CITY OF LAKE OSWEGO OREGON

TIGARD

City of Lake Oswego and the Tigard Water Service Area

Joint Water Supply System Analysis

DRAFT REPORT

July 2007

carollo

Engineers...Working Wonders With Water™

City of Lake Oswego and Tigard Water Service Area

DRAFT SUMMARY REPORT

JOINT WATER SUPPLY SYSTEM ANALYSIS

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SUMMARY REPORT

JOINT WATER SUPPLY SYSTEM ANALYSIS

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ES.1 BACKGROUND

The Cities of Lake Oswego and Tigard (Cities) retained Carollo Engineers in June 2006 to develop and evaluate options for the possible formation of a joint water supply system for the two communities. This report, which summarizes the results of the Joint Water Supply System Analysis (JWSSA), presents a range of supply alternatives, and addresses the design, financing, permitting, governance, and public outreach issues associated with implementing the proposed joint water supply system, as well as the potential impacts of conservation and interim supply alternatives.

ES.2 SUPPLY SCENARIOS

The City of Lake Oswego's (City, Lake Oswego) existing water supply system is essentially at capacity. The capacity of the existing system is 16 million gallons per day (mgd), existing demands are over 15 mgd, and projected build-out demands are 24 mgd. Therefore, Lake Oswego needs to expand their supply capacity or reduce per capita water demands substantially in the near future. The water service areas for Lake Oswego and Tigard are presented in Figures ES.1 and ES.2, respectively.

Four supply scenarios were developed to address the needs of Lake Oswego and Tigard. These scenarios are as follows:

1. Scenario 1: Existing Capacity (16 mgd)

   This scenario represents the existing demands and capacity of the Lake Oswego infrastructure.

2. Scenario 2: Future Capacity (24 mgd)

   This scenario represents the required capacity to treat the build-out demands of the Lake Oswego water service area.

3. Scenario 3: Senior Water Right Capacity (32 mgd)

   This scenario represents the capacity needed to convey the senior water rights that Lake Oswego has been permitted to withdraw from the Clackamas River.

4. Scenario 4: Combined Junior and Senior Water Right Capacity (38 mgd)

   This scenario represents the capacity needed to convey the combined junior and senior water rights that Lake Oswego has been permitted to withdraw from the Clackamas River.

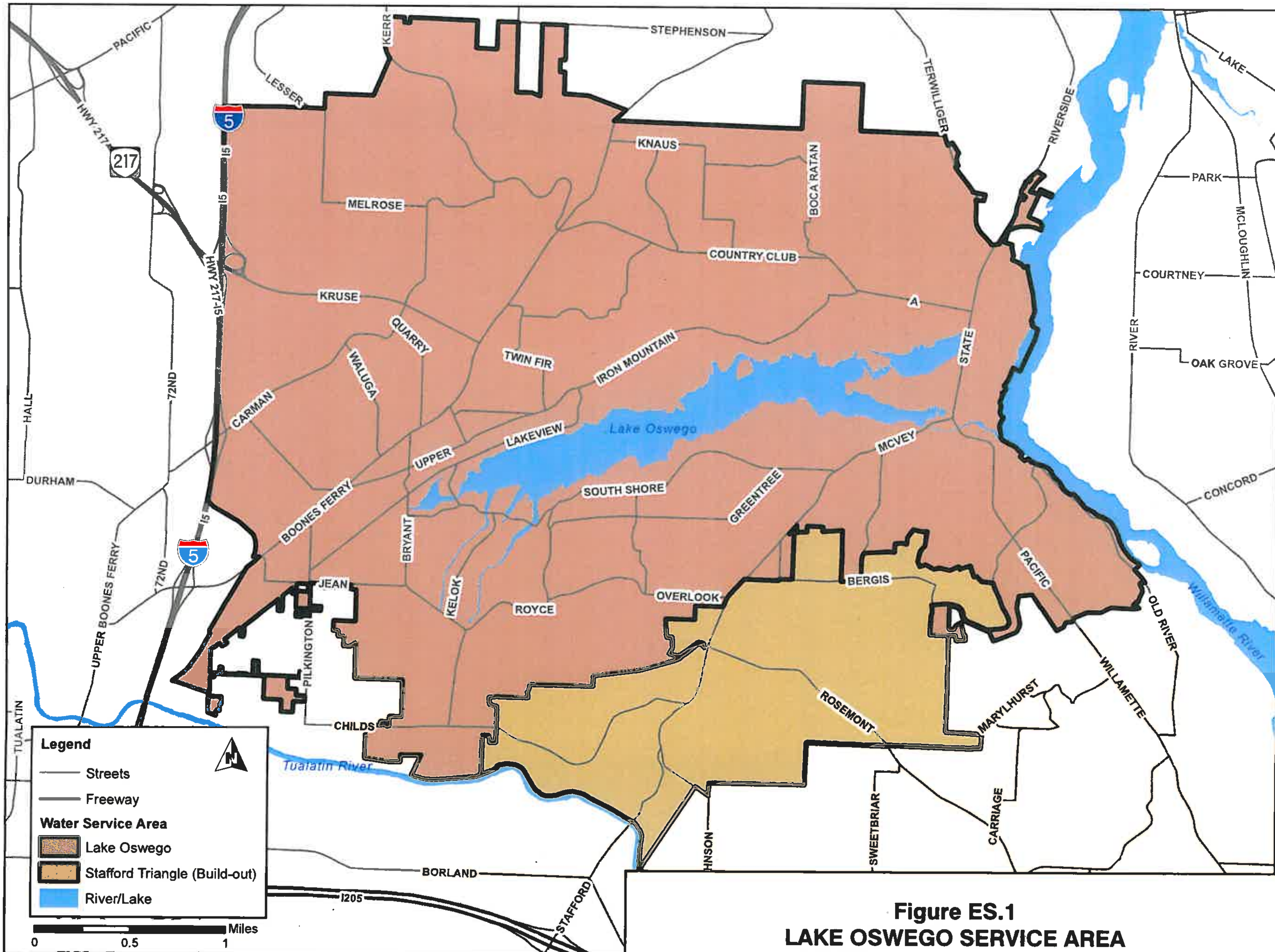

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Figure ES.1
LAKE OSWEGO SERVICE AREA
JOINT WATER SUPPLY SYSTEM ANALYSIS
CITY OF LAKE OSWEGO AND TIGARD WATER SERVICE AREA

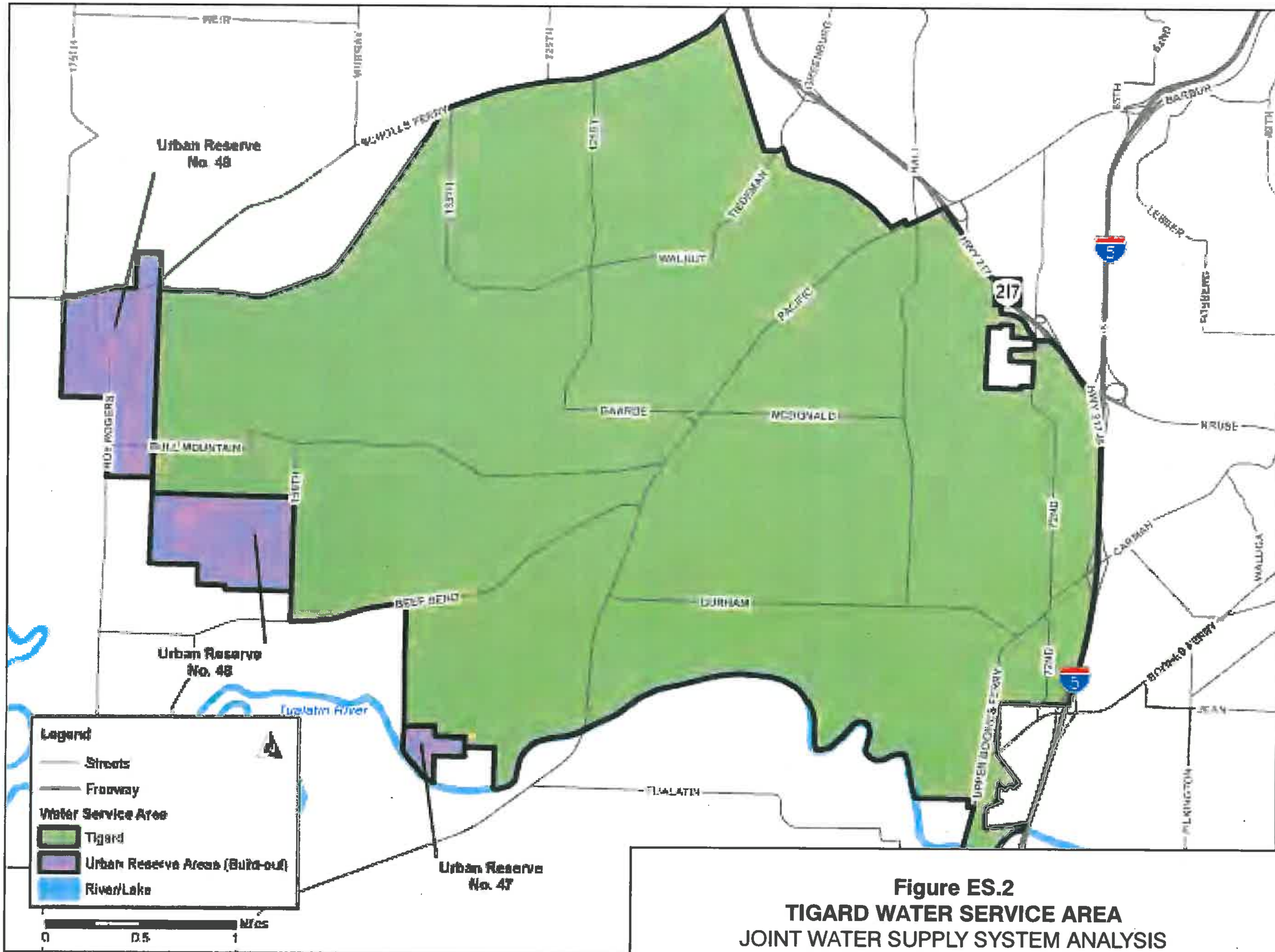

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Figure ES.2
TIGARD WATER SERVICE AREA
JOINT WATER SUPPLY SYSTEM ANALYSIS
CITY OF LAKE OSWEGO AND TIGARD WATER SERVICE AREA

ES.2.1 Capital Cost of Infrastructure Improvements

Lake Oswego's existing infrastructure is comprised of a raw water intake, treatment facility, conveyance, storage, and pumping. The capital costs for each of the supply scenarios are provided in Table ES.1.

Table ES.1 Conceptual Cost Estimate – Capital Cost[1]
Joint Water Supply System Analysis
City of Lake Oswego and Tigard Water Service Area

System Component	Scenario 1 16 mgd	Scenario 2 24 mgd	Scenario 3 32 mgd	Scenario 4 38 mgd
Clackamas River Intake	$2,000,000	$2,100,000	$4,440,000	$4,670,000
Raw Water Transmission Main	N/A	$19,890,000	$23,920,000	$23,920,000
Lake Oswego Water Treatment Plant	$3,000,000	$28,840,000	$39,430,000	$44,990,000
Finished Water Transmission Main	N/A	$25,290,000	$44,300,000	$55,240,000
Waluga Reservoir	N/A	$2,470,000	$3,820,000	$4,010,000
Bonita Pump Station	N/A	N/A	$1,480,000	$1,700,000
Total	**$5,000,000**	**$78,590,000**	**$117,390,000**	**$134,530,000**

Notes:

1. Presented in November 2006 dollars.

ES.2.2 Implementation Timing

The following assumptions were applied to development of implementation timing of component improvements for each scenario: 1) Tigard will begin using its share of the water supply infrastructure in 2016, and 2) the components of the infrastructure that are already at their maximum capacity will be improved immediately to meet the needs of Lake Oswego.

For scenarios 3 and 4, component improvements were phased to provide incremental capacity additions over time to defer costs.

Table ES.2 Implementation Capital Costs by Scenario[1]
Joint Water Supply System Analysis
City of Lake Oswego and Tigard Water Service Area

Scenario	Project Completion Date		
	Immediate[2]	2016	2020
1 (16 mgd)	$5,000,000	--	--
2 (24 mgd)	$76,120,000	--	$2,470,000
3 (32 mgd)	$88,360,000	$29,030,000	--
4 (38 mgd)	$91,450,000	$43,080,000	--

Notes:
1. Presented in November 2006 dollars.
2. Immediate improvements should be made by 2009.

Throughout the report, capital costs are presented in November 2006 dollars to facilitate comparison of scenarios. However, actual costs will be subject to construction cost escalation up to the time the improvements are actually constructed. This construction cost escalation, based on the anticipated implementation schedule for each scenario, is included in the financial evaluation of alternative scenarios. It should be further noted that because construction cost escalation is projected to occur at a rate greater than the general inflation rate[1], scenarios that are delayed beyond the anticipated implementation schedule will likely have a higher cost than the costs shown in the report. Further evaluation of the financial implications associated with delaying implementation of the proposed improvements should be conducted before final decisions are made regarding the timing of implementing Scenarios 2-4.

ES.2.3 Financial Evaluation

A financial evaluation of the supply scenarios was conducted, which presents a comparison of the economic impact of the scenarios for each City. Additionally, for the City of Tigard, an evaluation of three other water supply alternatives was developed: 1) partnership with the Joint Water Commission (JWC), 2) partnership with other regional suppliers for development of the Willamette River Project, and 3) Tigard-only development of the Willamette River Project.

A summary of the net present value of the scenarios over a 25-year timeframe is presented for Lake Oswego and Tigard, in Tables ES.3 and ES.4, respectively. The details, limitations, and assumptions for the net present value analysis are presented in Chapter 6 and Appendix D of this Summary Report. The cost sharing allocation between Tigard and Lake Oswego, the JWC, or other regional suppliers is based on a percent capacity proportion, and may need to be revised based on the terms of the institutional arrangement agreed upon between the two governments.

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[1] "Inflation is Set for a Strong Rebound; Steel and Rebar Prices Lead Resurgence in Construction Costs," McGraw Hill Construction, June 2007.

Table ES.3	Net Present Value of Lake Oswego's Supply Options (25 Year Outlook) Joint Water Supply System Analysis City of Lake Oswego and Tigard Water Service Area		
Cost Components	**Lake Oswego "Go it Alone" Scenario 2 (24 mgd)**	**Partner with Tigard Scenario 3 (32 mgd)**	**Partner with Tigard Scenario 4 (38 mgd)**
Capital Costs	$76,500,000	$61,500,000	$52,100,000
O&M Costs	$41,300,000	$33,200,000	$31,000,000
Total Costs	**$117,800,000**	**$94,700,000**	**$83,100,000**

Notes
1. Net Present Values are based on a 25-Year Outlook and include a discount factor of 5%, construction escalation rate of 6%, and a general escalation rate of 3.5%.

Table ES.4	Net Present Value of Tigard's Supply Options (25 Year Outlook) Joint Water Supply System Analysis City of Lake Oswego and Tigard Water Service Area				
Cost Components	**Partner with JWC Scenario 2A**	**Willamette With Partners Scenario 2B**	**Willamette Without Partners Scenario 2C**	**Partner with Lake Oswego Scenario 4**	**Purchase from Portland Scenario 6B**
Capital Costs	$145,800,000	$77,900,000	$183,100,000	$80,600,000	$1,400,000
O&M Costs	$17,400,000	$11,700,000	$14,600,000	$32,500,000	--
Purchased Water Costs	$33,600,000	$33,600,000	$33,6000,000	$27,800,000	$97,200,00
Total Costs	**$196,800,000**	**$123,200,000**	**$231,300,000**	**$140,900,000**	**$98,600,000**

Notes
1. Net Present Values are based on a 25-Year Outlook and include a discount factor of 5%, construction escalation rate of 6%, and a general escalation rate of 3.5%.

For Lake Oswego, the lowest cost option is to develop a joint supply with Tigard at a 38 mgd capacity (Scenario 4). Tigard's lowest cost option is to purchase water from Portland via the new gravity connection with the WCSL-Tualatin Line (see Chapter 5) for nine months of the year, and to purchase water from Portland via the existing water transmission main during the peak summer months. Tigard's second lowest cost option is to partner with other regional suppliers in the development of the Willamette River Project.

However, without the economies of scale associated with group development at the regional level, costs increase considerably. Therefore, the next the lowest cost option for Tigard is to develop a joint supply with Lake Oswego for 38 mgd (Scenario 4).

ES.3 CONSERVATION IMPACTS

As part of the JWSSA, the impacts of water conservation in Lake Oswego on the overall capacity, cost, and timing of the supply scenarios was assessed. Three scenarios were considered:

1. 5% Reduction Target, resulting in 0.5% reduction in per capita demands per year for eleven years,
2. 10% Reduction Target, resulting in 1.0% reduction in per capita demands per year for eleven years,
3. 25% Reduction Target, resulting in 2.5% reduction in per capita demands per year for eleven years.

Successful implementation of any of the proposed conservation strategies would enable Lake Oswego to defer the timing of the expansion of their water supply infrastructure; however, no conservation strategy will eliminate the need entirely. Therefore, Lake Oswego must still plan for the capacity expansion of their intake, raw water transmission main, treatment plant, storage, and distribution system. Depending on the conservation strategy adopted, Lake Oswego would be able to defer the timing of the expansion of supply capacity from 2017 to 2037. If supply capacity expansion is deferred beyond 2009, it is recommended that Lake Oswego implement near term reliability improvements (as identified in Scenario 1). A summary of the capital costs and timing for each of the proposed conservation strategies is presented in Table ES.5.

Table ES.5 Summary of Conservation on Supply Expansion Costs and Timing
Joint Water Supply System Analysis
City of Lake Oswego and Tigard Water Service Area

Conservation Strategy	Capital Cost Savings[1]		Implementation Timing	
	Amount	Percentage	Year	No. of Years Deferred
5% Target	N/A	N/A	2017	8
10% Target	N/A	N/A	2025	16
25% Target	$13.4M	17%	2037	28

Notes:
1. Presented in November 2006 dollars.

ES.4 INTERIM WATER SUPPLY

Lake Oswego's existing emergency intertie with the City of West Linn and a possible intertie to the City of Portland's Washington County Supply Line (WCSL-Tualatin Line) in Tigard were evaluated as possible interim peak season supplies that would allow Lake Oswego to defer near-term expansion of their existing supply system. In both cases, demands on these alternative sources are such that peak season capacity would not be available to meet Lake Oswego's projected peak day needs (in excess of Lake Oswego's existing capacity); thus, they are not feasible means of deferring expansion of the Lake Oswego supply system.

However, the proposed connection from the WCSL-Tualatin Line would potentially provide near-term benefits to the City of Tigard by decreasing Tigard's costs for non-peak season water purchases from Portland. If Tigard were able to purchase approximately 50% of its annual average supply from Portland through the new gravity connection, the total operating savings would be approximately 14 percent per year (actual savings will depend on required agreements with Portland and WCSL owners), resulting in a potential net savings (less construction cost) during the nine years remaining on Tigard's existing contract with Portland of approximately $1 million.

In addition, Lake Oswego, Tigard and other water providers in the region would benefit by having this connection available as an emergency intertie between the Portland and Lake Oswego supply systems.

Also considered as a potential source of interim supply was purchase of additional capacity from the South Fork Water Board (SFWB). As an alternative to constructing a new Lake Oswego intake, conceptual-level cost estimates were developed for purchasing raw water capacity from SFWB's existing intake on the Clackamas River.

The cost for purchasing raw water intake capacity from the SFWB ranges from approximately $13 million to $16 million for Scenarios 3 and 4, respectively. This cost is dominated by the relatively large cost of the transmission pipeline and river crossing required to convey water from the SFWB intake to the Lake Oswego intake. In comparison, the cost of constructing a new Lake Oswego raw water intake for Scenarios 3 and 4 is approximately $4.4 million to $4.7 million, respectively (see Chapter 2). Given the large cost difference between the SFWB option and construction of a new intake, it is recommended that the option for purchasing raw water capacity from the South Fork Water Board be dropped from further consideration in the Joint Water Supply System Analysis.

ES.5 WATER RIGHTS

The State of Oregon's water rights laws are based on the prior appropriation doctrine: the first person to obtain a water right on a stream is the last to be shut-off during times of drought. Therefore, Lake Oswego's water rights on the Clackamas River have relatively high priority as compared to most other municipal water rights holders. Lake Oswego's senior water rights are the second largest on the river, at 32 mgd, and their junior water rights (6 mgd) are senior to 109 mgd of other holders rights.

Recently, new regulatory requirements promulgated under House Bill 3038 (HB 3038) have modified the requirements for municipal water right extensions and the Oregon Water Resources Department's policy for perfection of municipal water rights. Under HB 3038, it is expected that instream flows will be increased 20%-60% over the existing instream rights on the Clackamas River. To address the potential impacts of HB 3038, Portland State University conducted extensive modeling[2] of the lower Clackamas River. This modeling indicates that in general, in typical weather years, the availability of Lake Oswego's water rights will not be impacted. This is due to two factors: 1) The timing of the City's peak demands, which typically occur in July or August, as compared to the timing of typical low stream flow, which occurs in September, and 2) Flow releases from Timothy Lake, based on existing agreements between other water rights holders and Portland General Electric. It should be noted that under the most extreme low flow conditions (based on the lowest flows on record), it is possible that Lake Oswego would need to reduce their supply by about 3.5 mgd over a two week period in the low flow season.

Specifically, under average conditions (average river flows from 2000-2005 and existing withdrawals by water rights holders on the Clackamas), the PSU modeling indicates that Lake Oswego would need to reduce their withdrawals from the river by about two percent (0.5 mgd) for approximately one day per year. In extreme conditions, based on flows from 2000-2005 and assuming future demands such that all holders are fully utilizing all of their available water rights (and with releases from Timothy Lake), it is possible that Lake Oswego would need to reduce their withdrawals by about 12 percent. This would result in an average reduction for Lake Oswego of 2.6 mgd in supply over a period of 40 days. Within this 40-day shortfall period, a maximum one-day reduction of up to 18 percent (4 mgd) could occur. However, it should be noted that this very conservative condition does not consider the priority of water rights. Additionally, the total existing build-out demand projections for municipal water right holders comprise only 60 percent[3] of the total existing maximum municipal rights on the Clackamas River.

ES.6 ORGANIZATION AND GOVERNANCE OPTIONS

As the City of Lake Oswego and the Tigard Water Service Area consider long-term water supply improvements, governance becomes a key consideration. The nature and complexity of the proposed Joint Water Supply project, and the associated significant capital investments, requires discussion and adoption of a service delivery model beyond the existing surplus water supply contract.

There are five alternative governance structures for a joint water supply that could be used by the Cities:

1. An intergovernmental agreement ("IGA")

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[2] "Lower Clackamas River Model: Model Development, Calibration, Scenarios, Executive Summary, and Hydrodynamics," Water Quality Research Group, Department of Civil and Environmental Engineering, Technical Report EWR-01-06-ES, October 2006.

[3] It should be noted that if the current CRW applications for 96 mgd are not permitted, the build-out demand projections will be 90 percent of the maximum municipal water rights on the Clackamas River.

2. People's Utility District ("PUD")
3. Domestic water supply district ("Water District")
4. County Service District ("Service District")
5. Water Authority ("Water Authority").

The details on each governance structure is provided in Chapter 8. A summary and comparison of utility service delivery models is presented in Appendix G.

Based on discussions with staff from both Cities, the preferred governance structure, should a joint water supply be developed, is an IGA, which is formed under ORS Chapter 190 by a written agreement between local governments, and approved by ordinances of each party's Council. An IGA is the simplest form of structure for water supply. Although there are some limitations, an IGA provides the most flexibility regarding the relationship between the participating entities. An IGA may be formed without a vote by the electors, the governing body of an IGA may be appointed by the participating cities, the participating entities may retain ownership in the facilities like a partnership agreement, and the agreement between the parties defines the powers of the new entity. It is also easier to withdraw from or dissolve an IGA, or to add new partners or make an amendment, than with the other governance structures. It should be noted that an IGA is limited by the inability to levy taxes or issue general obligation bonds. However, these factors are not usually major drivers in utility settings because of the ability of the entity and its underlying partners to charge utility fees and charges and system development charges.

If Lake Oswego and Tigard agree to use an IGA as the basis of a joint water supply system, it is further recommended that the parties engage in a process of developing the anticipated terms of such an agreement. The list of issues identified in Appendix I of this report is intended to serve as a starting point for further discussion between the Cities. It is recommended that the financial terms of such an agreement, including fiscal authority, system ownership, and fiscal standards, be an initial priority since these terms will establish the basis for subsequent financial evaluation of the proposed joint supply system.

ES.7 BENEFITS OF JOINT SUPPLY

The benefits of a potential joint water supply between Lake Oswego and Tigard are presented below:

COST SAVINGS

Partnering with Tigard would provide Lake Oswego significant financial benefits. By jointly constructing a 38 mgd water supply system with Tigard, Lake Oswego and its ratepayers could save about $63 million in equivalent annual costs over the next 25 years, including about $23 million in one-time capital savings.

Partnering will minimize and smooth future rate increases for Lake Oswego. By jointly constructing a 38 mgd water supply system with Tigard and assuming a 24mgd/14mgd (Lake Oswego/Tigard) allocation of new supply capacity, rate increases for Lake Oswego are forecasted to be increase cumulatively 56% over the next 25 years, as compared to cumulative increases of almost three times as much (148%) for the "Lake Oswego go it alone" scenario.

Based on a capacity share cost allocation, the least cost options for Tigard are to purchase water from Portland via a new intertie with the WCSL-Tualatin Line or to partner with TVWD to develop a supply on the Willamette River ($98 and $123 million, respectively). However, **Tigard's third lowest cost option is to partner with Lake Oswego for 38 mgd ($141 million), and would provide a supply on the Clackamas River.**

Although purchasing water from Portland is the least cost scenario for Tigard in the 25-year timeframe, the rate impacts of this scenario do not exhibit the same results. While the other scenarios include capital projects that can be offset with a supply SDC revenue stream, purchased wholesale water costs cannot be offset with any additional revenue source. Therefore, **the resulting annual rate impacts of Tigard's water supply options** are a cumulative increase of about 113% over the next 25 years to partner with Lake Oswego, 128% to partner with other regional providers on the Willamette River, or 169% to purchase water from Portland.

Partnering can be the first step in a multi-step process. An agreement to form a partnership means preliminary work related to cost sharing, operating protocols, form of governance, and allocation scenarios can be initiated without burdening either City with the need to immediately finance a large capital project.

WATER RIGHTS

Partnering would help secure Lake Oswego's rights. Lake Oswego holds senior water rights (32 mgd) and junior water rights (6 mgd) on the Clackamas River. These rights are of relatively high priority compared with other municipal users of the river, but rights in excess of future demands may be at risk from recent increases in instream rights. Partnership with Tigard would enable Lake Oswego to secure the unused portion of their existing water rights.

CONSERVATION

Partnering plus water conservation would provide significant benefits to both Cities. A successful conservation program in Lake Oswego would shift a greater capacity share to Tigard. Depending on conservation savings, Tigard's share could be sufficient to completely meet its long-term build-out demands. This would result in Tigard's cost share increasing to about 70% of the cost of the supply expansion needed to meet both cities' future water demands.

REGIONAL RELIABILITY

Constructing an intertie between Tigard and the Washington County Supply Line **would save Tigard approximately $300,000 in annual operating costs** and would pay for itself in about 5 years.

Partnering would provide regional benefits. Lake Oswego, Tigard, and other water suppliers would benefit from connections to other regional systems for emergency backup, improved reliability and source optimization, and is consistent with the goals of the Regional Water Supply Plan.

WATER SUPPLY SYSTEM EVALUATION

1.1 BACKGROUND

The City of Lake Oswego operates a raw water intake on the Clackamas River with water rights to appropriate a maximum of 38 million gallons per day (mgd). The water is treated at the Lake Oswego Water Treatment Plant (WTP), which has a current capacity of approximately 16 mgd. The water is then distributed to retail users within the Lake Oswego service area, as well as to several wholesale customers, including the City of Tigard.

In recent years, the City of Lake Oswego has been providing between one and three mgd of drinking water to the City of Tigard. Tigard's primary supplies of drinking water are provided by the City of Portland, the Joint Water Commission (JWC), and the City of Lake Oswego. In addition, Tigard has two Aquifer Storage and Recovery (ASR) wells that are used to help meet peak seasonal demands.

1.1.1 Joint Water Supply System Analysis

Because Tigard currently does not have an ownership position in a primary source of water supply, it has limited leverage to control the increasing cost of water or the availability of the water supply. Therefore, Tigard is limited in its ability to ensure a reliable water supply for the present and the future.

Conversely, the City of Lake Oswego has water rights on the Clackamas River, which provides a reliable supply of high quality water, with existing water rights in excess of the current projections for Lake Oswego's build-out maximum day demand. With increasing pressure on water rights in Oregon, Lake Oswego faces the potential loss of the excess water rights and the associated value of that water.

To address these issues, the Cities of Lake Oswego and Tigard have initiated a comprehensive study to develop and evaluate options for the possible formation of a joint water supply system to serve the communities of Lake Oswego and Tigard. This Joint Water Supply System Analysis (JWSSA) is intended to identify a preferred supply scenario as well as the permitting, governance, design, financing, and construction related issues associated with implementing the proposed joint water supply system.

1.2 PURPOSE

The purpose of this chapter is to present the findings and recommendations of the water supply system evaluation conducted for the Cities of Lake Oswego and Tigard (Cities) as part of the Joint Water Supply System Analysis. This effort includes an evaluation of the capacity of the existing water supply system infrastructure, development of population and demand forecasts for the two service areas, and identification of various water supply scenarios for the Cities.

1.3 SUPPLY INFRASTRUCTURE

1.3.1 Existing

A brief evaluation of the major components of the existing infrastructure was conducted to identify any issues which may influence the feasibility of developing a joint water supply for the service areas of Lake Oswego and Tigard. Additionally, the potential system improvements which may be required as part of the joint water supply were also identified. A description of the existing facilities is provided below.

The Lake Oswego water supply infrastructure consists of a raw water intake and pump station, a raw water transmission main, the water treatment plant, and a finished water distribution system that includes over 200 miles of pipeline, 15 storage reservoirs, 13 water pump stations, and 25 pressure reducing stations. Also included in the evaluation is the City of Tigard's Bonita Road Pump Station, which is the point of transfer from the Lake Oswego service area to the Tigard water service area.

1.3.1.1 Clackamas River Intake

Lake Oswego's existing raw water intake is located along the northern bank of the Clackamas River in the City of Gladstone. The intake was constructed in 1968 and delivers raw water via the raw water transmission main to the WTP. The intake structure is comprised of three fish screens, three screen cleaners, and four vertical turbine raw water pumps.

The intake structure was modified in 2002 to meet juvenile fish protection requirements. As part of these modifications, the fish screens and a screen cleaning system were installed, and the foundation of the intake structure was anchored to the underlying bedrock to protect the structure against catastrophic damage during a seismic event.

The intake structure was determined to have a significant risk of catastrophic damage due to the low friction and adhesion coefficients between the floor slab and the underlying soil. Therefore, the structure was modified in 2002 to update the seismic reinforcement and meet 1997 Uniform Building Code requirements for a Zone 3 seismic event.

Following these modifications, structural defects in the floor slab were observed. A structural inspection and evaluation was conducted in 2004[1], which noted the following observations:

[1] City of Lake Oswego Clackamas River Intake Structural Evaluation and Finite Element Analysis, MWH, 2005.

- The concrete floor slab is not uniform in strength and quality.
- Aggregate-silica reactivity (ASR) is likely occurring which causes delamination and spalling in the concrete.
- Settling has occurred (1.25-1.5 inches) since the installation of the anchors, resulting in 40%-45% decrease in the tension of the anchor bolts.

Because of the recent spalling of the concrete around the anchors, the capacity of the floor slab to withstand a significant seismic event has likely been compromised.

The results of the seismic inspection and testing resulted in a further analysis from which four scenarios were presented:

- No improvements, but continued monitoring of the structure.
- Add steel plates to the floor slab and grout the spalled areas, which offers limited structural benefits but would likely reduce ASR initiated spalling from worsening.
- Install a new cast-in-place concrete slab over the existing floor slab to increase the structural integrity but which may reduce pumping capacity due to loss of submergence.
- Construct a new intake structure if it is determined that the existing intake has reached the end of its useful life, or if the City identifies a need for additional water supply that cannot be met by the existing intake.

The City has not made a decision regarding implementation of these scenarios; a further evaluation of the raw water intake is being conducted as part of this Joint Water Supply System Analysis. The results of this evaluation will be presented as part of Chapter 2.

The existing maximum capacity of the raw water intake is 16.5 mgd (with all four pumps in service). However, the reliable capacity of the intake (defined as the capacity of the intake with the largest pump out of service) is only 11.7 mgd. Therefore, the existing demands of the service area are being met not by reliable capacity, but by the maximum capacity of the intake. By operating the intake at maximum capacity, rather than reliable capacity, the City is assuming a much higher risk of operation; namely, the inability to meet demands should the largest pump fail.

In addition to concerns regarding the reliable capacity of the intake pumps and the intake structural issues, concerns regarding sedimentation accumulation around the intake screens and decreasing river levels will be addressed as part of Chapter 2. These issues may ultimately impact the capacity of the raw water intake needed to serve both water service areas.

1.3.1.2 Raw Water Transmission Main

The existing raw water transmission main was constructed in 1968 and is a 27-inch diameter concrete cylinder pipe that conveys raw water from the intake structure to the

WTP. The condition of the transmission main is uncertain, although the pipeline does have a cathodic protection (CP) system to minimize corrosion of the pipeline's steel shell. The CP system was constructed in four phases from 1999 to early 2003. During Phases 2 and 4, it was determined that certain areas had become discontinuous since the original installation of the CP system. The discontinuous areas were caused by the breakdown of the existing corrosion on the exterior of the pipeline and were discovered during the installation of the CP system. Once the areas were identified, the steel bond straps and the associated discontinuous areas were repaired.[2]

The existing CP system has recently been tested again; the section of pipe from the intake to the west side of the Willamette River has been shown to be continuous, however, from this point on to the WTP, discontinuities exist. To better evaluate the remaining useful life of the pipeline, it is recommended that the pipeline be inspected to determine the condition of the pipe and identify areas to be repaired.

A single new replacement pipeline, or a second, parallel raw water transmission pipeline will need to be constructed to meet the projected water demands for Lake Oswego alone, as well as the combined demands of the Lake Oswego and Tigard Water Service Areas, should a joint water supply system be implemented.

1.3.1.3 Water Treatment Plant

The Lake Oswego WTP was constructed in 1967 and was expanded in 1980 to reach its current capacity of 16 mgd. In 1999 and 2000, modifications were made to the chemical storage and feed system, and engineered concrete sludge lagoons were constructed to replace the original earthen ponds.

The current facility is sited within a residential neighborhood within the City of West Linn and occupies approximately six acres. An adjacent 3.30 acres south of the existing property was acquired by Lake Oswego to accommodate future facility expansions. To maintain a healthy relationship with the surrounding community of West Linn, Lake Oswego has elected to preserve the natural condition of the adjacent property. Therefore, the expansion strategy for the Lake Oswego WTP must be reassessed.

The existing infrastructure of the WTP is overall in good condition, however, the maximum current capacity of the WTP is 16 mgd with one filter out of service. Additionally, the sludge drying lagoons are currently undersized to manage the entirety of the existing solids load. Therefore, the WTP will need to be expanded to treat the ultimate demand of the Lake Oswego water service area, as well as the combined demand with the Tigard water service area. The four finished water pumps have a theoretical maximum capacity of 24 mgd. However, because the #4 finished water pump is a low head pump, and the #1-#3 finished water pumps are high head pumps, hydraulic constraints prevent all four pumps from being operated in combination. Therefore, the realistic maximum capacity of the finished water

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[2] Cathodic Protection of Raw and Finished Water Transmission Mains - Work Order 1133, Cascade Corrosion Consulting Services, Inc., 2003.

pumps is 16 mgd. The reliable capacity of the pumps (in this case, with the second largest pump out of service) is only 12 mgd.

It should be noted that a recent leak was discovered at the WTP in a 14-inch pipe which coveys water from the surge tank to the High Service Pump "B" header. A subsequent hydraulic analysis[3] of the Lake Oswego distribution system identified that the surge tank is undersized by 50 percent. A new surge tank, with a capacity of 30,000 gallons, is recommended to be constructed to meet the existing capacity of the Lake Oswego water infrastructure.

Further discussion regarding the necessary expansion of the WTP will be presented as part of Chapter 2.

1.3.1.4 <u>Transmission and Storage</u>

The Lake Oswego transmission system is comprised of over 200 miles of pipeline in ten pressure zones throughout the water service area. The pipelines range in diameter from one to 42 inches, and include steel, ductile iron, cast iron, galvanized iron, polyvinyl chloride, and asbestos cement pipe. The system also includes 13 water pump stations and 16 treated water storage reservoirs with a combined storage capacity of 27 million gallons.

The transmission and storage system was constructed over several decades. The Tenth Street Reservoir was constructed in 1925, and the Aspen Street Reservoir was recently constructed in 2004, although the majority of the transmission system was constructed from the 1960s through the 1980s.

The finished water transmission main has an existing cathodic protection system, which indicates that the finished water transmission main is predominantly continuous. However, discontinuities have been shown to exist in the area near Kenthorpe Road, on which the WTP is located. In early 2007, maintenance staff installed additional cathodic protection stations along this section of the finished water transmission main. It is recommended that this section of pipeline be re-assessed to determine whether the discontinuous areas were rectified as part of the installation of the new cathodic protection stations.

The hydraulic capacity of the distribution system will be evaluated to determine whether expansions will be needed to accommodate the additional capacity associated with the joint water supply system. Further description of the distribution system and the results of the hydraulic evaluation will be presented in Chapter 2.

1.3.1.5 <u>Bonita Pump Station</u>

The Lake Oswego distribution system connects to the Tigard water service area through Tigard's Bonita Road Pump Station. The Bonita Pump Station was constructed in 1973, and is located just west of I-5 at Bonita Road and Sequoia Parkway. The pump station is

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[3] City of Lake Oswego Finished Water Pumping Surge Control System Review, Murray Smith & Associates, February 2006.

comprised of a below grade prefabricated steel structure which houses three vertical mounted end suction centrifugal pumps with a reliable capacity of 5.3 mgd and a maximum capacity of 8 mgd. The pump station is located on a constrained site consisting of existing public right-of-way for Bonita Road; the total fenced area is approximately 900 square feet, bounded by Bonita Road to the north, Sequoia Parkway to the west, and a commercial parking lot to the south and east. The limited size of the property may pose difficulties in increasing capacity of the pump station in the future. The pump station is currently fed from parallel 16-inch and 24-inch pipelines (part of Lake Oswego's infrastructure) and discharges to existing 16-inch and 24-inch pipelines to serve the 410-foot pressure zone of Tigard's distribution system. The hydraulic evaluation of this existing piping configuration will be presented in Chapter 2.

1.3.1.6 Aquifer Storage and Recovery

The City of Tigard constructed its first aquifer storage and recovery (ASR) well in 2001. In 2005, Tigard injected nearly 115 million gallons into the storage and is therefore able to reliably recover between 1.0 and 1.4 mgd when necessary. The system is in its fourth year of operation and the water is continually tested to verify safe storage conditions. The city recently completed construction of a second ASR well which will provide an estimated storage capacity of 160 million gallons by 2007. It is anticipated that the ASR system will provide a reliable 3.5 mgd capacity for supplemental supply during times of peak demand.

1.3.2 Anticipated Improvements

The anticipated supply infrastructure improvements are necessary based on meeting either 1) the ultimate Lake Oswego water service demands or 2) the combined Lake Oswego and Tigard ultimate water service demands. Table 1.1 presents the basis for the proposed supply improvements.

Table 1.1 Required Supply Improvements
Joint Water Supply System Analysis
City of Lake Oswego and Tigard Water Service Area

	Raw Water Intake Structure	Raw Water Transmission Main	Water Treatment Plant	Transmission and Storage	Bonita Pump Station
Lake Oswego Build-out Demand	✓	✓	✓	✓	
Combined Lake Oswego / Tigard Build-out Demand	✓	✓	✓	✓	✓

1.3.2.1 Raw Water Intake

The Lake Oswego raw water intake will need to be upgraded to increase the capacity of the existing influent pumps to handle the Lake Oswego and Tigard ultimate demands. Additionally, the structural integrity of the intake needs to be addressed, as well as the impacts of the decreasing river levels and sediment accumulation.

Regardless of whether the joint water supply system is implemented, the capacity, structural integrity, and impacts of the river levels and sediment accumulation need to be addressed to ensure that the raw water intake infrastructure is capable of meeting the ultimate Lake Oswego service area demands. Recommendations regarding these issues will be presented as part of Chapter 2 "Evaluation of Water Supply Facility Alternatives."

1.3.2.2 Raw Water Transmission Main

The raw water transmission main can currently convey approximately 16 mgd to the WTP, although only 13 mgd can be conveyed at the standard design velocity of 5 feet per second. Additionally, the projected demands of the Lake Oswego water service area will require an expansion of the capacity of the existing raw water transmission main. Therefore, to increase the raw water transmission capacity necessary to meet the ultimate demands of the two water service areas, the existing transmission main should be replaced with a larger capacity pipeline, or an additional, parallel pipeline should be constructed. Additionally, it is recommended that annual testing of the new pipeline should be conducted to determine the pipe to soil potentials and/or the continuity of the pipeline. The recommended size, material, and location of the pipeline will be presented in Chapter 2.

1.3.2.3 Water Treatment Plant

The WTP capacity, including solids handling, will need to be expanded in the future to meet the ultimate demands of the Lake Oswego and Tigard water service areas. The capacity increase can be obtained through conventional treatment, high rate conventional treatment, or membrane filtration. Further analysis regarding the advantages and disadvantages of each type of treatment, as well as the associated infrastructure, will be addressed as part of Chapter 2.

1.3.2.4 Transmission and Storage

Based on the results of the hydraulic evaluation, elements of the transmission system infrastructure will likely need to be expanded to meet the ultimate demands of the two water service areas. Recommendations regarding the expansion of the existing infrastructure will be presented in Chapter 2.

1.3.2.5 Bonita Pump Station

Lake Oswego currently has only one significant water supply source: the Clackamas River. By relocating the Bonita Pump Station one block further west along Bonita Road (at the intersection with SW 72nd Avenue) a connection could be made to Tigard's existing 36-inch pipeline, which conveys raw water from Bull Run, an acknowledged high quality water source. This would provide a redundant water source for Lake Oswego, and would create the flexibility needed to increase reliability to both water service areas.

1.4 DEMAND PROJECTIONS

The demand projections are based on historical per capita demands and projected population growth for the water service area. The Lake Oswego per capita demands are based on historical demands from 2000-2005. Per direction from Lake Oswego staff, the demand projections for the Lake Oswego wholesale customers and the Stafford Triangle are based on the Lake Oswego per capita demands. The Tigard demand projections are based on the per capita demands identified in the "Water Distribution System Hydraulic Study" (MSA, May 2000). Population projections for Lake Oswego and Tigard service areas are based on data provided by the Metro Regional Center for the year 2030.

A summary of the basis used to determine the historical population, per capita demands, and projected population for each water service area is presented in Table 1.2.

Table 1.2	Basis for Per Capita Demands and Historical and Projected Population Joint Water Supply System Analysis City of Lake Oswego and Tigard Water Service Area		
Factor	**Lake Oswego Service Area**	**Stafford Triangle**	**Tigard Service Area**
Historical Population	Portland State University and Metro Regional Center	Metro Regional Center	U.S. Census Bureau
Per Capita Demands	Lake Oswego Water Treatment Plant Data 2000-2005 [1]	N/A	City of Tigard Data 2000-2005
Projected Population	Saturation Build-out Analysis [2]	Metro Regional Center[3]	Metro Regional Center

Notes:

1. The three-day peak demand was used to determine the "Peak-Day" per capita demands for the Lake Oswego City Only service area. Definitions for the peak day demands, etc. are provided in Section 1.4.3.
2. "City of Lake Oswego Water Management and Conservation Plan," CH2M Hill, 2007.
3. The Lake Oswego Water Service Area in 2030 will include both the Stafford triangle and the water districts currently located within the Urban Services Boundary.

1.4.1 Service Areas

1.4.1.1 Lake Oswego Water Service Area

For the purposes of this study, the Lake Oswego Water Service Area is defined as the area within or adjacent to the current Urban Services Boundary (USB). The water service area includes Lake Oswego City Only, as well as Alto Park, Forest Highlands, Glenmorrie, Lake Grove, portions of Palatine Hill, Rivergrove, Southwood Park, and Skylands water districts.

Lake Oswego City Only is defined as the Lake Oswego city limits, less the existing wholesale areas within the city limits. This area was defined in order to provide an accurate correlation between population and water demand. Further explanation for the use of this area is contained in section 1.4.2.1.1.

The Stafford Triangle comprises approximately 925 acres north of the Tualatin River, as shown in Figure 1.1. The Stafford Triangle, which although currently not within the USB, is expected to be served by the City of Lake Oswego in the future and be included in the water service area. It is assumed that the City of Lake Oswego will be responsible for providing water to all customers (including existing wholesalers and the Stafford Triangle) by build-out. The Lake Oswego Water Service Area is presented in Figure 1.1.

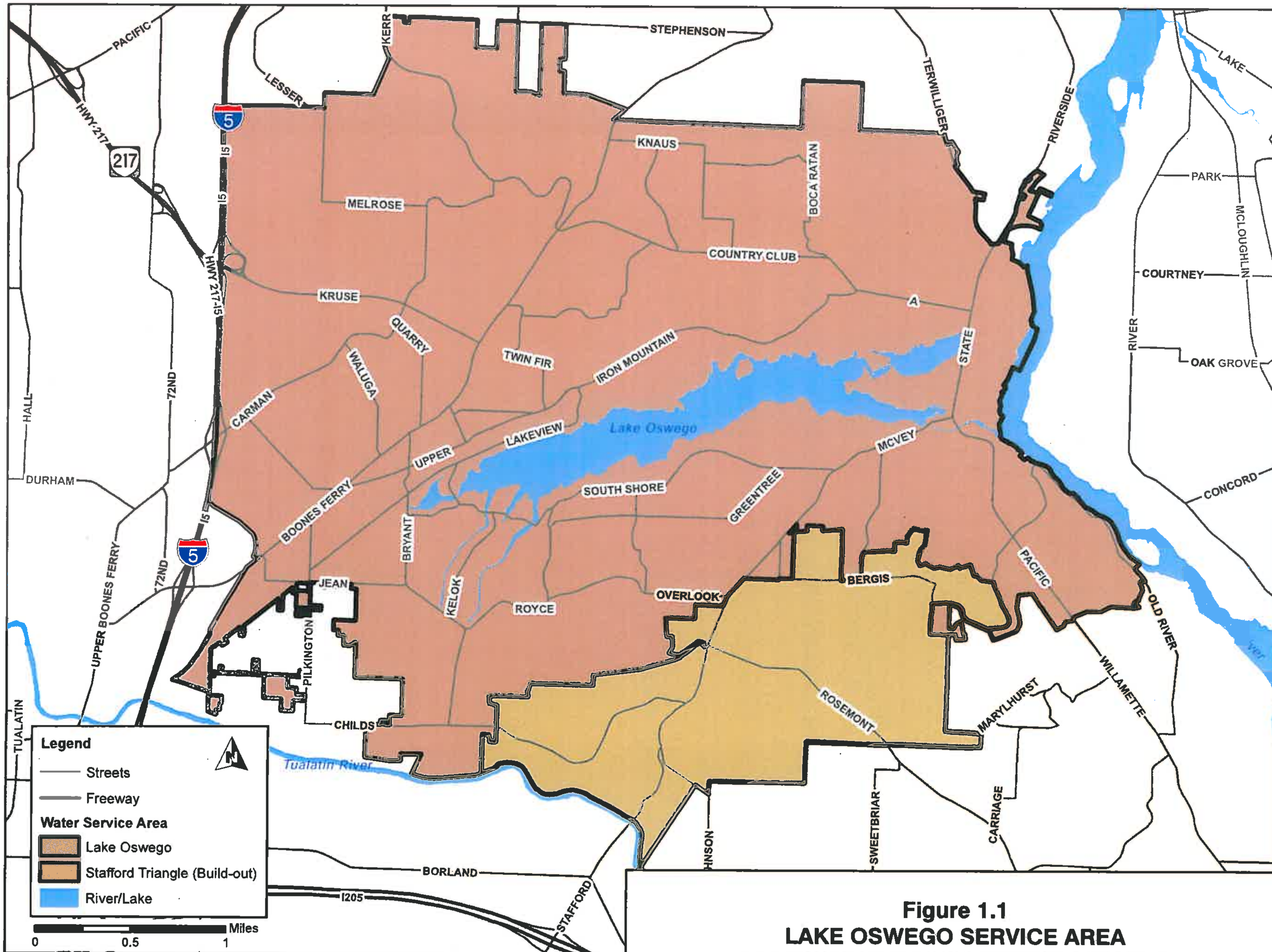

Figure 1.1
LAKE OSWEGO SERVICE AREA
JOINT WATER SUPPLY SYSTEM ANALYSIS
CITY OF LAKE OSWEGO AND TIGARD WATER SERVICE AREA

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1.4.1.2 <u>Tigard Water Service Area</u>

The Tigard Water Service Area includes the majority of the City of Tigard, the City of King City, the City of Durham, a portion of the Tualatin Valley Water District, and unincorporated areas of Washington County. Also included in the build-out service area are Urban Reserve Areas Nos. 47-79. Figure 1.2 presents the Tigard Water Service Area.

1.4.2 Population

1.4.2.1 <u>Historical Population</u>

1.4.2.1.1 *Lake Oswego City Only*

The historical population estimates from 2000-2005 were obtained from Portland State University Population Research Center (PSU). In order to obtain an accurate estimate for per capita demands, the 2005 population was developed for Lake Oswego City Only. These estimates were obtained using the PSU historical population data for the City of Lake Oswego, and subtracting out the populations of the wholesale water districts within LO city limits. Estimates for the wholesaler populations were developed by calculating the percent of a given wholesaler Metro TAZ block within the city limits, and multiplying that percentage by the corresponding Metro TAZ block population. The wholesaler populations for 2000-2004 were determined by adjusting the 2005 wholesaler population by the PSU population growth rates. The Lake Oswego City Only population was then determined by subtracting the adjusted wholesaler population from the published PSU population estimates.

The Lake Oswego City Only population, in conjunction with the Lake Oswego City Only water demand, provides the most accurate correlation between the water demand and the population served. This approach was used for several reasons:

- Historic demand data was not available for the portion of wholesaler population that received water from LO because these wholesalers also have other sources
- Some wholesaler populations include areas inside and outside of city limits.
- By excluding wholesaler population, LO only demand data corresponds directly with the Lake Oswego City Only population.

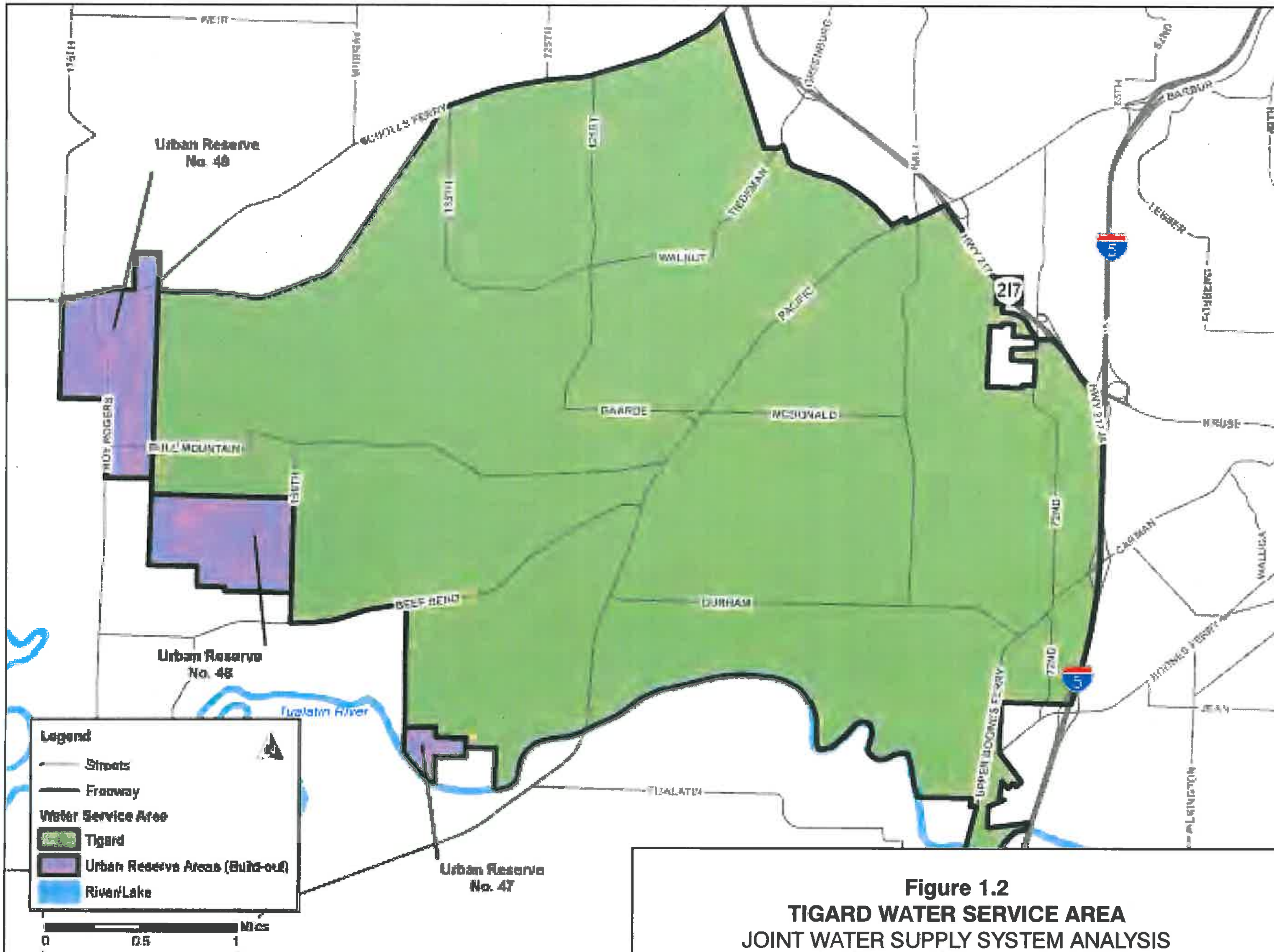

Figure 1.2
TIGARD WATER SERVICE AREA
JOINT WATER SUPPLY SYSTEM ANALYSIS
CITY OF LAKE OSWEGO AND TIGARD WATER SERVICE AREA

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The Lake Oswego City Only population for the years 2000-2005 is provided in Table 1.3.

Table 1.3 Lake Oswego City Only Population Estimates from 2000-2005
Joint Water Supply System Analysis
City of Lake Oswego and Tigard Water Service Area

Year	2000	2001	2002	2003	2004	2005
Population	32,669	32,822	32,978	33,080	33,145	33,278

1.4.2.1.2 *Tigard Water Service Area*

The Tigard historical population estimates from 2000-2005 were obtained from the United States Census Bureau. The estimates encompass the area within the Tigard water service boundary, and are escalated from the published estimates for the Tigard city limits based on census block data for the surrounding areas from the decennial census in 2000. The Tigard service area population estimates are provided in Table 1.4.

Table 1.4 Tigard Population Estimates from 2000-2005
Joint Water Supply System Analysis
City of Lake Oswego and Tigard Water Service Area

Year	2000	2001	2002	2003	2004	2005
Population	49,954	51,468	52,700	53,286	54,395	55,850

Note: The Tigard water service area boundary used in this study differs slightly from that used in the 2000 master plan "Water Distribution System and Hydraulic Study" (MSA, 2000) and includes an area in the eastern portion of the Tigard city limits which is part of the Tualatin Valley Water District but is served by Tigard. Therefore, a direct comparison of the population estimates in this study and that of the master plan cannot be made. However, it should be noted that the population estimate for 2005 (based on the revised service area and the US Census Bureau data) is very similar to the population estimate that is currently being used by Tigard staff (55,900 persons) to determine per capita demands.

1.4.2.2 Population Forecasts

1.4.2.2.1 *Lake Oswego Water Service Area*

The Lake Oswego water service area 2030 population forecast was developed by escalating the 2005 population estimate by the following rates[4]:

- Lake Oswego City Only: 0.5%
- Outside Lake Oswego City Limits[5] and Stafford Triangle: 1.69%

4 Per direction from Lake Oswego staff based on historical growth rates and Metro projected growth rates.

5 2005 population estimates for Lake Oswego water service area outside the City Limits (6,543) indicate that build-out conditions have been attained for 711 persons. The remaining population (5,832) is projected to grow at 1.69% (per Metro growth rate).

To fully evaluate the potential build-out population forecast, a saturation analysis was conducted. The saturation analysis-based population forecast predicts a total of 54,098 people within the Lake Oswego water service area. Further explanation of this analysis can be found within the CH2M Hill report, "City of Lake Oswego Water Management and Conservation Plan," to be finalized in 2007.

A summary of the population forecasts is provided in Table 1.5.

1.4.2.2.2 *Stafford Triangle*

The 2030 population forecast for the Stafford Triangle was determined by escalating the Metro 2005 population estimate of 1,707 people at a 1.69% growth rate over 25 years.

The build-out population forecasts for the Stafford Triangle were evaluated based on two methodologies: a low estimate based on zoning capacity (2,633 people), and a high estimate based on Metro forecasts (6,918 people). It is recommended that the build-out Stafford Triangle population be based on the more conservative Metro estimate, and an available 782 net developable acres at 8.85 persons/acre.

1.4.2.2.3 *Tigard Water Service Area*

The population forecasts for the year 2030 are based on data provided by the Metro Regional Center. The population projection for the Tigard Water Service Area was determined using an intersecting polygon method to determine the percentages of the TAZ jurisdictions (and associated populations) within the service area.

Table 1.5 Summary of Population Forecasts
Joint Water Supply System Analysis
City of Lake Oswego and Tigard Water Service Area

Service Area	2005	2030	Build-Out
Lake Oswego[1]	39,821	47,275	54,098
Stafford Triangle[2]	1,707	2,595	6,918
Tigard	55,850	64,045	85,560[3]

Notes:

1. The Lake Oswego Population includes Lake Oswego City Only and current wholesalers within the Urban Service Boundary.
2. The Stafford Triangle is located within the build-out Lake Oswego water service area boundary. This area is not currently served water by the Lake Oswego WTP.
3. The Tigard Build-out population is based on a service area which includes all of Urban Reserve Areas Nos. 47-49. These areas are not included in the 2005 population estimate or the 2030 population projection.

1.4.3 Historical Water Demand Data

The production data was provided by the Lake Oswego WTP staff and presents the Finished Water Production, the Reservoir Storage, and the System Demand on a daily basis from January 1, 2000 through December 31, 2005. The Finished Water Production and Reservoir Storage are direct inputs from the Lake Oswego SCADA system. The System Demand is hand entered by WTP staff.

Because the hand-entered System Demand values were subject to human error (typos, incorrect readings, readings not taken at exactly midnight), a Calculated System Demand was determined for each day.

Calculated System Demand = Finished Water Production +/- Change in Storage

It should be noted that the 2002 production and demand data is incomplete, resulting in annual average flow for 2002 that is significantly lower than that of the surrounding years. Therefore, the data for 2002 was not included in the determination of the average day flow, peak day flow, average day per capita demand, or peak day per capita demands for the Lake Oswego service area.

The ultimate demands on the system were developed based on the average historical peaking factor from 2000-2001 and 2003-2005. This methodology predicts the most conservative (i.e. highest) demands on the system. However, recognizing that the ultimate demand on the water infrastructure realistically arises from a three-day maximum, rather than a one-day peak, the three-day maximum is also presented. The three-day maximum (or 3-day Peak Demand) was determined by identifying the maximum demand on the system over a consecutive three-day period, and averaging this demand over three days.

A summary of the average day and peak day demands, as well as their respective peaking factors, is provided in Table 1.6. Definitions of the acronyms presented in Tables 6-11 are presented below:

- Average Day Demand (ADD): The average day demand is the total annual demand divided by 365 days.
- Peak Day Demand (PDD): The peak day demand is the highest demand that occurs on any single day within the calendar year.
- 3-Day Peak Demand (3DPD): The three day peak demand is the maximum consecutive three day demand occurring within the calendar year. The three day peak demand does not necessarily include the peak day demand.
- Peaking Factor (PF): The peaking factor is the ratio of the peak day demand to the average day demand.
- 3-Day Peaking Factor (3DPF): The three day peaking factor is the ratio of the three day peak demand to the average day demand.

Table 1.6	Summary of Lake Oswego City Only Demands and Peaking Factors[1] Joint Water Supply System Analysis City of Lake Oswego and Tigard Water Service Area				
Year	ADD (mgd)	Maximum Demands (mgd)		Peaking Factor	
		PDD	3DPD	PF	3D PF
2000	5.66	12.58	12.54	2.22	2.22
2001	5.39	13.63	12.79	2.53	2.37
2003	5.68	12.22	11.74	2.15	2.07
2004	5.75	13.86	11.70	2.41	2.03
2005	5.62	12.25	10.90	2.18	1.94
Average	5.62	12.91	11.93	2.30	2.12

Notes:

1. The demands presented in this table include only the demands of the Lake Oswego City Only and not the demands of the wholesalers located within the Lake Oswego water service area or Tigard.

The Tigard water service area average day demands, peak day demands, and 3-day peak demands were provided by Tigard staff. A summary of the historical demands and associated peaking factors for the Tigard water service area are presented in Table 1.7.

Table 1.7	Summary of Tigard Demands and Peaking Factors Joint Water Supply System Analysis City of Lake Oswego and Tigard Water Service Area				
Year	ADD (mgd)	Maximum Demands (mgd)		Peaking Factor	
		PDD	3DPD	PF	3D PF
2000	6.23	13.1	12.7	2.10	2.03
2001	5.88	11.6	10.9	1.97	1.85
2002	6.29	12.7	12.4	2.02	1.98
2003	6.60	14.3	14.1	2.17	2.13
2004	6.53	13.2	13.0	2.02	1.99
2005	6.04	13.4	12.3	2.22	2.03
Average	6.26	13.1	12.6	2.08	2.00

1.4.4 Per Capita Demands

The historical average of the average day per capita demand over the five year timeframe (2000-2001 and 2003-2005), as well as the average of the peak day per capita demand, were used to determine the average and peak day per capita demand for Lake Oswego City Only. The Lake Oswego City Only per capita demands are summarized in Table 1.8.

These per capita demands were applied to the entire Lake Oswego USB and the Stafford Triangle, per direction from Lake Oswego staff.

Table 1.8 Summary of Per Capita Demands for Lake Oswego City Only
Joint Water Supply System Analysis
City of Lake Oswego and Tigard Water Service Area

Year	Population	Average Day Per Capita Demand (gpcd)	Peak Day Per Capita Demand (gpcd)	3-Day Peak Per Capita Demand (gpcd)
2000	32,669	173	385	384
2001	32,822	164	415	390
2003	33,080	172	369	355
2004	33,145	173	418	353
2005	33,278	169	368	328
Average	32,999	170	391	362

The historical average of the average day per capita demand over the six year timeframe (2000-2005), as well as the average of the peak day per capita demand, was used to determine the average and peak day per capita demand for the Tigard Water Service Area. The Tigard service area per capita demands are summarized in Table 1.9.

Table 1.9 Summary of Per Capita Demands for Tigard
Joint Water Supply System Analysis
City of Lake Oswego and Tigard Water Service Area

Year	Population	Average Day Per Capita Demand (gpcd)	Peak Day Per Capita Demand (gpcd)	3-Day Peak Per Capita Demand (gpcd)
2000	49,954	125	262	253
2001	51,468	114	225	211
2002	52,700	119	241	236
2003	53,286	124	268	264
2004	54,395	120	243	239
2005	55,850	108	240	220
Average	52,942	118	247	237

The recommended per capita demands for the Lake Oswego City Only and Tigard service area are provided in Table 1.10.

Table 1.10 Summary of Historical Per Capita Demands for Lake Oswego and Tigard Joint Water Supply System Analysis City of Lake Oswego and Tigard Water Service Area

	Average Day Demand (mgd)	Peak Demand (mgd)	Average Day Per Capita Demand (gpcd)	Peak Demand (gpcd)
Lake Oswego Service Area [1]	5.62	12.91	170	391
Tigard Service Area	6.26	13.05	118	247

Notes:

1. Per Lake Oswego staff, the Stafford Triangle (which lies within the build-out Lake Oswego service area) is assumed to have the same average day per capita and 3-day maximum per capita demands as the City of Lake Oswego.

1.4.5 Demands Projections

Based on the per capita demands presented in Table 1.10, and the population forecasts In Table 1.5, the projected water demands for the Lake Oswego and Tigard service areas were calculated. These demand projections are presented in Figures 1.3 and 1.4, as well as in Table 1.11. It should be noted that the demand projections presented in Figures 1.3 and 1.4 are based on the average historical demands for each water service area from 2000-2005.

Table 1.11 Current and Projected Demands for Lake Oswego and Tigard
Joint Water Supply System Analysis
City of Lake Oswego and Tigard Water Service Area

	2005			2030			Build-out		
	Average Day Demand (mgd)	Peak Day Demand (mgd)	3-Day Peak Demand (mgd)	Average Day Demand (mgd)	Peak Day Demand (mgd)	3-Day Peak Demand (mgd)	Average Day Demand (mgd)	Peak Day Demand (mgd)	3-Day Peak Demand (mgd)
Lake Oswego[1]	5.6	12.3	10.9	8.1	18.5	17.1	9.2	21.2	19.6
Stafford Triangle	N/A[2]	N/A[2]	N/A[2]	0.4	1.0	0.9	1.2	2.7	2.5
Subtotal of Lake Oswego Water Service Area	5.6	12.3	10.9	8.5	19.5	18.0	10.4	23.9	22.1
Tigard	6.0	13.4	12.3	7.6	15.8	15.2	10.1	21.1	20.3
Total	11.6	25.7	23.2	16.1	35.3	33.2	20.5	45.0	42.4

Notes: N/A: Not applicable

1. The Lake Oswego demands for 2030 and build-out include the Other Wholesaler demands within the Lake Oswego water service area.
2. The Stafford Triangle is not currently provided water by Lake Oswego.

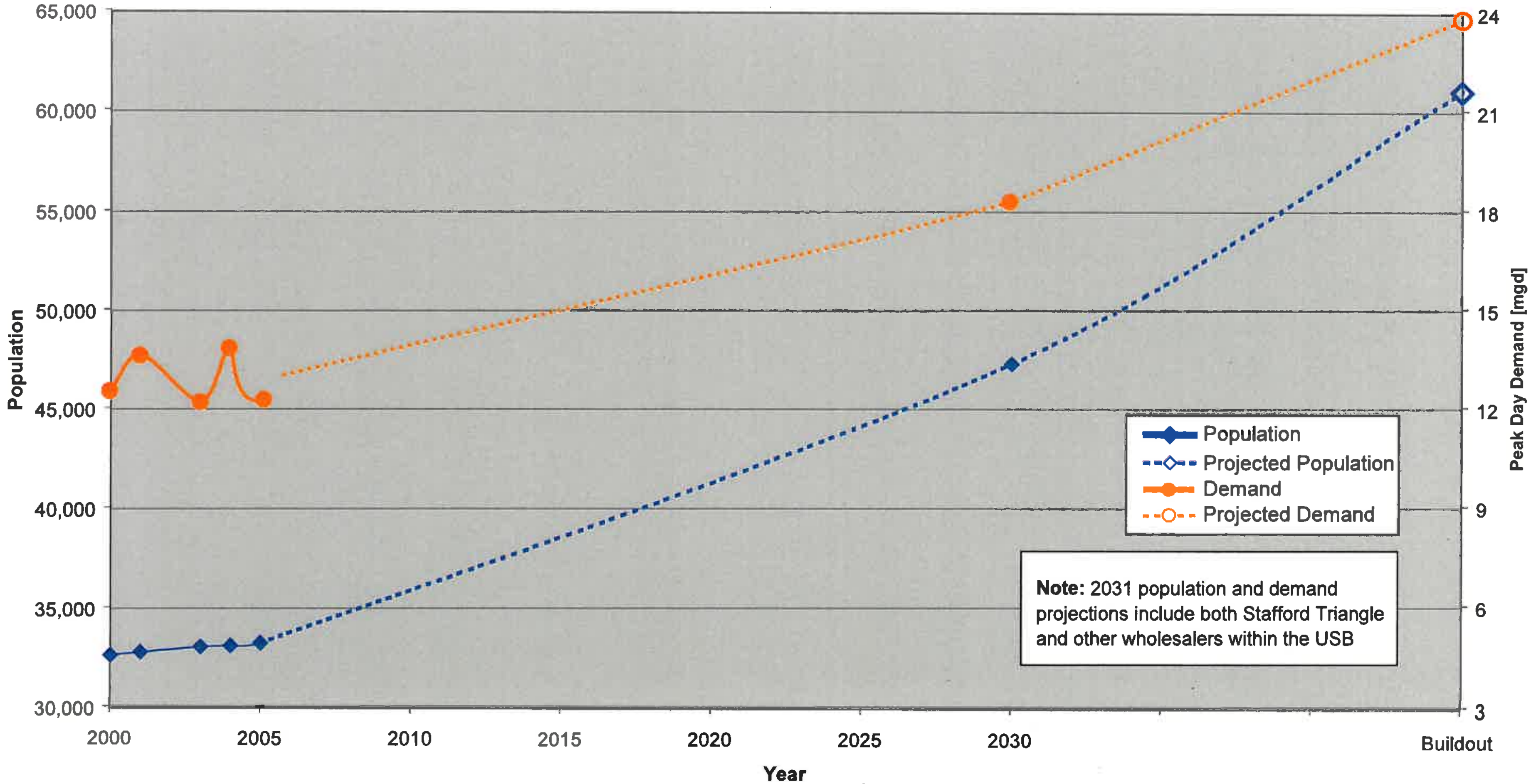

Figure 1.3
LAKE OSWEGO POPULATION AND DEMAND
JOINT WATER SUPPLY SYSTEM ANALYSIS
CITY OF LAKE OSWEGO AND TIGARD WATER SERVICE AREA

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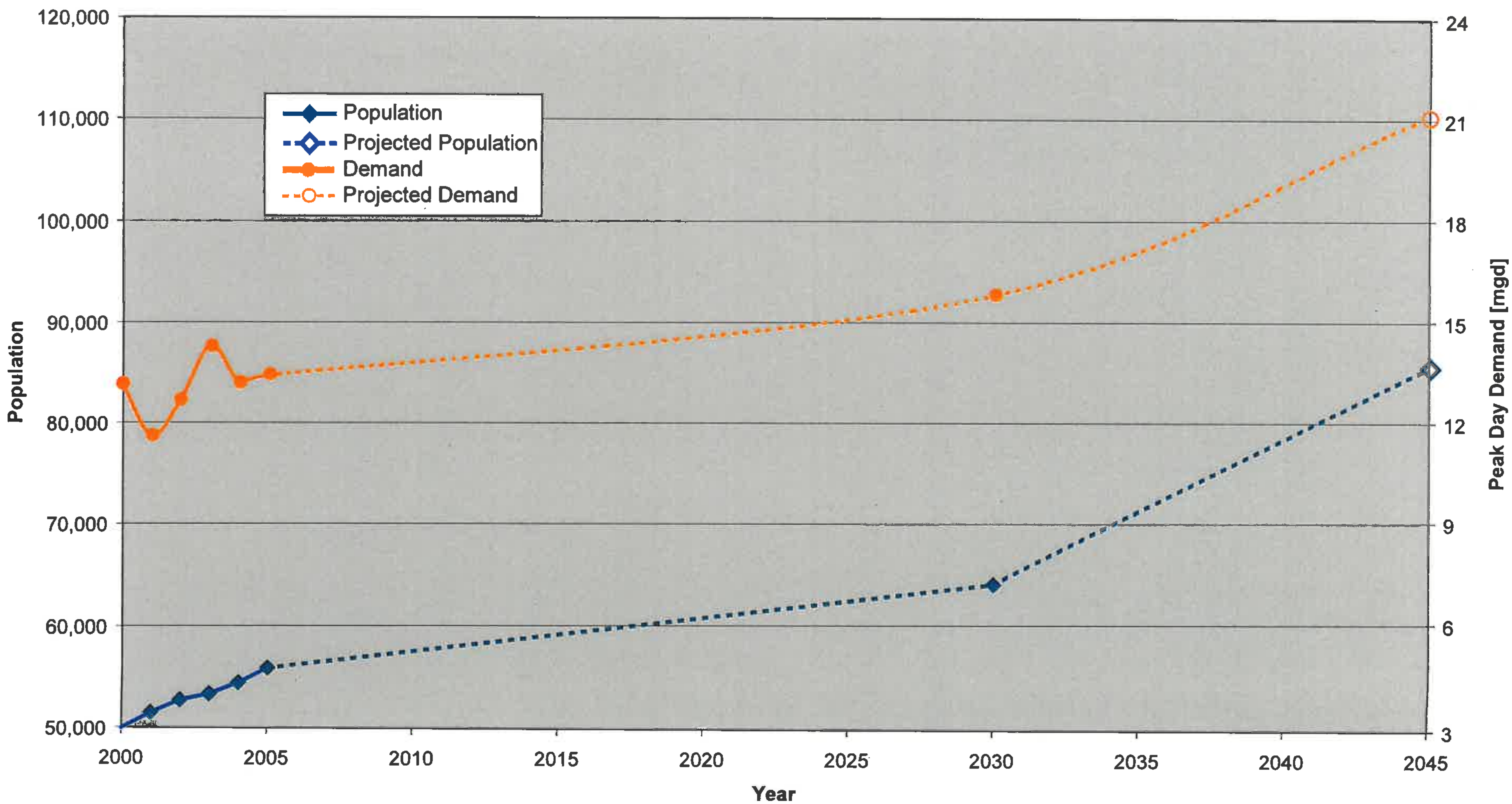

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Figure 1.4
TIGARD POPULATION AND
DEMAND PROJECTIONS
JOINT WATER SUPPLY SYSTEM ANALSYIS
CITIES OF LAKE OSWEGO AND TIGARD WATER SERVICE AREA

The maximum Build-out demand (45.0 mgd) for Lake Oswego, the Stafford Triangle, and Tigard is the ultimate capacity the Lake Oswego water supply system would need to accommodate. However, as discussed in Section 1.3.1.6, Tigard has the ability to obtain a reliable 3.5 mgd of supply via Aquifer Storage and Recovery. Therefore, the maximum, build-out demand for Lake Oswego, the Stafford Triangle, and Tigard will be considered as 41.5 mgd. The combined junior and senior water rights capacity for Lake Oswego and Tigard is 38 mgd. Because it is unlikely that Lake Oswego will be permitted to withdraw more than the 38 mgd for which they have existing rights, it is assumed that Tigard will obtain the remaining 3.5 mgd peak day demand from another supplier.

