Final Environmental Impact Statement

for the

Regional Wastewater Services Plan

King County Department of Natural Resources
Wastewater Treatment Division

April 1998

Prepared in compliance with the State Environmental Policy Act (SEPA) (RCW 43.21C), the SEPA Rules (WAC 197-11) and Chapter 20.44 King County Code, implementing SEPA in King County procedures.

This information is available in accessible formats on request at (206)684-1714 or (206)296-0100 (TDD).

FOREWORD

INTRODUCTION

This final Environmental Impact Statement, prepared under the provisions of the State Environmental Policy Act (SEPA), accompanies and supports the Executive's Preferred Plan (EPP). The EPP proposes a new (third) treatment plant located in north King or south Snohomish County. This ultimately 54-million gallon per day (mgd) "North Treatment Plant" would receive wastewater flows from parts of King County's current service area that lie north and east of Lake Washington. Under this plan, the West Treatment Plant would remain at its current average wet weather capacity, while the East Treatment Plant would be expanded in stages to an ultimate capacity of 135 mgd by 2020.

Along with approaches to wastewater conveyance and treatment and combined sewer overflow control, the plan also discusses application of treatment end products—biosolids and reclaimed water—and financing.

The Final EIS addresses and compares at a programmatic level the probable significant adverse environmental impacts of the EPP and the other service strategies discussed in the Draft RWSP. This "programmatic-level" EIS provides information necessary to decide on an overall plan of action, but more detailed or "project-level" review would be required before any element of the plan would be implemented. The FEIS will support the Metropolitan King County Council's adoption of a Regional Wastewater Services Plan.

REVISED POPULATION AND WASTEWATER FLOW ESTIMATES

As a result of comments on the Draft RWSP, assumptions about population growth in the region, particularly beyond 2020, have been reviewed and revised. It was determined that in the draft growth had been forecast to be greater than would likely occur and a different model was used in the Executive's Preferred Plan. As a result of this effort, estimates of population growth have been lowered by approximately 9% at 2030 and 30% at 2050, yielding a reduction in wastewater base flows of 7% and 25% at those years, respectively.

This reduction in estimated population growth resulted in a reduction in estimated wastewater flow during the same time period. In turn, facilities could be delayed and/or constructed at a smaller size than proposed in the *Draft Plan*. The Service Strategies described in the Draft Plan and Draft EIS have been revised in Part I of this Final EIS to reflect these modifications.

Since future population growth is uncertain, King County will revisit population growth assumptions when designing wastewater facilities to ensure that constructed facilities are neither overbuilt nor underbuilt.

Proposed Listing of Chinook Salmon under Endangered Species Act

In February 1998, the National Marine Fisheries Service proposed listing the Puget Sound Chinook salmon as a threatened species under the Endangered Species Act (ESA). King County is working in cooperation with Pierce and Snohomish Counties and local governments to develop a response to the listing that will allow the area to thrive economically while enhancing and improving salmon habitat. The Executive's Preferred Plan provides the flexibility to modify our facilities and programs to address changing conditions. For example, the EPP would allow production and use of reclaimed water to augment regional water supplies, thereby benefiting salmon streams by avoiding additional withdrawals for drinking water. (The County will conduct detailed studies to determine the feasibility of discharging highly treated reclaimed water to Lake Washington and the Ship Canal for the purpose of protecting in-stream flows.) As the ESA response is developed, King County will coordinate with federal, state, and local agencies including the National Marine Fisheries Service, tribal governments, and citizens to ensure our wastewater facilities will benefit salmon restoration programs in Puget Sound.

Organization

This Final EIS is divided into two parts:

Part I The Executive's Preferred Plan
Part II Full Text of Draft EIS, Revised in Response to Comments

Part I is divided into two sections. The first section highlights the environmental aspects of the EPP. This section describes the EPP and its probable operating (long-term) adverse environmental impacts as well as mitigation measures for these impacts.[1] The second section describes revised service strategies 1, 2 and 4, how their environmental impacts, as revised, compare to those described for these strategies in the Draft EIS, and how all four revised strategies compare to each other.

Part II consists of the revised text of the Draft Environmental Impact Statement. The text has been revised to reflect comments received but has not been changed to reflect service strategy revisions described in Part I.

Public and Agency Review

The SEPA environmental review of the RWSP began with scoping in the fall of 1994. Scoping consisted of six open houses and notices in several newspapers. Sixty-nine written comments were received. (See Part II, page 1-4 for more detail.)

[1] The EPP is based on Service Strategy 3. It reflects the new population and flow estimates and public comment.

The Draft RWSP, Draft Financing Plan and Draft EIS were issued on May 7, 1997. The public comment period for these documents ran from May 7 to August 5, 1997. During that period, King County held five combined open house/public hearings to present information, answer questions and take public testimony on the RWSP and Draft EIS. These hearings were held in downtown Seattle (June 11), Renton (June 18), Shoreline (June 24), Bellevue (June 30) and Woodinville (July 16). King County advertised these hearings with large display ads in seventeen different regional and local newspapers; the ads ran on multiple dates for many of the larger papers such as the Daily Journal of Commerce, Seattle Post Intelligencer, Seattle Times and the South County Journal. In addition, County staff presented information on the RWSP at many community meetings held throughout King County.

During the comment period, seventy-five commenters provided a total of 381 comments as either hearing testimony or written comments. The 75 commenters fell into the following categories: 55 private individuals or organizations, 12 local government agencies, 5 state agencies, 1 federal agency and 2 tribes. The comments and King County's responses to them are provided in a separate appendix to this Final EIS. This document also contains a summary of the comments and the results of King County's RWSP public opinion summary. To obtain a complete copy of the public opinion summary, call the King County Wastewater Treatment Division, Environmental Planning Unit at 206-684-1714.

NEXT STEPS

After the publication of the Executive's Preferred Plan and this accompanying Final Environmental Impact Statement, the King County Executive will submit the plan to the Metropolitan King County Council. The Council is expected to adopt a plan late in 1998 so implementation can begin in 1999.

When the plan is adopted, the Wastewater Treatment Division will begin to implement it. The plan discusses the timing of projects.

As discussed in Part II, page 1-4, the SEPA environmental review of the RWSP and its projects is a phased review. This programmatic EIS is the first step in that review. For most major projects under the RWSP the next review step will be a project-specific environmental review. These later reviews will evaluate potential site and project-specific environmental impacts and discuss related mitigation measures.

FACT SHEET

NAME OF PROPOSAL

Regional Wastewater Services Plan

DESCRIPTION OF PROPOSAL

King County is proposing a sewer comprehensive plan for the King County wastewater service area for the next 40 years. This plan, the Regional Wastewater Services Plan (RWSP), evaluates several means of providing wastewater treatment and related services to this growing region during that time. These services consist mainly of improvements related to wastewater treatment and conveyance (pipes), combined sewer overflow (CSO) control, and biosolids management. The RWSP also considers opportunities for water reuse. The adopted plan will amend the County's Water Pollution Abatement Plan, which is the sewer comprehensive plan for the King County system.

The draft RWSP, issued in May of 1997, identified four representative alternative strategies termed "service strategies." Each service strategy consists mainly of a system of wastewater treatment plants, conveyance facilities and CSO control facilities that will meet the region's increasing need for wastewater services over the life of the RWSP. The strategies vary in the location and size of those treatment plants and the associated facilities necessary to convey wastewater for treatment and to discharge treated effluent. All of the service strategies assume that King County will continue to emphasize recycling of biosolids. Each service strategy also includes a commitment to producing and using reclaimed water and a program for reducing the infiltration and inflow of groundwater and stormwater into the wastewater conveyance system.

The Executive's Preferred Plan (EPP) is based on Service Strategy 3 presented in the draft RWSP, and calls for King County to build a third treatment plant with associated conveyance and a marine outfall in north King County or south Snohomish County by 2010. The existing East Plant would be expanded in the future and the West Plant would not be expanded, reserving available land there for future treatment of Combined Sewer Overflow (CSO) flows if needed. The EPP proposes to control (CSOs) to the state-mandated annual level of one event per outfall by the year 2030, using storage and treatment technology. Class B biosolids would continue to be produced at King County treatment plants for recycling, and technologies will be evaluated to treat to Class A standards. Inflow and infiltration control would be pursued aggressively using a cost-sharing approach with local sewer agencies, followed by a surcharge on excess flows in later years. The three-plant system would be very flexible for reclaiming water and distributing it. Working with water suppliers, new applications for using reclaimed water would continue to be explored.

LOCATION OF PROPOSAL

The RWSP planning area is located within that portion of the Lake Washington/Green River Basin that is within King County's adopted Urban Growth Area. It also includes some sewer districts within the Urban Growth Area in south Snohomish County and a small area in north Pierce County.

Over the approximately 30-year planning period facilities would be located in a variety of locations under the EPP. The great majority of these would be in King County. Many would be at or near the sites of existing King County wastewater facilities. Others would be in new locations. Some facilities, mainly a northern treatment plant and associated conveyance, could be located in southern Snohomish County.

PROPONENT/LEAD AGENCY

King County Department of Natural Resources
Wastewater Treatment Division
Exchange Building
821 2nd Avenue, MS 81
Seattle, Washington 98104

RESPONSIBLE OFFICIAL

Pam Bissonnette, Director, King County Department of Natural Resources

CONTACT PERSON

Shirley Marroquin
206-684-1173

PREPARERS AND CONTRIBUTORS

King County Wastewater Treatment Division staff

Adolfson Associates	Biological Resources
	Energy
	Environmental Health
	Transportation
Herrera Environmental Consultants	Earth
	Water
	Land and Shoreline Use
	Public Services and Utilities
CH2M Hill	Air

PERMITS

Permits will be discussed for each facility proposed under the RWSP in the project-specific environmental review documentation.

FINAL EIS ISSUED: April 27, 1998

DRAFT EIS ISSUED: May 7, 1997

DATE DEIS COMMENTS WERE DUE: August 5, 1997

PUBLIC MEETINGS

King County held 5 open house/public hearings during the comment period. These were located in Seattle, Renton, Shoreline, Bellevue and Woodinville.

The King County Council will hold one or more public hearings during its deliberations, prior to a final decision on the RWSP.

PLANNED ACTION BY KING COUNTY

Adoption of the Regional Wastewater Services Plan (amendment to Water Pollution Abatement Plan) by the Metropolitan King County Council.

SUBSEQUENT ENVIRONMENTAL REVIEW

Each facility included in the adopted Regional Wastewater Services Plan will be subject to appropriate project-specific environmental review at the time the County proposes to implement the facility.

LOCATION OF RELATED DOCUMENTS

All documents referenced in this Final EIS are available at the Transportation and Natural Resources Library, Exchange Building, 9th floor, 821 2nd Avenue, Seattle, Washington.

Incorporated by reference in this EIS are the EIS on the Plan for Secondary Treatment Facilities and Combined Sewer Overflow Control (Nov. 1985); the Supplemental EIS on the Plan for Secondary Treatment Facilities and Combined Sewer Overflow Control (July 1986); Final EIS, Wastewater Management Plan for the Lake Washington/Green River Basins (EPA, 1981); Final Supplemental EIS on the Puget Sound Facilities Engineering Report (Metro, 1983); Final Supplemental EIS, Renton Effluent Transfer System for the Wastewater Management Plan, Lake Washington/Green River Basins (Metro, 1984); Final EIS – Municipality of Metropolitan Seattle Sludge Management Plan (EPA, 1983); and all documents incorporated by reference in those EISs.

AVAILABILITY OF FINAL EIS

The Regional Wastewater Services Plan Final EIS is available for a charge of $10 to interested citizens. Copies may be obtained from the King County Wastewater Treatment Division, Environmental Planning Unit, Exchange Building, 821 Second Avenue, Seattle, Washington 98104-1598. Phone ahead (206-684-1714) for the specific location to obtain the document.

The EIS may also be viewed on and downloaded from the Internet at **http://waterquality.metrokc.gov/rwsp/rwsp.htm**

Copies of the Final EIS are also available for review at the following libraries:

- King County Library System, All Branches
- Mill Creek Public Library
- Renton Public Library, Main Branch
- Seattle Public Library, Green Lake Branch
- Seattle Public Library, Fremont Branch
- Seattle Public Library, Magnolia Branch
- Seattle Public Library, Queen Anne Branch
- Seattle Public Library, West Seattle Branch
- University of Washington, Suzzallo Library

APPEALS

There is no agency appeal for this Final EIS.

Contents

Contents, Continued

Tables

Part I

Part II

Contents, Continued

Tables (cont'd)

Figures **Following Page**

Part I

Part II

CHAPTER EP-1
LONG-TERM OPERATING IMPACTS AND MITIGATION MEASURES FOR THE EXECUTIVES PREFERRED PLAN

INTRODUCTION AND DESCRIPTION OF THE EXECUTIVE'S PREFERRED PLAN

It has been almost one year since King County issued its *Draft Regional Wastewater Services Plan* (RWSP). Much has happened between then and now to move us closer to a final plan for managing the wastewater flows that our region's growing population will generate in the next 40 years. The major activity during this year was to go into the community and hear from citizens about services they are willing to support. This was no small effort. The choices are complex, involving a number of issues. The King County Executive carefully weighed the public's views and is now ready to recommend a plan to the King County Council—a plan that reflects a strong commitment to protecting our water resources so that future generations can enjoy them as much as we do.

WHAT ARE THE ISSUES? WHAT ARE THE CHOICES?

The King County wastewater system serves 1.3 million residents within a 420 square-mile service area. A total of 255 miles of pipes, 38 pump stations, and 22 regulator stations move wastewater from our homes and businesses to two treatment plants. Liquid effluent leaves the plants through outfalls to Puget Sound. Biosolids, the organic by-product of the treatment process, are recycled for agricultural and forestry uses.

Choices made in the past have consistently favored building and maintaining a regional system that protects public health and maintains the quality of our region's water bodies. The County provides a high level of treatment—secondary treatment—at both treatment plants and has implemented an aggressive program to reduce the amount of untreated wastewater that overflows into nearby water bodies. This level of service costs money. And it will cost even more money to build new facilities and expand existing facilities to serve our customers in the years to come.

During the planning process, we gave citizens an opportunity to tell us what level of service they would like us to provide in the future. The choices were presented in the draft RWSP as options that could be adopted under four possible strategies. Two of the strategies proposed expanding the capacity[2] of the two existing treatment plants—the West Treatment Plant in Seattle and the East Treatment Plant in Renton; the other two strategies propose building a new treatment plant (North Treatment Plant) in north King

[2] The word "capacity" used throughout this document refers to the volume of average wet weather flows that the treatment plant or conveyance system is designed to handle. Average wet weather flows are wastewater flows that occur during wet months but not during storms.

County or south Snohomish County. Each strategy and option presents difficult and complex issues to consider:

- **How much can we expand our existing treatment plants?** And when do we want to expand them? The West Treatment Plant has very limited room for expansion. Under both two-plant strategies, this plant would be expanded to its maximum capacity. The East Treatment Plant would have more room for expansion. In considering expansion, should we allow flexibility for meeting demands beyond our 40-year planning window?
- **How do we serve the fastest growing parts of the service area?** It looks as if the fastest rate of growth will occur in the north and northeastern parts of the service area. Should we build more pipes to convey flows from these parts to existing treatment plants? Or should we build a new plant to serve these areas?
- **What levels of flow should we plan for?** In addition to the wastewater that comes from our homes and businesses, rain water (stormwater) enters wastewater pipes through sources such as roof drains and leaking pipes (inflow and infiltration).
- **What is the appropriate level and timing to control combined sewer overflows?** In parts of Seattle, sanitary sewers collect both stormwater and wastewater. During storms, flows in these pipes may exceed the capacity of the conveyance pipes and treatment plants and then discharge untreated combined sewer overflows (CSOs) to local water bodies. Should measures be taken to reduce the amount of stormwater entering the sewer system to reduce the need to expand treatment plant and conveyance pipes in the future?
- **How much of a role should reclaimed water play in the region's future water supply picture?** We may choose to use reclaimed water from our treatment plants not only for irrigating lawns and golf courses, but also to add indirectly to existing water supply. Scientific studies are needed to understand how reclaimed water can be used to supplement water supply without impacting human and environmental health. What should we do now to prepare for a future in which reclaimed water may be an important part of our region's water supply?
- **How much do we value water quality?** The four strategies in the draft RWSP would meet or exceed state and federal standards for water quality. Do we need to go further?

WHAT ARE THE RECOMMENDATIONS?

The majority of the community expressed significant concern for protecting water quality and public health. They are willing to pay more to prevent water quality problems as long as costs and other impacts are distributed equitably. With few exceptions, they ranked CSO control as a top priority so that water bodies can be clean year round for everyone to enjoy. Reducing inflow and infiltration and continuing to recycle biosolids was also rated highly.

After reviewing citizen preferences and available technical and financial data, the Executive decided on a strategy and accompanying options that he could recommend with confidence to the King County Council. The *Executive's Preferred Pla*n reflects our region's strong commitment to preserving water quality and recycling our resources in a cost-effective manner. The main features of the plan are building a new North Treatment Plant, expanding the East Treatment Plant, and building a new outfall into Puget Sound.

The plan includes other important features:

- Making improvements to parts of the conveyance system, including pipes and pump stations, to serve treatment plants and to handle additional flows in the system
- Pursuing an aggressive CSO program, including building CSO storage tanks and treatment plants, to reduce discharges from each CSO outfall to one overflow event per year on average
- Providing financial incentives that encourage local agencies to reduce inflow and infiltration into the King County wastewater system
- Continuing to recycle biosolids and finding ways to make biosolids recycling even more efficient
- Providing opportunities to reuse highly-treated water from the plants and continuing to study ways to economically provide reclaimed water by conducting pilot and demonstration projects, investigating stream-flow augmentation and groundwater recharge, and exploring the idea of building satellite plants to provide reclaimed water to local communities
- In addition to monthly rates, we charge new customers directly for connection to the system—a charge termed a "capacity" or growth charge. The state imposes a limit on these charges. We propose to continue to work with the state to allow us more flexibility in applying these charges so that growth pays its share of improvements to the system

After the King County Council adopts a final plan by the end of 1998, we expect to begin implementing the plan in 1999 and continue through at least the year 2030. Much can happen in such a long stretch of time—regulations can change and more information can surface. We will monitor conditions and adapt the plan as needed throughout the course of the implementation period.

HOW MUCH WILL THE PLAN COST AND WHO WILL PAY FOR IT?

The costs for each major component of the *Executive's Preferred Plan* are shown in table 1.

Table EP1-1
Estimated Costs to Implement
the Executive's Preferred Plan

Treatment	$262,000,000
Conveyance	$489,000,000
CSO	$230,000,000
Biosolids	$85,000,000
Water Reuse	$20,000,000
TOTAL	$1,086,000,000

Note: All numbers are calculated in 1998 net present value. The total includes the net present value of new capital facilities and additional operating expenses stemming from these new facilities

Customers in King and Snohomish Counties connected to the regional system have paid for wastewater services in the past. This plan assumes that they will do so in the future. But the good news is that, even though the costs for the recommended improvements are high, monthly rates are predicted to remain relatively stable. The County will sell revenue bonds each year to obtain the capital to pay "up front" for the projects and then will spread the repayment of the bonds over a 35-year period. Currently, we charge local agencies a monthly wholesale rate of $19.10 per customer. These agencies, in turn, bill their customers. Monthly rates in 1998 dollars without considering inflation are predicted to rise slightly in the early years of the implementation period but will become even lower than today's rate toward the end of the period. This lower rate is predicted to occur because the costs will be spread out over a larger population and because repayment costs for current debts will decrease.

The average monthly rate necessary to support the plan over the period 1999-2015 is $19.92 in today's dollars. Because of the debt retirement and growth of customers noted above, the average monthly rate needed over the period 1999-2030 would be $18.97 in today's dollars although actual rates will be higher due to inflation.

Finally, these costs and rates are based on planned improvements to the wastewater system only. Should additional costs be incurred, for example as part of a salmon recovery plan in response to the proposed listing under the federal Endangered Species Act (ESA), costs and rates will be correspondingly higher.

IMPACTS AND MITIGATION MEASURES

The Executive's Preferred Plan (EPP) is described in the preceding section. The major features of the EPP are as follows:

- Create a three-treatment-plant system (comprised of the West Plant, East Plant and new North Plant)
- Reserve capacity at the West Plant (leave at 133 mgd) to provide future CSO treatment, if needed, after 2018, or to provide for unanticipated growth in the City of Seattle
- Expand East Plant in increments to 135 mgd (2020)
- Construct new North Plant in increments:

  18 mgd by 2010
  36 mgd by 2030
  54 mgd by 2040
- Construct a conveyance system to carry influent to the North Treatment Plant and an outfall from the North Treatment Plant to Puget Sound (2010)
- Implement CSO program to achieve one event per outfall per year by 2030.
- Implement aggressive I/I reduction program based on incentives/surcharges.
- Produce Class B biosolids at all three plants while continuing to explore alternative technologies to improve biosolids quality and marketability.
- Provide flexibility to produce and distribute reclaimed water at all treatment plants. Research new applications for reclaimed water and build smaller "satellite" plants if circumstances warrant.

The major features of the EPP are shown in Figure EP1-1. Table EP1-2 shows the chronological sequence of projects under this service strategy.

LONG-TERM OPERATIONAL IMPACTS

Following is a discussion of the probable long-term impacts of the EPP. These were first presented in the RWSP Draft EIS for Service Strategy 3. The EPP is based on Strategy 3, revised to reflect changed population and flow projections. A detailed description of the affected environment is provided in Chapter 4 of Part II of this FEIS.

Table EP1-2. Executive's Preferred Plan
List of Capital Facilities (by year required on-line)

1996 2000 2005 2010 2015 2020 2025 2030 2040

Treatment Plant Projects

- ✷Construct 18 MGD North End Plant (2010)
- ✷North End Plant Outfall (2010)
- ✷Increase East Plant capacity to 135 MGD (2020)
- ✷Increase NEP capacity to 36 MGD (2030)
- ✷Increase NEP to 54 MGD (2040)

Conveyance Projects

- ♦ESI-11 – Wilburton Siphon (1998)
- ♦Reuse Projects (1999)
- ♦Trunk Improvements (2000)
- ♦ESI-1 (2000)
- ♦Increase York PS capacity ot 68 MGD (2000)
- ♦I&I Reduction Program Project (2003)
- ♦Auburn Interceptor Sections 1,2,3 (2004)
- ♦Trunk Improvements (2001-2010)
- ♦Off-line storage at North Creek (2005)
- ♦Forcemain from new Kenmore PS to NEP (2010)
- ♦PS at Kenmore to pump to NEP (2010)
- ♦Tunnel from NEP to Puget Sound (2010)
- ♦Trunk Improvements (2010-2020)
- ♦Auburn Interceptor Storage (2020)
- ♦Trunk Improvements (2021-2030)
- ♦Convey N. Creek PS flows to Kenmore (2030)
- ♦Increase N. Creek PS to 50 MGD (2030)
- ♦Modify York PS to pump 35 MGD north (2030)
- ♦Transfer McAleer-Lyon PS flows to NEP (2038)
- ♦McAleer-Lyon PS flows to NEP (2038)
  Trunk Improvements (2031-2040)

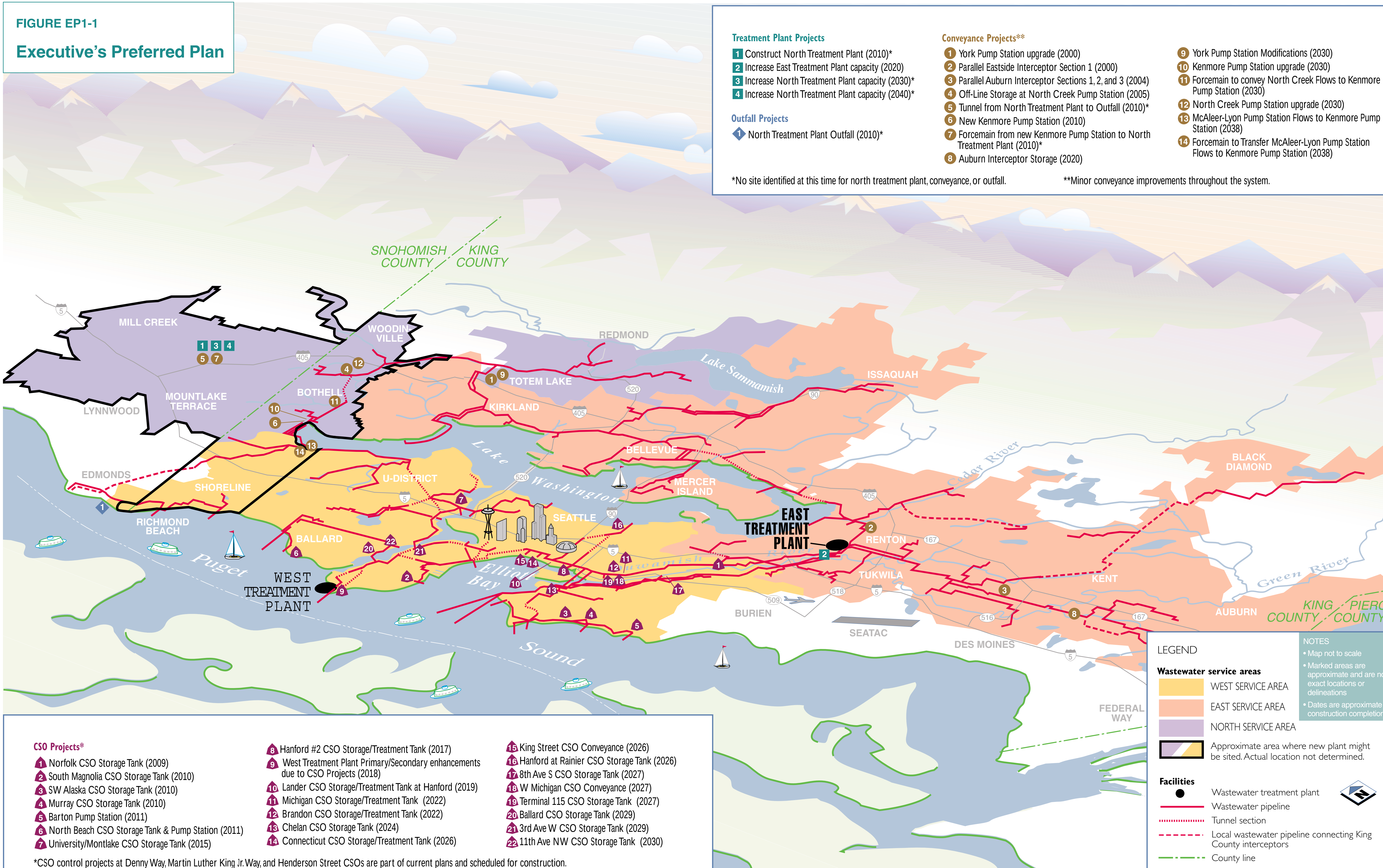
CSO Projects

- ★Harbor (1998)
- ★Denny Way (2006)
- ★MLK Way (2008)
- ★Henderson (2009)
- ★Norfolk (2009)
- ★ S. Magnolia (2010)
- ★SW Alaska St. (2010)
- ★Murray (2010)
- ★Barton (2011)
- ★North Beach (2011)
- ★University Montlake (2015)
- ★Hanford (2017)
- ★West Point (2018)
- ★Lander (2019)
- ★Michigan (2022)
- ★Brandon (2022)
- ★Chelan (2024)
- ★Connecticut (2026)
- ★King Street (2026)
- ★Hanford (2026)
- ★8th Avenue S. (2027)
- ★W. Michigan (2027)
- ★Terminal 115 (2027)
- ★3rd West (2029)
- ★Ballard (2029)
- ★11th Ave (2030)

1996 2000 2005 2010 2015 2020 2025 2030 2040

FIGURE EP1-1

Executive's Preferred Plan



Treatment Plant Projects

1. Construct North Treatment Plant (2010)*
2. Increase East Treatment Plant capacity (2020)
3. Increase North Treatment Plant capacity (2030)*
4. Increase North Treatment Plant capacity (2040)*

Outfall Projects

1. North Treatment Plant Outfall (2010)*

Conveyance Projects**

1. York Pump Station upgrade (2000)
2. Parallel Eastside Interceptor Section 1 (2000)
3. Parallel Auburn Interceptor Sections 1, 2, and 3 (2004)
4. Off-Line Storage at North Creek Pump Station (2005)
5. Tunnel from North Treatment Plant to Outfall (2010)*
6. New Kenmore Pump Station (2010)
7. Forcemain from new Kenmore Pump Station to North Treatment Plant (2010)*
8. Auburn Interceptor Storage (2020)
9. York Pump Station Modifications (2030)
10. Kenmore Pump Station upgrade (2030)
11. Forcemain to convey North Creek Flows to Kenmore Pump Station (2030)
12. North Creek Pump Station upgrade (2030)
13. McAleer-Lyon Pump Station Flows to Kenmore Pump Station (2038)
14. Forcemain to Transfer McAleer-Lyon Pump Station Flows to Kenmore Pump Station (2038)

*No site identified at this time for north treatment plant, conveyance, or outfall.

