing Title 3 through Chapter 32.000 of its development code. Continued implementation of Title 3 represents one of West Linn's implementation strategies for protecting existing shade along riparian corridors. Title 3 is generally enforced by the City through development review. If removal of vegetation occurs on private property, it is difficult for the City to identify the action, but the City does enforce on private property through the

City's code enforcement process, which is based on complaints received and city employee observations while on duty.

With regards to Title 13, the City has coordinated with Metro to amend their code language to also comply with Title 13 requirements, and Metro has approved of the City's efforts. The City has adopted selective wording from the Title 13 Model Ordinance into Chapter 32.000 of its development code. Specifically, reference to the two methods to accomplish the purposes of the chapter is adopted from the Title 13 Model Ordinance. These methods are to "protect and improve functions and values that contribute to fish and wildlife habitat in urban streamside areas" and to "provide mitigation standards for the replacement of both water quality values and ecological functions and values lost through development" adjacent to water resource areas. In addition, the City has conducted a separate inventory of riparian areas and amended the adopted Table 3.07-3 from Title 3 to require a 100 foot setback from areas defined as riparian corridors by the West Linn Riparian Corridor Inventory as defined in Ordinance 1545. This is more stringent than setback requirement for secondary protected water features, as required by Title 3.

Currently, the City is amending portions of the Willamette and Tualatin River Greenway sections of the City's code to also address Goal 5 and Title 13. Final adoption of these amendments is expected to occur in Summer 2008.

3.3.3 Other Measures (Design Standards for New Development)

The City of West Linn is currently undertaking measures in addition to the Water Resource Area Protection Chapter of the Community Development Code that have the potential for reducing stream temperatures. Although shade is the surrogate measure defined by DEQ to address the temperature TMDL, the City is pursuing other activities including the use of infiltration for stormwater runoff disposal activities to promote reduction in surface water temperatures.

As development occurs, increases in impervious areas can decrease the natural pre-development levels of groundwater recharge. Because less water infiltrates into the ground, less groundwater recharge occurs. This can result in a reduction of summer stream base flows which in turn results in higher temperatures due to unnaturally shallow base-flow conditions. By using best management practices and low impact development design techniques associated with development that promotes the infiltration of runoff, groundwater recharge is increased thus potentially augmenting streamflows during the warmer dry season, and reducing temperature impacts.

The City of West Linn recognizes the importance of infiltration and groundwater recharge in their Surface Water Management Plan (City of West Linn Surface Water Management Plan 2006). Chapter 4, Water Quality, references a number of structural water quality improvement techniques that promote stream and associated riparian area improvement and overall water quality enhancement. The Surface Water Management Plan references the use of tree planting and vegetative buffers for natural resource enhancement and lists a number of structural BMPs for water quality enhancement. One type of structural BMP referenced is bioswales, which can infiltrate and promote groundwater recharge. Also, the reduction of effective impervious surface is recommended as a BMP for the improvement of water quality through the use of porous

pavers and other structural, low impact development techniques. The City recognizes the fact that the increase of impervious surface has significant detrimental effects to surface water quality.

Chapter 4 of the Surface Water Management Plan also recommends that the City review existing publications as a first step in revisiting City codes and regulations in order to promote low impact development in designs. The City is already revising the West Linn Transportation System Plan to promote low-impact street design and has already implemented projects with a green street design component. In addition, the City has recently adopted the Sustainable West Linn Strategic Plan, which provides recommendations and associated timeline for various City Departments and community sectors with respect to sustainable activities. Use of native vegetation and implementation of green building practices are two such recommendations referenced.

3.4 Timeline and Schedule

This Section provides the anticipated timeline and schedule for implementation of management strategies for temperature as defined in Section 3.3.

3.4.1 Shading and Planting for Currently Exposed Areas

The City has committed to contribute $5,000 a year for the next five years towards shading and planting for those identified opportunity areas. Efforts will initially be focused on those public, high priority areas as indicated in Table 3-2. Ground truthing is expected to occur prior to planting activities, as ground truthing was not conducted when the original opportunity areas were identified. Revegetation efforts will be conducted annually in accordance with the allotted funds and the priority opportunity list from Table 3-2.

3.4.2 Protection of Existing Shaded Areas

The City of West Linn currently implements Chapter 32.000, Water Resource Area Protection, of their community development code to address the Title 3 and Title 13 requirements. The code is consistent with the Metro's Title 3 and Title 13 model ordinances and includes the City's version of Table 3.07-3 of Title 3, with the addition of a 100' buffer requirement for all inventoried riparian areas. The City will continue to enforce protection of existing shaded areas in accordance with Title 3 and Title 13 requirements through implementation of Chapter 32.000 of their community development code. The City also enforces Ordinance 1542, which encourages and promotes tree conservation and planting.