The combined junior and senior water rights capacity of 38 mgd will be used as the basis for sizing the raw water intake, raw water transmission main, water treatment plant, and distribution system which serves the Lake Oswego water service area. The Joint Water Supply System Analysis will address the capacity of the existing infrastructure and will develop scenarios regarding implementation of a joint water supply for the Cities of Lake Oswego and Tigard.

1.5 SUPPLY SCENARIOS

As part of the Joint Water Supply System Analysis, an evaluation of various water supply scenarios will be conducted. The scenarios range from the existing capacity of the LO WTP to the ultimate demand scenario for serving water to both the Lake Oswego and Tigard water service areas at build-out. Table 1.12 presents one description of the available capacities to each service area based on the proposed supply scenarios and the assumption that the Lake Oswego water service area demand has priority in receiving available capacity. This assumption is subject to change based on the governance agreement developed for the two service areas as part of the Joint Water Supply System Analysis (see Chapter 7 for further description of the potential governance agreements).

As seen in Table 1.12, Scenario No. 2, "Go It Alone" is entirely a Lake Oswego only scenario (including Stafford and wholesale customers within the USB). Because of the inherent advantage of increasing capacity in multiples (such as basin sizing, multiple pump capacity, and overall treatment configuration), it was determined that for this scenario the Lake Oswego demand of 23.9 mgd should be considered as 24 mgd. In this scenario, at build-out, no remaining capacity would be available to other wholesalers during peak flows. However, before build-out is reached, and during periods of off-peak water use, the opportunity would exist to lease unused water rights to other entities for their use.

Table 1.12 Summary of Supply Scenarios
Joint Water Supply System Analysis
City of Lake Oswego and Tigard Water Service Area

Scenario No.	Description	Ultimate Lake Oswego Service Area Demand (mgd)	Capacity Available to Tigard[1] (mgd)	Scenario Capacity (mgd)
1	Existing Capacity[2]	15.4[3]	0.6	16
2	Lake Oswego "Go It Alone"	24	0	24
3	Senior Water Right Capacity	24	8	32
4	Combined Junior and Senior Water Right Capacity	24	14	38

Notes:

1. The capacity available to Tigard shown in this table are based on the assumption that the Lake Oswego water service area demands have priority in receiving any available capacity. This assumption is subject to change based on the governance agreement developed for the two service areas as part of the Joint Water Supply System Analysis.
2. The existing capacity of the WTP is 16 mgd, of which a maximum of 2.5 mgd is provided to Tigard, and the remainder is provided to the Lake Oswego service area *including* wholesale customers other than Tigard. Should a joint water supply be developed for Lake Oswego and Tigard, the Lake Oswego retail customers and Tigard will have precedence over the other wholesale customers in using water from the WTP.
3. Per direction from Lake Oswego staff, the maximum historical (2000-2005) demand is presented, including a peak day demand from Other Wholesalers of 2.3 mgd. The average historical demand of the Lake Oswego service area (including a demand of 2.3 from Other Wholesalers) is 14.2 mgd.

Figure 1.5 presents the estimated timing during which the supply scenario capacities are sufficient to meet the projected demands of the Lake Oswego and Tigard water service areas. Figure 1.5 incorporates the average historical Lake Oswego City Only demand (12.9 mgd) with the estimated peak day Other Wholesaler demand (2.5 mgd) as the total present demand on the LO water infrastructure (15.4 mgd). It should also be noted that the demands presented in Figure 1.5 are based on the conservative assumption that the City of Lake Oswego will continue to provide water to the Other Wholesalers through build-out of the USB. This assumption should be confirmed or revised based on future governance agreements developed between Lake Oswego, Tigard and the Other Wholesalers.
A description of the service area demands (as shown in Figure 1.5) and the timing of the necessary increases are presented below. The available capacity descriptions included in these descriptions are based on the assumption that the Lake Oswego water service area demands have priority in receiving any available capacity. This assumption is subject to change based on the governance agreement developed for the two service areas as part of the Joint Water Supply System Analysis (see Chapter 7 for further description of the potential governance agreements).

Scenario 1: Existing Capacity (16 mgd)

Scenario 1 represents the existing demands and capacity of the Lake Oswego infrastructure. As seen in Figure 1.5, the average historical (2000-2005) Lake Oswego maximum day demand is 12.9 mgd, the projected maximum demand from wholesalers other than Tigard (Other Wholesalers) is 2.5 mgd, and the average historical (2000-2005) Tigard maximum day demand is 13.1 mgd. However, the capacity of the existing infrastructure is limited to 16 mgd. Therefore, only 0.6 mgd of the current maximum Tigard demand is served by the Lake Oswego infrastructure. The existing infrastructure is expected to provide enough capacity to Lake Oswego City Only through 2041. If Lake Oswego continues to provide water to the Other Wholesalers, the existing infrastructure is expected to provide enough capacity for Lake Oswego and Other Wholesalers through 2009.

Scenario 2: Lake Oswego "Go-It-Alone" (24 mgd)

Scenario 2 represents the required capacity to treat the build-out demands of the Lake Oswego water service area. Expansion to 24 mgd would also allow the Tigard and Other Wholesaler demands to be met up to 10.6 mgd in 2010, 9.9 mgd in 2020, and 9.2 mgd in 2030, but would not meet any portion of the Tigard demand at build-out.

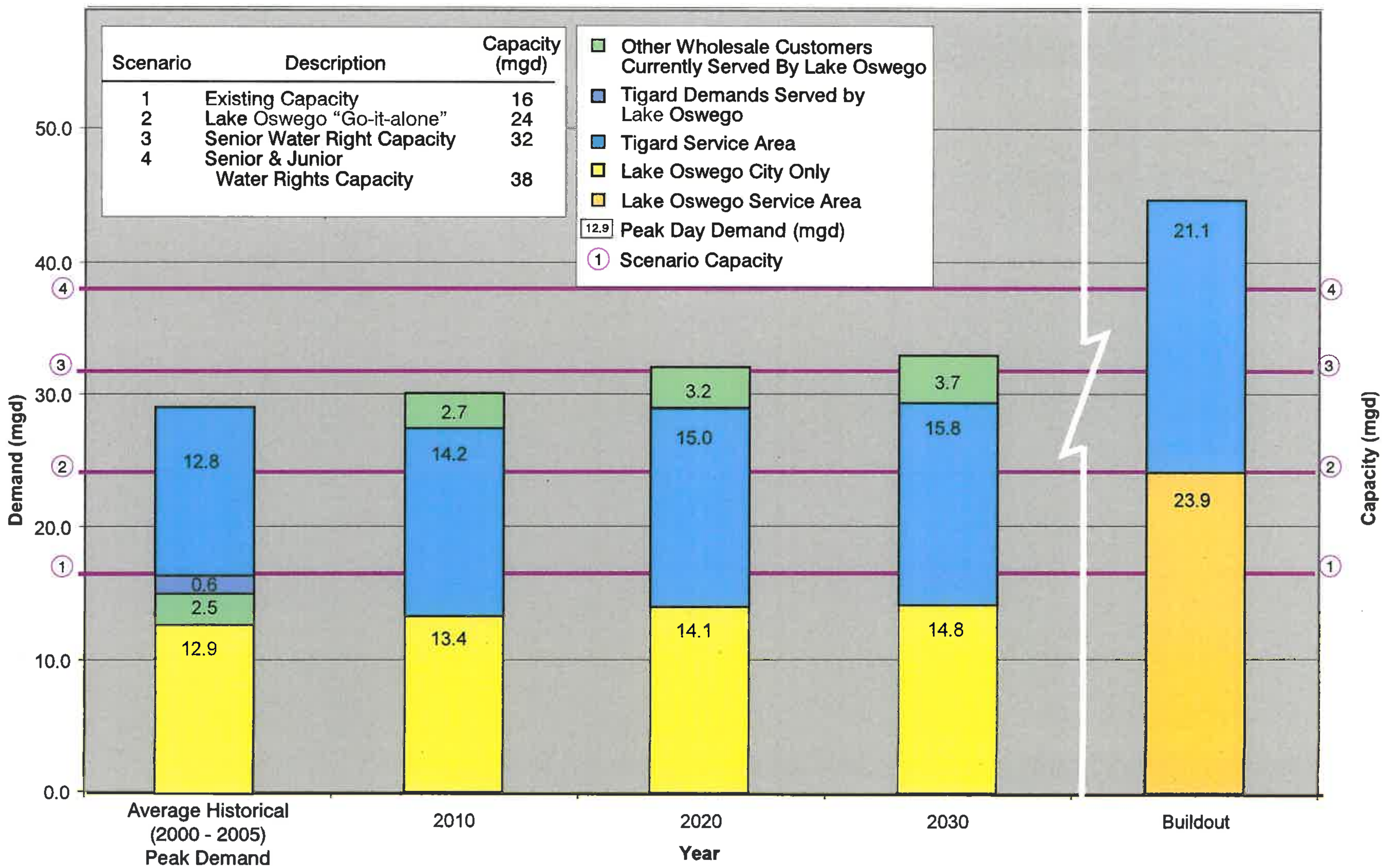

Figure 1.5
PROPOSED SCENARIO CAPACITIES VS. SERVICE AREA 3 DAY PEAK DEMANDS
JOINT WATER SUPPLY SYSTEM ANALYSIS
CITY OF LAKE OSWEGO AND TIGARD WATER SERVICE AREA

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Scenario 3: Senior Water Right Capacity (32 mgd)

Scenario 3 represents the capacity needed to convey the 32 mgd of Clackamas senior water rights that Lake Oswego has been permitted. This capacity exceeds the build-out demands of the Lake Oswego water service area. Therefore, this scenario would allow the Tigard and Other Wholesaler demands to be met up to 18.6 mgd in 2010, 17.9 mgd in 2020, 17.2 mgd in 2030, and 8.1 mgd of the Tigard demand at build-out.

Scenario 4: Combined Junior and Senior Water Right Capacity (38 mgd)

Scenario 4 represents the capacity needed to convey the combined junior and senior water rights that Lake Oswego has been permitted to withdraw from the Clackamas River. This capacity exceeds the build-out demands of the Lake Oswego water service area. However, 38 mgd is the maximum build-out demand of the Lake Oswego, Stafford Triangle, and Tigard water service areas. Therefore, expansion to 38 mgd would allow the Tigard and Other Wholesaler demand to be met up to 24.6 mgd in 2010, 23.9 mgd in 2020, 23.2 mgd in 2030, and 14.1 mgd of the Tigard demand at build-out.

EVALUATION OF WATER SUPPLY FACILITY ALTERNATIVES

2.1 INTRODUCTION

The purpose of this chapter is to present the findings and recommendations of the water supply facilities alternatives conducted for the City of Lake Oswego and the Tigard Water Service Area as part of the Joint Water Supply System Analysis. This effort includes an evaluation of, and facility alternatives for, the Clackamas River raw water intake, the raw water transmission main, the Lake Oswego water treatment plant, and the finished water transmission system, including transmission main, storage, and pumping improvements.

2.1.1 Demand Scenarios

Improvements were developed based on three of the four demand scenarios which are described in detail as part of Chapter 1. These scenarios are described below:

- Scenario 1: Existing Capacity (16 mgd). The existing capacity of the Lake Oswego water infrastructure.
- Scenario 2: Lake Oswego "Go It Alone" (24 mgd). The required capacity to treat the build-out demands of the Lake Oswego water service area.
- Scenario 3: Senior Water Right Capacity (32 mgd). The capacity needed to convey the 32 mgd of Clackamas senior water rights that Lake Oswego has been permitted. This capacity exceeds the build-out demands of the Lake Oswego water service area.
- Scenario 4: Senior and Junior Water Right Capacity (38 mgd). The capacity needed to convey the combined junior and senior water rights that Lake Oswego has been permitted to withdraw from the Clackamas River. 38 mgd is also the maximum build-out demand of the Lake Oswego, Stafford Triangle, and Tigard water service areas.

It should be noted that demand Scenario 1 was not included in the evaluation of proposed system improvements.

2.1.2 Cost Estimates

Project costs are presented in September 2006 dollars based on the Engineering News Record (ENR) Twenty-City Average construction cost index of 7763. Project costs include construction costs with a 30%-40% construction contingency and a 20% contingency for engineering, legal, and administrative costs. The construction contingency for the intake, treatment plant, reservoir, and pump station was allocated at 30% based on standard preliminary cost estimating guidelines. The construction contingency for the raw and finished water pipelines was increased to 40% to account for the additional unknowns related to geotechnical considerations, final pipeline alignment, and impacts of delays in timing of project implementation. Operations and maintenance (O&M) costs are also presented in September 2006 dollars and include labor and supply costs (including power) for operations and maintenance of the system components. Annual O&M costs are based on the assumed annual average demand of the given scenario.

2.2 RIVER INTAKE

The evaluation of the Clackamas River intake was conducted to determine the existing hydraulic conditions surrounding the intake and suggests two alternatives for the location and cost of a new intake on the Clackamas River. Analysis of the existing intake and development of conceptual alternatives for intake improvements was prepared by Eugene Yaremko of Northwest Hydraulic Consultants.

2.2.1 Existing Intake Structure and Pumping Facility

The existing intake structure is a bank-type intake situated on the north bank of the Clackamas River, approximately 0.8 miles upstream from its confluence with the Willamette River. The intake structure and pump station supply raw water to the Lake Oswego water treatment plant, which currently furnishes finished water to Lake Oswego and its wholesale customers.

Originally designed by CH2M Hill and constructed in 1968, the intake was expanded in 1980 to provide a capacity of 16 mgd (24.7 cfs). Originally, river water passed through a single port fitted with a conventional traveling screen where the intake opening measured 7-feet, 9-inches wide by 9-feet high (69.8 square feet). The top of opening was at about elevation 13.0 feet, compared to a design low river level of elevation 9.30 feet, so the screen area available below this level was 41 square feet. This screen installation had no special provision for collection and return of fish to the river. The port was located within a concrete wall relatively parallel to the adjacent bank.

During the summer of 2002, the screen system was revamped to comply with current fish screening standards. The changes designed by Montgomery Watson Harza involved:

- Removal of the traveling front screen and replacement with a fish screen 6 feet high by 9.8 feet wide (it is assumed that the screen bottom has been set at elevation 4.0 feet, the sill level within the opening).
- Addition of two fish screens measuring 6 feet high by 8 feet wide located on the upstream and downstream angled concrete walls of the intake structure (it is assumed that the screen bottom is at the floor level; elevation 3.0 feet).

The top of the front screen is at elevation 10.0 feet, or 0.7 feet above low river level; the top level of the two smaller screens is at elevation 9.0 feet. The screens consist of stainless steel material and a flat profile wedgewire screen with a bar spacing of 1.75 mm with a minimum percent opening of 27 percent. The total screen area is 154.8 square feet, with 147.9 square feet below the original design low river level of 9.3 feet. Screen backwash is provided by a system of water jets set up behind the screens.

2.2.1.1 Minimum River Level

Clackamas River flows at the intake site are affected considerably by storage developments within the upstream river basin. Five dams have been constructed; four are located directly on the Clackamas River, and the fifth is located on Oak Grove Fork, a tributary of the Clackamas. The last and furthest downstream dam, constructed in late 1959, is the Rivermill Dam, located 22.6 miles upstream of the intake. Drainage area upstream of the dam is in the order of 671 square miles, compared to a drainage area at the intake of about 900 square miles. A USGS hydrometric gage located on the Clackamas River close to and downstream of the Rivermill Dam (no.14210000, Estacada) has been recording discharges for over 80 years. Thus, flows upstream of this gage have been influenced by operation of the storage facilities, while inflow downstream is natural, except for licensed withdrawals.

A USGS gage was operated from 1962 to 1983 at Clackamas, four miles downstream of Rivermill Dam. It is expected that discharge would increase downstream in response to tributary inflow. An assessment of these data for the low flow season June through October by MWH[1] determined this to be the case. A comparison of Estacada and Clackamas data found that the increase, on average, was in the range of 10 to 15 percent. However, it is important to note that in some years there was little or no increase in flow.

Fundamental to design of a river intake is an estimate of potential minimum river level. A level of elevation 9.30 feet has been labeled Low Water Level for design of the 2002 intake modification project, along with a suggested lower level of elevation 8.0 feet based on anecdotal information. No information was found that stated a particular discharge that applied to either level. Standard practice is to utilize recorded annual minimum daily discharges as a data set and apply it to a frequency analysis, adjust it to the intake site and then conduct a channel hydraulic analysis to establish the corresponding river level for the selected design risk level. However, because flow data for the Clackamas River are greatly influenced by upstream hydro releases, discrete discharges such as annual minimum daily flow cannot be considered as a set of independent variables, so therefore should not be subjected to a frequency analysis. Furthermore, river cross-section data are not available for this site so a channel hydraulic analysis to develop a rating curve is not possible at this time.

In 1998, a pressure transducer was installed within the intake structure to record water levels. The recorded daily water level data for the period of record provided by the City of Oswego identify the levels as river elevation above sea level. Considering only the low flow period August through October, the record shows a minimum level of elevation 7.70 feet during the initial ten-day start-up period. This is considered to be erroneous data - the adopted lowest recorded level for 1998 was elevation 8.0 feet. A level of elevation 8.8 feet was recorded August 9, 2005. A discharge cannot be assigned at this time to either of these levels. It is noted again that elevation 8.0 feet is the level identified as being an "anecdotal" historic low level.

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[1] *"Biological Assessment for the City of Lake Oswego, Clackamas River Water Intake Modifications" MWH, February 2002*

For this study, the approach to establishing the design minimum river level was as follows:

- **Impacts of Downstream Control.** A low flow control in the form of a set of rapids is present approximately 100 feet downstream of the intake. These rapids have formed at the south edge of the channel (see Figure 2.1); a large gravel bar extends from the edge of the rapids to the north bank. An assumed average bed level of elevation 6.0 feet within the rapids control section and a flow depth of 2-feet would produce an estimated discharge of close to 400 cubic feet per second. A 3-foot depth would produce a discharge of about 850 cubic feet per second. At higher flow levels the effect of the control section would become drowned out. The important point to note is that within the lower range of discharges, water levels are somewhat insensitive to discharge. A river survey would be required to enable confirmation and quantification of this downstream hydraulic control.

  It is also important to note that the potential for these rapids to wash out represents a risk to the minimum water level at the intake, so a detailed assessment of the character of the rapids versus the hydraulic regime is recommended. At a minimum, establishment of a formal monitoring plan is recommended to detect and mitigate any deterioration of the control in a timely manner.

  The minimum discharge recorded at the Estacada gage (approximately 400 cfs) in 1965 was adopted as the minimum discharge that could occur at the intake. This is confirmed by Figure 2.2, which is a plot of daily discharges for the Clackamas gage for the period of record. A discharge of nearly 400 cfs was recorded during August of 1965, compared to a discharge of 400 cfs recorded August 16, 1965 at the Estacada gage. 400 cfs is also the prescribed Instream Water Rights discharge for July 1 - September 15 (which then increases to 640 cfs). The recommended intake design minimum discharge is therefore 400 cfs, which correlates with an elevation due to the downstream control of 8.0 feet.

- **Historical Minimum River Levels.** As previously discussed, the historical minimum river level was determined to be 8.0 feet above sea level.

Based on these two approaches, the recommended design minimum river level is at elevation 8.0 feet.

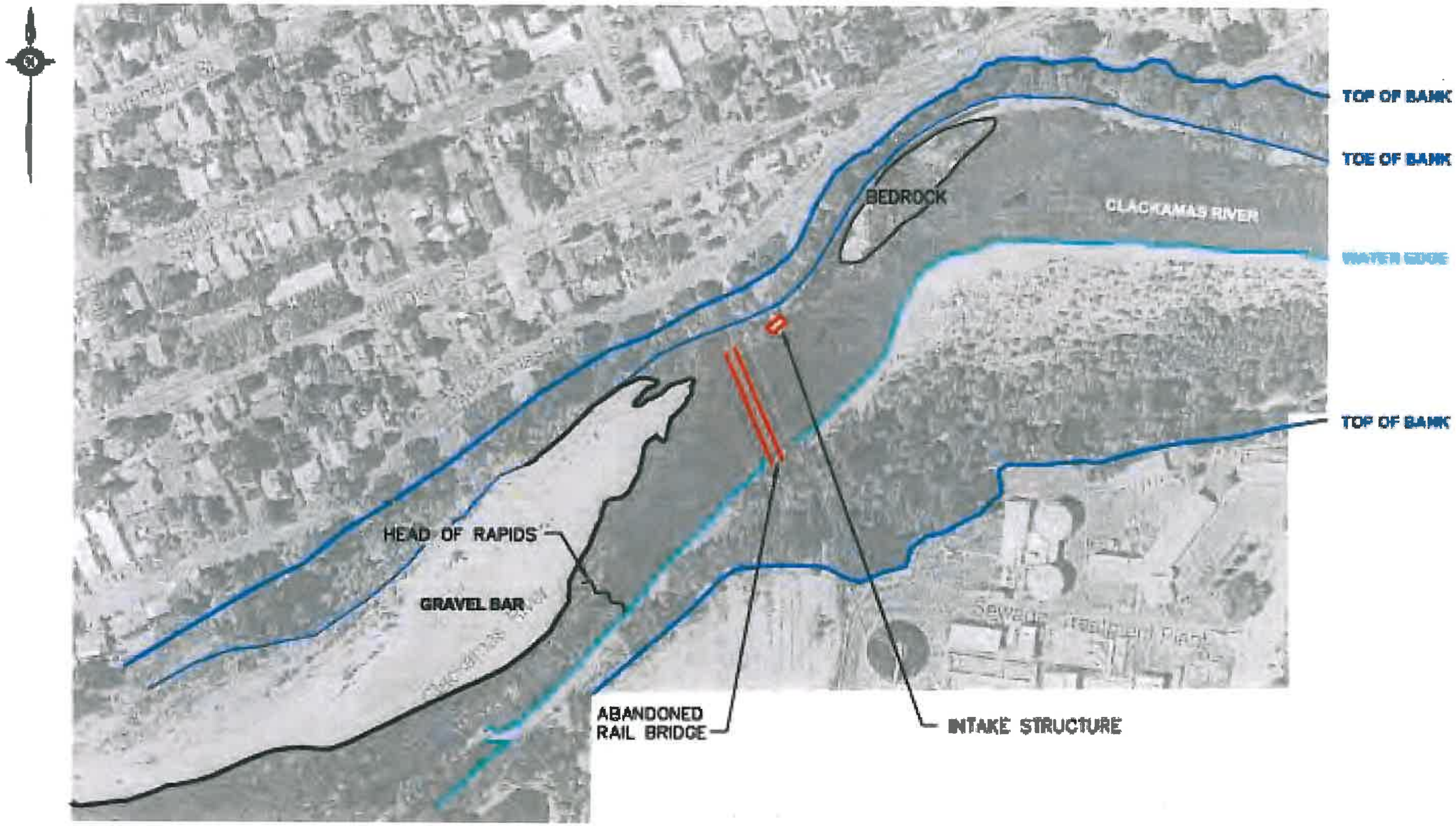

Figure 2.1
LOCATION PLAN
JOINT WATER SUPPLY SYSTEM ANALYSIS
CITY OF LAKE OSWEGO AND TIGARD WATER SERVICE AREA

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USGS 14211000 CLACKAMAS RIVER NEAR CLACKAMAS, OREGON

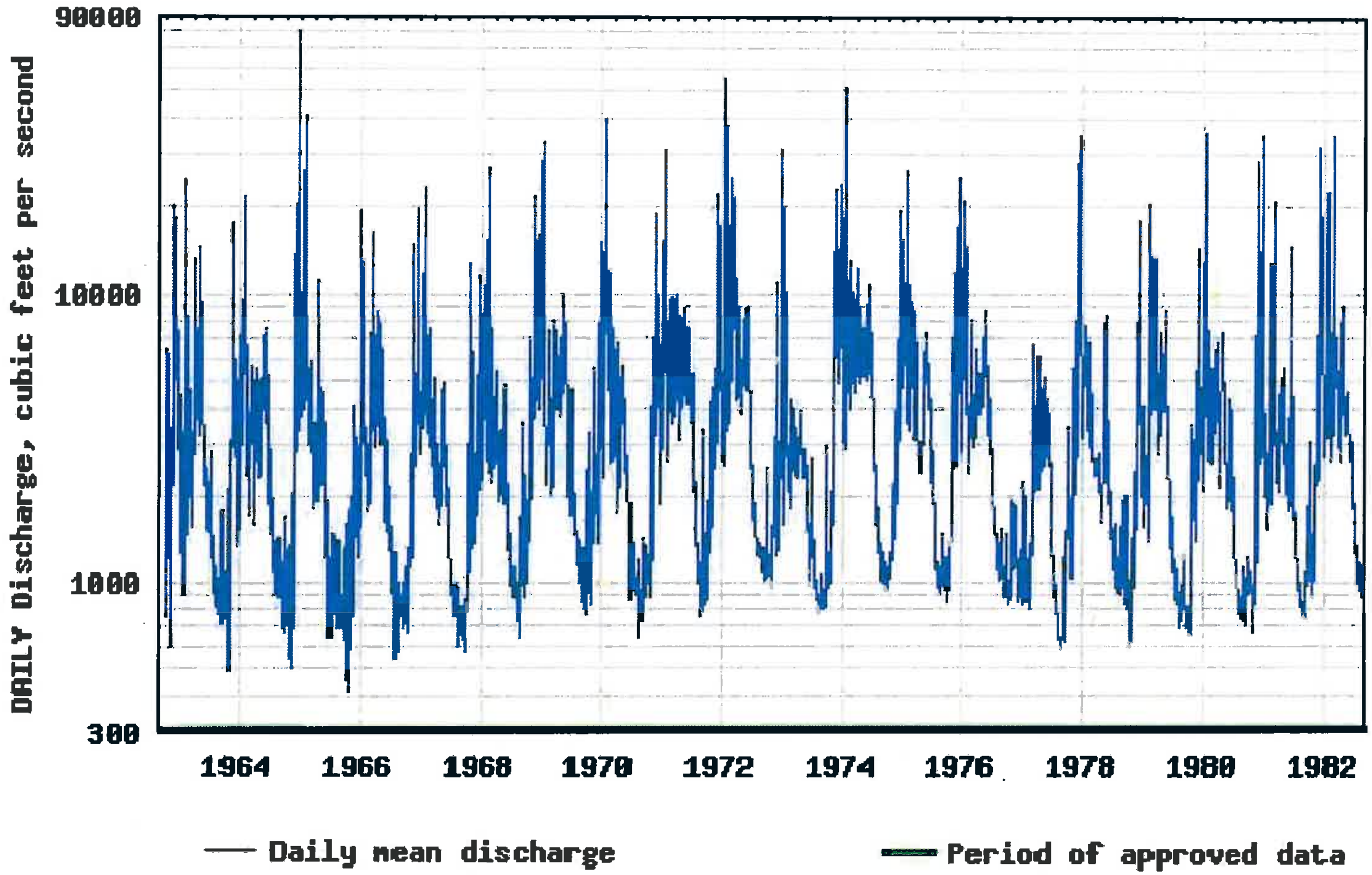

Figure 2.2
DAILY MEAN DISCHARGE RECORD 1964-1982
CLACKAMAS RIVER NEAR CLACKAMAS
JOINT WATER SUPPLY SYSTEM ANALYSIS
CITY OF LAKE OSWEGO AND TIGARD WATER SERVICE AREA

2.2.1.2 River Regime and Riverbed Morphology

Figure 2.3 provides a sketch that displays primary features of the river reach centered by the existing intake structure. Note that:

- The intake is located at the downstream end of a nearly 90 degree bend of the river.
- The intake is located within a constricted section of the river; the channel upstream and downstream of the intake broadens considerably.
- The north bank is high and well above any flood level; the south bank is lower and may occasionally overtop.
- The thalweg entering the upstream bend appears to be adjacent to the north bank but is forced to the channel's center approaching the intake section; it appears that this is in response to the presence of what appears to be a bedrock outcrop that takes up a large portion of the bed area adjacent to the north bank upstream of the intake.
- The thalweg crosses over to the south bank beginning at the intake section; as indicated previously, the thalweg downstream of the intake is confined by a large gravel/boulder bar that extends out from the north bank, with a set of rapids formed along the south bank.
- The straightness of the south bank beginning at the intake section suggests bank armoring, or possibly the presence of bedrock.
- The north bank upstream, along the beginning of the sharp bend, is being actively eroded, but at a slow rate – the bank through the intake reach is nearly vertical and largely stable.

From available riverbed topography, there are three scoured holes visible near the intake. Their locations are shown in Figure 2.3, where:

- Scour hole 1 has a bottom level of elevation -2.0 feet - this scoured hole sits directly in front of the intake and it is important to note that the intake floor level and the two side intake port sills are at elevation 3.0 feet.
- Scour hole 2 has a bottom level of elevation -3.0 feet.
- Scour hole 3 has a bottom level of elevation -6.0 feet.

Similar scour features were observed upstream of the intake along the outside edge of what appears to be bedrock outcrops located along the north bank. It is recommended that a geotechnical evaluation of the soil characteristics of the north and south banks of the Clackamas River be conducted during pre-design or final siting of any new intake construction.

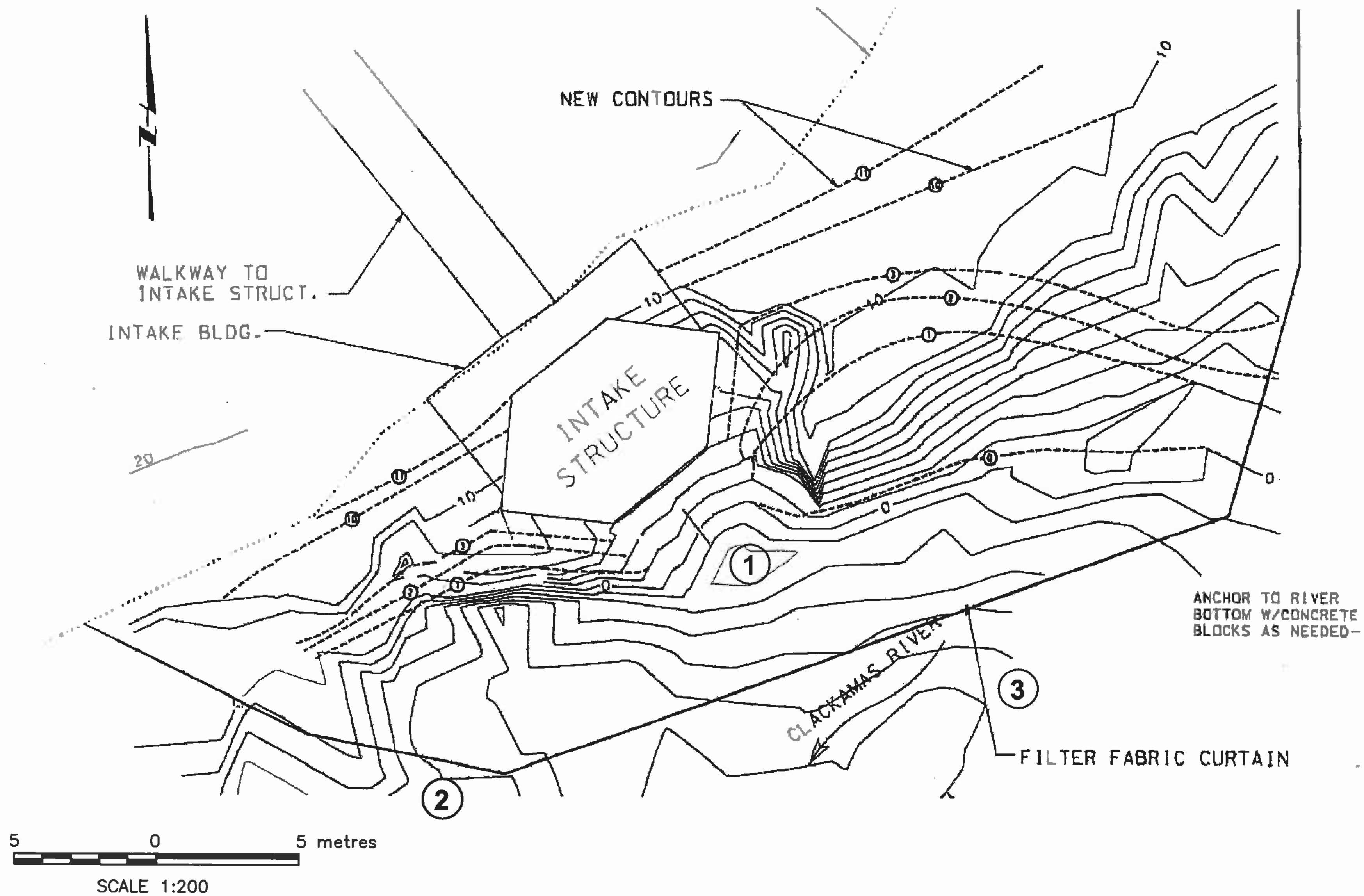

Figure 2.3
EXISTING INTAKE AND SCOUR HOLE LOCATIONS
JOINT WATER SUPPLY SYSTEM ANALYSIS
CITY OF LAKE OSWEGO AND TIGARD WATER SERVICE AREA

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The form of these scoured areas is interesting in that they have been formed within what appears to be basalt zones. Scoured holes have steep boundaries, suggesting that material removal has been in the form of blocks being plucked. Coarse bed material transport does occur along the bed of the Clackamas River, but visual evidence suggests that it is at relatively small amounts and not likely at rates that would significantly infill these scoured areas.

Ideally, an intake must be situated where minimum flow depths are adequate and unlikely to change in response to a shifting channel. As well, the bank and bed morphology should set up a flow pattern that establishes parallel or somewhat impinging flow across the intake ports. In consideration of the existing intake and intake ports, the following is observed:

- A constricted section and nearby scour holes are positive features.
- Stable banks are also a positive feature.
- Minimum depth relative to the scour hole directly in front of the intake and below the recommended river level of elevation 8.0 feet is 10 feet, which provides ample vertical room in which to establish intake ports and pump well floor levels having proper clearances.
- At low discharges, low velocity flow alignment is influenced greatly by the presence of what appears to be upstream bedrock protruding above the general bed level. The flow pattern would be more-or-less parallel to the front wall and port of the existing intake structure, there would be impingement on the upstream diagonally orientated wall and port and clockwise eddy flow past the downstream diagonally orientated intake wall and port. The flow pattern past the downstream port of the existing intake is therefore not ideal, but low suspended loads and flow velocities will unlikely affect intake operation or fish safety.
- As river discharge increases, the flow pattern approaching the intake will be less influenced by the upstream protrusion and more by the north bank alignment, in which case the flow pattern will increasingly be less parallel to the front wall and port, and more parallel to the upstream wall and port. The downstream port will be subjected to an increasingly strong clockwise eddy and a potential for screen clogging and fish impingement by debris.

In conclusion, the intake location is satisfactory in terms of river characteristics: deep and stable scour hole close to north bank; stable north bank; more than adequate minimum flow depth; reasonable distance to thalweg and strong flow; and the ability to have access to intake ports/screens at all times.

The existing intake configuration and orientation of ports to approaching river flow is not ideal in all cases. Least problematic will be the upstream port, as it will have good sweeping velocities. The front (center) port may experience a flow pattern that at times reduces its diversion ability in the upstream area of the port. The downstream port will not experience good flow characteristics, as a clockwise eddy will tend to form in front of the port, thereby inviting accumulation of debris and suspended sediment, and possibly impingement of fish on the screen if it becomes increasingly clogged.

Intake capacity related to screen performance would be compromised if the screen water backwash system was shown to be ineffective or if screen cleaning was not implemented at proper intervals.

2.2.1.3 <u>Sediment</u>

Approximately 75 percent of the Clackamas River basin upstream of the intake site is controlled by five reservoirs. Essentially all of the gravels, sands and silts will be trapped within these reservoirs – perhaps clay sizes may pass through. Therefore, the majority of suspended sediments carried by the river approaching the intake will be derived from the 229 square mile tributary area downstream of the Rivermill Dam. Thus, the overall sediment load has been significantly reduced in response to reservoir developments.

The time available for sediment to travel from the intake ports to the pump well is a function of the length of travel, flow depth, cross section width and discharge – this determines the potential for various sediment sizes to deposit. At minimum river level, for a discharge of 16 mgd, the retention time would be about one hour; for 19 mgd, two hours. At average flood level, the corresponding retention times might be three to four times greater.

Operations staff have identified that approximately 1.5 - 2 feet of sediment accumulates annually within the wet well. To dispose of the accumulated sediment, divers are retained to clean the wet well each year. Implementation of a backwash or pumping system to remove this accumulation is not justifiable for the existing intake; however, it is recommended that during preliminary design of modifications to the existing intake, or construction of a new intake, the issue of reducing sediment deposition within the wet well be revisited.

2.2.1.4 <u>Existing Pumping Capacity</u>

The existing intake pump station arrangement is as shown in Figure 2.4.

Water depth within the wet well below minimum river level is 5 feet. Clearance between well floor and bottom of pump bowls varies from one to two feet, so pump bell submergence could be as little as three feet.

The capacity of the three constant speed pumps is rated at 3,750 gpm (5.4 mgd), and the fourth variable speed pump is rated at 6,500 gpm (9.4 mgd). However, when run in combination, the capacity of the three constant speed pumps is reduced to 2,750 gpm each (3.9 mgd) and the variable speed pump is reduced to 3,400 gpm (4.8 mgd), resulting in a total installed pumping capacity of 16.5 mgd. Operational strategy is to utilize the variable-speed pump supplemented by one or more of the fixed-speed pumps to meet a particular demand.

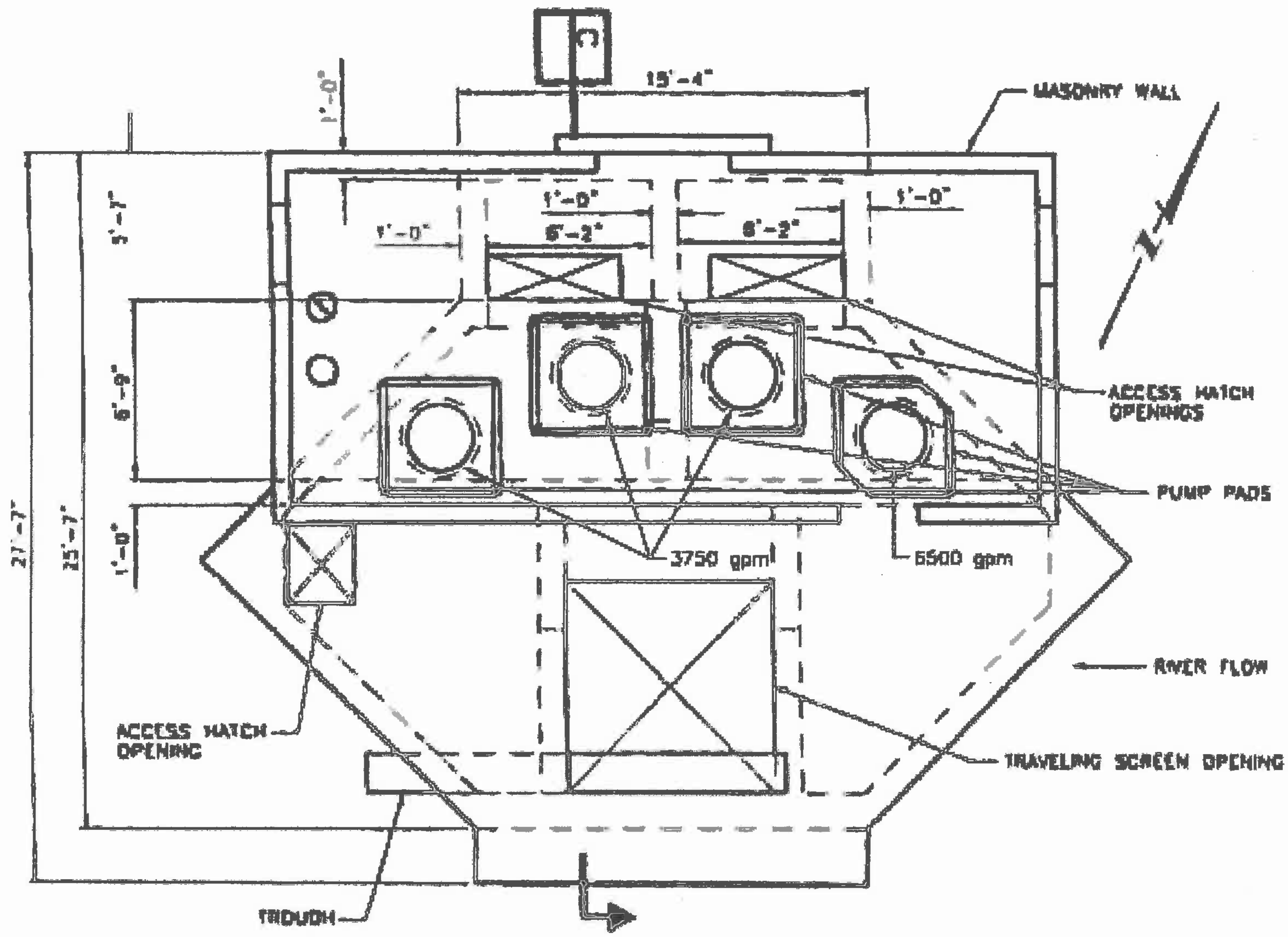

Figure 2.4
INTAKE STRUCTURE PLAN VIEW
JOINT WATER SUPPLY SYSTEM ANALYSIS
CITY OF LAKE OSWEGO AND TIGARD WATER SERVICE AREA

Operating experience has shown that pump operation problems arise at high demand and low water conditions. For the given configuration and the recommended design minimum river level, intake capacity could be further limited by pump performance. The following are possible reasons why problems arise with pump performance:

- Hydraulic Institute guidelines suggest that the minimum bell submergence for the 6500 gpm pump should be in the order of 5 feet; 3.5 feet for the 3750 gpm pumps. Presumably, pump operation may experience vortexing problems when river levels approach elevation 10.0 feet. A review of the river level record collected in the intake since 1998 shows that this has occurred in several years during the low flow season.
- Plugging off of one of the screens by woody debris or algae may be creating an unbalanced (skewed) flow pattern approaching the pumps.
- The two ends of the two side ports have been placed in close proximity to the two outside pumps – uneven flow approaching the pumps may be the result.
- The approach of utilizing the largest pump at all times in conjunction with one or more of the other three may create unfavorable flow patterns.

To establish whether changes can be made to the existing intake/pump well configuration that would result in better pump performance and increased pump capacity, common practice is to conduct physical model tests. The original intake design included a single intake port configuration that was more likely to produce a uniform approach of flow to the pumps. The addition of two side ports may have introduced a less favorable flow environment within the intake wet well.

2.2.1.5 Existing Fish Screening Capacity

The existing three-screen configuration has about 35.6 square feet above the design minimum river level of elevation 8.0 feet. This reduces the allowable capacity of the existing intake configuration to approximately 30 mgd at minimum river level.

2.2.2 Intake Alternatives

Four alternatives were evaluated to meet the projected supply needs of the Lake Oswego and Tigard water service areas. These alternatives are as follows:

- **Expand existing intake capacity.** Expansion of the existing intake would make use of the present structure, although significant structural modifications would be needed. Because the fish screen capacity of the existing intake is limited to 30 mgd, this alternative would provide only enough capacity to meet Scenarios 1 and 2 (16 mgd and 24 mgd, respectively) of the Joint Water Supply Scenarios.

- **Construct a new bank intake structure.** Due to the condition and capacity of the existing intake structure, a new riverbank intake was considered as an alternative.
- **Construct a river bottom infiltration intake.** A river bottom infiltration intake would allow river water to percolate through the bottom of the riverbed, would not require fish screens, and would not be at risk of functional failure due to low river levels.
- **Construct a riverbank infiltration intake.** A river bank infiltration intake would allow water to percolate through the river bank, and would not require fish screens.

As discussed in Chapter 1, the projected build-out demands of the Lake Oswego water service area are 24 mgd (Scenario 2). This is the "Lake Oswego Go-it-Alone" scenario for which it is understood that no joint water supply would be developed. To meet the Lake Oswego demands for this scenario, it is likely that the most economically feasible intake alternative would consist of expanding the existing raw water intake structure, rather than constructing a new intake. Therefore, the remaining three intake alternatives, which include construction of a new intake, have been developed to meet Scenarios 3 and 4 exclusively (at 32 mgd and 38 mgd, respectively).

Further description regarding each of the four proposed intake alternatives is provided below:

2.2.2.1 Expand Existing Intake

To increase the capacity of the existing intake structure, the wet well floor would need to be lowered by several feet to ensure adequate pump bell submergence at all times.

In addition to considering expansion of the existing intake capacity, it is important to consider the existing condition of the concrete intake structure itself. As discussed in Chapter 1, recent observations of the intake structure indicate that the concrete floor slab is delaminating and spalling (likely due to aggregate-silica reactivity) and has settled since the 2002 upgrade, resulting in 40%-45% decrease in the tension of the anchor bolts. Because of the recent spalling of the concrete around the anchors, the capacity of the floor slab to withstand a significant seismic event has likely been compromised. Should the existing intake capacity be increased by lowering the wet well floor and reorienting the fish screens, it is recommended that additional structural modifications be made to increase the seismic reliability of the structure.

2.2.2.2 New Riverbank Intake

Construction of a new bank intake would provide the opportunity to better orient the fish screens and establish a deeper wet well while taking advantage of the river morphology of this area. Figure 2.5 presents a potential location for the proposed new intake. The alignment and location of the thalweg and likely presence of bedrock abutting the north bank upstream of the existing intake, and a large bar abutting this bank downstream, preclude the ability to install a north bank intake in these areas. There is no site available for a south bank intake within this reach. The observation of bedrock on the north bank of the Clackamas River should be confirmed by a geotechnical evaluation of the area. If bedrock is indeed present in these areas, it is possible that the only feasible location for constructing a new intake is at, or just downstream of, the existing intake structure.

Figure 2.6 presents a cross section of the intake structure, and identifies proposed design criteria to meet a capacity of 32 mgd for the backfill area, fish screens, and the wet well. As seen in Figure 2.6, to obtain a capacity of 38 mgd, the fish screen length would be increased by 3.4 feet for a total of approximately 170 square feet. Additionally, the conductor pipes would be increased to a diameter of 42 inches.

2.2.2.3 River Bottom Infiltration Intake

The proposed river bottom infiltration intake is presented in Figure 2.7. The dimensions of the intake are shown for a 32 mgd capacity. To meet a capacity of 38 mgd, the overall length of the gallery would be extended by 20 feet and the width would be extended by 10 feet, for a total infiltration gallery area of 22,000 square feet. The conductor pipes and infiltration pipe diameters would not need to be increased. The main advantages of such an intake configuration are the 1) lack of fish screens and 2) the intake is not adversely impacted by low river levels. However, the river bottom intake would require some type of backwash system to prevent blockage of the infiltration piping, which would then resuspend the sediments within the river.

Prior to implementation of this type of intake, it is recommended that a hydraulic analysis of the river be conducted to quantify the risk of intake blockage based on the type and mobility of suspended solids within the Clackamas River. This evaluation could further identify the maintenance requirements for this type of intake.

2.2.2.4 Riverbank Infiltration Intake

The proposed riverbank infiltration intake has been sized for a capacity of 32 mgd, and is presented in Figure 2.8. A cross section of the intake is presented in Figure 2.9. The area of the open port at 32 mgd is 230 square feet (five feet high by 46 feet long). As seen in Figure 2.9, to achieve a capacity of 38 mgd, the open port height would need to be increased to six feet and the length increased to 50 feet, for a total area of 300 square feet of open port. The primary advantages of such an intake are the 1) lack of fish screens and 2) the simple design. However, due to the sedimentation concerns identified for the river bottom infiltration intake, it is recommended that a backwash system be implemented to prevent blockage of the overlying riprap armor. The backwash system would need to be configured such that equivalent pressure is released at each point in the filter backfill, otherwise only a small portion of the backfill would be flushed, resulting in a loss of capacity.

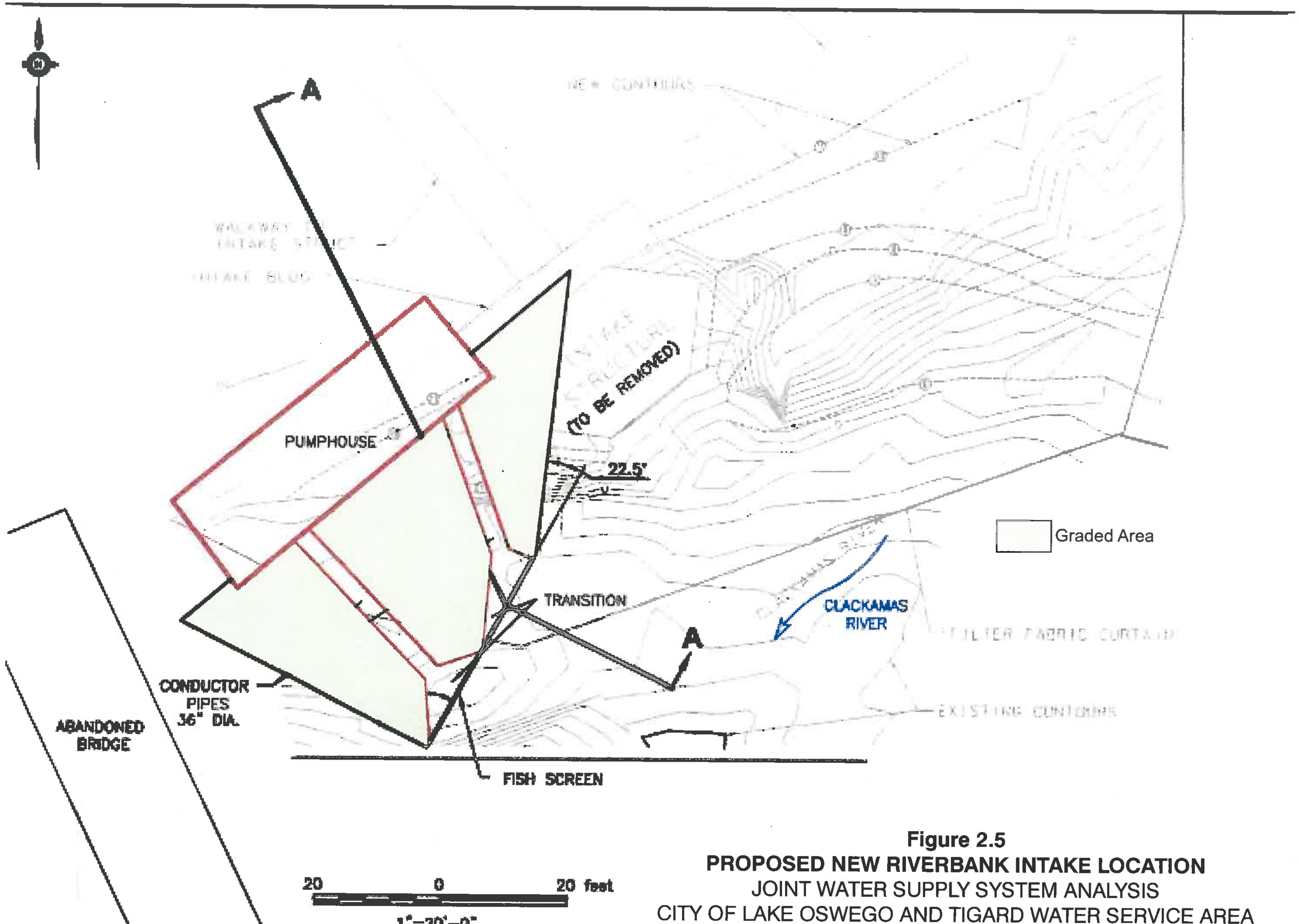

Figure 2.5
PROPOSED NEW RIVERBANK INTAKE LOCATION
JOINT WATER SUPPLY SYSTEM ANALYSIS
CITY OF LAKE OSWEGO AND TIGARD WATER SERVICE AREA

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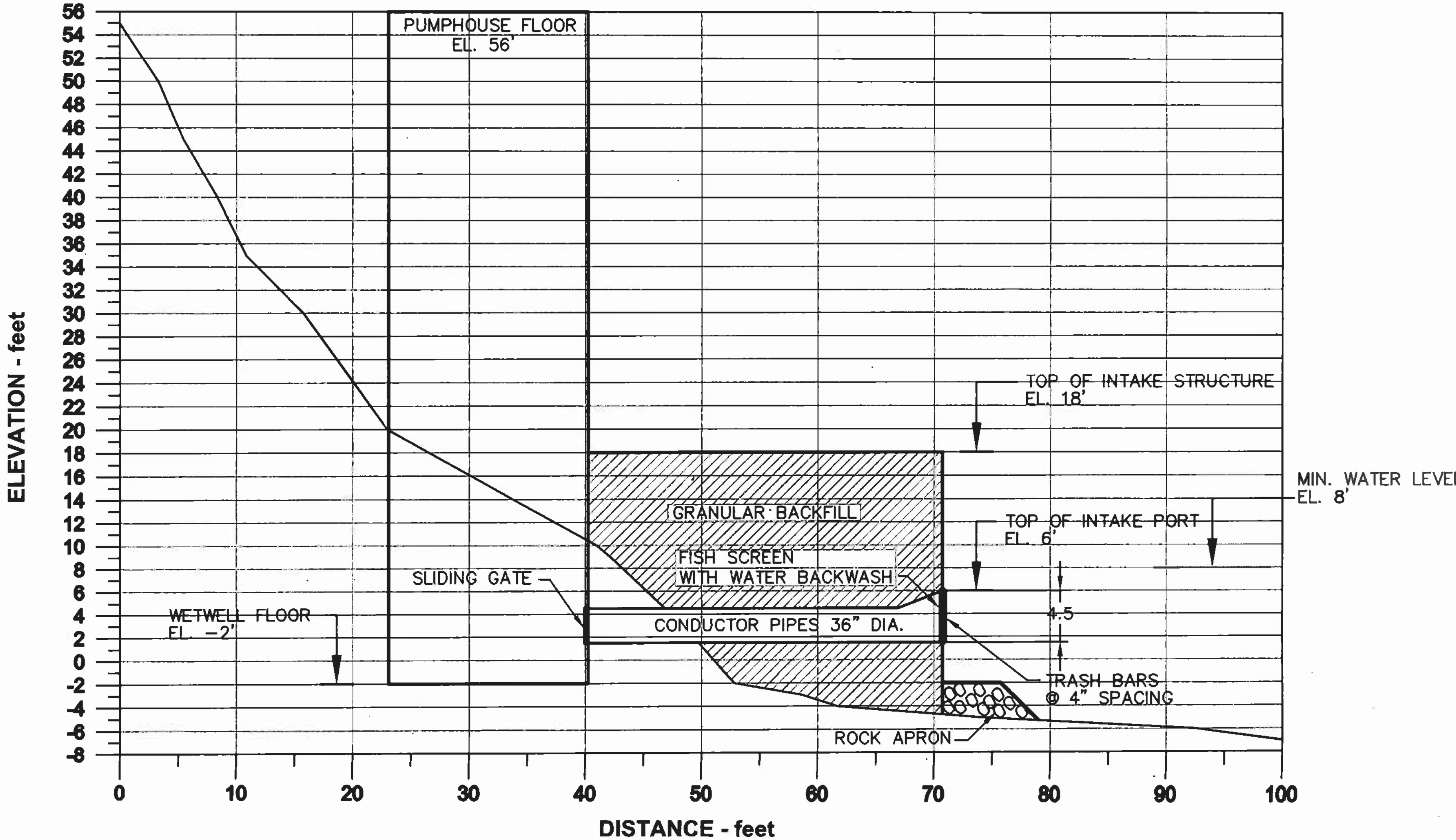

NOTE:

1. FOR A Q=38 MGD SCREEN LENGTH WOULD BE 3.4 FEET LONGER THAN SHOWN.
2. FOR A Q=38 CONDUCTOR PIPES WOULD BE 42" DIA.

Figure 2.6
PROPOSED NEW RIVERBANK INTAKE CROSS-SECTION
JOINT WATER SUPPLY SYSTEM ANALYSIS
CITY OF LAKE OSWEGO AND TIGARD WATER SERVICE AREA

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DESIGN NOTES:

1. Gallery area based on 1 GPM per sq. foot of bed area.
2. Gallery shall consist of two separate sections, each having a capacity of 16 MGD.
3. 32 MGD conductor pipe: 36" diameter.
4. 38 MGD conductor pipe: 42" diameter.

COMMENTS:

1. No fish screening required
2. Water or air backflush system must be installed.

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Figure 2.7
PROPOSED NEW RIVER BOTTOM UNFILTRATION INTAKE
JOINT WATER SUPPLY SYSTEM ANALYSIS
CITY OF LAKE OSWEGO AND TIGARD WATER SERVICE AREA

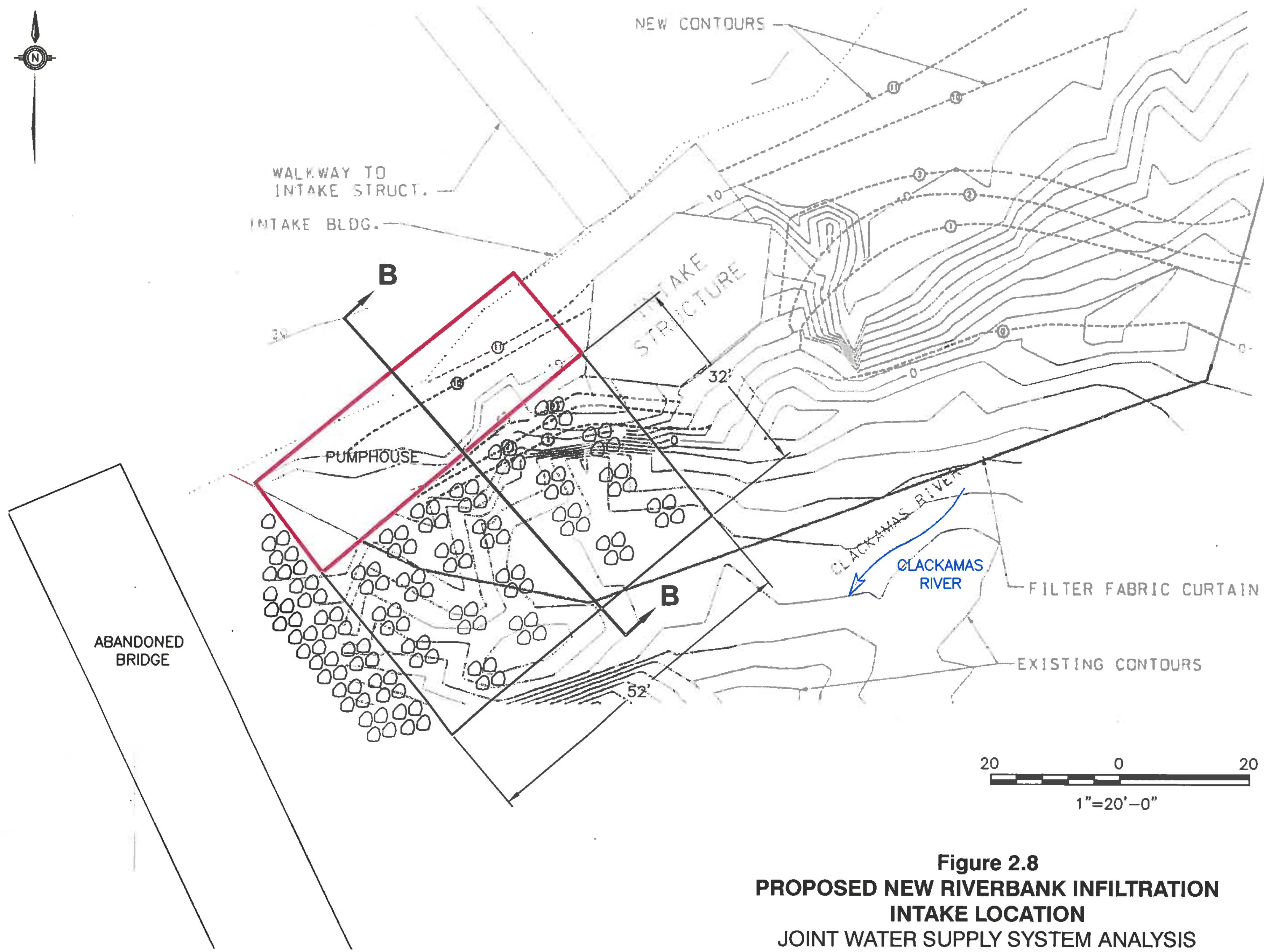

Figure 2.8
PROPOSED NEW RIVERBANK INFILTRATION INTAKE LOCATION
JOINT WATER SUPPLY SYSTEM ANALYSIS
CITY OF LAKE OSWEGO AND TIGARD WATER SERVICE AREA

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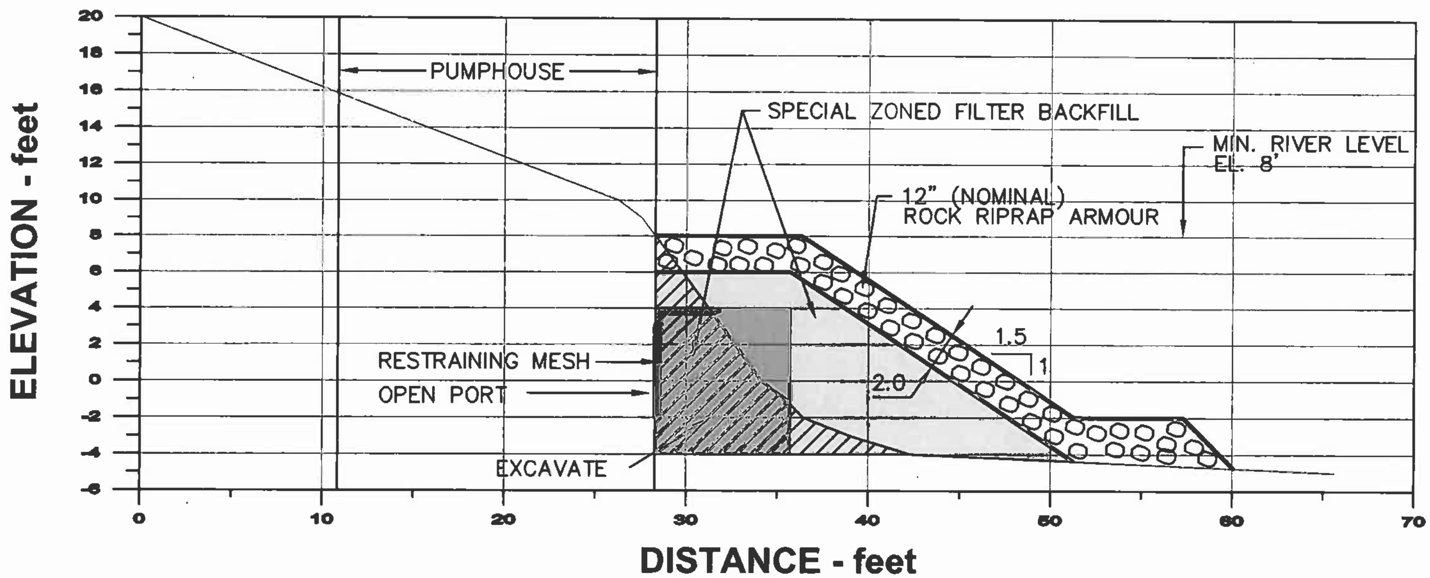

NOTE:

1. Q=38 MGD. INCREASE LENGTH AND HEIGHT OF OPEN PORT TO 50 FEET AND 6 FEET

LEGEND:

1/4"–1" GRAVEL

1/2"–2" GRAVEL

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Figure 2.9
PROPOSED NEW RIVERBANK INFILTRATION INTAKE CROSS-SECTION
JOINT WATER SUPPLY SYSTEM ANALYSIS
CITY OF LAKE OSWEGO AND TIGARD WATER SERVICE AREA

2.2.2.5 Required Pumping Capacity

The reliable pumping capacity of the chosen intake alternative for each supply scenario is summarized in Table 2.1. To achieve a reliable water supply, the intake pumps were sized to produce the peak day demand with the largest pump out of service. To size the pumps, a pump efficiency of 85% and a motor efficiency of 90% were assumed.

Table 2.1 Intake Pump Expansion
Joint Water Supply System Analysis
City of Lake Oswego and Tigard Water Service Area

Supply Scenario	Pump 1 (hp)	Pump 2 (hp)	Pump 3 (hp)	Pump 4 (hp)	Firm Capacity (mgd)
2	350	325	325	500	24
3	325	475	475	475	32
4	500	500	575	575	38

2.2.2.6 Intake Options and Capital Costs

Costs for a new Clackamas River Intake are assumed to include an auxiliary power generator inside the new intake pump building with a 24-hour fuel storage tank located outside. It is further assumed that the existing intake structure would be demolished without salvage of the existing building or equipment. Costs below are based on Scenario 3, with 32 mgd capacity. Pump sizes would be increased or decreased, as needed, to achieve the capacity of demand scenarios 2 or 4. Since the difference in pump prices for the scenarios is negligible in comparison to the total cost, only one cost estimate was given for the three demand scenarios. For the purpose of cost estimating, an average pump size of 500 horsepower was assumed.

2.2.2.6.1 Capital Costs

The conceptual level capital costs developed for each of the four proposed intake alternatives are presented in Table 2.2.

Table 2.2	Raw Water Intake Capital Costs[1] Joint Water Supply System Analysis City of Lake Oswego and Tigard Water Service Area		
	Capacity		
Intake Alternative	Scenario 2 (24 mgd)	Scenario 3 (32 mgd)	Scenario 4 (38 mgd)
Expand Existing Intake	$2,510,000	--	--
New Riverbank Intake	--	$4,440,000	$4,670,000
New River Bottom Infiltration Intake	--	$5,280,000	$5,520,000
New Riverbank Infiltration Intake	--	$4,400,000	$4,530,000

Note:

1. Capital costs are total project costs and are presented in 2006 dollars.

2.2.2.6.2 Operations and Maintenance Costs

Because the ultimate demand on the water infrastructure realistically arises from a sustained, three-day maximum demand, the Operations and Maintenance costs were developed based on the maximum 3-day peaking factor of 2.1. Annual operations and maintenance costs for the Clackamas River Intake, including estimated annual pumping costs, are calculated based on assumed average annual demands of 11.4, 15.2, and 18.1 mgd for their respective scenarios. The O&M costs for the proposed intake options for each supply scenario are presented in Table 2.3.

Table 2.3	Raw Water Intake O&M Costs Joint Water Supply System Analysis City of Lake Oswego and Tigard Water Service Area			
Parameter	Units	Scenario 2 (24 mgd)	Scenario 3 (32 mgd)	Scenario 4 (38 mgd)
Annual O & M costs	$/yr	$231,000	$352,000	$429,000
O&M cost	$/million gallons-yr	$55.52	$63.45	$64.94

Note:

1. O&M costs are based on the recommended options for each scenario, as presented in Section 2.2.2.6.3.

2.2.2.6.3 *Intake Options Summary & Recommendation*

A comparison of the relative advantages and limitations of options for a new Clackamas River Intake is presented in Table 2.4.

Table 2.4 Comparison of Intake Options
Joint Water Supply System Analysis
City of Lake Oswego and Tigard Water Service Area

Option	Description	Advantages	Limitations
1	Expand Existing Intake (24 mgd)	- Limits in-water construction to bank area. - Easy access to fish screens. - Minimal interference with boat traffic.	- Requires significant structural rehabilitation. - Would not satisfy 32 mgd or 38 mgd demand scenarios.
2	New Riverbank Intake (32 mgd/38 mgd)	- Can be constructed while operating existing intake. - Limits in-water construction to bank area. - Easy access to fish screens. - Minimal interference with boat traffic.	- Fish screens are vulnerable to debris impact.
3	New River Bottom Infiltration Intake (32 mgd/38 mgd)	- Does not require fish screens. - Is not affected by low river flows. - Minimal interference with boat traffic. - Can be constructed while operating existing intake.	- Requires in-river construction. - Requires more mechanical equipment and electrical/ instrumentation control - Reduced flow during backwash cycle.
4	New Riverbank Infiltration Intake (32 mgd/38 mgd)	- Does not require fish screens. - Is not affected by low river flows. - Can be constructed while operating existing intake.	- Requires in-river construction. - Requires more mechanical equipment and electrical/ instrumentation control - Reduced flow during backwash cycle.

Considering the advantages, disadvantages, and capital and O&M costs for each alternative, it is recommended that to reach a capacity of 24 mgd, the existing intake be expanded (Option 1), and to reach a capacity of 32 or 38 mgd, a new riverbank intake (Option 2) be constructed to increase the capacity of the Clackamas River intake.

2.3 RAW WATER TRANSMISSION ALTERNATIVES

2.3.1 Existing Transmission Main Alignment

Lake Oswego's current raw water transmission main serves to convey raw water from the Clackamas River source to the Lake Oswego water treatment plant (WTP) in West Linn. The transmission main begins at the Clackamas River Intake Pumping Facility near the intersection of Clackamas Boulevard and Portland Avenue in Gladstone. The main crosses underneath the Willamette River near Meldrum Bar Park in Gladstone, and terminates at the Lake Oswego WTP in West Linn. The entire transmission main is 27-inch diameter welded steel pipe, and is approximately 13,800 feet in length.

An aerial view of the existing alignment is presented in Appendix A of this report. Pipeline details and alignment information were obtained from as-built drawings provided by Lake Oswego staff.

2.3.2 Transmission Main Hydraulics

2.3.2.1 Existing System Hydraulics

The Lake Oswego water treatment plant currently treats a peak demand of up to 16 mgd. According to Lake Oswego WTP staff, all four of the existing intake pumps must be operational to meet peak demand. No pump redundancy exists.

The head loss of the existing transmission conveyance system was modeled based on flow, the existing intake pump curves, and a low mean river level of 8.5 feet above sea level. Figure 2.10 shows a combined pump curve and system curves for the transmission main at various river levels.

Figure 2.10 confirms that the intake pumps are at maximum capacity to produce approximately 16 mgd at the dry weather river level of 8.5 feet above sea level. This capacity is based on all intake pumps running at full speed without redundancy. The firm capacity of the intake with the largest pump out of service is approximately 12 mgd. The capacity of the existing 27-inch diameter raw water pipeline is also approximately 16 mgd, based on a maximum velocity of approximately 6 feet per second.

2.3.2.2 Future Water Supply Scenario System Hydraulics

To assure a reliable water supply to Lake Oswego, capacity of the Clackamas River Intake and the raw water transmission line must be increased. As described in Chapter 1, the capacity alternatives for the future water supply scenarios are 24 mgd, 32 mgd, and 38 mgd. Each of these future scenarios requires that the existing transmission main capacity be increased.