**Minor conveyance improvements throughout the system.

CSO Projects*

1. Norfolk CSO Storage Tank (2009)
2. South Magnolia CSO Storage Tank (2010)
3. SW Alaska CSO Storage Tank (2010)
4. Murray CSO Storage Tank (2010)
5. Barton Pump Station (2011)
6. North Beach CSO Storage Tank & Pump Station (2011)
7. University/Montlake CSO Storage Tank (2015)
8. Hanford #2 CSO Storage/Treatment Tank (2017)
9. West Treatment Plant Primary/Secondary enhancements due to CSO Projects (2018)
10. Lander CSO Storage/Treatment Tank at Hanford (2019)
11. Michigan CSO Storage/Treatment Tank (2022)
12. Brandon CSO Storage/Treatment Tank (2022)
13. Chelan CSO Storage Tank (2024)
14. Connecticut CSO Storage/Treatment Tank (2026)
15. King Street CSO Conveyance (2026)
16. Hanford at Rainier CSO Storage Tank (2026)
17. 8th Ave S CSO Storage Tank (2027)
18. W Michigan CSO Conveyance (2027)
19. Terminal 115 CSO Storage Tank (2027)
20. Ballard CSO Storage Tank (2029)
21. 3rd Ave W CSO Storage Tank (2029)
22. 11th Ave NW CSO Storage Tank (2030)

*CSO control projects at Denny Way, Martin Luther King Jr. Way, and Henderson Street CSOs are part of current plans and scheduled for construction.

LEGEND

Wastewater service areas

- WEST SERVICE AREA
- EAST SERVICE AREA
- NORTH SERVICE AREA
- Approximate area where new plant might be sited. Actual location not determined.

Facilities

- Wastewater treatment plant
- Wastewater pipeline
- Tunnel section
- Local wastewater pipeline connecting King County interceptors
- County line

NOTES

- Map not to scale
- Marked areas are approximate and are not exact locations or delineations
- Dates are approximate for construction completion

WATER RESOURCES

Impacts

Long-term operational impacts to the water quality of receiving water bodies include discharge from the treatment plants and CSO outfalls, conveyance system impacts, and infiltration and inflow impacts.

Treatment Plants

Systemwide, treatment plant discharges would increase for the EPP as a direct result of expected population growth in the region. Based on the region's anticipated growth, for example, Average Wet Weather Flow (AWWF) for the system is expected to grow from an estimated 190 mgd in 1990 to 283 mgd by 2030. Increased discharges would cause long-term impacts on water quality in Puget Sound off West Point, Duwamish Head, and the new North Plant outfall. Pollutant loadings from treatment plant discharges are expected to increase as the population grows in the King County wastewater service area although they would continue to meet permit requirements. The chemical constituents in these discharges include nutrients (nitrogen and phosphorous), metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel, silver, and zinc), organic compounds, fecal coliform bacteria, and total suspended solids. King County's Industrial Waste Program monitors and controls the discharge of industrial substances that may contaminate biosolids and treated effluent. In projecting pollutant loadings, it has been assumed that the Industrial Waste Program will continue to operate much as it does now.

Water quality impacts near the wastewater outfalls have been evaluated for both CSO and treatment plant discharges (Hays et al., 1995). The effluent plumes from these discharges contain both dissolved ions and particulates. They are dispersed at varying distances. The heavier suspended particulates tend to settle out of the effluent plume immediately. Metals and organic compounds have a high affinity for adsorbing to sediment particles (Hays, et al., 1995). Therefore, the sediment layer near these outfall pipes may contain elevated concentrations of these metals and organic compounds. These sediments are of concern due to the environmental persistence, toxicity to aquatic life, and potential for bioaccumulation of those pollutants present (Hays et al., 1995). Dissolved ions and compounds which are adsorbed to lighter particulates tend to mix within the water column, are transported away, and do not contribute to localized impacts at the outfall (Hays, et al., 1995).

The location and depth of treatment plant outfalls in Puget Sound influence the dispersion of the effluent plume and its water quality impacts. In Puget Sound, the upper layer of relatively less dense (less saline) water tends to circulate northward and out of Puget Sound, while the lower layer of denser (more saline) water slowly moves southward (Ebbesmeyer 1994). Flushing rates between the West Point and Duwamish Head outfalls also differ, based on their relative locations in Puget Sound. The West Point outfall discharges wastewater into the upper water layer; thus, it is flushed northward out of Puget Sound. The Duwamish Head outfall discharges into the lower water layer; thus, it takes longer to disperse as the layer moves southward (Ebbesmeyer

1994). Overall water quality impacts from treatment plant discharges to Puget Sound will depend on outfall locations and flushing rates. To the extent that the EPP would redirect effluent away from the Duwamish Head outfall and to a new, more northerly outfall that discharges into the upper water layer, it would be preferable from a water quality perspective.

Conveyance System

Sewer systems are designed with redundancies to prevent failures. On the rare occasions when leaks or breaks occurred, potential impacts would depend on the type of pipe and the environment at the point of leakage. If the pipe was in water, sewage could escape and cause short-term, local water quality impacts. If the pipe was underground and was a gravity flow (i.e., not pressurized) pipe, little or no sewage would be likely to escape due to surrounding groundwater pressure. Groundwater would instead enter the pipe and be conveyed with the sewage. If the pipe was a force main (i.e., pressurized flow pipe) sewage could be forced out of the pipe and enter groundwater and potentially surface water. The resulting loss of pressure would be detected at a pump station and repairs effected. Mechanical or electrical failures could also cause wastewater overflows to surface water. In all cases sewage spills would be detected and repaired quickly so any water quality impacts would be temporary and localized.

West Service Area Treatment and Conveyance

Under the EPP, no change would occur in the treatment capacity for the West Plant (Average Wet Weather capacity would remain at 133 mgd). King County will continue to meet the terms of the 1991 West Point Settlement Agreement.

East Service Area Treatment and Conveyance

Expanding the East Plant from 115 mgd to 135 mgd average wet weather flow would increase the treated wastewater effluent discharged to Puget Sound off Duwamish Head by 15 percent. Pollutant loading rates are expected to increase for nutrients, metals, organic compounds, fecal coliform bacteria, and total suspended solids. As noted previously, because the East Treatment Plant outfall discharges into the deeper waters of Puget Sound, this effluent would tend to move southward farther into the Sound. Thus, removal from the Sound would take somewhat longer than for effluent discharged into shallower, northward-moving waters of the Sound (e.g., from the West Point outfall or a new North Treatment plant outfall).

In addition, during extremely heavy storms of a magnitude expected to occur once every two years on average, the treated effluent that exceeds the capacity of the effluent transfer system would be discharged to the Green/Duwamish River through an existing outfall. No significant adverse impacts would result, as discussed in the report "Peak Flow Discharges to the Green River at the Renton Treatment Plant" (March 1998).

North Service Area Treatment and Conveyance

Operation of a North Plant with the capacity to treat 54 mgd would result in the discharge of wastewater effluent into Puget Sound from a new outfall off the north King County or south Snohomish County shore. Pollutant loadings to Puget Sound would be expected to increase overall. However, as described in Part II, Chapter 5 of this FEIS, differences in flushing rates occur between the West Point, Duwamish Head, and potential North Plant outfall locations based on whether they discharge to the upper or lower water layers in Puget Sound.

With discharge to the upper water layer, the North Plant outfall would be in a desirable location for flushing effluent out of Puget Sound because it would discharge to the main channel, where this layer is moving rapidly northward, out of the Sound. The strong currents in this channel would also maximize mixing and dispersion of the effluent. As noted in Part II, Chapter 3, the complexity of the flow layering in this area of the Sound will require additional study to determine the best location for the North Plant outfall.

The County will also investigate the possibility of discharging highly treated wastewater effluent from the new plant to freshwater. If the studies prove favorable in terms of environmental impacts and costs, the County would conduct a project-level environmental review to evaluate a freshwater discharge as an alternative to the currently-planned marine discharge.

CSOs

CSO impacts for the EPP would result in improved water quality over existing conditions.

Pollutant loading to receiving waters would be reduced for all pollutants of concern and benefit water quality for Puget Sound beaches, the Ship Canal and the Duwamish River. The CSO program for the EPP would achieve the state one-overflow-per-year goal by 2030 (13 years sooner than proposed in the *Draft RWSP)*.

The program would be phased to complete projects on Puget Sound beaches and the East Ship Canal first, followed in later years by projects along the Duwamish River and the West Ship Canal.

CSO outfall sites that would be improved include discharges to the Duwamish River (i.e., Michigan St., Brandon St., and Chelan Avenue), Elliott Bay (i.e. Denny Way, King St./Connecticut St., and Lander St./Hanford #2), the Ship Canal (University/Montlake), and Salmon Bay (i.e., 11^{th} Avenue W. and Ballard).

The individual projects north of the Ship Canal would generally store CSO volumes for later conveyance to the West Treatment Plant for secondary treatment after peak flows subside. For CSOs south of the Ship Canal, the EPP would generally provide for storage of CSOs and onsite treatment at CSO locations. The program would benefit water quality for Puget Sound beaches, the Ship Canal, and the Duwamish River.

To further our understanding of the impacts of CSOs and the benefits of the CSO control program, King County is conducting a CSO Water Quality Assessment (WQA) and sediment analysis in the Duwamish River and Elliott Bay. The CSO WQA will evaluate CSO impacts on human health and aquatic life relative to other pollutant sources. King County is developing a Sediment Management Plan that will evaluate seven sites in the Duwamish River identified by Ecology as a top priority for clean-up. The ultimate goal of these studies is to maximize improvements and protection of water quality. The CSO WQA will be completed in 1998, and the sediment analysis will be completed in 1999. King County may propose additional refinements to the CSO program as a result of these studies.

Infiltration/Inflow

The EPP includes an aggressive program for I/I reduction based on incentives and surcharges to local sewer agencies. This program would lead to more efficient treatment of sanitary wastewater flows at the treatment facilities (i.e., less-diluted wastewater would enter the WWTP facilities). Some of the groundwater that presently enters conveyance lines would be excluded with I/I control and, thus, might increase the local groundwater elevation in some areas.

Mitigation Measures

Potential adverse impacts to water resources from operation of all the wastewater facilities proposed under the EPP could be avoided or minimized through careful design and maintenance. Based on identification of environmentally sensitive areas in the King County service area, impacts would be avoided wherever feasible. Where this was not possible, impacts would be minimized to the greatest extent practicable. The following mitigation measures could be used to avoid or minimize impacts to water resources. More specific measures could be identified in the environmental reviews of specific projects.

- Select outfall sites with strong currents and favorable circulation patterns that most rapidly move pollutants northward out of Puget Sound. Research indicates that the upper water layer best provides these conditions. Outfall locations that meet these criteria would reduce long-term operational impacts.
- Include studies of local groundwater and surface water drainage patterns for I/I control projects to avoid exacerbating local flooding and wet basements.
- Reduce the levels of contaminants entering the sewer system and enhance both biosolids and reclaimed water products by continuing King County’s Industrial Waste/Source Control Pretreatment Program.
- Use appropriate procedures for handling chemicals and petroleum products during facility operation. This includes proper storage, use, and cleanup of these materials.
- Design and implement the CSO reduction program to maximize benefits to receiving waters.

- Maintain and operate treatment plants to meet permitted discharge requirements, including proper functioning of the outfall.

Unavoidable Adverse Impacts

Increases in wastewater volumes under the EPP (as under any of the alternative service strategies) would increase overall pollutant loadings to Puget Sound. Pollutant loadings under the EPP would be removed from the sound faster than alternatives that include larger volume discharges from the Duwamish outfall due to the more rapid flushing action associated with discharging to the upper water layer.

BIOLOGICAL RESOURCES

Impacts

Operational impacts to biological resources would generally relate to population growth in the King County Service Area. Increased wastewater flows will raise pollutant loadings to marine waters from new or expanded treatment plants, as discussed in the previous section, "Water Resources." These increased loadings, in turn, would mainly result in localized impacts near the outfalls. The extent of adverse impact on the marine environment will depend on outfall discharge volumes and location. Biological resources, including fish and shellfish, can be affected either through physical changes in their environment (sediment size, water temperature, and levels of dissolved oxygen), or through chemical toxicity associated with contaminants in the water column and sediments. Some contaminants, including metals and toxic organics, can be conveyed through wastewater discharges.

Design and operation of the system's treatment plants and outfalls would comply with federal and state water and sediment quality standards. This would minimize impacts on the biological resources of the marine environment.

New or expanded treatment plants and their associated facilities could also result in some habitat loss or conversion, particularly if the North Treatment Plant is sited at an inland undeveloped location. Other wastewater treatment and conveyance facility impacts on biological resources would be minimal.

Reduction of CSOs as part of the EPP would benefit fish and shellfish populations; improve foraging habitat for shorebirds, raptors, waterfowl, and other water-dependent birds; and improve conditions for other wildlife dependent on aquatic habitats. Cleaner water would contribute to productivity of food sources such as crustaceans, invertebrates, and aquatic plants. Chronic pollutant loadings to fish habitat, the potential exposure of fish to contaminants, ingestion of or entanglement in floatable material, and the likelihood of exposure to dissolved oxygen "sags" following CSO events would all be reduced.

Potential adverse operational impacts include accidental spills of diluted or undiluted sewage or other waste materials into water bodies if a pipeline or CSO storage facility leaked, particularly in cases where pipelines cross streams or pass through water bodies. Such accidental spills differ from CSOs in that they are rare and temporary and can be corrected quickly. These spills typically do not result in specific adverse impacts to biological resources because they are rare and the receiving water body further dilutes the waste.

An outfall from a new North Plant would introduce effluent to a new location, affecting marine biological resources in the immediate vicinity.

Impacts of the EPP

West Service Area Treatment and Conveyance

The West Plant would remain at its existing average wet weather capacity. No additional impacts to biological resources would occur.

East Service Area Treatment and Conveyance

Expansion of the East Plant to 135 mgd would result in the increase of treated wastewater effluent discharged to Puget Sound off of Duwamish Head. The East Plant outfall discharges into the deeper waters of Puget Sound, where the increased discharge volume would have an incrementally greater localized impact to biota near the outfall. As described in the Water Resources section, this effluent would tend to move southward farther into the deeper waters of Puget Sound and take longer to be removed from the Sound than effluent discharged to the upper, northward-moving layers (e.g. from West Point and a North Plant outfall). However the discharge would meet all water quality standards and would have no significant impacts to water quality.

The peak flow discharge to the Green/Duwamish River, described in the Water Resources section and discussed in detail in the report, "Peak Flow Discharges to the Green River at the Renton Treatment Plant"(March 1998) would have no adverse impacts to biota in the river. The impact to marine biota would be beneficial because a third outfall would not have to be built through the intertidal area.

North Service Area Treatment and Conveyance

Additional baseline studies would be required for proper design and operation of a new North Plant outfall to identify aquatic biological resources potentially at risk from discharge. Potential impacts include both physical and chemical changes in the aquatic environment that could adversely affect biological resources as generally discussed above. The outfall location at the northern edge of the service area is the most favorable for long-term impacts to Puget Sound-wide biological resources if effluent is discharged into upper water layers of the main channel, because effluent would generally flow northward and out of Puget Sound more quickly than effluent from other outfalls (particularly the Duwamish Head outfall). The outfall and any associated mixing and sediment impact zones would be designed to meet all applicable water quality and sediment standards. These standards have been developed to minimize adverse impacts on beneficial uses of marine waters including fish, shellfish, eelgrass, kelp, and other marine resources, which occur in the waters of western Washington. Consequently, the North Plant discharge is not expected to result in significant adverse impacts on the biological resources of central Puget Sound.

Studies that will be undertaken to evaluate the impacts of discharging highly-treated wastewater effluent to fresh water will also evaluate potential impacts to biological resources, including ESA-listed species.

CSOs

Impacts of CSO reduction on biological resources would be beneficial. Aquatic biota in the vicinity of CSO outfalls would likely benefit from the reduction in contaminant discharges associated with CSO reductions (see Water Resources discussion above).

Infiltration/Inflow

Impacts of I/I project operation on biological resources would be minimal.

Mitigation Measures

- Where feasible, native vegetation would be planted around new facilities to provide noise and visual buffers between the facility and any adjacent wildlife habitat.
- Outfalls would be sited to minimize adverse impacts to biological resources.

Unavoidable Adverse Impacts

Increases in treatment plant outfall discharges would unavoidably disturb or displace marine biota over a small area near discharge points.

LAND AND SHORELINE USE

The EPP would provide adequate wastewater conveyance and treatment capacity to accommodate the population growth anticipated in the King County Comprehensive Plan. It would provide capital facilities prior to or concurrent with growth occurring inside the County's designated Urban Growth Area. Changes to planned regional land use patterns would not be caused by implementation of the EPP as it is consistent with the Comprehensive Plan and the Growth Management Act.

Consistency with Policies and Regulations

Growth Management Act and Local Comprehensive Plans

The State of Washington and King and Snohomish Counties have prepared population and employment projections as part of the growth management process. These projections, which include information on geographic distribution, have provided the basis in the RWSP to determine future flows into the King County system (refer to the RWSP for a detailed discussion of flow projections). The timing, sizing, and location of proposed facilities under the EPP were developed to provide adequate capacity to handle these expected wastewater flows. This service strategy does not include the capacity to handle wastewater flows generated outside the King County wastewater service area, including flows generated within isolated urban growth areas such as those in the Snoqualmie River Valley. For these reasons, the EPP is consistent with the GMA.

Local comprehensive plans for counties and cities within the King County wastewater service area have been prepared in conformance with the GMA. The EPP, through conformance with the overall growth management process, is also consistent with the goals and policies for utility service levels in local comprehensive plans. In addition, because the timing, sizing, and location of proposed facilities are based on population and employment projections that are also used as a basis for development of local comprehensive plans, this service strategy is consistent with the growth management requirement for concurrency (i.e., the availability of necessary utilities and other infrastructure and services concurrent with development that depends on the infrastructure and services).

Shoreline Management Act

For the EPP, a number of major facilities (conveyance pipes, pumping stations and outfalls) are proposed for designated shoreline areas and would require shoreline permits. In most jurisdictions and shoreline environments, wastewater treatment plants and associated conveyances and other facilities are not prohibited. However, because wastewater facilities (except for outfalls) are not considered water-dependent uses, a demonstration of public benefit and need for the particular shoreline location is typically required before a shoreline permit is granted. In addition, conditions are usually attached to permit approvals specifying public access requirements, landscaping and visual mitigation, and other performance standards. These permit conditions would likely apply to facilities in the shoreline zone for the EPP.

Zoning

The East Treatment Plant is located in a Renton public zone, so plant expansion would be permitted subject to site plan review to ensure compliance with city zoning requirements and compatibility with surrounding land uses.

The zoning at the North Plant site would depend on its location. Shoreline areas in north King County and south Snohomish County typically have residential or other non-industrial/commercial zoning. Inland lowland areas north of Lake Washington, in south Snohomish County and north King County, have a mix of industrial, commercial, residential, and other zoning. Site plan review would be required for a treatment plant in any of these areas.

The numerous individual pump stations, conveyance lines, and storage facilities proposed under the EPP, which are usually classified as utilities, are generally permitted, either outright or by granting a special use, unclassified use, or similar land use permit. Where such a land use permit is required, landscaping or siting requirements and other performance standards are included as permit conditions to ensure compatibility with surrounding land uses.

Direct Land Use Impacts

West Service Area Treatment and Conveyance

The EPP proposes to reserve future capacity at the West Plant, and not increase its average wet weather capacity as part of this plan. Over time the County will evaluate the increased flows to the West Plant as a result of storing more CSOs. Additional improvements to the West Plant may be needed to assure treatment efficiency during wet weather. These improvements would be within the current footprint and meet terms of the permits and agreements currently in place.

East Service Area Treatment and Conveyance

The expanded East Plant would be located in a highly urbanized industrial/commercial area, and with continuation of the existing site design features and extension of perimeter buffering, the expanded plant would be compatible with surrounding land uses.

North Service Area Treatment and Conveyance

The compatibility of a new North Plant with adjacent land uses would depend on its location. A site of 30 to 60 acres would be required to accommodate the new plant facilities and a buffer. A North Plant could be located at a shoreline site or at an inland location. Regardless of the location chosen for a new North Plant, construction of a pipeline (either influent or effluent) from the area north of Lake Washington westward to the Puget Sound shoreline would be required. Additional facilities conveying influent to the plant would also be constructed. Additional project-level site selection and environmental review studies would be needed before a final plant location would be determined. Criteria to screen potential sites would be developed, and a more complete review of land use compatibility, as well as other environmental and operational issues, would be undertaken.

Some pump stations might need to be located in non-industrial areas. Because of potential concerns about odors, noise, and visual character in these areas, pump stations would need to be designed to maximize their compatibility with surrounding land uses.

CSOs

CSO conveyance and storage facilities would be compatible with surrounding land uses since they are largely underground and any associated aboveground facilities are typically unobtrusive. Relatively less developed sites (e.g., street ends, parking lots) would be sought for CSO facilities. CSO treatment facilities would be located along the Duwamish Waterway, the Elliott Bay shoreline and the Lake Washington Ship Canal in highly urbanized areas. Therefore, these facilities are likely to be compatible with surrounding land uses.

Infiltration/Inflow

No long-term land use impacts would result from the I/I program.

Mitigation Measures

For development of new aboveground wastewater facilities proposed under the EPP the site selection and design processes would include consideration of the nature of nearby land uses and natural environmental features, and place high priority on consistency with local comprehensive plans and compatibility with adjacent land uses. For example, land use consistency and compatibility would also be promoted through inclusion of appropriate design features (odor and noise control, for example) coupled with an appropriate degree of perimeter buffering.

Unavoidable Adverse Impacts

No significant unavoidable adverse impacts are anticipated.

ENVIRONMENTAL HEALTH

Public Health

As defined by SEPA, the term "environmental health" covers several types of impacts with the potential to affect human health and well being. These impacts are those that are not covered under other areas of SEPA and/or are not specifically addressed by protective regulations. Water and air quality, for example, have the potential to affect human health; however, they are separate SEPA "elements of the environment" and are regulated by standards expressly designed to minimize possible health effects.

For the RWSP, this section covers three topics related to environmental health: public health, noise, and hazardous materials. Public health is specifically related to CSO discharges, which—though short-term and infrequent—are not subject to pollutant discharge limitations under state and federal water quality regulations.[3] Therefore, direct human contact with these discharges, as well as ingestion of shellfish exposed to them, is a public health issue. Noise is generated by wastewater treatment facilities and pump stations, and is generally restricted to prescribed levels by local ordinances to protect receptors. Hazardous Materials (as specified by state and federal regulations) are used in various treatment processes and are transported to, and stored on, treatment plant sites.

Not all of these environmental health issues are applicable to all service areas or system components. Therefore, this section is organized to focus only on those service areas or components in which impacts may occur.

Impacts

King County will continue to plan and carry out CSO control projects to achieve Ecology's standard of one event per outfall per year by the year 2030. CSOs would be

[3] Regulation of CSOs by Ecology and EPA limits the **frequency** of discharge rather than the pollutant levels, which may vary according to many factors. For further discussion of CSO issues see Part II, Chapter 2, Background.

stored and subsequently would undergo either secondary treatment at the West or East Treatment Plants or onsite treatment before direct discharge.