The City is currently adopting language in Chapter 28.000, Willamette River Greenway, and Chapter 29.000, Tualatin River Protection, of their community development code to further address Title 13 requirements. These items are expected to be adopted by the City Council in the Summer of 2008.

3.4.3 Other Measures

The City of West Linn is currently implementing their Surface Water Management Plan, which includes provisions allowing for infiltration practices for water quality. One recommendation of their Surface Water Management Plan is to review existing City codes in order to promote future use of low impact development techniques. The City is in the process of revising the West Linn Transportation System Plan to promote low-impact street design and has already implemented projects with a green street design component (e.g., raingardens).

3.5 Monitoring

The City of West Linn is required to submit a TMDL Implementation Plan progress report to DEQ annually, related to their implementation of identified management strategies. In order to provide progress reports, the City will track planting efforts by acreage and/ or activities. Additional information tracked will include modifications to development/ design codes where relevant to the promotion of enhanced infiltration or protection of vegetation.

With respect to effectiveness monitoring some water quality sampling and analysis conducted for the City's MS4 NPDES permit (described in Section 2.3.2), includes the collection of instream temperature samples. Progress reports for the TMDL Implementation Plan will refer to actual monitoring results if collected in close proximity to an improved riparian vegetation location and if significant data exist to make statistically sound conclusions.

4.0 Evidence of Compliance with Applicable Land Use Requirements

Oregon Administrative Rule 340-042-0080(3)(a)(D) defines one of the required elements of a TMDL implementation plan to be evidence of compliance with applicable statewide land use requirements. Per the TMDL Implementation Plan Guidance Document, this would consist of the following:

1) Identify applicable acknowledged local comprehensive plan provisions and land use regulations, and
2) Explain how the implementation plan is consistent with these local planning requirements or what steps will be taken to make the local planning requirements consistent with the implementation plan.

Per item #1 above, West Linn's Comprehensive Plan was acknowledged by the Land Conservation and Development Commission (LCDC) in 1984 to be in compliance with the Statewide Planning Goals. The Plan is periodically reviewed by the City in coordination with LCDC and updated to ensure that it continues to comply with these goals. Since then, the Plan has been amended four times (2000, 2003, 2005, and 2006). As the City's Comprehensive Plan aligns with LCDC statewide goals, there are four specific goals within West Linn's Comprehensive Plan that contain intentions similar to the strategies described in this TMDL Implementation Plan. These are Goals 5, 6, and 11.

Per item #2 above, this TMDL Implementation Plan is consistent with the City's acknowledged comprehensive plan to the extent required by law. The above mentioned goals of the City's comprehensive plan (Goals 5, 6, and 11) align with specific components of the TMDL Implementation Plan, as the two documents contain similar goals and methods for improving water quality.

Goal 5 of the City of West Linn Comprehensive Plan is titled "Open Spaces, Scenic and Historic Areas, and Natural Resources." Section 2: Natural Resources of this Goal contains policies and recommended actions pertaining to natural resources that closely correspond to the intent of this TMDL plan. Such policies and recommended actions discuss the importance of preserving riparian wildlife through zoning requirements; enhancing and expanding native vegetation for erosion prevention and improving wildlife habitat; and controlling erosion through enforcement of new development standards. These policies and recommended actions align with the BMPs discussed in Section 2.0 (and included in Appendix A) associated with control of residential and commercial post-construction runoff, and general construction site runoff, as well as the management strategies outlined in Section 3.0 of this plan to preserve and enhance riparian vegetation to meet shade targets set for meeting the temperature TMDL.

Goal 6 of the City's Comprehensive Plan is titled "Air, Water, and Land Resources Quality." Section 2, Water Quality, of Goal 6 has one general goal, "maintain or improve the quality of West Linn's water resources." Within this goal there are several more specific policies and recommended action measures that are pertinent to this TMDL plan. One example is recommended action measure 7, "to reduce storm water runoff, create and implement standards

for new development that encourage use or maintenance of permeable surfaces and discourage the creation of impervious surfaces." This aligns with strategies in Section 2.0 for bacteria and mercury, as well as alternative strategies for temperature through ground water recharge, as mentioned in Section 3.0 of this plan.

Goal 11 of the City's Comprehensive Plan is titled "Public Facilities and Services." Section 3, Storm Drainage, of this goal contains several policies and recommended action measures pertinent to the intent of this plan. The goal encourages the use of impermeable surfaces within design; requires construction practices that minimize exposed soils and erosion potential; requires the maintenance and preservation of riparian vegetation; and recommends BMPs are utilized for new and significant re-development for the reduction of stormwater pollutant discharges. Portions of Goal 11are closely aligned with the strategies discussed in Section 2.0 of this plan, as well as strategies outlined in Section 3.0 for temperature.