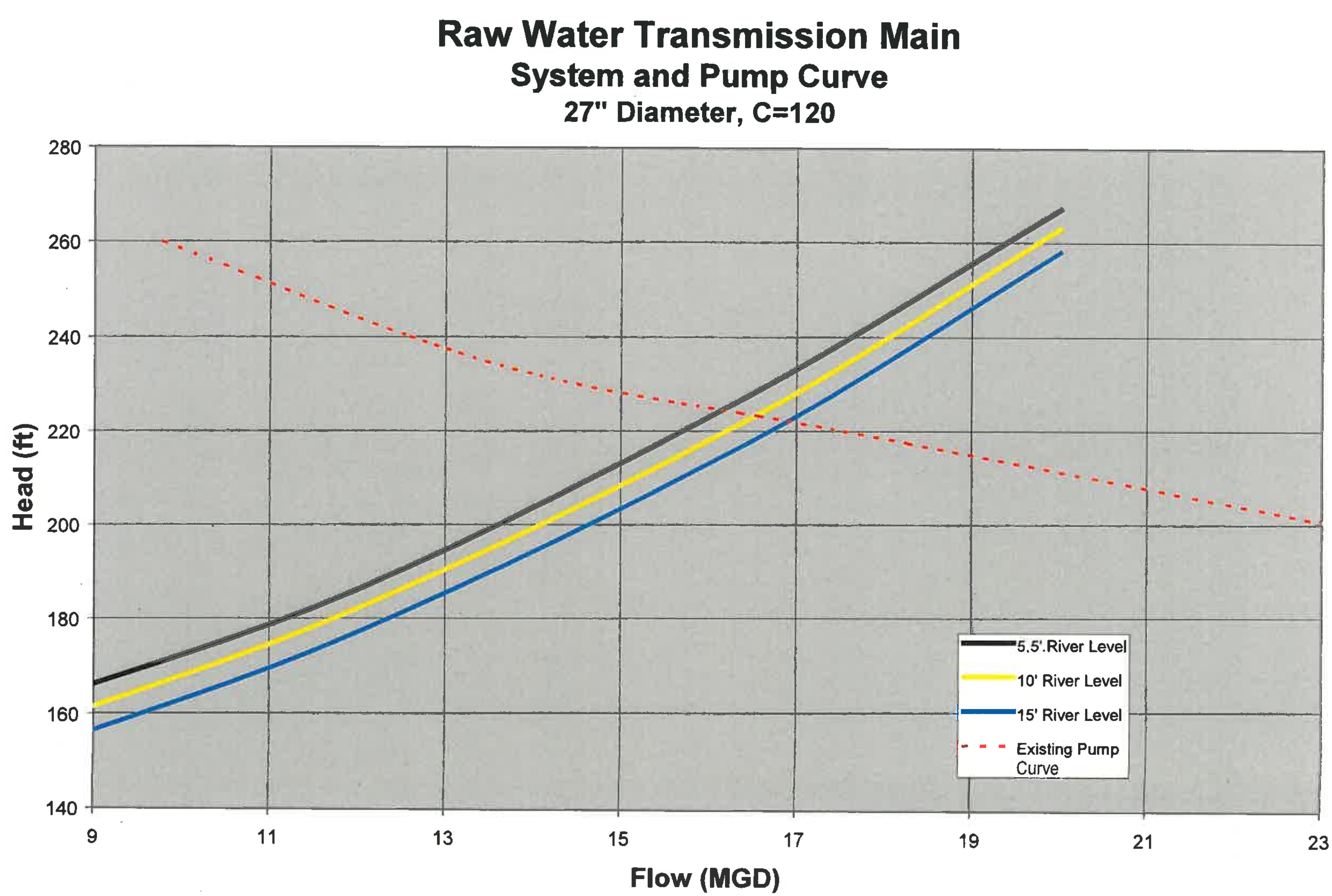

Figure 2.10
RAW WATER TRANSMISSION MAIN SYSTEM AND PUMP CURVE
JOINT WATER SUPPLY SYSTEM ANALYSIS
CITY OF LAKE OSWEGO AND TIGARD WATER SERVICE AREA

Within each scenario, there are two options for increasing transmission main capacity. These are: (a) provide a new main to replace the existing main, or (b) provide a second transmission main to parallel and supplement the existing main capacity. Option (a) involves constructing a new main sized to accommodate the full capacity of the proposed demand scenario. The existing main would serve as a back up conveyance system. Option (b) involves construction of a smaller new pipeline that would parallel the existing main, with the combined capacity of the two pipelines (existing and new parallel pipeline) providing sufficient conveyance capacity to meet capacity requirements of the given demand scenario.

A new carbon steel transmission main was selected for each supply scenario and sized to convey the peak day demand with a maximum line velocity of less than 6 fps in both the existing and new pipes. Table 2.5 summarizes the new pipe sizes required and additional hydraulic information for both replacement and parallel transmission main options.

Table 2.5 Raw Water Transmission Line Supply Sizing and Hydraulic Data
Joint Water Supply System Analysis
City of Lake Oswego and Tigard Water Service Area

Supply Scenario	New Pipe Diameter (inches)	Capacity (mgd)	Head Loss (feet)
2a	36	24	172
2b	24	11	194
3a	42	32	165
3b	30	19	193
4a	42	38	177
4b	36	27	181

The operational pumping costs were developed only for Option (a) of each scenario. This methodology is based on the conservative assumption that the incremental capital costs of the larger pipeline will be offset by the savings in long-term energy costs, as well as the decreased risk of operation associated with the increased reliability of the system.

2.3.3 Proposed Transmission Main Improvements

2.3.3.1 Alignment

The proposed raw water transmission main alignment is composed of six connected reaches. A description of each of the reaches, including general location and relevant characteristics, is presented in Figure 2.11.

In general, the proposed alignment for the replacement transmission main follows that of existing alignment. However, potential alternate alignments for each reach were noted, where applicable. Aerial views of the existing alignment are presented in Appendix A.

Reach No.	Description	Length	Comparable Alternative Alignment	Existing Utilities or Rural Conditions (1)	Street Width	Curbs/ Sidewalks	Traffic Conditions	Overall Reach Class
1	Intake pump station near intersection of Clackams Blvd. and Portland Ave. in Gladstone. Continues NW along Portland Ave., SW along Arlington St., NW along Beatrice Ave. until intersection of Beatrice and Gloucester St.	2878'	YES. Grid pattern of residential streets offers many options	Cable Television, City of Gladstone Utilities, Electric Utilities, Natural Gas, Telephone Lines	≤ 24'	NO	Medium Use Residential	1
2	Intersection of Beatrice Ave. and Gloucester St. along Gloucester to the intersection of Gloucester and River Road. Reach crosses 99E which will require 160' of bore and jack process to cross underneath the highway.	1621'	YES. Possible to continue on Arlington, cross 99E, and N on River Rd.	Cable Television, City of Gladstone Utilities, Electric Utilities, Natural Gas, Telephone Lines	> 24'	YES	Heavy Use Residential	2
3	Intersection of Gloucester St. and River Road, N along River Road, SW along Meldrum Bar Park Rd, terminating at Meldrum Bar Park. Pre-existing construction easement for narrow Meldrum Bar Park Rd.	3404'	NO. Alternate alignment would add significant length and private property/ easement acquisition.	Cable Television, City of Gladstone Utilities, Electric Utilities, Natural Gas, Telephone Lines	≤ 24'	NO	Medium Use / Parking Lot	1
4	Meldrum Bar Park, underneath Willamette River, terminating in Mary S. Young State Park. Willamette undercrossing will require approx. 2000' of tunneling.	± 2600'	NO. May not be exactly parallel to existing alignment, but will have to cross river in same general location	NONE		NO	Pedestrian/ Recreation	1,S
5	NW through Mary S. Young State Park ending at start of Nixon Dr./ Mapleton Dr.	1687'	YES. Directional drilling to Nixon Ave. to avoid surface disruption associated with open trench construction	Densly wooded area. Assume 24" trees every 10' on center.	N/A	NO	NONE	R
6	Nixon Dr./ Mapleton Dr. at Mary S. Young State Park along Nixon to point aligned west of LOWTP. Heads up steep embankment, along a private drive, across Kenthorpe?, terminating at LOWTP. Pre-existing construction easement for private drive.	1640'	NO. Alternate alignment would require private property acquisition.	Cable Television, City of West Linn Utilities, Electric Utilities, Natural Gas, Telephone Lines	≤ 24'	NO	Light Use Residential	3

Figure 2.11
REACH DESCRIPTIONS
RAW WATER TRANSMISSION MAIN
JOINT WATER SUPPLY SYSTEM ANALYSIS
CITY OF LAKE OSWEGO AND TIGARD WATER SERVICE AREA

2.3.3.2 Cost Criteria

Five separate reach classes were developed to account for varying installation requirements along the length of the raw transmission pipeline. Descriptions of the individual reach classes are presented in Figure 2.12.

These five classes do not include reaches where the main must be installed by specialized trenchless techniques, such as horizontal directional drilling, tunneling, or bore and jack. A sixth class, S, was assigned to represent either reaches, or sections of reaches, which require these special trenchless techniques. These reaches include crossings of water bodies, railroads, highway, and freeways. Due to the unique nature of each class S reach, a cost per linear foot is not assigned to the overall class. Individual cost criteria for these special reach scenarios are described in Section 2.3.3.3.

General installation criteria and assumptions for the 5 standard reach classes include:

- Project is in residential area, or in a densely wooded rural area. Rural areas are denoted as R class.
- Minimum 6 feet of cover over the top of the pipeline in urban areas, 3 feet in rural areas.
- Good soils conditions, requiring medium excavation effort.
- Imported pipe bedding & pipe zone material.
- Native material from trench excavation to be used for pipe backfill above pipe zone, when possible (i.e. in Dahl Park).
- Disposal of trench spoils within 10 mile round trip.
- No severe groundwater, rock, hazardous material, or archaeologically significant conditions exist.
- A trench box will be sufficient in lieu of solid set sheeting or shoring in urban areas.
- Open-cut trenching without shoring in rural areas.

The residential neighborhoods through which the pipeline passes contain a large number of underground utilities, including existing storm and sanitary sewers, power, natural gas, and communications lines. To account for underground utility adjustments the recommended 3 feet of cover has been adjusted to a conservative 6 feet. This average considers areas where conditions will be normal, and other areas where avoiding existing utilities will involve digging further underground.

Reach Class	Street Type	Street Width	Reach Construction Conditions	Repaving Depth	Traffic Control
1	Residential	≤ 24'	No or Few Curbs/ Sidewalks No Pavement Cuts Full Street Width Replacement	3"	Available Detours Road Closure Signage
2	Busy Residential	> 24'	Curbs and Sidewalks 2 Pavement Cuts Half Street Width Replacement	3"	Signage Flaggers
3	Residential	≤ 24'	No or Few Curbs/ Sidewalks No Pavement Cuts Full Street Width Replacement	3"	No Detour Option Signage Flaggers
4	Busy Highways Main Local Thoroughfares	> 24'	Curbs or Sidewalks 2 Pavement Cuts Half Street Width Replacement	4"	Electronic Signage Flaggers
R	Rural Densly Wooded	N/A	Cleaning and Grubbing Tree Removal Guaranteed Tree Replacement	N/A	None Required
S	River or Creek Crossing Railroad Crossing Highway/ Freeway Crossing	N/A	Bore and Jack Process or Micro-Tunnneling	N/A	Possible Park Closure Signage

Figure 2.12
REACH CLASS DESCRIPTIONS FOR TRANSMISSION MAIN
JOINT WATER SUPPLY SYSTEM ANALYSIS
CITY OF LAKE OSWEGO AND TIGARD WATER SERVICE AREA

The class S reaches will be traversed by either directional drilling or boring and jacking. It is assumed all crossings of waterways, including the Willamette River, will use directional drilling as the preferred construction method.

2.3.3.3 Noise mitigation and control. Class S reaches

2.3.3.3.1 *HWY 99E*

Reach 2 of the raw water transmission main includes the 160-foot HWY. 99E crossing. The heavy traffic in this area will require boring and jacking underneath the roadway to minimize disruption. Construction will require launching and receiving pits to be excavated 30 feet back on either side of the roadway as well as the installation of 52-inch diameter casing pipe. Good soil conditions are assumed in this area.

2.3.3.3.2 *Willamette River*

Reach 4 of the raw water transmission includes the nearly 2000 feet of crossing under the Willamette River. Launching and receiving pits will be excavated a minimum of 100 feet back from the water. The pits will be deep enough to allow installation of the pipe 40 feet below the riverbed. Good soil conditions are assumed in this area.

2.3.3.4 Capital Costs

For the purposes of this study, and as a conservative estimate, it is assumed that a replacement pipe will be installed to provide the required increased capacity for raw transmission main system.

A conceptual project cost estimate by reach for the raw water transmission main based on new replacement pipe is shown below in Table 2.6.

Table 2.6 Conceptual Project Cost Estimate - Raw Water Transmission Main[1]
Joint Water Supply System Analysis
City of Lake Oswego and Tigard Water Service Area

Reach	Type	Length (feet)	Scenario 2a 24 mgd 36-inch pipe	Scenario 3a 32 mgd 42-inch pipe	Scenario 4a 38 mgd 42-inch pipe
1	1	2,878	$2,630,000	$3,160,000	$3,160,000
2	2,S	1,621	$1,860,000	$2,160,000	$2,160,000
3	1	3,404	$3,110,000	$3,730,000	$3,730,000
4	1,S	2,600	$5,720,000	$7,180,000	$7,180,000
5	R	1,687	$4,930,000	$5,720,000	$5,720,000
6	3	1,640	$1,640,000	$1,970,000	$1,970,000
Total		**13,830**	**$19,890,000**	**$23,920,000**	**$23,920,000**

Note:

1. Conceptual costs are based on cement lined and coated carbon steel pipe; cathodic protection is not included.

2.3.3.5 Operations and Maintenance

Operations and Maintenance Costs for the pipeline are assumed negligible in comparison to the overall cost of the project, and within the error of overall project cost estimates. It should be noted that the costs for pumping through the raw and finished water treatment mains are included in the O&M costs associated with the Clackamas River Intake and the Water Treatment Plant, respectively.

2.4 WATER TREATMENT ALTERNATIVES

2.4.1 Water Treatment Plant Sites

2.4.1.1 Existing Site

The Lake Oswego WTP was constructed in 1967 and expanded to its current capacity of 16-mgd in 1980. From 1998 to 2000, modifications were made to chemical storage and feed and engineered concrete sludge lagoons were constructed to replace the original earthen ponds. The current facility is sited within a residential neighborhood and currently occupies property totaling 6.05 acres with frontage on Kenthorpe Way.

An additional 3.30 acres south of the existing property, with frontage on Mapleton Drive, was acquired by the City to accommodate future facility expansions. The City has elected to preserve the existing condition of this parcel, to help maintain a positive relationship with the surrounding neighborhood. With this property no longer available for future facilities, the expansion strategy for the Lake Oswego WTP must be revisited, particularly with respect to sludge management.

2.4.1.2 Alternatives Sites

The City has identified an alternative WTP site in unincorporated Clackamas County. The Luscher Farms area along Rosemont Road has available area for a new treatment facility. The alternative site is remote and is located at an elevation that places it in the upper zone of the distribution system. Table 2.7 lists the advantages and disadvantages of developing a new WTP site.

Although there are legitimate advantages to constructing a new facility, abandoning the existing site and the required expansion of raw and finished water infrastructure are significant disadvantages. Therefore, the recommended concept for expansion is to further develop the existing Lake Oswego WTP site.

Table 2.7 Alternative Site Assessment
Joint Water Supply System Analysis
City of Lake Oswego and Tigard Water Service Area

Advantages	Disadvantages
Remote location away from residential communities	Loss of investment in existing facilities
Ability to construct the new facility without disrupting the existing facility	Capability of the existing site to accommodate the expansion to 38-mgd
Potential for gravity flow into the lower zones of the distribution system	Requirement to pump the entire plant flowrate to the highest level in the distribution system
	The Luscher Farm is outside the existing USB and is currently zoned as Exclusive Farm Use
	No guarantee that future development will not surround the site
	New pipeline required from intake to new facility

2.4.2 Process Requirements

2.4.2.1 Water Quality

The available water quality of the source (raw water) and the quality objectives for the treated water (finished water) determine the appropriate treatment process. The objective in process selection is to determine the most economical process that can treat the available raw water quality to the finished water objectives in a manner that meets the goals set for process reliability, flexibility, and "operator friendliness".

Our recommendations for these goals are as follows:

- Reliability should be high because Lake Oswego relies on the water treatment plant as its sole source of supply with a limited backup (intertie) to the South Fork Water Board system. The Lake Oswego WTP also serves as a backup supply to the City of West Linn.
- Flexibility should be high because the Clackamas River raw water supply has a wide range of water quality characteristics; for example, river turbidity can rapidly climb from 1 to 4 NTU to over 270 NTU because of rainfall and spring runoff from snowmelt.
- "Operator friendliness" should be high because of the limited operations staff; selection should be made to avoid processes requiring high maintenance or intensive operator attention.

The existing raw water supply for the Lake Oswego WTP is the Clackamas River. The point of diversion is a free standing inlet with mechanical screens and vertical turbine pumps located on the north bank of the Clackamas River approximately 3/4 of a mile upstream of its confluence with the Willamette River. Lake Oswego has permits to appropriate up to 38 mgd from the Clackamas River. As stated in the Water Supply Feasibility Project (2005), an option for supplying the additional raw water would be to obtain additional points of diversion for the South Fork Water Board water right to the Lake Oswego intake. Due to the operational recovery limitations of membrane plants, additional raw water (up to 1-mgd) may be required to produce the design capacity at the buildout scenario (38-mgd).

The Clackamas River raw water quality has been characterized in the *Regional Water Supply Plan* (1995) as "generally good compared to other regional source options, and ... very good compared to sources nationwide." Currently the Clackamas River is used as a raw water supply for five water treatment plants:

- Lake Oswego WTP.
- North Clackamas Water Commission WTP (slow sand and membranes).
- Clackamas River Water.
- South Fork Water Board WTP.
- City of Estacada

Under EPA guidelines, the raw water exceeds primary (health related) drinking water standards for turbidity and microorganisms and requires filtration. The raw water supply also requires treatment for constituents exceeding secondary (aesthetic) standards including color, algae, and tastes and odors.

The water quality in the Clackamas River varies significantly throughout the seasons. Storm events and spring runoff can increase the turbidity and decrease the alkalinity rapidly. Based on conversations with the WTP operations staff and a review of operational data, the

Clackamas River raw water quality characteristics were established and are shown in Table 2.8.

A frequency analysis was performed on the operational data from 7 September through 16 June 2006 to establish the required level of treatment that reliably accomplishes the treatment goals. A frequency distribution plot showing Clackamas River raw water turbidity samples collected every four hours over an eight-year period is shown in Figure 2.13. The data indicate that during this period the raw water turbidity exceeded the 15 NTU limitation of the existing direct filtration process approximately four percent of the time. Significantly, the raw water turbidity occasionally exceeded the limitation of the direct filtration project by nearly an order of magnitude. This data demonstrates that conventional treatment is required to provide reliable performance.

Table 2.8 Clackamas River Raw Water Quality
Joint Water Supply System Analysis
City of Lake Oswego and Tigard Water Service Area

Parameter	Units	Minimum	Average	Maximum
Turbidity[1]	NTU	0.4	3.7	270
PH[1]	Units	6.04	7.3	8.99
Alkalinity[1]	mg/L as $CaCO_3$	10	23.7	44
Color[1]	A.C.U	0	30.1	1010
TOC[2]	mg/L	Not Available	0.72	2.76[3]
Algae, Taste & Odor[4]	-			

Notes: Algae blooms have occurred that contribute to earthy, swampy and musty taste and odor problems.

1. Data based on 4 hour operational logs from 7 September through 16 June 2006.
2. Data collected from 23 March 2000 through 16 October 2001.
3. Past data has reported TOC concentrations as high as 7 mg/L.
4. Based on conversations with operations staff.

The levels of color and, at times, algae and algal tastes and odors in Clackamas River raw water also exceed the process limitations of direct filtration and require a conventional treatment process. Color, algae, and taste and odors are secondary water quality standards and relate to the aesthetic quality rather than the health risk of the water supply. Nevertheless, the public perception of quality of service and safety of the water supply is often based on aesthetic considerations such as tastes, odors, or color. No quantitative data on algae and tastes and odors are available; however, data for raw water color exist and are presented in Figure 2.14. The data show that 40 percent of the time the raw water color exceeds the limit of the direct filtration process and requires conventional treatment.

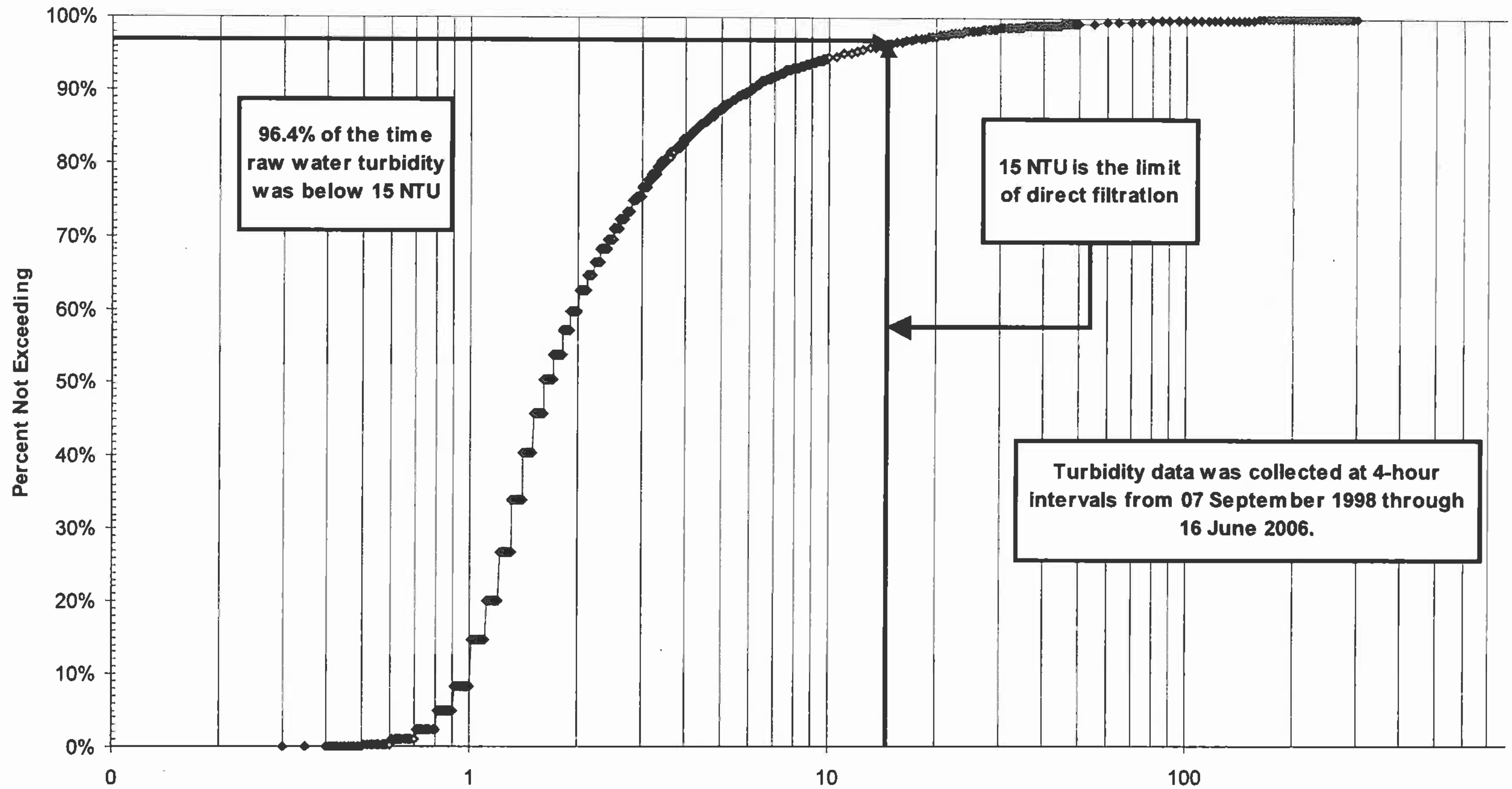

Figure 2.13
RAW WATER TURBIDITY FREQUENCY DISTRIBUTION
JOINT WATER SUPPLY SYSTEM ANALYSIS
CITY OF LAKE OSWEGO AND TIGARD WATER SERVICE AREA

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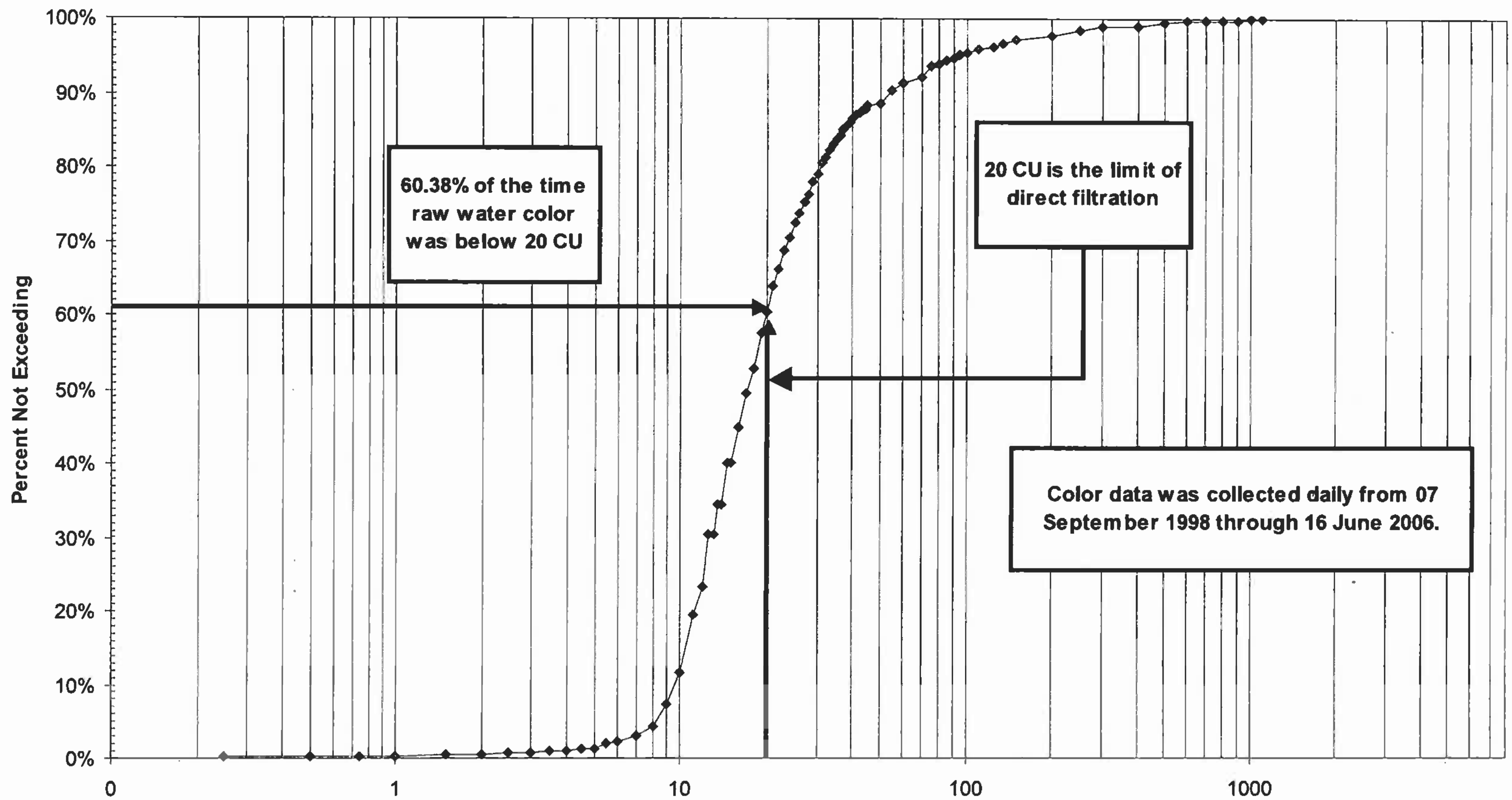

Figure 2.14
RAW WATER COLOR FREQUENCY DISTRIBUTION
JOINT WATER SUPPLY SYSTEM ANALYSIS
CITY OF LAKE OSWEGO AND TIGARD WATER SERVICE AREA

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2.4.2.2 Labor

The Lake Oswego WTP operations staff consists of six operators and one supervisor. WTP operations are accomplished in two shifts, one day shift and one swing shift. Table 2.9 shows the hours and number of operators for each shift and the seasonal variation. Currently, a total of 210 operator hours per week are utilized at the Lake Oswego WTP.

Table 2.9 Operator Shifts[1]
Joint Water Supply System Analysis
City of Lake Oswego and Tigard Water Service Area

Shift	Shift Hours Summer	Shift Hours Winter	Number of Operators	Weekly Shift Schedule
Day	5am - 3pm	6am - 4pm	2	Sunday - Wednesday Wednesday - Saturday
Swing	3pm - 1am	2pm - 12am	1	Sunday - Wednesday Wednesday - Saturday

Note:
1. Vacation and sick days are covered through overtime hours by operations staff.

Currently, the Lake Oswego WTP does not operate from the end of the swing shift until the start of the day shift. Around the clock operation does occur, but only when demand warrants, in order to reduce overtime operation. For safety reasons, maintenance is only performed during the day shift when two operators are present.

Operations activities include operations and distribution system monitoring, water quality sampling and reporting, equipment repair and maintenance, and instrumentation service and calibration. Table 2.10 details the current operator-hours required per week to perform each of the operations tasks.

The availability of experienced and qualified operations staff is becoming problematic nationwide. These national issues have not escaped the City of Lake Oswego. While the current staff at the Lake Oswego WTP is comprised of experienced veteran operators, over half will be eligible to retire within the next five years. This, combined with the proposed expansion of the WTP, requires that the expansion evaluation place a high priority on reducing operations and maintenance efforts.

Table 2.10 Operations Labor Breakdown Per Activity[1] Joint Water Supply System Analysis City of Lake Oswego and Tigard Water Service Area				
Activity	Hours per Week[1]		Percent of Available Operator Hours	
	Min	Max	Min	Max
General Operation	140	170	66%	80%
Maintenance	20	30	10%	14%
Instrumentation	10	20	5%	10%
Water Quality Sampling	10	20	5%	10%

Note:

1. Weekly work distribution provided by Bob Blezinski, WTP operator. Hours for general operation were assumed to be equivalent to the hours remaining after other tasks were completed.

2.4.3 Treatment Alternatives

2.4.3.1 Process Selection

The basic water treatment objectives are to provide removal of contaminants and disinfection of microorganisms. The contaminant removal process for most water supplies involves the addition of chemicals to destabilize particulates (coagulation) followed by the addition of sufficient energy (flocculation) to allow formation of settleable or filterable particulates (floc). The water treatment industry has developed a number of alternative processes that can be applied to different qualities of raw water. Basic process alternatives, which include chemical coagulation and filtration, are:

- Conventional (complete) treatment, consisting of:
  - Coagulation
  - Flocculation
  - Sedimentation (solids removal)
  - Filtration (final solids removal)
- Two stage filtration, consisting of:
  - Coagulation
  - Roughing filter (flocculation and partial solids removal)
  - Filtration (final solids removal)
- Direct filtration, consisting of:
  - Coagulation
  - Flocculation
  - Filtration (solids removal)

- Inline (contact) filtration, consisting of:
  - Coagulation
  - Filtration (flocculation and solids removal)

In general, the cost of water treatment (both capital and O&M) increases with the ability of the process to handle more severe raw water quality. The objective in process selection is to choose the least expensive process which is capable of treating the raw water quality available with the appropriate level of reliability, flexibility and operator friendliness." Table 2.11 shows treatment process selection criteria for six different parameters. This table reflects years of experience in plant operation and represents a high level of reliability in treatment.

Table 2.11 Process Selection Criteria
Joint Water Supply System Analysis
City of Lake Oswego and Tigard Water Service Area

Parameter	Conventional Complete	Two-Stage Filtration	Direct[1] Filtration	In-Line Filtration
Turbidity (NTU)	<5000[2]	<50	<15	<5
Color (apparent)	<3000	<50	<20	<15
Coliform (#/mL)	$<10^7$	$<10^5$	$<10^3$	$<10^3$
Algae (ASU/mL)	$<10^5$	$<5 \times 10^3$	$<5 \times 10^2$	$<10^2$
Taste and Odor (TON)	<30	<10	<3	<3

Notes:
1. Slow sand filtration is applicable in cases where the raw water quality is acceptable for direct filtration.
2. If the raw water turbidity exceeds 1000 NTU, a pre-sedimentation process is required for all conventional complete treatment processes.

The EPA Surface Water Treatment Rule Guidance Manual[6] divides the processes shown in Table 2.11 into two categories:

- **Direct filtration** includes those processes, which remove all solids on the filter.
- **Conventional treatment** includes those processes, which remove some solids through pretreatment prior to filtration.

In accordance with EPA guidelines, the Oregon Department of Health Services (DHS) has designated the Lake Oswego WTP as a direct filtration plant. Although the Lake Oswego WTP has contact basins upstream of the filters, it is appropriate to classify the plant as direct filtration because the lack of flocculation and solids removal equipment limits the use of the basins for pretreatment for solids removal. The DHS classification is important because a direct filtration plant must provide a higher level of disinfection than a conventional water treatment plant. Typically, this results in a requirement for more extensive chlorination facilities (for example, larger chlorine contact basins) at a direct filtration plant.

A comparison of raw water quality data for the Clackamas River and the process selection criteria shown in Table 2.11 leads to the following observations:

- The Clackamas River exceeds the direct filtration criteria for turbidity (15 NTU) approximately 4 percent of the time and would require conventional treatment for reliable treatment of raw water.
- The Clackamas River typically exceeds the direct filtration criteria for color (20 ACU) approximately 40 percent of the time and would frequently require conventional treatment for color removal.
- The Clackamas River probably exceeds the direct filtration criteria for algae and may occasionally require conventional treatment for algae removal.
- The Clackamas River probably exceeds the direct filtration criteria for tastes and odors (3 TON) and occasionally would require conventional treatment for odor removal.

Of these parameters, turbidity is the most critical. Turbidity removal represents the efficiency of the treatment plant as a barrier against the passage of microorganisms into the distribution system. In addition, turbidity can shield pathogenic microorganisms and interfere with the disinfection process. For these reasons, there are stringent Federal and State standards regulating treated water turbidity levels.

Recent studies on removal of chlorine resistant pathogens such as *Cryptosporidium* have resulted in recommendations of an association of water utility and regulatory agency groups (The Partnership for Safe Water) for an operating goal that individual filter finished water turbidity should be less than 0.1 NTU. From Figure 2.15, it can be seen that approximately 5 percent of the time the combined finished water turbidity exceeded 0.1 NTU. The majority of combined finished water turbidity readings were less than 0.1 NTU, which demonstrates that the raw water turbidity can normally be treated by the direct filtration process. However, finished water turbidity above this level reflects the lack of process reliability when the raw water turbidity exceeds the limitations of the direct filtration process.

It should be noted that the direct filtration process was selected for the Lake Oswego WTP more than 40 years ago, at a time when water quality standards were much less stringent than current requirements. Within the current context of the Long Term 1 Enhanced Treatment Rule (LT1) and the Long Term 2 Enhanced Treatment Rule (LT2), and the necessary future expansion of the treatment facility, the direct filtration process is no longer adequate to provide treatment of Clackamas River raw water. Recent regulatory requirements to remove chlorine resistant pathogens such as *Cryptosporidium* have driven the LT1 and LT2 to even more stringent finished water turbidity standards. Additionally, it is likely that potential future regulatory requirements will not be able to be met by direct filtration treatment.

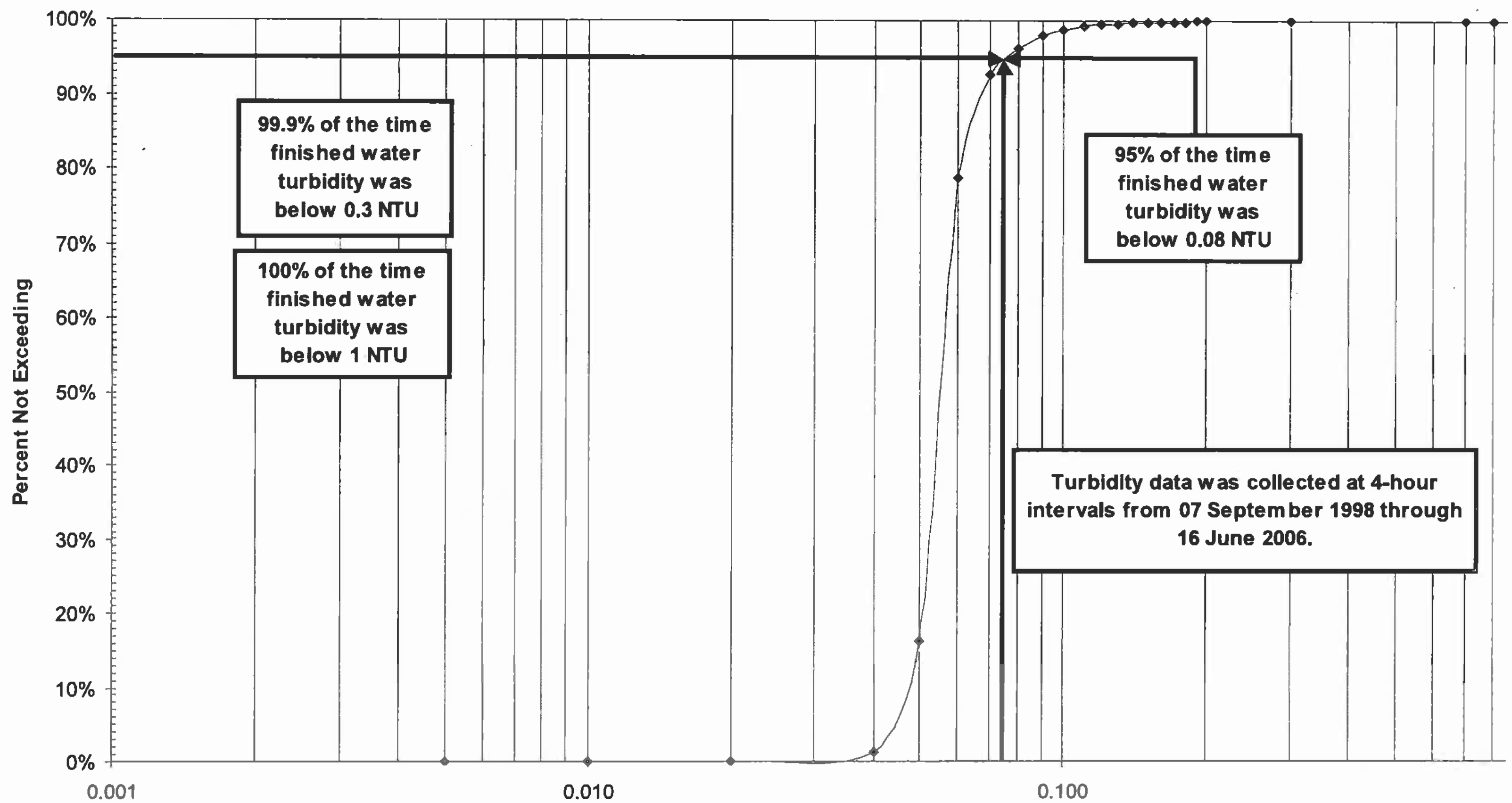

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Figure 2.15
FINISHED WATER TURBIDITY FREQUENCY DISTRIBUTION
JOINT WATER SUPPLY SYSTEM ANALYSIS
CITY OF LAKE OSWEGO AND TIGARD WATER SERVICE AREA

Although color is a secondary (aesthetic) standard it is also an indicator of the level of natural organic material (NOM) in the raw water supply. NOM and the related parameter total organic carbon (TOC) are of concern because of the potential for natural organic compounds to react with chlorine during the disinfection process to form disinfection by-products (DBPs) which are regulated under current water quality standards.

In order to achieve reliable treatment of Clackamas River raw water at the Lake Oswego WTP, it will be necessary to upgrade the facilities from a direct filtration process to conventional treatment. Candidate processes that provide conventional treatment are:

- Conventional - coagulation, flocculation, sedimentation, media filtration.
- High Rate Conventional - coagulation, flocculation, high rate sedimentation, media filtration.
- Membrane - coagulation, flocculation, membrane filtration.

Each of these options provides:

- The ability to reliably treat turbidity, algae, color, and tastes and odors in the raw water supply at full plant capacity.
- The flexibility to respond to changes in water quality.
- An increase in capacity without a significant increase in operator labor requirements.

The following sections provide a discussion of each of the process alternatives, including:

- A general overview of the process alternative.
- Description of the selected process option, including required facilities and design criteria for expansion to 24, 32, and 38 mgd.
- An assessment of process reliability.
- Operational impacts.
- Site requirements and the reuse of existing facilities.
- Constructability issues.

2.4.3.2 Conventional

Conventional treatment is a robust, time-tested process that involves coagulation, flocculation, sedimentation, and filtration. Conventional treatment provides a high level of removal of turbidity, color, and TOC, with the capability to treat algae on an intermittent basis. Conventional treatment, specifically the sedimentation process, operates at low loading rates, which increases the reliability of treatment and consistency of the finished water quality, but increases the site requirements for treatment.

In the *Water Treatment Plant Facilities Plan* (1997), conventional treatment was recommended because it satisfied the criteria for reliability, flexibility, and "operator friendliness", and has the ability to meet existing and future drinking water standards. This recommendation is still accurate, and thus, conventional treatment warrants consideration as the expansion process for the Lake Oswego WTP.

2.4.3.2.1 Process Description

The conventional process consists of four steps:

1. Coagulation
2. Flocculation
3. Sedimentation
4. Filtration

Coagulation, sometimes referred to as flash mixing or rapid mixing, is the process by which chemicals are added to the raw water supply to destabilize particulates and dissolved contaminants. The existing flash mix at the Lake Oswego WTP utilizes a pump diffusion flash mix system, which will remain the mixing method for the proposed expansion.

Flocculation, sometimes called slow mixing, involves the addition of energy through gentle agitation of the coagulated water to allow the formation of aggregated particles that can be removed through sedimentation or filtration. The recommended flocculation process for this water supply is three-stage tapered flocculation with an energy input ranging from 60 to 20 sec^{-1} and a minimum detention time of 30 minutes at the design flow.

Sedimentation refers to removal of floc by gravity settling. By creating a quiescent environment, the floc particles are allowed to settle as the clarified water overflows and is directed to the filters. In order to increase the capacity of the sedimentation basins, plate settlers are installed in a portion of the basin to increase the effective sedimentation surface area. Settled sludge is collected by chain and flight mechanisms or an underwater traveling siphon system and is sent to gravity thickeners and eventually to the sludge dewatering facility. Sedimentation basins with plate settlers are designed with a hydraulic loading rate of approximately 1.5 gpm/sf (total basin area) and a minimum detention time of 60 minutes.

Filtration in this context refers to the passage of chemically conditioned water through a granular media to allow removal of solids. Currently, nearly all solids removal occurs within the filter; the existing contact basins are not designed for significant solids removal. When a filter accumulates solids it must be cleaned by backwashing. Water used in backwashing must be recycled for retreatment thereby reducing the net production of finished water and reducing the plant capacity.

The existing six filters are equipped with dual media (anthracite, sand) and have been upgraded with Leopold Type S underdrains with permeable media-retaining caps. Filters of this design are typically operated at loading rates from 3 to 8 gpm/sf. Filter aid and chlorine may be added upstream of the filters to improve removal of unsettled solids and prevent algae growth in the basin and on the media.

The filtered water is stabilized using lime and carbon dioxide, and disinfected with sodium hypochlorite.

Figure 2.16 shows the detailed process flow diagram for the conventional process alternative.

2.4.3.2.2 Required Facilities

Expansion of the Lake Oswego WTP using a conventional treatment process will require the following modifications:

- Modification of the existing contact basins to include flocculation tanks, plate settlers, and sludge removal equipments
- New flocculation and sedimentation tanks
- Expansion of the filter gallery
- Gravity thickeners and sludge dewatering facilities

Table 2.12 presents the conventional treatment design criteria and required facilities for the three capacity scenarios for the Lake Oswego WTP.

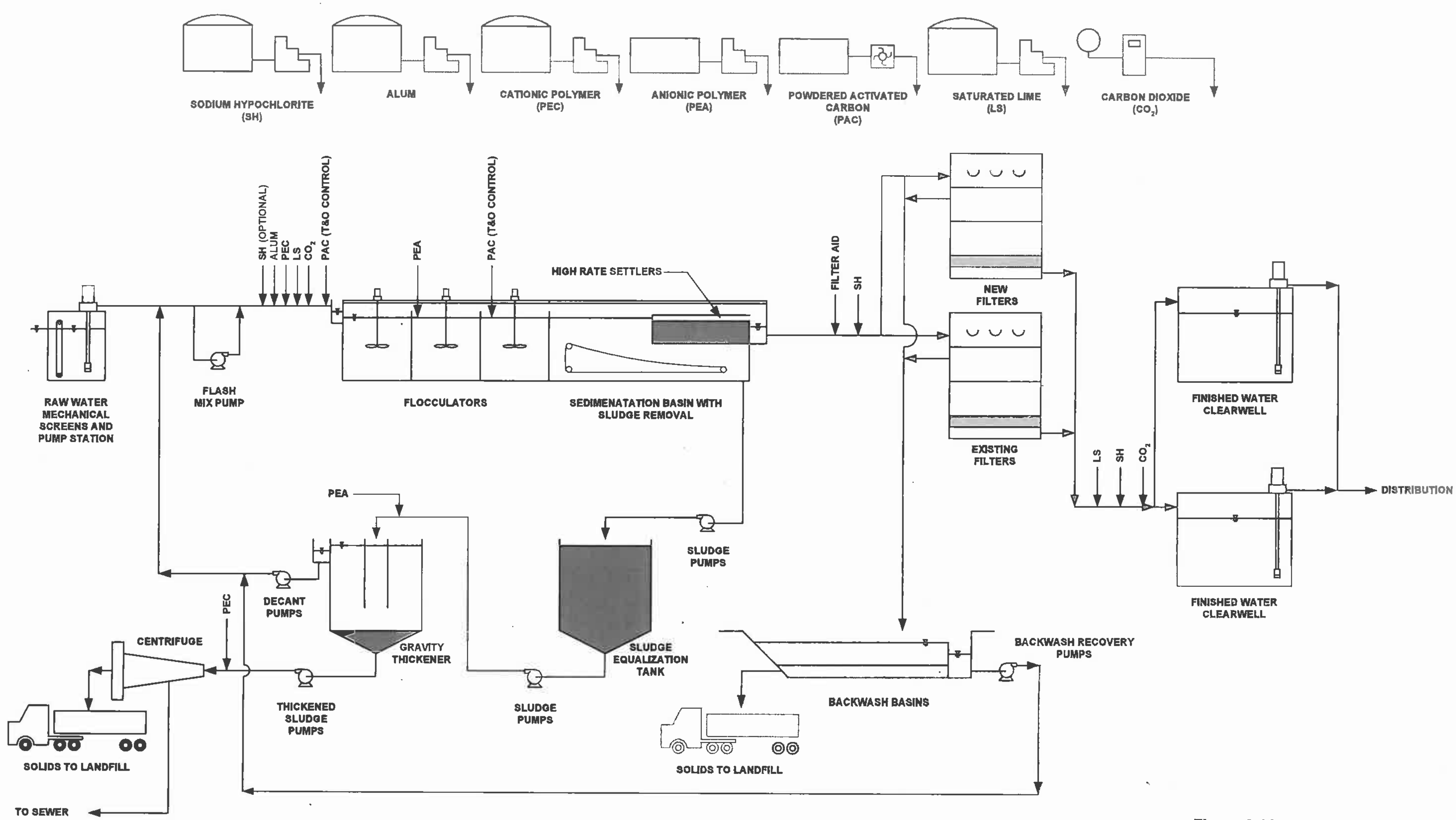

Figure 2.16
CONVENTIONAL TREATMENT OPTION
PROCESS FLOW DIAGRAM
JOINT WATER SUPPLY SYSTEM ANALYSIS
CITY OF LAKE OSWEGO AND TIGARD WATER SERVICE AREA

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Table 2.12	Design Criteria - Conventional Treatment Alternative Joint Water Supply System Analysis City of Lake Oswego and Tigard Water Service Area			
		WTP Capacity		
Parameter	**Units**	**24 mgd**	**32 mgd**	**38 mgd**
Number of New Treatment Trains	No.	3	5	6
Total Number of Treatment Trains	No.	6	8	9
Capacity Per New Treatment Train	mgd	4.0	4.0	4.3
Flocculation Basins				
Detention Time at Plant Capacity	min	34.9	34.9	32.2
Volume Per Train	gal	97,000	97,000	97,000
Volume Per Stage	gal	32,300	32,300	32,300
Number of Stages	No.	3	3	3
Water Depth	ft	14	14	14
Length	ft	16	16	16
Width	ft	20	20	20
Number of Flocculators	No.	9	15	18
Sedimentation Basins				
Type:	Rectangular, horizontal flow with mechanical solids removal and high-rate settlers (tubes or plates).			
Number of New Basins	No	3	5	6
Total Number of Basins	No.	6	8	9
Basin Length	ft	92	92	92
Basin Width	ft	20	20	20
Water Depth	ft	14	14	14
Basin Length to Width Ratio		5	5:1	5:1
Volume Per Train	gal	185,800	185,800	185,800
Total Volume	gal	1,115,000	1,486,500	1,672,200
Surface Loading Rate	gpm/sf	1.51	1.51	1.64
Detention Time at Plant Capacity	min	67	67	62

Table 2.12 **Design Criteria - Conventional Treatment Alternative, continued**
Joint Water Supply System Analysis
City of Lake Oswego and Tigard Water Service Area

Parameter	Units	WTP Capacity 24 mgd	32 mgd	38 mgd
Filters				
Type:	Dual Media, 36" Anthracite, 10" Sand			
Number of New Filters	No.	2	6	8
Total Number of Filters	No.	8	12	14
Area Per Filter	sf	360	360	360
Flowrate Per Filter, All Units On-Line	gpm	2,080	1,850	1,890
Flowrate Per Filter, One Unit in Backwash	gpm	2,380	2,020	2,030
Loading Rate, All Units On-Line	gpm/sf	5.79	5.14	5.24
Loading Rate, One Unit in Backwash	gpm/sf	6.61	5.61	5.64
Depth of Water Above Media	ft	6.0	6.0	6.0
Headloss Available for Solids	ft	8.9	8.9	8.9
Filter Media				
Anthracite Depth	in	36	36	36
Sand Depth	in	10	10	10
Backwash System				
Type:	Rotating arm surface wash with water backwash			
Underdrain:	Leopold Type S with permeable cap			
Surface Wash Water Supply:	Surface Wash Pump (existing)			
Wash Rate (assumed)	gpm/sf	1	1	1
Duration	min	3	3	3
Volume	gal	756	756	756
Backwash Water Supply:	Backwash Pumps			
Number of Pumps	No.	2	2	2
Pump Capacity	gpm	7,500	7,500	7,500
Backwash Rate	gpm/sf	20	20	20
Duration	min	8	8	8
Volume Per Backwash (max)	gal	57,600	57,600	57,600
Filter Drawdown Volume Per Filter	gal	16,200	16,200	16,200
Filter to Waste Volume Per Filter	gal	27,000	27,000	27,000
Total Backwash Waste Volume Per Filter Per Backwash	gal	101,600	101,600	101,600
Backwash Cycles per Day	No.	1	1	1

Table 2.12 Design Criteria - Conventional Treatment Alternative, continued
Joint Water Supply System Analysis
City of Lake Oswego and Tigard Water Service Area

Parameter	Units	WTP Capacity 24 mgd	32 mgd	38 mgd
Backwash/Thickening Water Recovery				
Total Backwash Volume Per Day (max)	gal	812,500	1,218,800	1,422,000
Backwash Water Recovery Volume	gal	810,000	1,215,000	1,417,400
Gravity Thickener Recovery Volume	gal	38,400	51,200	60,800
Recovered Water Percent of Influent Flow	%	3.5	4.0	3.9
Filter Washwater Lagoons				
Type: Concrete Lined				
Number of Lagoons:	No.	4	4	4
Depth of Solids Zone	ft	3.0	3.0	3.0
Water Surface (min)	ft	3.5	3.5	3.5
Water Surface (max)	ft	5.5	5.5	5.5
Total Depth	ft	6.0	6.0	6.0
Lagoon Length - Top	ft	174	174	174
Lagoon Width - Top	ft	58	58	58
Lagoon Length - Bottom	ft	126	126	126
Lagoon Width - Bottom	ft	58	58	58
One Lagoon In Service	gal	139,000	139,000	139,000
Two Lagoons In Service	gal	278,000	278,000	278,000
Volume Per Backwash	gal	102,000	102,000	102,000
Consecutive Backwash Storage (2 Ponds)	No.	2.73	2.73	2.73
Daily Solids Captured By Filters	lbs	316	316	376
Volume Available for Solids Storage	gal	180,000	180,000	180,000
Backwash Settled Solids Concentration	mg/L	10,000	10,000	10,000
Volume of Storage Used Per Day	gal/day	2,800	3,800	4,500
Days of Solid Storage Per Basin	days	63	47	40
Total Storage Available	days	253	189	160
Solids Drying Time Available Per Basin	days	189	142	120

Table 2.12	Design Criteria - Conventional Treatment Alternative, continued Joint Water Supply System Analysis City of Lake Oswego and Tigard Water Service Area			
		WTP Capacity		
Parameter	**Units**	**24 mgd**	**32 mgd**	**38 mgd**
Solids Production				
Alum Dose	mg/L	15	15	15
Influent Turbidity	NTU	3.5	3.5	3.5
Solids From Aluminum Hydroxide	lbs/day	1,300	1,800	2,100
Solids From Turbidity	lbs/day	1,100	1,400	1,700
Total Solids Production	lbs/day	2,400	3,200	3,800
Solids Captured By Filters	lbs/day	240	320	380
Solids in Sedimentation Basin	lbs/day	2,100	2,900	3,400
Sedimentation Basin Percent Solids	%	0.50	0.50	0.50
Sludge Blowdown Volume Per Day	mgd	0.05	0.07	0.08
Blowdown Percent of Influent Flowrate	%	0.21	0.21	0.21
Blowdown Events Per Day	No.	2	2	2
Blowdown Duration per Train	min	15	15	15
Total Blowdown Time	min	90	120	135
Instantaneous Blowdown Flowrate	gpm	569	569	600
Blowdown Equalization				
Flowrate In	gpm	569	569	600
Duration of Inflow	min/day	90	120	135
Flowrate Out	gpm	100	100	100
Duration of Outflow	min/day	512	683	811
Equalization Volume Required	gal	42,200	56,300	67,600
Equalization Tank				
Depth	ft	20	20	20
Diameter	ft	19	22	24
Volume	gal	42,400	56,900	67,700

Table 2.12	Design Criteria - Conventional Treatment Alternative, continued Joint Water Supply System Analysis City of Lake Oswego and Tigard Water Service Area			
		WTP Capacity		
Parameter	Units	24 mgd	32 mgd	38 mgd
Gravity Thickener				
Hydraulic Loading Rate	gpm/sf	0.13	0.13	0.13
Required Area	sf	769	769	769
Number of Gravity Thickeners	No.	2	2	2
Area Per Thickener	sf	385	385	385
Diameter	Ft	22	22	22
Solids Loading Rate	ppd/sf.	8	8	8
Thickened Sludge Concentration	%	2.0	2.0	2.0
Supernatant Overflow Flowrate	gpm	75	75	75
Total Overflow Volume Per Day	gpd	38,394	51,200	60,800
Thickened Sludge Flowrate to Dewatering	gpm	100	100	100
Thickened Sludge Pumpout Duration Per Day	min	128	171	203
Solids Capture Rate	%	90	90	90
Centrifuge				
Daily Solids Loading	lbs/day	1,900	2,600	3,000
Flowrate to Centrifuge	gpm	100	100	100
Daily Hours of Operation	Hrs	2.1	2.8	3.4
Dewatered Solids Concentration	%	20	20	20
Centrate Flowrate	gpm	90	90	90
Daily Centrate Flow Volume	gal	11,500	15,400	18,200

2.4.3.2.3 Reliability

Because of the robustness of the conventional process, the capability of the system to reliably meet the treatment goals is excellent. The inherent lack of process complexity contributes to the process reliability - fewer things to break or go wrong. This simplicity comes at the cost of site footprint.

2.4.3.2.4 Operational Impacts

Operation of the conventional process is only slightly more complex than the current direct filtration plant (not including the sludge management system). No additional chemicals are required over what is currently used. Only the scale of the facility and the flocculator and sedimentation basin sludge removal equipment contribute to added operational complexity.

2.4.3.2.5 Noise Impacts

Increased noise from the converted and expanded conventional treatment facilities will be limited to motor noise from flocculators and sludge collection devices. Higher noise generating facilities, specifically the dewatering centrifuges, will be contained within a building with the appropriate sound attenuating measures in place. In general, the ambient noise level at the property line is not expected to exceed current levels. However, more frequent truck traffic from sludge hauling and chemical delivery will increase individual noise events. These noise events can be scheduled for the middle of the day on weekdays to mitigate impacts on the surrounding community.

2.4.3.2.6 Site Impacts

As previously mentioned, the simplicity and robustness of the process requires a large footprint. As shown in Figure 2.17, the conventional treatment option nearly fills the available WTP site (excluding the 3.3 acre Mapleton parcel). Expansions beyond 38-mgd would be possible on the current site using conventional treatment, but would be limited to two additional treatment trains.

2.4.3.2.7 Reuse of Existing Facilities

The conventional process makes the most effective use of existing facilities. The contact tanks will be retrofitted as flocculation and sedimentation basins. The existing filters will remain in service, as will the sludge lagoons, although they will only receive backwash waste instead of the entire WTP solids load.

2.4.3.2.8 Constructability

By constructing new process tanks, the existing treatment process can remain online until the new process equipment is installed. Primary disruptions in treatment will occur during raw water and existing filter tie-ins. Once the new flocculation/sedimentation basins are on-line, the contact tanks can be taken offline and retrofitted similar to the new basins. Overall, challenges associated with implementation of the conventional treatment option are considered more complex than high rate conventional treatment, but less complex than membrane treatment.

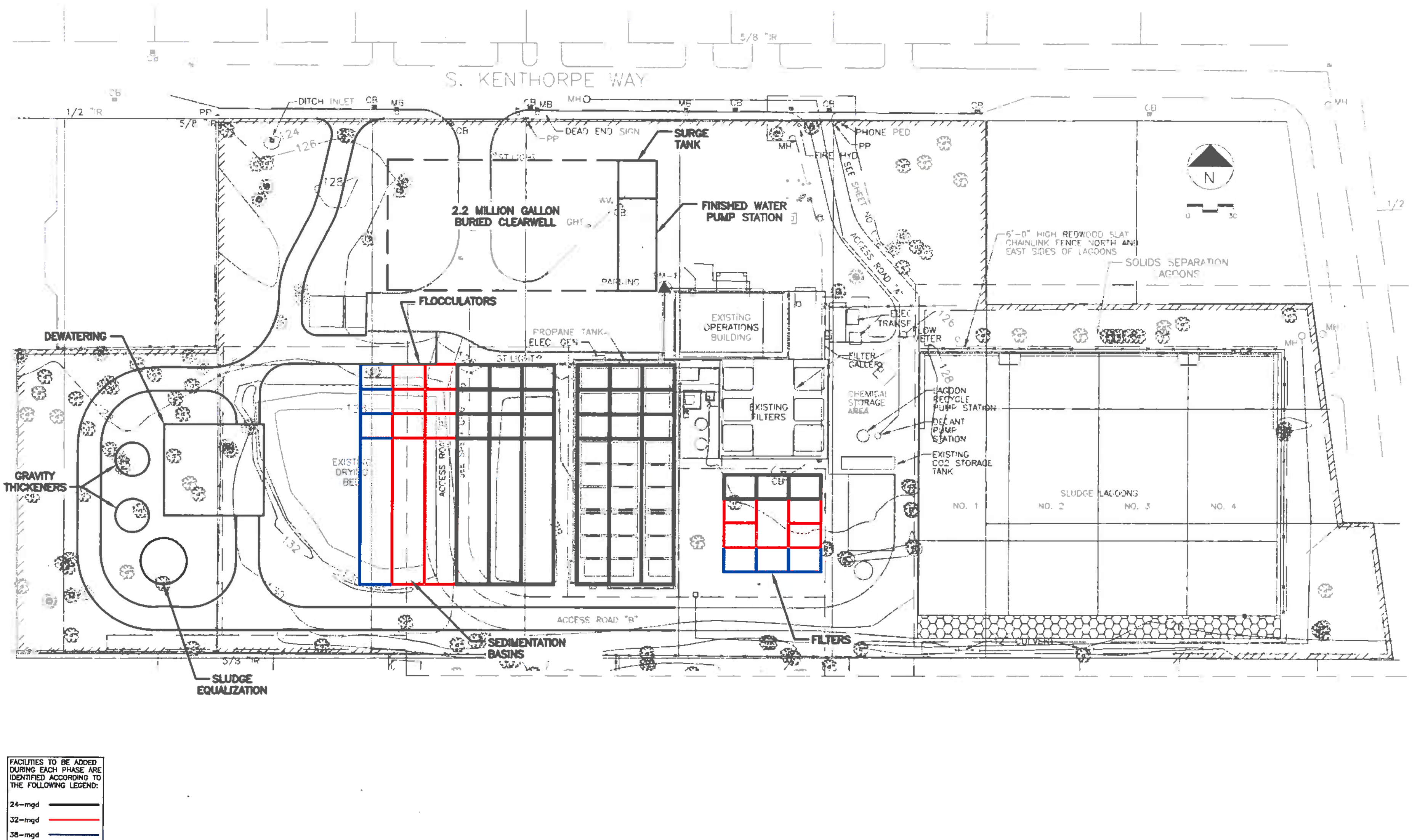

Figure 2.17
CONVENTIONAL TREATMENT OPTION
SITE PLAN
JOINT WATER SUPPLY SYSTEM ANALYSIS
CITY OF LAKE OSWEGO AND TIGARD WATER SERVICE AREA

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2.4.3.3 <u>High Rate Conventional</u>

High rate treatment processes are based on the same treatment concepts as conventional processes, but operate at higher treatment rates due to specific sedimentation process features. The types of high rate conventional treatment processes include:

- Sludge blanket clarification
- Dissolved air floatation
- Ballasted clarification

Sludge blanket clarifiers use a blanket of chemical sludge and solids from the raw water to capture solids that pass through the blanket during sedimentation. The primary example of this process is the Superpulsator®, developed by Infilco Degremont. In the Superpulsator® process, flocculation and sedimentation occur in a common tank. The sludge blanket is "pulsed" using vacuum pumps in order to increase the solids capture efficiency.

The Clackamas River raw water is relatively low in turbidity and suspended solids and is subject to rapid changes in quality during storm events. Sludge blanket clarification relies on a certain percentage of suspended solids in the raw water to maintain a heavy sludge blanket that is resistant to washing out. When treating low suspended solids waters, sludge blanket clarifiers require chemical doses in excess of that required for turbidity, TOC, and color removal in order to artificially create the solids necessary for successful operation. The excess chemical usage not only increases chemical coagulant costs, but also depletes raw water alkalinity thereby requiring more supplemental alkalinity addition. Additionally, the performance of sludge blanket clarifiers is sensitive to rapid changes in flowrate and raw water quality. For these reasons, sludge blanket clarification was not investigated as the high rate conventional treatment option.

Dissolved air floatation (DAF) is a high rate clarification process that uses minute air bubbles to float the floc particles to the surface where they are skimmed off. DAF is an effective technology for waters that have frequent algae blooms and low density solids that cannot be effectively settled. The Lake Oswego WTP has infrequent algae blooms and has shown success at producing settleable solids with alum and polymer addition. Therefore, DAF was not investigated as the high rate conventional treatment option.

The Actiflo® process, a ballasted clarification system, is a compact, conventional-type water clarification system that utilizes microsand as a seed for floc formation. Due to the weight of the sand/polymer/coagulant floc, upflow rates as high as 20 gpm per square foot are attainable. When compared to upflow rates of 1.5 to 2 gpm per square foot in conventional sedimentation basins with plate settlers, the capability to dramatically reduce the facility footprint is obvious.

Actiflo® uses microsand to develop a heavy floc and is not dependent upon the influent solids. Therefore, coagulant doses are based on water quality instead of system performance. Due to the high treatment rate and short residence time within the treatment units, Actiflo® is very responsive to rapid changes in water quality. Based on these advantages over sludge blanket clarification and DAF for this treatment application, Actiflo® is the recommended high rate conventional process for the expansion of the Lake Oswego WTP.

2.4.3.3.1 Process Description

The Actiflo® process combines the conventional treatment concepts of coagulation, flocculation and sedimentation with floc enhancement to allow for high rate operation. Coagulant is mixed in the coagulation tank, followed by the addition of microsand and polymer in the injection tank. The microsand provides surface area that enhances flocculation and acts as a ballast or weight. From the injection tank, the treated water moves to a maturation tank where the floc is built with gentle mixing. The floc is removed in an upflow sedimentation tank with plate settlers. The clarified water is then filtered using dual media filters, stabilized using lime and carbon dioxide, and disinfected with sodium hypochlorite.

Sludge from the sedimentation process is pumped to cyclone separators, where centrifugal action is used to separate the microsand from the chemical sludge, turbidity, and suspended solids. The recovered microsand (approximately 80 percent of the sludge recirculation flowrate) is returned to the injection tank to be reused. Additional microsand is added to the recycle stream to compensate for microsand lost in the separation process. Sludge from the cyclone separators (approximately 20% of the sludge recirculation flowrate) is sent to gravity thickeners and eventually to the sludge dewatering facility.

Figure 2.18 shows the detailed process flow diagram for the Actiflo® process alternative.

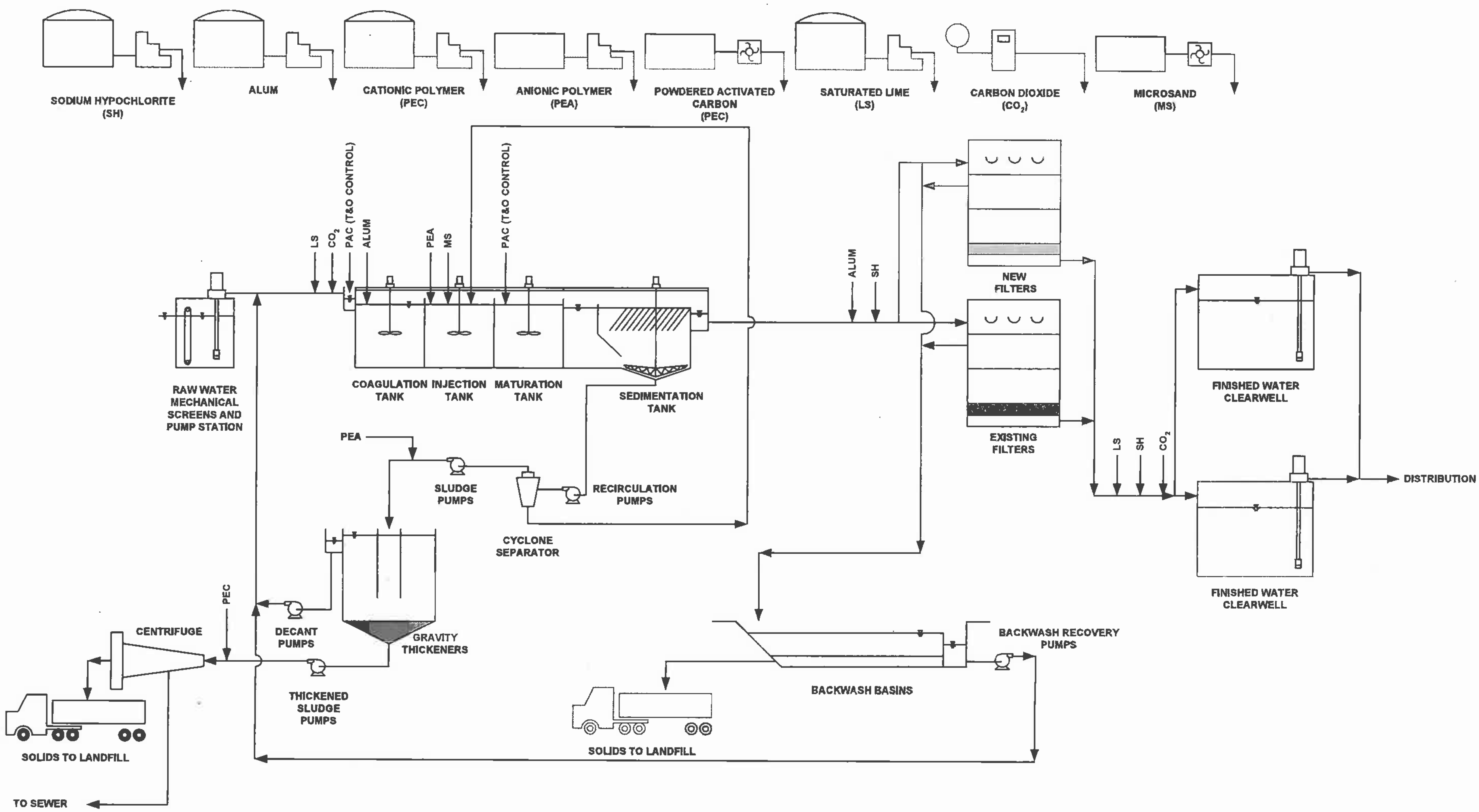

Figure 2.18
ACTIFLO® TREATMENT OPTION
PROCESS FLOW DIAGRAM
JOINT WATER SUPPLY SYSTEM ANALYSIS
CITY OF LAKE OSWEGO AND TIGARD WATER SERVICE AREA

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2.4.3.3.2 *Required Facilities*

Expansion of the Lake Oswego WTP using Actiflo® will require the following modifications:

- New Actiflo® process trains that include the coagulation tank, injection tank, maturation tank, and sedimentation tank.
- Microsand storage and feed facilities.
- Cyclone separators used to segregate the chemical sludge from the recycled microsand.
- Expansion of the filter gallery.
- Gravity thickeners and sludge dewatering facilities.

Table 2.13 presents the Actiflo® design criteria and required facilities for the three capacity scenarios for the Lake Oswego WTP.

2.4.3.3.3 Reliability

Because of the complexity and high rate operation of the Actiflo® process, it requires more operator attention than the conventional treatment process. The Actiflo® recovery time from a process upset is significantly faster than the conventional treatment process, but the small volume and reliance on several treatment aid feed systems makes the Actiflo® process the least reliable of the treatment options presented.

2.4.3.3.4 Operational Impacts

The advantages afforded by high rate conventional treatment processes are realized at the cost of increased operational complexity. The addition of the microsand feed system and cyclone separators increase the complexity and maintenance of the Actiflo® process over the conventional treatment option. Additionally, the high process rate requires increased monitoring of raw water quality and adjustments to chemical and microsand feed.

2.4.3.3.5 Noise Impacts

Increased noise from the Actiflo® facilities will be limited to motor noise from mixer motors and cyclone separators for sand recovery. The proposed Actiflo® alternative has included a structure over the process tankage, which will mitigate the added noise from the mixers and sand separating cyclones. Similar to the conventional treatment alternative, the dewatering centrifuges will be contained within a building with the appropriate sound attenuating measures in place. In general, the ambient noise level at the property line is not expected to exceed current levels. However, more frequent truck traffic from sludge hauling and chemical delivery will increase individual noise events. These noise events can be scheduled for the middle of the day on weekdays to mitigate impacts on the surrounding community.

Table 2.13 Design Criteria - High Rate Conventional Treatment Alternative (Actiflo®)
Joint Water Supply System Analysis
City of Lake Oswego and Tigard Water Service Area

Parameter	Units	WTP Capacity 24 mgd	32 mgd	38 mgd
Number of Treatment Trains	No.	3	4	5
Capacity Per Train	mgd	8.0	8.0	7.6
Actiflo ®				
Coagulation Tank				
Contact Time	min	2	2	2
Required Volume Per Train	gal	11,000	11,100	10,600
Water Depth	ft	18	18	18
Dimensions	ftxft	9	9	9
Injection Tank				
Contact Time	min	2	2	2
Required Volume Per Train	gal	11,000	11,100	10,600
Water Depth	ft	18	18	18
Dimensions	ftxft	9	9	9
Maturation Tank				
Contact Time	min	7.5	7.5	7.5
Required Volume Per Train	gal	42,000	42,000	40,000
Water Depth	ft	18	18	18
Dimensions	ftxft	18	18	17
Sedimentation Tank				
Loading Rate	gpm/sf	20	20	20
Required Area	sf	278	278	264
Tank Depth	ft	18	18	18
Tank Width	ft	18	18	17
Tank Length	ft	15	15	16
Filters		See Table 2.11		
Backwash/Thickening Water Recovery				
Total Backwash Volume Per Day (max)	gal	812,500	1,218,800	1,422,000
Backwash Water Recovery Volume	gal	809,700	1,215,000	1,417,400
Gravity Thickener Recovery Volume	gal	179,100	238,900	283,700
Recovered Water Percent of Influent Flow	%	4.1	4.5	4.5
Filter Washwater Lagoons		See Table11		

Table 2.13 Design Criteria - High Rate Conventional Treatment Alternative (Actiflo®), continued
Joint Water Supply System Analysis
City of Lake Oswego and Tigard Water Service Area

Parameter	Units	WTP Capacity 24-mgd	32-mgd	38-mgd
Solids Production				
Alum Dose	mg/L	15	15	15
Influent Turbidity	NTU	3.5	3.5	3.5
Solids From Aluminum Hydroxide	lbs/day	1,300	1,800	2,100
Solids From Turbidity	lbs/day	1,000	1,400	1,700
Total Solids Production	lbs/day	2,300	3,200	3,800
Solids Captured By Filters	lbs/day	230	320	380
Solids in Sedimentation Basin	lbs/day	2,100	2,900	3,400
Sedimentation Basin Percent Solids	%	0.13	0.13	0.13
Sludge Recirculation Rate	%	4.0	4.0	4.0
Sludge Recirculation Flowrate	gpm	667	889	1,055
Recirculation Flow Wasting Rate	%	20	20	20
Sludge Blowdown Flowrate	gpm	130	180	210
Sludge Blowdown Volume Per Day	gal	192,000	256,000	304,000
Gravity Thickener				
Hydraulic Loading Rate	gpm/sq.ft	0.13	0.13	0.13
Available Area	sq.ft	1,030	1,370	1,630
Number of Gravity Thickeners	No.	2	2	2
Area Per Thickener	sq.ft	513	684	812
Diameter	ft	26	30	32
Solids Loading Rate	ppd/sf	2.31	2.31	2.31
Thickened Sludge Concentration	%	2.0	2.0	2.0
Supernatant Overflow Flowrate	gpm	124	170	200
Total Overflow Volume Per Day	gpd	179,000	239,000	284,000
Thickened Sludge Flowrate to Dewatering	gpm	250	250	250
Thickened Sludge Pumpout Duration Per Day	min	51	68	81
Solids Capture Rate	%	90	90	90
Centrifuge				
Daily Solids Loading	lbs/day	2,140	2,850	3,380
Flowrate to Centrifuge	gpm	250	250	250
Daily Hours of Operation	Hrs	0.9	1.1	1.4
Dewatered Solids Concentration	%	20	20	20
Centrate Flowrate	gpm	225	225	225
Daily Centrate Flow Volume	gal	11,500	15,400	18,200

2.4.3.3.6 Site Impacts

The high treatment rate of the Actiflo® process allows for large volumes of treatment in a compact footprint. Of the proposed treatment options, the Actiflo® process requires the least site space for implementation. Figure 2.19 presents a proposed layout, including delineation of the expansion phases, for the proposed facilities described in this section.