Direct human contact with the CSO pollutants can occur during water contact activities such as swimming, wading, boating, or scuba diving. Reduction in the frequency and volume of discharges would substantially lower the potential for human exposure to harmful bacteria, viruses, metals, and petroleum products contained in CSOs. CSO reductions could reduce human health risks in areas where overflows discharge near areas of heavy human use such as parks, beaches, and other public access points. The County is currently preparing a CSO water quality assessment to evaluate the human health benefits of CSO reduction.

Mitigation Measures

The proposed reductions in CSO discharge represent a substantial improvement over existing conditions and will reduce regional public health risks. No mitigation is necessary.

Unavoidable Adverse Impacts

No significant unavoidable adverse public health impacts are anticipated.

Noise

Impacts

Operation of wastewater treatment plants, pump stations, and regulator stations creates varying levels of noise that can disturb adjacent properties, depending on the type and proximity of the receptor.

Mitigation Measures

All wastewater treatment plants would be designed to contain noise, particularly when there are nearby sensitive land uses (e.g., residential). Most noise-emitting equipment would be located in buildings, reducing noise levels to acceptable limits before reaching the property line. Fan openings could be directed away from sensitive receptors. Noise levels would be in compliance with the limits established by local jurisdictions.

If necessary, pump stations would be designed with noise baffles to supply enough dead air space between the noise and the outside wall of the building to minimize noise emissions to the exterior. Depending on project-specific design, pump stations could be equipped with emergency diesel generators for use in case of power outages. These generators have high noise levels and would be tested monthly for about 30 minutes. Pump stations served by dual power feeds do not usually have emergency generators. Any noise impacts would be temporary.

A new North Plant would be designed to minimize noise impacts to surrounding areas and would meet all applicable local noise requirements. Because no site has been identified for a North Plant, it is unknown whether truck noise would affect sensitive receptors.

Operational noise at the East Plant would be addressed during the design of facilities at each expansion stage. Operational noise at the new North Plant would be addressed during the siting and design processes for that facility.

With the noise reduction techniques described above, no exceedances of local noise standards would be expected to occur. No additional mitigation would be required.

Unavoidable Adverse Impacts

No significant unavoidable adverse noise impacts are anticipated.

Hazardous Materials

Impacts

Providing secondary treatment for increased wastewater flows would require the use of more chlorine than is currently used at the East Treatment Plant. Chlorine could also be used at a new North Treatment Plant. Increased risks to environmental health are unlikely. Buildings at the two existing plants where chlorine is stored are designed to contain spills and are equipped with automated alarm systems to minimize fire danger in accordance with the Uniform Fire Code. Chlorine storage buildings at a new North Plant would incorporate these same safety features. In addition, King County has extensive operating experience using chlorine and has developed safety measures and response plans to minimize risk to public health.

Chemicals used at pump stations to control odor and corrosion can be hazardous and require special storage and handling procedures. These chemicals are usually stored in containers, isolated from other areas within the pump station, and added to the wet well and/or force main under controlled conditions. Because of the safety features incorporated into the design of pump stations, control systems and alarms, and King County's experience with hazardous chemicals, impacts on environmental health associated with use of chemicals at pump stations are not expected to be significant.

West Service Area. Caustic soda is stored at the West Plant for use as an absorbent for chlorine, should a leak occur. Venting systems direct any chlorine gas to caustic soda tanks where the gas is absorbed and neutralized. When combined, chlorine and caustic soda produce salt water. Caustic soda use is very low; between 1978 and 1988 there were only two deliveries to the West Treatment Plant. Caustic soda is stored in large storage tanks surrounded by concrete berms to contain any leaks or spills. The potential for adverse impacts to public health is low.

East Service Area. Expansion of the East Treatment Plant would incorporate the same safety features, alarm systems, and response plans used at the existing plant. While chlorine use would increase, roughly in proportion to the size of the expansion, the risk to environmental health would remain low.

Risks associated with the use of chlorine gas and other chemicals at the East Treatment Plant would be somewhat lower under the EPP than service strategies that expand the capacity to 154 mgd.

North Service Area. Chlorine could be used for disinfection at a new North Plant although this would be thoroughly evaluated during plant design and another, less toxic, method could be selected. If chlorine gas were used, it is anticipated that it would be transported to the plant by truck or rail. Safety measures similar to those in place at the East Plant would be developed to minimize environmental health risks.

Mitigation Measures

- At each wastewater treatment plant, safety plans would continue to be implemented to minimize risks associated with hazardous materials and chemicals. Emergency response plans detail measures to be taken in the event of an emergency involving hazardous materials or chemicals. Workers receive regular training in the use of these materials, as well as in emergency response procedures.

- All facilities would be designed to minimize the potential for leaks or breaks. To prevent pipeline or facility leakage, King County conducts periodic routine pipeline inspections to detect possible defects. Inspections detect potential for failures before the failure is imminent. Should a leak occur, an emergency response team is mobilized so that repairs and cleanup begin immediately. Appropriate regulatory agencies, including EPA, Ecology, and the local jurisdiction in which the spill occurs, are notified.

- Chlorine would continue to be stored in concrete storage buildings designed to fully contain chlorine in the event of a leak; pressure sensors and leak detection alarms would also be provided.

- Vacuum distribution systems would be used for chlorine; these systems include fail-safe shutdown in the case of vacuum system failure.

- Sodium hydroxide would be used in emergencies to absorb chlorine in case of system malfunction.

- Chlorinated systems would be inspected regularly.

- Caustic soda storage tanks would be provided with concrete berms to contain any releases from leaks or ruptures.

- Chemicals, paints, solvents, lubricants, etc. would be stored in structures designed to contain any leakage or rupture.

Unavoidable Adverse Impacts

No significant unavoidable adverse impacts have been identified.

OTHER ELEMENTS OF THE ENVIRONMENT

Earth Resources

The EPP includes projects that would convert existing native soils to impervious surface. Such conversion increases surface water flows and runoff rates and corresponding erosion; it also impedes local aquifer recharge. In general, however, overall increases in impervious surface would be small.

Major earthquakes occur in the Puget Sound region and could result in structural damage to treatment and conveyance facilities. All structures proposed in identified seismic risk areas would be designed to withstand earthquake effects to the levels identified in applicable policies and regulations.

Impacts

New conveyances and CSO facilities under the EPP would contribute minor amounts of additional impervious surface area. Expansion of the East Plant and construction of a new 54-mgd North Plant would result in the following estimated additional impervious surface areas:

- East Plant expansion—about 6 acres
- North Plant—about 15 acres

Impacts on earth resources from proposed facilities would not be significant. A high-magnitude earthquake could result in structural damage to the East Plant, which is located in an area subject to liquefaction during seismic activity. Large earthquakes could also result in structural instability at a new North Plant, depending on final site selection.

Increased control of CSOs will reduce deposition of contaminants in sediments near outfalls.

Mitigation Measures

Structures located in high seismic risk areas would be designed to withstand 0.3-ground acceleration, consistent with current King County policy. Where practical, soils subject to liquefaction could be overexcavated down to firmer materials.

Unavoidable Adverse Impacts

No significant unavoidable adverse impacts are anticipated.

Aesthetics

The construction of new aboveground facilities (primarily treatment plants and pump stations) would change the visual character of the surrounding landscape to a greater or lesser degree, depending on the nature of local land uses, the size of the facility in question, and the techniques (e.g., landscaping) used to screen and buffer the facility from its neighbors.

Impacts

Expansion of the East Plant could result in approximately a 17 percent increase in the size of the existing treatment plant. Although the expanded plant would be similar in scale and visual character to the surrounding industrial and office development, its expanded size would make the facility more visible from nearby viewpoints and distant valley residences.

If a new North Treatment Plant were to be located at a shoreline location, the potential for adverse visual impacts could be significant. A new treatment plant could be a major visual element in an otherwise nonindustrial area on most shoreline sites. The visual impacts of a treatment plant at a lowland inland site north of Lake Washington would depend on site location. Some potential locations in this area are highly visible. At any location the new treatment plant would be a new visual element. The magnitude and character of this potential impact would depend on the site chosen.

Facilities potentially required for CSO treatment at the West Plant would be located completely inside the plant footprint and of lower height than most of the plant buildings.

Pump stations and other above-ground facilities associated with conveyance lines and CSO control could have aesthetic impacts, depending on their surroundings and design. No aesthetic adverse impacts would result from the operation of underground facilities.

Mitigation Measures

To mitigate adverse visual impacts resulting from an expanded East Plant, the extensive mitigation measures employed at the existing treatment plant should be expanded to include the new structures. These mitigation measures include perimeter berming, perimeter and interior landscaping, and siting of facilities to direct views into the site toward open areas and away from structures. Mitigation measures described for the East Plant would be employed for the North Plant with the goal of a design that is compatible with the site and its surroundings.

For pump stations located at sites visible from nearby properties, landscaping could be provided to obscure the visibility of the facility. Other above-ground structures could be designed to be visually compatible with the surrounding area and structures.

Unavoidable Adverse Impacts

Construction of a new North Treatment Plant would change the visual character of the immediately surrounding area to some degree.

Recreation

Operational impacts on recreation would occur if aboveground structures were located within or close to recreational facilities, such as parks. Such impacts could be direct (i.e., lost use of park lands or amenities) or indirect (e.g., aesthetic or noise impacts).

Impacts

Expansion of the East Plant would not result in the loss of any land used for recreation. A location for the new North Plant that avoided displacing existing recreation facilities would be sought. Consequently, the plant would be unlikely to result in the loss of recreational facilities. Adverse post-construction impacts on recreation resulting from treatment plant expansion or construction would be minimal.

Underground facilities (conveyances and tunnels) would not result in any post-construction adverse impacts on recreation. The Murray Avenue CSO control project could eliminate some recreational space at Lowman Beach Park.

Implementation of the I/I program would not result in any recreation impacts.

Mitigation Measures

Impacts to recreation would be avoided wherever possible. Unavoidable losses of recreational use would be fully mitigated with specific measures dependent upon the nature of the lost resources.

Unavoidable Adverse Impacts

No significant unavoidable adverse impacts are anticipated.

Cultural Resources

No cultural resource impacts would result from operation of the EPP. Potential construction impacts are discussed in Part II, Chapter 11.

Air Quality

Impacts

Volatile Organic Compounds. As described in Chapter 4 of the DEIS, VOC emissions from treatment plants are essentially proportional to the volume of wastewater treated. In general, the VOC emission potential of enclosed treatment processes, such as high-purity oxygen treatment, is considerably less than that of unenclosed treatment processes because of the limited potential for VOCs to volatilize into the ambient atmosphere. However, enclosed processes are generally more expensive initially and may not be practical or cost-effective for many municipal treatment needs. Activated sludge and trickling filter processes are estimated to have about an equal potential for releasing VOCs from wastewater.

Handling biosolids on the treatment plant site also poses the potential for release of VOCs that remain after completion of the liquid process. Again, enclosed solids handling facilities minimize this potential, but the space required for dewatering, storage, and other activities may make this impractical. Where anaerobic digestion of solids is accompanied by combustion of resulting digester gas, VOCs can be emitted during combustion.

Odor. The factors influencing a treatment facility's odor impacts are similar in many ways to those that determine its level of VOC emissions. Elements of a facility most likely to generate odors typically are not enclosed and, thus, expose wastewater or solids to open air. The highest potential sources of odor include the screenings building, sludge digester, sludge thickener, and the septage receiving and loading areas. Primary clarifiers have a moderate odor potential, while aeration basins and secondary clarifiers tend to produce few odors. Also, as with VOCs, treatment processes vary in their odor-causing potential. Trickling-filter processes have the highest potential for odor, followed by activated sludge and oxidation ditch processes. Processes with the lowest odor potential include rotating biological contactors and high-purity oxygen-activated sludge. Specific facility elements and treatment processes for the EPP will be determined during design and subject to environmental review.

Other facilities related to the conveyance of wastewater can generate odors similar to those experienced at treatment plants. Typically, odors are generated where wastewater becomes turbulent, such as at pump or regulator stations. Odors can also be present at high spots in conveyance pipelines, usually where force mains and gravity mains come together. Facilities can be designed to incorporate odor controls, such as carbon filters, to treat air before it is emitted to the environment.

Siting of a North Plant would play a large role in determining the probable extent of its odor impacts and the appropriate mitigation. Predominant wind conditions are a determining factor in how severely odor impacts are experienced. However, if a new treatment plant were sited with potential to adversely affect a sensitive neighborhood, the plant would be designed with odor control technology to enclose the more odorous processes and remove odorous compounds from the air exiting those enclosures.

Mitigation Measures

VOC (excluding toxic air contaminants (TAC)) and odor emissions from wastewater treatment facilities are not subject to regulation by PSAPCA or other agencies. However, King County actively pursues measures to reduce such emissions at its facilities. Ongoing source control efforts are the most effective method of reducing the range and concentrations of VOCs in wastewater influent. Odor control at the expanded treatment facilities would involve extending technologies currently in use to the newly constructed expansion areas. Part II, Chapter 4, Affected Environment, describes some of the types of technologies currently used to control odor at King County facilities.

In addition, King County will continue to seek practical technologies that will prevent odors from escaping wastewater facilities.

Unavoidable Adverse Impacts

Regional levels of VOC emissions would increase slightly under the EPP (as they would under any of the other alternatives).

Transportation

Operation of expanded treatment facilities would require several additional treatment plant operating staff members. Some staff members would be headquartered at the plant sites for functions such as facilities maintenance, administration, and site maintenance. Additional worker trips to and from the site would not occur during the morning and afternoon peak traffic periods. Most trips would occur during the day, although additional swing and graveyard shifts could be added at night.

The new and expanded pump stations proposed under the EPP strategy would not be staffed. Workers based at other facilities would visit each of them every 1 or 2 weeks. If repair or equipment replacement were needed, more traffic would be generated for the duration of those activities. Otherwise, very few additional trips would be generated by new or expanded pump stations.

Pipelines are inspected only periodically. Virtually no traffic would be generated by pipelines once construction was complete. Similarly, CSO control facilities would have no permanent staff. During some storm events, two to three treatment plant-based staff would make trips to the CSO facilities to ensure they were operating properly. Transportation operational impacts under the EPP would be experienced in the vicinity of the East Treatment Plant when it was expanded to 135 mgd. They would also be experienced as a result of operating a North Plant. Biosolids truck trips would increase proportionally to the solids removed from increased wastewater flows. Biosolids one-way truck trips to and from the North Plant are projected to average up to approximately 6 per day. Operational trips are shown in Table EP1-3.

Depending upon the site selected for a new North Plant, roads to the site might require improvements in order to accommodate plant traffic.

Mitigation Measures

No mitigation measures are proposed. However, King County continues to evaluate solids processing technologies that would reduce biosolids volumes and thus hauling trips.

Unavoidable Adverse Impacts

None anticipated.

Table EP1-3
Operational Trips (1)
Executives Preferred Plan

VEHICLE TYPE	FACILITY					
	West Plant	**East Plant**		**North Plant**[2]		
	Existing, Average/Day (133 mgd)	Existing, Average/Day (115 mgd)	(135 mgd)	(18 mgd)	(36 mgd)	(54 mgd)
CARS	320/day	330/day	385/day	45/day	85/day	130/day
TRUCKS	35/day	65/day[4]	75/day	5/day	10/day	15/day
BIOSOLIDS TRUCKS [3] (7 days a week)	12/day (6 loads)	10-12/day (5-6 loads)	12-14/day (6-7 loads)	2-4/day (1-2 loads)	4/day (2 loads)	6/day (3 loads)
Chlorine RAILROAD CARS	----------	7/year	8/year	NA[5]	NA	NA

Notes: (1) Trips are one-way; figures are rounded. "One-way" is defined as a single direction trip to a single destination.
(2) Projected North Plant trips are based on existing West Plant trips to reflect most recent traffic volume data.
(3) Biosolids truck trips are one-way. Final conditions to the Shoreline Substantial Development Permit for upgrade to secondary treatment at West Point state that "the number of loaded sludge trucks shall not exceed 13 per day on average over a year period (January through December)." Thirteen truck loads per day equals 26 one-way truck trips as defined in Note (1).
(4) East Plant truck trip numbers include septage trucks which are not processed at the West Plant.
(5) Data not available.

Public Services, Utilities, and Energy

The principal utilities affected by operation of proposed facilities would be electrical power and natural gas suppliers. Treatment plants and pump stations are the facilities that would consume most of the energy required for operation under any of the service strategies. Methane and other gases produced at treatment plants could be captured and sold to an electrical utility or used to generate power to reduce demand placed on suppliers.

The additional amount of energy consumed by new facilities under the EPP would be minor in the regional context. Energy requirements of individual facilities would be evaluated in light of available power supply during facility design.

Operation is unlikely to have a significant impact on police, fire, and emergency services. Demands on water, telephone, and other utilities are not likely to be significant.

Impacts

The additional electrical energy required to operate treatment plants in the year 2030 is estimated at 39 million kWh per year. The amount of energy produced to offset this demand has not been estimated.

Mitigation Measures

Local utilities attempt to meet the demands of their customers. More detailed environmental reviews of individual projects proposed as a result of this planning process would include assessments of possible impacts to services, utilities, and energy and any appropriate mitigation measures.

Unavoidable Adverse Impacts

Treatment of higher wastewater volumes would result in increased energy usage.

SHORT-TERM CONSTRUCTION IMPACTS

Chapter 11 of Part II of this FEIS contains a detailed discussion of construction impacts. Table EP2-9 at the end of Part I discusses and compares the construction impacts of all of the revised service strategies.

SUMMARY OF MITIGATION MEASURES

Table EP1-4 lists mitigation measures that would be employed during construction and operation of the EPP.

TABLE EP-1-4
SUMMARY OF MITIGATION MEASURES

Element of the Environment	Mitigation Measures
Earth	**Construction** • In areas of suspected contaminated soils, testing would be conducted to determine the extent of contamination before construction. • Contaminated soils from excavations would be disposed of in compliance with all applicable local, state and federal regulations. • Where contaminated soils and groundwater are found together, dewatering systems would be implemented to avoid discharging contaminated groundwater or letting soils leach to receiving surface waters. **Operations** • Adherence to state regulations and guidelines for the production and application of reclaimed water will ensure that potential adverse impacts to earth resources are minimal. • Biosolids are regulated by federal (part 503), state and local agencies. The 503 regulations limit the amount of biosolids that can be land applied in addition to limiting the level of constituents in the product.
Air	**Construction** • To minimize blowing dust, implement best management practices such as watering exposed soil areas, covering soil stockpiles and minimizing areas of earth disturbed at any one time. **Operations** • King County will continue to seek practical technologies that will prevent odors from escaping wastewater facilities. • Avoid direct exposure of humans to reclaimed water by irrigating at night or in temporarily restricted areas. Integrate signage, training and appropriate operations and maintenance procedures for equipment into health and safety program.
Water Resources	**Construction** • Include best management practices for erosion control in construction specifications to minimize sedimentation of water bodies. **Operations** • Select wastewater discharge outfall sites with strong currents and favorable circulation patterns that most rapidly move pollutants northward out of Puget Sound. Research indicates that the upper water layer best provides these conditions. Outfall locations that meet these criteria would reduce long-term operational impacts. • Infiltration and inflow control projects in flood-prone areas would include studies of local groundwater and surface water drainage patterns to avoid exacerbating local flooding and wet basements. • King County's Industrial Waste/Source Control Pretreatment Program reduces the levels of contaminants entering the sewer system and enhances both biosolids and reclaimed water products. • At biosolids application sites, use agronomic rates to maximize crop uptake of nutrients, maintain moderate pH and monitor for soil contaminant concentrations. Maintain buffers from surface water bodies. Adhere to federal, state and local regulations and permits. • Monitor reclaimed water quality. For dual distribution systems, incorporate safeguards to prevent cross connections between potable and reclaimed water. Adhere to state standards and guidelines.
Biological Resources	**Construction** • Routes would be selected to avoid sensitive riparian and wetland areas wherever

Element of the Environment	Mitigation Measures
	possible. • Pipeline alignments would be designed to minimize destruction of existing vegetation and wildlife habitat. These resources would be restored after construction. • Construction in streams and nearshore areas would not occur during designated fishery closure periods. • Outfall alignments would be designed to minimize impacts to sensitive intertidal communities wherever possible. • During construction, King County staff and contractors would coordinate with tribal governments to reduce the potential for disruption of tribal fishing operations. • Wetland mitigation plans would be developed for wetland areas disturbed during construction. • King County would work with resource agencies to develop specific site restoration methods for affected sensitive areas. **Operations** • Mitigation measures to protect ecological health include monitoring the quality of reclaimed water to ensure that it consistently meets the Class A standard. • If high levels of mineral salts and inorganic compounds are known to be present in the reclaimed water, plant materials can be selected that are proven to be tolerant of these conditions. • Applying biosolids to the soil as an amendment improves tilth and increases plant productivity.
Energy	**Construction** • All equipment used during construction would meet applicable energy efficiency standards. **Operation** • Methane and other gases produced at treatment plants could be captured and sold to power companies or used to generate power to reduce demand on suppliers.
Environmental Health	**Construction** • Construction noise would be controlled wherever possible to avoid adversely impacting sensitive receptors such as residential neighborhoods and schools. **Operation** • Use appropriate procedures for handling chemicals and petroleum products during facility operation. • The State of Washington Water Reclamation and Reuse Interim Standards protect public health by requiring a specific level of water quality and treatment corresponding to each beneficial use of reclaimed water. King County's adherence to these standards produces the highest quality effluent designated by the state, Class A. • Potential risks to public health from use of reclaimed water can be reduced even further through the following measures: Irrigation could occur at night when public exposure is likely to be low; public education (e.g., posting of signs); environmental monitoring (e.g. soil and water sampling); appropriate irrigation design and operation (e.g., providing for emergency shut-off of the irrigation system in the event of a pipe rupture) and; implementation of appropriate irrigation system maintenance procedures. • The 503 Regulations for biosolids application specify strict "ceiling concentrations" on the amounts of metals that are allowable in biosolids. King County's biosolids are well below this level. • Proper application of biosolids and adherence to permit and operations plan

Element of the Environment	Mitigation Measures
	requirements protect public health such that no significant adverse impacts are likely to occur from biosolids applications.
Land & Shoreline Use	**Construction** • Refer to mitigation measures discussed under air, noise, aesthetics and transportation. **Operations** • To site new treatment facilities (i.e. plant, pipelines), high priority would be given to sites where such facilities would be compatible with surrounding uses.
Recreation	**Construction** • Where short periods of temporary construction impacts are expected at recreational facilities, construction could be scheduled to avoid the periods of highest recreational use. • Where trail use is disrupted, King County would provide a safe detour around the construction area wherever possible.
Aesthetics	**Operations** • To make treatment facilities more compatible, measures such as landscaped buffers and architectural treatment would be used in design.
Transportation	**Construction** • Traffic plans would be developed to ensure continued circulation and access during construction. • Open trench segments would be covered to allow residents and service vehicles to access driveways and loading areas. • Temporary measures would be implemented along trails to separate pedestrians and bicyclists from vehicles.
Cultural Resources	**Construction** • Presence of known cultural resources would be taken into account when designing facilities and cultural resources will be avoided wherever possible. • If cultural resources are encountered during construction, construction would cease and a professional archaeologist will be consulted.

Chapter EP-2

Impacts and Mitigation Measures for Revised Service Strategies 1, 2 and 4

In addition to the Executive's Preferred Plan (which is based on Service Strategy 3), Service Strategies 1, 2 and 4 have also been revised to reflect the need to convey and treat a smaller quantity of wastewater in the future than was previously projected (see discussion of revised population and flow estimates in Foreword). Some key facilities considered in the revised Service Strategies 1, 2 and 4 are smaller than those previously described in Part II of this FEIS (Part II is directly derived from the Draft EIS). For example, under revised SS4, the ultimate planned capacity of the East Treatment Plant would be 154 mgd rather than 235 mgd as described in the *Draft RWSP* and DEIS.

Reduced flow projections have also eliminated the need for some facilities. For example, it is no longer necessary under any service strategy to construct a second interceptor, parallel to the existing East Side Interceptor (ESI). The third leg of the existing outfall for the East Treatment Plant has also been eliminated. Peak flow discharge at this treatment plant can now be handled by storing the flows temporarily in large tanks and using the outfall into the Green River to discharge secondary treated effluent during peak flow conditions (approximately once every two years).

These service strategy revisions have all resulted in projected environmental impacts that are of the same or less magnitude than those described in Part II of this FEIS. At the end of this chapter, these impacts are discussed and compared in Table EP2-9 for each element of the environment and for each revised service strategy. Figure EP2-1 compares discharge rates from King County outfalls for the revised strategies in 2030. In addition, Table EP2-4 compares the costs of the revised service strategies, Table EP2-5 provides volumes of excavated materials for construction of various types of facilities, Table EP2-6 provides operational trips for treatment plants, and Tables EP2-7 and EP2-8 provide construction transportation impact summaries for treatment plants and major conveyance facilities, respectively.

The CSO control program has been revised to achieve an average of one discharge event per year by 2030. This is 13 years earlier than previously considered and would benefit water quality for Puget Sound beaches, the Ship Canal, and the Duwamish River sooner than discussed in the Draft EIS. It would also reduce the accumulation of pollutants in sediments near outfall locations resulting in less potential for cumulative impacts to water quality and marine biota.

All environmental impacts of the revised service strategies fall within the range of those previously discussed in the Draft EIS and presented in Part II of this FEIS. Chapter 4 of Part II of the FEIS provides information on the "Affected Environment". Chapters 5 through 8 discuss operational impacts common to all service strategies and impacts and mitigation measures for each Service Strategy as described in the *Draft RWSP*.

Chapter 9 of Part II of this FEIS describes impacts and mitigation measures related to reclaimed water applications. Chapter 10 covers biosolids recycling program impacts and mitigation measures.

Chapter 11 of Part II of this FEIS contains the discussion of "Construction Impacts and Mitigation Measures". This information is applicable to all service strategies. Finally, Chapter 12 of Part II of this FEIS provides a description of the service strategy options that were considered as described in the *Draft RWSP*. Some of these options have been retained as part of the EPP (see Chapter EP-1).