In general, West Linn's acknowledged comprehensive plan has components that coincide with the management strategies contained in this TMDL Implementation Plan. Based on the above findings, this TMDL plan is considered to be compatible with the land use requirements as set forth in the comprehensive plan.

5.0 Additional Requirements

The fifth component of TMDL Implementation Plans required by OAR 340-042-0025 is "any other analyses or information as specified in the Water Quality Management Plan." The WQMP for the Willamette Basin TMDL requires a summary of legal authority, a fiscal analysis, DMAs below river mile 50 of the Willamette mainstem to address areas of cold water, public involvement, and record keeping and reporting. This section addresses these requirements.

5.1 Legal Authority

The City has existing ordinances that provide authority for implementation of portions of the TMDL Implementation Plan. As the City currently operates under an MS4 NPDES permit, they have ordinances for illicit discharges, erosion control, and post-construction site runoff, as necessary to implement the BMPs outlined in their permit and to implement the management strategies described in Section 2.0 to address bacteria and mercury. MS4 NPDES annual compliance reports submitted to DEQ have also included, as required, a demonstration of continued legal authority to implement the programs outlined in the SWMP. The City also has ordinances to implement Title 3 requirements, including the establishment of a Water Resource Area for protection, in addition to having a comprehensive plan that addresses the LCDC statewide planning goals. These ordinances all pertain to the management strategies proposed to address the temperature TMDL (Section 3.0). With respect to planting, the City will focus on opportunity areas that are publicly owned. As the public sites are planted, the City will look for methods for working with private property owners to plant trees in riparian areas. Methods could potentially include education and incentive programs.

5.2 Funding

The City currently charges a storm drainage fee that pays for implementation of the BMPs described in their MS4 NPDES permit in order to comply with permit requirements. The City has recently doubled its stormwater drainage charge (SDC) for new residents. A fiscal analysis is submitted with the NPDES annual report.

Additional funds necessary for new revegetation efforts will also come from the storm drainage fee from existing customers.

5.3 Cold Water Refugia

Per the WQMP, the TMDL Implementation Plans for areas below river mile 50 of the Willamette mainstem "shall look at identifying existing cold water refugia and provide options for protecting or enhancing such areas." Cold water refugia (CWR) can be described as patches of water within a stream that are one or two degrees cooler than the surrounding ambient stream temperature resulting from the cool in-flow of tributaries and/or upwelling of groundwater. Studies indicate that CWR may provide critical habitat for salmonids in basins affected by warm temperatures (Bartholow 1995). CWR are associated with different aspects of stream morphology, including side channels, alcoves, lateral seeps, and floodplain spring brooks (Ebersole 2003). McIntosh et. al. (1998), in their study of CWR in the Klamath Basin using

forward-looking infrared (FLIR), concludes that areas of CWR appeared to be at junction where tributaries meet.

Because tributary junctions are easy to map, a likely source of cool groundwater, and associated with CWR, these tributary junction points were utilized as potential CWR. Riparian areas at tributary junctions that would be accessible to fish from the mainstem Willamette River are identified in Figure 3-1: Riparian Shade Opportunities. To address cold water refugia these identified areas were used in the ranking of shade opportunities (Section 3.3.1). If an area was identified as an opportunity area for planting, it received a higher score or ranking if it was also identified as potential cold water refugia. Using this ranking scheme, these areas will likely be addressed first when developing planting plans.

5.4 Public Involvement

DEQ has promoted public involvement for the TMDL and TMDL Implementation Plans with existing interest groups having an interest in the Willamette TMDLs. The City addresses public involvement for management measures described in Section 2.0 through their NPDES Permit and SWMP. Public involvement will be addressed for the vegetation efforts and for the TMDL Plan as a whole by maintaining a copy of the plan and progress reports at the City Library and posting the documents on the City website, available for public review.

5.5 Record Keeping and Reporting

The TMDL Guidance Document requires the DMA to submit two types of reports to DEQ on a regular basis: 1) progress report and 2) an implementation plan review report. The progress report would provide the results of implementation and monitoring, as described above in Sections 2.3 and 3.5. The progress reports would be submitted to DEQ on an annual basis.

The implementation plan review report would use existing data and other information to evaluate this TMDL Implementation Plan effectiveness relative to pollutant reduction goals. If evidence indicates that the Plan and associated management strategies are not adequate, then modifications may be considered. The implementation plan review report would be submitted to DEQ once every five years or as determined by DEQ.

6.0 References

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APPENDIX A

Summary of Strategies to Address Bacteria and Mercury for the Willamette River TMDL