2.4.3.3.7 Reuse of Existing Facilities

Because of the customized configuration of the Actiflo® process, it is recommended that new process tanks be constructed. Existing filters can remain, with additional filters added in a similar configuration. The existing contact tanks are not suitable for conversion to gravity thickeners. Therefore, new gravity thickeners will be constructed and the existing contact tanks demolished.

2.4.3.3.8 Constructability

By constructing new process tanks, the existing treatment process can remain online until the new process equipment is installed. Disruptions in treatment will be required during tie-ins of raw water piping and filters. Since the contact tanks will not be retrofitted, the existing process can stay on-line during the construction of the high rate conventional treatment system. Overall, challenges associated with implementation of the high rate conventional treatment option are considered to be the least complex of all the options.

2.4.3.4 Membranes

The application of low pressure membranes for the treatment of surface water has increased significantly over the last 10 years. Membranes provide an absolute barrier against turbidity, *Giardia,* and *Cryptosporidium*, which has prompted regulatory agencies to grant log removal credit similar to that of conventional treatment with filtration. Dissolved material, such as color, is not removed by membranes without chemical coagulant. As a result, inside most membrane treatment facilities is a conventional treatment process. For example, the recently commissioned North Clackamas County Water Commission (NCCWC) membrane filtration facility employs coagulation and flocculation upstream of the membrane system, which performs the function of sedimentation and filtration.

Unlike conventional treatment processes, membrane processes provide consistent finished water quality (relative to filterable solids and pathogens) regardless of raw water quality. However, where conventional processes realize treated water quality degradation under challenging treatment conditions, membranes suffer performance degradation, such as rapid rise in driving pressure, increased backwashing frequency, and frequent chemical cleanings.

Two membrane configurations exist, pressure driven and vacuum driven. Pressure driven membrane systems use feed pressure to "push" the raw water through the membranes, which are contained in a pressure vessel. Vacuum driven systems "pull" filtered water through the membranes, which are immersed in open process tanks. The vacuum is generated by a pump on the filtered water side of the membranes. Both configurations have been applied successfully around the world.

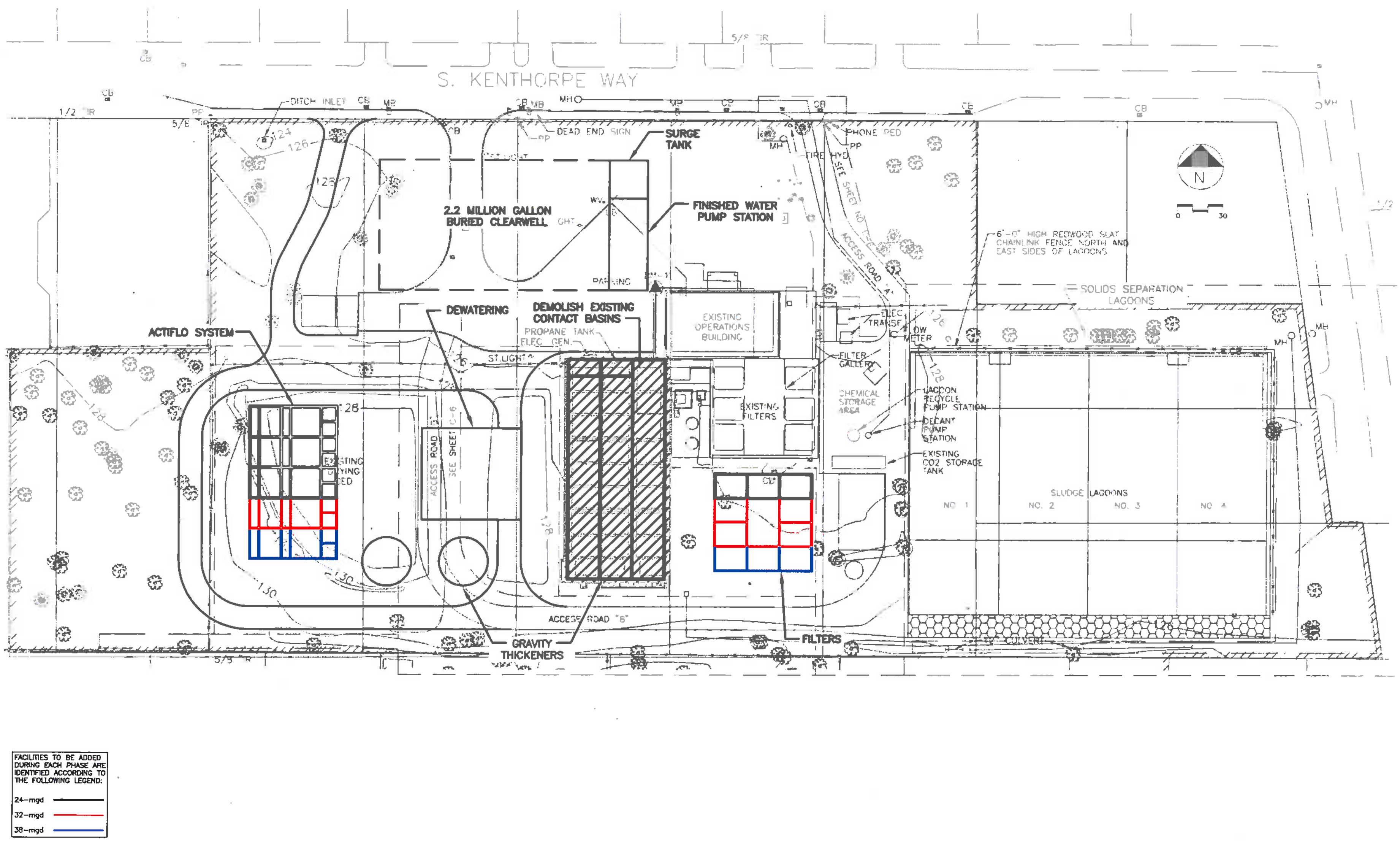

Figure 2.19
ACTIFLO® TREATMENT OPTION
SITE PLAN
JOINT WATER SUPPLY SYSTEM ANALYSIS
CITY OF LAKE OSWEGO AND TIGARD WATER SERVICE AREA

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For this analysis, immersed vacuum membrane systems were selected for evaluation. The use of immersed vacuum systems was selected because of their use at the North Clackamas WTP and the ability to utilize the filter tanks for membrane installation. Although Memcor CMF-S membranes were used at the NCCWC WTP, Zenon 500 series membranes were used to develop the site layouts, as they represent the most conservative footprint requirement.

2.4.3.4.1 Process Description

The membrane treatment process combines the conventional treatment concepts of coagulation and flocculation with filtration. If influent solids loading is high, a sedimentation process is recommended prior to application of the coagulated water to the membranes. For the Lake Oswego WTP, however, sedimentation basins are not proposed based on the low solids loading and successful operation of the North Clackamas WTP. The filtered water is stabilized using lime and carbon dioxide, and disinfected with sodium hypochlorite.

During normal operation, solids accumulate on the membrane surface. At intervals ranging from 15 to 30 minutes, the membranes are backwashed by pumping filtrate backwards through the membranes. The backwashing process forces solids on the membrane surface back into the process tank. Chlorine may be added to the backwash water intermittently to control the growth of biological material in the pore structure of the membranes.

As filtrate is drawn out of the membrane tank, solids are retained in the tank and the concentration increases over time. Periodic tank drains are used to deconcentrate the process tank and prevent overloading of the membranes with solids. Solids from the membrane tanks are pumped to an equalization tank. The contents of the equalization tank are pumped at a constant rate to gravity thickeners and eventually to the sludge dewatering system.

Occasionally, the fouling of the membranes cannot be removed with standard or chemically enhanced backwashing, at which time the membrane system (typically one train at a time) is taken offline for in-situ chemical cleaning.

Figure 2.20 shows the detailed process flow diagram for the membrane treatment process alternative.

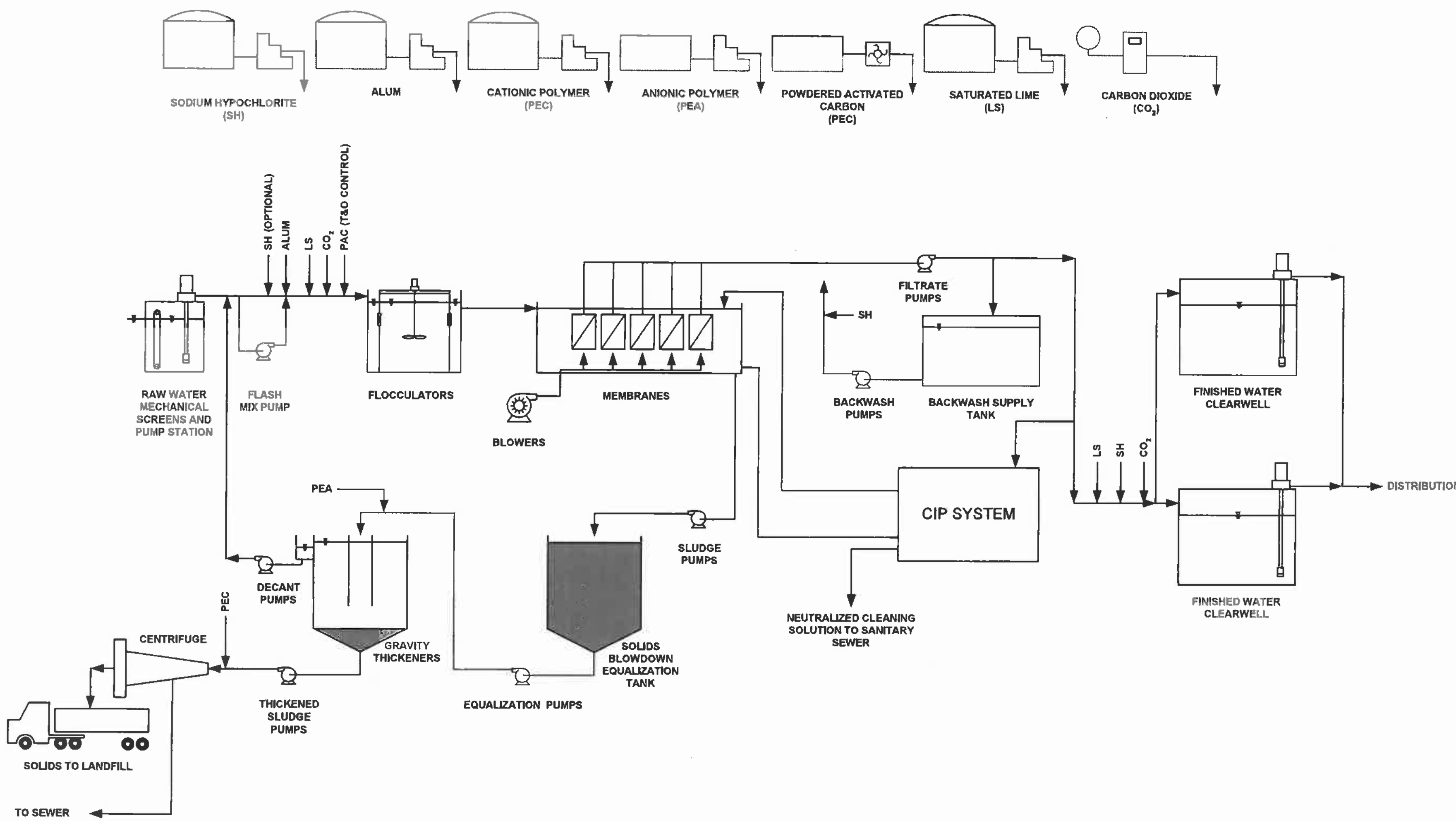

Figure 2.20
MEMBRANE TREATMENT OPTION
PROCESS FLOW DIAGRAM
JOINT WATER SUPPLY SYSTEM ANALYSIS
CITY OF LAKE OSWEGO AND TIGARD WATER SERVICE AREA

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2.4.3.4.2 Required Facilities

Expansion of the Lake Oswego WTP using membranes will require the following modifications:

- Conversion of a portion of the existing contact tanks to flocculation tanks.
- Conversion of the remaining portion of the contact tanks to a membrane cleaning system.
- Conversion of the existing filters to membrane tanks.
- Construction of new membrane tanks.
- Construction of a backwash water storage tank.
- Installation of blowers and air compressors.
- Construction of a blowdown equalization, gravity thickeners and sludge dewatering facilities.

Table 2.14 presents the membrane design criteria and required facilities for each of the three capacity scenarios for the Lake Oswego WTP.

2.4.3.4.3 Reliability

Membrane treatment systems are very reliable when assessed based on the quality of the treated water. Constant filtrate monitoring and daily integrity monitoring ensures to a high degree of confidence that the membranes are not compromised. Although water temperature significantly impacts the production capability of the membrane treatment option, these raw water conditions typically correlate to a decrease in demand, which does not impact the ability of the membrane treatment process to reliably meet the treatment goals. As a result, the membrane treatment option is considered the most reliable at consistently meeting water quality goals.

2.4.3.4.4 Operational Impacts

The highly automated nature of membrane plants allows for more a more hands-off approach to operation. However, the membrane pretreatment process is still conventional in nature and requires monitoring of raw water quality and chemical addition. This aspect of the membrane treatment process is operationally similar to the conventional treatment alternative. From a maintenance perspective, the membrane system alternative is significantly more rigorous than either the conventional or high rate conventional processes. The numerous automated valves and pumps required for filtrate production, backwashing, and cleaning require considerable attention. Although an automated process, the in-situ cleanings must be overseen. Additionally, the membrane system contains a large amount of instrumentation necessary for the high level of automation. Instruments must be serviced and calibrated to assure proper operation. For these reasons, the membrane treatment option will be the most intense from an operational perspective.

Table 2.14 Design Criteria - Membrane Treatment Alternative
Joint Water Supply System Analysis
City of Lake Oswego and Tigard Water Service Area

Parameter	Units	WTP Capacity 24 mgd	32 mgd	38 mgd
Facility Recovery	%	98	98	98
Total Required Raw Water Treatment Capacity	mgd	24.5	32.6	38.7
Total Number of Converted Filter Membrane Treatment Trains	No.	6	6	6
Total Number of New Membrane Treatment Trains	No.	2	5	6
Capacity Per Retrofitted Filter Treatment Train	mgd	3.18	3.18	3.18
Capacity Per New Treatment Train	mgd	3.18	3.18	3.71
Flocculator Capacity	mgd	25.9	34.5	38.8
Membrane Capacity	mgd	25.5	35.0	41.4
Flocculation Basins				
Number of Basins	No.	6	8	9
Volume Per Train	gal	37,400	37,400	37,400
Design Detention Time at Plant Capacity	min	12.5	12.5	12.5
Actual Detention Time at Plant Capacity	min	13.2	13.2	12.5
Volume Per Stage	gal	37,400	37,400	37,400
Number of Stages	No.	1	1	1
Water Depth	ft	12.5	12.5	12.5
Length	ft	20.0	20.0	20.0
Width	ft	20.0	20.0	20.0
Number of Flocculators	No.	6	8	9
Membrane System				
Type:		Immersed, vacuum driven		
Membrane Area Per Module	sf	340	340	340
Modules Per Cassette	No.	52	52	52
Design Flux Rate	gfd	30	30	30
Number of Cassettes Required	No.	62	62	73
Number of Cassettes Installed	No.	66	66	78
Number of Cassettes Per Converted Filter Train	No.	6	6	6
Number of Cassettes Per New Train	No.	6	6	7

Table 2.14	Design Criteria - Membrane Treatment Alternative, continued Joint Water Supply System Analysis City of Lake Oswego and Tigard Water Service Area			
		WTP Capacity		
Parameter	**Units**	**24-mgd**	**32-mgd**	**38-mgd**
Backwash Tank				
Backwash Flux	gfd	45	45	45
Backwash Flowrate Per Module	gpm	10.6	10.6	10.6
Backwash Flowrate Per Cassette	gpm	553	553	553
Backwash Duration	sec	40	40	40
Backwash Volume Per Cassette	gal	368	368	368
Modules Per Converted Filter Train	No.	312	312	312
Modules Per New Train	No.	312	312	364
Backwash Volume Per Converted Filter Train	gal	2,210	2,210	2,210
Backwash Volume Per New Train	gal	2,210	2,210	2,578
Required Backwash Water Storage	gal	19,900	26,500	31,300
Backwash Tank Depth	ft	12	12	12
Backwash Tank Length	ft	30	30	30
Backwash Tank Width	ft	15	15	15
Backwash Tank Volume	gal	41,000	41,000	41,000
Blowdown Waste				
Converted Filter Tanks				
Filter Tank Volume	gal	27,600	27,600	27,600
Blowdown Events Per Day Per Tank	No.	8	8	8
Blowdown Percentage of Tank Volume	%	25	25	25
Blowdown Volume	gal	7,000	7,000	7,000
Blowdown Time	min	5	5	5
Blowdown Instantaneous Flowrate	gpm	1,400	1,400	1,400
Total Daily Blowdown Volume	gal	331,000	331,000	331,000
New Tanks				
Filter Tank Volume	gal	30,300	30,300	30,300
Blowdown Events Per Day Per Tank	No.	8	8	8
Blowdown Percentage of Tank Volume	%	25	25	25
Blowdown Volume	gal	7,600	7,600	7,600
Blowdown Time	min	5	5	5
Blowdown Instantaneous Flowrate	gpm	1,520	1,520	1,520
Total Daily Blowdown Volume	gal	121,000	303,000	364,000
Total Daily Plant Blowdown Volume	gal	452,000	634,000	695,000
Plant Recovery	%	98	98	98

Table 2.14 Design Criteria - Membrane Treatment Alternative, continued
Joint Water Supply System Analysis
City of Lake Oswego and Tigard Water Service Area

Parameter	Units	WTP Capacity 24-mgd	32-mgd	38-mgd
Solids Production				
Alum Dose	mg/L	15	15	15
Influent Turbidity	NTU	3.5	3.5	3.5
Solids From Aluminum Hydroxide	lbs/day	1,300	1,800	2,100
Solids From Turbidity	lbs/day	1,100	1,400	1,700
Total Solids Production	lbs/day	2,400	3,200	3,800
Blowdown Percent Solids	%	0.06	0.06	0.07
Sludge Blowdown Volume Per Day	mgd	0.45	0.63	0.69
Blowdown Percent of Influent Flowrate	%	1.85	1.94	1.80
Blowdown Events Per Day	No.	8	8	8
Blowdown Duration per Train	min	5	5	5
Total Blowdown Time	min	480	480	480
Total Time Available Per Event	min	23	16	15
Instantaneous Blowdown Flowrate				
Converted Filter Tanks	gpm	1,400	1,400	1,400
New Tanks	gpm	1,520	1,520	1,520
Blowdown Equalization				
Flowrate In	gpm	1,520	1,520	1,520
Duration of Inflow	min	5	5	5
Flowrate Out	gpm	337	465	505
Total Inflow During Blowdown Event	gal	7,600	7,600	7,600
Total Outflow Per Event	gal	7,600	7,600	7,600
Duration of Outflow	min/day	23	16	15
Equalization Volume Required	gal	5,900	5,300	5,000
Equalization Tank				
Depth	ft	12	12	12
Diameter	ft	15	15	15
Volume	gal	16,000	16,000	16,000

Table 2.14 Design Criteria - Membrane Treatment Alternative, continued
Joint Water Supply System Analysis
City of Lake Oswego and Tigard Water Service Area

Parameter	Units	WTP Capacity 24-mgd	32-mgd	38-mgd
Gravity Thickener				
Hydraulic Loading Rate	gpm/sq.ft	0.13	0.13	0.13
Required Area	sq.ft	2,590	3,560	3,884
Number of Gravity Thickeners	No.	2	2	2
Area Per Thickener	sq.ft	1,295	1,780	1,942
Diameter	ft	41	48	50
Solids Loading Rate	ppd/sf	0.93	0.91	0.98
Thickened Sludge Concentration	%	2.0	2.0	2.0
Supernatant Overflow Flowrate	gpm	304	427	467
Total Overflow Volume Per Day	gpd	438,000	615,000	672,000
Thickened Sludge Flowrate to Dewatering	gpm	200	200	200
Thickened Sludge Pumpout Duration Per Day	min	72	97	115
Solids Capture Rate	%	90	90	90
Centrifuge				
Daily Solids Loading	lbs/day	2,200	2,900	3,400
Flowrate to Centrifuge	gpm	200	200	200
Daily Hours of Operation	Hrs	1.2	1.6	1.9
Dewatered Solids Concentration	%	20	20	20
Centrate Flowrate	gpm	180	180	180
Daily Centrate Flow Volume	gal	13,000	17,400	20,600

2.4.3.4.5 Noise Impacts

Increased noise from the membrane facilities will be comprised of noise from flocculator motors, pneumatic actuator operation, blowers, permeate pumps, backwash pumps, and air compressors. The high noise generating equipment, specifically the blowers, pumps, and air compressors, will all be contained within structures to attenuate the noise. Noise from pneumatic valves and flocculators is expected to be minimal. Similar to the conventional and Actiflo® treatment alternatives, the dewatering centrifuges will be contained within a building with the appropriate sound attenuating measures in place. In general, the ambient noise level at the property line is not expected to exceed current levels. However, more frequent truck traffic from sludge hauling and chemical delivery will increase individual noise events. These noise events can be scheduled for the middle of the day on weekdays to mitigate impacts on the surrounding community.

2.4.3.4.6 Site Impacts

While the membranes themselves have a small footprint due to the density of the membrane surface area, the other facilities, such as flocculation facilities, backwash facilities, and the clean-in-place system will occupy a considerable amount of the site. Additionally, the high volume of membrane tank blowdown will require large gravity thickeners. Of the proposed treatment options, the membrane process requires the second-most site space for implementation. Figure 2.21 presents a proposed layout, including delineation of the expansion phases, for the proposed facilities described in this section.

2.4.3.4.7 Reuse of Existing Facilities

Membranes, particularly the immersed vacuum type evaluated for this analysis, are amenable to retrofit into existing tanks. The existing filter tanks can be converted to membrane tanks; however, new membrane tanks will also be required to accommodate the expansion of the facility. The existing contact tank can be converted to flocculators and also used for the clean-in-place system. Since the existing washwater lagoons are not designed for sludge removal, they cannot be used for solids blowdown treatment. As a result, the backwash lagoons will be used only as a backup method of solids blowdown in the event the gravity thickeners are out of service. Since these basins are relatively new, using them only as a backup facility makes the membrane treatment option the least effective for using existing facilities.

2.4.3.4.8 Constructability

Since the membranes are to be installed in existing tanks, the phasing of construction is challenging. Retrofitting the filters and contact tanks would require innovative staging and the ability to bring retrofitted units on-line in parallel with the existing treatment process. A good option for construction phasing is to construct the new membrane trains first, place them on-line, and run in a direct coagulation/filtration mode without a flocculation step. This would provide a window for retrofitting the contact basins. The conversion of the existing filters to membrane tanks could then occur after the flocculators and new membrane trains are on-line.

Overall, challenges associated with implementation of the membrane treatment option are considered to be the most complex of the treatment options.

2.4.4 General Facilities

While the specific facilities are unique for each process option, the general facilities, such as chemical storage, clearwell storage, high service pumping, and surge suppression, are common to all three alternatives. The proceeding information provides a review of existing facilities and recommendations for expansions, as necessary.

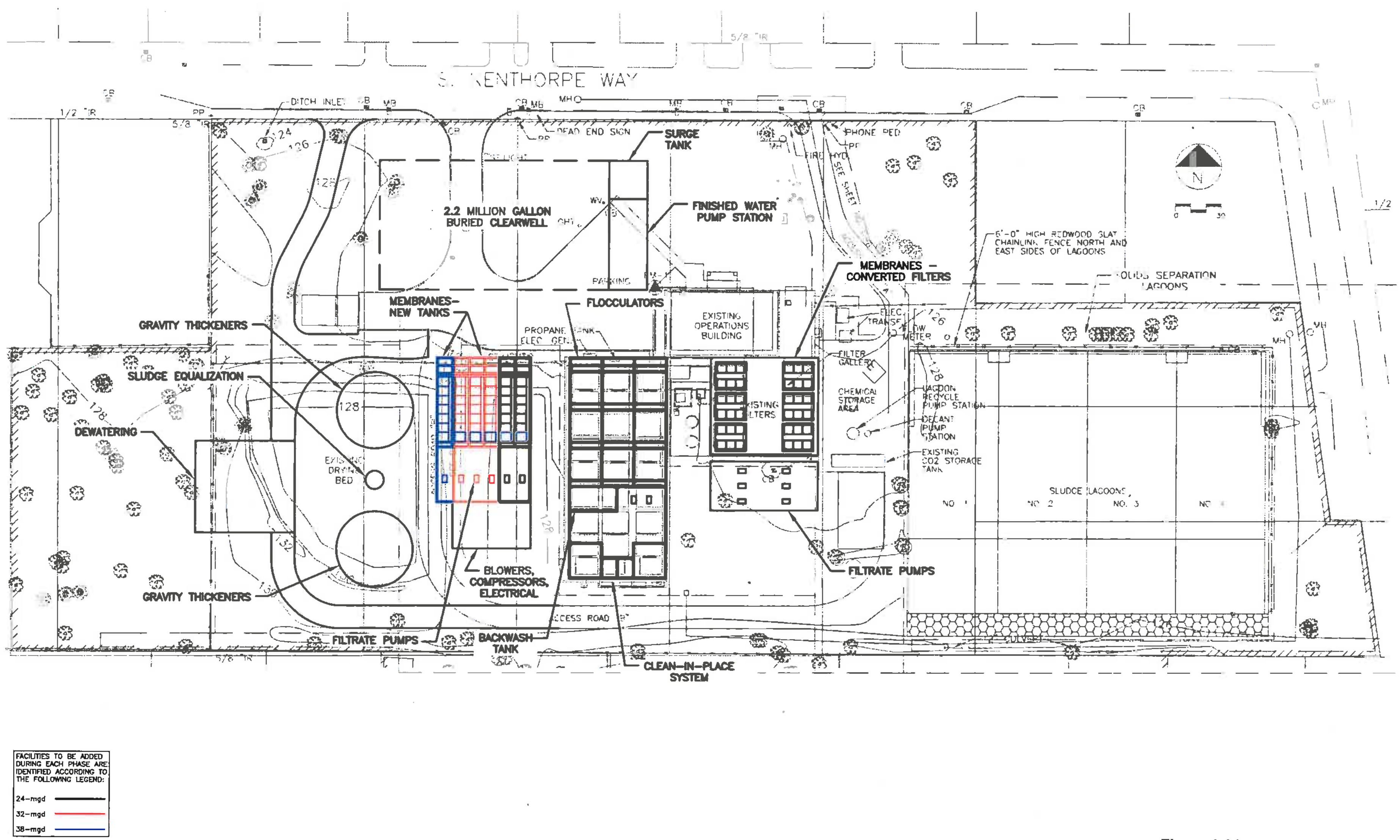

Figure 2.21
MEMBRANE TREATMENT OPTION
SITE PLAN
JOINT WATER SUPPLY SYSTEM ANALYSIS
CITY OF LAKE OSWEGO AND TIGARD WATER SERVICE AREA

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2.4.4.1 Clearwell

Disinfection of the filtered water serves two general purposes:

- To provide inactivation of target pathogens prior to reaching the first customers connection.
- To provide a disinfectant residual within the distribution system to maintain water quality.

Both objectives are accomplished at the Lake Oswego WTP with chlorine, delivered as sodium hypochlorite solution. Although alternate disinfectants (e.g. ozone or ultraviolet light) can be used for inactivation of pathogens, these practices do not result in a residual through the distribution system. A chlorine-based residual is required for continued disinfection in the distribution system.

Disinfection for the inactivation of pathogens is calculated as the product of the chlorine residual (C) and the contact time (T). A higher CT value indicates a higher level of disinfection. Because a conventional treatment process provides a more reliable barrier than a direct filtration plant to the passage of pathogens through the treatment process, the CT requirements for conventional treatment are less than those for direct filtration.

Table 2.15 compares the current disinfection log removal requirements compared to those for a conversion to any of the three treatment options presented herein.

Table 2.15 CT Requirements[1]
Joint Water Supply System Analysis
City of Lake Oswego and Tigard Water Service Area

Parameter	Total Log Removal Required	Direct Filtration: Provided by Treatment	Direct Filtration: Required by Disinfection	Conventional Treatment: Provided by Treatment	Conventional Treatment: Required by Disinfection
Giardia lamblia	3.0	2.0	1.0	2.5	0.5
Cryptosporidium[1]	3.0	3.0	0.0	3.0	0.0
Virus	4.0	1.0	3.0	2.0	2.0

Note:

1. The Clackamas River water quality places the Lake Oswego WTP into Bin 1, as defined by the Long Term 2 Enhanced Surface Water Treatment Rule.

The inactivation CT requirements for *Giardia lamblia* and virus are presented in Table 2.16. The effectiveness of chlorine as a disinfectant diminishes with decreasing temperature and increasing finished water pH. For this analysis, the average water temperature of 13.8°C and a pH of 8.0 were used to assess the CT capacity of the existing clearwell.

**Table 2.16 Disinfection CT Requirements[1]
Joint Water Supply System Analysis
City of Lake Oswego and Tigard Water Service Area**

Parameter	Log Removal Required By Disinfection	CT Requirement at 13.8 °C[1]
Giardia lamblia	0.5	48
Virus	2.0	3.5

Note:
1. CT requirements are for free chlorine at 0.8 mg/L.

The data in Table 2.16 shows that the *Giardia lamblia* inactivation requirement drives the CT requirement. Based on the information in the recently completed tracer study (2006), the existing 400,000-gallon clearwell has an effective volume of 325,000 gallons for CT and a T_{10}/T factor of 0.51 to 0.56 for flow rates of 8 mgd and 16mgd, respectively. To conservatively estimate the capacity of the existing clearwell, a T_{10}/T factor of 0.50 will be used. Based on these assumptions, the clearwell provides 9.36 mgd of capacity for CT compliance (does not include filters or distribution piping as part of the available CT volume).

Based on these assumptions, new chlorine contact volume will be required to meet the CT requirements of the Lake Oswego WTP at 24 mgd, 32 mgd, and 38 mgd. Applying the T_{10}/T factor of 0.50 to the new required chlorine contact basin, the required volumes to achieve CT compliance were calculated assuming a pH of 8 and a residual chlorine concentration of 0.8 mg/L. The results of this analysis are presented in Table 2.17.

**Table 2.17 Clearwell Capacity Requirements
Joint Water Supply System Analysis
City of Lake Oswego and Tigard Water Service Area**

Plant Capacity	Required Additional Clearwell Capacity[1,2]
24-mgd	1,275,000-gal
32-mgd	1,800,000-gal
38-mgd	2,200,000-gal

Notes:
1. CT Required = 48 mg/L. min; T/T_{10} = 0.5; Chlorine Residual = 1.0 mg/L.
2. Assumes 325,000-gal available for CT from existing clearwell.

Based on the Water Treatment Facilities Plan (1997), the site can accommodate a new 2.2 million gallon clearwell. The recommended criteria for water treatment plant clearwell storage is to provide 20 percent of maximum day capacity as an ideal condition. Many plants cannot meet this ideal condition and operate adequately at 10 percent of maximum day capacity for clearwell storage. The percent of plant capacity provided by the existing clearwell is shown in Table 2.18.

Table 2.18	Existing Clearwell Capacity Versus Plant Flowrate Joint Water Supply System Analysis City of Lake Oswego and Tigard Water Service Area
Capacity	**Existing Clearwell Volume Percent of Capacity[1]**
24-mgd	1.4
32-mgd	1.0
38-mgd	0.9

Note:

1. Assumes usable volume = 325,000-gal.

From this table it can be seen that the available clearwell storage at the water treatment plant falls well below any reasonable standard. The practical result of this is that the plant is forced to overflow the clearwell frequently at certain times of the year with a resulting of wastage in finished water and discharge of chlorinated water to the Willamette River.

Additional clearwell capacity is needed at the Lake Oswego WTP. Because of site constraints it is not physically possible to construct the recommended 10 to 20 percent of plant capacity for ultimate conditions. The largest clearwell which could reasonably be constructed on the site would have a total capacity of approximately 2.2 million gallons (MG). The resulting combined clearwell capacity is also shown in Table 2.19.

Table 2.19	Proposed Clearwell Capacity Joint Water Supply System Analysis City of Lake Oswego and Tigard Water Service Area	
Capacity	**Combined Storage Volume**	**Percent of Plant Capacity**
24 mgd	2,525,000-gal	10.5
32 mgd	2,525,000-gal	7.9
38 mgd	2,525,000-gal	6.6

The new clearwell should be designed to offer the following features:

- Rectangular, reinforced concrete, below-grade construction to provide maximum volume with minimum visual impact.
- Baffling to provide a minimum $T_{10}/T = 0.5$ to provide additional CT compliance.
- Compartmentalization to allow maintenance while keeping the plant and high service pumps in operation.

To provide the recommended clearwell capacity of 10 to 20 percent of total plant capacity, the clearwell would need to be located off the existing plant site. It is theoretically feasible that a larger clearwell be constructed on the adjacent 3-acre lot; however, there are likely to be related issues which might preclude this option (such as neighborhood regulations, existing covenants, etc). It is recommended that this possibility be further evaluated during the preliminary design phase to determine the viability of locating the clearwell on the neighboring lot.

2.4.4.2 High Service Pumping & Surge Suppression

The existing high service pumping station is located above the clearwell. The four high service pumps and one backwash pump are vertical turbine pumps taking suction directly from the clearwell. The three high-pressure finished water pumps are capable of a combined pumping capacity of 16-mgd during summer demand conditions. The single low-pressure pump is capable of pumping approximately 9 mgd; this pump will not run in conjunction with the high-pressure pumps.

Any expansion of plant capacity beyond the current 16 mgd will require construction of additional finished water pumping capacity. It is recommended that a new high service pumping station should be constructed in conjunction with the proposed 2.2 MG buried clearwell. Design of the new finished water pumping station should incorporate the following:

- A new motor control center
- Acoustical design to eliminate nuisance noise
- Overhead crane and inside vehicle bay for pump removal
- Variable speed pumping capability

The variable speed pumping recommendation is important because of the limited size of available clearwell capacity (even including the new 2.2 million gallon clearwell) and because of the need to match raw water pumping flow rate to finished water pumping to minimize the disruption to the treatment process caused by flow changes.

The existing surge tank has been reported to be in need of replacement. This serves a vital function in preventing damage to the finished water transmission main and high service pump station resulting from water hammer. Establishing the type and capacity of new surge suppression is beyond the scope of the current study; however, an allowance has been included in the proposed project costs for replacement of the existing surge tank.

Final sizing of proposed upgrades to the high service pumps, including establishing design criteria, is beyond the scope of the current study. In general, costs assume the upgrades to the high service pumps that are consistent with the capacity of the treatment plant.

2.4.4.3 Chemical Storage Facilities

2.4.4.3.1 Alum

The required dose of alum is driven by the removal requirements for turbidity, color, and TOC, which are expected to be similar regardless of the process selected. Table 2.20 shows the projected alum usage at 24 mgd, 32 mgd, and 38 mgd as well as the additional facilities required for 30 days of storage at design flow and average dose conditions.

Table 2.20 Alum Storage Summary
Joint Water Supply System Analysis
City of Lake Oswego and City of Tigard

		WTP Capacity		
	Units	**24-mgd**	**32-mgd**	**38-mgd**
Daily Usage				
Minimum	lb/day	666	887	1,057
	gal/day	123	164	196
Average	lb/day	1,426	1,902	2,264
	gal/day	264	352	419
Maximum	lb/day	4,003	5,338	6,338
	gal/day	741	988	1,174
Storage Tanks	No.	2	2	2
Storage Volume, Each	Gal	5,000	5,000	5,000
Storage Volume, Total	Gal	10,000	10,000	10,000
Days of Storage[1]	Days	38	28	24
Additional Volume Required for 30 days of Storage	gal	0	0	2,580
Total Volume Required for 30 days of Storage	gal	7,923	10,564	12,580
Annual Usage[1]	gal/yr	96,400	128,500	153,100
Delivery Frequency[2]	trucks/yr	23	31	36
Dose				
Minimum 7 mg/L				
Average 15 mg/L				
Maximum 20 mg/L				

Notes:

1. Assumes average dose at annual average flowrate.
2. Assumes 4,200 gal per delivery truckload.

Although the existing alum storage will not meet the 30-day storage requirement for the expansion of the Lake Oswego WTP at 38-mgd, it is not recommended that additional alum storage be added. Additional storage is not recommended for the build-out capacity of 38 mgd since the existing alum storage will provide a 24-day supply at 38 mgd, and final storage requirements will depend on actual demands and dose rates. It is recommended that new alum storage be reconsidered in the future based on final plant performance and actual demands.

2.4.4.3.2 Sodium Hypochlorite

Sodium hypochlorite is the primary disinfectant at the Lake Oswego WTP. Additionally, chlorine can be used upstream of the filters intermittently for algae control on the filters. Table 2.21 shows the projected sodium hypochlorite usage at 24 mgd, 32 mgd, and 38 mgd as well as the additional facilities required for 30 days of storage at design flow and average dose conditions.

Table 2.21 Sodium Hypochlorite Storage Summary
Joint Water Supply System Analysis
City of Lake Oswego and City of Tigard

		WTP Capacity		
	Units	**24-mgd**	**32-mgd**	**38-mgd**
Daily Usage				
Minimum	lb/day	95	127	151
	gal/day	115	153	182
Average	lb/day	190	254	302
	gal/day	229	305	364
Maximum	lb/day	380	507	604
	gal/day	458	611	727
Storage Tanks	No.	2	2	2
Storage Volume, Each	gal	4,000	4,000	4,000
Storage Volume, Total	gal	8,000	8,000	8,000
Days of Storage[1]	days	35	26	22
Additional Volume Required for 30 days of Storage	gal	0	0	2,912
Total Volume Required for 30 days of Storage	gal	6,873	9,164	10,912
Annual Usage[1]	gal/yr	83,600	111,500	132,800
Delivery Frequency[2]	trucks/yr	17	22	27
Dose				
Minimum 1 mg/L				
Average 2 mg/L				
Maximum 4 mg/L				

Notes:

1. Assumes average dose at annual average flowrate.
2. Assumes 5,000 gal per delivery truck load.

Although the existing sodium hypochlorite storage will not meet the 30-day storage requirement for the expansion of the Lake Oswego WTP above 32 mgd, it is not recommended that additional sodium hypochlorite storage be added because of the degradation rate of sodium hypochlorite when stored for long periods of time.

On-Site Generation

The option for converting from bulk storage of sodium hypochlorite at 10-15% concentration to on-site generated sodium hypochlorite at 0.8% may be considered for the Lake Oswego WTP.

On-site generation of bleach is advantageous for the following reasons:

- Eliminates frequent shipments of hazardous chemical through the adjacent residential neighborhood
- Eliminates issues associated with storage and feed of high strength bleach, specifically degradation of chemical strength, air binding of metering pumps from offgassing, and risk of exposure to the operators.

On-site generation, however, is not void of disadvantages. These include:

- Significantly larger volume of solution to be fed because of low concentration, which requires large "day" tanks for storage of the generated bleach
- Requires abandonment of existing metering pumps (capacity is too low)
- Additional storage required for brine solution and salt
- Operational intensity greater than bulk storage and feed due to daily solution generating operations and salt handling
- Significant increase in energy demand due to generation process
- Storage and feed facilities that are designed to accommodate bulk solution delivery in case of a generation system shutdown
- A past history of explosions from improper venting of generated hydrogen gas (related to design issues)

Based on the dosage requirements for bulk sodium hypochlorite storage and feed, the average daily usage ranges from 2,800 to 4,600 gallons per day of 0.8% solution (for 24- to 38-mgd) at average daily flows. Peak usage (peak flow and dose) is approximately 12,000 to 19,000 gallons per day (24- to 38-mgd at 4 mg/L Cl dose). The peak usage quantity establishes the amount of day tank storage required. Therefore, the two existing 4,000 gal storage tanks are not adequate to accommodate the increase in required day tank storage. As a result, an additional 4,000 to 11,000 gallons of day tank storage would be required, in addition to the salt and brine solution storage facilities.

The City should weigh the advantages and disadvantages of on-site generation during the preliminary design phase before making a final decision to convert to on-site generation. The site footprint is available to accommodate the additional tanks required, so the decision should be made based on the importance of the improvements in safety (hauling and handling) and delivery (no air binding of metering pumps) versus the additional capital costs and operational requirements.

2.4.4.3.3 *Lime*

Lime is used in conjunction with carbon dioxide to provide alkalinity for coagulation and post treatment stabilization. Lime is fed by supersaturating hydrated lime in a solids contact clarifier. The saturated overflow is fed to the application points. The supersaturation concept allows for addition of lime without creating turbidity problems. Table 2.22 shows the projected lime usage at 24 mgd, 32 mgd, and 38 mgd.

Table 2.22 Lime Storage Summary
Joint Water Supply System Analysis
City of Lake Oswego and City of Tigard

			WTP Capacity		
		Units	**24-mgd**	**32-mgd**	**38-mgd**
Daily Usage					
Minimum		lb/day	294	392	467
Average		lb/day	490	653	778
Maximum		lb/day	2,064	2,751	3,267
Number of Silos		No.	1	1	1
Storage Capacity		tons	24	24	24
Days of Storage		days	98	73	62
Annual Usage[1]		lb/yr	119,850	159,800	190,300
Delivery Frequency[2]		trucks/yr	4	5	6
Dose					
Minimum	3	mg/L			
Average	5	mg/L			
Maximum	10	mg/L			

Notes:

1. Assumes average dose at annual average flowrate.
2. Assumes 15 tons per delivery truck load

The existing lime storage will meet the 30-day storage requirement for the expansion of the Lake Oswego WTP to 38 mgd. Therefore, no modifications to the existing lime storage and feed system are proposed.

Noise and Vibration

In order to conform to height restrictions for the WTP facilities, the lime silo was installed on a recessed foundation with a low retaining wall surrounding the recessed area. Installed on the silo is a bin activator, which consists of a spinning eccentric weight, that prevents bridging and clogging of the lime within the silo as material is removed. Presumably, the vibration generated from the bin activator is being translated through the retaining wall (drum affect) and is causing disturbances at surrounding residences. A likely solution to this problem is to reinforce and thicken the surrounding retaining wall on the side exposed to the residences from which the noise complaints are received. A thick concrete "block" should dampen the translation of the vibrations from the silo into the surrounding soil. A more detailed analysis should be performed during the design of the modifications to determine the depth and thickness of the concrete dampener.

2.4.4.3.4 Carbon Dioxide

Carbon dioxide is used to lower pH after the addition of lime. Unlike acid, carbon dioxide adjusts pH without consuming alkalinity. Carbon dioxide is stored as a pressurized liquid and fed to the process as carbonic acid. Table 2.23 shows the projected carbon dioxide usage at 24 mgd, 32 mgd, and 38 mgd.

Table 2.23 Carbon Dioxide Storage Summary
Joint Water Supply System Analysis
City of Lake Oswego and Tigard Water Service Area

		Units	WTP Capacity 24-mgd	32-mgd	38-mgd
Daily Usage					
Minimum		lb/day	285	380	453
Average		lb/day	475	634	755
Maximum		lb/day	2,002	2,669	3,169
Storage Tank Capacity		lb	52,000	52,000	52,000
Days of Storage		days	109	82	69
Annual Usage[1]		lb/yr	173,500	231,400	275,500
Delivery Frequency[2]		trucks/yr	4	6	7
Dose					
Minimum	3	mg/L			
Average	5	mg/L			
Maximum	10	mg/L			

Notes:

1. Assumes average dose at annual average flowrate.
2. Assumes 20 tons per delivery truck load.

The existing carbon dioxide storage will meet the 30-day storage requirement for the expansion of the Lake Oswego WTP to 38 mgd. Therefore, no modifications to the existing carbon dioxide storage and feed system are proposed.

2.4.4.3.5 Polymers and PAC

Since these systems require either very low or intermittent usage, no modifications to the current systems are being proposed.

2.4.5 Treatment Summary and Recommendations

2.4.5.1 Performance Comparison

All three process concepts meet the expansion criteria in that they are:

- Reliable - consistently meet treatment criteria as well as current and future drinking water regulations
- Flexible - ability to respond to changing water quality
- Operator Friendly - operator level of effort is manageable

A summary of the relative ranking of each process concept with respect to reliability, constructability, site impacts, operator impacts, and reuse of existing facilities is presented in Table 2.24. However, since no relative ranking of importance for each of these criteria has been established, the table simply serves to summarize the various aspects for implementation of each process option with respect to the others.

Table 2.24 Process Alternative Ranking Summary
Joint Water Supply System Analysis
City of Lake Oswego and Tigard Water Service Area

Parameter	Conventional Treatment Option	High Rate Conventional Treatment Option	Membrane Treatment Option
Reliability	2	3	1
Operational Impacts	1	2	3
Site Impacts	3	1	2
Reuse of Existing Facilities	1	2	3
Constructability	2	1	3
Total	**9**	**9**	**12**
OVERALL RANKING	**1**	**1**	**3**

Note: 1 = Best, 3 = Worst

2.4.5.2 Labor Comparison

Expansion of this magnitude cannot occur without a corresponding increase in labor hours required to operate and maintain the treatment system components. At a minimum, a second swing shift operator should be provided daily to handle the sludge dewatering operations. Because of the increase in plant capacity and the operational benefits of running 24 hours per day (i.e. process stability), an eight-hour graveyard shift should be added. This results in a baseline increase in labor of approximately 110 hours per week (52 percent increase over current staffing levels), and applies to the conventional and high rate conventional treatment options. For the membrane expansion option, which includes numerous automated valves, pumps, instruments, a dedicated maintenance shift per week should be added to relieve the operators from having to perform all but the normal routine maintenance. This results in an additional 40 labor hours per week above the baseline 110 hour per week increase (76 percent increase over current staffing levels).

2.4.5.3 Cost Comparison

2.4.5.3.1 Capital Costs

Capital costs were developed at a conceptual level using previously developed costs adjusted for year and capacity and comparisons with recently bid projects of similar scope. The capital cost breakdowns for the options are presented in Tables 2.25, 2.26, and 2.27 for the conventional, high rate conventional, and membrane options, respectively.

Table 2.25 Conceptual Capital Cost Estimate - Conventional
Joint Water Supply System Analysis
City of Lake Oswego and Tigard Water Service Area

	WTP Capacity		
	24-mgd	**32-mgd**	**38-mgd**
Floc/Sed Basins	$3,075,000	$4,636,000	$5,440,000
Filters	$1,152,000	$3,456,000	$4,608,000
Gravity Thickeners	$92,000	$92,000	$92,000
Centrifuge Facility	$4,500,000	$4,500,000	$4,500,000
Decant Pump Station	$75,000	$75,000	$75,000
Clearwell	$1,650,000	$1,650,000	$1,650,000
Finished Water Pumping	$1,680,000	$2,240,000	$2,660,000
Chemical Storage	$100,000	$200,000	$200,000
Sub-Total:	$12,324,000	$16,849,000	$19,226,000
Site Work/Yard Piping (5%):	$616,000	$842,000	$961,000
Electrical/I&C Upgrades (15%):	$1,849,000	$2,528,000	$2,884,000
Sub-Total:	$14,789,000	$20,219,000	$23,071,000
Contingency (30% of Construction):	$4,437,000	$6,066,000	$6,921,000
Sub-Total:	$19,226,000	$26,285,000	$29,992,000
General Conditions (10%):	$1,923,000	$2,629,000	$2,999,000
Contractor Overhead and Profit (15%):	$2,884,000	$3,943,000	$4,499,000
Total Construction Cost:	$24,033,000	$32,857,000	$37,490,000
Engineering and Legal (20% of Construction):	$4,807,000	$6,571,000	$7,498,000
Total Project Cost:	**$28,840,000**	**$39,428,000**	**$44,988,000**
Project Cost $/gal of Total Capacity:	**$1.20**	**$1.23**	**$1.18**

Table 2.25	**Conceptual Capital Cost Estimate - Conventional Joint Water Supply System Analysis City of Lake Oswego and Tigard Water Service Area**		
		WTP Capacity	
	24-mgd	**32-mgd**	**38-mgd**
Construction Cost $/gal of Total Capacity:	**$1.00**	**$1.03**	**$0.99**

Table 2.26	**Conceptual Capital Cost Estimate - High Rate Conventional Joint Water Supply System Analysis City of Lake Oswego and Tigard Water Service Area**		
		WTP Capacity	
	24-mgd	**32-mgd**	**38-mgd**
Actiflo System	$7,200,000	$9,600,000	$11,400,000
Actiflo Building	$1,600,000	$1,100,000	$1,400,000
Filters	$1,152,000	$3,456,000	$4,608,000
Gravity Thickeners	$123,000	$164,000	$195,000
Centrifuge Facility	$4,500,000	$4,500,000	$4,500,000
Decant Pump Station	$75,000	$75,000	$75,000
Clearwell	$1,650,000	$1,650,000	$1,650,000
Finished Water Pumping	$1,680,000	$2,240,000	$2,660,000
Chemical Storage	$100,000	$100,000	$200,000
Sub-Total:	$18,105,000	$22,890,000	$26,653,000
Site Work/Yard Piping (5%):	$905,000	$1,145,000	$1,333,000
Electrical/I&C Upgrades (15%):	$2,716,000	$3,434,000	$3,998,000
Sub-Total:	$21,726,000	$27,469,000	$31,984,000
Contingency (30% of Construction):	$6,518,000	$8,241,000	$9,595,000
Sub-Total:	$28,244,000	$35,710,000	$41,579,000
General Conditions (10%):	$2,824,000	$3,571,000	$4,158,000
Contractor Overhead and Profit (15%):	$4,237,000	$5,357,000	$6,237,000
Total Construction Cost:	$35,305,000	$44,638,000	$51,974,000
Engineering and Legal (20% of Construction):	$7,061,000	$8,928,000	$10,395,000
Total Project Cost:	**$42,366,000**	**$53,566,000**	**$62,368,000**
Project Cost $/gal of Total Capacity:	**$1.77**	**$1.67**	**$1.64**
Construction Cost $/gal of Total Capacity:	**$1.47**	**$1.39**	**$1.37**

Table 2.27	Conceptual Capital Cost Estimate - Membrane Joint Water Supply System Analysis City of Lake Oswego and Tigard Water Service Area		
	WTP Capacity		
	24-mgd	32-mgd	38-mgd
Floc Basins	$422,000	$597,000	$632,000
Membrane System	$12,226,000	$16,317,000	$19,347,000
Gravity Thickeners	$1,000,000	$1,500,000	$1,800,000
Membrane Building	$311,000	$427,000	$466,000
Centrifuge Facility	$4,500,000	$4,500,000	$4,500,000
Decant Pump Station	$75,000	$75,000	$75,000
Clearwell	$1,650,000	$1,650,000	$1,650,000
Finished Water Pumping	$1,680,000	$2,240,000	$2,660,000
Chemical Storage	$200,000	$100,000	$200,000
Sub-Total:	$22,100,000	$27,500,000	$31,400,000
Site Work/Yard Piping (5%):	$1,105,000	$1,375,000	$1,570,000
Electrical/I&C Upgrades (15%):	$3,315,000	$4,125,000	$4,710,000
Sub-Total:	$26,520,000	$33,000,000	$37,680,000
Contingency (30% of Construction):	$7,956,000	$9,900,000	$11,304,000
Sub-Total:	$34,476,000	$42,900,000	$48,984,000
General Conditions (10%):	$3,448,000	$4,290,000	$4,898,000
Contractor Overhead and Profit (15%):	$5,171,000	$6,435,000	$7,348,000
Total Construction Cost:	$43,095,000	$53,625,000	$61,230,000
Engineering and Legal (20% of Construction):	$8,619,000	$10,725,000	$12,246,000
Total Project Cost:	**$51,714,000**	**$64,350,000**	**$73,476,000**
Project Cost $/gal of Total Capacity:	**$2.15**	**$2.01**	**$1.85**
Construction Cost $/gal of Total Capacity:	**$1.80**	**$1.68**	**$1.61**

2.4.5.3.2 *Operations and Maintenance (O&M) Costs*

O&M costs were developed at a conceptual level and include projected power usage, chemical usage, equipment maintenance, sludge disposal, replacement membranes (if applicable), and labor. Chemical, power, and sludge disposal costs were provided by the City. The O&M cost breakdowns for the option are presented in Tables 2.28, 2.29, and 2.30 for the conventional, high rate conventional, and membrane options, respectively.

Table 2.28	**Conceptual O&M Cost Estimate - Conventional Joint Water Supply System Analysis City of Lake Oswego and City of Tigard**			
			WTP Capacity	
	Units	**24-mgd**	**32-mgd**	**38-mgd**
Annual Power Cost[1]	$/yr	$684,536	$913,148	$1,086,450
Annual Chemical Cost[2,3]	$/yr	$796,226	$1,061,635	$1,261,403
Annual Sludge Disposal Costs[2]	$/yr	$10,987	$14,649	$17,444
Equipment Maintenance Costs[4]	$/yr	$40,995	$50,949	$58,466
Labor Costs[5]	$/yr	$558,000	$558,000	$558,000
Fixed Costs[6]	$/yr	$248,500	$248,500	$248,500
Total Annual O&M Costs	$/yr	$2,339,243	$2,846,880	$3,230,263
Unit Treatment Cost	$/mgal	$562	$513	$489

Notes:
1. Power cost = $0.0737/kWh.
2. Unit costs provided by Kari Duncan, WTP Manager.
3. Chemical usage assumes annual average flow and dose 365 days per year.
4. Maintenance costs assumed to be 2% of overall operating costs.
5. Assumes average operator hour cost at an annual salary of $45,000/yr.
6. Derived from current Materials and Services budget.

Table 2.29	**Conceptual O&M Cost Estimate - High Rate Joint Water Supply System Analysis City of Lake Oswego and City of Tigard**			
			WTP Capacity	
	Units	**24-mgd**	**32-mgd**	**38-mgd**
Annual Power Cost[1]	$/yr	$714,030	$951,039	$1,133,781
Annual Chemical Cost[2,3]	$/yr	$796,226	$1,061,635	$1,261,403
Annual Sludge Disposal Costs[2]	$/yr	$10,987	$14,649	$17,444
Equipment Maintenance Costs[4]	$/yr	$41,585	$51,706	$59,413
Labor Costs[5]	$/yr	$558,000	$558,000	$558,000
Fixed Costs[6]	$/yr	$248,500	$248,500	$248,500
Total Annual O&M Costs	$/yr	$2,369,328	$2,885,528	$3,278,540
Unit Treatment Cost	$/mgal	$569	$520	$496

Notes:
1. Power cost = $0.0737/kWh.
2. Unit costs provided by Kari Duncan, WTP Manager.
3. Chemical usage assumes annual average flow and dose 365 days per year.
4. Maintenance costs assumed to be 2% of overall operating costs.
5. Assumes average operator hour cost at an annual salary of $45,000/yr.
6. Derived from current Materials and Services budget.

Table 2.30	Conceptual O&M Cost Estimate - Membranes Joint Water Supply System Analysis City of Lake Oswego and City of Tigard			
			WTP Capacity	
	Units	**24-mgd**	**32-mgd**	**38-mgd**
Annual Power Cost[1]	$/yr	$769,000	$1,027,402	$1,219,682
Annual Chemical Cost[2,3]	$/yr	$162,938	$217,274	$258,651
Annual Sludge Disposal Costs[2]	$/yr	$26,184	$34,945	$41,435
Membrane Replacement Costs[4]	$/yr	$534,857	$735,429	$869,143
Equipment Maintenance Costs[5]	$/yr	$42,415	$52,856	$60,333
Labor Costs[6]		$627,750	$627,750	$627,750
Fixed Costs[7]	$/yr	$248,500	$248,500	$248,500
Total Annual O&M Costs	$/yr	$2,411,644	$2,944,156	$3,325,494
Unit Treatment Cost	$/mgal	$580	$531	$503

Notes:

1. Power cost = $0.0737/kWh.
2. Unit costs provided by Kari Duncan, WTP Manager.
3. Chemical usage assumes annual average flow and dose 365 days per year.
4. Membrane replacement based on 7 year membrane life.
5. Maintenance costs assumed to be 2% of overall operating costs.
6. Assumes average operator hour cost at an annual salary of $45,000/yr.
7. Derived from current Materials and Services budget.

2.4.5.4 Summary

Table 2.31 presents a summary of the capital (project) and O&M costs for all three treatment options. As shown in the table, as the level of process complexity increases, so do the project and O&M costs.

Present worth calculations are based on a 25-year project life and a marginal interest rate of 3 percent (the difference between the discount rate and the rate of inflation).

Table 2.31	Conceptual Cost Estimate Summary - Process Alternatives Joint Water Supply System Analysis City of Lake Oswego and Tigard Water Service Area				
Capacity	**Parameter**	**Units**	**Conventional**	**High Rate Conventional**	**Membrane**
24 mgd	Total Project Cost	$	$28,840,000	$42,366,000	$51,714,000
	Unit Project Cost	$/gal	$1.20	$1.77	$2.15
	Annual O&M Cost	$/yr	$2,339,300	$2,369,300	$2,411,600
	25 Year Present Worth	**$**	**$69,575,000**	**$83,623,000**	**$93,708,000**
32 mgd	Total Capital Cost	$	$39,428,000	$53,566,000	$64,350,000
	Unit Capital Cost	$/gal	$1.23	$1.67	$2.01
	Annual O&M Cost	$/yr	$2,846,900	$2,885,500	$2,944,200
	25 Year Present Worth	**$**	**$89,001,000**	**$103,812,000**	**$115,618,000**
38 mgd	Total Capital Cost	$	$44,988,000	$62,368,000	$73,476,000
	Unit Capital Cost	$/gal	$1.18	$1.64	$1.85
	Annual O&M Cost	$/yr	$3,230,300	$3,278,500	$3,325,000
	25 Year Present Worth	**$**	**$101,238,000**	**$119,457,000**	**$131,375,000**

2.4.5.5 Recommendations

The Conventional option is recommended for all demand scenarios. This is based on the observations that it takes advantage of existing infrastructure, it uses technology that has historically met operational requirements, operators are familiar and confident in the technology, and it has the lowest capital cost and 25-year present worth for each scenario.

2.5 FINISHED WATER TRANSMISSION ALTERNATIVES

2.5.1 Existing Alignment

2.5.1.1 Transmission Main

The Lake Oswego finished water transmission main serves to convey drinking water from the Lake Oswego water treatment plant (WTP) in West Linn to the Bonita Road Pump Station in Tigard, as well as feeding the Lake Oswego distribution system. The existing transmission main consists of sizes ranging from 16 to 24 inches in diameter.

Lake Oswego's current finished water transmission main begins at the Lake Oswego WTP on Kenthorpe Way in West Linn. The main follows Highway 43 until reaching George Rogers Park in Lake Oswego, where it leaves the highway alignment and passes under Oswego Creek. The pipeline continues through downtown Lake Oswego, following Middle Crest Road to the under crossing at Oswego Lake on North Shore Boulevard. After following North Shore Boulevard, the main then crosses under the railroad at Mulligan Lane. The line then follows Iron Mountain Boulevard from Mulligan Lane to the Lake Oswego Hunt Club. The line then follows along the Hunt Club property to Brookside Road, where it then travels through residential developments until reaching the Waluga Reservoir in Waluga Park. From the reservoir, the main heads down Carmen Drive to Bonita Road. The main terminates at the Bonita Pump Station after crossing Interstate 5 at Bonita Road. The Bonita Pump Station serves as the connection between Tigard and Lake Oswego.

For an aerial view of the existing finished water main alignment, see Appendix A. Pipeline details and alignment information were obtained from as-built drawings provided by Lake Oswego staff.

2.5.1.2 <u>Distribution System</u>

The distribution network of piping within the Lake Oswego service area currently consists of pipe ranging from 2 to 16 inches in diameter. The distribution system is used to serve individual residents and businesses of Lake Oswego. Branches from the main also provide service to Lake Oswego's wholesale customers.

2.5.1.3 <u>Transmission Main Hydraulics</u>

Transmission main hydraulics were evaluated using Lake Oswego's H20Net model. Recommendations for new pipe diameters for the finished water main are based on the model and a maximum velocity of 6 fps.

2.5.2 Proposed Alignment

The alignment of the proposed new finished water transmission main consists of seven connected reaches. A description of each of the reaches, including general location and relevant characteristics, is presented in Figure 2.22. Each flow scenario requires different transmission main diameters. Recommended diameters obtained from H20Net are shown in Appendix B. In general, it is assumed the existing finished water transmission main will remain in service, with the proposed improvements consisting of a new pipeline "parallel" to the existing line and the combined capacity of the new and existing lines meeting the required capacity of the demand scenario. The exception is the steel portion of the finished piping coming directly from the treatment plant and ending at Oswego Creek. Because this pipe is old and likely in poor condition, the parallel piping for this reach has been sized to provide the total capacity of the scenario.

2.5.3 Finished Water Transmission Main Improvements Summary

2.5.3.1 <u>Finished Main and Distribution System Cost Criteria</u>

Cost criteria for the finished water main are the same as those applied to the raw water transmission main, which are detailed in Section 2.3.3.2. Capacity improvements to, and maintenance of, discrete localized reaches within Lake Oswego's distribution system will be required as demands increase. Due to the variability of these reaches, they were not included in the conceptual cost estimate for this chapter.

Reach No.	Description	Length	Comparable Alternative Alignment	Existing Utilities or Rural Conditions (1)	Street Width	Curbs/ Sidewalks	Traffic Control	Overall Reach Class
7	Lake Oswego WTP on Kenthorpe Way. Continues W along Kenthorpe, NW along Old River Drive, and W along Cedar Oak Drive until the intersection of Cedar Oak and Highway 43.	2640	NO	Cable Television, City of West Linn Utilities, Electric Utilities, Natural Gas, Telephone Lines	> 24'	YES	Signage Flaggers	2
8	Intersection of Cedar Oak and Highway 43 along Highway 43 to Oswego Creek at George Rogers Park.	9561	NO	Cable Television, City of West Linn and Lake Oswego Utilities, Electric Utilities, Natural Gas, Telephone Lines	> 24'	YES	Signage Flaggers Traffic Plan	4
9	Directional drilling under Oswego Creek in George Rogers Park to intersection of Green Street and Furnace Street. Continues N along Furnace Street, and W along Wilbur Street, ending on the W side of S. State Street via jack and bore under S. State Street.	3034	YES, grid pattern of residential streets offers many options	Cable Television, City of Lake Oswego Utilities, Electric Utilities, Natural Gas, Telephone Lines	> 24'	YES	Signage Detours Possible Road Closure	2,S
10	West side of S. State Street along Middle Crest Road, crossing Oswego Lake and continuing along N. Shore Boulevard to Mulligan Lane. Ending on N side of Pacific Railroad tracks via jack and bore.	5722	NO	Cable Television, City of Lake Oswego Utilities, Electric Utilities, Natural Gas, Telephone Lines	≤ 24'	YES	Signage Flaggers Driveway Access	3,S
11	Intersection of Mulligan Lane and Iron Mountain Boulevard, continuing W along Iron Mountain, leaving the road before traffic circle with Upper Drive and Lakeview Boulevard.	6350	NO	Cable Television, City of Lake Oswego Utilities, Electric Utilities, Telephone Lines	> 24'	NO	Signage Flaggers Traffic Plan	4
12	Lake Oswego Hunt Club property to E end of Brookside Road, continuing W along residential streets to Waluga Reservoir in Waluga Park. Ending on Carmen Drive at N end of Waluga Park.	7523	YES, options exist for alignment through small residential streets	Cable Television, City of Lake Oswego Utilities, Electric Utilities, Natural Gas, Telephone Lines	≤ 24'	YES	Signage Flaggers Driveway Access	3,R
13	West along Carmen Drive to Bonita Road, continuing W along Bonita Road to Interstate 5 where pipe cross underneath the interstate. Ending at Bonita Pump Station near the intersections of Bonita Road and Sequoia Parkway.	5360	NO	Cable Television, City of Lake Oswego and Tigard Utilities, Electric Utilities, Natural Gas, Telephone Lines	> 24'	YES	Signage Flaggers Traffic Plan	4,S

Figure 2.22
REACH DESCRIPTIONS
FINISHED WATER TRANSMISSION MAIN
JOINT WATER SUPPLY SYSTEM ANALYSIS
CITY OF LAKE OSWEGO AND TIGARD WATER SERVICE AREA

2.5.3.2 <u>Class S Reaches</u>

2.5.3.2.1 <u>Oswego Creek Crossing</u>

Reach 9 of the finished water transmission main includes a 1,100 foot long crossing of Oswego Creek through George Rogers Park. Directional drilling is the preferred method for this section. Rocky soil conditions are assumed for this area.

2.5.3.2.2 <u>S. State Street Crossing</u>

Reach 9 of this finished water transmission main includes a 100 foot long crossing under S. State Street. The heavy traffic in this area will require boring and jacking underneath the roadway to minimize disruption. Construction will require launching and receiving pits to be excavated 30 ft. back on either side of the roadway. Rocky soil conditions are assumed for this area.

2.5.3.2.3 <u>Oswego Lake Crossing</u>

Reach 10 of the finished water transmission main includes a 250 foot long crossing under Oswego Lake on N. Shore Boulevard. To minimize disturbance to the existing lake and bridge, jack and bore is the preferred method for this section. Construction will require launching and receiving pits to be excavated 30 ft. back on either side of the roadway. Rocky conditions are assumed for this area.

2.5.3.2.4 <u>Railroad Crossing</u>

Reach 10 of the finished water transmission main includes a 120 foot long crossing under the railroad tracks near the intersection of Mulligan Lane and N. Shore Boulevard. To minimize disturbance to the railroad, jack and bore is the preferred method for this section. Construction will require launching and receiving pits to be excavated 30 ft. back on either side of the roadway. Rocky conditions are assumed for this area.

2.5.3.2.5 <u>I-5 Crossing</u>

Reach 13 of the finished water transmission main includes a 600 foot long crossing under Interstate 5 at Bonita Road. The heavy traffic in this area will require boring and jacking underneath the interstate to minimize disruption. Construction will require launching and receiving pits to be excavated 30 ft. back on either side of the roadway.

2.5.3.2.6 <u>Capital Cost</u>

It is assumed that Lake Oswego would prefer continued use and maintenance of the existing finished water transmission main for the remainder of its life. Therefore, for the purposes of this study, it is assumed that a parallel pipe will be installed to provide required capacity improvements for the finished transmission main system. Estimated capital project costs for capacity improvements to the finished water main are summarized below in Table 2.32.

Table 2.32 Conceptual Project Cost Estimate Summary – Finished Water Main
Joint Water Supply System Analysis
City of Lake Oswego and Tigard Water Service Area

		Scenario 2		Scenario 3		Scenario 4	
Reach	**Class**	**Length**	**Project Cost**	**Length**	**Project Cost**	**Length**	**Project Cost**
7	2	2640	$2,620,000	2640	$3,140,000	2640	$3,370,000
8	4	9570	$11,730,000	9570	$13,610,000	9570	$14,590,000
9	2,S	3040	$4,640,000	3040	$5,940,000	3040	$7,060,000
10	3,S	5722	$6,670,000	5722	$8,460,000	5722	$9,010,000
11	4	NA	NA	6350	$3,830,000	6350	$5,420,000
12	3,R	NA	NA	7523	$9,310,000	7523	$11,600,000
13	4,S	NA	NA	NA	NA	4760	$4,200,000
Total		**20,972**	**$25,290,000**	**34,845**	**$44,300,000**	**39,605**	**$55,240,000**

2.5.3.3 Operations and Maintenance

Operations and maintenance costs for the pipeline are assumed to be negligible in comparison to the overall cost of the project, and within the error of the overall project cost estimates.

2.5.4 Waluga Reservoir

2.5.4.1 Existing Storage Capacity

Waluga Reservoir is located in Waluga Park between reaches 12 and 13 of the finished water transmission main. The existing reservoir storage capacity is 4.0 MG.

2.5.4.2 Future Storage Capacity Improvements

As described in Lake Oswego's 2001 Water System Master Plan, at least an additional 1.0 million gallons in storage is required at the Waluga Reservoir site by the year 2020 to meet additional demands within the Waluga (320) pressure zone. Additional capacity to meet operational requirements of the Bonita Pump Station serving Tigard will also be needed based on pump station flows. For the purposes of sizing this additional storage capacity, it was assumed the additional Waluga reservoir would function as a "clearwell" or "buffer" to serve the inlet of the Bonita Pump Station. It is further assumed that Tigard will continue to provide its own in-system storage to meet Tigard's operational, fire flow and emergency needs within the Tigard system and will not add operational or emergency storage at the Waluga site. This results in the added benefits of minimizing the size of the second Waluga reservoir and improved reliability of the Tigard system by placing their emergency storage on the discharge side of the Bonita Pump Station.

Based on typical clearwell sizing criteria of providing a storage volume equal to 10% of the peak day demand, additional storage capacity required for Tigard pumping is approximately 1 million gallons under demand scenario 3, and approximately 1.5 million gallons under demand scenario 4.

Figure 2.23 shows an aerial view of the existing Waluga reservoir. The proposed location of the new reservoir is adjacent to the existing on the northwest side. This location will allow the construction of the new reservoir on land currently owned by the City and will not disturb the homes located on those parcels.

2.5.4.3 Project Cost Estimate

2.5.4.3.1 Capital Cost

Proposed sizes and associated capital costs for Waluga Reservoir are set forth in Table 2.33.

Table 2.33 Conceptual Project Cost Estimate Summary - Waluga Reservoir Addition
Joint Water Supply System Analysis
City of Lake Oswego and Tigard Water Service Area

Parameter	Units	Scenario 2 24 mgd	Scenario 3 32 mgd	Scenario 4 38 mgd
Reservoir Capacity	MG	1	2	2.5
Total Project Cost	$	$2,500,000	$3,800,000	$4,000,000

2.5.4.3.2 O & M costs

Operations and Maintenance Costs for the reservoir are assumed negligible in comparison to the overall costs of the project, and within the error of the project cost estimates. Therefore, they are not included.

2.5.5 Bonita Pump Station

2.5.5.1 Existing Capacity

Bonita pump station receives finished water from the Lake Oswego distribution system and delivers it to the Tigard water distribution service area. A detailed description of the pump station is set forth in Chapter 1, Section 1.3.1.5. The existing Bonita Pump Station has a firm capacity of 5.3 mgd, and a maximum capacity of 8 mgd.

2.5.5.2 Future Demands

According to existing water rights and future projections, Lake Oswego will be capable of delivering to Tigard a peak of approximately 0 mgd, 8 mgd, or 14 mgd, for scenarios 2, 3, and 4, respectively. As the firm capacity of the existing pump station is 5.3 mgd, additional pumping capacity will be required under scenarios 3 and 4. The pump station will be designed for firm capacity equivalent to meet peak capacity available to Tigard.

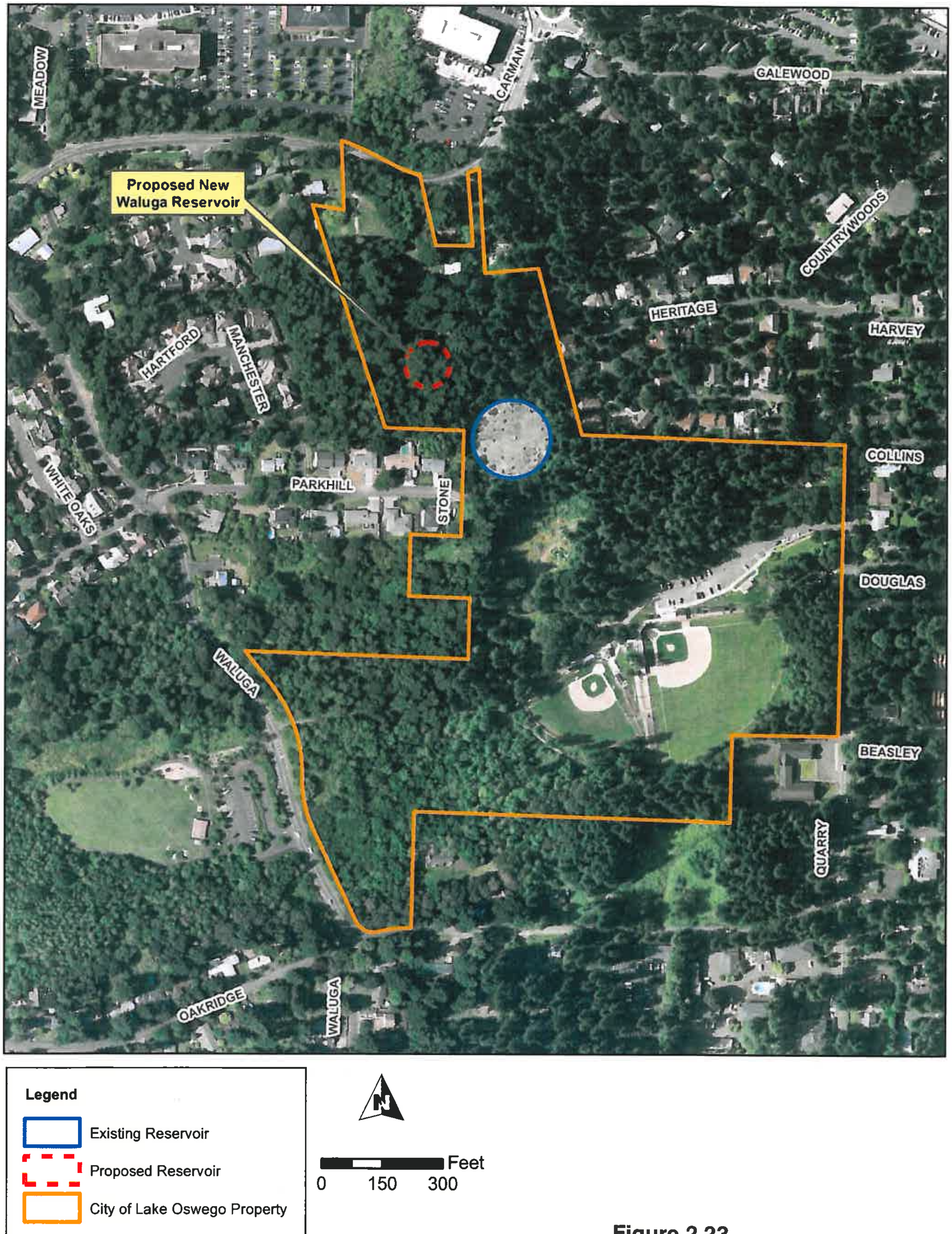

Figure 2.23
WALUGA RESERVOIR
JOINT WATER SUPPLY SYSTEM ANALYSIS
CITY OF LAKE OSWEGO AND TIGARD WATER SERVICE AREA

Lo507SRf2.23-7525.indd

2.5.5.3 Cost Estimate

2.5.5.3.1 Estimating Criteria

For scenario 2, the Bonita Pump Station will not be upgraded. For scenarios 3 and 4, it is assumed that existing pump station will be taken out of service and replaced in its entirety in its existing location. Construction of the new pump station will require the existing pump station to be out of service for up to 9 months. The new pump station structure will be above ground to provide operations personnel with a safer operating environment. Additional improvements will include an auxiliary power generator with an 8-hour fuel storage capacity.