SUMMARY OF KEY FEATURES OF REVISED SERVICE STRATEGY 1

Key Components of this Strategy:

- Maintain the existing two-treatment-plant system (West and East Plants)
- Expand East Treatment Plant in increments:
  - Plant capacity of 135 mgd (2013)
  - Plant capacity of 154 mgd (2021)
- Expand West Treatment Plant to planned capacity of 159 mgd (2029)
- Construct a new parallel Kenmore interceptor (2010)
- Construct 5-million gallons of storage to reduce ETS peak flows (2016)
- Implement CSO program to achieve one overflow event per year per outfall by 2030
- Implement I/I incentives/surcharge program
- Biosolids:
  - Produce Class B biosolids at all three plants
  - Explore alternative technologies to improve biosolids quality and marketability
- Water Reuse:
  - Research new applications for reclaimed water
  - Allow flexibility to produce and distribute reclaimed water at all treatment plants

The important features of revised Service Strategy 1 are shown in Figure EP2-2. Table EP2-1 shows the chronological sequence of projects under this service strategy.

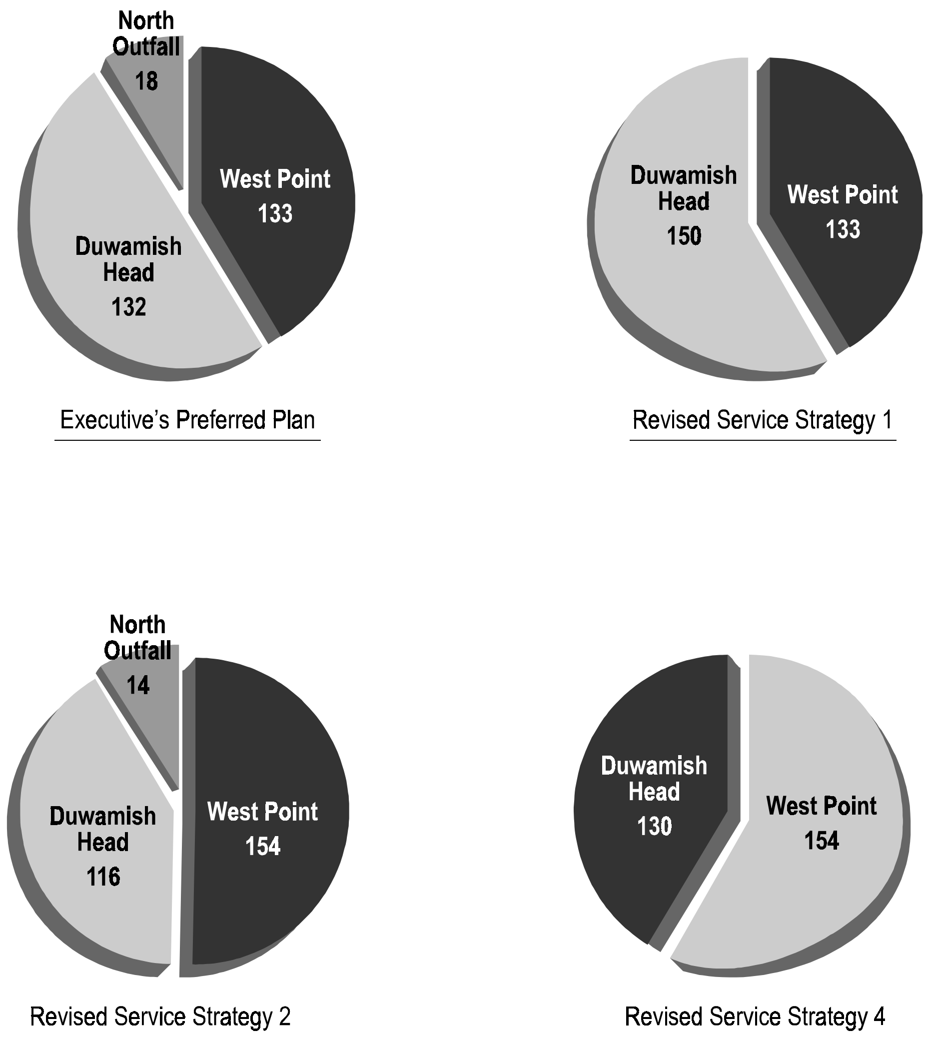


FIGURE EP2-1

Comparison of Discharge Rates (in mgd) **from King County's Puget Sound Outfalls in 2030**
(for average wet-weather flow)

141661.A0.04_comp discharge pies.fh7_ROY_4-9-98

NOTES:
1. East Plant discharges at Duwamish Head.
2. West Plant discharges at West Point.
3. North Plant would discharge from outfall somewhere off north King or south Snohomish County.
4. Numbers below discharge locations denote projected average wet weather flow discharges under that service strategy in 2030.
5. Total system discharge may vary slightly by strategy due to rounding.

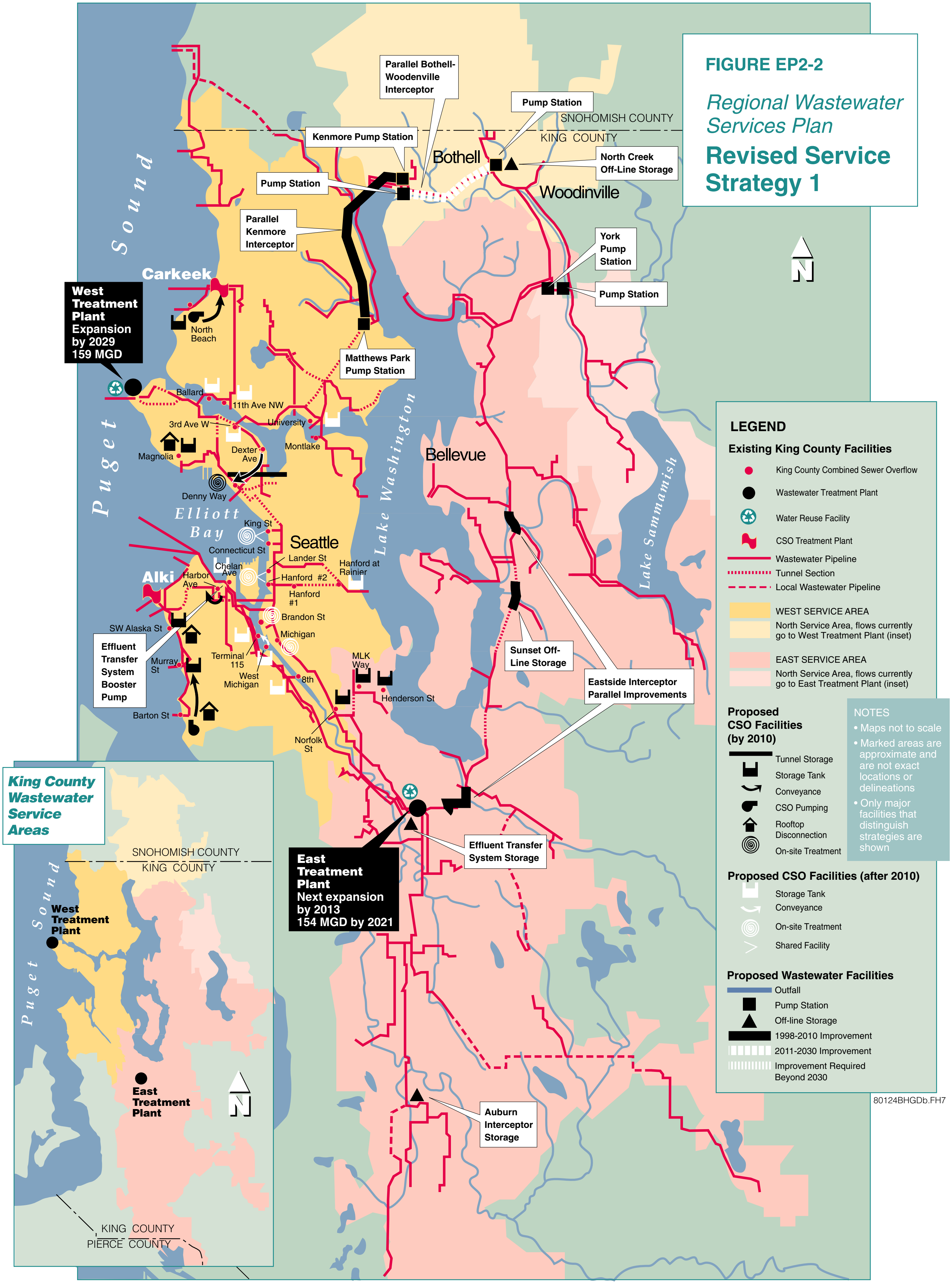


FIGURE EP2-2

Regional Wastewater Services Plan

Revised Service Strategy 1

Table EP2-1. Service Strategy 1
List of Capital Facilities (by year required on-line)

1996 2000 2005 2010 2015 2020 2025 2030 2040

Treatment Plant Projects

- ✷ Increase East Plant capacity to 135 MGD (2013)
- ✷Increase East Plant capacity to 154 MGD (2021)
- ✷Increase West Point capacity to 159 MGD (2029)

Conveyance Projects

- ♦ESI-11 – Wilburton Siphon (1998)
- ♦Reuse Projects (1999)
- ♦Trunk Improvements (1990-2000)
- ♦ESI –1 (2000)
- ♦Increase York PS capacity to 68 MGD (2000)
- ♦ I&I Reduction Program – Project (2003)
- ♦Auburn Interceptor Sections 1,2,3 ((2004)
- ♦Trunk Improvements (2001-2010)
- ♦Off-line storage at North Creek (2005)
- ♦Increase Kenmore PS capacity to 35 MGD (2010)
- ♦Pump Station at end of Kenmore Tunnel (2010)
- ♦Sunset Tunnel (2010)
- ♦Tunnel Kenmore to Matthew's Park PS (2010)
- ♦Trunk Improvements (2011-2020)
- ♦ETS storage (5 mg) to reduce peak flows by 34 MGD (2016)
- ♦Convey Kenmore PS flows to N. Creek PS (2024)
- ♦Modify Kenmore PS to pump to N. Creek and Logboom (2024)
- ♦Trunk Improvements (2031-2050)

CSO Projects

- ★Harbor (1998)
- ★Denny Way (2006)
- ★MLK Way (2008)
- ★Henderson (2009)
- ★Norfolk (2009)
- ★ S. Magnolia (2010)
- ★SW Alaska St. (2010)
- ★Murray (2010)
- ★Barton (2011)
- ★North Beach (2011)
- ★University Montlake (2015)
- ★Hanford (2017)
- ★West Point (2018)
- ★Lander (2019)
- ★Michigan (2022)
- ★Brandon (2022)
- ★Chelan (2024)
- ★Connecticut (2026)
- ★King Street (2026)
- ★Hanford @ Rainier (2026)
- ★8th Avenue S. (2027)
- ★W. Michigan (2027)
- ★Terminal 115 (2027)
- ★3rd West (2029)
- ★Ballard (2029)
- ★11th Ave (2030)

1996 2000 2005 2010 2015 2020 2025 2030 2040

Service Strategy 1 splits the northern flows between the two existing treatment plants, first expanding the East Treatment Plant (by 2010 and again by 2021) and then the West Treatment Plant (by 2029).

There are some differences between the revised Service Strategy 1 described here and Service Strategy 1 as presented in the draft RWSP and Part II of this FEIS (chapters 3 and 5). In the revised SS1, the West Treatment Plant is expanded to 159 mgd in 2029 rather than in 2020. The planned capacity of the East Treatment Plant is now less than was previously described. Under the revised strategy, it is only expanded to 154 mgd in 2021 rather than to 235 mgd in 2040 as described in Part II of this FEIS.
Because of the smaller planned capacity at the East Treatment Plant, it is no longer necessary to construct a third outfall at Duwamish Head to discharge peak flows. Additionally, a small storage tank would need to be constructed: 5 mg rather than the 20 mg described in Part II of the FEIS.

As with all revised service strategies (and the EPP) the CSO program achieves an average of one overflow event per outfall per year earlier than is described in Part II of this FEIS. All revised service strategies also include implementation of an I/I incentives and surcharge program.

SUMMARY OF KEY FEATURES OF REVISED SERVICE STRATEGY 2

Key Components of this Strategy:

- Create a new three-treatment plant system (comprised of West Plant, East Plant, and a new North Plant)
- Expand West Treatment Plant to planned capacity of 159 mgd (2013)
- Construct a new parallel Kenmore interceptor (2009)
- Construct a new 27 mgd North Plant (2024)
- Construct a conveyance system to carry influent to the North Plant and an outfall from the North Plant to Puget Sound (2024)
- Expand East Treatment Plant to 127 mgd (2029)
- Implement CSO program to achieve one overflow event per year per outfall by 2030
- Implement I/I incentives/surcharge program.
- Biosolids: Same as for SS1
- Water Reuse: Same as for SS1, but also adds greater flexibility to build smaller "satellite" treatment plants if circumstances warrant (as for EPP)

The important features of Service Strategy 2 are shown in Figure EP2-3. Table EP2-2 shows the chronological sequence of projects under this service strategy.
Revised Service Strategy 2 splits the northern flows between the West Treatment Plant and a new treatment plant in north King or south Snohomish County. The flows are first sent to the West Treatment Plant. Until a new treatment plant is constructed, all northern flows would be conveyed through the Kenmore Interceptor, requiring a parallel interceptor to be constructed.

The West Treatment Plant is expanded to planned capacity of 159 mgd but this would occur in 2013 rather than 2010. The Kenmore parallel would be constructed by 2009. The East Treatment Plant is smaller than previously discussed but the additional capacity is needed earlier under revised Service Strategy 2. Under revised SS2, it is expanded to 127 mgd in 2029.

A new 27 mgd North Plant would be constructed by the year 2024. This is smaller than the 65 mgd plant described in Part II of the FEIS.

Table EP2-2. Service Strategy 2
List of Capital Facilities (by year required on-line)

1996 2000 2005 2010 2015 2020 2025 2030 2040

Treatment Plant Projects

✷Increase West Point Capacity to 159 MGD (2013)
✷Construct 27 MGD North End Plant (2024)
✷NEP Outfall (2024)
✷Increase East Plant to 127 MGD (2029)

Conveyance Projects

♦ESI-11 – Wilburton Siphon (1998)
♦Reuse Projects (1999)
♦ESI-1 (2000)
♦Trunk Improvements (1990-2000)
♦Increase York PS capacity ot 68 MGD (2000)
♦I&I Reduction Program – Project (2003)
♦Auburn Interceptor 1,2,3 (2004)
♦Trunk Improvements (2001-2010)
♦Off-line storage at North Creek (2005)
♦Tunnel Kenmore to Matthew's Park PS (2009)
♦Increase Kenmore PS capacity to 35 MGD (2010)
♦PS at end of Tunnel (2010)
♦Trunk Improvements (2011-2020)
♦Convey N. Creek PS flows to Kenmore (2017)
♦Modify N. Creek PS to pump to Kenmore (2017)
♦Modify York PS to pump 35 MGD north (2017)
♦Auburn Interceptor Storage (2020)
♦Tunnel from NEP to Puget Sound (2024)
♦Forcemain from Kenmore PS to NEP (2024)
♦PS at Kenmore to pump to NEP (2024)
♦Trunk Improvements (2021-2030)
♦Trunk Improvements >2031

CSO Projects

★Harbor (1998)
★Denny Way (2006)
★MLK Way (2008)
★Henderson (2009)
★Norfolk (2009)
★ S. Magnolia (2010)
★SW Alaska St. (2010)
★Murray (2010)
★Barton (2011)
★North Beach (2011)
★University Montlake (2015)
★Hanford (2017)
★West Point (2018)
★Lander (2019)
★Michigan (2022)
★Brandon (2022)
★Chelan (2024)
★Connecticut (2026)
★King Street (2026)
★Hanford @ Rainier (2026)
★8th Avenue S. (2027)
★W. Michigan (2027)
★Terminal 115 (2027)
★3rd West (2029)
★Ballard (2029)
★11th Ave (2030)

1996 2000 2005 2010 2015 2020 2025 2030 2040

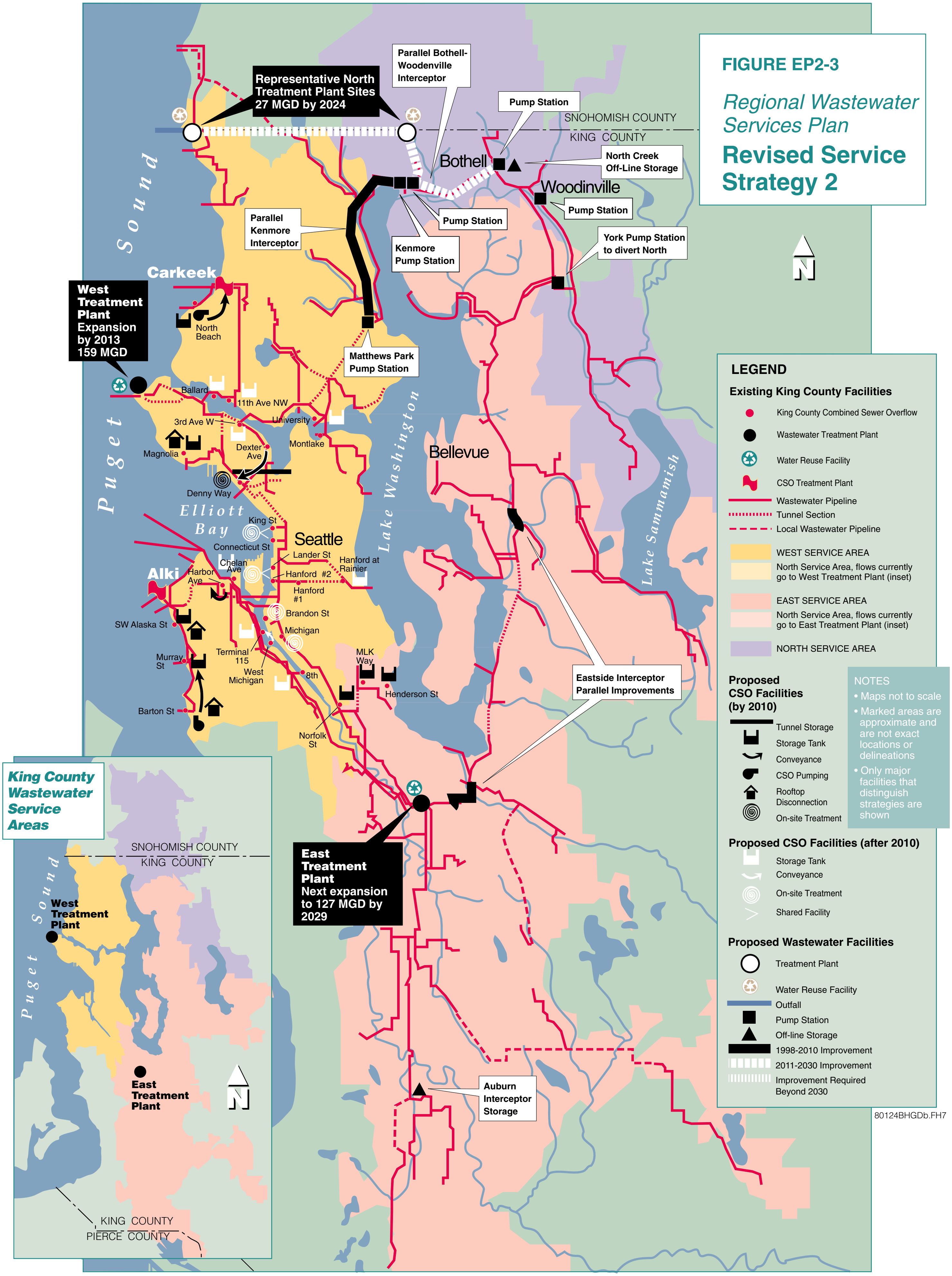


FIGURE EP2-3

Regional Wastewater Services Plan

Revised Service Strategy 2

SUMMARY OF KEY FEATURES OF REVISED SERVICE STRATEGY 4

Key Components of this Strategy:

- Maintain the existing two-treatment-plant system (West and East Plants)
- Expand West Plant to planned capacity of 159 mgd (2013)
- Expand East Plant in increments:

  Plant capacity of 135 mgd (2024)
  Plant capacity of 154 mgd (2037)
- Construct Kenmore-to-Duwamish deep tunnel for CSOs and wastewater in increments (2025)
- Implement CSO program to achieve one overflow event per outfall per year by 2030.
- Implement I/I incentives/surcharge program.
- Biosolids (Same as for SS1)
- Water Reuse (Same as for SS1)

The important features of Service Strategy 4 are shown in Figure EP2-4. Table EP2-3 shows the chronological sequence of projects under this service strategy.

Revised Service Strategy 4 splits the northern flows between the two existing treatment plants. However, flows that exceed the capacity of the existing Kenmore and Eastside Interceptors are conveyed south through a new deep tunnel underneath the City of Seattle. Eventually, the tunnel would be operated to optimize efficiency by routing variable flows to the East and West Treatment Plants.

The main differences between Service Strategy 4 in the draft RWSP and the revised Service Strategy 4 are the length and diameters of the tunnel. The length was initially proposed to be 18 miles. Under revised SS4 it would be about 15 miles. The initial diameters were 18 feet and 29 feet (for different segments). Under revised SS4 the diameters would be 12 feet and 19 feet.

Under revised service strategy 4, the planned capacity of the East Plant is smaller. It is expanded to an ultimate planned capacity of 154 mgd rather than 235 mgd.

Table EP2-3. Service Strategy 4
List of Capital Facilities (by year required on-line)

1996 2000 2005 2010 2015 2020 2025 2030 2040

Treatment Plant Projects

- ✷Increase West Point Capacity to 159 MGD (2013)
- ✷Increase East Plant Capacity to 135 MGD (2024)
- ✷Increase East Plant capacity to 154 MGD (2037)

Conveyance Projects

- ♦ESI-11 – Wilburton Siphon (1998)
- ♦Reuse Projects (1999)
- ♦ESI-1 (2000)
- ♦Trunk Improvements (1990-2000)
- ♦Increase York PS capacity to 68 MGD (2000)
- ♦I&I Reduction Programs (2003)
- ♦Auburn Interceptor Sections 1,2,3 (2004)
- ♦Trunk Improvements 2001-2010
- ♦North end of Kenmore to Thornton Creek Tunnel (2005)
- ♦Thornton Crk to University Tunnel (2013)
- ♦Trunk Improvements 2011-2020
- ♦Convey N. Creek PS flows to Kenmore (2017)
- ♦Modify York PS to pump 35 MGD north (2017)
- ♦Auburn Interceptor Storage (2020)
- ♦Off-line storage at Sunset Tunnel (2020)
- ♦Trunk Improvements 2021-2030
- ♦ETS Storage (2030)
- ♦Trunk Improvements (2031+)

CSO Projects

- ★Harbor (1998)
- ★Denny Way (2006)
- ★MLK Way (2008)
- ★Henderson (2009)
- ★Norfolk (2009)
- ★U+M to Kenmore Tunnel (2010)
- ★ S. Magnolia (2013)
- ★SW Alaska (2014)
- ★Murray (2015)
- ★Barton (2016)
- ★North Beach (2017)
- ★Ballard (2017)
- ★11th Avenue West (2019)
- ★West Point Improvements (2020)
- ★Chelan (2021)
- ★3rd W. Tunnel (2025)
- ★3rd W. Pump Station to WP (2025)
- ★Hanford, Lander, Connecticut, King to tunnel (2025)
- ★Michigan+Brandon to tunnel (2028)
- ★8th Ave. S (2029)
- ★W. Michigan (2029)
- ★Terminal 115 (2030)
- ★Hanford @ Rainier (2030)

1996 2000 2005 2010 2015 2020 2025 2030 2040

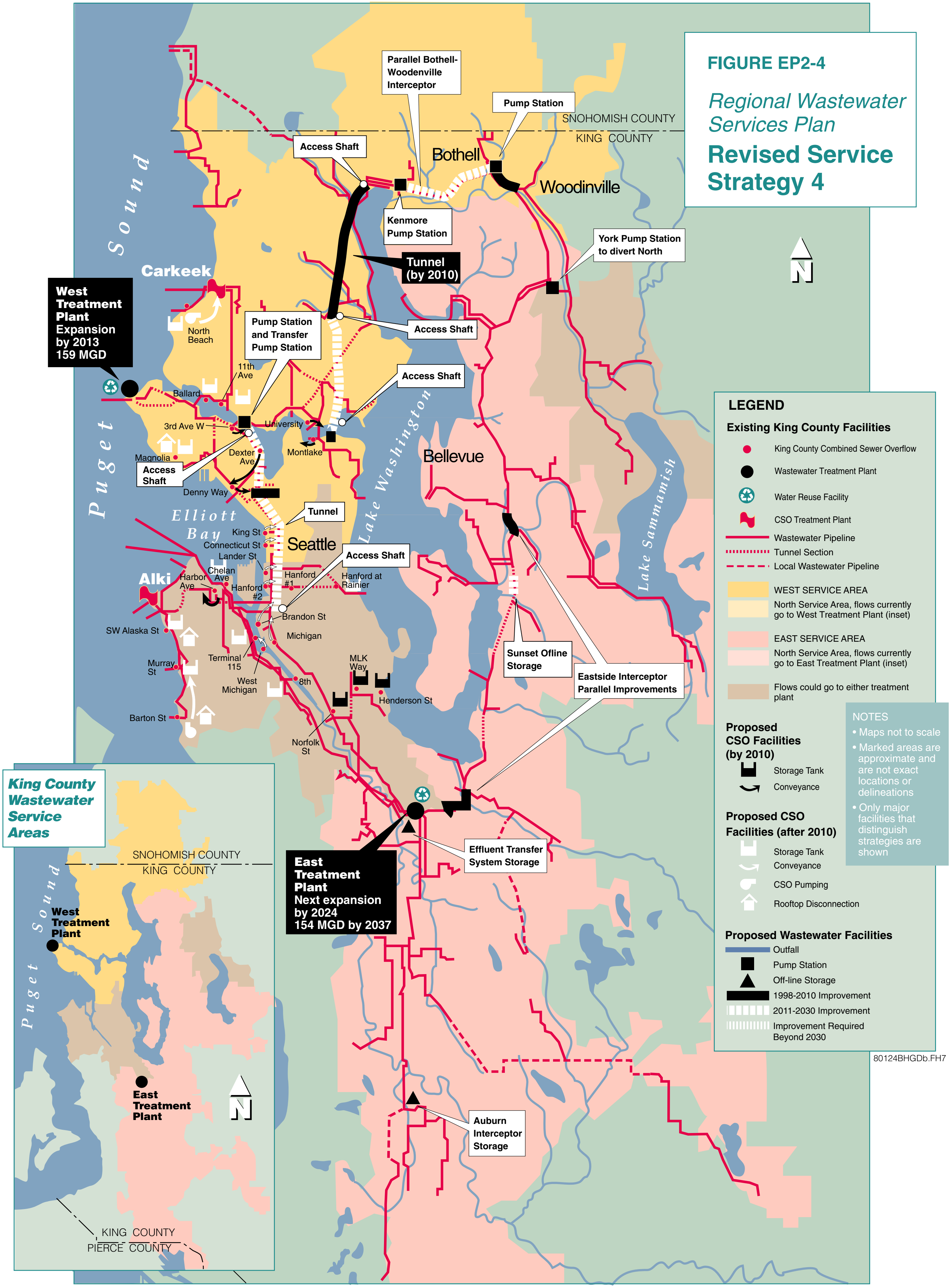


FIGURE EP2-4

Regional Wastewater Services Plan

Revised Service Strategy 4

80124BHGDb.FH7

ALTERNATIVE PHASING OF SERVICE STRATEGY 3

The County evaluated different facility phasing for Service Strategy 3 to attempt to optimize the overall cost, rate impact and benefits of the strategy. The facility phasing under so-called "Strategy 3B" reversed the order of treatment plant capacity additions so that the East Plant would be expanded before the North Plant was built. To control sewer backups in the northend, an additional parallel interceptor between Kenmore and Mathews Beach Park would also be needed, and the ultimate size of the East Plant would increase while the North Plant size decreased.