2.5.5.3.2 Capital Cost

Capital costs for the Bonita Pump Station as total project costs are presented in Table 2.34.

Table 2.34 Conceptual Project Cost Estimate - Bonita Pump Station
Joint Water Supply System Analysis
City of Lake Oswego and Tigard Water Service Area

Type	Scenario 2 24 mgd	Scenario 3 32 mgd	Scenario 4 38 mgd
Firm Pump Station Capacity	5.3 mgd	8 mgd	14 mgd, expandable to 16 mgd
Total Project Cost	N/A	$1,480,000	$1,700,000

2.5.5.3.3 O & M Costs

Annual O & M for the Bonita Pump Station are presented in Table 2.35 for assumed average demand of the supply scenario and in resulting cost per million gallons delivered.

Table 2.35 Conceptual Cost Estimate Summary - Bonita Pump Station
Joint Water Supply System Analysis
City of Lake Oswego and Tigard Water Service Area

Parameter	Units	Scenario 2 24 mgd	Scenario 3 32 mgd	Scenario 4 38 mgd
Annual O & M costs	$/yr	N/A	$231,000	$235,000
Annual O & M costs	$/MG	N/A	$91.72	$93.31

2.6 PROJECT COST SUMMARY & IMPLEMENTATION PLAN

2.6.1 Capital Costs

Table 2.36 provides a summary of the capital cost for each proposed component of each demand scenario.

Table 2.36 Conceptual Cost Estimate – Capital Cost
Joint Water Supply System Analysis
City of Lake Oswego and Tigard Water Service Area

Type	Scenario 2 24 mgd	Scenario 3 32 mgd	Scenario 4 38 mgd
Clackamas River Intake	$2,100,000	$4,440,000	$4,670,000
Raw Water Transmission Main	$19,890,000	$23,920,000	$23,920,000
Lake Oswego Water Treatment Plant	$28,840,000	$39,430,000	$44,990,000
Finished Water Transmission Main	$25,290,000	$44,300,000	$55,240,000
Waluga Reservoir	$2,470,000	$3,820,000	$4,010,000
Bonita Pump Station	N/A	$1,480,000	$1,700,000
Total	**$78,590,000**	**$117,390,000**	**$134,530,000**

Throughout the report, capital costs are presented in November 2006 dollars to facilitate comparison of scenarios. However, actual costs will be subject to construction cost escalation up to the time the improvements are actually constructed. This construction cost escalation, based on the anticipated implementation schedule for each scenario, is included in the financial evaluation of alternative scenarios. It should be further noted that because construction cost escalation is projected to occur at a rate greater than the general inflation rate[2], scenarios that are delayed beyond the anticipated implementation schedule will likely have a higher cost than the costs shown in the report. Further evaluation of the financial implications associated with delaying implementation of the proposed improvements should be conducted before final decisions are made regarding the timing of implementing Scenarios 2-4.

2.6.2 Operation & Maintenance Costs

Table 2.37 provides a summary of the operations and maintenance costs for each relevant component of each demand scenario.

Table 2.37 Conceptual Cost Estimate – Operations & Maintenance
Joint Water Supply System Analysis
City of Lake Oswego and Tigard Water Service Area

System	Units	Scenario 2 24 mgd	Scenario 3 32 mgd	Scenario 4 38 mgd
Clackamas River Intake	$/million gallons	$55.52	$63.45	$64.94
Water Treatment Plant	$/million gallons	$569.00	$520.00	$496.00
Bonita Pump Station	$/million gallons	NA	$91.72	$93.31

[2] "Inflation is Set for a Strong Rebound; Steel and Rebar Prices Lead Resurgence in Construction Costs," McGraw Hill Construction, June 2007.

2.6.3 Implementation Plan

The purpose of this section is to establish the completion dates for required water system improvements under Scenarios 2 through 4. These completion dates will serve as the basis from which the financial analysis will be prepared.

2.6.3.1 Implementation Timing Assumptions

The following assumptions were applied to development of implementation timing of component improvements for each scenario:

- Tigard entered into a 10-year contract for water supply with the City of Portland in 2006. This contract is effective through June 2016. As such, the required completion dates for required water system improvements assume Tigard will fully utilize their allotted capacities under Scenarios 3 and 4 starting in 2016, with no increased capacity required for Tigard use prior to that date.
- A number of the existing water system components are already at their maximum capacity. These components include:
  - Clackamas River Intake structure and pump station.
  - Raw water transmission main.
  - Water treatment plant.
  - Reaches 7 through 10 of the finished water transmission main.

Therefore, it is assumed that these facilities must be expanded immediately to meet the needs of Lake Oswego, independent of the scenario. However, the design capacity of these immediate improvements will be dependent on the selected scenario.

For scenarios 3 and 4, component improvements were phased to provide incremental capacity additions over time to defer costs.

The following sections present a summary of the phasing of improvements under each of the scenarios 2, 3, and 4.

2.6.3.2 Scenario 2 Implementation Plan

The required completion dates for system component upgrades under scenario 2 are summarized in Table 2.38.

Most of the system components require immediate upgrades. When implemented, the upgrades were assumed constructed to meet Lake Oswego's full build-out capacity of 24 mgd. The exception is the new Waluga Reservoir, which is not required to be in operation until 2020 according to the previous master plan.

Table 2.38 Implementation Plan – Scenario 2 Joint Water Supply System Analysis City of Lake Oswego and Tigard Water Service Area			
	Project Completion Date		
Infrastructure Components	Immediate	2016	2020
Intake Structure & Pump Station	$2,100,000	-	-
Raw Transmission Main	$19,890,000	-	-
Water Treatment Plant	$28,840,000	-	-
Finished Transmission Main	$25,290,000	-	-
Waluga Reservoir	-	-	$2,470,000
Bonita Pump Station	-	-	-
Totals	**$76,120,000**		**$2,470,000**

2.6.3.3 Scenario 3 Implementation Plan

The required completion dates for system component upgrades under scenario 3 are summarized in Table 2.39.

As for the previous scenario 2, most system components require immediate upgrades. Implemented upgrades were assumed constructed to the full scenario capacity of 32 mgd. The exceptions are the WTP, finished water transmission line, Waluga Reservoir, and Bonita Pump Station. The phasing for the WTP is an immediate expansion to 24 mgd, with further incremental expansion to 32 mgd by 2016. Upgrades to the finished transmission main must be completed immediately for reaches 7 through 10, with further upgrades to reaches 11 and 12 by 2016. Both the Waluga Reservoir and Bonita Pump Station will need to be in place by 2016 in order to meet Tigard's peak water supply and delivery needs.

Table 2.39 Implementation Plan – Scenario 3 Joint Water Supply System Analysis City of Lake Oswego and Tigard Water Service Area			
	Project Completion Date		
Infrastructure Components	Immediate	2016	2020
Intake Structure & Pump Station	$4,440,000	-	-
Raw Transmission Main	$23,920,000	-	-
Water Treatment Plant	$28,840,000	$10,590,000	-
Finished Transmission Main	$31,160,000	$13,140,000	-
Waluga Reservoir	-	$3,820,000	-
Bonita Pump Station	-	$1,480,000	-
Totals	**$88,360,000**	**$29,030,000**	**-**

2.6.3.4 Scenario 4 Implementation Plan

The required completion dates for system component upgrades under scenario 4 are summarized in Table 2.40.

Table 2.40 Implementation Plan – Scenario 4
Joint Water Supply System Analysis
City of Lake Oswego and Tigard Water Service Area

	Project Completion Date		
Infrastructure Components	**Immediate**	**2016**	**2020**
Intake Structure & Pump Station	$4,670,000	-	-
Raw Transmission Main	$23,920,000	-	-
Water Treatment Plant	$28,840,000	$16,150,000	-
Finished Transmission Main	$34,020,000	$21,220,000	-
Waluga Reservoir	-	$4,010,000	-
Bonita Pump Station	-	$1,700,000	-
Totals	**$91,450,000**	**$43,080,000**	**-**

Note:
1. All costs are presented in November 2006 dollars.

As for the previous two scenarios, most components required immediate upgrades; upgrades were generally assumed to be to the full capacity of 38 mgd. The exceptions are the WTP, finished water transmission line, Waluga Reservoir, and Bonita Pump Station. The phasing for the WTP is an immediate expansion to 24 mgd, with further expansion to 38 mgd by 2016. Upgrades to the finished transmission main must be completed immediately for reaches 7 through 10, with further upgrades to reaches 11 through 13 by 2016. Both the Waluga Reservoir and Bonita Pump Station will need to be in place by 2016 in order to meet Tigard's peak water supply and delivery needs.

WATER RIGHTS AND PERMITTING STRATEGY

3.1 BACKGROUND

The City of Lake Oswego (Lake Oswego) operates a raw water intake on the Clackamas River with water rights to appropriate a maximum of 38 million gallons per day (mgd). The water is treated at the Lake Oswego Water Treatment Plant (WTP), which has a current capacity of approximately 16 mgd. The treated water is then distributed to retail users within the Lake Oswego service area, as well as to several wholesale customers, including the City of Tigard.

The existing raw water intake and pumps are located in the city of Gladstone, near the mouth of the Clackamas River. The raw Clackamas River water is conveyed through the City of Gladstone, beneath the Willamette River, and overland to the WTP located in the City of West Linn. Treated water is transferred overland via West Linn from the WTP to retail users within the Lake Oswego service area and Lake Oswego's storage reservoirs. Treated water is stored in the reservoirs and, as needed, piped to the Bonita Pump Station in the City of Tigard (Tigard).

To provide sufficient water to meet Lake Oswego's and Tigard's future water needs, the capacity of the supply system must be increased. This means that the entire system must be modified, including:

- The existing intake and pumping facility in Gladstone must be expanded and the raw water transmission capacity must be increased.
- In West Linn, the existing water treatment plant must be expanded within the existing site.
- A new finished water pipeline must be constructed in both West Linn and Lake Oswego to provide increased capacity.
- A new storage reservoir at Lake Oswego's Waluga Reservoir site must be constructed.
- The Bonita pump station in Tigard will need to be enlarged under Scenarios 3 and 4.

This chapter presents a review of water rights and permitting requirements applicable to water supply system improvements identified in Chapter 2. This includes an assessment of Lake Oswego's Clackamas River junior and senior water rights, as well as a review of local, state, and federal permitting requirements associated with the potential projects. Also included are proposed permitting strategies for meeting local as well as state and federal permitting requirements.

3.1.1 Review of Water Rights

This chapter presents a review of surface water rights held by Lake Oswego and Tigard on the Clackamas and Willamette Rivers to support Lake Oswego and Tigard's Joint Water Supply System Analysis (JWSSA). The focus of this review is on municipal water rights and demands on the Clackamas River, and a brief review of Willamette water rights held by both cities. This information has been developed by Golder and Associates based on a update to the 2003 "Water Right Master Plan, Part 1" for the Clackamas River Water Users by CH2M Hill.

Lake Oswego currently holds 38.14 mgd of water rights on the Clackamas River. Tigard has recently completed construction of two Aquifer Storage and Recovery wells with reliable capacity of 3.5 mgd to help meet water demands during time of peak use. Additionally, both Lake Oswego and Tigard have water rights on the Willamette River, for 3.9 mgd and 25.9 mgd, respectively. Further description of these water rights can be found in the Section 3.2.

3.1.2 Local Land Use Permits

Chapter 3 examines the applicability of local land use regulations to construct the water system improvements identified in Chapter 2. Lake Oswego's existing water supply system is located within the cities of Gladstone, West Linn, and Lake Oswego, and small portions of urban unincorporated Clackamas County. Each of the jurisdictions listed above has primary (base) zones and overlay zones that regulate reconstruction of Lake Oswego's water supply facilities. In the sections that follow, applicable city zoning and overlay districts are identified, as well as review criteria and standards, which apply to the reconstruction of water facilities.

Chapter 3 focuses on local land use permits. Since both raw and treated water pipes are located primarily in public rights-of-way (ROW), construction permits issued by the local jurisdictions will also be required.

This information is based on a review by Winterbrook Planning (Winterbrook) of local land use regulations and offers a preliminary land use permitting strategy. It is important to remember that city land use regulations are subject to local interpretation by appointed and elected officials. Therefore, this chapter identifies areas where follow-up with local planning officials is required prior to implementing the proposed permitting strategy.

3.1.3 State and Federal Permits

Chapter 3 provides a preliminary review of state and federal permits that are likely to apply to reconstruction of water facilities necessary to accommodate increased demands from Lake Oswego and Tigard. This review is based on Winterbrook's review of aerial photos showing the anticipated locations and alignments of the proposed water system improvements. Some parts of the proposed projects may require utility easements, licenses, and other legal agreements in addition to the identified state and federal permits.

As alignment and construction options are further refined, the proposed permitting requirements and regulatory strategy should be updated accordingly.

3.2 WATER RIGHTS

3.2.1 City of Lake Oswego Water Rights Review

Lake Oswego holds three surface water permits, which allow for the diversion of 59 cfs (38.14 mgd) from the Clackamas River and 6 cfs (3.88 mgd) from the Willamette River, for a total of 65 cfs (42.02 mgd). There are no pending permit applications for Lake Oswego on the Clackamas or Willamette Rivers.

The Clackamas River water rights held by Lake Oswego are summarized in Table 3.1. In summary, Lake Oswego has permits (S32410 and S37839) sufficient to meet the projected demand for Lake Oswego under build-out conditions. Additional rights are available to serve a joint system up to Lake Oswego's existing 38 mgd of permitted rights.

Table 3.1 City of Lake Oswego Surface Water Rights - Clackamas River
Joint Water Supply System Analysis
City of Lake Oswego and Tigard Water Service Area

Holder	Water Right (Application/Permit/ Certificate)	Permitted Rate (cfs/mgd)	Source - Priority Date
City of Lake Oswego	S43365 / S32410 / C78332	**50**/32.32	Clackamas - 3/14/1967
City of Lake Oswego	S50819 / S37839 / certificate issued but number not available	**9**/5.82	Clackamas - 7/5/1973
TOTAL		**59/38.14**	

Under Permit Amendment T-8538 issued by the Oregon Water Resources Division (OWRD) in 2000, Permit S37839 has been amended authorizing use by the Cities of Tigard and Tualatin.

Clackamas River In-stream Water Rights

The Clackamas River has three in-stream water rights that set minimum flows on the river. In-stream water right C59490 sets the minimum June 1st to August 31st flow at 400-cfs. Water right C59491 extends the 400-cfs minimum flow from September 1st to September 15th and C59492 sets a minimum flow of 640-cfs from September 15th to June 30th.

Lake Oswego holds no water rights senior to Oregon Water Resources Department (OWRD) in-stream water rights C59490 and C59492, however, Lake Oswego permit S32410 is senior to in-stream right C59491 (priority date August 26, 1968). The Lake Oswego permit S37839 for 9 cfs (5.82 mgd) is junior to all in-stream rights. Water rights senior to the in-stream rights provide an addition level of reliability. In the case that an extreme drought reduced flow in the Clackamas River to the limit of the in-stream water right, Lake Oswego could be vulnerable to a call on the junior right for restricted use.

Willamette River Source

The City of Lake Oswego holds one permit on the Willamette River (S43246) for 3.88 mgd. This permit should be retained as an option to provide an emergency supply from the Willamette River to Lake Oswego and Tigard. This water right might also be used together with the Tigard Application S80342 to develop a new Willamette source of supply. The Willamette River permit held by Lake Oswego is summarized in Table 3.2 below:

Table 3.2 City of Lake Oswego Surface Water Rights - Willamette River
Joint Water Supply System Analysis
City of Lake Oswego and Tigard Water Service Area

Holder	Water Right (Application/Permit/ Certificate)	Permitted Rate (cfs/mgd)	Source - Priority Date
City of Lake Oswego	S55550 / S43246 / NA	6/3.88	Willamette - 3/24/1977

3.2.2 City of Tigard - Review of Willamette Application S-80342

Application S80342, submitted May 18, 1995, requests a permit to divert 40 cfs (25.86 mgd) for municipal purposes from the Willamette River in the area of Wilsonville, Oregon. The permit information is presented in Table 3.3 below:

Table 3.3 City of Lake Tigard Surface Water Rights
Joint Water Supply System Analysis
City of Lake Oswego and Tigard Water Service Area

Holder	Water Right (Application/Permit/ Certificate)	Permitted Rate (cfs/mgd)	Source - Priority Date
City of Tigard	S80342 / NA / NA	40/25.85	Willamette – May 18, 1995

Following a lengthy administrative hold at the request of Tigard, the application is now scheduled for review by OWRD and a Proposed Final Order (PFO) for this application is pending. Tigard can expect OWRD, in consultation with Oregon Department of Fish and Wildlife (ODFW) and Oregon Department of Environmental Quality (ODEQ), to place limitations on the quantity of the water diverted from the Willamette during the specific periods in Spring and early Summer. This application is also competing with several other pending applications for water availability on the Willamette River, identified as an available source for regional water supply in the Regional Water Supply Plan.

The Regional Water Supply Plan (RWSP), adopted in 1996, identified the need for substantial additions to the region's water supplies by 2017, and the Willamette River was one source listed for future development. In response to this finding, several water providers filed individual applications for withdrawal on the Willamette River to meet projected long-term water supply demands. However, the independent filings exceeded the projected demand for water supplies anticipated by the RWSP. To eliminate the need for the Department to choose between competing applications on the Willamette, the Tualatin Valley Water District, Tigard, and other providers formed the Willamette Water Supply Agency (WWSA) to coordinate supply planning activities for the members, as well as the processing of their water right applications. The WWSA was subsequently dissolved and its members formed the WRWC (Willamette River Water Coalition). Tigard's water rights application on the Willamette is now a part of the WRWC's pooled water rights on the Willamette River, of which Tigard is granted 20 mgd of the total WRWC rights for 130 mgd.

In compliance with the WRWC planning activities, Tigard's Application S80342 was originally scheduled to be withdrawn from consideration by August 2, 1999 (TVWD Letter dated May 28, 1999) along with permit S-73581 held by TVWD. The proposed withdrawal was intended to show support for a coordinated planning effort. However, Tigard and TVWD chose to retain the applications until finalizing planning efforts and agreements among water providers. Application S80342 remains viable and can proceed to permit status pending public comment on the PFO.

If Tigard moves forward with Application S-80342 and OWRD issues a permit under Application S-80342, that permit could be amended to add a point of appropriation at a downstream location on the Willamette closer to the Lake Oswego water treatment plant. Because the current Lake Oswego intake on the Clackamas River is approximately 0.9 miles up river from the confluence of the Clackamas and Willamette Rivers, amending the Willamette permit to withdraw from the Clackamas River is not a possibility. Amending the permit to a downstream Willamette location near West Linn or Lake Oswego would require the construction of a new intake or bank filtration well field. In addition, development of this permit to serve Lake Oswego and Tigard would require concurrence with Lake Oswego to use this new source as well as agreement by Tigard pursuant to its existing limitation on use of the Willamette supply.

3.2.3 Clackamas River Municipal Water Rights

This section presents an overview of the municipal water rights on the Clackamas River. There are five active municipal points of diversion (POD) on the Clackamas River, and one inactive site. The Lake Oswego diversion is at located at the furthest downstream position. The highest upriver diversion is the original South Fork of the Clackamas diversion formally operated by the South Fork Water Board. The diversions are presented in Table 3.4 with the approximate water rights and demand presented at each POD for the year 2005. Appendix C contains a summary list of municipal water rights on the Clackamas and a table of demand estimates for municipal entities with permits or applications pending on the Clackamas.

Table 3.4 Clackamas River Municipal Water Rights
Joint Water Supply System Analysis
City of Lake Oswego and Tigard Water Service Area

Holder	Total Water Rights (Applications/Permits/Certificates) cfs (mgd)	2005 Demand (mgd)	Status of the POD
City of Oregon City and West Linn (South Fork Water Board)	50 (32.32)	0	Presently Inactive
City of Estacada	4 (2.58)	2.58	Active
Clackamas River Water (CRW-N and CRW-S)	195.4 (126.31)	21.5	Active
North Clackamas County Water Commission (with Gladstone, Milwaukie, and Oak Lodge)	85.73 (55.42)	32.7	Active
South Fork Water Board	66 (42.66)	14.2	Active
City of Lake Oswego	59 (38.14)	16	Active
TOTAL	**460.13 (297.43)**	**84.35**	

The presentation of water rights and water demand in Table 3.4 is accurate in total. However, the breakdown of the demand to each of the individual PODs may vary depending on changing water supply agreements; water rights may have multiple PODs and normal operating conditions may allow a service area to accept water from more than one POD. The exact uses in each service area are somewhat transient and the redundancies built into the water supply infrastructure make it possible to move water across systems (wheeling water) to service areas far from the original diversion. Because of these variables, the demands assigned in Table 3.4 can vary considerably in the field. However, even given the variability, Table 3.4 does make clear that based on 2005 data, there are presently about 213 mgd in applications, permits, and certificates that are not currently being put to beneficial use.

Analysis of Demand and Water Rights 2005 to 2040

The apparent abundance of Clackamas River water rights shown in 2005 data does not take into account future projected water demands of the municipal water rights holders . An analysis of long-term availability that includes the increases in demand with time is presented in Figures 1, 2 and 3. The analysis examines the water right profile and projected water demand for Clackamas River Water (CRW), the North Clackamas County Water Commission (NCCWC), and the South Fork Water Board (SFWB). This analysis is intended to determine if and where additional water rights capacity would be available to Lake Oswego and Tigard in 2030 and beyond (the time at which combined demand from Lake Oswego and Tigard is expected to exceed current water rights).

The bar graph in Figure 3.1 presents distribution permits, certificates, and applications listed on the CRW POD verses the increasing demand for water use from 2005 to 2060. In the figure the demand portion of the bar consumes the current capacity of certificates and permits by 2020. In the year 2020 CRW will have to rely on water right capacity that is currently in application status. Lake Oswego and Tigard could participate in the development of these permits to obtain a share of any resulting permit.

Figure 3.2 presents the water right and demand profile of NCCWC. Based on the projected demand at this POD, the permits, certificates and applications will be exhausted shortly following 2010. NCCWC is projecting a water right deficit by 2015 and will be actively competing for available water on the Clackamas River. It does not appear that NCCWC will have any water to spare.

Figure 3.3 presents the permits, certificates and projected demands for the South Fork Water Board (SFWB). This graph indicates that SFWB may have a relative surplus of water rights available for beneficial use. Should projected demands remain accurate, up to 50-mgd may be available into 2060. Another limiting factor for water rights listed at SFWB is that some permits have PODs high in the watershed on the South Fork of the Clackamas River without operable transmission lines in place. Using these rights would require amending the right and moving the location of the POD down stream. Transfer or amendment of a water right may result in a reduction in the total paper right held by SFWB during the open permitting process.

3.2.4 Regulatory and Legislative Requirements

This section presents a brief overview of the origin of House Bill 3038 (HB-3038), how enactment of HB-3038 required amendments to existing statutes (ORS Chapter 537) and Administrative Rules (OAR Chapter 690, Division 315) affecting municipal water rights and extensions thereto, and the impacts of HB-3038 on future water availability to the Cities of Lake Oswego and Tigard.

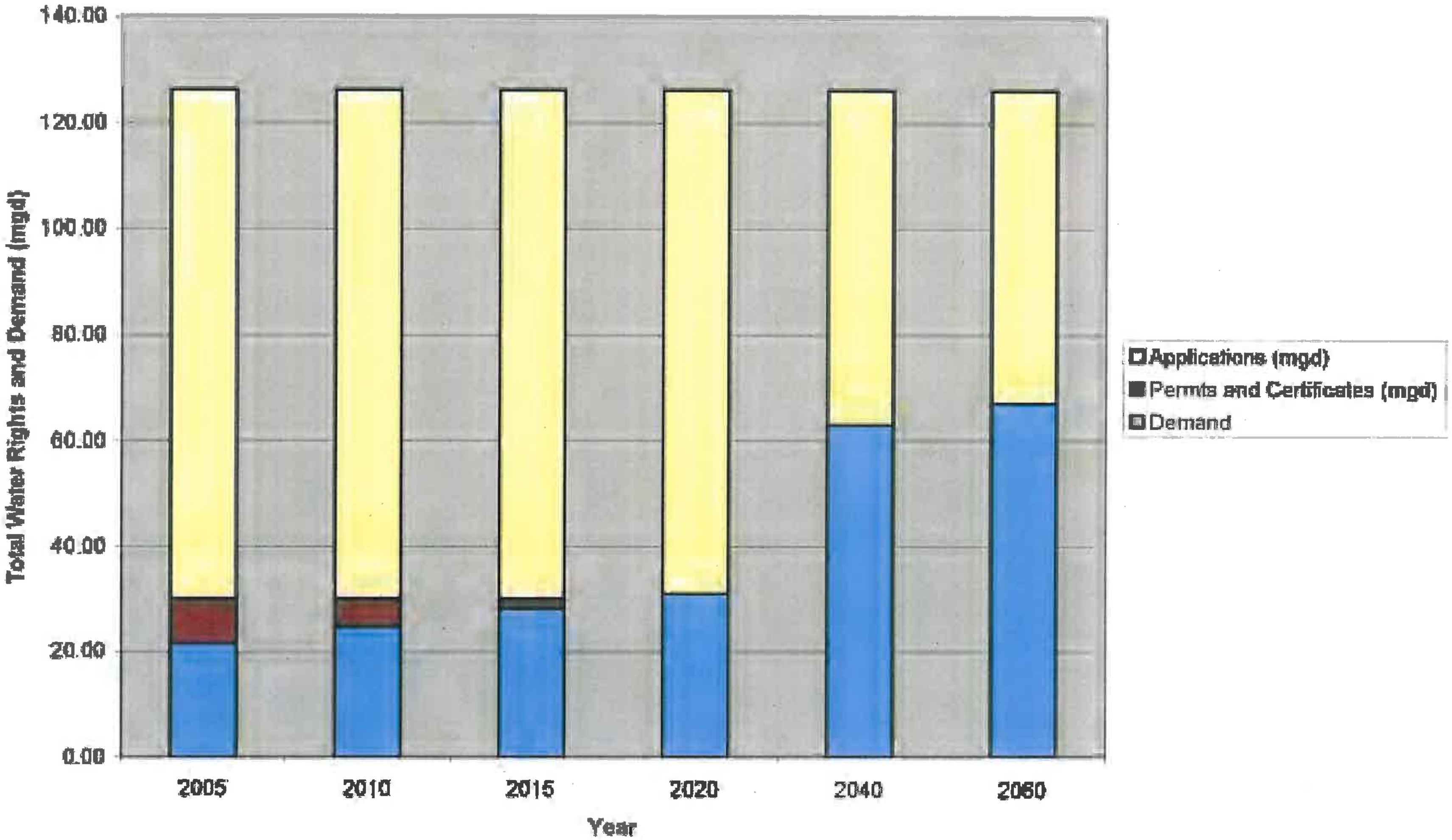

Figure 3.1
CLACKAMAS RIVER WATER RIGHT PROFILE OVER TIME
JOINT WATER SUPPLY SYSTEM ANALYSIS
CITY OF LAKE OSWEGO AND TIGARD WATER SERVICE AREA

Lo507f3.1-7525.ai

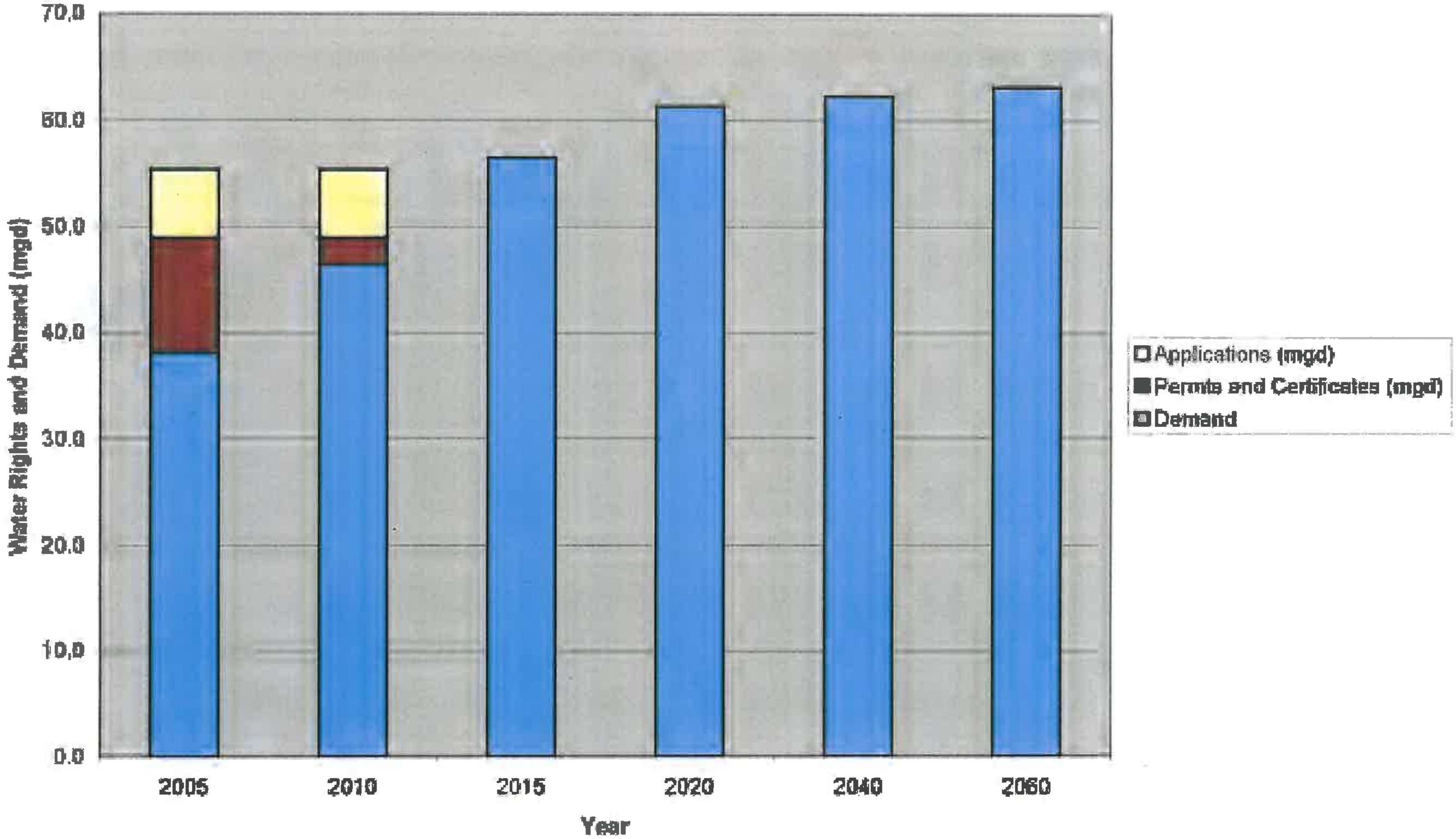

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Figure 3.2
CLACKAMAS RIVER WATER RIGHT PROFILE OVER TIME
JOINT WATER SUPPLY SYSTEM ANALYSIS
CITY OF LAKE OSWEGO AND TIGARD WATER SERVICE AREA

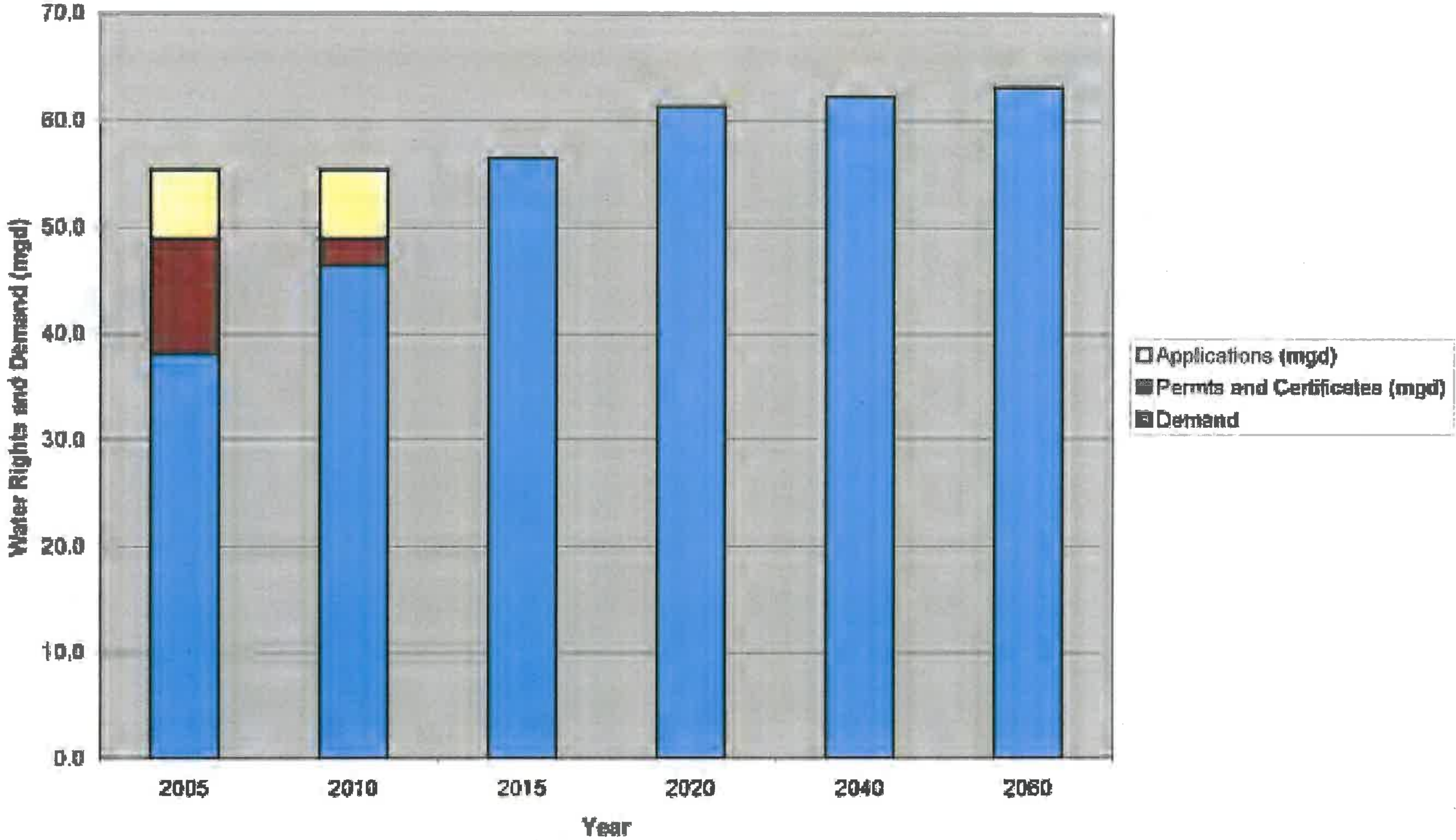

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Figure 3.2
NORTH CLACKAMAS COUNTY WATER COMMISSION
WATER RIGHT PROFILE OVER TIME
JOINT WATER SUPPLY SYSTEM ANALYSIS
CITY OF LAKE OSWEGO AND TIGARD WATER SERVICE AREA

The Genesis of HB-3038

In 1997, after considerable review and modification, the Oregon Water Resources Department (OWRD) issued a proposed final order (PFO) approving an application filed by the Coos Bay North Bend (CBNB) Water Board to appropriate 38.7 cubic feet per second (cfs) of water from Tenmile Creek for municipal use. CBNB submitted the application to the OWRD in March 1990. Water Watch protested the PFO on grounds that OWRD erred in issuing the permit alleging the permit was not in the public's interest, the appropriation would harm fish, and the water could not be put to beneficial use within the then statutorily required five year time period. Subsequent to contested case hearings and a petition by Water Watch to the Oregon Court of Appeals for judicial review, the appellate court reversed the final order issued by the Oregon Water Resources Commission approving the permit. In 2004, the parties filed petitions for review with the Oregon Supreme Court. In response to the appellate courts decision, HB-3038 became law. Subsequent to the enactment of HB-3038 and pursuant to a 2006 settlement agreement, CBNB was issued a final order authorizing a maximum withdrawal rate of 23 cfs.

HB-3038 was an attempt at a legislative fix to define the term "construction" as it applied to the development for beneficial use of waters of the state and to recognize the lengthy timelines by which municipal water works are planned for, permitted, designed, and constructed in order to apply water authorized in municipal permits to use. In the waning days of the 2005 legislative session, negotiations between a coalition of municipal water utilities and environmental interests resulted in an expansion of the five year construction window to a 20 year time frame. However, to garner support for the bill from environmental interests, a fish protection provision was added that now, in application of the new rules to municipal extensions, appears to create a new in-stream water right that takes precedence over other more senior permits and thus turns western water law on its head.

HB-3038 in Application

To implement the legislature's intent behind HB-3038, ORS Chapter 537 "Appropriation of Water Generally" and OAR Chapter 690, Division 315 "Water Rights Extensions" were revised. The revised statutes and rules require that all municipal permit extensions be conditioned to require a water management and conservation plan (WMCP) prior to diverting water beyond the maximum amount beneficially used by the municipality at the time of application for the extension. For the first extension issued after June 29, 2005 for a permit for municipal use issued before November 2, 1998, HB-3038 requires the Department to condition the undeveloped portion of the permit to maintain the persistence of listed fish species. ORS 537 also mandates the following additional conditions on municipal water rights:

- New municipal water right permits will be conditioned to require dirt and shovel type construction to begin within 20 years of permit issuance. Final Orders approving a Water right certificate, permit or extension of time issued prior to the effective date of the act would not be subject to challenge with respect to the time to commence or complete construction.

- Future municipal water right extensions will be subject to a one-time evaluation (by ODFW) as to whether future use of undeveloped portions of a water right not currently put to beneficial use by the permit holder will "maintain the persistence of listed fish species in portions of waterways affected by water use under the permit". If it is found that use of the undeveloped portion of the permit will not "maintain persistence of listed fish species", it can be conditioned to do so.
- Municipal water right extensions granted by the department will be conditioned to place a "hold" on any water granted under the permit but not yet put to beneficial use by the permit holder. Water can be freed for use, or "green-lighted" if municipalities show need for further water diversion / appropriation after having worked toward freeing up water through conservation (i.e., by implementing an approved WMCP).

Impacts of "Persistence" Standard on Additional Diversions

Pursuant to OAR 690-315-0080, the OWRD in evaluating an application for an extension, is required to seek the advice of the Oregon Department of Fish and Wildlife (ODFW) regarding the effect of further withdrawals on the persistence of listed fish species. The ODFW is expressly limited to use of existing data in support of its persistence determination. With regard to extension applications filed on the Clackamas River, including Lake Oswego's, the ODFW is relying on a biological survey conducted in 1964 in the upper reaches of the Clackamas River basin. This report was the basis for ODFW to recently make its determination that current in-stream water rights are insufficient to maintain the persistence of fish and thus is advising OWRD that increased minimum flows are needed to preserve fish populations.[1] With this advice, OWRD is required to condition permit extensions in such a way as to satisfy the ODFW that proposed new minimum fish flows will be maintained in the river as a means of ensuring the persistence standard will be met.

In response to this new fish flow threshold, the Clackamas Water Providers commissioned Portland State University to conduct extensive modeling[2] of the lower portion of the Clackamas River system. In general, the results of the modeling indicate that in typical weather years, daily average stream flows are sufficient to meet the needs of municipalities and maintain the proposed new minimum fish flows. This is due to two factors: 1) The timing of the City's peak demands, which typically occur in July or August, as compared to

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[1] Certificate S-59491, dated August 26, 1968 established an in-stream water right of 400 cfs (May through September 15) increasing to 640 cfs (September 16 through April). Current ODFW advice based upon a 1964 biological survey proposes minimum fish flows of 650 cfs (May through Labor Day) increasing to 800 cfs (day after Labor Day through April).

[2] "Lower Clackamas River Model: Model Development, Calibration, Scenarios, Executive Summary, and Hydrodynamics," Water Quality Research Group, Department of Civil and Environmental Engineering, Technical Report EWR-01-06-ES, October 2006.

the timing of typical low stream flows, which occurs in late August or September, and 2) Flow releases from Timothy Lake, which are managed through an intergovernmental agreement between the Clackamas River Water Providers (including Lake Oswego) and Portland General Electric. However, going forward, as growth in the basin continues, and weather patterns vary from average conditions, there will likely be occasions when access to water may be restricted to ensure sufficient water is left in the river to support listed fish stocks.
For example:

- Under existing withdrawal conditions and average stream flow conditions (data collected from 2000-2005) with releases from Timothy Lake and using the higher fish flows recommended by the ODFW, the model indicates that Lake Oswego and other municipal water providers on the river would not need to reduce their withdrawals to maintain minimum fish flows.
- At the other extreme, assuming all current permittees are fully using their permitted diversions and an extremely low water year occurs (for example, 2005 was statistically a year of extremely low flows relative to 100-years of record keeping), then it is possible that Lake Oswego would have to reduce its diversions by 12 percent (4.1 cfs/2.6 mgd) for up to 40 days, with as much as an 18 percent (6.1 cfs/3.9 mgd) reduction over a one day period, even with releases from Timothy Lake.[3]

The consequences of the persistence standard established by HB-3038 and the proposed new fish flows determined necessary by the ODFW to maintain persistence creates some uncertainty as to future water availability under a joint water supply partnership. The development of all undeveloped water in Lake Oswego's Clackamas River permits (34 cfs/22 mgd), (for example implementation of Scenario 4 by 2016), will create an immediate weather dependent uncertainty of peak season supply. While other Clackamas River municipal providers with remaining undeveloped permits might experience a "paper loss" in access to water during times of shortage, Lake Oswego and Tigard's loss would, by contrast, be "wet". However, this uncertainty in availability and potential loss of water can be mitigated in a variety of ways including:

- Effective, sustained conservation programs. A 0.5% reduction in per capita water use per year over an 11-year period could potentially reduce peak day consumption in Lake Oswego by more than 1.3 mgd. More aggressive conservation targets could further reduce risks of shortages.
- Securing agreements to access other sources of supply. Purchase of water from the Willamette River, Trask River, and/or Bull Run systems present opportunities to mitigate

[3] This "worst case" scenario assumes maximum use of all permitted rights combined with a statistically infrequent prolonged, dry weather pattern. Also, this scenario does not reflect that total future build-out water demands for all Clackamas Basin providers could be satisfied with 60% of all water allowed for use under all permitted rights. It should be noted that if the current CRW applications for 96 mgd are not permitted, the build-out demand projections will be 90 percent of the maximum municipal water rights on the Clackamas River.

potential shortages in the Clackamas River and increase water supply reliability for both cities. Both Lake Oswego and Tigard hold permits to withdraw water from the Willamette River in quantities sufficient to offset any shortage of water from the Clackamas River. The City of Wilsonville's use of the Willamette River as its primary source of drinking water over the last five years demonstrates it is a viable source of water supply.

- The South Fork Water Board holds permits on the Clackamas River well in excess of its forecasted build-out water demand. Oregon water law allows multiple points of diversion and thus some amount of unused water under the SFWB permit could be transferred to Lake Oswego's intake for diversion and use by Lake Oswego or Tigard in times of shortage.

How this potential future water availability uncertainty is managed between the parties of a joint water supply entity is a subject that will need to be addressed in any partnership agreement.

Water Management and Conservation Plan

Within three years of receiving a water right extension, the municipality must complete the water development or submit a Water Management and Conservation Plan (WMCP) to show how the additional water use is necessary and reasonable. It should be noted that should a partnership be developed between the Cities of Lake Oswego and Tigard, each City would need to update their WMCPs to address the additional demands.

An important consideration for managing the process is that once the plan is approved by OWRD, the file requires progress reports at the indicated (usually 5-year) intervals. Even though they are not formally reviewed or approved, these progress reports are taken into consideration when a municipality asks to use more water under their permit (i.e., the OWRD looks at progress made in conserving water before authorizing more "green light" water to a municipality). Once the water is green lighted and the project is complete, a claim of beneficial use report can be filed to perfect the right. Municipal water providers should be especially careful when completing claims of beneficial use on PODs with multiple water rights, so as to not limit the usefulness of junior water rights at the POD.

OWRD Policy for Municipal Perfection

The OWRD issued a policy statement (OWRD, 2002) that provides guidelines for perfecting municipal water rights. The policy allows the perfection of a permit to the full capacity of the water system or the limit of the permit, whichever is less. Any such perfection in combination with one or more additional permits is allowed. In the case of multiple permits, each permit, if sufficient in capacity, can be perfected to the full capacity of the water system. However, each certificate subsequent to the first, will be conditioned such that the rate of the permit or combination of permits will allow only the diversion of water that the system can put to beneficial use. With this approach, effective water right rates would be limited to the capacity of the water system at the time the permits are perfected into certificates.

Under this policy guideline, the strategy presented in this document seeks to maintain the flexibility of water rights for long-term planning while increasing the portion of water under certification. The perfection of permits to certificates, under this policy, requires permit holders to balance the flexibility of a permit, which can be amended and transferred without loss of capacity, with the strength and rigidity of a certificate which is permanent and less flexible. This balance includes optimizing the amount of the water right retained as a permit with the capacity that can be partially perfected based on current use and capacity of the POD. This strategy also includes avoiding over-certification at any one POD, which can diminish the value of junior water rights.

As an example, this policy would allow a water system that can prove 30 cubic feet per second (cfs) of beneficial use to perfect three permits (permits X, Y, and Z) of 30 cfs each at the same point of diversion (POD). Although each of the individual permits may allow the development of 30 cfs, for a total of 90 cfs, all three permits would be conditioned such that no more than 30 cfs could be diverted at any one time under permits X, Y, and Z, as an individual certificate or in combination. This results in the certificated portion of each permit being limited to 10 cfs, which is only one third of the authorized amount.

Once the permit is perfected into a certificate of beneficial use, the limiting conditions would remain in affect, even if the certificate were transferred to a different POD. A transfer of any of the certificates (X, Y, or Z) to allow the operation of an additional 30 cfs POD would be considered by OWRD as an illegal enlargement of the certificate. This type of transfer would only be allowed if production at the original POD was discontinued or reduced by the same amount as was diverted to the second POD. This is an example of over certification that can occur at a municipal POD.

These certificate conditions would effectively limit the permits to a total of 30 cfs in combination, down from the intended 90 cfs of the original permits. The oldest priority date would then determine the order of water use in times of limited water availability. For this reason, certification of additional water rights beyond the capacity of the water system's beneficial use at a POD is not recommended. Over certification may cause excess junior certificates to become water rights on paper only, with little retained value. These junior certificates could not be utilized while the senior water right demand was serviced to the capacity of the system.

A permit holder may retain the flexibility and value of junior water rights by amending the permits to use a POD with available capacity and by completing partial perfection. If a junior permit lists an additional POD that does not have associated senior rights then a partial perfection has the advantage of using the beneficial use of more than one POD. This is an advantage because portions of the permit perfected at POD "Y" as a junior right and at POD "Z" as a senior right will not be shown on the certificate as separate distinct rates for each POD. The certificate will only show the full amount of the beneficial use and indicate that both PODs are options for use of the certificate. An example of this advantage is that if a permit were partially perfected for 50 percent on POD "Y" and 50 percent on POD "X," the full perfected use could be made wholly at either POD without showing 100 percent proof at either location. However, the certificate would still be limited to the total beneficial use of the combined PODs.

3.2.5 Opportunities for Additional Water Rights

The downstream position of Lake Oswego's POD is an advantage on the Clackamas River. The downstream position allows upstream water right holders to more readily complete potential transfers of water rights, in-stream leases, or amendments to permits to allow additional uses by Lake Oswego at it's POD. The downstream position is important because any movement of water rights must hold other senior water rights harmless and be in the public interest. Keeping additional water in the river and diverting it further downstream is beneficial to the public interest and to water right holders along the reach of the transfer. This provides the river with more cold water for fish in the higher reaches, and does not have the potential to impact other PODs with lower flows.

Lake Oswego has several options to explore. The water right analysis completed in Section 3.2.3 suggests that the SFWB permits and the CRW applications for junior water rights on the Clackamas could conceivably be used to provide additional water to meet the future demands of the combined Lake Oswego and Tigard service area. It should be noted that the status of the CRW junior water rights application is uncertain, and subject to the approval of OWRD.

Clackamas River Water

CRW holds two large applications (S80438 and S80465 for a total of 96.23 mgd) and has entered into agreements to share these applications with other providers on the Clackamas. However, there are limitations to these applications. Insufficient live flow in the Clackamas requires that these applications be partially met with stored water releases from Timothy Lake. Stored water may not be available at all times of the year. Use of these applications will also require significant coordination with other water users and close monitoring of the river flow to meet the conditions of a permit issued on these applications.

South Fork Water Board

The South Fork Water Board (SFWB) holds a total of 74.98 mgd in permits and certificates. These water rights are senior to the Clackamas River in-stream water rights and many of the other water rights on the Clackamas River.

Demand projections for SFWB service area suggest that a maximum day demand of approximately 25 mgd is anticipated at build out. SFWB also services several water supply contracts. The predominant contract includes service to Clackamas River Water - South (CRW-S), formerly the Claremont Water District. Should SFWB continue service to CRW-S the anticipated demand for this area is 17 mgd by 2060, resulting in a total build-out demand of 42 mgd.

SFWB's total water right holding may also be further diminished by a history limited beneficial use of water rights high in the watershed on the South Fork of the Clackamas River and Memloose Creek (Permits S3778 and S9982). However, the degree of the impact is not clear and a full-winter month allocation may be preserved.

Assuming SFWB maintains the use of Permits S3778 and S9982 and continues to service CRW-S, approximately 32 mgd will be available to meet increased demands within the SFWB service area and for potential agreements that would allow service to others, including Lake Oswego and Tigard.

3.2.6 Proposed Course of Action

Lake Oswego's existing water rights on the Clackamas River (up to 38 mgd) appear to be sufficient to meet demands identified in Chapter 1. It is recommended that Lake Oswego continue to work with other Clackamas River water providers to maximize the protection of these existing rights. In the event that Lake Oswego and Tigard reach an agreement to provide additional water service to Tigard using Lake Oswego's existing water rights, it is further recommended that Lake Oswego update its Water Management and Conservation plan and document perfection of these rights as described in Section 3.2.4.

Options to obtain additional water rights to meet Lake Oswego and Tigard's future need in excess of Lake Oswego's existing rights are available. SFWB has the capacity to meet additional demands though existing water rights. If additional rights are desired, it is recommended Lake Oswego and Tigard develop a water right sharing proposal for each facility to consider, and begin developing a framework for a long-term strategy to partner with one or more water providers.

3.2.7 Alternative Options

Aquifer Storage and Recovery

A regional aquifer storage and recovery (ASR) network could allow water to be diverted in high flow winter months for use later in the year. The winter water could be treated and distributed to key geographically located ASR wells and stored until the peak demands of summer occur. ASR technology has been used throughout the Northwest to provide solutions to many drinking water management issues including:

- Maintaining and proving up surface water rights.
- Mitigating overdrawn aquifers and restoring natural groundwater levels.
- Restoring summer base flow to temperature impacted streams.
- Meeting peak system demands during critical surface water low-flow months .

- Optimizing the necessary treatment plant capacity by storing treated water during winter months and pumping the stored water to local distribution during high demand months. This use can supplement the demand on the treatment facilities and delay or eliminate some treatment plant expansions.

ASR may also be used to treat groundwater quality issues and reduce undesirable water quality constituents including iron and manganese. Fluoride concentrations may also be managed through displacement of native groundwater high in fluoride with injected treated drinking water that has little or no fluoride concentration.

3.3 LOCAL LAND USE PERMITTING STRATEGY

3.3.1 City of Gladstone

Lake Oswego has a raw water intake and pump station structure located on land owned by the State of Oregon within ordinary high water of the Clackamas River and zoned C2 (Community Commercial) with a WQ (Water Quality Resource Area) overlay. Once leaving the intake site, the conveyance pipe is located within public street rights-of-way that pass through the R-5 (Single Family Residential), MR (Multi-Family Residential) and C-3 (General Commercial) districts, until reaching Meldrum Bar Park – zoned OS (Open Space). The raw water pipe then crosses the GW (Greenway Conditional Use) overlay district before crossing the Willamette River to West Linn. Expansion of existing water facilities may also be subject to design review. (GMC Chapter 17.80, Design Review) Since water facilities are located within the 100-year floodplain, they must be constructed consistent with floodplain standards of GMC Chapter 17.29.020.

Applicable Gladstone Base Zones and Overlay Zones

Table 3.5 lists the Gladstone zoning districts that control reconstruction of Lake Oswego's raw water intake and conveyance system.

Gladstone Permitting Strategy

Permitting Strategy Summary:

- Confirm / Revise Winterbrook Planning observations by meetings with Gladstone planning staff. Focus on reconstruction of water intake and pumping facilities (Clackamas River and WQ district) and Meldrum Bar Park (OS, WR and WQ Districts). Determine whether improvements within public right-of-way are subject to conditional use review.
- Request "pre-application conference" to develop consolidated permitting approach (i.e., view as a single project on a city-wide "site").
- Consolidate applications for water system reconstruction: conditional use permits, Willamette Greenway review, Water Quality district overlay standards, floodplain development standards, and design review.

- This approach (if acceptable to the city) will allow for alternatives analysis, environmental and neighborhood impacts, and appropriate mitigation programs to be considered on a city-wide basis.
- Coordinate with Public Works regarding water conveyance system improvements within public rights-of-way.

Table 3.5 Applicable Gladstone Zoning Districts
Joint Water Supply System Analysis
City of Lake Oswego and Tigard Water Service Area

Water Facility	Zone / Overlay	Permitted Use	Conditional Use Permit	Comment
Intake Well; Pump	C-2/	"Utility facility" (17.18.020)		Reconstruction of utility facilities permitted in WQ overlay zone if disturbance area restored with native vegetation.
	WQ	17.27.040(2)(a)		
Raw water pipe	R-5		"Utility facility" (17.12.040(9))	Not clear if CUP required when reconstruction of utility facilities occurs within public ROW.
Raw water pipe	C-3	"Utility facility" (17.20.020)		
Raw water pipe	MR		"Utility facility" (17.14.040(7))	Not clear if CUP required when reconstruction of utility facilities occurs within public ROW.
Raw water pipe	OS/	Not listed	Not listed	Not clear if CUP required when reconstruction of utility facilities occurs within public ROW.
	WQ/	Permitted 17.27.040(2)(a)		Reconstruction permitted in WQ overlay zone if disturbance area restored with native vegetation.
	GW	Permitted* if "Committed to Urban Use" 17.28.040(1)		If use existed in 1975, then "Committed to Urban Use" and subject to 17.28.040(1) and 17.28.050 standards.

Note: City of Gladstone interpretation required, since *not* a listed use. May be deemed a "non-conforming use," but this is unlikely since other public facilities (streets, water, sewer) exist in park but are not listed in OS district.

3.3.2 City of West Linn

There are two alternative locations for the reconstructed raw water pipe as it crosses the Willamette River before entering the City of West Linn (West Linn):

1. The existing route enters West Linn immediately west of Mary S. Young State Park and passes through the park before connecting with Nixon Avenue.

2. A more direct route crosses the Willamette River diagonally and enters West Linn at the west end of Mary S. Young State Park and continues on the same route along Nixon Avenue.

Both routes would pass through the city's R-10 residential zone, as well as the Willamette River Greenway (WRG) and Wetland and Riparian Area Protection (WRA) overlay zones, before reaching the Kenthorpe Road WTP. Both routes avoid Cedar Island Park and associated limitations on nonauthorized uses, such as "siting of facilities that are not directly required for the park's use" in city-owned open space.[4] The capacity of the WTP must be increased; however, this can occur on the existing site – rather than expanding on to three residential lots owned by the city of Lake Oswego to the west.

Treated water is piped from the WTP within the Kenthorpe Road and Cedar Oak public rights-of-way that passes through the R-10 (Single Family Residential).

Applicable West Linn Base Zones and Overlay Zones

Table 3.6 lists the West Linn zoning districts that control reconstruction of Lake Oswego's raw water pipes, WTP capacity increase, and treated water conveyance system. The following definitions (WLMC 03.030) are important in determining whether reconstruction of water facilities in certain zones is a "permitted" or "conditional" use:

Utilities. Services and utilities which can have substantial visual impact on an area. Such uses may be permitted in any zoning district when the public interest supercedes the usual limitations placed on land use and transcends the usual restraints of the district for reasons of necessary location and community-wide interest. There are two classes of utilities--major and minor.

Utility, major. A utility which may have a significant impact on the surrounding uses or the community in terms of generating traffic or creating noise or visual effects and includes

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[4] Chapter XI of the City Charter, reads (in relevant part) as follows:

*(a) The City shall not engage in the lease, sale, exchange or nonauthorized use of City owned park or open space without first receiving voter approval for such lease, sale, exchange or nonauthorized use. Such approval shall consist of a majority of votes cast at a regularly scheduled election in favor of a specific proposal for a lease, sale, exchange or nonauthorized use of City owned park or open space. (b) For the purposes of this section the term "nonauthorized use" shall have the following meanings: (1) A nonauthorized use for a City owned park shall be the siting or construction of facilities that are not directly required for the park's use. * * * (2) A nonauthorized use for a City owned open space shall be the siting or construction of facilities that are not directly required for the maintenance of the open space or use of said open space as open space. (c) For the purposes of the above section the term "open space" shall be defined as City-owned real estate identified in documents adopted or accepted by the City Council or authorized City official as "open space," "green space," "wetland," "drainageway," (excluding city owned roadside drainage swales), "wildlife habitat" and "stream corridor." Property with the above designations that is not owned by the City shall be exempt from the provisions of this section. (d) This section shall apply to all City-owned park or open space as of the adoption of this section, as well as all park and open space coming into the City's ownership after the adoption of this section."*

utility, substation, pump station, water storage tank, sewer plant, or other similar use essential for the proper function of the community. (1408).

Utility, minor. A utility which has a minor impact on the surrounding uses or on the community in terms of generating traffic or creating noise or visual effects and includes the overhead or underground electric, telephone or cable television poles and wires, the underground gas and water distribution systems and the drainage or sewerage collection systems or other similar use essential for the proper functioning of the community."

From the definitions above, it would appear that the WTP and pump station qualify as a "major utility" and that the water pipes qualify as a "minor utility."

Table 3.6 Applicable West Linn Zoning Districts
Joint Water Supply System Analysis
City of Lake Oswego and Tigard Water Service Area

Water Facility	Zone	Permitted Use	Conditional Use Permit	Comment
Raw / treated water pipe	R-10	"minor utilities" (03.030)		Public Works construction permits required within ROW.
WTP	R-10		"major utilities" (03.030)	
Treated water pipe	CG	"minor utilities" (03.030)		Public Works construction permits required within ROW.
Treated water pipe	R-10	"minor utilities" (03.030)	"major utilities" (03.030)	
Raw water pipe	WRG	Exempt (28.030(D))		"D. Addition or modification by public utilities for existing utility lines"
Raw water pipe	WRA	Permitted (30.030(B)) "Intensifications of existing uses or activities" (30.030(C)(8)		"B. All uses permitted under the provisions of the underlying base zone ... However, the amount and placement of uses and activities may be limited to conform with the requirements of this chapter."

West Linn Permitting Strategy

Permitting Strategy Summary:

- Confirm / Revise Winterbrook Planning observations by meeting with West Linn planning staff.

- The City of West Linn is considering adoption of a new Open Space (OS) district that would be applied primarily to publicly-owned parks. Mary S. Young State Park is currently zoned R-10 (which allows improvements to water lines outright). It is recommended that the OS adoption process be followed closely to ensure that reconstruction of water lines remains a permitted use within the OS district.
- Request "pre-application conference" to develop consolidated permitting approach.
- Consolidate applications for water system reconstruction by jurisdiction: conditional use permits, Willamette River Greenway, Wetland and Riparian Area Protection overlay standards and mitigation, and floodplain development standards.
- This approach (if acceptable to the city) will allow for alternatives analysis, environmental and neighborhood impacts, and appropriate mitigation programs to be considered on a city-wide basis.
- Coordinate with Public Works regarding water conveyance system improvements within public rights-of-way.

3.3.3 City of Lake Oswego

The water pipe crosses from West Linn into Lake Oswego beneath Pacific Highway at the southeast corner of Marylhurst University. The water pipe passes through and/ or adjacent to areas zoned for R-10 (residential) and CI (campus), following the highway until just south of Oswego Creek. The Oswego Creek corridor is protected by the City's Sensitive Lands Overlay District (RC, RP-I, W-29).

North of the creek, the pipeline once again follows public streets, including North Shore Road as it crosses Lakewood Bay. From the north shore of Lakewood Bay, the pipeline continues to generally follow street rights-of-way, through various residential and commercial zones, as noted in Table 3.7. The pipeline crosses through the Lake Oswego Hunt Club, entering via Iron Mountain Boulevard on the southern edge of the Hunt Club and exiting onto Brookside Road on the eastern edge of the Hunt Club.

At East Waluga Park, the pipeline enters from the east via Douglas Way and reaches the Waluga Reservoir at the northern edge of the Park. Here another Sensitive Lands area is crossed (Tree Grove (-6/ RC). From the reservoir, the pipeline crosses land zoned residential and a third Sensitive Lands area (1B-3), before connecting to Carmen Drive. The pipeline follows Carmen Drive to Bonita Drive, through land zoned residential and commercial.

The pipeline continues through a small section of unincorporated Clackamas County before entering Tigard.

<u>**Applicable Lake Oswego Base Zones and Overlay Zones**</u>

Table 3.7 lists the Lake Oswego zoning districts that control reconstruction of Lake Oswego's finished water transmission system. The following definitions (50.02.005) are

important in determining whether reconstruction of water facilities in certain zones is a "permitted" or "conditional" use:

Table 3.7 Applicable Lake Oswego Zoning Districts
Joint Water Supply System Analysis
City of Lake Oswego and Tigard Water Service Area

Water Facility	Zone	Permitted Use	Conditional Use Permit	Comment
Treated water pipe	R-0	Minor Public Facility (50.06.010(3))		
Treated water pipe	R-7.5	Minor Public Facility (50.08.010 (6))		
Treated water pipe	R-10	Minor Public Facility (50.08.010 (6))		
Treated water pipe	R-15	Minor Public Facility (50.08.010 (6))		
Treated water pipe	DD	Minor Public Facility (50.09.010(7))		
Treated water pipe	EC	Minor Public Facility (50.11.010(14b))		
Treated water pipe	CI	Minor Public Facility (50.12.015(12))		
Raw/ treated water pipe	GC	Minor Public Facility (50.11.010(14b))		
Raw/ treated water pipe	MC	Minor Public Facility (50.11.010(14b))		
Treated water pipe, **Waluga Reservoir**	PF	Minor Public Facility (50.13A.010(2))	**Major public facility**	Conditional use may be required if Waluga Reservoir to be expanded
Treated water pipe	CR&D	Minor Public Facility (50.11.010(14b))		
Treated water pipe	Sensitive Lands (RP, RC) in ROW	Permitted as "existing utility" in ROW. (50.16.015(3))		Permitted if work is contained in ROW and staging areas are not in Sensitive Lands overlay zone (e.g., in George Rogers Park, if bore pits are outside of RC and RP zones). Otherwise, a sensitive lands development review may be required.
Raw/ treated water pipe	Sensitive Lands (RP, RC) Not in ROW	Permitted as existing utility. (50.16.015(3))		The pipeline is an existing utility and as such is permitted, subject to mitigation measures, as well as state and federal permits.

Public Facility, Minor. The following public service improvements or structures developed by or for a public agency:

- Minor utility structures, except substations, but including poles, lines, pipes, telecommunications facilities or other such facilities.
- Sewer, storm drainage, or water system structures except treatment plants, reservoirs, or trunk lines, but including reconstruction of existing facilities, pump stations, manholes, valves, hydrants or other portions of the collection, treatment and distribution systems located within public property."

Guidelines for working in Sensitive Lands areas:

- Expansion of utility is permitted in Sensitive Lands Overlay Zones that are in ROW. Plan must demonstrate that staging area is not in SL, and that all work is in ROW.
- Expansion of utility is permitted in Sensitive Lands Overlay Zones not in ROW (specifically Oswego Creek). City requires grading and erosion control plan and that methods for minimizing impacts to Oswego Creek (or other relevant Sensitive Lands) are defined. Included in requirements is staking top of creek banks and illustrating this in buffer.
- Federal and state permits are required from the Department of State Lands and the US Army Corp of Engineers (see State and Federal Permitting memo).

Lake Oswego Permitting Strategy

Permitting Strategy Summary:

- Confirm / Revise Winterbrook Planning observations by meetings with Lake Oswego planning staff. Focus on Sensitive Lands: Oswego Creek, East Waluga Park, and area immediately north of Waluga Reservoir. Also, determine if expansion of Waluga Reservoir is necessary.
- Request "pre-application conference" to develop consolidated permitting approach.
- Consolidate applications for water system reconstruction by jurisdiction: conditional use permits and Sensitive Lands development permits.
- Coordinate with Lake Oswego City Council to review alternatives analysis, environmental and neighborhood impacts, and identify appropriate mitigation programs to be considered on a city-wide basis.
- Coordinate with Public Works regarding water conveyance system improvements within public rights-of-way.

3.3.4 City of Tigard

The pipeline enters Tigard via Bonita Road, passing beneath Interstate-5. It accesses the Bonita pump station just east of Sequoia Road. The pipeline continues past the Bonita pump station approximately 1000 feet and terminates just west of 72nd Ave. The zoning for this entire area is Light Industrial (I-L), and the pipeline runs along public streets.

Applicable Tigard Base Zones and Overlay Zones

Table 3.8 lists the Tigard zoning districts that control reconstruction of Tigard's conveyance system and pump station upgrade.

Table 3.8 Applicable Tigard Zoning Districts
Joint Water Supply System Analysis
City of Lake Oswego and Tigard Water Service Area

Water Facility	Zone	Permitted Use	Conditional Use Permit	Comment
Treated water pipe	I-L		Basic utility (18.530.1)	Pipe runs along public streets and is likely permitted use – confirm with City.
Bonita Pump Station	I-L		Basic utility (18.530.1)	

Tigard Permitting Strategy

Permitting Strategy Summary:

- Confirm / Revise Winterbrook Planning observations by meetings with Tigard planning staff. Focus on conditional use requirements for enlarging Bonita Pump Station.
- Coordinate with Public Works regarding water conveyance system improvements within public rights-of-way.

3.3.5 Overall Permitting Strategy

At the local level, the project will require conditional use and related land use permits for major facility improvements (i.e., pump stations, treatment plant). The broader strategy for local permits includes the following steps:

- Confirmation of project alignment and construction methods (most permits can be obtained beginning at the 60% design stage).
- Follow-up with City staff on code interpretation questions (as identified above).
- Schedule pre-application conferences with each City to jointly develop consolidated permitting approach.
- Coordinate the local land use review timelines so that the four jurisdictions can be processing applications concurrently.

A well-planned, coordinated local permit strategy could result in permit approvals within a four to six month period (from acceptance of "complete application" packages by each jurisdiction).

3.4 STATE AND FEDERAL PERMITTING STRATEGY

3.4.1 Federal Permits

This project is expected to require federal permits from the U.S. Army Corps of Engineers and consultation with NOAA Fisheries and US Fish and Wildlife Services. National Pollutant Discharge Elimination System (NPDES) permits (i.e., the 1200-C permit) are administered through the Oregon Department of Environmental Quality (see State Permits). Permits are also required from the Union Pacific Railroad Company (a quasi-federal agency) for crossings or encroachments along their tracks.

U.S. Army Corps of Engineers (in consultation with NOAA Fisheries, US Fish and Wildlife Service)

Project construction work below the ordinary high water mark of the Willamette and Clackamas Rivers, and within other waters and wetlands, will trigger federal permits under the Federal Clean Water Act (Section 404) and/or River and Harbors Act (Section 10). A Section 404 permit is required for activities that may impact jurisdictional wetlands or waters, either directly (e.g., through filling) or indirectly (e.g., through materials staging). In addition to rivers, this permit applies to any work within other jurisdictional waters or wetlands along the project corridor. The U.S. Army Corps of Engineers (USACE) issues Section 404 permits in conjunction with the Oregon Department of State Lands Removal/Fill permits (see State Permits). Section 10 (Rivers and Harbors Act) regulates work in navigable or tidal waters (Willamette and Clackamas Rivers) including fills and in-water construction.

In addition, Section 7 of the Endangered Species Act (ESA) requires all federal agencies to insure that any actions they authorize are not likely to jeopardize a listed species or adversely modify its critical habitat. Consultation with the National Oceanic and Atmospheric Administration National Marine Fisheries Service (NOAA Fisheries, formerly known as NMFS) and U.S. Fish and Wildlife Service (USFWS) may be required for actions potentially affecting listed, proposed, or candidate species.[5] Generally, a Biological Assessment would be required to evaluate the potential effects of the proposed action on identified listed or candidate species (e.g., salmonids, bald eagle).

3.4.1.1.1 *Applicability*

Based on a review of preliminary plans of the project alignment, a Section 404 permit, Section 10 permit, and/or Section 7 consultation, will be required for work on several key project elements. These elements include:

- Upgrades to the Clackamas River Intake facility (pump station replacement and new intake pipes, if required).

[5] Generally, NOAA Fisheries has oversight over fish while USFWS reviews terrestrial species impacts.

- Willamette River crossing, related bore pit construction, and connecting pipeline along river edge (within Ordinary High Water line or adjacent wetlands).
- Bore pit construction for Oswego Creek crossing (if fill or removal within stream OHW mark or stream-associated wetland).
- Bore pit construction for Oswego Lake crossing (if fill or removal within OHW mark).
- Other jurisdictional wetlands or water bodies that may be impacted during the water system construction process.

3.4.1.1.2 *Planning Considerations*

NOAA Fisheries has prepared a programmatic biological opinion, the Standard Local Operating Procedures for Endangered Species (SLOPES), which may allow certain utility-related activities and other minor impacts to be approved by the USACE without the need for Section 7 consultation. However, construction of water lines to support a new or expanded service area for which effects have not been analyzed under SLOPES are generally not eligible (review of project with NOAA Fisheries staff will be needed to determine eligibility).

Directional drilling and boring and jacking below water or wetland areas are permitted under SLOPES, provided that the associated pits: 1) span the channel migration zone and any associated wetlands, 2) will not damage the river bed or banks, and 3) no spoil material will enter the waterway. However, trenching (as is currently planned along the east bank of the Willamette River south of the bore pit) is generally not eligible under SLOPES.[6] Also to be eligible, stream or river crossings should be perpendicular to the watercourse, or nearly so (the diagonal Willamette River crossing option is another area to be reviewed with NOAA Fisheries). Therefore, prior to implementation of the proposed Willamette River crossing, the status of the permitting and planning requirements should be revisited as part of a preliminary design alternatives analysis to confirm the piping configuration.

Jack and bore or directional drilling construction methods are planned for most water and wetland crossings. This will significantly reduce potential impacts and limit the scope of related permits. However, there are several areas where these methods will not, and perhaps cannot, be used. Such areas warrant focused attention by the design team to review available alternatives that may reduce impacts, and thereby reduce the scope, timeline, and risk associated with required permits. Two such areas are alluded to above: trenching or bore pit construction located within the ordinary high water mark of rivers or streams.

Another area where environmental/permit impacts should be given paramount consideration is the in-water disturbance related to the replacement of the intake pump station and the reconstructed intake on the Clackamas River. For example, the proposal for

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[6] However, it may qualify as a Nationwide 12 Permit (Utility Line Backfill and Bedding) with a streamlined review process.

a screened intake integrated with the pump station on the riverbank would conceptually be far preferable (from a biological and permitting standpoint) to extending multiple intake pipes out into the river. A full individual permit with formal NOAA Fisheries consultation and preparation of Biological Assessments for multiple species can be expected under the latter scenario, whereas streamlined permit options (e.g., SLOPES or Nationwide Permit 12) may be available if the overall in-water impacts can be minimized.