Although "3B" afforded potential near term cost savings, it was not carried forward because, relative to "3A", it has greater environmental impacts and less flexibility in the near term.

REVISED SERVICE STRATEGY COSTS

Table EP2-4A shows the net present value of each system strategy through 2050. Table EP2-4B compares the monthly rate impacts of the service strategies.

TABLE EP2-4A
Revised Strategy Costs (in $million)

Service Strategy	2030	2050
Executive's Preferred Plan	1,086	1,252
Revised System Strategy 1	789	881
Revised System Strategy 2	1,027	1,149
Revised System Strategy 4	1,218	1,335

All costs shown in 1998 net present value through 2050.

Table EP2-4B
Comparison of Levelized (average) Monthly Rate Impacts,[a]
1998 to 2030 (in 1998 dollars)

Rates	Service Strategy			
	1	2	3	4
Current	19.10	19.10	19.10	19.10
Average, 1998-2030	17.65	18.23	18.97	19.25
Maximum	19.94	19.96	21.46	21.55
Minimum	14.59	15.95	16.01	17.09

[a] Dollars/month for a single-family residence

Table EP2-5
Approximate Areas Disturbed and Volumes of Excavated Material [1]
Construction Impact Summary

Type of Facility	Executives Preferred Plan		Service Strategy 1		Service Strategy 2		Service Strategy 4	
	Area Disturbed (acres)	Volume Excavated (cubic yards) [2]	Area Disturbed (acres)	Volume Excavated (cubic yards)	Area Disturbed (acres)	Volume Excavated (cubic yards)	Area Disturbed (acres)	Volume Excavated (cubic yards)
Treatment Plants	28	1,000,000	17	880,000	20	860,000	17	880,000
Major Conveyances [3]	17	670,000	10	330,000	17	650,000	11	1,200,000
CSO Projects	9	1,000,000	5	1,600,000	12	940,000	1	1,600,000
Total	**54**	**2,670,000**	**32**	**2,810,000**	**49**	**2,450,000**	**29**	**3,680,000**

Notes: (1) Numbers for "areas disturbed" and "volumes excavated" are rounded.
(2) "Volumes excavated" include estimated volumes of preload material (East Plant) and a 30% swell factor.
(3) Major conveyances correspond to those listed in Table EP2-8.

Table EP2-6 Operational Trips (1) Service Strategies 1, 2, and 4							
VEHICLE TYPE	**FACILITY**						
	West Plant		**East Plant**				**North Plant[2]**
	Existing, Average/Day (133 mgd)	(159 mgd)	Existing, Average/Day (115 mgd)	(127 mgd)	(135 mgd)	(154 mgd)	(27 mgd)
CARS	320/day	380/day	330/day	375/day	385/day	440/day	65/day
TRUCKS	35/day	40/day	65/day[4]	75/day	75/day	85/day	7/day
BIOSOLIDS TRUCKS [3] (7 days a week)	12/day (6 loads)	Maximum of (13 loads)	10-12/day (5-6 loads)	12/day (6 loads)	12-14/day (6-7 loads)	14-16/day (7-8 loads)	2-4/day (1-2 loads)
Chlorine RAILROAD CARS	----------	----------	7/year	8/year	8/year	10/year	NA[5]

Notes: (1) Trips are one-way; figures are rounded. "One-way" is defined as a single direction trip to a single destination.
(2) Projected North Plant trips are based on existing West Plant trips to reflect most recent traffic volume data.
(3) Biosolids truck trips are one-way. Final conditions to the Shoreline Substantial Development Permit for upgrade to secondary treatment at West Point state that "the number of loaded sludge trucks shall not exceed 13 per day on average over a year period (January through December)." Thirteen truck loads per day equals 26 one-way truck trips as defined in Note (1).
(4) East Plant truck trip numbers include septage trucks which are not processed at the West Plant.
(5) Data not available.

Table EP2-7 Treatment Plants Construction Transportation Impact Summary					
Facility	**Potentially Affected [1] Roadways**	**Excavation Volumes [2] (cubic yards)**	**Total One-Way [3] Haul Truck Trips (16 cy/load)**	**Maximum Daily Haul Truck Trips (16 cy /load)**	**Total Construction [4] Related Trips (average/maximum per day)**
West Plant (133 mgd to 159 mgd)	• 15th Ave W • W Dravus St • 20 Ave W • Gilman Ave W • W Government Wy • Discovery Pk/Fort Lawton roadways	100,000	13,000	150-200	150-200/300-350
East Plant (115 mgd to 135 mgd)	• SW 7th St • Longacres Drive SW • Monster Rd SW • Oaksdale Ave SW • SW Grady Wy	300,000	38,000	125-150	100-150/200-250
East Plant (135 mgd to 154 mgd))	Same as East Plant (115 to 135 mgd)	280,000	35,000	125-150	100-150/200-250
East Plant (115 mgd to 127 mgd)	Same as East Plant (115 to 135 mgd)	220,000	28,000	90-115	80-125/150-200
North End Plant (0 mgd to 27 mgd)	Dependent on location.	300,000	38,000	150-200	150-250/300-350
North End Plant (0 mgd to 18 mgd)	Dependent on location.	200,000	25,000	100-150	100-150/200-250
North End Plant (18 mgd to 36 mgd)	Dependent on location.	150,000	19,000	100-150	100-150/200-250
North End Plant (36 mgd to 54 mgd))	Dependent on location.	150,000	19,000	100-150	100-150/200-250

Notes: (1) Roadways listed are major and/or principal affected roadways.
(2) Excavation volumes include estimates for preload material (East Plant) and a 30% swell factor; numbers are rounded.
(3) A one-way truck trip is defined as a single direction trip to a single destination; numbers are rounded.
(4) Construction related trips include haul truck, delivery, inspection, and worker trips.

Table EP2-8
Major Conveyance Facilities
Construction Transportation Impact Summary

Conveyance	Potential Affected Roadways [1]	Excavation Volumes [2] (cubic yards)	Total One-Way [3] Haul Truck Trips (16 cy/load)	Average Daily [4] Haul Truck Trips (16 cy /load)	Total Construction [5] Related trips (Average/day)
Auburn Interceptor (Sections 1, 2, 3)	• SR 167 • SR 516 • SR 181 • S 228th St • James St • W Meeker St • S 277th St • 37th St NW • 29 St NW	121,000	15,000	50-100	100-150
Tunnel (Kenmore to Mathews Beach Park)	• SR 522 • NE 175th St • 61st Ave NE • Sand Pt Wy NE	147,000	18,000	50-100	100-150
New Kenmore Pump Station (PS) to North End Plant (NEP).	Dependent on NEP location.	112,000	14,000	50-100	100-150
NEP Tunnel (NEP to Puget Sound)	Dependent on NEP location.	173,000	22,000	50-100	100-150
NEP Outfall	Dependent on NEP location.	22,000	3,000	50-100	100-150
Kenmore PS to North Creek PS	• I-405 • SR 522 • North Creek Pkwy • NE 195th St • NE 175th St • 68th Ave NE	61,000 - 96,000 (dependent on Service Strategy)	8,000 - 12,000	50-100	100-150
Deep Tunnel (Kenmore/Duwamish)	• I-90 • I-5 • SR 522 • SR 520 • SR 99 • SR 167	983,000	123,000	50-100	100-150

Notes: (1) Roadways listed are major and/or principal affected roadways.
(2) Excavation volumes are rounded to the nearest thousand and include a 30% swell factor; numbers are rounded.
(3) A one way trip is defined as a single direction trip to a single destination; numbers are rounded.
(4) Numbers for daily truck trips are based on a single construction site.
(5) Construction related truck trips include haul truck, delivery, inspection, and worker trips.

TABLE EP-2-9, REVISED SERVICE STRATEGIES
COMPARISON OF ENVIRONMENTAL IMPACTS

Elements of the Environment	Impacts Common to all Strategies	Executive's Preferred Plan (based on Service Strategy 3)		Revised Service Strategy 1		Revised Service Strategy 2		Revised Service Strategy 4		No Action	
		Construction	Operation	Construction	Operation	Construction	Operation	Construction	Operation	Construction	Operation
Earth	<u>Biosolids application</u>: Amending soils with biosolids improves soil tilth, reducing wind erosion. Federal regulations limit amount of biosolids applied, minimizing potential for metals buildup in soil. <u>Reuse of reclaimed water</u>: Constituents (e.g. metals) with the potential to build up in soils are not present in Class A reclaimed water in sufficient quantities to cause adverse impacts to soils.	**Areas of high potential for contaminated soils: Duwamish Valley, Kenmore, and Montlake.** **Pt. Wells, if used for North Plant or North outfall, has the potential for contaminated soils. Lesser potential along Eastside Interceptor Sec. 1 and 11.**	**<u>CSO</u>: Treatment of discharge and reduced frequency/volume of discharges overall will reduce deposition of contaminants in sediments near outfalls.**	Areas of high potential for contaminated soils: Duwamish Valley, Kenmore, Montlake. Lesser potential along Eastside Interceptor Sec. 1 and 11.	Same as EPP.	Same as EPP.	Same as EPP.	Areas of high potential for contaminated soils: Duwamish Valley, Kenmore, Montlake.	Greater improvement to sediments off CSOs than other service strategies because there would be fewer discharge events at many existing CSO points.	Least likelihood of impacts because only projects now planned or under development would be carried out.	Potentially greater impacts than all SSs because CSOs and sanitary sewer overflows would increase over time, increasing soil and sediment contamination.
Air	<u>Construction</u>: Potential fugitive dust and exhaust emissions at construction sites and along associated haul routes for all construction sites. <u>Operation</u>: Emission of Volatile Organic Compounds from treatment plants would increase with wastewater flow. Odor emissions would occur at some points along pipelines and tunnels, and at treatment plants. Odor at treatment plants depends on liquids and solids processing technologies selected.	**No specific additional impacts.**	**New North Plant and conveyance would generate odors; potential impacts would depend on site chosen.** **Increase in East Plant capacity would increase odor potential.**	Same as EPP.	Increased odor potential to sensitive odor receptors adjacent to West Plant (park, residences). This SS has the largest increase in capacity at East Plant, which would increase odor potential.	Same as EPP.	Same as EPP. Also increased odor potential to sensitive odor receptors adjacent to West Plant (park, residences).	Same as EPP.	Same as SS 1.	No impacts beyond projects now planned or under development.	Sewer overflows would contain odorous materials. Odor potential would be greatest from separated sewer system overflows; odors could persist until cleanup was complete.

Elements of the Environment	Impacts Common to all Strategies	Executive's Preferred Plan (based on Service Strategy 3)		Revised Service Strategy 1		Revised Service Strategy 2		Revised Service Strategy 4		No Action	
		Construction	**Operation**	**Construction**	**Operation**	**Construction**	**Operation**	**Construction**	**Operation**	**Construction**	**Operation**
Air (cont'd)	Biosolids: Musty odor from Class B biosolids for a short time after application. Reuse: Aerosols may be generated from spray applications; risks to health are negligible.										
Water	Construction: Impacts can include erosion from construction sites, causing sedimentation, increased turbidity, increased runoff, increased nutrients and chemicals in runoff and changes in receiving water temperature. Treatment Operation: Increased pollutant loading to Puget Sound, although all discharges would meet water quality standards, permit requirements and legal agreements. CSO Operation: Significant reduction in all pollutant loadings to receiving waters. I/I Operation: Small increases in surface water runoff and groundwater recharge. Slightly longer water residence times during wet weather in some areas that tend to accumulate water.	**Potential impacts due to North Plant conveyance would be localized because much of this conveyance would be tunneled. Areas most affected would be at and near tunnel portals. For any conveyance segments that are trenched, impacts could occur along these segments.** **Excavation for outfall construction would release sediments into the water column.**	**Treatment and Conveyance: More rapid flushing of effluent from Puget Sound than SS 1 and 4 because more flows routed through new North Plant outfall, which would discharge effluent flows into fast, northward-flowing upper water layer.** **CSO: Storage/ treatment improves water quality in Elliott Bay and Duwamish River. Improvement not as great as SS 4's storage and secondary treatment at East and West Plants.**	Involves construction of parallel Kenmore Interceptor in Lake Washington or on land. If in lake, this could result in construction impacts to lake water quality. Routes and/or construction methods could be chosen that minimized these impacts. If tunnel is used impacts would be localized near tunnel portals.	Treatment and Conveyance: Involves greatest discharge from East Plant outfall, which discharges to southward-flowing water layers (slower flushing from Puget Sound than at West Plant and potential North Plant outfalls). CSO: Same as EPP.	Potential impacts from North Plant conveyance would be similar to EPP. Impacts of Kenmore Parallel Interceptor would be same as for SS1.	Treatment and Conveyance: Most rapid flushing of effluent from Puget Sound because more flows routed through West and North Plant outfalls, which would discharge effluent flows into fast, northward-flowing upper water layer. CSO: Same as EPP.	Less potential impact on water than other SSs because most construction impacts would be associated with tunnel portals, which would be located mainly in urban areas away from water bodies.	Treatment and Conveyance: Similar to SS 1. CSO: Greatest improvement to Elliott Bay and Duwamish River because CSOs given higher level of treatment at regional treatment plants and are discharged through deep water outfalls.	No impacts beyond projects now planned or under development.	Least protection of Puget Sound water quality due to eventual occurrence of sewage overflows and increasing CSO discharges Overflows from separated sewer system would increasingly contaminate surface waters (streams and lakes) and ground waters. Increasing CSO discharges would contaminate Puget Sound and other surface waters such as the Duwamish River and the Lake Washington Ship Canal. Contamination would increase over time if no action were taken.

Elements of the Environment	Impacts Common to all Strategies	Executive's Preferred Plan (based on Service Strategy 3)		Revised Service Strategy 1		Revised Service Strategy 2		Revised Service Strategy 4		No Action	
		Construction	Operation	Construction	Operation	Construction	Operation	Construction	Operation	Construction	Operation
Water (cont'd)	<u>Biosolids</u>: Use of best management practices results in no probable adverse impacts to surface or groundwater quality. <u>Reuse</u>: By adhering to Washington interim standards, applying Class A reclaimed water would have no adverse impacts to water quality.										
Biological Resources	<u>Construction</u>: Adverse impacts on aquatic life through water quality effects described above. Adverse impacts on terrestrial life through habitat destruction or alteration associated with construction activities. Conveyance pipelines often located in lowland areas; could disturb streams or wetlands. <u>Biosolids</u>: Generally increases plant productivity. No adverse impacts to wildlife anticipated. <u>Reuse</u>: Adverse impacts to wildlife unlikely with Class A reclaimed water. If some constituents (e.g. sodium) accumulate, could adversely affect growth and/or appearance of some plants.	**Potential impacts to terrestrial life due to North Plant conveyance would be localized because much of this conveyance would be tunneled; some impacts could occur to terrestrial life near tunnel portals. For trenched segments localized impacts on terrestrial and riparian wildlife could occur near these segments. Impacts of new conveyance from Kenmore Pump Station to new plant would depend upon treatment plant site selected.** **Outfall construction in marine environment would disrupt aquatic habitat, including eelgrass beds, and associated biota.**	**<u>Treatment and Conveyance</u>: This strategy would route greatest amount of flows through the North Plant and outfall, reducing future discharges from the Duwamish outfall compared to SS1 and 4. Flushing from the Sound would be more rapid from the North Plant outfall (since discharges would be to upper water layers), reducing the potential for adverse impacts to biological resources as compared to strategies that direct greater flows to the Duwamish outfall (SS1 and 4).** **Increasing flows from East and new North outfalls could have localized adverse impacts on benthic organisms.** **<u>CSO</u>: Reduced**	Involves construction of parallel Kenmore Interceptor on land or in Lake Washington. If on land, localized impacts on terrestrial wildlife could occur. If in Lake Washington, in-water dredging would disturb fresh-water biota.	<u>Treatment and Conveyance</u>: This strategy would route greater flows through the Duwamish outfall than EPP and SS2. Flushing from the Sound would be slower from the Duwamish outfall (since discharges would be to lower water layers), increasing the potential for adverse impacts to biological resources compared to these strategies. Increasing flows from East and West Plant outfalls could have localized adverse impacts on benthic organisms. <u>CSO</u>: Same as EPP.	Same as EPP for North Plant conveyance and outfall.. Construction of parallel Kenmore interceptor would have same impacts as SS1.	<u>Treatment and Conveyance</u>: Similar to EPP, except more flows routed through West Plant and outfall. Combined discharges from North and West outfalls are greater (and discharge from Duwamish outfall is slightly less) than the other strategies. Flushing from the Sound would be more rapid from the West and North Plant outfalls (since discharges would be to upper water layers), with potential benefits similar to those of the EPP. Increasing flows from East, West and North Plant outfalls could have localized adverse impacts on benthic organisms. <u>CSO</u>: Same as EPP.	Less potential impact on biological resources than the other SSs because most construction impacts would be associated with tunnel portals, which would be located mainly in already-developed urban areas. No new outfalls required, so no marine construction.	<u>Treatment and Conveyance</u>: Outfall discharge impacts same as SS1. Increasing flows from East and West Plant outfalls could have localized adverse impacts on benthic organisms. <u>CSO</u>: Greatest improvement to habitat quality in Duwamish River, Elliott Bay, the Lake Washington Ship Canal and Puget Sound beaches because CSOs would no longer be discharged there, but treated and discharged from marine outfalls.	No impacts beyond projects now planned or under development.	Greatest potential for habitat degradation due to eventual occurrence of sewage overflows and increasing CSO discharges Overflows from separated sewer system would contaminate surface and ground waters. Increasing CSO discharges would contaminate Puget Sound and other surface waters such as streams and lakes. Contamination would increase over time if no action were taken. This contamination would degrade aquatic habitat value, adversely affecting plants and animals that use this habitat.

Elements of the Envi-ronment	Impacts Common to all Strategies	Executive's Preferred Plan (based on Service Strategy 3)		Revised Service Strategy 1		Revised Service Strategy 2		Revised Service Strategy 4		No Action	
		Construction	Operation	Construction	Operation	Construction	Operation	Construction	Operation	Construction	Operation
Biological Resources (cont'd)			**CSOs would improve local habitat quality in the Duwamish River, Elliott Bay, the Lake Washington Ship Canal, and Puget Sound off West Seattle and North Beach.**								
Public Services, Utilities and Energy	Construction: Construction of treatment and conveyance facilities would involve short-term increases in energy consumption (e.g., fossil fuels and electricity). Operation: New or expanded facilities would increase energy (primarily electricity) demands. Reuse: Irrigation with reclaimed water places less demand on potable water supplies, extending those supplies particularly in drought periods.	**No specific additional impacts.**	**Treatment: Estimated additional electrical energy requirement for treatment (not including conveyance) in the year 2030 would be about 39 million kWh per year.** **There is no projection at this time for energy production to offset energy consumed.** **Reclaimed water: Potential benefit to water supply in future because 3-plant system, with greatest ability to add satellite plants as needed, optimizes flexibility to provide reclaimed water in region.**	Same as EPP.	Treatment: Same as EPP, except that the projected additional energy requirement for this service strategy is 37 million kWh per year. Reclaimed water: 2-plant system offers less opportunity to provide reclaimed water in the future.	Same as EPP.	Treatment: Same as EPP, except that the projected additional energy requirement for this service strategy is 37 million kWh per year. Reclaimed water: Same as EPP.	Same as EPP.	Treatment: Same as SS 1. Reclaimed water: Same as SS1.	No impacts beyond projects now planned or under development.	No impacts beyond projects now planned or under development.
Environ-mental Health	All service strategies would substantially reduce the volume of wastewater pollutants in the environment by better CSO control. Biosolids: Adherence to federal and state regulations for recycling of biosolids results in no probable adverse impacts to environ-	**No specific additional impacts.**	**CSO storage/ treatment on Elliott Bay, Lake Washington Ship Canal and the Duwamish River improve protection of biological resources and human health. This protection not as great as centralized treatment and offshore discharge of CSO flows pro-**	Same as EPP.	Same as EPP.	Same as EPP.	Same as EPP.	Same as EPP.	All CSOs now discharging to Elliott Bay and the Duwamish River would be stored in the tunnel and routed to East or West Plant for treatment. This strategy would provide the greatest reduction in pollutant loadings to the Lake Washington Ship Canal, Elliott Bay	No impacts beyond projects now planned or under development.	Greatest potential for adverse impacts to human health through contact with, or ingestion of pollutants, due to eventual occurrence of sewage overflows and increasing CSO discharges. Overflows from separated sewer system would contaminate surface and

Elements of the Environment	Impacts Common to all Strategies	Executive's Preferred Plan (based on Service Strategy 3)		Revised Service Strategy 1		Revised Service Strategy 2		Revised Service Strategy 4		No Action	
		Construction	Operation	Construction	Operation	Construction	Operation	Construction	Operation	Construction	Operation
Environmental Health (cont'd)	mental health from exposure to pathogens, trace metals or organic compounds. Reuse: Treatment to Class A quality removes sufficient contaminants from wastewater such that reuse would pose a negligible risk to public health.		**vided under SS 4. The Water Quality Assessment will determine the significance of this reduction in terms of benefits to Environmental Health.**						and the Duwamish River compared to SSs 1and 2 and the EPP.		ground waters. Overflows could also release sewage to streets and basements. Increasing CSO discharges would contaminate Puget Sound and other surface waters. Increased contamination over time if no action were taken, increasing potential for human contact with disease-causing organisms in sewage.
Noise	Construction: Temporary localized noise impacts from operation of heavy equipment. Operation: Varying levels of operational noise at treatment plants and pump stations.	**Potential construction noise impacts at new North Plant site. Potential impacts would depend on site chosen.**	**Would add North Plant as potential new noise source, with potential impacts dependent on site chosen.** **Landscape buffering would minimize operational noise impacts at East Plant.**	Construction noise at West Plant could affect sensitive noise receptors, including residences, park users.	Operational noise impacts at West Plant site should be minor due to ambient site background noise (water and wind). Truck noise would be heard in Discovery Park and at residences along Government Way. Landscape buffering would minimize operational noise impacts at East Plant.	Same as EPP, plus construction noise impacts at West Plant site as for SS1.	Same as EPP for North and East Plants. In addition, noise impacts at West Plant as described for SS1.	Same as SS 1.	Same as SS 1.	No impacts beyond projects now planned or under development.	No impacts beyond projects now planned or under development.
Land & Shoreline Use	Construction: Potential temporary impacts on access/use of some properties. Operation: Conversion of land to sewage treatment use (pipeline alignments, CSO tanks/treatment plants). Biosolids: Biosolids that are beneficially reused as a soil amendment/fertilizer are compatible with agricultural and forest land use. Com-	**Construction of North plant conveyance (including outfall) would have temporary shoreline impacts. Construction impacts on shoreline if North Plant sited on shoreline.** **Land use impacts of constructing tunneled portion of the North Plant conveyance would concentrate impacts at portals. For trenched segments,**	**New North End plant would have long-term impacts on land use. Compatibility with zoning and shoreline regulations would depend on location selected for plant and outfall.**	Construction of Kenmore Interceptor parallel could temporarily affect access to shorelines. Construction impacts on shoreline from construction of West Plant expansion.	Existing treatment plants would be expanded within existing property boundaries. West Treatment Plant is located in single-family zone. Some expansion facilities would be located in the conservancy management shoreline zone. Expansion would require a Council conditional use permit from the City of Seattle and adher-	Similar to EPP for treatment plant construction, but adds impacts of West Plant construction as described for SS1. Land use impacts of North Plant conveyance as for EPP. Construction of parallel Kenmore Interceptor, and conveyance associated with the North End plant (including outfall) would have temporary shoreline im-	Impacts from new North plant same as for EPP. Impacts from West plant expansion same as for SS1.	Treatment and Conveyance: Treatment plant construction impacts as for SS1. Tunnel impacts would be temporary and at few locations (i.e., tunnel portals). CSO: Fewer CSO construction impacts because Elliott Bay and Duwamish CSOs would be routed through the large tunnel.	Existing treatment plants would be expanded within existing property boundaries as for SS1. No Kenmore Interceptor parallel.	No impacts beyond projects now planned or under development.	King County would fall out of compliance with the State Growth Management Act, which requires plans for capital facilities, including utilities, to meet projected demands of population growth. Building moratoria could be imposed if wastewater treatment capacity were insufficient, hampering future development in the region.

Elements of the Environment	Impacts Common to all Strategies	Executive's Preferred Plan (based on Service Strategy 3)		Revised Service Strategy 1		Revised Service Strategy 2		Revised Service Strategy 4		No Action	
		Construction	Operation	Construction	Operation	Construction	Operation	Construction	Operation	Construction	Operation
Land & Shoreline Use (cont'd)	posted Class A biosolids compatible with home garden and large scale landscaping use. Reuse: Reuse of Class A reclaimed water does not require land use restrictions although irrigated areas may be restricted to nighttime applications to reduce the potential for human exposure.	**any required crossings of major streams could temporarily impact shoreline access.**			ence to 1991 West Point settlement agreement.	pacts.					
Recreation	Reuse: Class A reclaimed water is state-approved for irrigating parks, playfields and golf courses; potential adverse impacts are negligible. Beneficial impacts include enhanced plant (turf) growth and less reliance on existing water supplies, especially during drought when irrigation with potable water may be restricted or banned.	**Treatment and Conveyance: Temporary impacts could occur during construction of a North Plant and its conveyance, depending on sites selected.** **CSO: Storage tank/treatment facility construction could temporarily disrupt use of some playgrounds, ballfields or parks.**	**Treatment and Conveyance: North Plant is not expected to adversely affect recreational uses but this won't be known prior to site selection process. Potential beneficial impact to recreation through provision of open space in park-like buffer around new plant.** **CSO: Some recreational space at Lowman Beach Park could be eliminated by Murray Avenue CSO control project.**	Treatment and Conveyance: West Plant expansion would temporarily disrupt recreation on beach at West Point. Kenmore Interceptor parallel could temporarily disrupt use of Burke-Gilman Trail, parks and some northwest Lake Washington boating areas. CSO: Same as EPP.	Treatment and Conveyance: Minimal long-term impacts on recreation. Some recreational space at Matthews Beach Park could be eliminated due to expansion of pump station associated with Kenmore Interceptor parallel. CSO: Same as EPP.	Treatment and Conveyance: Impacts would include those described under SS 1 and EPP. CSO: Same as EPP.	Treatment and Conveyance: North plant impacts same as described for EPP. Kenmore Interceptor parallel impacts same as described for SS1. CSO: Same as EPP.	Treatment and Conveyance: Similar to SS 1 except no Kenmore Interceptor parallel and most impacts at tunnel portals. CSO: Impacts may be less than under other SSs because fewer tanks/treatment facilities to be built.	Treatment and Conveyance: Probably involves the least impact because no Kenmore Interceptor parallel and East and West Plants remain within existing boundaries. CSO: Impacts may be less than under other SSs because fewer tanks/treatment facilities to be built.	No impacts beyond projects now planned or under development.	Greatest potential for adverse impacts to recreational resources due to eventual occurrence of sewage overflows and increasing CSO discharges Overflows and increasing CSO discharges would contaminate waters and beaches used for recreation, adversely affecting recreational use.
Aesthetics	Conveyance and Treatment: Temporary aesthetic impacts during construction (e.g., dust, noise, disruption). Biosolids: Biosolids applications typically	**No specific additional impacts.**	**Treatment and Conveyance: The new North Plant would change the aesthetic character of its surroundings. The plant's aesthetic compatibility would depend on**	Same as EPP.	Treatment and Conveyance: This SS would result in few long-term aesthetic changes, except that the size of the developed areas within existing plant sites would be greater.	Same as EPP.	North Plant impacts same as for EPP. Expansion of developed area at East and West Plant impacts same as for SS1.	Treatment and Conveyance: Probably the lowest magnitude of aesthetic impacts from construction because impacts would be mostly at tunnel portals and at existing treatment	Same as SS 1.	No impacts beyond projects now planned or under development.	Greatest potential for adverse impacts to aesthetics due to eventual occurrence of sewage overflows and increasing CSO discharges Overflows and in-

Elements of the Environment	Impacts Common to all Strategies	Executive's Preferred Plan (based on Service Strategy 3)		Revised Service Strategy 1		Revised Service Strategy 2		Revised Service Strategy 4		No Action	
		Construction	Operation	Construction	Operation	Construction	Operation	Construction	Operation	Construction	Operation
Aesthetics (cont'd)	occur on low visibility agricultural or forest land sites, so there would be little adverse impact. Biosolids applications support revegetation of logged areas, improving the aesthetic appearance.		**the character of surrounding land uses.** **At the East Plant expansion of existing facilities would not depart substantially from the aesthetic character of those facilities prior to expansion.** **<u>CSO</u>: Facilities would have little aesthetic impact because they would be either mostly underground or in industrial areas.**		Expansions of existing facilities would not depart substantially from the aesthetic character of those facilities prior to expansion. <u>CSO</u>: Same as EPP.			plant sites. <u>CSO</u>: Most of the CSO facilities proposed under the other SSs would not be constructed, since the associated CSO flows would be directed to the large tunnel.			creasing CSO discharges would have adverse aesthetic impacts including odors and unsightly material deposited in streets, basements and water bodies.
Transportation	<u>Conveyance and Treatment</u>: Temporary construction traffic at facility construction sites. Excavation and concrete pouring generate greatest concentrations of truck trips at treatment plant sites. <u>Biosolids</u>: Biosolids haul trips would increase commensurate with flow increases. These comprise a small percentage of total treatment plant trips but typically use larger tractor/trailer combinations. <u>I/I</u>: Control program would result in construction traffic in neighborhoods.	**Much of North Plant conveyance would be tunneled, with construction vehicle trips concentrated at portals, where large volumes of localized truck traffic would occur.** **Trenched sections would increase truck traffic wherever construction is taking place at any given time.**	**Relatively small operation impacts due to small number of staffed facilities. Addition of staffed North Plant and biosolids-related traffic would increase trips generated systemwide. Most trips to and from treatment plants occur outside of peak traffic hours.**	Kenmore interceptor parallel construction would generate large volumes of localized truck traffic, and if a lake line is built, would require barges on Lake Washington. Lake construction could interrupt boat traffic.	Fewer staff trips systemwide than EPP because of fewer treatment plants. Biosolids haul trips more concentrated because only being hauled from two plants, instead of three as in EPP.	Conveyance construction impact same as for SS1 (Kenmore interceptor parallel) and EPP (North Plant conveyance).	Similar to EPP, but more traffic generated at expanded West Plant and less traffic at the smaller North Plant.	Probably less widespread construction impact than the other three SSs. Construction vehicle trips would be localized at/near portals.	About the same operation impacts as SS 1.	No impacts beyond projects now planned or under development.	No impacts beyond projects now planned or under development.

Elements of the Environment	Impacts Common to all Strategies	Executive's Preferred Plan (based on Service Strategy 3)		Revised Service Strategy 1		Revised Service Strategy 2		Revised Service Strategy 4		No Action	
		Construction	Operation	Construction	Operation	Construction	Operation	Construction	Operation	Construction	Operation
Cultural Resources	Known cultural resources at West Plant, Lake Washington shoreline, East Plant, Elliott Bay shoreline and the Eastside Interceptor corridor.	**Moderate potential to encounter cultural resources because paralleling of the Eastside Interceptor would be minor (Secs. 1 and 11) and much of North Plant conveyance would be tunneled. East Plant expansion may also encounter buried cultural resources.**	**No operational impacts to cultural resources.**	This SS has potentially the most likelihood of encountering cultural resources because it requires more construction in areas of known cultural resources (West Plant expansion, East Plant expansion, Kenmore Interceptor parallel).	Same as EPP.	Similar to SS1.	Same as EPP	Probably least potential to encounter unknown cultural resources because the large tunnel is deep. Potential to encounter cultural resources at East and West Plants.	Same as EPP.	No impacts beyond projects now planned or under development.	No impacts beyond projects now planned or under development.

CHAPTER EP-3
SUMMARY OF PUBLIC COMMENTS

This section summarizes public comments gathered during the formal 90-day comment period for the Draft RWSP and Draft EIS, and from public opinion research conducted from June through September, 1997. The full text of comment letters and public hearing testimony is contained in the *Public Comments and Responses* appendix to this Final EIS. The public opinion research is described in detail in the *Public Opinion Summary* (King County, 1997).

Public comment on the Draft RWSP, Draft EIS and Draft Financing Plan included letters, hearing testimony, and mailback forms from 75 commenters including cities, state and federal agencies, citizens, tribes, environmental/community groups, business interests, sewer and water districts, and other organizations.

The public opinion research first involved focus groups with 68 residents representing a cross section of the King County population, followed by an extensive telephone survey with 736 randomly selected residents from King and Snohomish Counties.

The public opinion research respondents were selected to represent a cross section of citizens in King and Snohomish counties. Most respondents had no previous experience with or interest in wastewater issues. Respondents were asked very specific questions in focus groups and in a telephone survey. These questions were designed to gauge community attitudes about wastewater issues. Because of the method used to select respondents, their comments can be assumed to reflect the attitudes of the general population in the service area.

The commenters addressing the RWSP documents include citizens, agencies, and other organizations with significant expertise and interest in wastewater issues. Commenters wrote or testified on their own initiative; they spoke directly to the strategies and options presented in the draft plan, and to the potential outcomes and consequences of different decisions. Their comments are not necessarily considered to be representative of the entire King County population.

Key Findings

Following are the key findings from the public comments and the public opinion research organized under major headings pertinent to the RWSP. For each category, a bullet highlights the key findings interpreted from each source of public opinion: a diamond (♦) represents findings from the public opinion research, and a dot (•) represents findings from the formal comments about the RWSP documents.

Water Quality

- ♦ A majority of respondents in both the focus groups and telephone survey expressed significant concern about water quality in this region; fifty-six percent of respondents said they would be willing to pay higher sewer rates to prevent water quality problems.

- Commenters felt overall that King County should work to preserve and improve water quality in Puget Sound and other waterbodies.

Treatment and Conveyance

- ♦ Forty-six percent of respondents said that areas with existing wastewater plants should not have to accept additional negative impacts of expanding those plants; about 38 percent support the idea of expanding existing plants.

- Commenters supported the three-plant strategies with specific support of Service Strategy 3, which adds a third treatment plant and forms the basis for the Executive's Preferred Plan.

- Several commenters questioned the feasibility of expanding the West Treatment Plant within the constraints of the West Point Settlement Agreement.

Combined Sewer Overflows (CSOs)

- ♦ Over 75 percent of respondents said King County should prevent the release of diluted raw sewage into Puget Sound, rivers, and lakes, even if it cost $1.50 more per month in sewer rates.

- Commenters showed only limited support for reducing efforts to meet the CSO control goal of one event per location per year; tribes and state/federal regulators were strongly opposed to any reduction in efforts to meet this goal.

Biosolids

- ♦ Eighty-four percent of respondents supported some level of biosolids recycling; 46 percent said we should continue to recycle biosolids as soil amendments, and another 38 percent felt we should invest funds to treat biosolids to a higher degree for wider recycling opportunities.

- There was general support among commenters for biosolids recycling with sentiment for maximizing economic return on biosolids to benefit ratepayers.

Water Reuse

- Sixty-one percent of respondents either strongly support (22 percent) or somewhat support (39) percent) discharging treated water to Lake Washington to offset the amount of water used to operate the Ballard Locks.

- Many commenters expressed interest in reclaimed water and a desire to further investigate potential projects or uses.

Inflow and Infiltration

- Nearly 60 percent of respondents said that we should all pay to bring older pipes up to standard; thirty-three percent said the local sewer agencies should fix their own pipes.

- There was broad support among commenters for inflow and infiltration control; many advocated an aggressive inflow and infiltration reduction program.

Costs

- Thirty-eight percent of respondents felt that costs to upgrade the system should be paid primarily by residents of new homes and businesses; forty-five percent support a surcharge of “a little more” for new residents and businesses.

- Commenters supported the concept of “growth paying for growth” and to increase the county’s capacity charge, but they were not in consensus on how this should be done or how much the charge should recover.

PART II: Full Text of Draft EIS, Revised in Response to Comments

CHAPTER 1
SUMMARY

PROPOSAL AND OBJECTIVES

King County is proposing a sewer comprehensive plan for the regional wastewater service area for the next 40 years. This plan, the Regional Wastewater Services Plan (RWSP), evaluates several means of providing wastewater treatment and related services to this rapidly growing region during that time. These services consist mainly of improvements related to wastewater treatment and conveyance (pipes), combined sewer overflow (CSO) control, and biosolids management. The RWSP also considers opportunities for water reuse. The adopted plan will amend the county's Water Pollution Abatement Plan, which is the sewer comprehensive plan for the King County system.

The primary objective of the RWSP is to help the public and decision-makers guide King County toward a long-term wastewater management strategy to protect water quality and public health until 2030 and beyond. With the exception of some service strategy options, the RWSP is intended to meet all existing applicable regulatory requirements. The RWSP seeks to meet these objectives in as cost-effective a manner as possible.

The Draft RWSP, issued in May 1997, identified four representative alternatives to meet its objectives. These are termed Service Strategies. Each Service Strategy consists mainly of a system of wastewater treatment plants, conveyance facilities, and CSO control facilities that will meet the region's increasing need for wastewater services over the life of the RWSP. The location and size of those treatment plants vary, as do the associated facilities necessary to convey wastewater for treatment and to discharge treated effluent. Each service strategy also includes a representative option for processing and recycling biosolids, a water reuse program, and a program for reducing the infiltration and inflow of groundwater and stormwater into the wastewater conveyance system.

The service strategies fall into two basic groups according to the treatment plants they include. Service Strategies 1 (SS1) and 4 (SS4) include expanding only the County's two existing treatment plants. Service Strategies 2 (SS2) and 3 (SS3) add a new North Treatment Plant and expand one or both of the existing plants (East and West). SS1 expands both the West and East Treatment Plants, while requiring the greatest increases in existing conveyance line capacities.[4] SS4 similarly expands both plants, but calls for construction of a series of large storage and conveyance tunnels north and west of Lake Washington. These tunnels connect to both plants. SS2 and SS3 both include con-

[4]Because this document makes repeated references to components of the existing and proposed wastewater treatment system such as the West Point Treatment Plant, and the East Section Reclamation Plant at Renton, a standardized naming convention was adopted as presented below.

Actual Name	Standardized Name
The West Point Treatment Plant	The West Treatment Plant
The West Division Service Area	The West Service Area
The East Section Reclamation Plant at Renton	The East Treatment Plant
The East Division Service Area	The East Service Area
The North End Treatment Plant	The North Treatment Plant
The North End Service Area	The North Service Area

struction of a North Treatment Plant in north King or south Snohomish County. Key differences between these two strategies are the size of the plant and the expansion of the existing West Treatment Plant under SS2, but not under SS3. Under both SS2 and SS3, the North Plant would treat wastewater flows from the area north and east of Lake Washington (expected to be one of the region's fastest growing areas) and discharge them through a new outfall in north King or south Snohomish County. Construction of this plant would reduce the need to increase the combined capacity of the two existing plants and their associated conveyance facilities.

In addition to the four basic service strategies, the Draft RWSP examined a variety of options that could be pursued to modify one or more of the service strategies to achieve particular objectives.

Three documents were issued for review in May 1997. The Draft Environmental Impact Statement (DEIS), the revised text of which is repeated here, provided an analysis of environmental impacts associated with proposals included in the RWSP. It is a companion to the Draft Plan. The third document is the Draft RWSP Financing Plan, which provided detailed information about cost assumptions and projections.

PURPOSE AND NEED FOR THE PROJECT

King County has planned for necessary wastewater capacity improvements since 1958, when the regional wastewater treatment system was established. Since then, the 1958 Water Pollution Abatement Plan has been amended several times to provide facilities needed to avoid wastewater overflows. Amendments made in the 1980s resulted in upgrading the West Service Area system to provide secondary treatment (but not adding treatment capacity) and expanding capacity at the East Treatment Plant to 115 mgd.

Through our current planning, we project that King County's wastewater system will run out of capacity in about 10 years, and some components are already at capacity as evidenced by recent overflows during storms. If population growth and economic development continue at projected rates, and new wastewater facilities are not in place as planned, there will be a number of adverse impacts on public health and water quality. These impacts could reduce the quality of life the region has thus far enjoyed.

Given that it can take up to 10 years to site, permit, design, and construct major wastewater facilities, decisions about future wastewater management must be made very soon.

This long-range plan is not intended to be an exact blueprint for construction. Instead, it is a guide or a road map for decision-makers to evaluate the potential results of various service strategy options. Although the plan will ultimately include dates when it is anticipated that new facilities will be needed, King County will track both regional growth and wastewater flows to make sure that appropriate facilities are built at the right time.

More specific discussions of needs in the major sectors of the wastewater system follow. Categories include wastewater treatment and conveyance, CSO control, biosolids management, and water reuse.

Wastewater Treatment and Conveyance

When current construction activities at the East Treatment Plant are completed, the average wet weather flow (AWWF) treatment capacity of the King County system (consisting of the combined capacity of the West and East Treatment Plants) will be 248 million gallons per day (mgd). Based on current projections, an additional 35 mgd system capacity will be needed by 2030. Planned capacity increases would add 38 mgd to system capacity before that year, bringing this capacity to 286 mgd. Additional planned capacity increases beginning in 2030 would add 36 more mgd, bringing system capacity to 322 mgd by the year 2040. The RWSP identifies the facilities needed to provide this capacity.

The Draft Plan and EIS were based on an earlier set of projections. Based on those projections, an additional 57 mgd system capacity would be needed by 2030 (bringing total capacity to 305 mgd), and 146 more mgd would be needed by the time the urban growth area is built out in about 2050 (bringing total capacity to 394 mgd).

Combined Sewer Overflow Control

CSOs occur during wet weather when combined sewers which collect both sanitary sewage and stormwater runoff overflow into the closest surface water body. They occur when the flows in the system exceed the capacity of the wastewater collection system to convey the dilute wastewater to facilities for treatment. Remedies for this situation include providing temporary storage, or storage and treatment for excess flows.

The RWSP includes CSO facilities needed to reach the state mandate of one overflow event per outfall per year. CSO levels in the King County system will have to be reduced 85 percent from 1981 to 1983 (baseline) levels to reach this goal.

Biosolids Management

Biosolids is a term for treated wastewater solids of high enough quality for reuse in the environment (e.g., as a fertilizer). More wastewater from a growing population and the recent addition of secondary treatment facilities at the West Treatment Plant will produce a substantial increase in biosolids volumes in the service area. Current projections are for biosolids volumes to nearly double between now and 2030.

This increase in solids will require facilities to process the raw sludge coming from the primary and secondary treatment phases into biosolids. Additional end users will have to be identified to reuse the biosolids. Biosolids processing facilities and end uses for the additional material are identified in the RWSP.

Water Reuse

The rising demand for water and concerns related to recent summers of drought caused King County to conduct a study of the potential demand for reclaimed water (King County, 1995). Because of the region's expected population growth in the next 30 years, regional water supply agencies have focused their long-term planning on a broad range of strategies to meet future water demands. Among the alternatives for additional non-potable (i.e., not drinkable) water supply is the wastewater from King County's sewage treatment plants. Treated effluent is suitable for a range of nonpotable uses such as irrigation, heating and cooling, and industrial processes. The King County study estimates the potential market for, and economic feasibility of, supplying reclaimed water to potential customers. The study also supports the other three system elements of the RWSP (wastewater treatment and conveyance, combined sewer overflow, and biosolids) because it provides data that could be useful to those making decisions on the locations of future treatment plants and pump stations that might also serve as sources of reclaimed water.

There is also the opportunity to investigate discharging highly treated reclaimed water to surface waters allowing water to be withdrawn elsewhere as a water supply source. Highly treated reclaimed water could also be used to recharge depleted groundwater. Both of these uses of reclaimed water would require changes in state laws.

SCOPE OF THIS FEIS AND FUTURE ENVIRONMENTAL REVIEW

This FEIS has been prepared pursuant to the State Environmental Policy Act (SEPA) (Chapter 43.21C Revised Code of Washington [RCW]), the SEPA rules (Washington Administrative Code [WAC] 197-11) and King County's SEPA procedures (King County Code [KCC] 20.44). This FEIS addresses the probable significant adverse environmental impacts and mitigation measures associated with implementing the RWSP service strategies under consideration and with other proposed service strategy options. This FEIS is a "programmatic" document, with the level of detail needed to support a Metropolitan King County Council decision on the comprehensive plan amendment. The programmatic EIS is the first step of a "phased review" as provided for in SEPA (WAC 197-11-060[5]). As projects included in the RWSP approach implementation, appropriate project-level environmental review will be conducted.

PUBLIC AND AGENCY REVIEW

King County conducted the SEPA scoping process in the fall of 1994. A SEPA Determination of Significance and scoping document was issued on September 1, 1994, as required by SEPA. A legal notice of the scoping effort was published in the Seattle Times and other local newspapers on that date. Approximately 2,000 people received a copy of the scoping document. The public review and comment period started on September 1 and ended on October 15, 1994.

Six scoping open houses were held during September 1994 in King County. Two were held in downtown Seattle, and one each was held in the Georgetown area, Renton, Auburn, and Bothell. The scoping open houses were formatted to allow the public an opportunity to ask questions of King County staff and examine exhibits and handouts. King County received 69 written comments: 17 from government agencies, 7 from private organizations, and 45 from citizens.

The draft EIS was issued to provide environmental information to the public and agencies and to solicit comments on the proposals and issues discussed in the RWSP. During the 90-day public review period, King County held public meetings and public hearings to receive comments on the RWSP and the draft EIS.

This Final EIS is intended to complete the environmental process for a Comprehensive Water Pollution Abatement Plan amendment. Part I presents the Executive's Preferred Plan and its environmental impacts, as well as a discussion of planning assumptions that have changed in the year since the draft RWSP was issued. Part II includes the entire text of the Draft EIS, revised in response to public comments. In the chapters that follow, revised text is shown in italics.

NOTE: The flow volumes and service strategy descriptions in Part II are as originally presented in the Draft Plan and EIS, and therefore do not reflect revised assumptions for flow volumes and facility size. Part I details those changes. The impacts of the revised system strategies, including the EPP, are of the same or a lesser magnitude than the analysis presented in Part II, presenting a worse-case analysis of impacts.

AREAS OF CONTROVERSY AND ISSUES TO BE RESOLVED

Inter-County Cooperation

King County met with neighboring cities and wastewater districts to evaluate the potential for flow transfers between the County and nearby utilities that might benefit both parties. Tacoma and Pierce County appear to provide options to receive and treat flows from the King County system. The costs of constructing and operating a transfer system to Pierce County would have to be compared to the benefits related to the reduction in both East Treatment Plant expansion and conveyance expansion in the southern service area. To know if such a flow transfer would be cost-effective for King County, the full cost of building and operating the conveyance system, plus paying another entity for treatment and discharge, would have to be evaluated. Additionally, the impacts of the transfer system and discharge to south Puget Sound would have to be evaluated.

Shared treatment plants between counties may provide for cost-efficient wastewater treatment for all parties. As part of the RWSP, King County is working with south Snohomish County wastewater service providers to assess interest and mutual benefits that could be realized from cooperatively siting and operating a treatment plant.

Ability to Obtain Permits for West Point Treatment Plant Expansion

When the West Treatment Plant was upgraded to provide secondary treatment, there was a lengthy, complex, and controversial planning and permitting process before the City of Seattle and other regulatory agencies granted approval. The treatment plant is located in a single-family residential zone, and partially in the shoreline zone. This requires Shoreline Substantial Development and Council Conditional Use permits. Such permits are based on a finding that there is no feasible alternative to locating the treatment plant in a residential zone or shoreline location. The City Council made such a determination with respect to the upgrade of the West Treatment Plant to secondary treatment. In large part, this determination reflected the substantial cost difference between upgrading the West Treatment Plant and any alternative that avoided a shoreline location. Alternatives considered included a new treatment plant in the Duwamish industrial area or in the Interbay area. Either alternative would have required construction of an entirely new treatment plant and substantial additional costs to construct new collection system pipelines to direct flows to the new plant and a new outfall to Puget Sound.

The City of Seattle's permit process was conducted in two phases: plan-level and project-level reviews. The plan-level permit was issued after a finding that no feasible alternative to the West Point site existed, and it included a number of conditions relating to environmental impact reduction. The plan-level zoning and shoreline permits were appealed through the courts and the Shorelines Hearing Board by a coalition of groups and individuals opposed to the West Treatment Plant upgrade. The courts and the Shoreline Hearings Board decided to support the 1991 Settlement Agreement that was reached with the coalition to avoid appeal of that permit and other key permits and approvals.

The Settlement Agreement required that Metro contribute additional funds to a community impact fund that had been established in the plan-level permit decision. In addition, Metro agreed to several conditions, including pursuing an applied wastewater treatment program to explore technologies that could reduce the plant footprint and an agreement that any future expansions would not expand the plant footprint beyond the permitted 32 acres or increase pollutant loadings discharged to Puget Sound beyond the level permitted for a 133-mgd plant.

Expansion of the West Treatment Plant under the RWSP would require the same two-phase permitting process and have to meet the same feasibility tests as the upgrade to secondary treatment. It would also have to adhere to the terms of the 1991 Settlement Agreement.

The City of Seattle plan-level permit for the West Point secondary treatment upgrade is included as an appendix to this EIS, bound separately as Appendix K. The 1991 Settlement Agreement and City of Seattle project-level permit are bound into this volume as Appendix I and Appendix J, respectively.

Changes to Environmental Regulations

Regulations governing King County's wastewater treatment and conveyance facilities may change over time. In the early l980s, for example, Metro was required to add secondary treatment to all of its Puget Sound treatment plant service areas, which, at that time, discharged primary-treated wastewater. Most of the facilities needed to implement the secondary treatment requirement began operating in 1995.