For the Willamette River crossing, the pipeline must be deep enough to maintain navigation within the river's navigation channel. This means that the pipe must be placed below the river dredging depth and deep enough to allow adequate cover to protect the pipe. As Portland recently did with it's river crossing for the West Side CSO project[7], a bathymetric survey of the river bottom along the proposed pipeline corridor should be completed (unless a recently survey is available) so that accurate cross-sections and depths can be determined. This survey will also be useful to set the boundaries of the Submerged Lands Easement that will be required from the Department of State Lands (see State Permits, below).

All "in-water work" (below ordinary high water) must occur within Oregon Department of Fish and Wildlife designated in-water work windows to minimize impacts to listed species. For work in the Clackamas River, this window is relatively short: July 15 to August 31. For the Willamette River, this window is July 1 to October 31 and December 1 to January 31. Both NOAA Fisheries and the USFWS prefer that work in the Willamette occur during the summer/fall in-water work window and avoid the winter in-water work window to lessen potential adverse impacts and avoid higher river flows in the winter. The same constraints would apply for all water crossings, including Oswego Lake and Sucker Creek.

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[7] At the crossing near Swan Island, the USACE required a minimum depth of -55 feet (Columbia River Datum) for pipe placement to maintain navigation in Portland Harbor.

3.4.1.1.3 *USACE Permitting Strategy*

The following steps are recommended to address federal permitting related to river, stream and wetland crossings:

- Map the ordinary high water mark along the Clackamas and Willamette Rivers, using elevations and datum obtained from USACE.
- Review design options for intake, bore pits, and in-water trenching with City and design team to set appropriate "weighting" for environmental/permit factors to be used in the alternatives evaluation.
- Conduct a field reconnaissance along the proposed alignment to review the presence and extent of "waters of the U.S.," including wetlands, and habitat for listed or candidate species (e.g., presence of shallow-water habitat for juvenile Chinook salmon, bald eagle habitat); update project maps and permitting strategy as needed.
- Meet with agency staff to review preliminary project plans with updated base maps (containing OHW, wetland limits, etc) and confirm jurisdictional limits and applicable permit processes. If Section 7 consultation will be triggered, discussions should include scope of the Biological Assessment (BA), identification of target species for review, any specific data or issues to address in assessment, and preferred mitigation strategies. Also, identify any other studies that may be required by regulators as part of the evaluation of fish impacts.
- Refine plans and begin preparation of Biological Assessment and other permit-related studies, if needed. Identify questions to be reviewed with team and regulators.
- When preferred options for in-water construction work are selected, design team representatives (including BA author) should plan to conduct a joint meeting and tour of the alignment with representatives from the USACE, NOAA Fisheries, US Fish and Wildlife Services, Department of State Lands, State Marine Board, and other appropriate agencies. The pre-application tour will provide an opportunity to review the alternatives evaluation and measures taken to minimize impacts, ensure that all concerns have been addressed, and lay the groundwork for a coordinated permit review process.

<u>**Union Pacific Railroad Company**</u>

A utility encroachment permit is required for parallel encroachments and crossings within the Union Pacific Railroad (UPRR) right-of-way. A UPRR line is located on the north side of Oswego Lake in Lake Oswego [per design staff[8]]. Both UPRR encroachments and crossings may be required based on preliminary alignment plans.

[8] We understand from project engineers that the railway is owned or controlled by Union Pacific. We have not independently verified this.

The UPRR defines an "encroachment" as a pipeline that enters the railroad company's right-of-way and either does not leave the right-of-way or follows along the right-of-way for some distance. A "crossing" is a pipeline that enters the railroad company's trackage from one side of the right-of-way to the other side of the right-of-way in as near a straight line as possible.

Encroachments and crossings have different sets of standards but will generally be covered under a single "encroachment permit," for which requirements can be onerous. Right-of-entry permits for construction work and site investigation are normally issued as part of the encroachment permit. In cases where pre-construction site investigation is planned, a separate right-of-entry permit will be needed. The review process includes determination of areas of potential impact, coordination with the railroad, and submittal of plans and permit application for review.

3.4.1.1.4 *Applicability*

Based on preliminary project maps, the water line will require one UPRR crossing permit and potentially up to two distinct encroachment permits. The crossing is located at North Shore Road and Mulligan Lane. The potential encroachments are located to the east of this location where North Shore Road and the railroad are adjacent and parallel to each other.

3.4.1.1.5 *Planning Considerations*

Parallel encroachments tend to be a greater concern for the railroad than perpendicular crossings. Crossings must be bored beneath the railroad bed (as planned) and normally require casing pipes. Several general requirements apply to parallel encroachments, including the following:

- Encroachments must generally be located along the outer edge of the railroad right-of-way, at least 35 feet from centerline of nearest track.
- The mainline tracks must be kept operational at all times.
- If construction takes place within 25 feet of an active rail, a flagger is required.
- It is possible to perform construction as close as 12 feet to the centerline of a track, but the shoring or shaft must be designed to carry the substantial railroad loading.

3.4.1.1.6 *UPRR Permitting Strategy*

The following permitting strategy is recommended for UPRR:

- Coordination with UPRR can be a long process and should be initiated during the preliminary design phase, as soon as the crossing and encroachment options are well defined.
- Depending of scope of impacts, a trip to UPRR headquarters in Omaha can help to ensure clear communication and expedient permit approval.

- Coordination should continue throughout the pre-design and design phases of the project. The permit application process can take 6 months or more, particularly if long encroachments are planned or late design changes occur.

3.4.2 State Permits

The project will require several different permits from state level regulatory agencies. The Oregon Department of State Lands (DSL) reviews applications for Section 404/Removal/Fill permits concurrently with the USACE. The Oregon Department of Environmental Quality (DEQ) reviews Section 404 permits for compliance with Section 401 Water Quality Certification requirements. The DEQ also issues the National Pollutant Discharge Elimination System (NPDES) #1200-C construction permit, which will be necessary for the project. The Oregon State Historic Preservation Office (SHPO) issues Phase II and III Archaeological permits, which may be necessary if potential cultural resources are identified along the alignment corridor.

At least four other state agencies will have a role in the review of the project though they do not technically issue construction-related permits.

The Oregon State Marine Board consults with DSL during review of Removal/Fill permits for work within boat/recreation activity areas (i.e., Clackamas and Willamette Rivers). They will be looking for potential navigational hazards created by the project, and are likely to pay particular attention to the design of the intake and pump station on the Clackamas River. It will be important to avoid intake pipes, trash protection devices, or other in-water structures that may create hazards, including submerged hazards that become exposed during low water conditions.

The Oregon Department of Fish and Wildlife (ODFW) sets in-water work windows for Oregon rivers and may also provide comment to DSL on the Removal/Fill permit. Currently, as noted above, the in-water work window for the Willamette River is July 1 to October 31 and December 1 to January 31 (the summer/fall window is preferred). For the Clackamas River, the window is July 15 to August 31.

A section of the proposed raw water line passes through Mary S. Young Park in West Linn. This is a state park owned by the Oregon State Parks Department (OSPD). However, the park is managed by the City of West Linn Parks Department and, according to OSPD, the park is subject only to local zoning provisions that may apply to utility construction in the applicable zone.

Finally, the Oregon Health Division (OHD) regulates drinking water quality for the state. These regulations include requirements for lime and carbon dioxide storage and feed systems, solids handling and dewatering facilities, and sodium hypochlorite and chemical system modifications. All OHD requirements are, or will be, addressed as part of the capacity upgrade of the Lake Oswego Water Treatment Plant.

Department of State Lands

Under the Oregon Department of State Lands' (DSL) Removal/Fill Law, permits are required for removal or fill of 50 cubic yards or more of material out of or into waters of the state, including wetlands. Work within a river or stream that is designated essential salmonid habitat (ESH), requires a permit regardless of the volume of fill or removal. Both the Clackamas and Willamette Rivers are designated ESH in the area of the proposed project alignment. Similar to USACE, DSL jurisdiction extends to the ordinary high water mark of rivers and streams, and to the boundaries of jurisdictional wetlands.

The Willamette River crossing and other permanent structures within waters of the state will require a Submerged Lands Easement from DSL.

3.4.2.1.1 *Applicability*

Based on a review of preliminary plans of the project alignment, Removal/Fill permits will be required for the same project elements identified under USACE Permits, above. These elements include:

- Upgrades to the Clackamas River Intake facility.
- Willamette River crossing, related bore pit construction, and connecting pipeline.
- Other impacted jurisdictional wetlands or water bodies (e.g., along Oswego Creek or Lake Oswego).

3.4.2.1.2 *Planning Considerations*

While the Clackamas and Willamette Rivers are designated as essential salmon habitat, Oswego Creek and Lake Oswego are not. Thus, the 50 cubic yard threshold may not apply to fill or removal activities within the OHW mark of these waterbodies.

There are no streamlined review procedures (known as General Authorizations) for utility construction under DSL's Removal/Fill law. Therefore, a full individual permit with a 120 day review period is anticipated for project elements within DSL's jurisdiction.

Like the USACE, DSL will require compensatory mitigation for unavoidable impacts and implementation of best management practices during construction (i.e., construction should occur in a manner that does not adversely affect other resources and uses (e.g., water quality, fish and their habitats, and recreation).

Submerged Lands Easements will require surveys and negotiation. However, this work need not extend beyond the permit review time significantly (90 days if no protest is made).

3.4.2.1.3 *DSL Permitting Strategy*

In addition to the strategies recommended for the USACE permit above, the following actions are recommended for DSL:

- Field reconnaissance should address the areas of DSL jurisdiction (i.e., "waters of the State") and required earthwork within these areas, including review of work along Oswego Creek and Lake Oswego.
- Meet with DSL staff to review preliminary project plans with updated base maps (containing OHW, wetland limits, etc) and confirm jurisdictional limits and applicable permit processes.
- When plans are further developed, meet with State Marine Board staff to review any comments they may have, particularly with respect to the Clackamas River intake.
- When preferred options for in-water construction work are selected, include DSL representative in a joint meeting and tour of the alignment with regulatory agencies. The pre-application tour will provide an opportunity to review the alternatives evaluation and measures taken to minimize impacts, ensure that all concerns have been addressed, and lay the groundwork for a coordinated permit review process.

Oregon Department of Transportation

The Oregon Department of Transportation (ODOT) requires a Street Opening Permit for any surface construction that occurs within the right-of-way of State owned and maintained roadways. Two ODOT roadway crossings are anticipated for this project: Highway 99E (McLoughlin Blvd) and Highway 43 (Willamette Drive).

The Street Opening Permit allows surface cuts, borings under the highway, and other construction methods within the highway right-of-way. The permit process begins with submittal of an Application and Permit to Occupy or Perform Operations upon a State Highway, which will include a set of project plans (including traffic and landscape plans), a narrative describing the project and construction activities, and a description of a settlement monitoring program (where applicable). Any ground improvement work that may be required for the crossings and encroachments should be coordinated with ODOT.

3.4.2.1.4 *Applicability*

The preliminary project alignment indicates that two ODOT facilities will be impacted: Highway 99E (McLoughlin Blvd) and Highway 43 (Willamette Drive). At Highway 99E, a perpendicular crossing (jack and bore) occurs at Gloucester Street. At Highway 43, the proposed alignment shows a long section of parallel encroachment from Cedar Oak Road north to George Rogers Park and a crossing at Wilbur Road.

3.4.2.1.5 *Planning Considerations*

Primary ODOT concerns are expected to be construction work within ODOT highways, particularly the long encroachment on Highway 43. A major component of the ODOT review will be the traffic control plan (TCP) established for the project, which should be developed in close association with ODOT. Boring is the construction option preferred by ODOT, which is generally consistent with the construction plans for the two highway crossings. ODOT will generally require that disturbed surface areas be restored to pre-existing conditions.

Early coordination will be critical to address any concerns related to the impacts of the Highway 43 work. Review by ODOT normally takes one month once a complete application is submitted. However, the review process is expected to be longer given the scale of this project.

3.4.2.1.6 *ODOT Permitting Strategy*

The following strategy is recommended for addressing ODOT permits:

- Review existing utility as-builts, road and landscape conditions within the project impact area.
- Meet with ODOT permitting and technical staff once the preferred alignment is selected, then at 30 percent and at 60 percent design stages. Meetings should address:
  - All ODOT owned lands impacted by the project, including both rights-of-way and independent parcels owned by ODOT (if any).
  - ODOT projects and plans for future street improvements.
  - ODOT recommended traffic control options and street/landscape reconstruction standards.

<u>Oregon Department of Environmental Quality</u>

A NPDES 1200-C General Construction Permit is required from the Department of Environmental Quality (DEQ) for construction activities including clearing, grading, excavation, and stockpiling activities that will result in the disturbance of one or more acres of land.

The permit application will include submittal of project design plans, an Erosion and Sediment Control Plan (ESCP), an Erosion Control Worksheet, and a Land Use Compatibility Statement (LUCS) signed by a local planner. For this project, the LUCS will likely need to be signed by planners in each of the four affected Cities. The ESCP must be submitted to DEQ at least 30 days before starting the project.

3.4.2.1.7 *Applicability*

A 1200-C permit will be required since the project will disturb more than one acre of land. The permit will apply to all surface construction disturbance (e.g., bore pits, trenching, facility improvements) for the project as a whole.

3.4.2.1.8 *Planning Considerations*

This relatively straightforward permit is often obtained by the construction contractor. As erosion control specifications are developed, it is helpful to review current DEQ requirements with the agency contact; recently, more attention has been given to such things as gravel construction aprons, concrete truck washes, and seed specifications. The ESCP needs to show both existing and proposed grading.

Coordination of the LUCS is important since four city planners will need to sign off before submittal of the 1200-C permit to DEQ. Some planning departments charge a fee and may take a week or two to review the LUCS.

3.4.2.1.9 *DEQ Permitting Strategy*

- Compile required elements for the permit application at least one to two months before construction is scheduled to commence. These elements include the ESCP, Erosion Worksheet, and a LUCS signed by local planners.
- Permit submittal is best done after all land use permits for the project are obtained so that the land use decision findings can be attached to the LUCS (as required).
- Most efficient strategy is to have the staff planner who reviewed the local land use case sign the LUCS (e.g., set up an appointment).
- Allow at least two weeks for permit review once the complete package is submitted.

<u>Oregon State Historic Preservation Office</u>

Archaeological permits will be required if archaeological resources are found along the project corridor during pre-construction field assessment or during construction. The determination of archaeological (cultural) resources includes three phases, of which Phases II and III require permits obtained from the SHPO. Phase I is a field assessment of cultural resources in the project area.[9] The Phase II evaluation (if needed) determines the level of significance associated with the resources through a formal review process. Based on the Phase II findings, Phase III may or may not be required. Phase III is the final mitigation process, which is usually focused on avoidance. A Finding of Effect, which evaluates the project's impacts to the resource, is produced in Phase III.

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[9] Projects such as this will typically have an archaeologist involved during the preliminary design phase to conduct a "Phase I" field assessment of the project alignment corridor.

3.4.2.1.10 *Applicability*

The archaeological permit, if required, will apply to the whole project. The field investigation focuses on construction activities (e.g., trenching, pit construction, facility upgrades) located at or near the ground surface where resources are most likely to be found.

3.4.2.1.11 *Planning Considerations*

A project archaeologist may recommend that a Phase II investigation be conducted and permits be obtained even if no resources are discovered if they believe that there is a strong likelihood of discovery during construction (a permit avoids the potential for work stoppage if artifacts are found during construction).

At a minimum, if no archaeological resources are found during the initial assessment, construction specifications for the project should include discovery provisions to address what happens if resources are found during construction.

3.4.2.1.12 *SHPO Permitting Strategy*

- Retain an archaeologist to conduct a Phase I field assessment of the project alignment corridor during the pre-design phase.
- If resources are found, or if desired by the City, complete a Phase II investigation; this normally takes from three to six months to complete and an additional month to process). Complete the Phase III process only if required.

3.4.3 Overall Permitting Strategy

Of the permits reviewed in this memorandum, three may be potential critical path elements for the project schedule. These permits are the following:

- U.S. Army Corps of Engineers (particularly the Section 7 consultation component). Early coordination with USACE, NOAA Fisheries and USFWS is needed, and the permit itself should be submitted by November in anticipation of the July in-water construction start date.
- Department of State Lands. Processed jointly with the above permit, this permit has a 120-day (potentially more) review timeline.
- Union Pacific Railroad. This permit sometimes warrants one or more trips to Omaha and may require six months for processing.

The broader strategy for obtaining state and federal permits is a well-coordinated and focused collaboration with the engineering team and key agency personnel. It includes early field visits to assess potential impacts to wetland and sensitive species, followed by field trips with regulatory agency staff to establish jurisdictional limits and scope of permits. Interagency meetings and/or tours may be warranted (particularly for the USACE and DSL permits) to ensure that all reviewers are on the same page, and to agree on the most efficient permit processing approach. Thorough and well-documented alternative analyses (e.g., at the intake) and technical reports (e.g., biological assessments) are keys to a successful permit strategy. The strategy will be organized around a permit tracking matrix including all the basic permit and contact information, as well as target dates for each step of the process such as permit preparation, supporting data collection, internal review, permit submittal, and permit issuance, all tied to construction start dates for the affected project elements.

SIGNIFICANCE OF CONSERVATION ON SUPPLY IMPROVEMENTS

4.1 BACKGROUND

The Cities of Lake Oswego and Tigard (Cities) retained Carollo Engineers in June 2006 to develop and evaluate options for the possible formation of a joint water supply system for the two communities. The Joint Water Supply System Analysis (JWSSA) will identify a preferred supply scenario from a range of alternatives, and addresses the permitting, governance, design, financing, and construction related issues associated with implementing the proposed joint water supply system.

As part of this effort, the City of Lake Oswego (Lake Oswego) has requested that an evaluation of the impacts of water conservation within the City on short and long-term supply improvements also be conducted.

4.2 PURPOSE

The purpose of this chapter is to describe the relative significance of three potential conservation strategies on the capacity, cost, and implementation schedule of supply requirements, supply scenarios, and the associated capital improvements for the proposed water supply scenarios.

4.3 DEMAND PROJECTIONS

The projected build-out demands of Lake Oswego and Tigard are presented in Table 4.1. Further description regarding the basis for these projections can be found in Chapter 1, Water Supply System Evaluation.

Table 4.1 Build-out Demands for Lake Oswego and Tigard
Joint Water Supply System Analysis
City of Lake Oswego and Tigard Water Service Area

	Average Day Demand	Peak Day Demand
Lake Oswego Water Service Area	10.4 mgd	23.9 mgd
Tigard Water Service Area	10.1 mgd	21.1 mgd
Total	20.5 mgd	45.0 mgd

4.4 CONSERVATION STRATEGIES

To reduce Lake Oswego's projected build-out demands, and therefore reduce the expansion effort of Lake Oswego's water supply infrastructure, the City has identified the need to consider implementing conservation strategies for the community. Based on input from both Lake Oswego and Tigard, three conservation strategies were identified for this analysis:

1. 5% Reduction Target, resulting in 0.5% reduction in per capita demands per year for eleven years,
2. 10% Reduction Target, resulting in 1.0% reduction in per capita demands per year for eleven years,
3. 25% Reduction Target, resulting in 2.5% reduction in per capita demands per year for eleven years.

These strategies were determined to be reasonable alternatives based on an evaluation of the City of Tigard's historical conservation efforts. The type and level of effort needed to obtain these conservation levels is beyond the scope of this effort; however, typical conservation techniques for water suppliers and water users is as follows:

- Water Suppliers: water reuse, water use restrictions, vigilant water metering, and increased awareness of water distribution system maintenance needs.
- Water Users: rainwater collection, water-conserving landscaping and irrigation practices, installation of low-flow fixtures and appliances, and proper swimming pool maintenance.

4.4.1 Impacts of Conservation on Demand

The impacts of these three conservation strategies on the build-out demands of the Lake Oswego water service area are presented in Table 4.2.

Table 4.2 Conservation Impacts on Lake Oswego Service Area Demands Joint Water Supply System Analysis City of Lake Oswego and Tigard Water Service Area

Strategy	Build-out Demand	Overall Reduction
No Conservation	23.9 mgd	--
5% Target	22.6 mgd	5.4%
10% Target	21.4 mgd	10.5%
25% Target	18.1 mgd	24.3%

The impact of these conservation strategies on Lake Oswego's future demands will defer the necessary timing of the expansion to the City's water supply facilities. The service area demands, as predicted by the three conservation strategies, are presented in Figure 4.1.

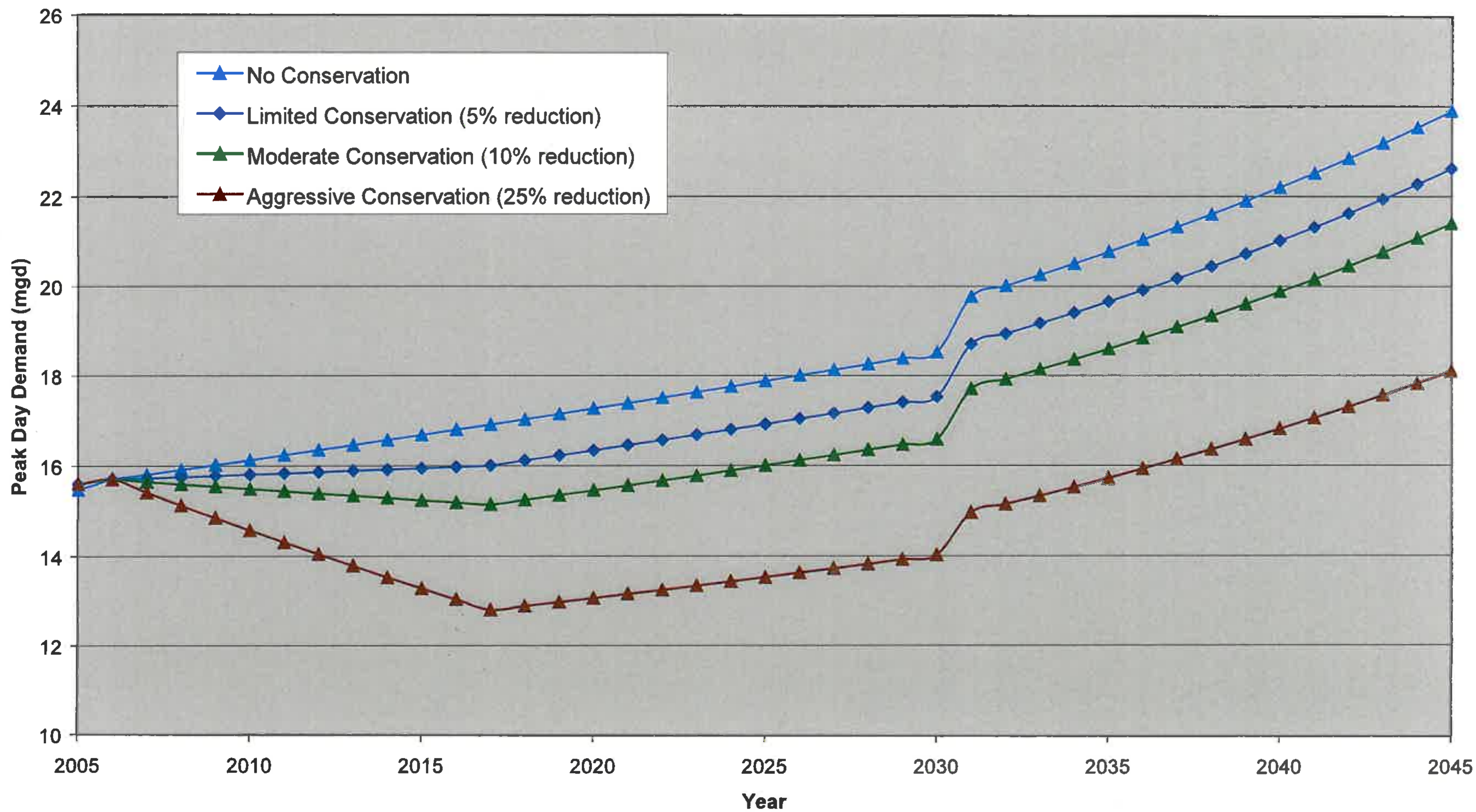

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Figure 4.1
CONSERVATION IMPACTS ON LAKE OSWEGO FUTURE DEMANDS
JOINT WATER SUPPLY SYSTEM ANALYSIS
CITY OF LAKE OSWEGO AND TIGARD WATER SERVICE AREA

4.4.2 Impacts of Conservation on Timing of Supply Improvements

By implementing the proposed conservation strategies, the City of Lake Oswego will be able to defer the implementation of its future water supply improvements to 2017 at the earliest. This would allow the City to pursue alternative funding strategies for the supply improvements thereby potentially reducing impacts to customer rates and fees. However, it should be noted that conservation alone will not be sufficient to eliminate the City's need to expand the existing water supply infrastructure.

4.4.3 Impacts of Conservation on Supply Scenarios

As discussed in Chapter 1, Water Supply System Evaluation, the supply scenarios are as follows:

1. Scenario 1: Existing Capacity (16 mgd)

This scenario represents the existing demands and capacity of the Lake Oswego infrastructure.

2. Scenario 2: Future Capacity (24 mgd)

This scenario represents the required capacity to treat the build-out demands of the Lake Oswego water service area.

3. Scenario 3: Senior Water Right Capacity (32 mgd)

This scenario represents the capacity needed to convey the senior water rights that Lake Oswego has been permitted to withdraw from the Clackamas River.

4. Scenario 4: Combined Junior and Senior Water Right Capacity (38 mgd)

This scenario represents the capacity needed to convey the combined junior and senior water rights that Lake Oswego has been permitted to withdraw from the Clackamas River.

The scenarios were developed to document the supply impacts for four alternatives: existing capacity, intermediate capacity, capacity equivalent to Lake Oswego's senior water rights, and capacity equivalent to Lake Oswego's senior and junior water rights. The first, third, and fourth scenarios are based on fixed parameters; therefore, the only scenario that could be impacted by implementation of conservation techniques is the intermediate capacity scenario, or Scenario 2.

As seen in Table 4.2, the impact of the conservation strategies results in a build-out peak day demand for the Lake Oswego water service area of 22.6 mgd, 21.4 mgd, or 18.1 mgd, respectively. Due to the inherent advantage of increasing capacity in multiples (such as basin sizing, multiple pump capacity, and overall treatment configuration), it was determined that Scenario 2 will be based on a capacity of 24 mgd for the low and moderate conservation strategies (5% and 10% target reduction), and a capacity of 20 mgd for the aggressive conservation strategy (25% target reduction).

The supply allocations for Lake Oswego and Tigard, as defined by these scenarios and the proposed conservation strategies, are presented in Table 4.3.

Table 4.3 Conservation Impacts on Supply Allocation per Scenario at Build-out
Joint Water Supply System Analysis
City of Lake Oswego and Tigard Water Service Area

Scenario Description		No Conservation		Low Conservation (5% Target)		Moderate Conservation (10% Target)		Aggressive Conservation (25% Target)	
		Lake Oswego	Tigard	Lake Oswego	Tigard	Lake Oswego	Tigard	Lake Oswego	Tigard
1	16 mgd	23.9	0	22.6	0	21.4	0	18.1	0
2	24 mgd	23.9	0.1	22.6	1.4	21.4	2.6	18.1	5.9
3	32 mgd	23.9	8.1	22.6	9.4	21.4	10.6	18.1	13.9
4	38 mgd	23.9	14.1	22.6	15.4	21.4	16.6	18.1	19.9

Scenario 4 represents the maximum water rights available to Lake Oswego from the Clackamas River (38 mgd). As seen in Table 4.3, if Lake Oswego does not implement any conservation techniques, Tigard would receive a maximum capacity of 14.1 mgd, which falls considerably short of Tigard's build-out peak day demands of 21.1 mgd. However, it should be noted that Tigard does expect to supplement their peak day demands with Aquifer Storage and Recovery (ASR) for up to 3.5 mgd, reducing their overall build-out peak day demands to 17.6 mgd. Therefore, if Lake Oswego implements an aggressive (25% target) or moderately aggressive (15% target) conservation strategy, they could reduce their demands sufficiently to meet both Cities' build-out peak day demands under Scenario 4 (38 mgd capacity).

4.4.4 Impacts of Conservation on Capital Costs

As previously stated, only Scenario 2 would be impacted by the proposed aggressive conservation strategy. Therefore, the costs associated with implementing the aggressive conservation strategy for Scenario 2 will also be impacted. The capital costs for implementing the aggressive conservation strategy for Scenario 2 are presented in Table 4.4.

Table 4.4	Conservation Impacts on Scenario 2 Capital Costs Joint Water Supply System Analysis City of Lake Oswego and Tigard Water Service Area
Type	**Scenario 2 24 mgd**
Clackamas River Intake	$2,100,000
Raw Water Transmission Main	$18,200,000
Lake Oswego Water Treatment Plant	$24,000,000
Finished Water Transmission Main	$18,400,000
Waluga Reservoir	$2,470,000
Bonita Pump Station	N/A
Total	**$65,170,000**

The total costs for Scenario 2 with and without implementation of the aggressive conservation strategy are $65.2 and $78.6 million, respectively, resulting in an overall reduction of 17%.

4.5 CONCLUSIONS

As previously stated, implementing the proposed conservation strategies will enable Lake Oswego to defer the timing of the expansion of their water supply infrastructure; however, it will not eliminate the need entirely. Therefore, Lake Oswego must still plan for the capacity expansion of their intake, raw water transmission main, treatment plant, storage, and distribution system. Depending on the conservation strategy adopted, Lake Oswego will be able to defer the timing of the capacity improvements from 2017 to 2037.

A summary of the capital costs and timing for each of the proposed conservation strategies is presented in Table 4.5.

Table 4.5 Summary of Conservation on Infrastructure Costs and Timing
Joint Water Supply System Analysis
City of Lake Oswego and Tigard Water Service Area

Conservation Strategy	Cost Savings		Implementation Timing	
	Amount	Percentage	Year	No. of Years Deferred
5% Target	N/A	N/A	2017	8
10% Target	N/A	N/A	2025	16
25% Target	$13.4M	17%	2037	28

EVALUATION OF INTERIM SUPPLY TO LAKE OSWEGO

5.1 BACKGROUND

The Cities of Lake Oswego and Tigard (Cities) retained Carollo Engineers in June 2006 to develop and evaluate options for the possible formation of a joint water supply system for the two communities. The Joint Water Supply System Analysis (JWSSA) will identify a preferred supply scenario from a range of alternatives, and addresses the permitting, governance, design, financing, and construction related issues associated with implementing the proposed joint water supply system. As part of this effort, an evaluation of two alternatives to provide interim supply to the City of Lake Oswego (City, Lake Oswego) will be conducted.

5.2 PURPOSE

This chapter presents the findings and recommendations of the two interim supply alternatives, including identification of the available capacity of the two alternatives, capital and operations and maintenance (O&M) costs for the associated upgrades, and the implications for timing of future supply improvements to implement the four supply scenarios.

5.3 INTERIM SUPPLY ALTERNATIVES

Four water supply scenarios were developed and evaluated as part of the JWSSA, and are described in detail in Chapter 1, Water Supply System Evaluation. The supply scenarios are as follows:

- Scenario 1: "Do Nothing" Existing Capacity (16 mgd)
- Scenario 2: Lake Oswego Only, Future Capacity (24 mgd)
- Scenario 3: Lake Oswego & Tigard, Senior Water Right Capacity (32 mgd)
- Scenario 4: Lake Oswego & Tigard, Combined Junior and Senior Water Right Capacity (38 mgd)

Scenario 1 represents the existing capacity of the Lake Oswego water supply infrastructure (16 mgd). Based on the Lake Oswego water service area population growth and historical per capita demands, it is projected that the capacity of the existing supply system will need to be expanded in 2009 unless further action is take to reduce the existing peak day demands or increase the existing peak day supply capacity. Options for conservation strategies to reduce the existing peak day demand are presented in Chapter 4. Options for increasing Lake Oswego's existing peak day supply capacity are presented in the following subsection. Such near-term interim supply improvements would potentially allow Lake Oswego to defer the expansion of the water supply infrastructure for several years.

5.3.1 Description of Interim Supply Alternatives

The two interim supply alternatives evaluated for the JWSSA are as follows:

- Supply from Portland: This interim supply alternative to Lake Oswego consists of providing supply via the Washington County Supply Line (WCSL) from the City of Portland (Portland). It is assumed this would consist of a connection to the 36-inch diameter "Tualatin Line" that connects to the WCSL and provides gravity flow from Portland to the City of Tualatin. This pipeline passes within approximately two blocks of Tigard's existing Bonita Pump Station. It is further assumed that Tigard's existing wholesale water supply agreement with the City of Portland could be used as the basis for purchasing water from this line.
- Supply from SFWB: This alternative consists of supply from the South Fork Water Board (SFWB) via the existing intertie with the City of West Linn (West Linn).

5.3.1.1 Supply from Portland

The available capacity of the WCSL-Tualatin Line is based on a recent capacity evaluation of the supply pipeline[1] provided by the City of Tigard. As identified in this report, the 2010 peak season demands indicate that the available capacity at the Tualatin Park pressure reducing valve is anticipated to be 11.1 mgd. The 2005 peak 3-day demand of the City of Tualatin (the last user on this segment of the WCSL) is about 8.5 mgd, resulting in an available capacity of about 2.6 mgd. It is assumed that the City of Sherwood, which can purchase water from the City of Tualatin, will continue to implement an alternative supply from the Willamette WTP in Wilsonville; thus, Sherwood's demands are not included in this estimate of available capacity. Is also assumed the existing owners of the WCSL will not object to Tigard's use of the supply line.

To access this additional capacity, it is proposed that the City of Tigard construct a connection to the Tualatin Line at approximately SW 72nd and Bonita Road, about two blocks west of Tigard's Bonita Road Pump Station. It is proposed this be a 12-inch diameter connection to provide up to about 3.5 mgd of gravity supply to the City of Tigard for use when non-peak day capacity is available on the Tualatin Line. From the WCSL connection, water would flow to a new vault containing a meter and control valve that would be connected to the existing pipelines from Lake Oswego that are currently used provide supply from Lake Oswego to Tigard's Bonita Road Pump Station. Based on this preliminary analysis, this configuration would provide about 2.5 mgd of peak day capacity from the proposed WCSL connection to Lake Oswego's Waluga Reservoir without pumping and without construction of a new transmission line from Tigard to Lake Oswego.

[1] "Washington County Supply Line - Delivery System Capacity Assessment", 2005, MSA.

5.3.1.2 Supply from SFWB

The alternative would provide interim supply to Lake Oswego is from the SFWB, via the existing intertie with West Linn. Per Lake Oswego staff, the 18-inch intertie has enough capacity to provide 2 to 6 mgd of gravity-fed supply to Lake Oswego. However, West Linn staff has indicated[2] that the existing intertie between West Linn and Lake Oswego was developed as an emergency intertie and, as such, there is not sufficient capacity in the West Linn system to provide peak demands to Lake Oswego. This capacity limitation is based on capacity of West Linn's existing Willamette River crossing as well as transmission and distribution system capacity up to the point of the existing intertie with Lake Oswego. Thus, extensive upgrades in West Linn's existing transmission system capacity would be required to provide peak day capacity to serve Lake Oswego. West Linn recently started an update to their water system master plan and was unable to identify specific improvements that would be required.

In addition, West Linn staff also indicated that a new water supply agreement would need to be negotiated by West Linn and Lake Oswego inasmuch as the existing agreement is specifically limited to emergency supply.

Based on these significant limitations with the West Linn connection, this alternative was dropped from further consideration in this analysis.

5.3.2 Factors to Consider in Evaluating the Interim Supply Alternative

Further evaluation of the potential interim supply from Portland has identified two additional factors to consider with respect to the viability of this alternative:

- Recent discussions with Tualatin Valley Water District (TVWD) staff have indicated that the remaining 2.6 mgd within the WCSL-Tualatin Line is available only if the City of Sherwood is not purchasing water in the summer. However, TVWD – which operates the Sherwood water system under contract with the City of Sherwood - has identified that Sherwood anticipates continuing to use their connection with Tualatin for peak season supply for the next two years (through 2009); thus, there would be no excess peak capacity available from this segment of the WCSL for the next two years.
- Additionally, demand projections for the City of Tualatin indicate their peak demands after 2010 will be equal to the available capacity of the WCSL; thus, there would be no excess peak capacity available from this segment of the WCSL after 2010.

Therefore, based on existing agreements and anticipated growth in the service area, a connection to this segment of the WCSL would not be available to meet to meet Lake Oswego's near-term demands or allow a delay in the expansion of Lake Oswego's supply system.

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[2] Personal communication with Dennis Wright, City of West Linn, Acting City Engineer, February 2007.

However, additional considerations warrant further consideration of the possible construction of a connection to the WSCL in Tigard.

- Tigard is currently purchasing pumped water from Portland via their existing connection at Bradley Corner, at a cost of about $1.02/ccf. Should a connection to the WCSL be made, Tigard might be able to purchase non-peak water from Portland at the gravity rate (a likely cost of $0.73/CCF). Depending on operational strategies and availability of non-peak season water, this scenario could result in a savings to Tigard of approximately 15% of their annual cost of water from the City of Portland. Further analysis of these savings is presented in Section 8.3.4 of this chapter.
- The new connection by Tigard to the WCSL would provide both Tigard and Lake Oswego with additional reliability through interconnections to the regional water supply infrastructure. Lake Oswego would be able to receive emergency supply via Portland. Similarly, Lake Oswego could potentially provide emergency supply to Tigard and/or the City of Tualatin. The long-term reliability benefit to the region's water providers may help further justify the cost of the new intertie.

5.3.3 Implications of Interim Supply on Timing of Future Expansion Needs

As discussed in Section 8.3.2, the interim supply from the WCSL-Tualatin Line does not have sufficient capacity to offset Lake Oswego's peak day demands. Therefore, this alternative does not allow for expansion of Lake Oswego's supply infrastructure to be deferred. The timing of the supply improvements is presented in Table 5.1, and is further discussed in Chapter 2, Evaluation of Water Supply Facility Alternatives.

Table 5.1 Supply Improvement Implementation Timing
Joint Water Supply System Analysis
City of Lake Oswego and Tigard Water Service Area

Service Area	Scenario 1 (16 mgd) Do Nothing	Scenario 2 (24 mgd) LO Go It Alone	Scenario 3 (32 mgd) LO and Tigard	Scenario 4 (38 mgd) LO and Tigard
Lake Oswego Service Area[1]	2009	2045	N/A[2]	N/A
Lake Oswego and Tigard Water Service Area	Now	Now	2019	2035

Notes:
1. Lake Oswego Service Area includes current wholesalers and the Stafford Triangle (to be served in 2030).
2. Scenario capacity not applicable for this option.

5.3.4 Conceptual Capital and Operations Costs for Interim Supply

The capital costs for the interim supply to Lake Oswego from the WCSL-Tualatin Line are presented in Table 5.2.

Table 5.2	Conceptual Capital Costs for Interim Supply from WCSL Joint Water Supply System Analysis City of Lake Oswego and Tigard Water Service Area
Component	**Capital Cost**
Connection to WCSL	$500,000[1]
Control Valves and Vault	$200,000
Connection to Waluga Reservoir Pipeline[2]	$700,000
Total	**$1,400,000**

Notes:
1. "Washington County Supply Line - Delivery System Capacity Assessment", 2005, MSA.
2. 900 linear feet of 18-inch diameter pipe.

As previously discussed, the potential exists for Tigard to incur substantial savings in purchased water if the connection to the Lake Oswego supply system was constructed. If Tigard were able to purchase approximately 50% of its annual average supply from Portland through the gravity connection at a rate of $0.73/ccf, the total savings would be approximately $272,000 per year, which represents a savings of about 14%.

If this degree of savings could be achieved, simple payback of cost the Tigard connection to the WCSL-Tualatin Line would be slightly more than five years. In addition, the potential net savings (savings less construction cost) during the nine years remaining on Tigard's existing contract with Portland would be approximately $1 million.

It should be noted that this savings could potentially be achieved without changes in Tigard's seasonal peaking factor; Tigard would continue to purchase the same quantity of water but would do so from the gravity connection when capacity is available and purchase water from the pumped system when gravity capacity is not available. Specific details and terms for such an arrangement would need to be negotiated with the existing owners of the WCSL, including Portland, TVWD, the Raleigh Water District and the City of Tualatin.

5.4 ALTERNATIVE RAW WATER SUPPLY

In addition to evaluating the feasibility of developing an interim supply source for Lake Oswego, an evaluation was also made to determine the feasibility of purchasing additional raw water capacity from the SFWB's existing intake on the Clackamas River. This alternative assumes the following:

- SFWB would be willing to enter into such an agreement for selling, leasing or transferring capacity of their existing intake to Lake Oswego,
- Lake Oswego and the SFWB are able to establish mutually agreeable terms for such an arrangement, and

- The point of diversion for some of Lake Oswego's existing water rights would be transferred to the SFWB intake.

5.4.1 Cost to Obtain Intake Capacity from the SFWB

This alternative is assumed to consist of: purchasing a proportionate share of the SFWB intake facility (either as purchase or equivalent lease), expanding the pumping capacity of the existing SFWB intake to deliver Lake Oswego's purchased capacity, construction of a new raw water transmission pipeline and river crossing to convey water from the SFWB intake to the Lake Oswego intake, and expansion of the existing Lake Oswego intake pumping capacity. These improvements would deliver the additional raw water only to the existing Lake Oswego intake. This allows for a direct comparison of this alternative to replacing Lake Oswego's existing intake with a new structure. In either case, additional improvements, as outlined in Chapter 2, would be required to convey the raw water to an expanded Lake Oswego water treatment plant.

Capital costs for purchasing raw water intake capacity from the SFWB were developed for Scenarios 3 and 4, which would require purchasing capacity of 8 mgd and 14 mgd, respectively. Conceptual costs, in November 2006 dollars, are summarized in Table 5.3.

Table 5.3 Conceptual Costs to Purchase Raw Water Capacity from the SFWB Intake
Joint Water Supply System Analysis
City of Lake Oswego and Tigard Water Service Area

Scenario	Project Element	Capital Cost ($ Millions)
No. 3 Capacity: 32 mgd Purchase: 8 mgd	SFWB Intake Cost Share	$0.9
	SFWB Intake Pump Expansion	$0.5
	Pipeline & River Crossing (5,000 LF, 20-inch diam.)	$10.6
	Expansion of Lake Oswego Intake Pumps	$1.0
	Total	$13.0
No. 4 Capacity: 38 mgd Purchase: 14 mgd	SFWB Intake Cost Share	$1.5
	SFWB Intake Pump Expansion	$0.6
	Pipeline & River Crossing (5,000 LF, 26-inch diam.)	$12.1
	Expansion of Lake Oswego Intake Pumps	$1.3
	Total	$15.5

As shown in Table 5.3, the cost for purchasing raw water intake capacity from the SFWB ranges from approximately $13 million to $16 million for Scenarios 3 and 4, respectively. This cost is dominated by the relatively large cost of the transmission pipeline and river crossing required to convey water from the SFWB intake to the Lake Oswego intake. In comparison, the cost of constructing a new Lake Oswego raw water intake for Scenarios 3 and 4 is approximately $4.4 million to $4.7 million, respectively (see Technical Memorandum No. 2, Evaluation of Water Supply Facility Alternatives).

Given the large cost difference between the SFWB option and construction of a new intake, it is recommended that the option for purchasing raw water capacity from the South Fork Water Board be dropped from further consideration in the Joint Water Supply System Analysis.

5.5 CONCLUSIONS

Lake Oswego's existing emergency intertie with the City of West Linn and a possible intertie to the Portland-Washington County Supply Line in Tigard were evaluated as possible interim peak season supplies that would allow Lake Oswego to defer near-term expansion of their existing supply system. In both cases, demands on these alternative sources are such that peak season capacity would not be available to meet Lake Oswego's projected peak day needs; thus, they are not feasible means of deferring expansion of the Lake Oswego supply system.

However, the proposed connection from the WCSL-Tualatin Line would potentially provide near-term benefits to the City of Tigard by decreasing Tigard's costs for non-peak season water purchases from Portland. In addition, Lake Oswego, Tigard and other water providers in the region would benefit by having this connection available as an emergency intertie between the Portland and Lake Oswego supply systems.

FINANCIAL EVALUATION AND RATE IMPACTS

6.1 FINANCIAL EVALUATION

The financial evaluation of the supply scenarios for Lake Oswego and Tigard was conducted to provide comparative costs of the scenarios for each City, and to evaluate the economic advantages and disadvantages of each scenario. The FCS Group was tasked to 1) define the total costs of each scenario, 2) allocate the costs between Lake Oswego and Tigard, and 3) quantify the economic costs of each scenario for both Cities. This chapter summarizes the financial evaluation and rate impact evaluation conducted by FCS Group; technical memoranda presenting the complete evaluation by FCS Group can be found in Appendix D of this Summary Report.

6.1.1 Methodology

The financial evaluation was conducted for Scenarios 2 - 4 for both Cities. Scenario 1 was excluded from this evaluation because this scenario has a significantly different objective of providing no increase in existing supply capacity and therefore could not be fairly compared to the other scenarios as part of the financial evaluation. An additional scenario (Scenario 5) was originally included in the financial evaluation, which described a scenario in which Lake Oswego and Tigard partnered at a capacity of 38 mgd, and included the costs associated with developing an interim supply source for Lake Oswego to offset the immediate need for expansion to their water supply infrastructure. Further evaluation of the interim supply option (see Chapter 5) identified that an interim supply source is not a feasible alternative to defer the timing of the improvements; therefore, Scenario 5 is not included in this summary of the financial evaluation.

In general, demands used for this evaluation were based on information presented in Chapter 1. Lake Oswego demands were based on the existing degree of water conservation, with no additional conservation savings assumed. It was further assumed that Tigard demands would be satisfied in part by up to 3.5 mgd from Tigard's existing ASR system. The costs associated with Tigard's ASR system are not included in this financial evaluation.

A summary of the scenarios evaluated for each City is presented below:

6.1.1.1 Lake Oswego

- **Scenario 2 - Lake Oswego "Go-It-Alone" (24 mgd):** Represents the required capacity to meet the projected build-out demands of the Lake Oswego water service area. Under this scenario, Tigard does not receive any supply capacity from the Lake Oswego system.
- **Scenario 3 – Senior Water Right Capacity (32 mgd):** Represents a capacity expansion equivalent to Lake Oswego's senior water rights. This capacity exceeds the build-out demands of the Lake Oswego water service area and thus provides some capacity to meet a portion of Tigard's demands.
- **Scenario 4 – Combined Junior and Senior Water Right Capacity (38 mgd):** Represents a capacity expansion equivalent to Lake Oswego's senior and junior water rights. This capacity meets the build-out needs of Lake Oswego, while providing the majority of Tigard's demands.

6.1.1.2 Tigard

Scenarios 2, 3 and 4 do not provide sufficient capacity to meet Tigard's ultimate max day demands at build-out (without additional conservation by Lake Oswego). Under each scenario, it was necessary to identify an alternative source of supply to meet Tigard's demands to provide a complete solution for water supply for each community.

In addition to partnering with Lake Oswego, three sub options were developed, including: partnering with the Joint Water Commission (JWC), partnering with other regional water providers to expand the Willamette River source (Willamette with Partners), and Tigard "go it alone" on the Willamette supply (Willamette "Go It Alone"). These options were combined with Scenarios 2 and 3, as needed, to provide a complete cost comparison for Tigard. It was further assumed that these alternative sources would not be available until FY 2016/17. To meet Tigard's needs until then, it was assumed that Tigard would continue to purchase water from the City of Portland.

In the case of Scenario 4, the capacity of a joint supply system (38 mgd) is sufficient to meet about 80 percent of Tigard's projected build-out demands (without Lake Oswego conservation). This was assumed to provide sufficient capacity to Tigard such that it would not be economical for Tigard to invest in an alternative regional supply. Thus, it was assumed that Tigard would continue to purchase water from Portland to make up any shortfall from the joint supply under Scenario 4. It should also be noted that under Scenario 4, if Lake Oswego is able to reduce its per capita demand through implementation of a water conservation strategy (as described in Chapter 4), the potential does exist for a joint Lake Oswego-Tigard supply system to meet the max day build-out demands for both communities under Scenario 4. However, this option was not submitted for financial evaluation given the assumption of no additional conservation saving by Lake Oswego.

Tigard's supply scenarios were further defined as follows:

- **Scenario 2A – JWC**. Tigard invests in expanded JWC capacity to fulfill all Tigard demands (in excess of ASR capacity). No capacity is provided by Lake Oswego. Portland is an interim source for all water needs in the first 10 years.
- **Scenario 2B – Willamette with Partners.** Tigard invests with other regional partners in an expanded Willamette supply from Wilsonville to meet all Tigard demands (in excess of ASR capacity). No firm capacity is provided by Lake Oswego. Portland is an interim source for all water needs in the first 10 years.
- **Scenario 2C – Willamette "Go It Alone"**: Tigard invests without partners in an expanded Willamette supply from Wilsonville to meet all Tigard demands (in excess of ASR capacity). No capacity is provided by Lake Oswego. Portland is an interim source for all water needs in the first 10 years.
- **Scenario 3A – LO (32 mgd) plus JWC**: Tigard invests in expanded JWC capacity to meet demands not met by the Lake Oswego source, as available in Scenario 3. Required contract quantities are purchased from Portland for the first 10 years.
- **Scenario 3B – LO (32 mgd) plus Willamette with Partners**: Tigard invests in expanded Willamette capacity to fulfill demands not met by the Lake Oswego source, as available in Scenario 3. Required contract quantities are purchased from Portland for the first 10 years. Regional capital and operation costs in this scenario assume major cost-sharing partners also invest in Willamette capacity.
- **Scenario 3C – LO (32 mgd) plus Willamette Go It Alone**: Tigard invests in expanded Willamette capacity to fulfill demands not met by the Lake Oswego source, as available in Scenario 3. Required contract quantities are purchased from Portland for the first 10 years. Regional capital and operation costs in this scenario assume Tigard must develop Willamette without the help of major cost-sharing partners.
- **Scenario 4 – LO (38 mgd) plus purchased water**: Tigard does not invest in regional sources other than Lake Oswego. Required contract quantities are purchased from Portland through 2016. In later years, Tigard purchases water from Portland to meet any demand not met by Lake Oswego source available in Scenario 4.
- **Scenario 6A**: Tigard does not invest in Lake Oswego or any other regional source. Instead, it purchases all water from Portland, based on terms of current contract and adjustments for inflation.
- **Scenario 6B**: Tigard does not invest in Lake Oswego or any other regional source. Instead, it purchases all water from Portland, utilizing a gravity connection for a portion of the purchases. The unit price of water is based on terms of current contract but also includes a pumping discount on 2.6 mgd of purchased water, during off-peak months. This discount of $0.29 per ccf (in 2007 dollars) is also escalated using the inflation rate of 5.6%.

6.1.2 Cost Allocation

The capital and operations and maintenance (O&M) costs for the joint supply scenarios are presented in Chapter 2 of this Summary Report. In addition to these costs, an appropriate "buy-in" cost for Tigard was assessed for each scenario. The buy-in costs incorporate the infrastructure assets owned by Lake Oswego that will also provide benefit to Tigard under a joint supply scenario.

Capital costs, along with the fixed assets eligible for Tigard's buy-in, were allocated on either a proportional basis (costs split on each City's share of total capacity) or an incremental basis (costs split on each City's share of increased capacity). An annual inflation factor of 6% was applied to the capital cost estimates (expressed in current costs) to reflect cost in the year of construction. Reimbursement and replacement costs have not been factored into this analysis.

The O&M costs for each scenario were categorized based on whether or not they fluctuate with water flow. Annual fixed costs were allocated to each City using the corresponding project's capacity allocation percentage. To assign shares of variable costs, the equivalent unit O&M cost (presented in Chapter 2) was applied to each City's average day demand supplied from the project, and then annualized. A 3.5% general inflation factor was applied to future O&M costs to reflect future dollars.

Discount costs were used in the development of net present value computations for the cost stream of each City. The 5% discount factor relates to public agencies' assumed cost of capital, while the 7.0% factor reflects more of a rate impact by taking into account growth in customer base.

A summary of the three interest rates used in the financial analysis is presented in Table 6.1.

Table 6.1 Interest Rates Used in Financial and Rate Analysis
Joint Water Supply System Analysis
City of Lake Oswego and Tigard Water Service Area

Type of Interest Rate	Percentage	Calculation Applied To
Capital Inflation	6%	Cost of Construction in Future Day Dollars, SDC Escalation
General Inflation	3.5%	O&M Costs in Future Day Dollars
Discount Factor[1]	5%, 7%	Net Present Value

Notes:
1. Two discount factors are used for comparative purposes in Section 6.2.

6.1.3 Total Scenario Costs

The net present value of each scenario for Lake Oswego is presented in Table 6.2.

Table 6.2 Net Present Value of Lake Oswego's Supply Options
Joint Water Supply System Analysis
City of Lake Oswego and Tigard Water Service Area

Cost Components	Lake Oswego "Go it Alone" Scenario 2 (24 mgd)	Partner with Tigard Scenario 3 (32 mgd)	Partner with Tigard Scenario 4 (38 mgd)
Capital Costs	$76,500,000	$61,500,000	$52,100,000
O&M Costs	$41,300,000	$33,200,000	$31,000,000
Total Costs	**$117,800,000**	**$94,700,000**	**$83,100,000**

Notes
1. Net Present Values are based on a 25-Year Outlook and a discount factor of 5%.

The net present value of the lowest cost alternative for each of Tigard's primary supply options is presented in Table 6.3. It should be noted that the Scenario 3 options (LO at 32 mgd plus alternative source) are not included in Table 6.2 since they have significantly higher costs as compared to the Scenario 2 and 4 options given the need to invest in Lake Oswego and an alternative source of supply under the Scenario 3 options.

Table 6.3 Net Present Value of Lowest Cost Supply Options for the City of Tigard
Joint Water Supply System Analysis
City of Lake Oswego and Tigard Water Service Area

Cost Components	Partner with JWC Scenario 2A	Willamette With Partners Scenario 2B	Willamette Without Partners Scenario 2C	Partner with Lake Oswego Scenario 4	Purchase from Portland Scenario 6B
Capital Costs	$145,800,000	$77,900,000	$183,100,000	$80,600,000	$1,400,000
O&M Costs	$17,400,000	$11,700,000	$14,600,000	$32,500,000	--
Purchased Water Costs	$33,600,000	$33,600,000	$33,6000,000	$27,800,000	$97,200,00
Total Costs	**$196,800,000**	**$123,200,000**	**$231,300,000**	**$140,900,000**	**$98,600,000**

Notes
1. Net Present Values are based on a 25-Year Outlook and a discount factor of 5%.

The net present value of each scenario for Tigard is presented in Appendix D.

6.1.4 Equivalent Annual Cost Comparison

Equivalent annual costs are an economic statistic that can be used to compare the economic impacts of each alternative. Equivalent annual costs are based on the net present value of the scenarios, with a discount rate of 5 percent, annualized over a 25-year period.

Lake Oswego's lowest cost option is Scenario 4, developing a joint supply with Tigard at 38 mgd. Tigard's lowest cost option is to purchase water from Portland via the new gravity connection with the WCSL-Tualatin Line (see Chapter 5) for nine months of the year, and to purchase water from Portland via the existing water transmission main during the peak summer months. Tigard's second lowest cost option is to partner with other regional suppliers in the development of the Willamette River Project.

However, without the economies of scale associated with group development at the regional level, costs increase considerably. Therefore, the next the lowest cost option for Tigard is to develop a joint supply with Lake Oswego for 38 mgd (Scenario 4). The equivalent annual costs for both Cities are presented in Table 6.4.

6.2 RATE IMPACTS

To evaluate the rate impacts of the supply scenarios, the following steps were taken:

1. Both Cities provided copies of their rate models, along with current financial and budget information. These rate models were updated with FY 2007 budget numbers. All operating and maintenance costs relating to supply and treatment (including water purchases) were replaced with the annual O&M costs calculated for the individual supply system scenarios. For all non-supply/treatment expenses, the gross assumption was made that these costs would continue to annually escalate based on inflation.
2. Rate revenues were annually escalated using the growth forecasts present in each City's models. Adopted rate increases were also integrated (3% in FY 2007/08 for Lake Oswego, 7% in FY 2007/08 for Tigard).
3. Annual capital cost streams for the various scenarios were incorporated. No other planned capital improvement project costs were included in the analysis. Because of this, current capital or system development charge (SDC) fund balances that either City might hold were not used in this analysis. The debt service needed to fund the joint supply projects was calculated and built-in to the impact analysis.
4. Capital supply costs were used to develop a potential SDC that could be implemented; this included supply projects only. This charge was calculated for each of the City's scenarios as detailed below:
   a. Lake Oswego - Supply SDC was broken into two parts: (1) total capital costs that were allocated based on proportional capacity were divided by the total capacity available to Lake Oswego (23.9 mgd in each scenario), and (2) total capital costs that were allocated on incremental capacity were divided by the added capacity (7.9 mgd in each scenario).
   b. Tigard - Supply SDC is the total cost of all capital projects (Lake Oswego as well as regional partner projects) divided by their total capacity needs. Tigard's buy-in payment to Lake Oswego is also included in the capital costs.

Table 6.4 Equivalent Annual Costs[1]
Joint Water Supply System Analysis
City of Lake Oswego and Tigard Water Service Area

Scenario	Lake Oswego	Tigard
2 (24 mgd): Lake Oswego "Go It Alone"	$8,400,000	N/A
2A: Tigard to JWC	N/A	$14,000,000
2B: Tigard to Willamette with partners	N/A	$8,700,000
2C: Tigard to Willamette without partners	N/A	$16,400,000
3 (32 mgd): Lake Oswego and Tigard Partner for Joint Water Supply	$6,700,000	N/A
3A: Tigard partners with Lake Oswego for 32 mgd and invests in JWC to fulfill demands not provided by Lake Oswego	N/A	$15,400,000
3B: Tigard partners with Lake Oswego for 32 mgd and invests in Willamette with partners to meet demands not provided by Lake Oswego	N/A	$10,800,000
3C: Tigard partners with Lake Oswego for 32 mgd and invests in Willamette without partners to meet demands not provided by Lake Oswego	N/A	$14,600,000
4 (38 mgd): Lake Oswego and Tigard Partner for Joint Water Supply	$5,900,000	$10,000,000
6A: Tigard purchases water from Portland through existing connection year-round	N/A	$7,400,000
6B: Tigard purchases water from Portland via new gravity connection for 9 months	N/A	$7,000,000

Notes:
1. Equivalent annual costs are based on a 5% discount rate and annualized over a 25-year period.

5. An SDC revenue stream was forecasted from each supply SDC charge. The growth provided in each City's rate model was lower than the annual growth forecasted in supply planning. In order to remain conservative in our analysis, the lower annual growth rate was used to predict this SDC revenue. SDC charges were also escalated annually with construction cost inflation of 6 percent. The stream of revenues generated from supply SDCs were assumed to be fully available to pay debt service and meet coverage requirements.

6. With all supply-related costs incorporated into the technical models, rate impacts were analyzed. All rate increases were smoothed over several years to mitigate sharp rate impacts on customers. It is important to note that levelizing rates in earlier years buys down future rate impacts.

The annual and cumulative impact on rates for Lake Oswego and Tigard are presented in Table 6.5 and Table 6.6, respectively.

Table 6.5 Lake Oswego Summary of Rate Impacts
Joint Water Supply System Analysis
City of Lake Oswego and Tigard Water Service Area

	FYE	2007	2008[1]	2009	2010	2011	2012	2013	2014	2015	2016	2023
SCN 2	Annual Rate Impact	0.00%	0.00%	148.00%	35.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	Cumulative Rate Impact	0.00%	0.00%	148.00%	148.00%	148.00%	148.00%	148.00%	148.00%	148.00%	148.00%	148.00%
	Average Customer Bill[2]	**$21.01**	**$21.59**	**$53.54**	**$53.54**	**$53.54**	**$53.54**	**$53.54**	**$53.54**	**$53.54**	**$53.54**	**$53.54**
SCN 3	Annual Rate Impact	0.00%	0.00%	60.00%	4.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	Cumulative Rate Impact	0.00%	0.00%	60.00%	66.40%	66.40%	66.40%	66.40%	66.40%	66.40%	66.40%	66.40%
	Average Customer Bill[2]	**$21.01**	**$21.59**	**$34.54**	**$35.93**	**$35.93**	**$35.93**	**$35.93**	**$35.93**	**$35.93**	**$35.93**	**$35.93**
SCN 4	Annual Rate Impact	0.00%	0.00%	56.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	Cumulative Rate Impact	0.00%	0.00%	56.00%	56.00%	56.00%	56.00%	56.00%	56.00%	56.00%	56.00%	56.00%
	Average Customer Bill[2]	**$21.01**	**$21.59**	**$33.68**	**$33.68**	**$33.68**	**$33.68**	**$33.68**	**$33.68**	**$33.68**	**$33.68**	**$33.68**

Notes:

1. 2008 Rate Increase does not include the 3% increase already adopted by City.
2. Based on assumed monthly usage of 10 ccf.
3. Rate impacts presented in this table do not include impacts from other, non-supply improvement projects.

Table 6.6 Tigard Summary of Rate Impacts
Joint Water Supply System Analysis
City of Lake Oswego and Tigard Water Service Area

	FYE	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2023
SCN 2A	Annual Rate Impact	0.00%	0.00%	15.00%	15.00%	15.00%	15.00%	15.00%	15.00%	28.00%	0.77%	0.00%
	Cumulative Rate Impact	0.00%	0.00%	15.00%	32.35%	52.09%	74.90%	101.14%	131.31%	196.07%	198.35%	198.35%
	Average Customer Bill	**$24.83**	**$26.57**	**$30.55**	**$35.14**	**$40.41**	**$46.47**	**$53.44**	**$61.45**	**$78.66**	**$79.26**	**$79.26**
SCN 2B	Annual Rate Impact	0.00%	0.00%	15.00%	15.00%	15.00%	15.00%	15.00%	5.00%	5.00%	2.90%	0.00%
	Cumulative Rate Impact	0.00%	0.00%	15.00%	33.25%	52.09%	74.90%	101.14%	111.19%	121.75%	128.18%	128.18%
	Average Customer Bill	**$24.83**	**$26.57**	**$30.55**	**$35.14**	**$40.41**	**$46.47**	**$53.44**	**$56.11**	**$58.92**	**$60.62**	**$60.62**
SCN 2C	Annual Rate Impact	0.00%	0.00%	15.00%	15.00%	15.00%	15.00%	26.00%	43.00%	15.00%	10.69%	0.00%
	Cumulative Rate Impact	0.00%	0.00%	15.00%	33.25%	52.09%	74.90%	120.37%	215.14%	262.41%	301.14%	301.14%
	Average Customer Bill	**$24.83**	**$26.57**	**$30.55**	**$35.14**	**$40.41**	**$46.47**	**$58.55**	**$83.73**	**$96.28**	**$106.57**	**$106.57**
SCN 3A	Annual Rate Impact	0.00%	0.00%	40.00%	14.00%	14.00%	14.00%	14.00%	14.00%	14.00%	0.52%	0.00%
	Cumulative Rate Impact	0.00%	0.00%	40.00%	59.60%	81.94%	107.42%	136.45%	169.56%	207.30%	208.89%	208.89%
	Average Customer Bill	**$24.83**	**$26.57**	**$37.20**	**$42.40**	**$48.34**	**$55.11**	**$62.82**	**$71.62**	**$81.64**	**$82.07**	**$82.07**
SCN 3B	Annual Rate Impact	0.00%	0.00%	40.00%	10.00%	10.00%	10.00%	10.00%	10.00%	6.50%	6.15%	0.00%
	Cumulative Rate Impact	0.00%	0.00%	40.00%	54.00%	69.40%	86.34%	104.97%	125.47%	140.13%	154.91%	154.91%
	Average Customer Bill	**$24.83**	**$26.57**	**$37.20**	**$40.91**	**$45.01**	**$49.51**	**$54.46**	**$59.90**	**$63.80**	**$67.72**	**$67.72**
SCN 3C	Annual Rate Impact	0.00%	0.00%	30.00%	16.00%	16.00%	16.00%	15.00%	15.00%	10.00%	9.58%	0.00%
	Cumulative Rate Impact	0.00%	0.00%	30.00%	50.80%	74.93%	102.92%	133.35%	168.36%	195.19%	223.47%	223.47%
	Average Customer Bill	**$24.83**	**$26.57**	**$34.54**	**$40.06**	**$46.48**	**$53.91**	**$62.00**	**$71.30**	**$78.43**	**$85.94**	**$85.94**
SCN 4	Annual Rate Impact	0.00%	0.00%	67.00%	5.00%	5.00%	5.00%	5.00%	5.00%	0.00%	0.08%	0.00%
	Cumulative Rate Impact	0.00%	0.00%	67.00%	75.35%	84.12%	93.32%	102.99%	113.14%	113.14%	113.30%	113.30%
	Average Customer Bill	**$24.83**	**$26.57**	**$44.37**	**$46.59**	**$48.92**	**$51.36**	**$53.93**	**$56.63**	**$56.63**	**$56.67**	**$56.67**
SCN 6A	Annual Rate Impact	0.00%	0.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%
	Cumulative Rate Impact	0.00%	0.00%	5.00%	10.25%	15.76%	21.55%	27.63%	34.01%	40.71%	47.75%	171.97%
	Average Customer Bill	**$24.83**	**$26.57**	**$27.90**	**$29.29**	**$30.76**	**$32.29**	**$33.91**	**$35.60**	**$37.38**	**$39.25**	**$72.26**
SCN 6B	Annual Rate Impact	0.00%	0.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	1.44%
	Cumulative Rate Impact	0.00%	0.00%	5.00%	10.25%	15.76%	21.55%	27.63%	34.01%	40.71%	47.75%	169.14%
	Average Customer Bill	**$24.83**	**$26.57**	**$27.90**	**$29.29**	**$30.76**	**$32.29**	**$33.91**	**$35.60**	**$37.38**	**$39.25**	**$71.50**

6.2.1 Summary of Rate Impact Analysis

For Lake Oswego, the lowest impact on rates results from the implementation of a joint supply system with Tigard (Scenario 4). The worst-case scenario for Lake Oswego would be under Scenario 2 (Lake Oswego "Go-It-Alone"), in which case the cumulative rate impact would be 148% over 25 years. Table 6.5 shows a summary of the annual and cumulative rate impacts for the first ten years and the last year of each scenario. It also calculates an average monthly customer bill based on the rates of each fiscal year. This average bill assumes a usage of 10 ccf per month and helps to provide an actual dollar comparison among all scenarios. At the end of 25 years, the lowest cost option produces a typical bill (increased solely for supply system impacts) of $33.68 for Scenario 4.

For Tigard, partnership with Lake Oswego as presented in Scenario 4 provides the lowest impact on rates. Under this scenario, supply costs would impact rates approximately 113% over a 25-year period. Scenario 2C (Willamette supply without cost-sharing partners) produces the highest impact on rates, with approximately a 301% increase needed over the next 25 years. Table 6.6 presents the annual and cumulative impact, as well as the average monthly customer bill (again, assuming a usage of 10 ccf per month). In the twenty-fifth year, the monthly customer bills for Scenarios 2B and 4 are within approximately four dollars of one another, with Scenario 4 at $56.67 and Scenario 2B at $60.62.

6.2.2 Conclusions

The rate impact analysis illustrates cost preferences similar to those identified in the economic analysis of the joint supply system scenarios. For Lake Oswego, partnership with Tigard provides considerably lower impacts to rates than developing the necessary improvements alone. In Tigard's case, materially lower impacts are seen in both the Lake Oswego-based scenario (Scenario 4) as well as in the Willamette option with partners (Scenario 2B) as compared to the JWC and Willamette "go it alone" options (Scenarios 2A and 2C).

The analysis also shows that, though Scenarios 6A and 6B are considerably less expensive than the other scenarios in the 25-year time frame, this is not the same for the rate impacts. It should be noted that, whereas other scenarios can collect a supply of SDC revenue stream, all costs in Scenarios 6A and 6B are wholesale water purchase costs, and therefore no additional revenue source can be used to offset the impact on rates.

Again, it should be emphasized that this study provides only an analysis of how supply costs would affect each City's rates; it makes a gross assumption regarding the constant continuation of existing operating costs and does not include any capital costs other than those defined in the joint supply analysis. A rate study incorporating all financial aspects of each City's utility is necessary to determine actual rate increases and SDC charges.

STRATEGIC OUTREACH & COMMUNICATION

7.1 INTRODUCTION

Strategic outreach and communication is a key aspect of a joint water supply system between Lake Oswego and Tigard. It will allow Lake Oswego, Tigard, and West Linn policy makers to actively participate in the water supply analysis. Outreach and communication will also allow Lake Oswego and Tigard to inform customers, environmental groups, and other interested parties of issues and opportunities related to the project. Providing the public with clear information as the project progresses will allow conflicts to be resolved as they arise, reducing the potential for delays in later stages of the project.

Content of this chapter was prepared by Clark Worth of Barney & Worth, Inc. to provide outreach and communication planning related to the Joint Water Supply System Analysis.

7.2 STRATEGIC OUTREACH & COMMUNICATIONS PLAN

7.2.1 Goals

The goals for strategic outreach and communication are to:

- Invite Lake Oswego, Tigard, and West Linn policy makers to participate actively in the water supply analysis, and ensure the results contribute meaningfully to effective and timely decision processes for those jurisdictions.
- Inform water customers in Lake Oswego and Tigard, along with other interested parties, of the issues and opportunities surrounding a possible joint water supply system.

7.2.2 Objectives

- Organize and conduct the analysis as an education process, recognizing that few participants are knowledgeable about water supply options.
- Target the most affected and deeply interested organizations for public outreach.
- Inform and involve policymakers from the early stages of the analysis.
- Structure the analysis to answer policymakers' most pressing questions.
- Inform / involve customers later in the analysis, when more answers are known regarding the feasibility of a water systems merger. Anticipate and answer their questions.
- Inform / involve other water suppliers at appropriate intervals in the process.

- In communications, highlight the benefits to both parties – especially cost savings.
- Clarify the relationship between a possible joint water system and regional growth.
- Highlight the policy priorities for Lake Oswego and Tigard to promote water conservation and sustain adequate stream flows during critical times for fish passage.

7.2.3 Target Audiences

Audiences to target with information regarding the joint water supply system analysis include, but are not limited to, those listed in Table 7.1.

Table 7.1 Target Audiences
Joint Water Supply System Analysis
City of Lake Oswego and Tigard Water Service Area

Lake Oswego	Tigard	West Linn	Others
City Council	City Council	City Council	Clackamas River Water Suppliers
City Manager	City Manager	City Manager	Regional Water Suppliers
Water System Manager	Water System Manager	Robinwood Neighborhood Association	Watershed Councils
Other Key Managers	Other Key Managers		Environmental Interest Groups
Neighborhood Association	Intergovernmental Water Board		Growth Interest Groups
Water Customers	Neighborhood Association		
	Water Customers		

7.2.4 Outreach and Communications Activities

7.2.4.1 Stakeholder Interviews

A cross-section of Lake Oswego and Tigard policymakers and other key stakeholders were interviewed at the outset of the project to gain their views and suggestions, and enlist their participation. Interview results are summarized in Section 7.3.

7.2.4.2 Strategic Outreach & Communications Plan

The Cities of Lake Oswego and Tigard will adopt a joint work plan that guides public outreach for water supply analysis. The Strategic Outreach & Communications Plan will define goals and objectives for outreach, identify target participants, outline specific methods to inform and involve interested citizens, and establish an outreach schedule and assignments.

7.2.4.3 Information Materials & Tools

Information materials and tools will be created to enable the Cities of Lake Oswego and Tigard to identify and reach policymakers, and other interested stakeholders, answering their questions and inviting their involvement. These materials and tools may include:

- Fact sheets / Updates
- Targeted communications for interested groups
- Project mailing list
- Synopses of technical issues and analysis
- Portable displays
- Website

7.2.4.4 Policymaker Workshops

Two workshops will be convened to include Lake Oswego and Tigard City Council members and other key policymakers. The workshops will enable the participants to learn more about the water supply options, ask questions, and share their views on a preferred directions, individuals supply options, operations issues, costs, and intergovernmental arrangements.

7.2.4.5 Public Meetings

Public meetings, workshops, and open houses will be scheduled near the culmination of the analysis, to publicize the results and promote public understanding. Held in Lake Oswego and Tigard, the meetings will be organized and facilitated to enable interested citizens to learn more about future water system options, and share their views.

7.2.4.6 Media Relations

Lake Oswego and Tigard will identify project spokespersons that will be responsible for all media contacts. Draft media releases will be distributed at key intervals to the Cities' standard lists. Media briefings conducted by City staff will be scheduled as needed. Local news coverage on the joint water supply options will also be monitored.

7.2.4.7 Website(s)

Timely information will be developed and posted on the Cities' websites. The websites will provide general information, publicize study findings, announce public meetings, and offer water system facts, project schedule, timely information and opportunities for public comment, downloadable documents, web survey(s) and information contacts.

7.2.4.8 Strategic Communication

Messaging about joint water supply options will be developed thoughtfully and will be centrally coordinated to maintain a continuous flow of accurate public information that remains current during the dynamic project.

7.2.4.9 Documentation

An "interested parties" mailing list will be developed and maintained. The results of public outreach and communications will be documented, and highlights shared with key policymakers.

7.2.4.10 Presentations and Briefings

Lake Oswego, Tigard, and West Linn City Councils, as well as the Intergovernmental Water Board, will be briefed at key intervals of the analysis.

7.3 STAKEHOLDER INTERVIEWS

As an early step in the project, Barney & Worth, Inc. interviewed elected officials and top managers in Lake Oswego and Tigard, representatives of their partner agencies, and other key stakeholders. Interviews were conducted in-person and by telephone with some nineteen persons who are involved or have an interest in Lake Oswego and Tigard water supply.

Participants were asked to share personal perceptions related to their understanding of water supply issues, their outlook on Lake Oswego/Tigard water sharing arrangements, and their suggestions for public participation.