Steps taken by the federal government under the Endangered Species Act (ESA) could also affect King County's wastewater programs. In February 1998, the National Marine Fisheries Service proposed listing the Puget Sound Chinook salmon as a threatened species under the ESA. King County is working in cooperation with Pierce and Snohomish Counties and local governments to develop a response to the listing that will allow the area to thrive economically while enhancing and improving salmon habitat. The Executive's Preferred Plan provides the flexibility to modify our facilities and programs to address changing conditions. For example, the EPP would allow production and use of reclaimed water to augment regional water supplies, thereby benefiting salmon streams by avoiding additional withdrawals for drinking water. (The County will conduct detailed studies to determine the feasibility of discharging highly treated reclaimed water to Lake Washington and the Ship Canal for the purpose of protecting in-stream flows.) As the ESA response is developed, King County will coordinate with federal, state, and local agencies including the National Marine Fisheries Service, tribal governments, and citizens to ensure our wastewater facilities will benefit salmon restoration programs in Puget Sound.

New requirements, policies, or initiatives at the state or federal levels have the continued potential to affect allowable pollutant discharge levels from existing and future treatment facilities. Watershed planning, for example, is one federal and state initiative that could affect allowable pollutant discharges to the region's waters by designating "total maximum daily loading" of pollutants to each body of water from all sources. The changing regulatory environment is addressed when a wastewater utility such as King County negotiates its federal National Pollutant Discharge Elimination System (NPDES) permit every 5 years. Existing facilities and plans for new facilities will be modified, as needed, to remain in compliance with regulatory requirements.

Sites for New Treatment Plants

Two service strategies discussed in this final EIS include a new (third) secondary treatment plant in the North End. Service strategy options also address developing treatment plants on the Eastside to provide reclaimed water to augment water supplies. Sites have not been identified for any of these facilities. Unlike the 1985-86 secondary planning effort, which identified several representative sites for a third plant, the RWSP will take a broader look at siting a new plant or plants. This effort has advanced only far enough to develop planning-level cost estimates for comparison purposes. A concerted site selection process and accompanying environmental review will proceed only if County staff are directed to move forward on one of the strategies or options that calls for a new plant.

Water Conservation

The Seattle Water Department's Water Supply Program includes three levels of water conservation to reduce commercial and domestic water use. Each of these levels are designed to reduce regional demands on water supply particularly during late summer and early fall months. This focus on reducing water usage during July, August and September does not match up with wastewater capacity needs which are most critical in late fall and winter months of October, November, December and January. As a result, water conservation has a minimal effect on the sizing and phasing of new wastewater facilities which are based on peak wet weather flows and solids loadings. The timing and sizing for conveyance and for the liquid portions of the treatment process are by far more influenced by stormwater and ground water during wet weather months than any foreseen conservation activities. In planning for the region's wastewater facilities we have and will continue to evaluate any potential benefits derived from conservation efforts. However, since storm weather and ground water factors play the predominant role in sizing wastewater facilities it is unlikely that conservation efforts will significantly alter currently projected facilities needs.

Practicability of Water Reuse

Increasing difficulties in developing new traditional sources of water supply make using reclaimed water as a potential water supply an increasingly viable option. Developing new water sources is a complex and lengthy process. Diverting surface water from mountain lakes or streams may decrease flows in important fish streams. Water rights from the state for new surface and groundwater sources may be difficult to obtain. To determine if large-scale effluent reuse is feasible, however, the costs and adverse impacts of developing new water sources must be weighed against the costs and impacts of developing infrastructure to treat and distribute reclaimed water to replace potable water for uses for which drinking water quality is not required.

Service Strategy Options

Some of the service strategy options listed later in this chapter involve unresolved environmental issues. These include conveyance and treatment of water other than sewage (inflow and infiltration), CSO control requirements and East Treatment Plant effluent discharge alternatives. These service strategy options, most of which are not included in the EPP, and their unresolved environmental issues, are discussed in detail in Chapter 12 of this FEIS and in Chapter 4 of the draft RWSP.

SUMMARY OF SERVICE STRATEGIES

This section summarizes the four service strategies as presented in the Draft Plan and EIS. Elements common to all of the service strategies are identified first, followed by a listing of the defining features of each service strategy. More detailed descriptions of the service strategies are provided in Chapter 3 of this part of the FEIS and in the draft RWSP.

Elements Common to All Service Strategies

Ongoing Projects

King County is currently in the process of planning, designing, and constructing several projects that were called for in previous comprehensive plan updates. These include the current expansion at the East Treatment Plant, as well as conveyance capacity improvements such as the North Creek diversion, the South Interceptor parallel, the Wilburton siphon, the Mill Creek relief sewer, and the Swamp Creek interceptor extension. These conveyance improvements are needed to handle increasing wastewater volumes from the basins they serve, no matter which service strategy is adopted. Several CSO control projects are also being planned or designed as a result of previous plans and commitments. These include Denny Way, Henderson/Martin Luther King, North Beach, Brandon, Michigan and Kingdome/Industrial. Site-specific impacts of these projects have been or will be evaluated in project-specific environmental review documents and are not discussed in this FEIS.

Common Facilities and Programs

Under the current plan, several future projects will be required regardless of the system strategy adopted by the King County Council. For example, sections of the Eastside and Bothell-Woodinville interceptors will have to have parallel pipelines constructed.

Expansion of the East Treatment Plant is proposed under any of the service strategies, although the capacity and timing differs among them. Major trunk improvements are also common to all the service strategies, as well as several CSO facilities.

All service strategies include an inflow and infiltration (I/I) component. The level of I/I control, as well as the timing required to achieve it, is included under each service strategy.

The more definitive of the facilities and programs described in this chapter are described more fully in Chapter 3 of this part of the FEIS and in the draft RWSP. Their potential environmental impacts are discussed in Chapters 5 through 8 of this part of the FEIS.

Appendix E lists trunk sewer improvements common to all strategies according to the decade in which need is anticipated under current population and flow estimates.

Biosolids Management

Many options for managing biosolids were evaluated. One of the alternatives, the current system of land application of Class B biosolids, was chosen as the base case and was used in the cost model to demonstrate the biosolids component of the wastewater plan. The County's current biosolids recycling program and its potential environmental impacts are discussed in Chapter 10 of this part of the FEIS. Alternative biosolids recycling methods and their potential environmental impacts are discussed in Chapter 12.

Potential for Water Reuse

The use of reclaimed water to supplement water supply is of interest to a number of community members and local elected officials. While present costs for the provision of reclaimed water generally exceed those for development of new potable supply, some re-use service proposals are economically viable and are in the process of being implemented, with several others potentially viable in the near term. Examples of potential applications of reclaimed water include wastewater treatment plant process water, landscape irrigation, and industrial heating and cooling. Chapter 9 of this part of the FEIS discusses the potential environmental impacts of using reclaimed water for treatment plant process water and landscape irrigation. Several of the service strategy options discussed in Chapter 12 would involve large scale uses of reclaimed water.

Service Strategy Defining Features

NOTE: Changes resulting from revision of the strategies are shown in italics.

Service Strategy 1 (SS1)

- Maintain the existing two-treatment-plant system (West and East Treatment Plants).
- Expand the East Treatment Plant capacity by 2010, with subsequent expansions required at the East and West Treatment Plants. *(Revised Strategy: Expand East*

Plant capacity by 2013, with subsequent expansions required at the East and West Treatment Plants.)

- Parallel the Kenmore Interceptor by 2010.

- Parallel two-thirds of the Eastside Interceptor by 2035 to carry flows to the East Treatment Plant. *(Revised Strategy: Only parallel two short sections of Eastside Interceptor.)*

- Include a full-scale I&I reduction program. *(Revised Strategy: Implement aggressive incentive-based I/I control program involving cost sharing and surcharges.)*

- Store CSOs along the Lake Union Ship Canal in large, underground storage tanks, and convey them to the West Treatment Plant after peak flows subside.

- Store CSOs south of the Lake Union Ship Canal on-site and/or provide treatment at CSO locations.

- Produce Class B Biosolids using anaerobic digestion at both plants pending analysis of other technologies.

- Produce Class A reclaimed water at both treatment plants.

Service Strategy 2 (SS2)

- Create a three-treatment-plant system (comprised of West Treatment Plant, the East Treatment Plant, and a new North Treatment Plant).

- Expand the capacity at the West Treatment Plant to 159 mgd by 2010. *(Revised Strategy: Expand capacity at the West Plant to 159 mgd by 2013)*

- Construct a new North Treatment Plant in north King or south Snohomish County by 2018. *(Revised Strategy: Construct new North Plant by 2024)*

- Expand the East and North Treatment Plants by 2023 and 2032, respectively. *(Revised Strategy: Expand East Plant by 2029; no expansion of North Plant.)*

- Parallel the Kenmore Interceptor by 2003. *(Revised Strategy: Parallel the Kenmore Interceptor by 2009.)*

- Construct a conveyance system to carry influent to the North Treatment Plant and an outfall from the North Treatment Plant to Puget Sound by 2018. *(Revised Strategy: Construct North Plant conveyance system and outfall by 2024)*

- Include a small-scale I&I reduction program. *(Revised Strategy: Implement aggressive incentive-based I/I control program involving cost sharing and surcharges.)*

- Store CSOs along the Lake Union Ship Canal in large underground storage tanks for conveyance to the West Treatment Plant after peak flows subside.

- Store CSOs south of the Lake Union Ship Canal on-site and/or provide treatment at CSO locations.

- Produce Class B biosolids using anaerobic digestion at all three plants pending analysis of other technologies.

- Produce Class A reclaimed water at all three plants.

Service Strategy 3 (SS3) (Basis for EPP)

- Create a three-treatment-plant system (West Treatment Plant, East Treatment Plant, and new North Treatment Plant).

- Construct a new North Treatment Plant to accommodate 35 mgd by 2010. *(Revised Strategy: Construct new North Plant to accommodate 18 mgd by 2010.)*

- Expand both the East and the North Treatment Plants by 2020 and 2030, respectively; no expansion is required at the West Treatment Plant.

- Construct a conveyance system to carry influent to the new North Treatment Plant and an outfall from this plant to Puget Sound by 2010.

- Initiate a smaller scale I&I reduction program. *(Revised Strategy: Implement aggressive incentive-based I/I control program involving cost sharing and surcharges.)*

- Store CSOs along the Lake Union Ship Canal in underground storage tanks for conveyance to the West Treatment Plant after peak flows subside.

- Store CSOs south of the Lake Union Ship Canal on-site and/or provide treatment at CSO locations.

- Produce Class B biosolids by using anaerobic digestion at all three plants pending analysis of other technologies.

- Produce Class A reclaimed water at all three plants.

Service Strategy 4 (SS4)

- Maintain the existing two-treatment-plant system (West and East Treatment Plants).
- Expand the treatment capacity at the West Treatment Plant by 2010. *(Revised Strategy: Expand the West Plant by 2013)*
- Expand the treatment capacity at East Treatment Plant in 2020, 2030, and 2040. *(Revised Strategy: Expand treatment capacity at East Plant in 2024 and 2037)*
- Construct an 18-mile-long deep tunnel in phases from the Kenmore Pump Station to the Duwamish Pump Station for wastewater conveyance and CSO storage. *(Revised Strategy: Construct a 15-mile-long deep tunnel in phases.)*
- Include a full-scale I&I reduction program.. *(Revised Strategy: Implement aggressive incentive-based I/I control program involving cost sharing and surcharges.)*
- Produce Class B biosolids by using anaerobic digestion at both plants pending analysis of other technologies.
- Produce Class A reclaimed water at both treatment plants.

SERVICE STRATEGY OPTIONS

A number of alternative ideas for meeting stated planning objectives were discussed in the Draft RWSP. These Service Strategy Options are fully described in the draft plan. They consist of measures designed to reduce costs, increase efficiencies, or optimize operations in six categories: treatment, conveyance, CSOs, biosolids, water reuse, and other issues. The options are listed by category in Table 1-1. The options are discussed in greater detail in Chapter 12 of this part of the Final EIS and Chapter 4 of the Draft RWSP. The potential environmental impacts of the options are discussed in Chapter 12 of this part of the FEIS.

NOTE: Options included for further study in the EPP are shown in bold.

Table 1-1: SERVICE STRATEGY OPTIONS	
TREATMENT	
4A	*Redefine Secondary Treatment: Negotiate to change the treatment requirements for wastewater effluent discharges*
4B	*Re-rate Plant Capacities: Increase the amount of wastewater treated at the East and West Treatment Plants without expanding existing facilities*
4C	*Build in Smaller Increments: Delay construction of facilities until they are actually needed, instead of planning and constructing facilities well ahead*
CONVEYANCE	
4D	*Decrease Conveyance Design Standard: Design the system to handle a 5-year storm instead of a 20-year storm*

4E	*Decrease Conveyance Design Standard: Continue to size new pipes to handle a 20-year storm, but wait until existing pipes reach capacity during 5-year storm flows before constructing new pipes*
4F	**Discharge to the Duwamish: Discharge a portion of peak winter flows from the East Treatment Plant directly to the Green/Duwamish River**
4G	*No I/I Program: Build additional facilities instead of implementing an I/I control program*
COMBINED SEWER OVERFLOW	
4H	*Reduce CSO Control Goal: Negotiate to increase the number of allowed CSO events from the state requirement of 1 event per CSO location per year to the federal requirement of 4-6 events per CSO location per year*
BIOSOLIDS	
4I	**Alternative Biosolids Technologies: Alternatives to the existing biosolids processing technology (anaerobic digestion).**
WATER REUSE	
4J	**Discharge at Hiram Chittenden Locks: Discharge reclaimed water from the West Treatment Plant at locks to allow withdrawal from Lake Washington for water supply.**
4K	**Discharge to Lake Washington/Sammamish: Build two Eastside plants with advanced treatment to postpone/minimize expansion of the existing conveyance system, and allow withdrawal from lakes for water supply.**
4L	**North Treatment Plant Discharge to Lake Washington: Build the North Treatment Plant initially as an advanced treatment facility to postpone construction of marine outfall and allow additional withdrawal from Lake Washington for water supply.**
OTHER	
4M	*Implement Pollutant Source Trading: Substitute wastewater treatment facility upgrades with non-wastewater projects that would better improve water quality.*
4N	**Offer siting partnerships: Work with communities to develop mitigation measures that are appropriate to the community in which facilities are located.**

SUMMARY OF IMPACTS AND MITIGATION MEASURES

Service Strategies

Long-term Operational Impacts

Long-term impacts of the service strategies involve their operation and primarily affect water quality, biological resources, environmental health, and land use. Detailed discussions of these impacts are found in Chapters 5 through 10 and Chapter 12 of this part of the FEIS.

The effluent discharge point is a critical siting decision, because effluent should be diluted and transported out to the ocean fairly quickly to avoid concentration of pollutants in central Puget Sound. Discharges to the upper layer of Puget Sound are considered best by oceanographers, because currents there move northward to the open ocean. The West Treatment Plant outfall discharges to the upper layer. The Duwamish outfall for the East Treatment Plant is located in the lower layer of water, at 600 feet. Although dilution is adequate to meet discharge permit requirements, the currents move more slowly in a southward direction before mixing into the upper layer and moving out of the Sound. Oceanographers believe that constituents of the effluent from the Duwamish outfall remain and accumulate in the Sound, along with effluent from other outfalls. A new outfall associated with a new North Treatment Plant would be sited north of the outfall for the

West Treatment Plant. In final siting of the new North Treatment Plant outfall, one objective would be to direct effluent to the upper water layer.

All the service strategies increase the volume of effluent discharged from the East Treatment Plant outfall off Duwamish Head because the East Treatment Plant would be expanded under all strategies. Of the four strategies, SS1 and SS4 would discharge the greatest volume of effluent from the East Treatment plant outfall into the southward-moving lower layer off Duwamish Head. SS2 and SS3 redirect a portion of the effluent that would otherwise be discharged from the Duwamish Head outfall to a new outfall associated with a North Treatment Plant. To the extent that final siting of this outfall directs effluent to the upper water layer and northward, these strategies would be preferable from a water-quality perspective. SS1, SS2, and SS4 also increase the discharge from West Point, where the flushing is good.

Under all strategies, the CSO program will be designed to meet water quality and public health standards in area waters. Project priorities will address first those areas with highest potential for public contact with combined sewage. SS4, however, will eliminate all CSOs from the Duwamish River and Elliott Bay, storing and transporting those flows to the East and West Treatment Plants for treatment and discharge from marine outfalls. Overall, this strategy would discharge the lowest total volume of pollutants to these waters.

Since most of the wastewater system is buried, people are not usually aware of it, except in extreme conditions, or when it is under repair. Odors can be released from the underground conveyance system in certain conditions, as well as from the treatment plants. King County has an odor control program aimed at identifying and treating those odor sources that are most likely to reach residential neighborhoods and other areas sensitive to odors.

Treatment plants have substantial above-ground structures and are typically industrial in appearance and type of operation. If surrounding land uses are not compatible, landscaping and architectural treatments are needed to blend the treatment plant with surrounding areas. The East Treatment Plant is located on land zoned for a treatment plant and is surrounded by an undeveloped buffer, followed by business park and industrial land uses. The West Treatment Plant is located in a single-family zone surrounded by Discovery Park. No site has been identified for the potential new North Treatment Plant; wherever it is located, however, it will probably require buffering or other means to make it compatible with surrounding uses. Compatibility with nearby land uses would be a high priority in selecting a new treatment plant site and design.

Truck traffic to and from treatment plants is also a long-term, operational activity. In the case of the East Treatment Plant, trucks quickly access the regional transportation system from the plant. West Treatment Plant traffic travels through the Armed Forces housing area and Discovery Park before entering Government Way, a commercial and residential street. Treatment plant-related truck traffic to a new North Treatment Plant would be a new impact to the area. King County is seeking ways to reduce truck traffic by evaluating alternative methods to process solids from the treatment process, thus reducing the volume.

The end products of the wastewater treatment process, reclaimed water and biosolids, can be beneficially recycled without adverse impacts provided that regulations regarding product quality and application methods are followed.

Short-term Construction Impacts

Short-term impacts are those caused by construction of facilities and are typically experienced in a local area for the duration of construction. The service strategies may differ somewhat in their short-term impacts, because facility construction would take place in different areas. Appropriate mitigation measures for these impacts would be taken whichever service strategy were implemented. A more detailed discussion of probable construction impacts is provided in Chapter 11 of this part of the FEIS.

Impacts of construction at the treatment plants would be experienced locally for up to 5 years for each expansion phase, during which many separate, but coordinated, activities would occur simultaneously. Construction would entail large-scale earth movement and hauling of concrete and equipment. Construction noise, dust, and traffic would occur around the treatment plant sites.

While conveyance construction impacts are much shorter in duration in any one area, the facilities would be located close to homes and businesses, so impacts would be experienced by many more people. Installation of pipes and pumping stations requires noisy excavation, usually in or near streets. Projects located in streets, and trucks hauling soils and equipment, may disrupt traffic. Access to residential and business properties is sometimes interrupted for short periods. These impacts are mitigated by proper construction management, but cannot be avoided entirely. Pipelines that are not located in streets are often built along water bodies. In such cases, wildlife habitat, including wetlands, may be affected. Stream crossings cause temporary impacts to water quality and aquatic life and have to be timed to avoid salmonid migration periods.

New pumping stations and CSO storage/treatment facilities take up to 18 months to build. They involve typical construction impacts such as noise, dust, and traffic.

Conveyance pipelines are built a length at a time, so impacts at any one location are usually only experienced for a few weeks. Tunnels concentrate impacts at one end point, the working portal. This is where all soils are removed, and truck traffic and workers move to and from the working portal. Depending on the size and length of the tunnel, the portal can be active for a year or more, impacting the surrounding area with noise, dust, and truck traffic.

Infiltration and inflow control involves such measures as installing a plastic liner in existing sewer pipes, replacing broken pipes, and disconnecting roof drains on individual residential and commercial buildings from the sanitary sewer system. This causes traffic disruption and noise and interferes with paving and landscaping on private property. Pipe lining, which is the least intrusive method, involves installing a sewer bypass pipe aboveground and elevated noise levels for about a week in one place. Noise reduction measures would be taken as needed. After construction, areas would be restored.

Service Strategy Option Impacts

The service strategy options listed earlier in this chapter have been developed to explore opportunities to minimize costs of the wastewater system and to provide new opportunities for coordination with other utilities, such as water supply.

Several service strategy options would constitute a change from current, more conservative, policies under which the County wastewater system is managed. They could allow for more frequent and greater discharges of wastewater pollutants from the County wastewater system. Such policies would not be implemented without technical studies to demonstrate no significant environmental harm or risk to public health.

Other policies call for reuse of treated wastewater to augment the water supply. Two would involve discharges of treated wastewater to the Lake Washington system. This would increase pollutant loadings to this freshwater system. To minimize these impacts, additional treatment steps would be added to achieve greater pollutant removals before discharge. Advanced technical studies would be conducted to demonstrate no long-term significant adverse impacts from implementing these policies.

POLICIES AND REGULATIONS

The quality of effluent discharged from King County's treatment facilities is governed by a number of federal and state laws in place to protect the quality of the region's water. The most important are the Federal Clean Water Act, the Washington Water Pollution Control Act, and the NPDES permit program.

RELATIONSHIP TO LAND USE PLANNING UNDER GROWTH MANAGEMENT ACT

In order to carry out its mission of providing wastewater treatment facilities to protect public health and prevent water pollution, King County must meet the requirements of the Washington State Growth Management Act (GMA). The GMA, passed in 1990 and subsequently amended, is a significant new factor affecting King County decisions. This legislation directs urban and fast-growing counties in the state to develop comprehensive growth management plans that define urban growth boundaries to ensure that facilities and services needed to sustain growth are in place when required.

In complying with the GMA, King County's facility planning must be consistent with other regional planning efforts so that its regional wastewater treatment and conveyance infrastructure is in place when development occurs. King County's wastewater planning must comply with the GMA requirements that cities and counties coordinate and adopt mutually supporting plans for capital facilities and utilities. The GMA further requires that capital facilities planning include an inventory of existing facilities and a forecast of future needs for such facilities. The RWSP uses subarea demographic forecasts prepared and adopted by the Puget Sound Regional Council (PSRC) to determine the impact of regional growth on King County's existing wastewater conveyance and treatment facilities and to plan future facilities to accommodate that growth. Additionally, the RWSP implements the King County Comprehensive Plan (KCCP), as it assumes all new development in the urban area will have sewers.

NOTE

Chapter 2 is as it appeared in the Draft EIS (May 1997) for the RWSP. References to the RWSP in Chapter 2 are to the draft Plan issued at the same time as the Draft EIS. Projections in this chapter are the ones used for the original four service strategies.

CHAPTER 2
BACKGROUND

This chapter presents information on the background and history of the existing King County wastewater system. It also contains a brief description of the RWSP planning process leading to the selection of service strategies and service strategy options analyzed in this DEIS.

HISTORY

As early as 1911, Seattle had completed the Fort Lawton tunnel to take wastewater flows to West Point for discharge. Early systems, which were the beginning of the current combined sewerage system in the City of Seattle, were built to collect sanitary sewage from homes and businesses and runoff from streets, as well as carrying away horse manure and litter.

By the 1950s, more than 25 small sewage treatment plants had been built in the Seattle area. The treatment plants did not serve all communities, and untreated sewage entered Lake Washington and Lake Sammamish as well as Elliott Bay, the Duwamish River, the Lake Washington Ship Canal and Puget Sound off West Point. By the late 1950s, about 40 million gallons of raw sewage were being discharged daily off West Point alone.

The degradation of water quality in Lake Washington and concern over the future of other bodies of water led to the formation of a grassroots citizens' committee. The committee successfully sponsored state legislation to enable formation of a municipal corporation to manage the wastewater pollution problem for the Seattle metropolitan area. This led to the formation of the Municipality of Metropolitan Seattle (Metro) by a vote of citizens in 1958. In 1959, the Metro Council, comprised of elected representatives and appointees from local cities and sewer districts, assumed responsibility for cleaning up Lake Washington and establishing a regional sewerage system.

The *Comprehensive Sewerage Plan* was adopted by the newly created Metro Council in 1959. The plan was to become the core planning document for wastewater treatment services in the Lake Washington drainage basin, which includes most of the Seattle/King County region and a portion of Snohomish County, for the ensuing 35 years.

In 1961, Metro entered into a series of agreements with local sewer service providers to accept and treat wastewater collected in their systems. Metro would own and operate the regional pipelines, pump stations, and treatment plants serving Seattle and suburban King County. As noted earlier, the City of Seattle had a combined system; it carried sanitary sewage, as well as stormwater runoff. Relief points built into the system allow for overflows into area waterways when large storms inundate the system. These overflow points prevent sewer backups into streets and basements during heavy storms.

Studies showed that a system with large central facilities was more cost-effective to build and operate than a system with many small plants. With the construction of one regional treatment plant in Renton (the East Treatment Plant) in 1965 and another at West Point in 1966, along with the major trunk lines and pump stations needed to take wastewater to these regional plants, Metro began closing 28 small treatment plants and eliminating 46 raw sewage discharge points into Lake Washington and Lake Sammamish. Metro continued to operate three small treatment plants at Alki, Carkeek Park, and Richmond Beach. The plants served small drainage basins discharging into Puget Sound. Overflows of untreated sewage during the dry season were eliminated, and the discharge of treated wastewater to lakes and rivers in the Lake Washington drainage basin was brought to a halt.

By the late 1960s, Lake Washington's water quality had dramatically improved, and the independent action of citizens in the King County area to invest in protecting their water resources was gaining national recognition. Across the country the King County area was held as a model of citizen action in cleaning up the environment.

The success of the 1960s did not end efforts to protect water resources. Much work has since been done to improve wastewater treatment and reduce combined sewer overflows. That work, along with the original construction of a regional system in the 1960s, amounted to a $3.3 billion investment (1995 dollars) in protecting public health and water resources in the Seattle/King County region. Highlights of those investments include the following:

- The East Treatment Plant, originally built as a secondary treatment plant because of its discharge into the Green/Duwamish River, has been expanded to handle increasing volumes of wastewater from a growing suburban population.
- A new effluent discharge pipeline and outfall for the East Treatment Plant (called the Effluent Transfer System, or ETS) was completed in 1986 to eliminate discharges to the Green/Duwamish River and carry treated wastewater 12 miles to a deep-water outfall in Puget Sound.
- The West Treatment Plant has recently been upgraded to a secondary treatment plant, producing a higher quality effluent for discharge into Puget Sound.
- Major trunks and interceptors have been constructed, and old sewers and pipelines built in the early part of the century have been rehabilitated for continued use.
- The volume of CSOs has been greatly reduced since Metro built the regional wastewater treatment infrastructure in the 1960s. City of Seattle efforts to build storage facilities and separate storm sewers to collect street runoff, as well as Metro efforts to separate stormwater from sewage, reduced the volume of combined sewer overflows from an estimated 20 to 30 billion gallons each year in the 1960s to 1.6 billion gallons per year today. Several additional CSO control projects are underway.