7.3.1 Summary of Findings

The following findings highlight the main points offered by nineteen key stakeholders and other observers who were interviewed for the joint water supply analysis. This report reflects the advice, feelings and attitudes of the individuals interviewed. It is not intended to provide a scientifically valid profile of community opinion as a whole. Specific interview questions and answers along with a list of interviewed persons can be found in Appendix E.

Policymakers are hopeful the Lake Oswego and Tigard joint water supply will be shown to be feasible. Elected officials, top managers and other participants envision benefits that make this decision, in their view, the best option available.

Costs and rate impacts are the biggest issue(s) for most stakeholders when considering Lake Oswego / Tigard water supply options. In evaluating various water supply scenarios, both jurisdictions say they will first and foremost examine costs.

Another important matter will be the shape of any agreement between the two cities. Tigard policymakers expect Lake Oswego will take the lead, but want to know what say they'll have in drinking water affairs, and what assurances will be given: "The real questions are political, not technical." All parties seem confident a workable deal can be arranged: "It will be up to the two city governments to iron out the details and present a salable deal to the public."

Motivating factors for each participating city are apparent to most observers. It's no secret why both cities are interested. For Lake Oswego, the primary driver is thought to be cost savings. Facing substantial costs to upgrade its water system, Lake Oswego can lessen the impact on rates by spreading the costs over a larger customer base. Another impetus is the necessity to protect its undeveloped water rights on the Clackamas River. For Tigard, the main motivator is the prospect to share ownership of water resources, and along with it, the assurance of future supply for the community: "It's time for Tigard to secure its drinking water future."

A multitude of additional benefits are foreseen. Participants say merging the two water systems offers numerous advantages to Lake Oswego, Tigard, West Linn and other communities, as illustrated in Table 7.2.

A leading concern is the need to expand Lake Oswego's treatment facility. Located outside town in West Linn's Robinwood neighborhood, the plant must be expanded to meet the needs of Lake Oswego. Therefore, stakeholders are concerned its neighbors will raise questions about how they are to be impacted. The potential does exist, however, to develop a win-win opportunity, by upgrading the facility and installing new membrane technology, while minimizing the impact of the facility footprint and providing other benefits to the Robinwood community, such as a connection to the community hike and bike trails.

Another top issue is Lake Oswego's future growth. Although Lake Oswego is a mature community with slow population growth, policymakers want to be certain that future water needs can be met if a portion of Lake Oswego's water is allocated for Tigard. Uncertainty about future development scenarios for the Stafford area fuels these concerns.

Deliberations on Lake Oswego / Tigard water supply issues will require an education process. A few policymakers report they have been deeply involved in this topic. Most say they'll need to know more about the two cities' water systems, pros and cons of the various alternatives – including effects of the "status quo". A frequent suggestion is to convene a joint meeting of the two City Councils, to background elected leaders and foster collaboration.

Table 7.2	Benefits of Merger Joint Water Supply System Analysis City of Lake Oswego and Tigard Water Service Area
Participant	**Benefits**
Lake Oswego	▪ Cost sharing; cost savings; economies of scale ▪ Minimize long-term rate impacts ▪ Protect water rights ▪ Upgrade L.O. water treatment facility ▪ Provide emergency intertie and alternate sources ▪ Diversify water sources ▪ Improve location of L.O. water intake ▪ Merge with more modern plant ▪ Build stronger relations with neighboring communities ▪ Strengthen L.O. voice in regional water issues
Tigard	▪ System ownership and control ▪ Secure, long-term source ▪ Access to water rights ▪ O&M cost savings; economies of scale ▪ Easier permitting than other options ▪ Emergency intertie / alternate sources ▪ Keeps other supply options open
West Linn	▪ Leverages portions of South Fork system and frees up South Fork water rights to meet other needs ▪ Provides backup connections to Portland, Willamette, JWC ▪ O&M cost savings; economies of scale
Others	▪ Frees up Washington County water sources for other growing communities ▪ Promotes regional water supply system; bigger pipes able to move water both ways ▪ Helps lower water rates ▪ Indirectly benefits wholesale customers and partners

The Lake Oswego / Tigard water discussions present an opportunity to re-think, and perhaps reorganize, the regional water supply system. Several observers see an opening to consolidate the number of water suppliers in the area. Others see trouble: "The Clackamas River is fraught with issues."

What about the public? A proactive information / education program is warranted, participants say. But there's no consensus about when and how to involve the public in decisions for the joint water supply option, should citizens be involved during the study – or afterwards? "The public is almost totally unaware of this possibility." "Most people don't or won't pay much attention to where their water comes from." Consensus advice: "Be prepared to answer citizens' questions."

"Please include us!" Other area water suppliers ask to be included in the Lake Oswego / Tigard study. They extol the advantages of a regional approach, and point to additional opportunities for regional water supply arrangements. Another logical participant is the City of West Linn, where Lake Oswego's water treatment facility is located.

7.3.2 Values and Principles

The following is a list of values and principles that were found to be important aspects of the potential joint water supply system and should be considered as the analysis proceeds:

- Secure Lake Oswego's and Tigard's water future, ensuring both communities can meet their long-term growth needs.
- Demonstrate cost savings and favorable rates when compared with other supply options.
- Retain / obtain ownership interest in long-term drinking water resources.
- Retain and perfect Lake Oswego's full Clackamas River water rights.
- Design the Lake Oswego / Tigard partnership to offer parity – fairness – balance.
- Develop redundant water sources, for backup and emergencies.
- Promote equitable distribution of natural resources throughout the region.
- Communicate openly with policymakers and the public, educating them on the communities' current water sources, water system assets, future infrastructure needs and various supply options.
- Nurture cooperation among Lake Oswego, Tigard and surrounding communities that is beneficial to drinking water and other public services.
- Expand Lake Oswego / Tigard leadership in regional water supply decision making.

7.4 SCHEDULE AND STAFFING

7.4.1 Schedule

The joint water supply system analysis began in June 2006 and is planned to continue through December 2007. Table 7.3 shows milestones and their approximate due dates.

Table 7.3 Schedule
Joint Water Supply System Analysis
City of Lake Oswego and Tigard Water Service Area

Date	Milestone
June 2006	Project Startup
June – August 2006	Stakeholder Interviews
August 2006	Strategic Outreach & Communications Plan
September – October 2006	Information Materials & Tools City Council Briefings
November 14, 2006	Policymaker Workshop #1
November 2006 – July 2007	Council Briefings
July 17, 2007	Policymaker Workshop #2
August - October 2007	Documentation, Presentation & Briefings
December 2007	Partnership Agreement between Lake Oswego and Tigard

7.4.2 Preliminary Staff Assignments

Completion of the joint water supply system analysis will require cooperation of individuals from varying disciplines. Table 7.4 gives a preliminary list of staff assignments needed for public outreach. .

Table 7.4	**Preliminary Staff Assignments Joint Water Supply System Analysis City of Lake Oswego and Tigard Water Service Area**
Staff	**Responsibilities**
Joel Komarek City of Lake Oswego	Project manager Lake Oswego spokesperson Policymaker workshops Community briefings Public meetings Presentations
Jane Heisler City of Lake Oswego Dennis Koellermeier City of Tigard	Media relations Lake Oswego spokesperson Tigard spokesperson Policymaker workshops Community briefings Public meetings
Mark Knudson Carollo Engineers	Consultant team lead Policymaker workshops Public meetings Displays Presentations
Clark Worth Barney & Worth, Inc.	Public outreach lead Stakeholder interviews Outreach & Communications Plan Information materials & tools Policymaker workshops Public meetings Strategic communications Presentations
Michele Neary Barney & Worth, Inc.	Information materials & tools Website / web surveys Mailing list Documentation

EVALUATION OF ORGANIZATIONAL AND GOVERNANCE OPTIONS

8.1 INTRODUCTION

As the City of Lake Oswego and the Tigard Water Service Area consider long-term water supply improvements, governance becomes a key consideration. Lake Oswego and Tigard have a long-standing relationship for supplying water to the two service areas through the traditional surplus water supply contract (wholesale contract). The nature and complexity of the proposed Joint Water Supply project, and the associated significant capital investments, requires discussion and adoption of a service delivery model beyond the existing surplus water supply contract. There are various governance and institutional models for water utility service that could be used by the Cities. This memorandum describes and compares various governance options to provide a basis for further discussion and consideration by the cities. Once a governance model or concept has been selected, detailed work can proceed to develop the information needed to further refine and implement such a concept.

Much of the content of this chapter was developed by Clark I. Balfour of Cable Huston Benedict Haagensen & Lloyd LLP. A disclaimer concerning limitations of use of this information is presented in Appendix F.

8.2 GOVERNANCE OPTIONS

There are five alternative governance structures for joint water supply: (1) an intergovernmental agreement ("IGA"); (2) a People's Utility District ("PUD"); (3) a domestic water supply district ("Water District"); (4) a County Service District ("Service District"); and (5) a Water Authority ("Water Authority"). The following gives details on each governance structure. A summary and comparison of utility service delivery models is presented in Appendix G.

8.2.1 Methods of Formation

8.2.1.1 <u>Intergovernmental Agreement</u>

The IGA method is formed under ORS Chapter 190 by a written agreement between local governments, and approved by ordinances of each party's Council. The agreement specifies the functions the IGA will perform, describes the governing body, and indicates the powers the parties delegate to the IGA. Following formation of the IGA, the individual participating entities continue in existence and control decisions under the agreement. Amendments can be made as circumstances dictate. Additional parties can be added. No election or boundary decision is required. Formation through this method is the simplest and fastest as the Councils consider what is best for their respective citizens.

8.2.1.2 People's Utility District

A PUD is a unit of local government formed under ORS Chapter 261. An example is Rockwood Water People's Utility District. To form a PUD, citizens file a petition, which ultimately results in an election to determine whether or not a PUD should be formed within the designated boundaries. Another method is by resolution from the Board of County Commissioners. If the area for the proposed PUD overlaps County boundaries, each County Commission must adopt a resolution. Presumably, they could hold combined hearings. There is no authority for the County having the largest population or territory to act as the Principal County. The Principal County is the County having the greater portion of property tax assessed value in the proposed district. Each City would need to pass a consent resolution. The election process can be cumbersome. For example, a City is considered a "separate parcel of territory" and the vote of those electors are counted separately. In this case, voters of one City could pass the PUD formation and the others could reject and be excluded. Also, if there are non-contiguous territories within a City, those would be separately counted. A patchwork election result is possible. Drafting the measures in a manner that passage of one is dependent on passage of the others would be necessary.

8.2.1.3 Domestic Water Supply District

A Water District is a special district formed under ORS Chapter 264. A past example of a District overlaying an entire City is the Tigard Water District (boundaries prior to 1994). To form a Water District, electors file a petition or the Board of County Commissioners initiates proceedings. A consent resolution of each City is necessary. The Board of County Commissioners may approve the formation of the Water District following a public hearing. The Order of the County Commissioners is final unless remonstrances from 100 voters are received. If so, formation is approved upon the majority vote of the electors within the proposed boundaries. Where multiple Counties are involved, the Principal County presides.

8.2.1.4 County Service District

A County Service District may be formed under ORS Chapter 451 to provide water services. Like a water district, it may be by elector petition or the County Board can initiate proceedings. A consent resolution of each City is necessary. The Board of County Commissioners is the governing body. The Board of County Commissioners will decide on formation following a public hearing. The Commissioners' Order is final unless remonstrances are received from 100 voters. If so, an election on formation would occur. If the area overlaps County boundaries, the consents of the Principal County as discussed above and the Affected County are necessary. The formation process is presided over by the Principal County. The statute is not clear, but seems to imply that if formed, the Principal County Board will be the governing body. This creates interesting questions about voter disenfranchisement in the affected non-represented County. Finally, prior to construction of any service facilities, a referendum election may be held on the facilities to be constructed and the method of financing.

The example of a County Service District overlaying Cities is most prevalent in the wastewater and surface water management world. Examples of this would be Tri-City Service District, which provides wastewater treatment, major transmission and pumping for the Cities of Gladstone, Oregon City and West Linn, while the underlying Cities provide collection sewer services. The other example is Clean Water Services, which provides treatment, transmission and pumping as well as collection sewer services. Some of the Cities also provide collection sewer service. Clackamas County Service District No. 1, in the North Clackamas urban area, is another example. The Metropolitan Wastewater Management Commission provides services similar to Tri-City Service District for the Cities of Eugene and Springfield.

8.2.1.5 Water Authority

A Water Authority typically results from a resolution passed by a combination of two or more cities or districts to consolidate existing water supply entities into a new, single unit of local government under ORS Chapter 450. It may also start by formation petition. The Board of County Commissioners holds a public hearing, which focuses on the ability to provide more efficient and effective service. The election and remonstrance provisions apply. The Water Authority may provide all aspects of service (source to tap or the underlying cities could provide the "retail side" to tap). The major issue with authorities from a City perspective is the inability of a City to withdraw infrastructure upon annexation into the Authority as it could with a District. That may not be an issue in this case if the two cities seek to form an Authority with co-terminus boundaries.

8.2.2 Governing Bodies

8.2.2.1 Structures

The Water District, PUD, and Water Authority entities are generally governed by a five- or seven-member board of separately elected directors with equal voting power. Directors of PUDs, Water Districts and Water Authorities are elected to alternating four-year terms. Upon approval of the formation order for a Water District, Authority or County Service District by the Board of County Commissioners, one and possibly two things occur. First, if remonstrances are received, there is an election on formation at the next available election date. Whether remonstrances are received or not, there is an election for the five or seven Board seats. The PUD elections on both formation and new Board members are automatic. These are non-lucrative offices so absent a City Charter prohibition, a Councilor could run for the new Board, but there is a good chance that the Board members will be new people, separately elected, and free to develop their own consensus and direction on water service. Cities would still need to negotiate transfer of the assets and this is significant leverage, but once transferred, the Cities' ability to control water policy erodes significantly. The Board of County Commissioners governs the County Service District. The concept of a separately elected Board may be the main issue for the Councils.

In contrast, the form of governing body for an IGA is determined by agreement. Assets and powers are delegated. How decisions are made and how money is spent are all negotiated up front in the agreement. The parties may choose to consolidate existing water supply departments or let them stand as is. They will create a board of appointed directors or commissioners, and appoint administrative or managing officers. Board members are appointed by the City Councils rather than elected. They may be either appointed or elected officials from the individual parties. Some models have Councilors while others have a combination of Councilors/Staff and citizens. The agreement may provide for population based voting, equal voting or supermajority voting on key issues. The agreement terms are negotiated to fit the parties' desires. A structure is not imposed by statute.

8.2.2.2 Powers

All models have the relevant powers, including eminent domain, to provide the full range of service. The PUD, Water District, County Service District, and Water Authority governing bodies and Special Districts cannot regulate zoning or land use. They must follow the provisions of the applicable land use decision maker: County or City. In contrast, the individual Cities to an IGA may delegate some authority to carry water related land use issues and control extension of services consistent with state law and the Metro Code. Even without delegation, the Cities probably have more comfort knowing that water policy and service are in conformance with other City policies.

8.2.3 Operating Characteristics

8.2.3.1 Operations and Maintenance

Once we are past the governance, powers, and formation issues, daily operations and maintenance of the facilities under each governance structure is essentially the same. Each governance structure provides the authority to hire administrative staff and operate facilities. The entities may also contract with private companies or existing public agencies (including the underlying cities) for staffing and services. As the Table shows, utility ratemaking, system development charges, procurement and other typical governmental powers and restrictions are all virtually the same.

8.2.3.2 Ownership

8.2.3.2.1 *Intergovernmental Agreement*

The assets along with associated liabilities of the water supply system are often assigned to the entity and valued as a partnership contribution to capital. There is flexibility so that title or deed transfer is not necessary. The agreement may specify that specific assets are held by individual parties to the agreement and dedicated for the use and benefit of the group.

This has occurred in the Joint Water Commission. South Fork is an example where all supply assets are held in the name of South Fork. There can be formulas and buy-out mechanisms if a party wishes to sell or transfer. That can be coupled with mandatory buy-outs by the remaining partners. Upon dissolution, the assets and liabilities of an IGA are distributed under the terms of the agreement.

8.2.3.2.2 *Districts and Authorities*

The creation of any Water District, County Service District, PUD or Water Authority winds up on the desk of the County Commissioners. There are some variations with a PUD, but generally the factors the Board of County Commissioners will consider are whether service will be provided in a more efficient or effective manner. The ownership of assets and financial structure are key components. In the formation proceeding, it would need to be clearly articulated what assets and liabilities will be transferred and on what conditions. It would have to be by mutual agreement with the underlying Cities. In the absence of a mutual agreement, the District or Authority cannot compel transfer or condemn and pay for the assets. One public entity cannot condemn another.

Once transferred (and monetary or non-monetary consideration may be involved) then the assets belong to another separate public entity. While there may be reverter rights under the plan of distribution and liquidation if the new entity is dissolved, the practical effect is that the assets are gone and owned by a separately elected, independent governing body. The Cities at that point would not have the ability to influence policies such as line extensions, timing of major capital improvements, rate increases, or other matters that may have an impact on other City values and practices.

Another curious situation is that there is no entity for the City to make a binding commitment with until after formation and election of the District/Authority Board of Directors. The formation proceeding carries with it a leap of faith that if the Board of County Commissioners approves and the District is formed, then good faith negotiations will yield a resulting transfer. That may not happen. If the mutual agreement referred to above is not consummated between the Council and the new Board, then there could be a situation where a shell organization lays over the City. A shell organized with no assets is probably not an impact to the City other than nuisance. It does matter in the case of a PUD.

It is important to note that in the case of Districts and Authorities the formation order limits them to the type of service it will provide. In the case of PUDs, formation automatically vests the power to provide water and electricity service. There is no menu approach in the statutes. There are nine PUDs in Oregon. Six provide power only, and three provide water only. However, the three that provide water are fully empowered to enter into electricity service. An unintended consequence of PUD formation could be that while it is for water only, once formed the governing body of the PUD may decide to acquire investor-owned electric utility assets within its boundaries which may cause extreme discord within the City. The Councils may be faced with criticism that they created an organization for water purposes that changed to something much broader than what the Council or their citizens had in mind. Admittedly, the ability to energize and acquire assets will probably be voted upon by the people within the City, but the Cities need to be prepared that they may have an unintended consequence if the PUD model were chosen.

8.2.4 Capital Financing and Rates

Each governance structure may set rates, system development charges, and issue revenue bonds. The authority to issue revenue bonds is generally subject to the majority vote of the electors by remonstrance. There are some variations with the PUD. IGAs may issue revenue bonds either through the individual parties to the agreement or by delegation of power to the IGA.

In addition, most governance structures are also authorized to issue general obligation bonds and levy taxes. The authority to issue general obligation bonds or to obtain a local operating levy is also subject to the majority vote of the electors. IGAs, however, cannot be delegated power to issue general obligation bonds or levy taxes.

8.2.5 Additional Issues

8.2.5.1 Annexation

Annexation statutes and extension of services are large issues. Cities may have different views and restrictions by Charter or Comprehensive Plan as to what, when and where services are provided to unincorporated areas. Districts and Authorities may not have these limitations so that they become more ad hoc policy choices.

Annexation to an existing entity generally requires the majority vote of electors in the new territory. For Water Districts, County Service Districts, and Water Authorities, annexation also generally requires the majority vote of the existing entity to which the new territory will be annexed. This latter point is open with respect to PUDs. In contrast, new territory would be subject to an IGA as each City makes a decision on annexation and the agreement provisions react to the expanded territory as specified.

8.2.5.2 New partners

In addition to annexation, Water Districts and Water Authorities may annex, merge or consolidate with cities and other districts or authorities. PUDs, on the other hand, cannot annex territory already part of another PUD except by dissolving and forming a new PUD. PUDs cannot merge or consolidate with non-like kind districts. They can only annex. The key point is that once a new entity is created, new partners and territory could be brought in that are objectionable to the original City founders. With an IGA, new partners require unanimous consent.

8.2.5.3 Withdrawal/Dissolution

Withdrawal from a District or Authority generally requires the majority vote of the electors in the territory seeking to withdraw following a public hearing. Individual territories within a PUD, however, cannot withdraw without dissolving the PUD. Only where the PUD cannot provide service is withdrawal allowed. Withdrawal or territory transfer under the District/Authority statutes is not clear. The safer thing to conclude is once in, always in.

Dissolution generally requires the majority vote of electors upon the petition of the governing body along with a plan of distribution. An IGA, however, may be dissolved by unanimous vote of the individual parties to the agreement.

8.3 ORGANIZATIONAL & GOVERNANCE FRAMEWORK

After a preferred governance model has been identified by the parties, formation of a new joint water supply system will require additional decisions regarding key considerations such as specific objectives and scope of the joint system, fiscal authority, system ownership, and operational standards. A summary of potential governance and organizational details is provided in Appendix H. Decisions regarding these and other key issues will help establish a framework for an agreement between Lake Oswego and Tigard to form a joint water supply system.

8.4 RECOMMENDATIONS

It is clear that all the service delivery models can provide efficient and effective water service on a utility revenue-based system appropriate for Tigard and Lake Oswego. In our opinion, the real issue is control and certainty. The IGA provides the best path for the Cities.

An intergovernmental agreement ("IGA") is the simplest form of structure for water supply. A surplus water supply contract is an IGA. Although there are some limitations, an IGA provides the most flexibility regarding the relationship between the participating entities. An IGA may be formed without a vote by the electors; the governing body of an IGA may be appointed by the participating cities; the participating entities may retain ownership in the facilities like a partnership agreement; and the agreement between the parties defines the powers of the new entity. It is also easier to withdraw from or dissolve an IGA than the other governance structures. It is also easy to add new partners or make an amendment. An IGA is limited by the inability to levy taxes or issue general obligation bonds. However, these factors are not usually major drivers in utility settings because of the ability of the entity and its underlying partners to charge utility fees and charges and system development charges.

There are three excellent examples of the intergovernmental agreement model. The first is the Joint Water Commission, consisting of the Cities of Hillsboro, Beaverton, Forest Grove, Tigard and the Tualatin Valley Water District. The Joint Water Commission owns supply, treatment, storage, and transmission facilities in the Tualatin River system. This partnership has been in place since 1976. Tualatin Valley and Tigard joined subsequent to 1976. The second example is the North Clackamas County Water Commission consisting of the Sunrise Water Authority (including the City of Happy Valley and the City of Damascus) Oak Lodge Water District and the City of Gladstone. That entity owns supply, treatment and transmission facilities on the Clackamas River facility up stream from the Lake Oswego intake. A third example is the South Fork Water Board consisting of Oregon City and West Linn. It also owns treatment, transmission, and storage facilities on the Clackamas River just upstream from the Lake Oswego intake. While there will always be some issues that arise in any partnership, these entities show a tried and proven track record of long-term success.

If Lake Oswego and Tigard agree with this recommendation to use an IGA as the basis of a joint water supply system, it is further recommended that the parties engage in a process of developing the anticipated terms of such an agreement. The list of issues identified in Appendix I of this report is intended to serve as a starting point for further discussion between the Cities. It is recommended that the financial terms of such an agreement, including fiscal authority, system ownership, and fiscal standards, be an initial priority since these terms will establish the basis for subsequent financial evaluation of the proposed joint supply system.

Figure A-1
EXISTING AND PROPOSED
TRANSMISSION MAIN ALIGNMENT
JOINT WATER SUPPLY ANALYSIS
CITY OF LAKE OSWEGO AND
TIGARD WATER SERVICE AREA

lo707f1-7525.ai

Figure A-2
EXISTING AND PROPOSED
TRANSMISSION MAIN ALIGNMENT
JOINT WATER SUPPLY ANALYSIS
CITY OF LAKE OSWEGO AND
TIGARD WATER SERVICE AREA

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Figure A-3
EXISTING AND PROPOSED
TRANSMISSION MAIN ALIGNMENT
JOINT WATER SUPPLY ANALYSIS
CITY OF LAKE OSWEGO AND
TIGARD WATER SERVICE AREA

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Figure A-4
EXISTING AND PROPOSED
TRANSMISSION MAIN ALIGNMENT
JOINT WATER SUPPLY ANALYSIS
CITY OF LAKE OSWEGO AND
TIGARD WATER SERVICE AREA

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Figure A-5
EXISTING AND PROPOSED
TRANSMISSION MAIN ALIGNMENT
JOINT WATER SUPPLY ANALYSIS
CITY OF LAKE OSWEGO AND
TIGARD WATER SERVICE AREA

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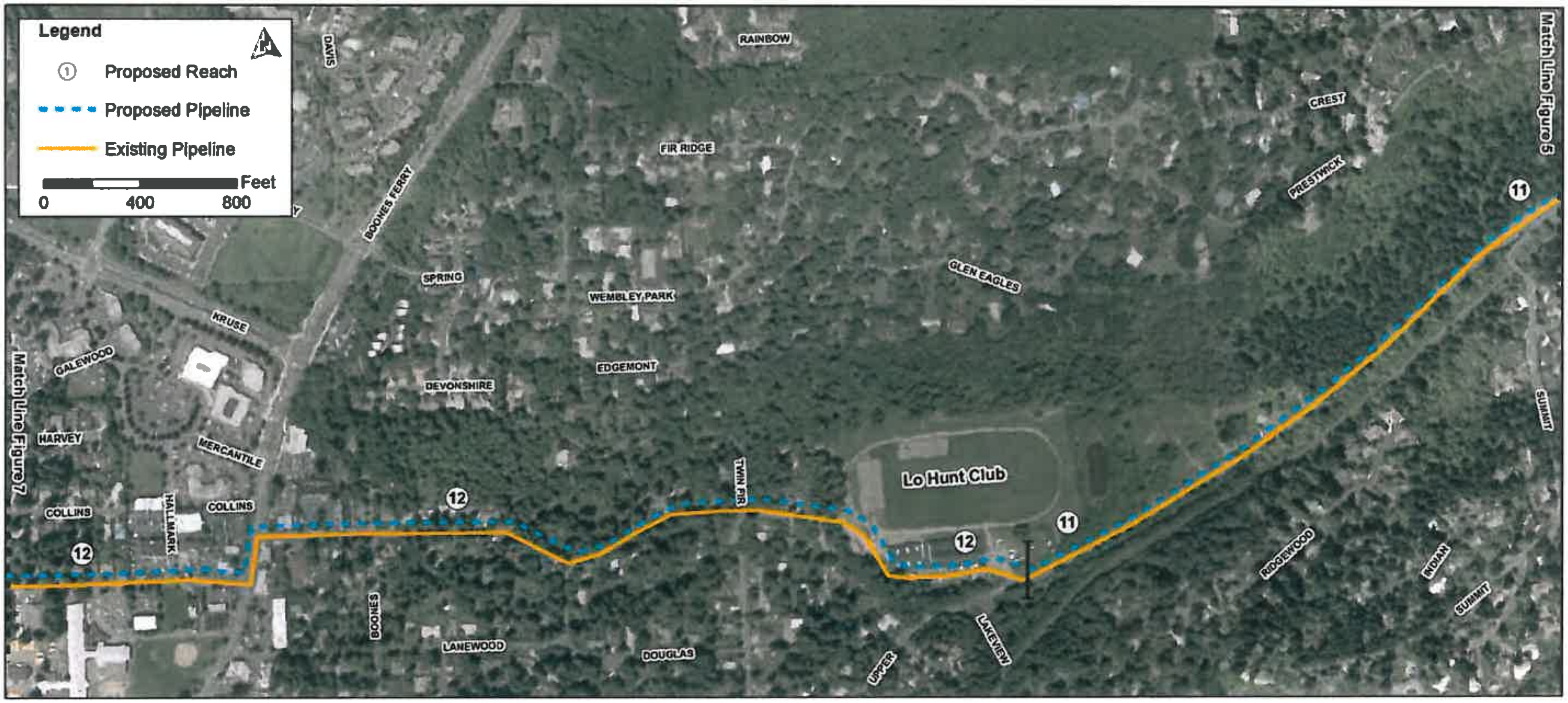

Figure A-6
EXISTING AND PROPOSED TRANSMISSION MAIN ALIGNMENT
JOINT WATER SUPPLY ANALYSIS
CITY OF LAKE OSWEGO AND
TIGARD WATER SERVICE AREA

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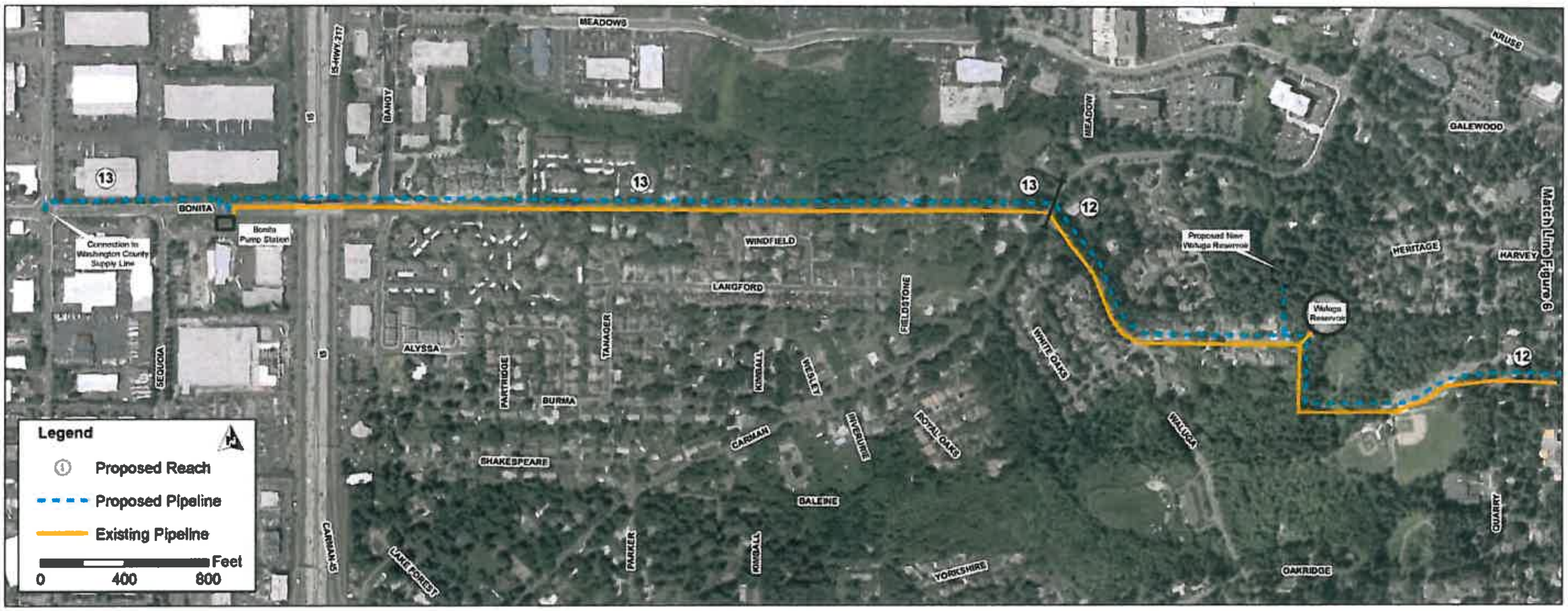

Figure A-7
EXISTING AND PROPOSED
TRANSMISSION MAIN ALIGNMENT
JOINT WATER SUPPLY ANALYSIS
CITY OF LAKE OSWEGO AND
TIGARD WATER SERVICE AREA

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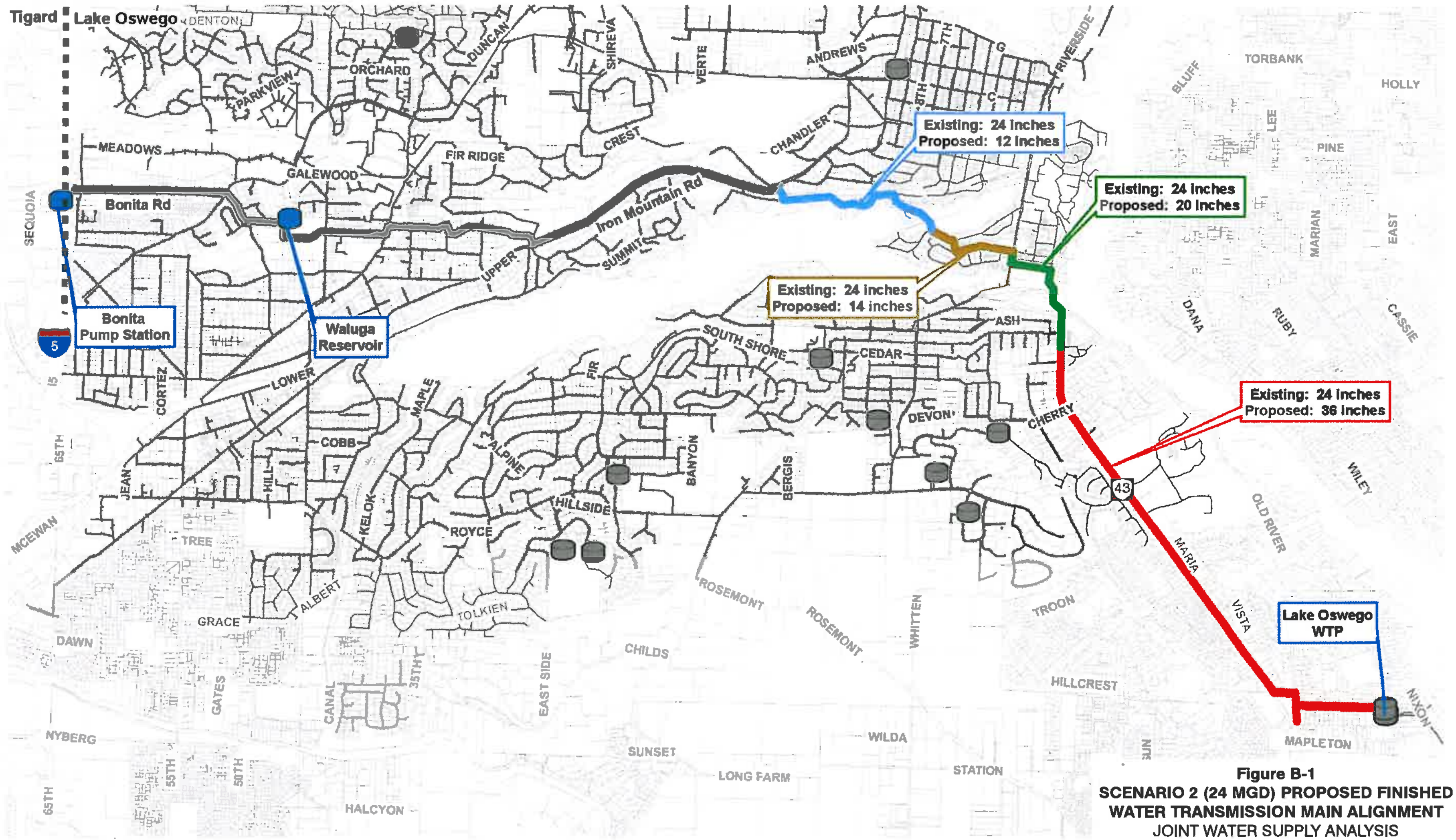

Figure B-1
SCENARIO 2 (24 MGD) PROPOSED FINISHED WATER TRANSMISSION MAIN ALIGNMENT
JOINT WATER SUPPLY ANALYSIS
CITY OF LAKE OSWEGO AND
TIGARD WATER SERVICE AREA

Scenario 2 version C.jpg (Original pdf dated 10-26-06 from Debra Dunn in the Fresno Office)

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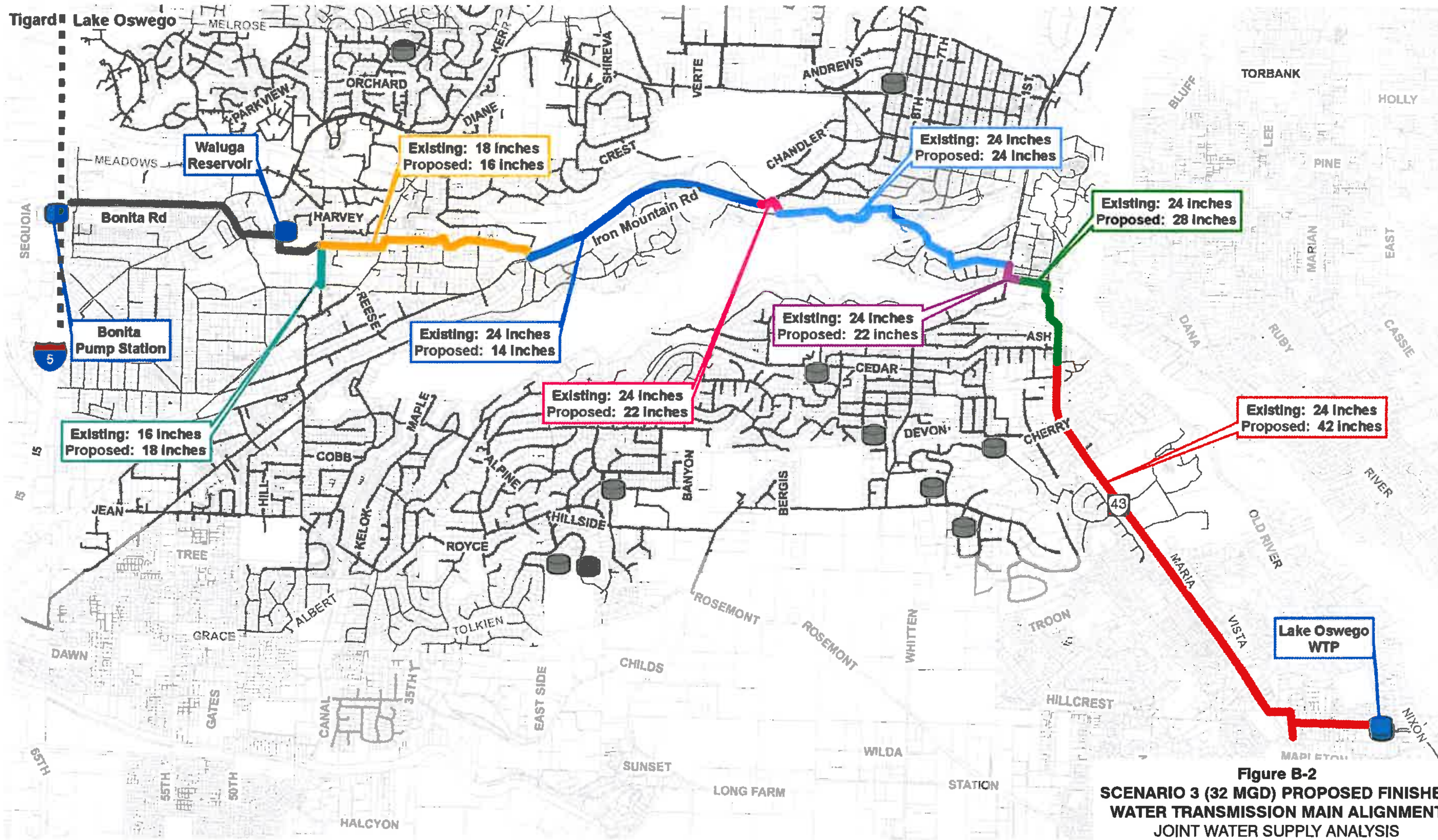

Scenario 3 version C.jpg (Original pdf dated 10-26-06 from Debra Dunn in the Fresno Office)

Figure B-2
SCENARIO 3 (32 MGD) PROPOSED FINISHED WATER TRANSMISSION MAIN ALIGNMENT
JOINT WATER SUPPLY ANALYSIS
CITY OF LAKE OSWEGO AND
TIGARD WATER SERVICE AREA

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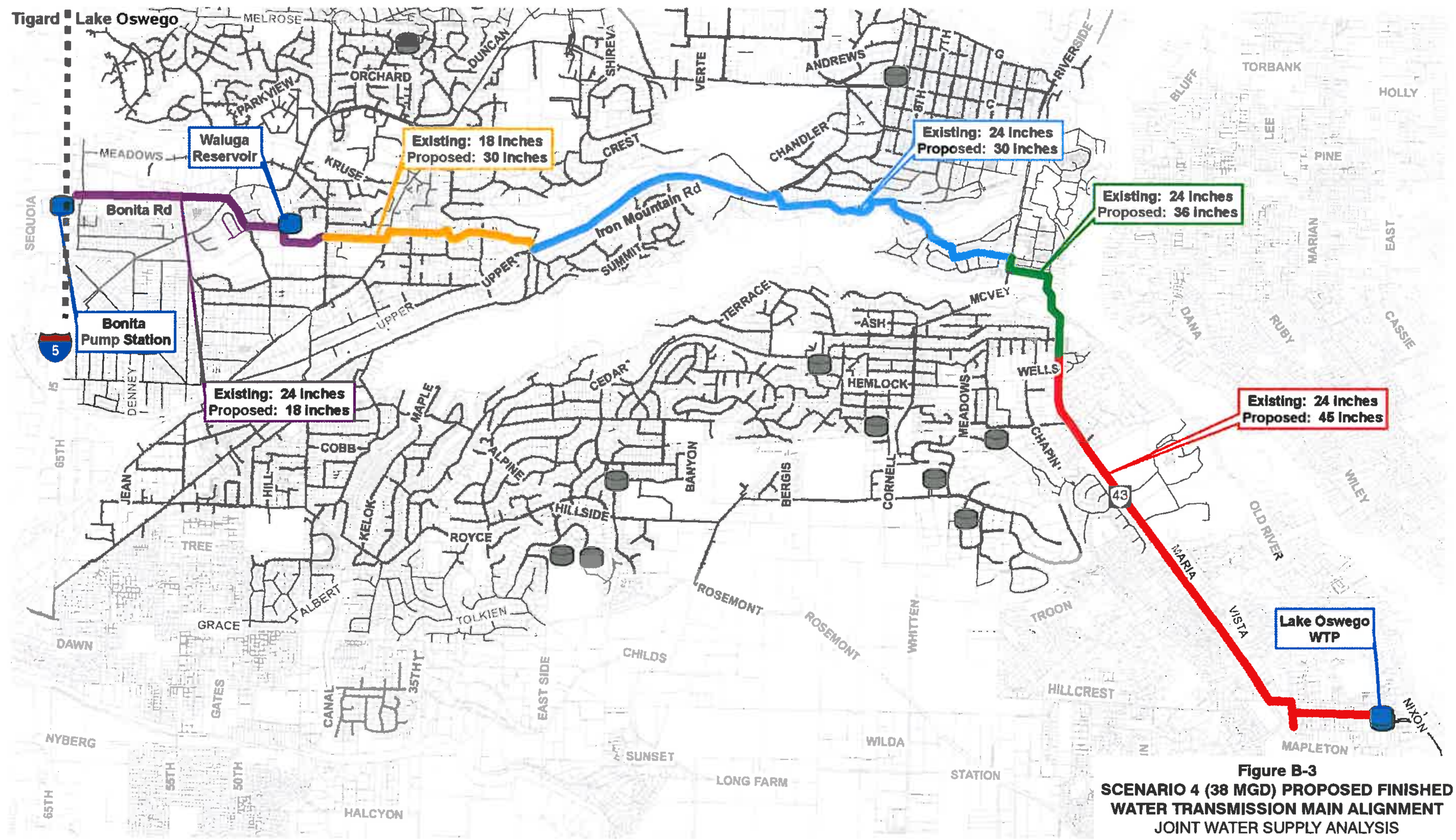

Figure B-3
SCENARIO 4 (38 MGD) PROPOSED FINISHED WATER TRANSMISSION MAIN ALIGNMENT
JOINT WATER SUPPLY ANALYSIS
CITY OF LAKE OSWEGO AND
TIGARD WATER SERVICE AREA

Scenario 4 version C.jpg (Original pdf dated 10-26-06 from Debra Dunn in the Fresno Office)

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Appendix C - Municpal Water Rights on the Clackamas River

Current Water Rights Holder	Water Rights Holder On Certificate	Source	Source Description	Certificate Number	Status	Permit No.	Application Number	Transfers/ Amendments	Amount cfs	Amount mgd	Priority Date
City of Estacada	City of Estacada	Clackamas	Clackamas River	C26471	Non-cancelled	S 23610	S 29972		2	1.29	5/10/1955
City of Estacada	City of Estacada	Clackamas	Clackamas River	C50566	Non-cancelled	S 37375	S 49991		2	1.29	1/19/1973
City of Gladstone	City of Gladstone	Clackamas	Clackamas River		Pending Certification	S 20145	S 25728	T5791	4	2.59	3/15/1951
City of Gladstone	City of Gladstone	Clackamas	Clackamas River		Non-cancelled	43170	57226	T7434	1.73	1.12	3/28/1978
City of Gladstone	City of Gladstone	Clackamas	Clackamas River		Non-cancelled	46120	60632	T7434	8	5.17	4/21/1981
City of Lake Oswego	City of Lake Oswego	Clackamas	Clackamas River	C78332	Non-cancelled Pending Certification	S 32410	S 43365	T8538	25 (Certificated) 25 (Pending)	16.16 (Certificated) 16.16 (Pending)	3/14/1967
City of Lake Oswego	City of Lake Oswego	Clackamas	Clackamas River		Non-cancelled	S 37839	S 50819		9	5.82	7/5/1975
Clackamas River Water	Clackamas River Water	Clackamas	Clackamas River		Pending Application	File-80438			77.4	50.02	6/13/1995
Clackamas River Water	Clackamas River Water	Clackamas	Clackamas River		Pending Application	File-80465			71.5	46.21	6/15/1995
Clackamas River Water	Clackamas Water District	Clackamas	Clackamas River	C37794	Non-cancelled	27925	37245		15	9.69	4/25/1962
Clackamas River Water	Clackamas Water District	Clackamas	Clackamas River	C64979		33586	44939		25	16.16	5/20/1968
Clackamas River Water	Clackamas Water District	Clackamas	Clackamas River		Non-cancelled	S 34426	S 46072		6.5	4.20	5/23/1969
North Clackamas County Water Commission	Mt. Scott Water District	Clackamas	Clackamas River		Pending Application		S-74056		10	6.46	18-May-1994
Oak Lodge Water District (NCCWC)	Oak Lodge Water District	Clackamas	Clackamas River		Non-cancelled	S-35297	47144	T7389	62	40.07	7/1/1970
South Fork Water Board	City of Oregon City	Clackamas	S. Fork Clackamas R	C1067	This certificate was cancelled by T6162. A confirming right should be issued.	2257	3797	T 6162	6	3.88	7/17/1914
South Fork Water Board	City of Oregon City	Clackamas	S. Fork Clackamas R		Non-cancelled	3778	5942		20	12.93	1/16/1918
South Fork Water Board	South Fork Water Commission	Clackamas	Clackamas River		Partial Proof of 14.46 mgd	22581	28676		60	38.78	8/3/1953
South Fork Water Board	City of Oregon City and City of West Linn	Clackamas	S. Fork Clackamas River and Memaloose Creek		Of total, likely only 15 cfs to be certificated, due to available flows.	9982	11007		30	19.39	08/11/1926 for S Fork; 1/16/1931 for Memaloose
								total	460.13	297.39	
								total permits	226.23	146.22	
								total certificates	75.00	48.47	
								total applications	158.90	102.70	
								Total certificates and permits	301.23	194.69	
								Total certificate and Permits less S.Fork permits (50 cfs)	251.23	162.37	
								Total certificates and permits less S. Fork, Lake Oswego, and Estacada	188.23	121.66	

FCS GROUP
Solutions-Oriented Consulting

Date: July 6, 2007

To: **Mark Knudsen, Carollo Engineers**
Cara Wilson, Carollo Engineers

From: Ed Cebron, FCS Group
Samantha Holert, FCS Group

Re: **Update - Lake Oswego/Tigard Joint Supply Analysis**

The purpose of this memo is to describe the general approach and findings of the joint supply system analysis conducted by FCS Group for the City of Lake Oswego and the City of Tigard. Data for this analysis was supplied by Carollo Engineers and the Cities. The role of FCS Group was to develop an analysis that provided comparative costs and evaluate the economic advantages and disadvantages of each scenario.

In developing this comparative analysis, FCS Group had the following responsibilities: to define total costs of each supply option, allocate these costs between the Cities of Lake Oswego and Tigard, and quantify the economic costs of each project, using present value and unit costs. This provided the basis of comparison to evaluate Tigard's supply options and the potential benefit to Lake Oswego of developing their source into a joint supply.

The three supply options evaluated, as defined in Carollo's Technical Memorandum No. 1, include:

- **Scenario 2 - Lake Oswego "Go-It-Alone" (24 mgd):** Provides the required capacity to treat the build-out demands of the Lake Oswego water service area. Under this scenario, Tigard does not receive any supply capacity.
- **Scenario 3 – Senior Water Right Capacity (32 mgd):** Represents capacity needed to deliver the senior water right of Lake Oswego. This capacity exceeds the build-out demands of the Lake Oswego water service area and thus provides capacity to meet a share of Tigard's demand.
- **Scenario 4 – Combined Junior and Senior Water Right Capacity (38 mgd):** Provides capacity needed to deliver the senior and junior water rights of Lake Oswego. This capacity meets the build-out needs of Lake Oswego, while providing the majority of Tigard's demand needs through build-out.

A fourth and fifth supply scenario were added, as defined below:

- **Scenario 5 – Combined Water Right Capacity, Interim Supply to Lake Oswego:** Beginning in 2016, scenario provides capacity needed to meet build-out needs of Lake Oswego, while providing the majority of Tigard's demand. Until 2016, assumes that, to the extent Lake Oswego needs peak water capacity, a water trade will occur with Tigard. No net purchase of water is assumed due to limited duration and volume constraints.

- **Scenario 6 – Tigard only Scenario, Tigard Continues Purchasing Water from Portland:** Tigard meets all demand needs through water purchases from Portland Water Bureau.

General Approach

The comparative costs developed for this evaluation were generated from present value computations based on the demand forecasts of each city, parameters of each supply scenario, and the capital and operating costs associated with them. To develop such a comparison, the following data was required:

1. **Supply requirements for each City:**

   Carollo provided (through Technical Memorandum 1 and subsequent demand updates) 2005 and 2030 peak day demand (PDD) and average day demand (ADD) figures for both the Cities of Lake Oswego and Tigard. Using linear interpolation, we forecasted annual demands for each City from FY 2005/06 through 2055/56. Both Lake Oswego and Tigard reach build-out demand in 2030.

2. **Definition of supply scenarios:**

   The supply scenarios evaluated in this analysis are defined in the introduction of this memorandum. In Scenarios 2 and 3, Tigard is not able to obtain all of their capacity needs from Lake Oswego. Therefore, to create a complete cost comparison, the costs incurred to fill these excess capacity needs were also incorporated.

   Two alternative regional sources of supply were analyzed for Tigard's use: the Joint Water Commission (JWC) and the Willamette River Project (Willamette). Should Tigard become a partner in either JWC or Willamette, the source would not be available until FY 2016/17.

   In Scenario 6, Tigard does not invest in any supply system; instead they purchase water on a wholesale basis to fulfill all of their water demand needs.

   To meet Tigard's needs until 2017, this analysis assumes water purchases from Portland. The analysis uses the terms of Tigard's current contract with Portland and the 2006 Portland water cost of $1.02 per ccf, escalated annually at 5.6%. The floor constraint provided in the contract are also taken into account, and thus in all scenarios, this minimum amount is purchased from Portland. In scenarios where more capacity is needed in these interim years, it is assumed that Tigard will purchase more water from Portland to meet their needs.

   Tigard's supply scenarios were further defined as follows:

   - **Scenario 2A**: Tigard invests in expanded JWC capacity to fulfill demands not met by the Lake Oswego source, as depicted in Scenario 2. Portland is an interim source for all water needs in the first 10 years.
   - **Scenario 2B**: Tigard invests in expanded Willamette capacity to fulfill demands not met by the Lake Oswego source, as depicted in Scenario

2. Portland is an interim source for all water needs in the first 10 years. Regional capital and operation costs in this scenario assume major cost-sharing partners also invest in Willamette capacity.

- **Scenario 2C**: Tigard invests in expanded Willamette capacity to fulfill demands not met by the Lake Oswego source, as depicted in Scenario 2. Portland is an interim source for all water needs in the first 10 years. Regional capital and operation costs in this scenario assume Tigard must develop Willamette without the help of major cost-sharing partners.
- **Scenario 3A**: Tigard invests in expanded JWC capacity to fulfill demands not met by the Lake Oswego source, as depicted in Scenario 3. Required contract quantities are purchased from Portland for the first 10 years.
- **Scenario 3B**: Tigard invests in expanded Willamette capacity to fulfill demands not met by the Lake Oswego source, as depicted in Scenario 3. Required contract quantities are purchased from Portland for the first 10 years. Regional capital and operation costs in this scenario assume major cost-sharing partners also invest in Willamette capacity.
- **Scenario 3C**: Tigard invests in expanded Willamette capacity to fulfill demands not met by the Lake Oswego source, as depicted in Scenario 3. Required contract quantities are purchased from Portland for the first 10 years. Regional capital and operation costs in this scenario assume Tigard must develop Willamette without the help of major cost-sharing partners.
- **Scenario 4**: Tigard does not invest in any regional source. Required contract quantities are purchased from Portland for the first 10 years. In later years, it purchases water from Portland to meet any increments of demand not met by Lake Oswego source.
- **Scenario 5**: Tigard does not invest in any regional source. Portland is an interim source for all water needs in the first 10 years. In later years, it purchases water from Portland to meet any increments of demand not met by Lake Oswego source.
- **Scenario 6A**: Tigard does not invest in Lake Oswego or any other regional source. Instead, it purchases all water from Portland, based on terms of current contract and adjustments for inflation.
- **Scenario 6B**: Tigard does not invest in Lake Oswego or any other regional source. Instead, it purchases all water from Portland, utilizing a gravity connection for a portion of the purchases. The unit price of water is based on terms of current contract but also includes a pumping discount on 2.6 mgd of purchased water, during off-peak months. This discount of $0.29 per ccf (in 2007 dollars) is also escalated using the inflation rate of 5.6%.

It should be emphasized that this analysis assumes that the percentage of PDD Tigard receives from each of its supply sources (less the capacity realized via Aquifer Storage and Recovery) determines the percentage of ADD Tigard will use from the corresponding source. This assumption is used for two reasons: first, to avoid a distortion of volumetric unit costs for individual supply sources; and second, to provide reasonable assurance that wholesale cost structures are consistent with the planned utilization. The exception to this occurs in the first ten years of Scenario 3 and 5, when Tigard must first fulfill its contract purchases to Portland and then obtain the remainder of water from Lake Oswego.

Exhibit 1 below summarizes how Lake Oswego's and Tigard's PDD and ADD are met in each of the supply scenarios.

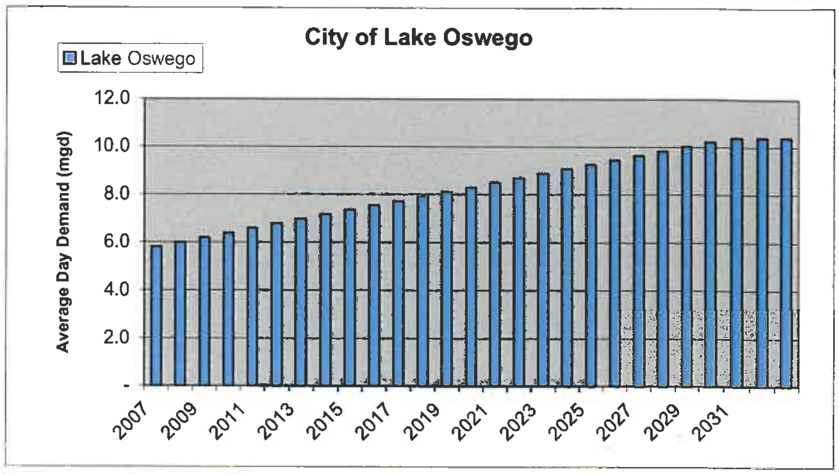
Exhibit 1: 2030 Water Needs by Source of Supply

	City of Lake Oswego: Sources of Supply Assumed
	Lake Oswego
Scenario 2	PDD: 23.9 mgd ADD: 10.4 mgd
Scenario 3	PDD: 23.9 mgd ADD: 10.4 mgd
Scenario 4	PDD: 23.9 mgd ADD: 10.4 mgd
Scenario 5	PDD: 23.9 mgd ADD: 10.4 mgd
Scenario 6	N/A

	City of Tigard: Sources of Supply Assumed		
	Aquifer Storage and Recovery	Lake Oswego	Other Regional Sources
Scenario 2	PDD: 3.5 mgd ADD: 0 mgd	PDD: 0 mgd ADD: 0 mgd	PDD: 17.6 mgd ADD: 10.1 mgd
Scenario 3	PDD: 3.5 mgd ADD: 0 mgd	PDD: 8.1 mgd ADD: 4.6 mgd	PDD: 9.5 mgd ADD: 5.5 mgd
Scenario 4	PDD: 3.5 mgd ADD: 0 mgd	PDD: 14.1 mgd ADD: 8.1 mgd	PDD: 3.5 mgd ADD: 2.0 mgd
Scenario 5	PDD: 3.5 mgd ADD: 0 mgd	PDD: 14.1 mgd ADD: 8.1 mgd	PDD: 3.5 mgd ADD: 2.0 mgd
Scenario 6	PDD: 3.5 mgd ADD: 0 mgd	PDD: 0 mgd ADD: 0 mgd	PDD: 17.6 mgd ADD: 10.1 mgd

The following graphs, Exhibits 2 through 6, illustrate the assumed use of each source (ADD) in each of the supply scenarios. As stated in the previous section, it was assumed Tigard receives ADD from each source in proportional to PDD, as described in the preceding tables, excluding the portion of PDD provided to Tigard via ASR.

Exhibit 2: Scenario 2 Utilization by Source (ADD)



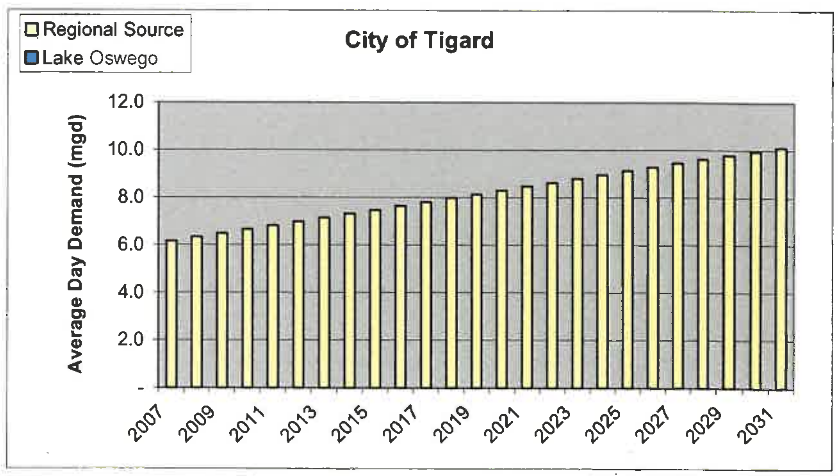
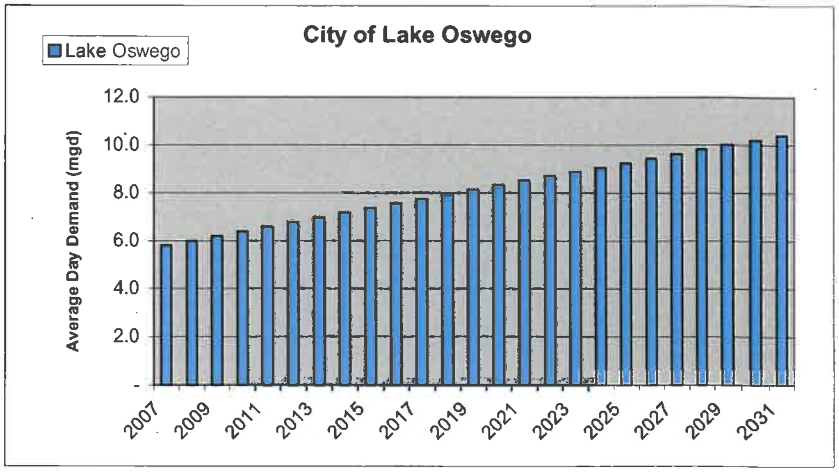


Exhibit 3: Scenario 3 Utilization by Source (ADD)



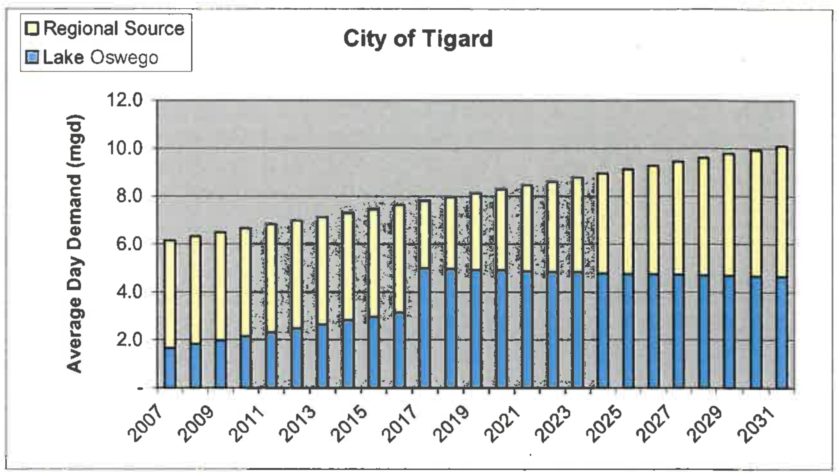


Exhibit 4: Scenario 4 Utilization by Source (ADD)

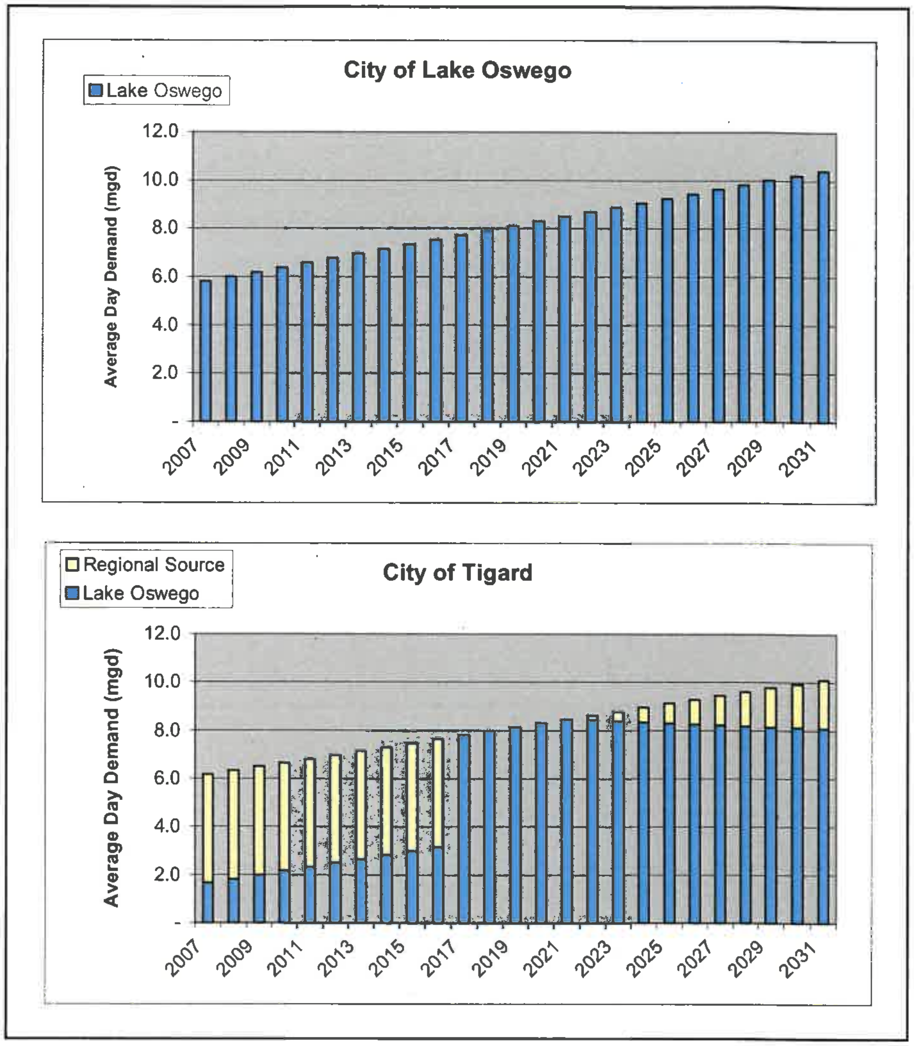
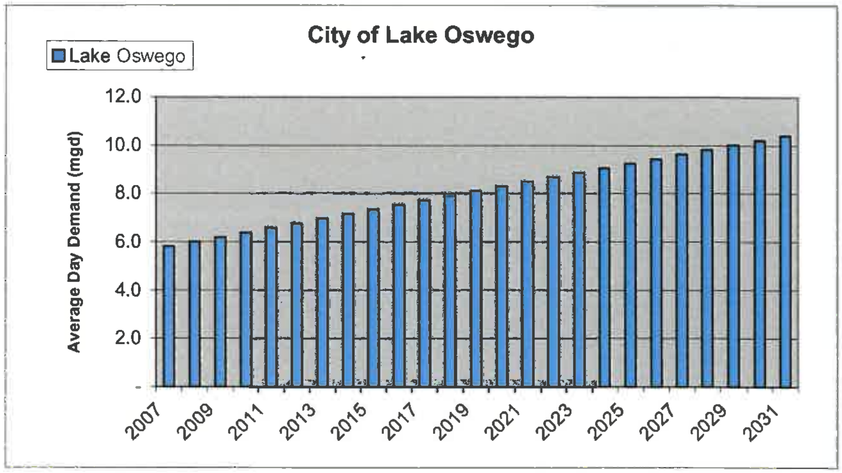


Exhibit 5: Scenario 5 Utilization by Source (ADD)



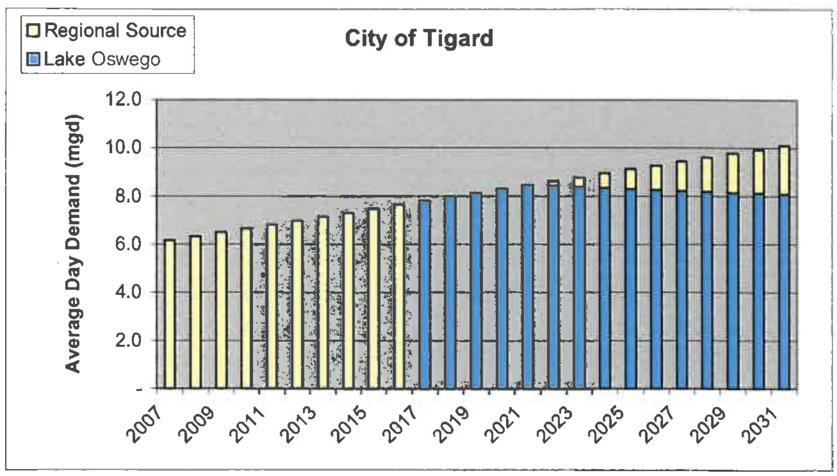
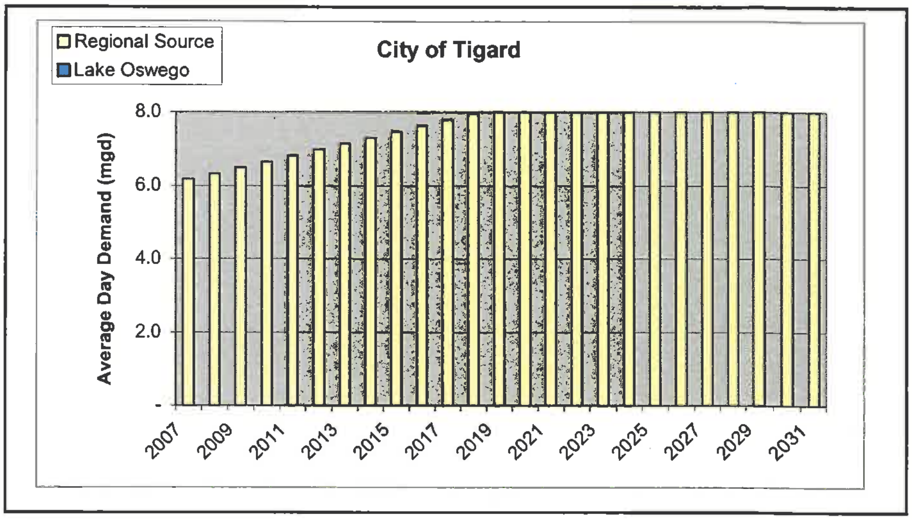


Exhibit 6: Scenario 6 Utilization by Source, Tigard only (ADD)



3. Definition of costs for each supply scenario:

A. Lake Oswego Supply System

Capital costs for Lake Oswego's and Tigard's joint supply scenarios were provided by Carollo in Technical Memorandum 2 and subsequent updates. An allocation basis for all project costs was determined for each City. An appropriate "buy-in" cost for Tigard to pay to Lake Oswego was also assessed. This buy-in took into account plant assets owned by Lake Oswego that would also provide benefit to Tigard.

Capital costs, along with the fixed assets eligible for Tigard's buy-in, were allocated either on a proportional basis (costs split on each City's share of total capacity) or an incremental basis (costs split on each City's share of increased capacity). The schedule of these project costs was also provided by Carollo. A 6% annual inflation factor was applied to the capital cost estimates (expressed in current costs) to reflect year of construction dollars. Reimbursement and replacement costs have not been factored into this analysis.

The O&M costs corresponding to each capital project were also defined in Technical Memorandum No. 2. These costs were categorized based on whether or not they fluctuate with water flow. Annual fixed costs were allocated to each City using the corresponding project's capacity allocation percentage. Along with the annual O&M costs, Carollo provided equivalent costs per million gallons. To assign shares of variable costs, this unit cost was applied to each City's ADD supplied from the project, and then annualized. A 3.5% general inflation factor has been applied to future O&M costs to reflect future dollars.

The basis on which each of the costs has been allocated is shown in Exhibit 7.

Exhibit 7: Lake Oswego Supply System Cost Allocation Matrix

	Capital Costs	Buy-In for City of Tigard	O&M Cost Assumptions
Raw Water Intake	Proportional: Total replacement; costs of new intake proportional to each City's share of total capacity	None: Existing intake to be completely replaced.	Costs assumed to vary based on water consumption; allocated to each city based on forecasted average day demand (ADD).
Raw Transmission Main	Proportional: Replacement; costs of new transmission main proportional to each City's share of total capacity	Proportional: Existing transmission main to be used for emergencies; shared by both parties.	N/A
Water Treatment Plant: Land	N/A	Proportional: Land benefits both Cities.	N/A
Water Treatment Plant: Structures & Equipment	Incremental: Addition to existing WTP; costs of new WTP split on each City's share of increased capacity.	None: New WTP sufficient to serve City of Tigard. There may be rationale for some fractional buy-in to some existing structures or equipment.	Power, chemical and sludge disposal costs assumed to vary with usage. Remaining O&M costs assumed fixed. Allocate variable costs on each city's ADD; fixed costs on proportion of WTP capital expense.
Finished Water Main	Incremental: Main added parallel to existing; costs of new main split on each City's share of increased capacity needs.	None: New main sufficient to serve City of Tigard.	N/A
Waluga Reservoir: Land	N/A	Proportional: Land benefits both Cities.	N/A
Waluga Reservoir: Structures & Equipment	Proportional: Reservoir added to serve both Cities. Costs of new reservoir proportional based on storage analysis in TM 2.	None: New reservoir sufficient to serve Tigard's future storage needs.	N/A
Bonita Pump Station	All to Tigard: Pump station to only serve City of Tigard.	None: Existing pump station to be completely replaced.	Costs assumed to vary based on water consumption; 100% of costs to Tigard, based on their forecasted ADD.
Interim Supply to Lake Oswego	All to Lake Oswego: Built to serve only City of Lake Oswego.	None: Built to serve Lake Oswego.	N/A
Computer Systems/Software	N/A	Proportional: Equipment to be shared by both Cities.	N/A
General Plant	N/A	Proportional: Equipment to be shared by both Cities.	N/A

B. Outside Supply Sources

Our analysis looks to regional suppliers to meet Tigard's remaining capacity needs. The floor constraints and unit purchase cost set in Tigard's contract with Portland was provided to FCS Group and used in the analysis. Capital and O&M costs associated with both Willamette scenarios were developed and provided to FCS Group by Carollo. To maintain consistency with the Lake Oswego methodology, the provision for reimbursements and replacements was taken out of the regional cost analysis. The capital and O&M costs associated with the JWC were based on an existing study FCS Group conducted for a regional consortium of water service providers. Tigard's current demand forecast, as provided by Carollo, had been revised since its use in the existing regional supply analysis. It was necessary to account for this shift in demand and thus resize capital costs. To calculate these adjusted capital costs, as well as the costs associated with the portion of capacity needed in Scenario 3, capital costs were scaled in proportion to the revised demand needs for each scenario. To reduce potential error and more precisely allocate these costs, further cost estimation would be needed for varying supply commitments. This simplification was necessary to provide scalability to outside cost estimates, but the limited accuracy of the assumption should be recognized when comparing source options.

C. Summary of Project Costs

Exhibit 8 summarizes the capital costs, in current dollars, that each City would incur in satisfying their future capacity needs for each scenario. In Exhibit 9, annual O&M and wholesale water purchase costs for all scenarios are expressed in escalated dollars.

Exhibit 8: Total Capital Costs (Current Dollars)

	Lake Oswego Capital Costs	Tigard Capital Costs	
		Lake Oswego Supply	Other Regional Supplies
Scenario 2A	$ 78,590,000	$ -	$ 142,086,182
Scenario 2B	$ 78,590,000	$ -	$ 77,100,000
Scenario 2C	$ 78,590,000	$ -	$ 180,900,000
Scenario 3A	$ 64,433,063	$ 52,956,938	$ 107,234,716
Scenario 3B	$ 64,433,063	$ 52,956,938	$ 48,100,000
Scenario 3C	$ 64,433,063	$ 52,956,938	$ 97,400,000
Scenario 4	$ 55,577,287	$ 78,952,713	$ -
Scenario 5	$ 56,977,287	$ 78,952,713	$ -
Scenario 6A	N/A	$ -	$ -
Scenario 6B		$ -	$ 1,484,000

Exhibit 9: Annual O&M and Purchased Water Costs (Escalated Dollars)

		Lake Oswego Costs			Tigard Costs		
		2010	2020	2030	2010	2020	2030
Scenario 2A	O&M Costs	$ 2,112,876	$ 3,448,123	$ 5,523,659	$ -	$ 2,475,688	$ 3,658,558
	Purchased Water	$ -	$ -	$ -	$ 4,221,157	$ -	$ -
Scenario 2B	O&M Costs	$ 2,112,876	$ 3,448,123	$ 5,523,659	$ -	$ 1,609,210	$ 2,653,684
	Purchased Water	$ -	$ -	$ -	$ 4,221,157	$ -	$ -
Scenario 2C	O&M Costs	$ 2,112,876	$ 3,448,123	$ 5,523,659	$ -	$ 2,065,358	$ 3,297,126
	Purchased Water	$ -	$ -	$ -	$ 4,221,157	$ -	$ -
Scenario 3A	O&M Costs	$ 1,648,236	$ 2,801,750	$ 4,624,649	$ 1,648,236	$ 3,973,360	$ 6,599,438
	Purchased Water	$ -	$ -	$ -	$ 2,784,712	$ -	$ -
Scenario 3B	O&M Costs	$ 1,648,236	$ 2,801,750	$ 4,624,649	$ 1,648,236	$ 3,531,463	$ 6,088,867
	Purchased Water	$ -	$ -	$ -	$ 2,784,712	$ -	$ -
Scenario 3C	O&M Costs	$ 1,648,236	$ 2,801,750	$ 4,624,649	$ 1,648,236	$ 3,888,871	$ 6,593,026
	Purchased Water	$ -	$ -	$ -	$ 2,784,712	$ -	$ -
Scenario 4	O&M Costs	$ 1,521,399	$ 2,623,884	$ 4,375,233	$ 1,137,996	$ 3,477,860	$ 4,747,302
	Purchased Water	$ -	$ -	$ -	$ 2,784,712	$ -	$ 3,696,598
Scenario 5	O&M Costs	$ -	$ 2,623,884	$ 4,375,233	$ -	$ 3,477,860	$ 4,747,302
	Purchased Water	$ -	$ -	$ -	$ 4,221,157	$ -	$ 3,696,598
Scenario 6A	O&M Costs	N/A			$ -	$ -	$ -
	Purchased Water				$ 4,221,157	$ 9,029,354	$18,588,607
Scenario 6B	O&M Costs				$ -	$ -	$ -
	Purchased Water				$ 3,897,098	$ 8,470,545	$17,624,994

Capital costs can have a different impact on rates due to potential inclusion in water SDCs. It is important to note that this analysis does not extend to rate and SDC impacts.

The components of the one-time buy-in cost are illustrated in Exhibit 10. For economic analysis, the buy-in is treated as a one-time payment from Tigard to Lake Oswego. This is also equivalent, from the Cities' perspectives, to installment payments at prevailing interest rates. The buy-in was based on estimated replacement cost (depreciated) of system assets allocated as outlined in Exhibit 7. This analysis assumes the buy-in from Tigard is paid to Lake Oswego in the year construction projects for the joint supply system occur; therefore an annual escalation factor will be added to original buy-in payment (shown in Exhibit 10 in 2007 dollars).

Exhibit 10: Tigard Buy-In Payment

	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 6
Raw Water Intake	$ -	$ -	$ -	$ -	$ -
Raw Water Transmission	$ -	$ 940,184	$ 1,378,203	$ 1,378,203	$ -
Water Treatment Plant: Land	$ -	$ 555,734	$ 814,643	$ 814,643	$ -
Water Treatment Plant: Structures & Equipment	$ -	$ -	$ -	$ -	$ -
Finished Transmission Main	$ -	$ -	$ -	$ -	$ -
Waluga Reservoir: Land (Reservoir Property)	$ -	$ 212,800	$ 311,941	$ 311,941	$ -
Waluga Reservoir: Structures & Equipment	$ -	$ -	$ -	$ -	$ -
Bonita Pump Station	N/A	N/A	N/A	N/A	N/A
Computer System/Software	$ -	$ 83,628	$ 122,589	$ 122,589	$ -
General Plant	$ -	$ 26,148	$ 38,330	$ 38,330	$ -
TOTAL Buy-In	**$ -**	**$ 1,818,494**	**$ 2,665,706**	**$ 2,665,706**	**$ -**

An annual cost stream, incorporating capital, buy-in and O&M costs, was developed for each City and scenario combination. The buy-in is applied as a cost to Tigard and credit to Lake Oswego. Tigard's cost stream also integrated the costs of purchasing remaining capacity from other sources, forming a complete supply portfolio. These cost streams were used in the generation of meaningful comparisons between scenarios.

The present value calculation determines a "lump sum" cost expressed in terms of total equivalent cost. For comparative purposes, and to provide scale to these results, we have also expressed each present value result as an equivalent annual cost, both in total dollars and as a cost per hundred cubic feet (ccf). This is achieved by amortizing the net present value of each supply scenario over 25 years, using rates equal to the discount factor. It is these equivalent annual cost results that are used in visual comparisons of supply scenarios.

In our net present value computations for each annual cost stream, we have produced two outcomes: 1) using a 5.0 % discount factor, and 2) using a 7.0% discount factor. The 5.0% discount factor relates to public agencies' assumed cost of capital, while the 7.0% factor reflects more of a rate impact by taking into account growth in customer base. It should be noted that our computations assume raw annual costs, and do not factor in any use of debt financing for the capital programs. In particular, low interest loans from assistance programs would reduce the net present value of affected projects.

The present value comparative analyses do not consider salvage value at the end of the analysis period. In each scenario, residual values of resources and facilities are likely to be substantial. Therefore, while these findings reasonably track and compare costs incurred during the analysis period, some differential in residual useful lives and value could affect comparative results.

Summary of Analysis

Exhibit 11 below shows the net present values costs of each City broken down into capital, O&M and purchased water costs. A five percent discount rate is used in the values shown.

Exhibit 11: Allocated Net Present Value Costs

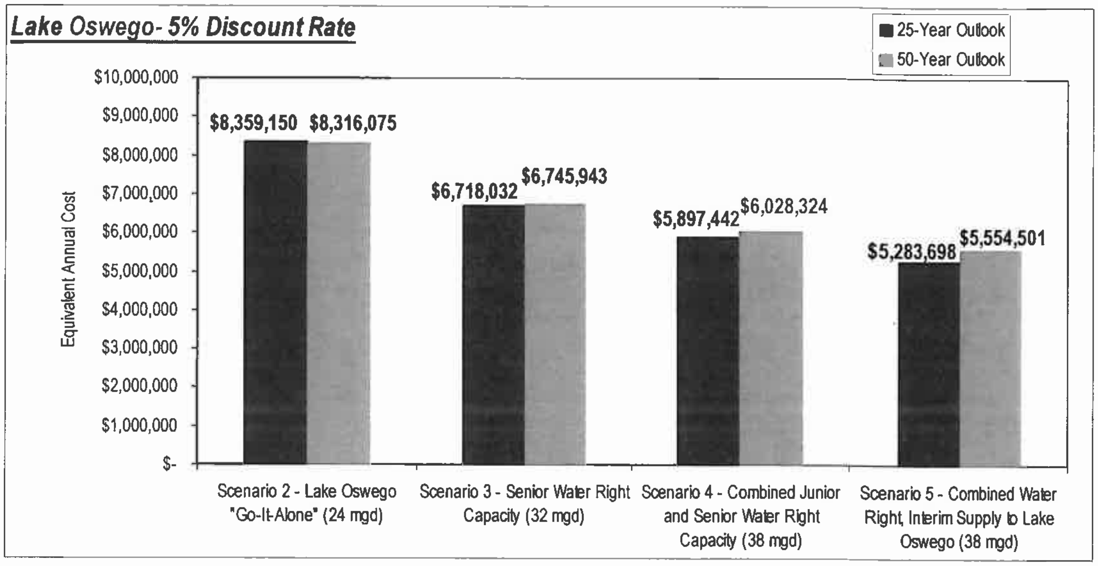
		CITY OF LAKE OSWEGO PRESENT VALUE COSTS				
		Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 6
25-Year Outlook	Capital Costs Only	$ 76,506,006	$ 61,450,081	$ 52,101,552	$ 55,397,256	N/A
	O&M Costs Only	41,307,386	33,233,496	31,016,671	19,070,890	N/A
	Purchased Water Costs Only	N/A	N/A	N/A	N/A	N/A
	Total Costs	**$ 117,813,392**	**$ 94,683,577**	**$ 83,118,223**	**$ 74,468,146**	N/A
50-Year Outlook	Capital Costs Only	$ 76,506,006	$ 61,450,081	$ 52,101,552	$ 55,397,256	N/A
	O&M Costs Only	75,311,642	61,703,347	57,951,089	46,005,308	N/A
	Purchased Water Costs Only	N/A	N/A	N/A	N/A	N/A
	Total Costs	**$ 151,817,648**	**$ 123,153,428**	**$ 110,052,641**	**$ 101,402,564**	N/A

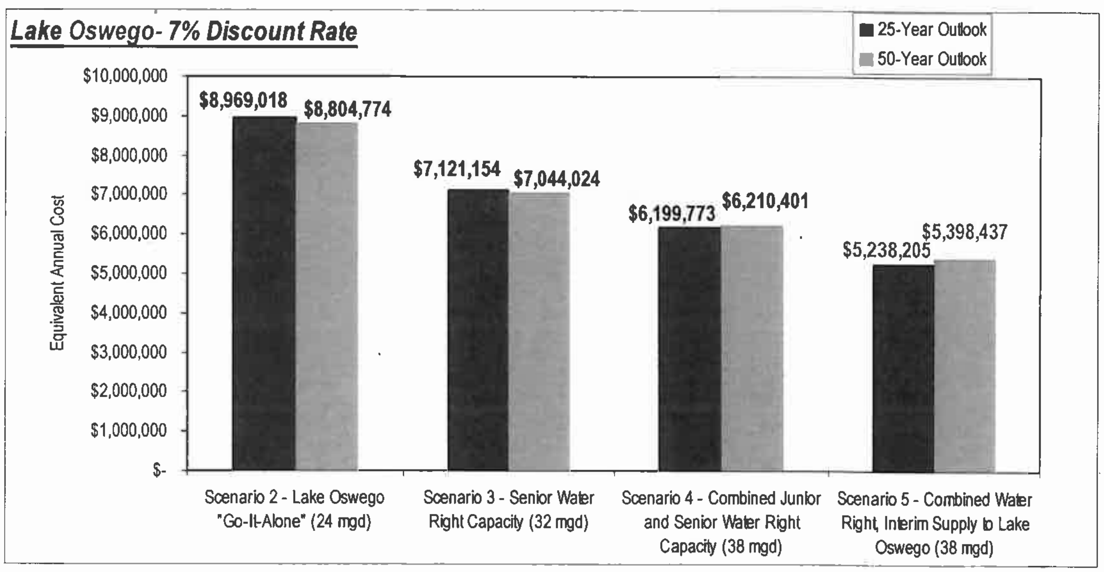
			CITY OF TIGARD PRESENT VALUE COSTS									
			Scenario 2A	Scenario 2B	Scenario 2C	Scenario 3A	Scenario 3B	Scenario 3C	Scenario 4	Scenario 5	Scenario 6A	Scenario 6B
25-Year Outlook	Lake Oswego Supply	Capital Costs Only	$ -	$ -	$ -	$ 53,929,473	$ 53,929,473	$ 53,929,473	$ 80,611,102	$ 83,210,173	$ -	$ -
		O&M Costs Only	-	-	-	22,839,964	22,839,964	22,839,964	32,513,468	23,548,037	-	-
		Purchased Water Costs Only	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Other Regional Supplies	Capital Costs Only	$145,858,630	$ 77,889,372	$183,133,485	$110,189,344	$ 48,592,462	$ 98,602,551	$ -	$ -	$ -	$ 1,220,890
		O&M Costs Only	17,364,217	11,656,337	14,596,331	8,544,082	5,635,021	8,109,636	-	-	-	-
		Purchased Water Costs Only	33,609,020	33,609,020	33,609,020	21,884,129	21,884,129	21,884,129	27,832,320	39,557,210	103,893,416	97,244,036
	Total	**Total Costs**	**$196,831,866**	**$123,154,729**	**$231,338,836**	**$217,386,992**	**$152,881,049**	**$205,365,753**	**$ 140,956,889**	**$ 146,315,420**	**$103,893,416**	**$ 98,464,926**
50-Year Outlook	Lake Oswego Supply	Capital Costs Only	$ -	$ -	$ -	$ 53,929,473	$ 53,929,473	$ 53,929,473	$ 80,611,102	$ 83,210,173	$ -	$ -
		O&M Costs Only	-	-	-	41,193,875	41,193,875	41,193,875	61,738,384	52,772,953	-	-
		Purchased Water Costs Only	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Other Regional Supplies	Capital Costs Only	$145,858,630	$ 77,889,372	$183,133,485	$110,189,344	$ 48,592,462	$ 98,602,551	$ -	$ -	$ -	$ 1,220,890
		O&M Costs Only	41,130,273	27,992,713	35,112,086	23,032,210	14,648,910	20,227,184	-	-	-	-
		Purchased Water Costs Only	33,609,020	33,609,020	33,609,020	21,884,129	21,884,129	21,884,129	57,245,796	68,970,686	251,801,182	237,484,428
	Total	**Total Costs**	**$220,597,922**	**$139,491,105**	**$251,854,591**	**$250,229,031**	**$180,248,849**	**$235,837,212**	**$ 199,595,282**	**$ 204,953,813**	**$251,801,182**	**$238,705,318**

Equivalent annual costs are derived from present value costs. To calculate these costs, the total annual costs for each scenario are compiled and the present value of these total scenario costs is computed. This present value total is equally annualized over the time period, providing a cost statistic that can be used in the comparison of scenarios. Again, it is important to emphasize that this analysis does not define impacts on rates, and that this levelized statistic, while a basis for scenario comparison, does not translate directly into rate impacts.

For Lake Oswego, we find that Scenario 5, initially implementing a water trade option with Tigard, and then joining to utilize the junior and senior water right, results in the lowest equivalent costs. The highest cost option for Lake Oswego would be to "go-it-alone" as presented in Scenario 2. Please refer to Exhibit 12 for Lake Oswego's equivalent cost comparisons, shown as levelized annual cost (Scenario 6A & 6B are not applicable to Lake Oswego).

Exhibit 12: Lake Oswego Comparative Supply Costs

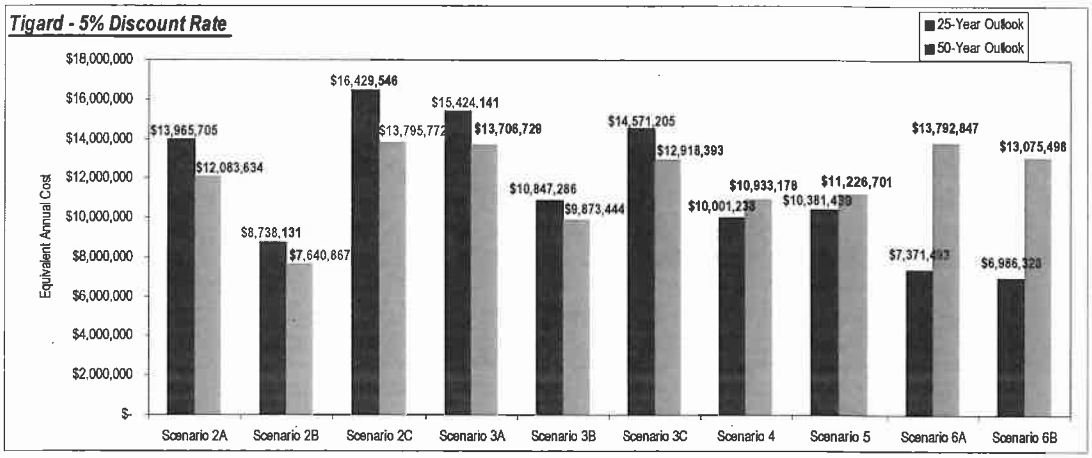


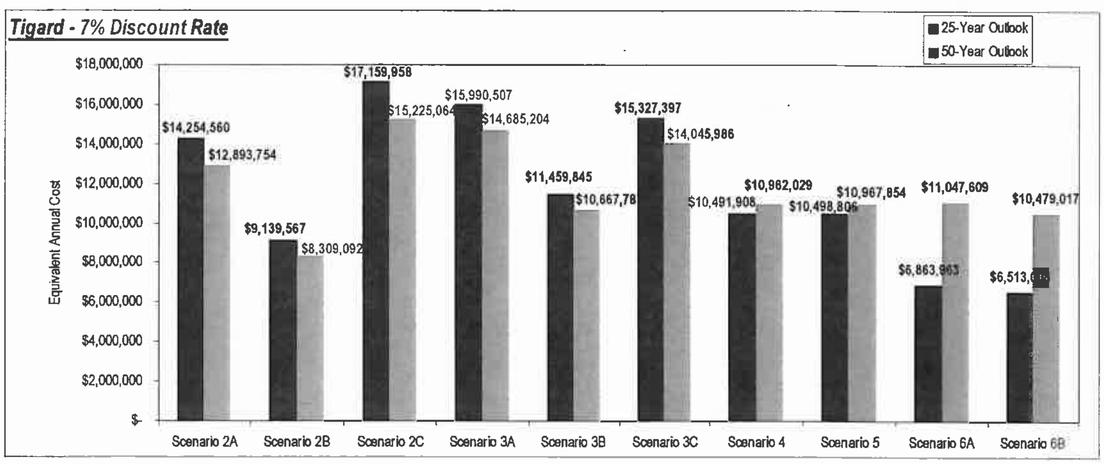


In a 25-year outlook, Tigard's least expensive option would be to meet all demand needs through water purchases from Portland, utilizing the gravity connection; in a more long-term outlook, this becomes a more expensive option. The lowest cost option in the 50-

year outlook would be to obtain interim water from Portland and then partner with Willamette, assuming the involvement of other major cost-sharing partners (Scenario 2B). However, without the economies gained by such group development at the regional level, costs are much higher, and the lowest cost option is full service from Lake Oswego (Scenario 4). The highest equivalent cost is Scenario 2C, where water is attained from Portland and then Willamette without a major cost-sharing partner. Exhibit 13 shows the Tigard's equivalent costs for all scenarios.

Exhibit 13: Tigard Comparative Supply Costs per CCF





Conclusions

Regarding Lake Oswego, a joint system with Tigard provides material cost savings opportunities with or without buy-in. There is a slight economic benefit, particularly near-term, for larger scale regionalization, as contemplated in Scenario 4 and 5.

For Tigard, the regional analysis has illustrated strong cost preference for Willamette versus the JWC. In this context, this preference remains. Further Willamette, provided major cost-sharing partners, appears the most cost effective supply source for Tigard, as illustrated in Exhibit 13. If pursued individually, this option is no longer the low cost option, and in fact becomes the highest cost supply scenario. Between the two Lake

Oswego-only scenarios, beginning construction of major projects immediately provides a slightly reduced cost. However, the costs of both scenarios are extremely close, and lower in cost than all other long-term supply options except those involving regional development of Willamette capacity. Beginning immediately on major construction projects provides a slightly reduced cost.

The summary provided in Exhibit 13 illustrates a side-by-side comparison of complete supply options where:

Scenario 2A = JWC,

Scenario 2B = Willamette with major cost-sharing partnership

Scenario 2C = Willamette without major cost-sharing partnership

Scenario 4 = Lake Oswego, immediately

Scenario 5 = Lake Oswego, postponing construction until 2016.

Scenario 6A = Portland, without incorporating gravity connection

Scenario 6B = Portland, utilizing gravity connection

This shows Scenario 6B as the lowest cost option in a 25-year outlook; Scenario 2B as the long-standing lowest cost option. However, if Tigard must develop the Willamette River Project without major cost-sharing partners (Scenario 2C), the costs to join with Lake Oswego (Scenario 4 or 5) becomes a less expensive option long term.

Scenarios 3A, 3B and 3C illustrate costs for a combination of sources, with findings generally consistent with an average of individual source costs.

Economic comparison is but one part of the decision making basis, which could also include environmental concern, political issues, schedule, risk water quality and various other related factors. A composite of all these factors and criteria lead to a final decision.

FCS GROUP
Solutions-Oriented Consulting

Date: July 6, 2007

To: **Mark Knudsen, Carollo Engineers**
Cara Wilson, Carollo Engineers

From: Ed Cebron, FCS Group
Samantha Holert, FCS Group

Re: **Lake Oswego/Tigard Rate Impact Analysis**

This memorandum defines the methodology used and results found by FCS Group in the joint supply system rate impact analysis. FCS Group was tasked to evaluate how the implementation of the various supply scenarios would impact rates for the City of Lake Oswego and the City of Tigard. The cost data used in this analysis was taken from the Joint Supply System cost comparison that FCS Group also developed.

The five supply options evaluated, as defined in Carollo's Technical Memorandum No.1, are summarized below:

- **Scenario 2 - Lake Oswego "Go-It-Alone" (24 mgd):** Provides the required capacity to treat the build-out demands of the Lake Oswego water service area. Under this scenario, Tigard does not receive any supply capacity.
- **Scenario 3 – Senior Water Right Capacity (32 mgd):** Represents capacity needed to deliver the senior water right of Lake Oswego. This capacity exceeds the build-out demands of the Lake Oswego water service area and thus provides capacity to meet a share of Tigard's demand.
- **Scenario 4 – Combined Junior and Senior Water Right Capacity (38 mgd):** Provides capacity needed to deliver the senior and junior water rights of Lake Oswego. This capacity meets the build-out needs of Lake Oswego, while providing the majority of Tigard's demand needs through build-out.
- **Scenario 5 – Combined Water Right Capacity, Interim Supply to Lake Oswego:** Beginning in 2016, this scenario provides capacity needed to meet build-out needs of Lake Oswego, while providing the majority of Tigard's demand. Until 2016, assumes that, to the extent Lake Oswego needs peak water capacity, a water trade will occur with Tigard. No net purchase of water is assumed due to limited duration and volume constraints.
- **Scenario 6 – Tigard only Scenario, Tigard Continues Purchasing Water from Portland:** Tigard meets all demand needs through water purchases from Portland Water Bureau.

The City of Tigard's scenarios were further defined to incorporate the costs incurred from obtaining any capacity needs not fulfilled by Lake Oswego. These scenarios are recapped below:

- **Scenario 2A**: Tigard invests in expanded JWC capacity to fulfill demands not met by the Lake Oswego source, as depicted in Scenario 2. Portland is an interim source for all water needs in the first 10 years.
- **Scenario 2B**: Tigard invests in expanded Willamette capacity to fulfill demands not met by the Lake Oswego source, as depicted in Scenario 2. Portland is an interim source for all water needs in the first 10 years. Regional capital and operation costs in this scenario assume major cost-sharing partners also invest in Willamette capacity.
- **Scenario 2C**: Tigard invests in expanded Willamette capacity to fulfill demands not met by the Lake Oswego source, as depicted in Scenario 2. Portland is an interim source for all water needs in the first 10 years. Regional capital and operation costs in this scenario assume Tigard must develop Willamette without the help of major cost-sharing partners.
- **Scenario 3A**: Tigard invests in expanded JWC capacity to fulfill demands not met by the Lake Oswego source, as depicted in Scenario 3. Required contract quantities are purchased from Portland for the first 10 years.
- **Scenario 3B**: Tigard invests in expanded Willamette capacity to fulfill demands not met by the Lake Oswego source, as depicted in Scenario 3. Required contract quantities are purchased from Portland for the first 10 years. Regional capital and operation costs in this scenario assume major cost-sharing partners also invest in Willamette capacity.
- **Scenario 3C**: Tigard invests in expanded Willamette capacity to fulfill demands not met by the Lake Oswego source, as depicted in Scenario 3. Required contract quantities are purchased from Portland for the first 10 years. Regional capital and operation costs in this scenario assume Tigard must develop Willamette without the help of major cost-sharing partners.
- **Scenario 4**: Tigard does not invest in any regional source. Required contract quantities are purchased from Portland for the first 10 years. In later years, it purchases water from Portland to meet any increments of demand not met by Lake Oswego source.
- **Scenario 5**: Tigard does not invest in a regional source. Portland is an interim source for all water needs in the first 10 years, as construction projects for joint supply system with Lake Oswego are not expected to be completed until 2016. In later years, Tigard purchases water from Portland to meet any increments of demand not met by Lake Oswego source.
- **Scenario 6A**: Tigard does not invest in Lake Oswego or any other regional source. Instead, it purchases all water from Portland, based on terms of current contract and adjustments for inflation.

- **Scenario 6B**: Tigard does not invest in Lake Oswego or any other regional source. Instead, it purchases all water from Portland, utilizing a gravity connection for a portion of the purchases. The unit price of water is based on terms of current contract but also includes a pumping discount on 2.6 mgd of purchased water, during off-peak months. This discount of $0.29 per ccf (in 2007 dollars) is also escalated using the inflation rate of 5.6%.

The results of the Joint Supply System cost comparison are shown in Exhibits 1 and 2. Exhibit 1 shows both Cities' total capital costs in current day dollars. Exhibit 2 depicts annual O&M costs for years 2010, 2020 and 2030 (shown in future day dollars).

Exhibit 1: Total Capital Cost Comparison

	Lake Oswego Capital Costs	Tigard Capital Costs	
		Lake Oswego Supply	Other Regional Supplies
Scenario 2A	$ 78,590,000	$ -	$ 142,086,182
Scenario 2B	$ 78,590,000	$ -	$ 77,100,000
Scenario 2C	$ 78,590,000	$ -	$ 180,900,000
Scenario 3A	$ 64,433,063	$ 52,956,938	$ 107,234,716
Scenario 3B	$ 64,433,063	$ 52,956,938	$ 48,100,000
Scenario 3C	$ 64,433,063	$ 52,956,938	$ 97,400,000
Scenario 4	$ 55,577,287	$ 78,952,713	$ -
Scenario 5	$ 56,977,287	$ 78,952,713	$ -
Scenario 6A	N/A	$ -	$ -
Scenario 6B		$ -	$ 1,484,000

Exhibit 2: Annual O&M Cost Comparison

		Lake Oswego Costs			Tigard Costs		
		2010	2020	2030	2010	2020	2030
Scenario 2A	O&M Costs	$ 2,112,876	$ 3,448,123	$ 5,523,659	$ -	$ 2,475,688	$ 3,658,558
	Purchased Water	$ -	$ -	$ -	$ 4,221,157	$ -	$ -
Scenario 2B	O&M Costs	$ 2,112,876	$ 3,448,123	$ 5,523,659	$ -	$ 1,609,210	$ 2,653,684
	Purchased Water	$ -	$ -	$ -	$ 4,221,157	$ -	$ -
Scenario 2C	O&M Costs	$ 2,112,876	$ 3,448,123	$ 5,523,659	$ -	$ 2,065,358	$ 3,297,126
	Purchased Water	$ -	$ -	$ -	$ 4,221,157	$ -	$ -
Scenario 3A	O&M Costs	$ 1,648,236	$ 2,801,750	$ 4,624,649	$ 1,648,236	$ 3,973,360	$ 6,599,438
	Purchased Water	$ -	$ -	$ -	$ 2,784,712	$ -	$ -
Scenario 3B	O&M Costs	$ 1,648,236	$ 2,801,750	$ 4,624,649	$ 1,648,236	$ 3,531,463	$ 6,088,867
	Purchased Water	$ -	$ -	$ -	$ 2,784,712	$ -	$ -
Scenario 3C	O&M Costs	$ 1,648,236	$ 2,801,750	$ 4,624,649	$ 1,648,236	$ 3,888,871	$ 6,593,026
	Purchased Water	$ -	$ -	$ -	$ 2,784,712	$ -	$ -
Scenario 4	O&M Costs	$ 1,521,399	$ 2,623,884	$ 4,375,233	$ 1,137,996	$ 3,477,860	$ 4,747,302
	Purchased Water	$ -	$ -	$ -	$ 2,784,712	$ -	$ 3,696,598
Scenario 5	O&M Costs	$ -	$ 2,623,884	$ 4,375,233	$ -	$ 3,477,860	$ 4,747,302
	Purchased Water	$ -	$ -	$ -	$ 4,221,157	$ -	$ 3,696,598
Scenario 6A	O&M Costs	N/A			$ -	$ -	$ -
	Purchased Water				$ 4,221,157	$ 9,029,354	$18,588,607
Scenario 6B	O&M Costs				$ -	$ -	$ -
	Purchased Water				$ 3,897,098	$ 8,470,545	$17,624,994

General Approach

In this analysis, the impacts of the supply scenario costs were isolated from the rest of the system. To do this, the following steps were taken:

1. Both Cities provided copies of their rate models, along with current financial and budget information. These rate models were updated with FYE 2007 budget numbers. All operating and maintenance costs relating to supply and treatment (including water purchases) were replaced with the annual O&M costs calculated for the individual supply system scenarios. For all non-supply/treatment expenses, the gross assumption was made that these costs would continue to annually escalate based on inflation.
2. Rate revenues were annually escalated using the growth forecasts present in each City's models. Adopted rate increases were also integrated (3.0% in FY 2007/08 for Lake Oswego, 7.0% in FY 2007/08 for Tigard).
3. Annual capital cost streams were incorporated into the corresponding models. No other planned capital improvement project costs were included in the analysis. Because of this, current capital or system development charge (SDC) fund balances that either City might hold were not used in this analysis. The debt service needed to fund the joint supply projects was calculated and built-

in to the impact analysis. It is important to note that Scenario 6A did not include any capital project costs.

4. Capital supply costs were used to develop a potential SDC that could be implemented; this included supply projects only. This charge was calculated for each of the City's scenarios as detailed below:

    - Lake Oswego - Supply SDC was broken into two parts: (1) total capital costs that were allocated based on proportional capacity were divided by the total capacity available to Lake Oswego (23.9 mgd in each scenario), and (2) total capital costs that were allocated on incremental capacity were divided by the added capacity (7.9 mgd in each scenario).

    - Tigard - Supply SDC is the total cost of all capital projects (Lake Oswego as well as regional partner projects) divided by their total capacity needs. Tigard's buy-in payment to Lake Oswego is also included in the capital costs.

5. An SDC revenue stream was forecasted from each supply SDC charge. The growth provided in each City's rate model was lower than the annual growth forecasted in supply planning. In order to remain conservative in our analysis, the lower annual growth rate was used to predict this SDC revenue. As allowable by Oregon statute, SDC charges were also escalated annually with inflation. The Cities chose to use construction cast inflation (6.0%) for this escalator. The stream of revenues generated from supply SDCs were assumed to be fully available to pay debt service and meet coverage requirements.

6. With all supply-related costs incorporated into the technical models, rate impacts were analyzed. All rate increases were smoothed over several years to mitigate sharp rate impacts on customers. It is important to recognize that levelizing rates in earlier years buys down future rate impacts, allowing for a lower cumulative increase.

Summary of Analysis

For Lake Oswego, the lowest impact on rates results from the implementation of a joint supply system with Tigard. In Scenario 5 (Combined Water Right, Interim Supply to Lake Oswego), rates would cumulatively increase 52% due to supply costs over the 25-year period. The worst-case scenario for Lake Oswego would be under Scenario 2 (Lake Oswego "Go-It-Alone"), in which case the cumulative rate impact would be 148% over 25 years. Exhibit 3 below shows a summary of the annual and cumulative rate impacts for the first ten years and the last year of each scenario. It also calculates an average monthly customer bill based on the rates of each fiscal year. This average bill assumes a usage of 10 ccf per month and helps to provide an actual dollar comparison among all scenarios. At the end of 25 years, the two lowest cost options produce a typical bill (increased solely for supply system impacts) of $33.68 and $32.84 for Scenario 4 and 5, respectively.

Exhibit 3: Lake Oswego Summary of Rate Impacts

	FYE	2007	2008 [a]	2009	2010	2011	2012	2013	2014	2015	2016	2032
SCN 2	Annual Rate Impact	0.00%	0.00%	148.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	Cumulative Rate Impact	0.00%	0.00%	148.00%	148.00%	148.00%	148.00%	148.00%	148.00%	148.00%	148.00%	148.00%
	Average Customer Bill [b]	**$ 21.01**	**$ 21.59**	**$ 53.54**	**$ 53.54**	**$ 53.54**	**$ 53.54**	**$ 53.54**	**$ 53.54**	**$ 53.54**	**$ 53.54**	**$ 53.54**
SCN 3	Annual Rate Impact	0.00%	0.00%	60.00%	4.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	Cumulative Rate Impact	0.00%	0.00%	60.00%	66.40%	66.40%	66.40%	66.40%	66.40%	66.40%	66.40%	66.40%
	Average Customer Bill [b]	**$ 21.01**	**$ 21.59**	**$ 34.54**	**$ 35.93**	**$ 35.93**	**$ 35.93**	**$ 35.93**	**$ 35.93**	**$ 35.93**	**$ 35.93**	**$ 35.93**
SCN 4	Annual Rate Impact	0.00%	0.00%	56.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	Cumulative Rate Impact	0.00%	0.00%	56.00%	56.00%	56.00%	56.00%	56.00%	56.00%	56.00%	56.00%	56.00%
	Average Customer Bill [b]	**$ 21.01**	**$ 21.59**	**$ 33.68**	**$ 33.68**	**$ 33.68**	**$ 33.68**	**$ 33.68**	**$ 33.68**	**$ 33.68**	**$ 33.68**	**$ 33.68**
SCN 5	Annual Rate Impact	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	15.00%	15.00%	15.00%	0.00%
	Cumulative Rate Impact	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	15.00%	32.25%	52.09%	52.09%
	Average Customer Bill [b]	**$ 21.01**	**$ 21.59**	**$ 21.59**	**$ 21.59**	**$ 21.59**	**$ 21.59**	**$ 21.59**	**$ 24.83**	**$ 28.55**	**$ 32.84**	**$ 32.84**

[a] 2008 Rate Increase is on top of 3% increase already adopted by City. Both increases included in average customer bill
[b] Based on assumed monthly usage of 10 ccf

In Tigard's case, the joint system with Lake Oswego presented in Scenario 4 provides the lowest impact on rates. Under this scenario, supply costs would impact rates approximately 113% over a 25-year period. Scenario 2C (partnering with Willamette, absent major cost-sharing partner) produces the highest impact on rates, with approximately a 301% increase needed over the next 25 years. Exhibit 4 shows the annual and cumulative impact, as well as the average monthly customer bill (again, assuming a usage of 10 ccf per month). In the twenty-fifth year, the monthly customer bills for Scenarios 2B, 4 and 5 are all within seven dollars of one another, with Scenario 4 at $56.67, Scenario 2B at $60.62 and Scenario 5 at $63.01.

Exhibit 4: Tigard Summary of Rate Impacts

	FYE	2007	2008 [a]	2009	2010	2011	2012	2013	2014	2015	2016	2032
SCN 2A	Annual Rate Impact	0.00%	0.00%	15.00%	15.00%	15.00%	15.00%	15.00%	15.00%	28.00%	0.77%	0.00%
	Cumulative Rate Impact	0.00%	0.00%	15.00%	32.25%	52.09%	74.90%	101.14%	131.31%	196.07%	198.35%	198.35%
	Average Customer Bill [b]	**$ 24.83**	**$ 26.57**	**$ 30.55**	**$ 35.14**	**$ 40.41**	**$ 46.47**	**$ 53.44**	**$ 61.45**	**$ 78.66**	**$ 79.26**	**$ 79.26**
SCN 2B	Annual Rate Impact	0.00%	0.00%	15.00%	15.00%	15.00%	15.00%	15.00%	5.00%	5.00%	2.90%	0.00%
	Cumulative Rate Impact	0.00%	0.00%	15.00%	32.25%	52.09%	74.90%	101.14%	111.19%	121.75%	128.18%	128.18%
	Average Customer Bill [b]	**$ 24.83**	**$ 26.57**	**$ 30.55**	**$ 35.14**	**$ 40.41**	**$ 46.47**	**$ 53.44**	**$ 56.11**	**$ 58.92**	**$ 60.62**	**$ 60.62**
SCN 2C	Annual Rate Impact	0.00%	0.00%	15.00%	15.00%	15.00%	15.00%	26.00%	43.00%	15.00%	10.69%	0.00%
	Cumulative Rate Impact	0.00%	0.00%	15.00%	32.25%	52.09%	74.90%	120.37%	215.14%	262.41%	301.14%	301.14%
	Average Customer Bill [b]	**$ 24.83**	**$ 26.57**	**$ 30.55**	**$ 35.14**	**$ 40.41**	**$ 46.47**	**$ 58.55**	**$ 83.73**	**$ 96.28**	**$ 106.57**	**$ 106.57**
SCN 3A	Annual Rate Impact	0.00%	0.00%	40.00%	14.00%	14.00%	14.00%	14.00%	14.00%	14.00%	0.52%	0.00%
	Cumulative Rate Impact	0.00%	0.00%	40.00%	59.60%	81.94%	107.42%	136.45%	169.56%	207.30%	208.89%	208.89%
	Average Customer Bill [b]	**$ 24.83**	**$ 26.57**	**$ 37.20**	**$ 42.40**	**$ 48.34**	**$ 55.11**	**$ 62.82**	**$ 71.62**	**$ 81.64**	**$ 82.07**	**$ 82.07**
SCN 3B	Annual Rate Impact	0.00%	0.00%	40.00%	10.00%	10.00%	10.00%	10.00%	10.00%	6.50%	6.15%	0.00%
	Cumulative Rate Impact	0.00%	0.00%	40.00%	54.00%	69.40%	86.34%	104.97%	125.47%	140.13%	154.91%	154.91%
	Average Customer Bill [b]	**$ 24.83**	**$ 26.57**	**$ 37.20**	**$ 40.91**	**$ 45.01**	**$ 49.51**	**$ 54.46**	**$ 59.90**	**$ 63.80**	**$ 67.72**	**$ 67.72**
SCN 3C	Annual Rate Impact	0.00%	0.00%	30.00%	16.00%	16.00%	16.00%	15.00%	15.00%	10.00%	9.58%	0.00%
	Cumulative Rate Impact	0.00%	0.00%	30.00%	50.80%	74.93%	102.92%	133.35%	168.36%	195.19%	223.47%	223.47%
	Average Customer Bill [b]	**$ 24.83**	**$ 26.57**	**$ 34.54**	**$ 40.06**	**$ 46.48**	**$ 53.91**	**$ 62.00**	**$ 71.30**	**$ 78.43**	**$ 85.94**	**$ 85.94**
SCN 4	Annual Rate Impact	0.00%	0.00%	67.00%	5.00%	5.00%	5.00%	5.00%	5.00%	0.00%	0.08%	0.00%
	Cumulative Rate Impact	0.00%	0.00%	67.00%	75.35%	84.12%	93.32%	102.99%	113.14%	113.14%	113.30%	113.30%
	Average Customer Bill [b]	**$ 24.83**	**$ 26.57**	**$ 44.37**	**$ 46.59**	**$ 48.92**	**$ 51.36**	**$ 53.93**	**$ 56.63**	**$ 56.63**	**$ 56.67**	**$ 56.67**
SCN 5	Annual Rate Impact	0.00%	0.00%	15.00%	15.00%	15.00%	10.00%	10.00%	10.00%	10.00%	6.51%	0.00%
	Cumulative Rate Impact	0.00%	0.00%	15.00%	32.25%	52.09%	67.30%	84.03%	102.43%	122.67%	137.17%	137.17%
	Average Customer Bill [b]	**$ 24.83**	**$ 26.57**	**$ 30.55**	**$ 35.14**	**$ 40.41**	**$ 44.45**	**$ 48.89**	**$ 53.78**	**$ 59.16**	**$ 63.01**	**$ 63.01**
SCN 6A	Annual Rate Impact	0.00%	0.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	0.00%
	Cumulative Rate Impact	0.00%	0.00%	5.00%	10.25%	15.76%	21.55%	27.63%	34.01%	40.71%	47.75%	171.97%
	Average Customer Bill [b]	**$ 24.83**	**$ 26.57**	**$ 27.90**	**$ 29.29**	**$ 30.76**	**$ 32.29**	**$ 33.91**	**$ 35.60**	**$ 37.38**	**$ 39.25**	**$ 72.26**
SCN 6B	Annual Rate Impact	0.00%	0.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	1.44%
	Cumulative Rate Impact	0.00%	0.00%	5.00%	10.25%	15.76%	21.55%	27.63%	34.01%	40.71%	47.75%	169.14%
	Average Customer Bill [b]	**$ 24.83**	**$ 26.57**	**$ 27.90**	**$ 29.29**	**$ 30.76**	**$ 32.29**	**$ 33.91**	**$ 35.60**	**$ 37.38**	**$ 39.25**	**$ 71.50**

[a] Any FYE 2007 rate increase is on top of 7% increase already adopted by City for this year. Both increases included in average customer bill
[b] Any FYE 2008 rate increase is on top of 7% increase already adopted by City for this year. Both increases included in average customer bill
[c] Based on assumed monthly usage of 10 ccf

Conclusions

This rate impact analysis illustrates cost preferences similar to those shown in our economic analysis of the joint supply system scenarios. For Lake Oswego, a joint system with Tigard provides considerably lower impacts to rates than continuing alone. In Tigard's case, materially lower impacts are seen in both of Lake Oswego-only scenarios (Scenarios 4 and 5) as well as in the Willamette option, though only with the presence of a major cost-sharing partner.

The analysis also shows that, though Scenarios 6A and 6B are considerably less expensive than the other scenarios in the 25-year time frame, this is not the same for the rate impacts. It should be noted that, whereas other scenarios can collect a more substantial supply SDC revenue stream, all costs in Scenario 6A, and the majority in Scenario 6B, are wholesale water purchase costs, and therefore the additional supply SDC revenue source can not be used to offset the impact on rates.

Again, this study provides only an analysis of how supply costs would affect each City's rates; it makes a gross assumption regarding the constant continuation of existing operating costs and does not include any capital costs other than those defined in the joint supply analysis. A rate study incorporating all financial aspects of each City's utility is necessary to determine actual rate increases and SDC charges.

Appendix E

STAKEHOLDER INTERVIEWS

Name & Affiliation	Address	Phone & E-mail
Lake Oswego		
Joel Komarek, P.E., W.R.E.; City Engineer City of Lake Oswego	City of Lake Oswego 380 A Avenue Post Office Box 369 Lake Oswego, OR 97034	Direct (503) 697-6588 Home (503) 245-2541 jkomarek@ci.oswego.or.us
Frank Groznik City Council	City of Lake Oswego 380 A Avenue Post Office Box 369 Lake Oswego, OR 97034	Cell (503) 708-1191
Judie Hammerstad, Ellie McPeak, Lynn Peterson City of Lake Oswego	City of Lake Oswego 380 A Avenue Post Office Box 369 Lake Oswego, OR 97034	(503) 699-1928
Tigard		
Dennis Koellermeier Tigard Public Works Director	City of Tigard Public Works 13125 SW Hall Boulevard Tigard, OR 97223	Direct (503) 718-2596 Fax (503) 684-8840 dennis@tigard-or.gov
Craig Dirksen, Mayor	City of Tigard 13125 SW Hall Boulevard Tigard, OR 97223	Cell (503) 310-3659 Fax (503) 684-7297 craigd@tigard-or.gov
Tom Woodruff Tigard City Council Tigard member of IntGov WB Chair of the Joint Water Commission	City of Tigard 13125 SW Hall Boulevard Tigard, OR 97223	Office (503) 603-3143
Craig Prosser City Manager City of Tigard	City Administration 13125 SW Hall Boulevard Tigard, OR 97223	Direct (503) 718-2486 Fax (503) 684-7297 craig@tigard-or,gov
Gary Firestone, City Attorney	Ramis Crew Corrigan, LLP 1727 N.W. Hoyt Street Portland, OR 97209	Tel: (503) 222-4402 Fax: (503) 243-2944 garyf@rcclawlers.com
Robert Sesnon, Director of Financial & Information Services	City of Tigard 13125 SW Hall Boulevard Tigard, OR 97223	Tel: (503) 639-4171 Fax: (503) 684-7297 bobj@tigard-or.gov
Patrick Carroll, Durham Durham member of Intergovernmental Water Board	City of Durham 17160 SW Upper Boones Ferry Road Durham, OR 97281	Home (503) 620-5778 Work (503) 630-2253 Other (503) 703-3155 Patrick.suzycarroll@verizon.net

Name & Affiliation	Address	Phone & E-mail
Beverly Froude Tigard Water District Board and Intergovernmental Water Board	City of Tigard 13125 SW Hall Boulevard Tigard, OR 97223	Home (503) 639-2529
Dick Winn King City member of Intergovernmental Water Board	City of King City 15300 SW 116th Avenue King City, OR 97224	(503) 920-2097 thermw@webtv.net
West Linn		
Chris Jordan West Linn City Manager	City of West Linn 22500 Salamo Road Suite 100 West Linn, OR 97068	(503) 657-0331 Fax (503) 650-9041 cjordan@ci.west-linn.or.us
Others		
Dan Bradley General Manager North Clackamas Water Commission (Oak Lodge Water District)	Oak Lodge Water District 14496 SE River Rd. Milwaukie, OR 97267	Direct (503) 654-7765 dan@oaklodgewater.org
John Collins General Manager South Fork Water Board	South Fork Water Board 15962 S. Hunter Avenue Oregon City, OR 97045	Work (503) 657-6581 johnc@sfwb.com
John Thomas and Nicki Iverson Sunrise Water Authority	Sunrise Water Authority 10602 SE 129th Avenue Portland, OR 97236	(503) 761-0220 jthomas@sunrisewater.com

Appendix F

LIMITATIONS OF ORGANIZATIONAL AND GOVERNACE INFORMATION

DISCLAIMER

Sections 2 and 4 and Appendix B of this Technical Memorandum were prepared by Cable Huston Benedict Haagensen & Lloyd LLP to provide general information about potential governance structures for joint water supply under Oregon law. These documents are not intended to provide legal advice and the Cities of Lake Oswego and Tigard need to consult with their respective legal counsel to obtain a more detailed analysis of these laws, and how they may apply to the specific circumstances and facts of this proposed project.

CLARK I. BALFOUR

Cable Huston Benedict Haagensen & Lloyd LLP
Suite 2000, 1001 SW Fifth Avenue
Portland, OR 97204
(503) 224-3092

Appendix G

UTILITY SERVICE DELIVERY MODELS

UTILITY SERVICE DELIVERY MODELS

Clark I. Balfour
Cable Huston Benedict Haagensen & Lloyd LLP
Suite 2000, 1001 SW Fifth Avenue
Portland, OR 97204

Interlocal Partnership/ Joint Operating	*People's Utility District*	*Domestic Water Supply District*	*County Service District*	*Authority*
Statutory Basis				
ORS 190 (Intergovernmental Unit Cooperation). Local governments may enter into a written Agreement to perform any or all functions that a party to the Agreement has authority to perform.	ORS 261 (People's Utility District). Individual property owners may choose to form a unit of local government with statutory authority to provide water and power.	ORS 264 (Domestic Water Supply Districts). Communities may be incorporated into special districts to supply water.	ORS 451 May provide full range of services. Governed by County Commissioners.	ORS 450 (Authorities). Two or more existing cities or districts consolidate into a single, independent Authority. These are units of local government.
Formation & Security of Boundaries				
Approval of Agreement by parties adopting ordinance; Boundaries affected by withdrawal/termination of a party and Agreement provisions.	Vote; Inclusion of municipality requires favorable vote of its voters; after formation, not subject to annexation and withdrawal of territory by City except in very limited circumstances.	Vote; subject to annexation and withdrawal by city Boundary change in limited circumstances.	Authority to own or operate facilities upon formation by BCC; assets subject to annexation and withdrawal by City. Boundary changes in limited circumstances.	Vote; land subject to annexation but assets not subject to withdrawal by City. Boundary change in limited circumstances.
Viable for providing Utility Service				
Yes	Yes Water and Power	Yes	Yes	Yes
Voting				
Details of governance structure are determined by Agreement between jurisdictions. Board members may not be directly elected for the 190 positions, but may be elected or appointed officials. Weighted voting possible as per Agreement.	A five-member Board of Directors, elected by apportioned geographic subdivision, ORS 261.405. Each Director has equal vote.	A five-member Board of Commissioners elected at large, ORS 264.410 (1). Each Commissioner has equal vote.	County Commission is governing body.	A five- or seven-member Board of Directors, ORS 450.600-655. Directors may be elected at-large or by apportioned geographic subdivision. Each Director has equal vote.
Ownership				
In general a joint agency is the legal owner of any assets, with individual partners owning percentage interest shares in the common agency. However, ownership of specific assets may be retained by specific jurisdictions by Agreement and assigned (e.g. leased) to the entity.	District would own all assets.	District would own all assets.	District would own all assets.	Newly formed Authority may acquire all existing water supply assets (including receivables), depending on the incorporation resolution. The Authority would own all regional assets. Pre-existing debt may be distributed among constituent agencies by agreement.
Operations & Maintenance				
May hire staff and operate facilities owned by the joint agency or any of its constituent jurisdictions, ORS 190.010 (2-3). May also contract with private companies for O&M. May contract with existing public agencies for staffing or services.	May hire administrative and operational staff and operate facilities owned by the district, ORS 261.305 (4). May also contract with private companies for O&M. May contract with existing public agencies for staffing or services.	May hire administrative and operational staff and operate facilities owned by the district, ORS 264.210. May also contract with private companies for O&M. May contract with existing public agencies for staffing or services.	May hire administrative and operational staff and operate facilities owned by the district. May also contract with private companies for O&M May contract with existing public agencies for staffing or services.	May hire administrative and operational staff and operate facilities owned by the district, ORS 450.075. May also contract with private companies for O&M. May contract with existing public agencies for staffing or services.

UTILITY SERVICE DELIVERY MODELS

Interlocal Partnership/ Joint Operating	People's Utility District	Domestic Water Supply District	County Service District	Authority
System Expansion				
Determined by agreement. Joint agency determines how and when to expand. Individual entities may have option to not participate in projects. May allow for members to "buy back" at a later date. Possible differential rates to account for participants/nonparticipants.	District Board of Directors controls planning and timing of system expansion. Possible differential rates to account for participants/nonparticipants.	District Board of Commissioners control planning and timing of system expansion. Possible differential rates to account for participants/ nonparticipants.	District Board controls planning and timing of system expansion. Possible differential rates to account for participants/ nonparticipants.	District Board of Directors controls planning and timing of system expansion. Possible differential rates to account for participants/nonparticipants.
Latecomers				
Joint agency Agreement may be expanded to include new partner jurisdictions. Precise procedures for expansion and/or dissolution of the joint agency are specified in the initial Agreement.	The district may annex a parcel or municipality, or consolidate with one or more other districts, following approval of voters in both the district and the area to be annexed, ORS 261.105 (1-3).	District may annex property or consolidate or merge with one or more Districts. Vote usually required. Potential Metro Process.	Boundary is established in the formation order. District may annex property. Vote usually required.	The Authority may annex a parcel or municipality, or consolidate with one or more additional districts, following approval of all elected bodies and approval of voters in all affected areas (ORS 450.680) with some exceptions. Potential Metro Process.
Capital Financing				
Agency may issue revenue bonds pursuant to the partnership Agreement if the parties have the ability to delegate this power to entity. Alternatively, the governing bodies of each of the partner jurisdictions may approve the issuance of revenue bonds (100% consensus). Finally, one or more member jurisdictions may issue revenue bonds backed by revenue pledged from other partners. Agency may not levy taxes or issue G.O. bonds. Agreement may allow the following: Levy SDCs: Yes Set Rates: Yes/Differential SRF Grants/Loans: Yes Create LIDs: Yes	May issue revenue bonds, following a public hearing and independent financial review, with the approval of the board of directors and voters. May issue G.O. bonds in an amount ≤2.5% of the property value in the district with approval of voters in a special election at which at least 25% of registered voters turn out. May levy taxes to cover bond payments when revenues are exhausted. Levy SDCs: Yes Set Rates: Yes/Differential SRF Grants/Loans: Yes Create LIDs: No	May issue revenue bonds when approved by district commission. May issue G.O. Bonds or tax levy with voter approval. G.O. Bonds may not exceed 2.5% of taxable value. Levy SDCs: Yes Set Rates: Yes/Differential SRF Grants/Loans: Yes Create LIDs: Yes	May issue revenue bonds when approved by Council. May issue GO bonds up to 13% of real property value. May levy taxes with vote. Levy SDCs: Yes Set Rates: Yes/Differential SRF Grants/Loans: Yes Create LIDs: Yes	May levy taxes on property with vote and impose various other fees and charges. May issue G.O. bonds with approval of the Board of Directors and the voters, following a public hearing. May issue revenue bonds with approval of the Board, following a public hearing. Levy SDCs: Yes Set Rates: Yes/Differential SRF Grants/Loans: Yes Create LIDs: Yes
Financial Risk Sharing				
Risk shared among members. Generally, risk follows ownership of assets. However, agreement may make specific risk assignments. Statute says Joint and Several Liability	Risk borne by the district and its citizens/landowners/ratepayers.	Risk borne by the district and its citizens/landowners/ ratepayers.	Risk borne by the district and its citizens/landowners/ ratepayers.	Risk ultimately borne by the Authority and its citizens/landowners/ ratepayers. Specific pre-existing liabilities could be assigned to specific surviving jurisdictions according to the incorporation resolution

UTILITY SERVICE DELIVERY MODELS

Interlocal Partnership/ Joint Operating	*People's Utility District*	*Domestic Water Supply District*	*County Service District*	*Authority*
Resource Planning				
A joint agency may be authorized to conduct any and all water resource planning conducted by its individual partners (including zoning enforcement, land use, etc.), depending on the details of the partnership Agreement.	Resource Planning authority held by district commissioners. District enjoys most relevant planning powers—including eminent domain—no zoning and land use codes and enforcement.	Resource Planning authority held by district commissioners. District enjoys most relevant planning powers—including eminent domain—no zoning and land use codes and enforcement.	Resource Planning authority held by District Board. District enjoys most relevant planning powers–including eminent domain. No zoning and land use code enforcement.	Water Resource Planning authority held Authority Board of Directors. Authority enjoys most relevant planning powers-- including eminent domain—no zoning and land use codes and enforcement.
System Management & Reliability				
Determined by agreement. The agreement may assign administrative roles to particular member jurisdictions, or create an independent joint agency structure with responsibility for system management.	District is responsible for system management and reliability.	District is responsible for system management and reliability.	District is responsible for system management and reliability.	Authority is responsible for system management and reliability.
Subject to Laws				
Public Contracting – Yes Tort Liability – Yes Public Records – Yes Open Meetings – Yes Elections – No	Public Contracting – Yes Tort Liability – Yes Public Records – Yes Open Meetings – Yes Elections – Yes	Public Contracting - Yes Tort Liability - Yes Public Records - Yes Open Meetings - Yes Elections - Yes	Public Contracting – Yes Tort Liability – Yes Public Records – Yes Open Meetings – Yes Elections – Yes	Public Contracting - Yes Tort Liability - Yes Public Records - Yes Open Meetings - Yes Elections - Yes
Dissolution/Withdrawal				
Dissolution/Withdrawal. According to terms of Agreement for process Compensation provisions.	Vote. Liability for incurred obligations.	Vote. Liability for incurred obligations.	Vote. Liability for incurred obligations.	Vote. Liability for incurred obligations.

UTILITY SERVICE DELIVERY MODELS

Interlocal Partnership/ Joint Operating	*People's Utility District*	*Domestic Water Supply District*	*County Service District*	*Authority*
Pros/Cons				
• Easier process for formation and expansion without public vote. • No direct voter election of governing body • Individual members may have charter or statutory limitations on ability to delegate legislative power or to transfer property/title. Lease or other operational agreements may be needed. • Withdrawal/termination is an easier process, but it could also contribute to uncertainty as to whether parties are committed for the long term. • Can split supply/ distribution functions • Members can use SDC's to fund Agency projects.	• Cities must place issue on ballot as part of formation in proceeding before County Commissioners. • Electoral vote to select commissioners. • Upon formation or authorization, clear power to act in all aspects: legislative/ ministerial. • Succeed to or obtain all assets necessary • Probably can split supply/ distribution functions • Achieving legal agreement on exactly how the agency will function prior to formation not possible (unlike ORS 190 entity where all terms are spelled out in ORS 190 Agreement) • Water and Power • Not covered by Oregon budget law • Difficult to add new territory or withdraw • Existing agencies do not become owners of the new entity • Existing Pub's disappear into new entity; districts may be incorporated; cities can continue	• Cities must consent to formation In proceeding before County Commissioners. • Electoral vote to select commissioners. • Upon formation or authorization, clear power to act in all aspects: legislative/ ministerial • Succeed to or obtain all assets necessary • Probably can split supply/ distribution functions • Achieving legal agreement on exactly how the agency will function prior to formation not possible (unlike ORS 190 entity where all terms are spelled out in ORS 190 Agreement) • Difficult to add new territory or withdraw • Existing agencies do not become owners of the new entity • Some existing entities may cease to exist	• Cities must consent to formation in proceeding before County Commission. • Possible proceeding before Metro. • Electoral vote for County Commissioners • Upon formation or authorization, clear power to act in all aspects: legislative/ ministerial • Succeed to or obtain all assets necessary • Can split supply/ distribution functions • Achieving legal agreement on exactly how the agency will function prior to formation not possible (unlike ORS 190 entity where all terms are spelled out in ORS 190 Agreement) • Difficult to add new territory or withdraw • Existing agencies do not become owners of the new entity • Some existing entities may cease to exist	• Cities must consent to formation in proceeding before County Commissioners. Possible proceeding before Metro. • Electoral vote to select commissioners. • Upon formation or authorization, clear power to act in all aspects: legislative/ ministerial • Succeed to or obtain all assets necessary • Clearly can split supply/distribution functions • Achieving legal agreement on exactly how the agency will function prior to formation not possible (unlike ORS 190 entity where all terms are spelled out in ORS 190 Agreement) • Difficult to add new territory or withdraw • Existing agencies do not become owners of the new entity • Some existing entities may cease to exist

NOTES:

1. The ability of the interlocal partnerships/joint operating agreement (ORS 190) to receive a delegation of powers from underlying members depends upon the statutory/charter powers and limitations of those members. Some entities may not be able to delegate "legislative" functions to the entity, which could require issues to be referred back to the members for a decision. Each entity should seek an opinion of legal counsel. Even if the delegation of a power is not a legislative matter, the process to adopt the ordinance approving and entering into the intergovernmental agreement may be legislative and thereby subject the agreement to initiative or referendum powers.
2. Vote or voter approval means vote of electors in the affected territory.
3. Assets could mean "wholesale" or "retail."
4. "Differential rates" means the ability to levy a different rate within a defined area based upon facilities used for that area of service.
5. SRF means the State Revolving Loan Fund from OEDD or DEQ.
6. Tort Liability/Damage Cap Limitations are in flux with the recent case of *Clarke v. OHSU*, 2006 WL 1867755 (2006), but this question is applicable to all service models and does not make a significant difference in the alternative selected.

Appendix H

ORGANIZATIONAL AND GOVERNANCE FRAMEWORK

Organizational and Governance Framework

In creating a new joint water supply system to serve the City of Lake Oswego and the Tigard Water Service Area, many of the following factors or key issues will need to be decided upon. These decisions will serve as the framework for a new joint water supply agency or water supply agreement between the parties.

1. Scope and Objectives of Agency
    a. Define Service Area: LO/Tigard or LO and entire Tigard Service Area
    b. Water supply (supply, treatment, transmission) versus distribution?
    c. Water supply sources (Clackamas only or other, future sources?)
    d. Operation and maintenance of joint facilities for:
        i. Reliable water supply, including backup
        ii. Regulatory compliance to meet state and federal water quality standards
        iii. Efficient and effective use of water resources
2. Nature of Agreement Between Agencies
    a. Created under existing Oregon law
    b. IGA, PUD, Special District, or Water Authority
3. Type of Agency / Rights of Agency
    a. Enterprise utility
    b. Full municipal powers to provide water service
4. Governance
    a. Board composition / member representation
    b. Appointment versus election of governing Board
    c. Powers of the Board
    d. Board voting system
    e. Executive Committee
    f. Managing Agency
    g. Managing Agency's powers
5. Agency Formation
    a. Name (at least a "placeholder")
    b. Required approvals - authorization of agency creation and funding
    c. Financial contributions & accounting
    d. Assumptions for valuation of existing assets
    e. Transition process
    f. Interim service to Tigard while projects constructed; interim improvements to provide service and allocation of payment
6. Fiscal Authority
    a. Budgeting and payment by members
    b. Ability to make and administer rates
    c. Ability to fund capital improvements
    d. Authority to sell debt
    e. Contract for wholesale water sales to non-members
    f. Contract for wholesale purchase for alternative supplies

7. System Ownership
    a. Basis of ownership in the joint system
    b. Method of assigning value to agency (e.g., capacity versus shares versus units)
    c. Treatment of existing water rights and assets contributed
    d. Source of starting capital / structure of initial capitalization
    e. Treatment of existing debts
    f. Upfront proof of project funding source
8. Operational Standards & Authorities
    a. Standards of operation
    b. Process and time frame for water supply allocation
    c. Water quantity
        i. Routine / reliable supply
        ii. Emergency supply
    d. Water quality
        i. Compliance with applicable state and federal standards
    e. Wholesale water sales - Policy on contracting services to others (first rights of water supply to members then to wholesalers)
    f. Wholesale water purchases
    g. Ability to resell water
    h. Conservation and curtailment policies
    i. Role in source water protection and water resource management
    j. Emergencies
9. Fiscal Standards & Authorities
    a. Basis of rates & charges
    b. Overuse charges or system impacts
    c. Planning and implementation of capital improvements
    d. "Must lease" excess capacity
    e. Policies and procedures for fiscal accountability
    f. Initial capitalization of first year O&M with true-up at end of year
    g. Emergencies
10. Future Considerations
    a. Planning and forecasts of future demands
    b. Latecomer policy
    c. Policy on members changing system ownership amount
    d. Policy of expansion to supply system / authority to develop alternative supplies and/or emergency supplies
    e. Notice of proposed project to other; may proceed alone after notice of offer
    f. Ability to modify agency responsibilities and services over time
    g. Joint pursuit and perfection of existing and future water rights
11. Access by Customers and Members of the Public
    a. Policies on public participation and access by the public
    b. Policies on accountability to the public
12. Other
    a. Member exit terms
        i. Voluntary

   ii. Involuntary
   iii. Valuation
   iv. Purchase terms option/mandatory
b. Dispute resolution process
c. Dissolution and winding up

Appendix I

ORGANIZATIONAL AND GOVERNANCE ISSUES BETWEEN IGA AND IGA ENTITY

Organizational and Governance Issues Between IGA and IGA Entity

May 16, 2007

Issue	Options	Advantages	Limitations
Governance	• Separate IGA entity with governing board appointed from Council of each party (equal vote)	• Separate entity bears some or all risks • Liability shield to underlying parties (at least partial) • Population or investment shifts will not affect voting powers	• Population not related to voting power • Voting power not related to investment • Additional layer of decision-making
	• Separate entity with governing board appointed from Council of each party (weighted vote by investment or population)	• Separate entity bears some or all risks • Liability shield to underlying parties (at least partial) • Vote may be weighted toward party to reflect larger interest	• Relative populations may shift, upsetting power balance • Relative investment ratio may shift, upsetting power balance • Additional layer of decision-making
	• Separate entity with board of appointed officials/staff or citizens (Non Council Members or Combination) (Equal vote or weighted vote)	• Separate entity bears some or all risks • Liability shield to underlying parties (at least partial) • More direct citizen involvement if non Council members appointed • Same issues on equal or weighted voting as above	• Council control somewhat limited if citizen members appointed • Decisions may not be consistent with underlying partner's goals and policies • Same issues on equal or weighted voting as above
	• Agreement (without creating entity) to delegate/allocate operations and management to one party with oversight governing body appointed from each Council (equal vote)	• No separate entity. Some additional layer of decision-making and recommendation to Councils. Major decisions by each Council. • Least amount of formality in operations • Population or investment shifts will not effect voting powers • Direct responsibility and risk to partners	• Parties directly bear risks and liability • Population or investment may shift, but no change in voting • Timing issues if major decisions must be made by each Council • Risk of split Council decisions
	• Agreement (without creating entity) to delegate/allocate operations and management to one party with governing body appointed from each Council (weighted vote)	• Same as above • Vote may be weighted toward party bearing greater investment risk or population	• Same as above • Parties directly bear risks and liabilities • Population or investment may shift, upsetting power balance
	• Agreement to delegate/allocate operations and management to one or among parties without governing body (separate Council vote on all issues (equal or weighted votes)	• Greater control by individual city councils on each issue • Same issues as above	• Parties directly bear risks and liabilities • Slower process and more room for political influence • Same issues as above
Ownership	• Separate entity owns assets	• Responsibility and risk borne by separate entity	• Individual parties do not retain <u>any</u> benefits of title • Agreement must provide a method to recover assets or value on dissolution

DRAFT

Organizational and Governance Issues Between IGA and IGA Entity

May 16, 2007

Issue	Options	Advantages	Limitations
	• Assets dedicated for use by or held in trust by individual parties for separate entity	• Assets used for mutual benefit along with clear right of underlying members to compel rights of supply • Individual parties retain assets upon dissolution without having to compel a transfer back	• Individual parties do not retain all benefits of title • Agreement must provide a clear release of trust interest on assets or dedication of use on dissolution
	• Individual parties retain title to assets or title. No transfers made to reflect joint ownership	• Responsibility and risk borne primarily by individual partner. No change in City's asset base • Individual parties retain assets upon dissolution without having to compel a transfer back	• Agreement must clearly address ability of City to enforce rights against the other City to compel delivery of water to get benefit of bargain
Management	• Entity Board hires separate management/staff • Parties appoint governing body	• Entity Board has equal control over management and perception of no allegiances	• Less control over management by individual parties • May lead to increased staffing and defeat efficiencies
	• Entity Board appoints general manager/ staff from the parties • Parties appoint governing body	• Probably not hiring new staff. Transfer of existing staff to obtain efficiencies and institutional/ operational knowledge	• General Manager/Staff from one party may afford greater control or allegiance to that party
	• Individual parties appoint management advisory committee and designate existing staff • Decisions by respective Councils	• More participatory model for Councils • Keeps staff efficiencies	• Management committee may slow process • Full Council involvement may create timing issues and risk of split Council decisions
	• Facilities managed by assigned parties	• Individual parties may manage individually owned assets • No joint control	• May not achieve desired comfort level on facility operation
Expansion -Territory	• Include new territory of individual party upon expansion without further process (automatic)	• Individual parties have control and assurance over the provision of services upon expansion	• Unilateral large expansion or water use intensive expansion could commit existing capacity earlier than anticipated and force improvements
	• Require majority vote of each governing body to include new territory in water supply system	• Some flexibility regarding the expansion of the water supply system but restricted	• More difficult to provide service demands if approval of others needed • May create veto and defacto moratorium unless adoption of clear criteria for decision
	• If entity, require unanimous vote of governing body to include new territory in water supply system	• Requires consideration of system capacity • All parties have a say in whether new territory should be included • Veto power over another based on impact to water supply system	• Creates veto and defacto moratorium unless adoption of clear criteria for decision

Organizational and Governance Issues Between IGA and IGA Entity

Issue	Options	Advantages	Limitations
	• If entity, require majority approval of entity governing body to include	• Reduces veto somewhat, but need a definition of majority. • Same as above	• Same issues as above on veto and defacto moratorium • Depending on definition of majority. May allow party with majority vote to include territory at will and deny minority party
Expansion of System Capital Improvements	• "Must lease" excess capacity to avoid premature capital investment	• Provides for use of existing capital assets prior to expansion • Lease provides revenue stream for unused capacity. Gives flexibility and time in considering scope of improvements and capital financing	• The lease term must be on the shorter side to give the Lessor City assurance that it can get the water when it needs it. A vigorous demand planning exercise must be employed so that Lessor and Lessee have predictability in determining the term
	• Proposal to expand by party and others may join or decline. If joinder, then move to financing, design, and construction. If decline, proposing party may proceed at its sole cost. • Buy Back/No Buy Back	• Once capacity is used or lease expires, a party has the right to continue with expansion at its cost without forcing others to participate • One party cannot prevent another from proceeding • One party cannot proceed and impose a financial burden on another	• One party bears risk and debt to benefit of other parties if nonparticipating party has buy back right • One party bears risk and retains benefits if no buy back right • If no buy back, may influence party to invest with partners even though it does not have an immediate need for improvement. Hardship to ratepayers
	• Proposal by party and others must participate	• Requires some parties to invest when expansion not needed • Improvements required by change in Regulations can carry mandatory participation requirements	• Forces parties to participate that may lack finances or need for expansion
Buy-Out - Formulas and Terms Voluntary Withdrawal	• Remaining party must purchase at set formula (ex: original cost less depreciation)	• Mandatory buyout creates certainty for withdrawing partner and an unexpected, but predictable burden on remaining partners • Preserve relationships with known remaining partners if multiple parties • Formula terms or limits may induce a party to remain	• Formula may not account for value to remaining partner of not having to find a new water source
	• Remaining party must purchase at negotiated price	• Same as above • Potential high purchase price might induce a partner to leave and reinvest in a cheaper alternative	• Allows for value of assets to remaining party to reflect value of not having to find a new water source • Negotiated price may be too burdensome

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	• Remaining party may purchase at set formula. If a party declines then may sell to 3rd party (local government)	• Optional purchase retains flexibility for all	• Optional purchase creates doubt as to whether a partner can leave if a decline by the partner and no 3rd party interested • Remaining party may not want to be partners with 3rd party buyer
	• Remaining party may purchase at negotiated price. If party declines, then may sell to 3rd party	• Same as above	• Same as above
Dispute Resolution	• No exhaustion of alternate remedies required	• Parties may proceed directly to legal action in the event of an otherwise irresolvable dispute	• No requirement to attempt to resolve disputes before parties invest in legal action
	• Formal negotiation and mediation before taking legal action	• Some opportunity for resolution before initiating legal action	• May delay ultimate resolution if parties cannot agree prior to legal action
	• Formal negotiation, mediation and nonbinding arbitration before legal action	• More opportunity for resolution before initiating legal action	• Longer delay in resolution if parties cannot agree prior to legal dispute
Capital Financing Tools (authority to levy SDCs, set rates, get SRF grants/loans, create LIDs)	• Individual parties responsible for contributing appropriate share and choose method to raise funds when entity makes a capital call	• Individual parties control preferred mode of raising finances. All financial tools available. • Parties take on risk and burden to finance. Not responsible for another	• Parties take on the risk that another party will not raise sufficient funds or budget in timely fashion so project is not constructed or constructed late.
	• Parties delegate some authority to raise financing to separate entity	• Individual parties retain some control over financing their share. Some tools may not be available. • Parties may not be primary debtor in financing	• Pass through liability or guaranty of debt of others • Separate entity has limited range of financing options because of lack of history or statutory limitations • May impact ability of individual partner to use some financing tools (sdc's).
	• Parties delegate all possible authority to raise financing to separate entity	• Separate entity has wide range of financing options • Parties may not be primary debtor in financing	• Individual parties retain much less control over the chosen method of financing • May impact individual's ability to charge sdc's and use financing tools • Pass through liability or guaranty of debt of others
Opportunity For Buy-In or Initial Contribution/Capital Investment	• Require initial cash or in-kind contributions and initial proportional investment for all improvements so equal ownership attained	• Stable relationship for existing parties • Initial equality in system	• May require capital contribution at outset and work a hardship on a partner who needs to "even up" the initial contribution
	• Have initial parties contribute current assets or cash but disproportionate initial capital contributions result	• Stable relationship for existing parties without financial hardship. "Contribute what you have."	• If voting is weighted based on investment, one party may become a minority interest

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New Partners	• Allow nonparticipating parties to buy share of improvements upon consent of all. Consent not unreasonably withheld	• Allow for specified method of bringing in new partners. Reasonableness is standard	• A party may want to object to a new member, but reasonableness standard creates risk the party's objections will not be recognized.
	• Prohibit nonparticipating parties from later buying in	• Agreement is clear there will not be new partners except with unanimous consent. No reasonableness standard.	• Requires full negotiation to bring in a new partner
	• Buy in with full up front proportional investment on formula basis	• Allow for immediate cash payment to reimburse original members for investment	• Financial hardship for new members
	• Buy in with full up front proportional investment on negotiated basis	• Allows for some "blue sky" value to account for previous risk taken by existing members	• Financial hardship for new members
	• Buy in with partial up front proportional investment on formula and payment terms • Buy in with partial up front proportional investment as negotiated and payment terms	• Allow for cash payment over time to reimburse original members for investment • Allows for some "blue sky" value to account for previous risk taken by existing members	• Initial parties take risk to get supply facilities in place and then act as bank to let another entity obtain benefits of same deal. • Particularly a problem if expansion and capital call on all parties at the same time.
Charter Limitations	• Agreement consistent with existing Charter limitations	• Consistency with existing Charter	• Difficult to change existing Charter provisions
	• Agreement modified to incorporate future charter amendments	• Provides for automatic amendment	• Impact of one Party's charter amendments on the other
	• Future Charter amendments that are contrary to terms of the agreement may not be enforced as impairment of contract	• Preserves effect of the agreement	• May create issues within one party
	• Consistent ordinance provisions on conservation and other system/user matters affecting source and demand	• Uniformity of water policies and goals to reduce demands and defer capital improvements	• Uniformity may run contrary to individual community values