A NEW GOVERNMENT

In 1993, the citizens of King County voted to combine the Metro and King County governments into a new regional government, Metropolitan King County. Metro's wastewater treatment, water quality, and transit responsibilities became part of an interim Department of Metropolitan Services for 2 years while the new government created its new structure. In 1996, the wastewater treatment and water quality functions of the Department of Metropolitan Services were transferred to the new King County Department of Natural Resources. The responsibilities of the former Metro Council, which provided oversight of wastewater treatment services for the first 35 years, now lie with the new Metropolitan King County Council and the King County Executive.

EXISTING REGIONAL KING COUNTY WASTEWATER SERVICE AREA

Major Facilities

King County provides wholesale wastewater services to 17 cities and 19 local sewer/water districts. The wastewater treatment plants and the major sewer interceptors and pumping stations that deliver the wastewater from local systems are owned, operated, and maintained by King County. The smaller pipelines and other conveyance facilities that carry wastewater to King County's interceptors are owned, operated, and maintained by the respective cities and districts (also known as local wastewater service agencies). King County has sewage disposal agreements which extend to July 1, 2036, with each of the 36 sewer agencies within the service areas.

Major elements of King County's wastewater system are shown in Figure 2-1. This figure also shows the locations of facilities which are under design or construction and are scheduled to be on-line by 1999. The King County system consists of over 255 miles of pipeline, 38 pump stations, 22 regulator stations, 2 secondary treatment plants, 2 CSO treatment plants, and 34 CSO control structures.

Wastewater Service Areas

When Metro was first established in 1958, its service area boundaries were legally defined as lying entirely within the boundaries of King County. To accommodate northern areas that naturally drain south into King County and Lake Washington, the service area was expanded to include part of southwestern Snohomish County. More recently, a small portion of northeastern Pierce County has been added to the service area. King County's wastewater service areas and the urban growth boundary are shown in Figure 2-2.

The current King County wastewater service area is divided into two subareas based upon where flows are conveyed for treatment. Approximately 1.2 million residents are served by the whole wastewater system. These service areas (including the North Service Area, which is currently part of the West Service Area) are shown in Figure 2-2.

West Service Area System

The West Service Area receives a mixture of separated flows (i.e., sewage not deliberately mixed with stormwater) from north of Lake Washington and combined sewage from the City of Seattle. The total service area consists of 66,800 acres; approximately

30,400 acres are served by combined sewers. The separated and the combined flows are joined before being routed through the treatment facilities.

The West Service Area wastewater treatment and conveyance facilities are primarily located in the City of Seattle. These facilities include the West Treatment Plant (located at West Point adjacent to Discovery Park in the Magnolia neighborhood in Seattle); the Kenmore Interceptor, Lake City Tunnel, and North Interceptor (these three interceptors carry flows from north King and south Snohomish counties and north Seattle to the West Treatment Plant); the Elliott Bay Interceptor (this carries flows to the West Treatment Plant from south Seattle); and CSO treatment plants located at Alki and Carkeek Park. (The Alki Plant will continue to operate as a primary treatment plant until 1999, when it will be converted to a CSO treatment facility; see below.)

West Treatment Plant Facilities. The West Treatment Plant, located on a sand spit on Puget Sound, is bordered by Discovery Park and the U.S. Coast Guard's West Point lighthouse. The plant, currently the largest in the King County system, began providing primary treatment to wastewater in July 1966. (Primary treatment includes screening, settling, and disinfection of wastewater with less solids removal than secondary treatment.) It was constructed at this location because the existing collection system was already in place to deliver wastewater to the North Trunk outfall at the north beach of West Point. The plant was upgraded to provide secondary treatment in 1995 with an average wet-weather capacity of 133 mgd and a peak wet-weather capacity of 440 mgd. The plant's secondary treatment process involves influent pumping, screening, grit removal, primary sedimentation, air activated sludge, secondary sedimentation, disinfection (chlorination), and anaerobic digestion. After treatment is completed, secondary effluent is discharged through an outfall to Puget Sound.

Processing equipment has recently been added to treat a small portion of the West Treatment Plant's secondary effluent to a higher quality. This equipment carries out chemical coagulation, filtration and disinfection processes, storage and distribution pumping, and piping. The resulting highly treated effluent is available for use as process water within the plant. It can also be used for landscape irrigation. Chapter 9 of this DEIS provides more information on the effluent reuse program.

The treatment plant operates under an NPDES permit, which sets limits for biochemical oxygen demand and total suspended solids contained in the discharged effluent. Average monthly effluent biochemical oxygen demand (BOD) and total suspended solids (TSS) limits are each 30 milligrams per liter (mg/l).

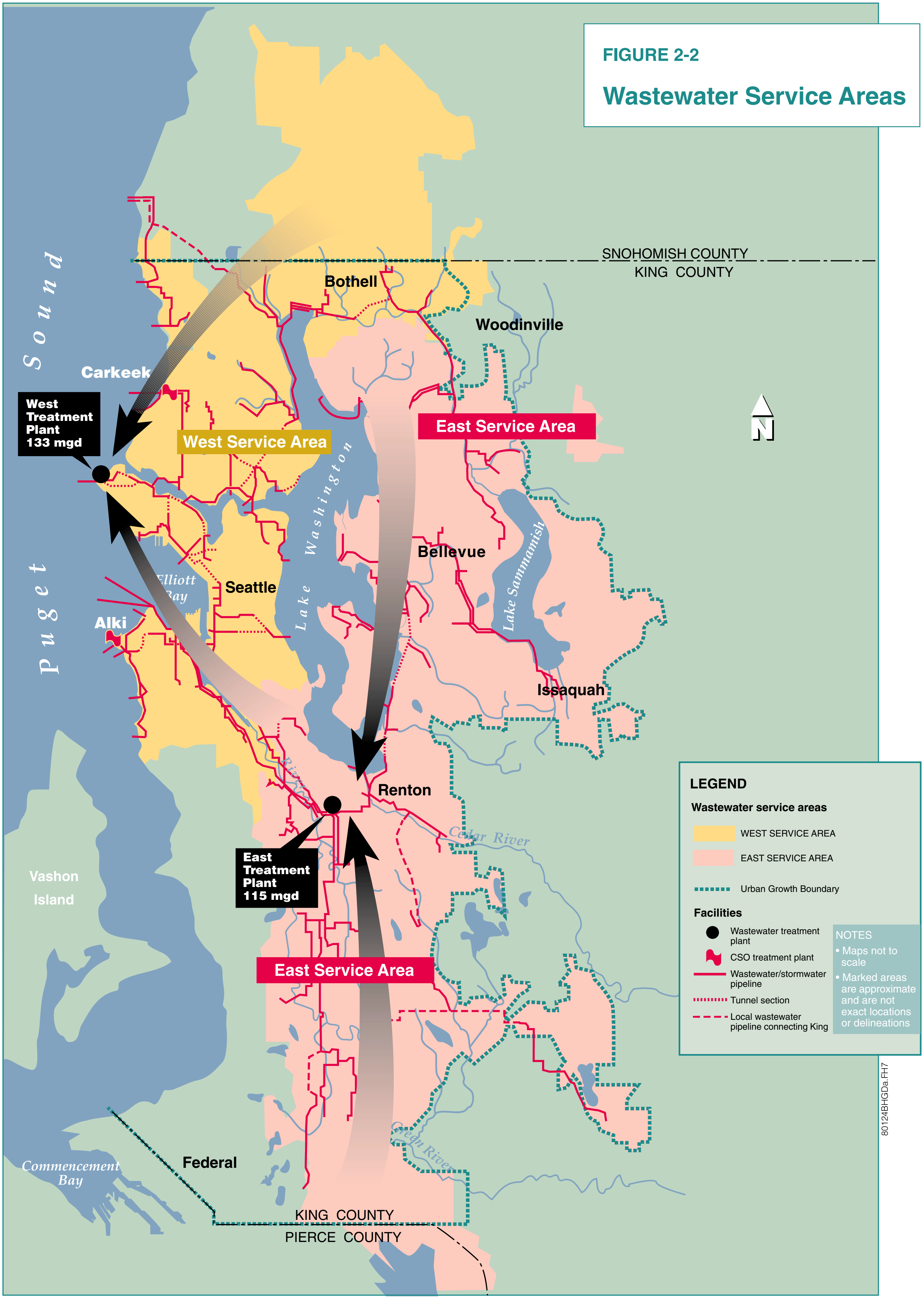
Solid matter (called primary sludge) that settles in the primary clarifiers (settling tanks), requires additional treatment before it is suitable for reuse. Sludge processing consists of anaerobic digestion, thickening via gravity belt thickeners, and dewatering by centrifuges. The product resulting from this process is called "biosolids" and is suitable for reuse as a

FIGURE 2-1 King County Wastewater Treatment

70114BH1.FH5 3/97

FIGURE 2-2

Wastewater Service Areas



fertilizer or soil amendment. Further information on biosolids processing, distribution, and use is presented in Chapter 10.

Both the West and the East Treatment Plants produce methane gas (a by-product of the wastewater treatment process). At the treatment plants, this gas is used to run equipment and help heat the plants. Excess methane gas at the West Treatment Plant is used to produce electricity which is sold to Seattle City Light at a higher rate than King County pays to purchase electricity.

Service Area and Collection/Conveyance System. The West Service Area includes most of the City of Seattle and neighboring cities and unincorporated areas to the north and northeast. Most of the service area within city limits and part of the unincorporated North Service Area (most of which is located in southern Snohomish County) currently have sewer service.

The North Service Area includes the Swamp Creek, North Creek, Bear Creek, and lower Sammamish River drainage basins. Only about one quarter of the North Service Area is currently served by sewers, all of which are tributary to the King County wastewater system. The 1990 population of the area served by sewers was about 98,000. By 2030, the population served by sewers is projected to be over 450,000. By that year the entire North Service Area is expected to be served by sewers, all of which will be tributary to the King County wastewater system.

Major interceptors that convey wastewater to the West Treatment Plant include the Kenmore Interceptor, Lake City Tunnel, the North Interceptor, and the Elliott Bay Interceptor.

The West Service Area System has two storm weather plants. The Carkeek Treatment Plant is a 20-mgd storm weather treatment plant located in Carkeek Park. From 1962 (when the plant first went into service) to 1994, the plant was a primary wastewater treatment plant. In 1994, sanitary stormwater flows up to 8.4 mgd were transferred to the West Treatment Plant, and the Carkeek Treatment Plant was converted to a storm weather plant. The plant provides primary treatment (screening, settling, and disinfection) of flows exceeding 8.4 mgd. Such flows occur during periods of heavy rain and are expected to take place about eight times per year and result in annual discharges of 14 million gallons.

The former Richmond Beach Treatment Plant was placed into service in 1963 as a primary wastewater treatment plant with a wet-weather design capacity of 3.2 mgd. The plant was dismantled in 1992 and replaced with a pump station that transfers its flows to the Edmonds Wastewater Treatment Plant.

The Alki Treatment Plant is located on a 2.8-acre site in West Seattle near the Alki Point lighthouse. The City of Seattle began operating the plant as a primary wastewater treatment plant in 1958 and it became part of the Metro system in 1962. In 1987, the plant has overhauled, including equipment upgrades, addition of odor control equipment, and architectural and landscaping improvements. A conveyance system is now under construction that, by 1999, will transfer a maximum wet-weather flow of 18.9 mgd from the Alki Treatment Plant to the West Treatment Plant. In conjunction with this transfer, the Alki Treatment Plant will be converted to a 65-mgd storm weather plant. As a storm weather plant, the facility will provide primary treatment for a combination of sanitary sewage and stormwater for flows to the plant that exceed 18.9 mgd.

East Service Area System

The East Service Area receives wastewater flows from 97,300 acres east and south of Lake Washington. Most of the development within this area was originally constructed with separate conveyance systems for sanitary sewage and stormwater. The major East Service Area System treatment and conveyance facilities include the East Treatment Plant (located on Monster Road in the City of Renton), the South Interceptor (which collects and carries wastewater through the Green River valley from as far south as Pacific near the county line), the Eastside Interceptor (which conveys flows from the east side to the East Treatment Plant), and the effluent transfer system (ETS) (which conveys the treated wastewater from the East Treatment Plant to Puget Sound for discharge).

East Treatment Plant Facilities. The East Treatment Plant is located in the City of Renton near the Green/Duwamish River, 13 miles upstream of the river's mouth at Elliott Bay. The original treatment plant, constructed in 1965, had a secondary treatment capacity of 24-mgd, average dry-weather flow with effluent discharged into the Duwamish River. The plant's capacity was increased to 72 mgd in 1986 and is in the process of being increased to 115 mgd (average wet-weather flow) and a peak wet-weather capacity of 325 mgd. As part of the upgrade to 72 mgd, Metro transferred the plant's discharge from the Green River to Puget Sound through an effluent transfer system that parallels the Duwamish River and discharges to Puget Sound in deep water off Duwamish Head.

The plant's secondary treatment process is similar to the West Treatment Plant's process, as is its sludge processing. The sludge processing facilities consist of thickening using dissolved air flotation, anaerobic digestion, and dewatering by belt filter press. The resulting biosolids are taken from the treatment plant by truck to be land-applied at various locations (see Chapter 10).

Several alternative solids processing technologies are currently being tested as demonstration projects at the East Treatment Plant as part of the Applied Wastewater Technology Research Program (AWT). Currently, the Centridry (centrifuge/dryer) process is in the early phases of start up testing. Later in 1997, the Vertad, deep shaft aerobic reactor will be pilot tested. Tests completed last year include demonstrations of the Cyclus (anoxic gas floatation) and Vertech (wet oxidation) solids treatment systems. In addition, the AWT program hopes to stage a demonstration of molten carbonate fuel cell technology which can produce electricity from methane gas produced at the plant.

The East Treatment Plant also accepts septic tank solids from throughout the region and sludge from the Snoqualmie Valley cities. The treatment plant accepts septage collected by private companies and hauled to the plant for processing from other public agencies and private companies. Approximately 20 million gallons of septage per year is processed for a fee.

Methane gas produced by the solids treatment process is used to run equipment and heat the plant. Excess methane gas produced by the solids digestion process is sold to the Washington Energy Company.

A 0.7-mgd, Class A, reclaimed water treatment system was recently installed at the East Treatment Plant. The highly treated, reclaimed water produced by this system is currently used to meet plant process, operation, and landscaping irrigation needs. Two distribution lines make the reclaimed water available for use to meet heating/cooling and irrigation needs in the immediate vicinity. This system is similar to the facility installed at the West Treatment Plant (see previous subsection).

Service Area and Collection/Conveyance System. The East Service Area lies primarily east and south of Lake Washington. It is approximately bounded by Juanita Bay on the north, the County's urban growth boundary on the east, the City of Auburn on the south, Mercer Island and Lake Washington on the northwest, and the western edge of the Green River watershed on the west. The largest conveyance pipelines are the Eastside Interceptor (located between Kirkland and the treatment plant in Renton) and the South Interceptor (located between Kent and the treatment plant).

The conveyance system for the East Service Area also includes the Sammamish, Redmond, Issaquah, Lake Hills and Auburn interceptors. All of these except the Auburn Interceptor connect to the Eastside Interceptor. The Auburn interceptor connects to the South Interceptor.

The East Treatment Plant's collection system is a separated system in which wastewater and stormwater are independently collected. Although the wastewater collection system is designed to convey only wastewater to the plant, a substantial amount of stormwater reaches the plant through unwanted infiltration and inflow into the system. Infiltration occurs where stormwater and groundwater enter the sewer system through cracked pipes and leaky joints. Stormwater also enters the system directly through manhole covers or roof connections (downspouts). When this occurs, it is called "inflow." Most of the infiltration and inflow reaching King County's system originates in local collection systems tributary to the King County system.

Infiltration and inflow comprise significant portions of the total wastewater flow in the East Service Area. A 1990 study showed that infiltration and inflow (I/I) comprise over 75 percent of peak flow at the East Treatment Plant (see Figure 2-3). Nearly all of the excess flow (95 percent) enters through the smaller collection systems owned by the local agencies, not the King County interceptors. The highest flows at the plant occur during, or shortly after, large storm events. They include a substantial quantity of rainfall-dependent infiltration and inflow. This flow proves very costly to King County as it must build additional conveyance lines to prevent overflows.

Combined Sewer Overflow Control

In the late 1800s, the City of Seattle built a combined sewerage system to collect untreated wastewater, stormwater and street litter and discharge it directly into local water bodies during periods of heavy rainfall. Construction of combined sewers was a standard practice until about 50 years ago.

In a combined sewer system, such as exists in the older parts of Seattle, sanitary sewage from businesses and households are combined with runoff from precipitation during storms. During long or intense storms, the additional stormwater exceeds the capacity of the sewers, causing overflows at designated relief points within the system.
Areas that have been developed since the 1940's have separate sanitary and storm sewer systems. In separated sewer systems only sanitary wastewater is conveyed to local sewage treatment plants while separate piping systems collect and convey stormwater to the closest body of water (see Figure 2-4).

In the early 1960s, Metro acquired facilities owned and operated by the City of Seattle and other sewer districts. Metro assumed responsibility for the CSOs associated with the trunks and interceptors it acquired and the City of Seattle retained responsibility for the rest of the combined system.

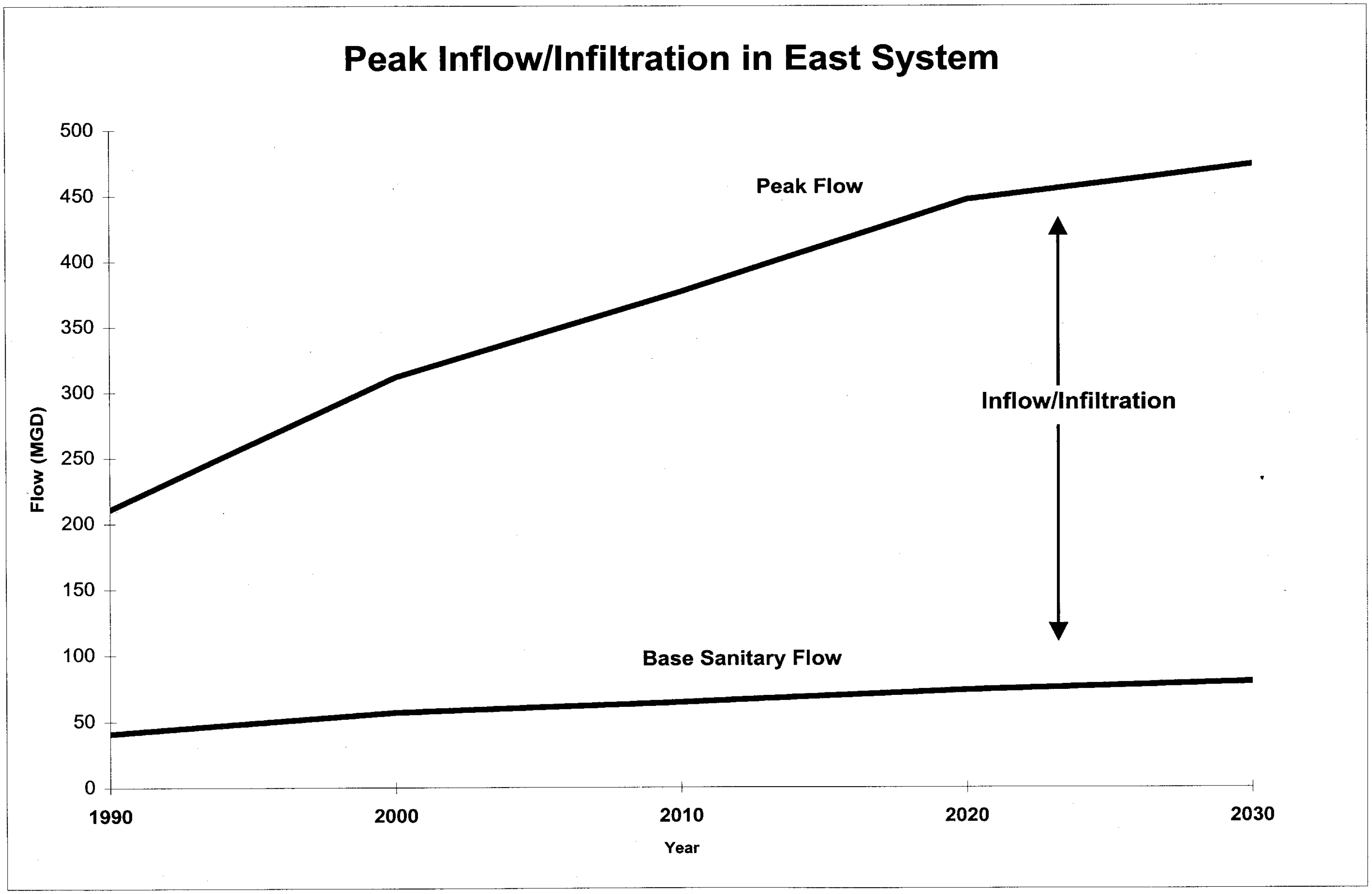
Before Metro was established, sewage treatment was provided for about half the sewage being generated in the greater Seattle metropolitan area. City of Seattle sewage was discharged into Puget Sound near West Point, along Elliott Bay and into the Duwamish River. Suburban areas had separate sanitary sewerage systems with small treatment plants discharging primarily into Lake Washington and local rivers. In subsequent years, Metro and the City of Seattle made improvements to reduce or eliminate CSOs. Current overflows occur from both the Seattle and King County system along the shorelines of Lake Washington, Lake Union, the Lake Washington Ship Canal, the Duwamish River, Elliott Bay and West Seattle (see Figure 2-5 for locations of King County CSOs). Metro and the City of Seattle, through partial sewer separation, treatment and storage projects, have eliminated virtually all problems of localized backups and flooding and reduced the incidence of overflows in the City and Metro systems.

Both King County and Seattle manage their own CSO control programs and, when possible, undertake joint projects to reduce CSO discharges. Since 1960, CSO discharge has been reduced from between 20 and 30 billion gallons per year (combined Metro and City discharges) to 2.4 billion gallons per year in 1982 (Metro discharges only) to a projected 1.6 billion gallons in 1998, when CSO projects currently underway will be complete and on-line. The City of Seattle has also substantially reduced volumes discharged from its CSOs.

In the mid-1980s, the Washington State Department of Ecology (Ecology) began requiring all municipalities with combined sewerage systems to develop plans to limit CSO frequency to no more than one event per year, on average, at each overflow location. As discussed above, Seattle and King County have made substantial progress towards the goal. The RWSP includes additional CSO facilities needed to reach the state goal.

RWSP PLANNING PROCESS

This section summarizes the processes used to develop the wastewater service strategies presented in Chapter 3 and the service strategy options discussed in Chapter 12. More



Peak Inflow/Infiltration in East System
Peak Flow
Inflow/Infiltration
Base Sanitary Flow
Flow (MGD)
500
450
400
350
300
250
200
150
100
50
0
1990
2000
2010
2020
2030
Year

FIGURE 2-3

FIGURE 2-4

Combined and Separated Systems

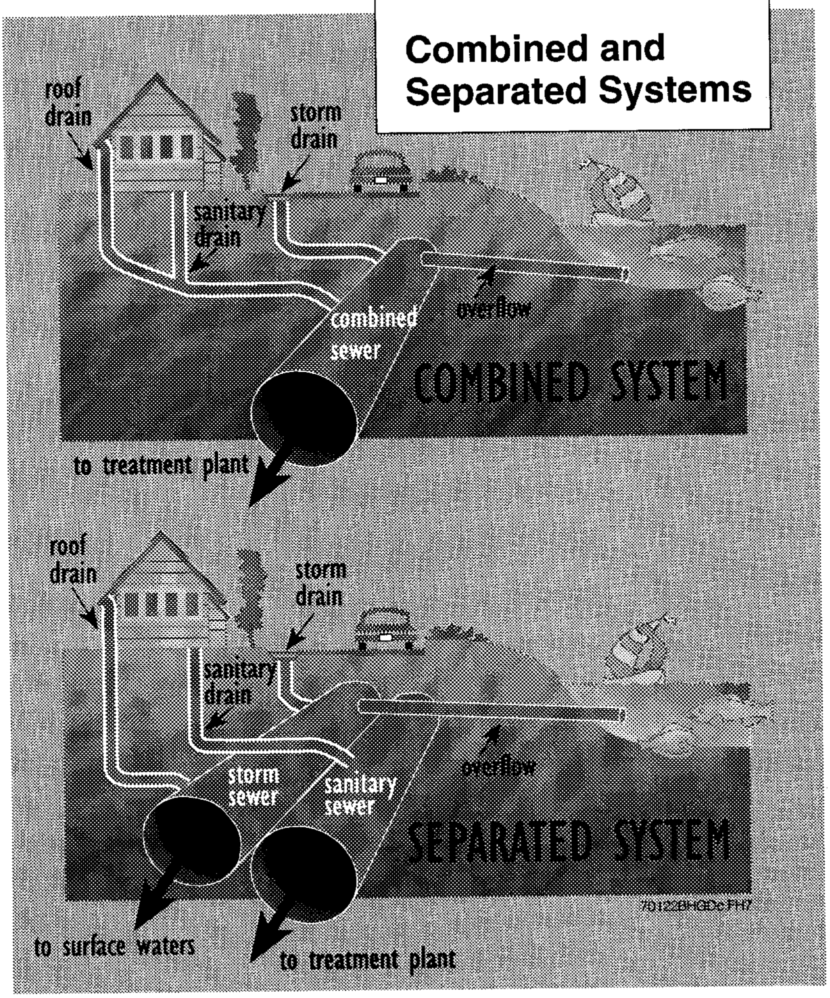
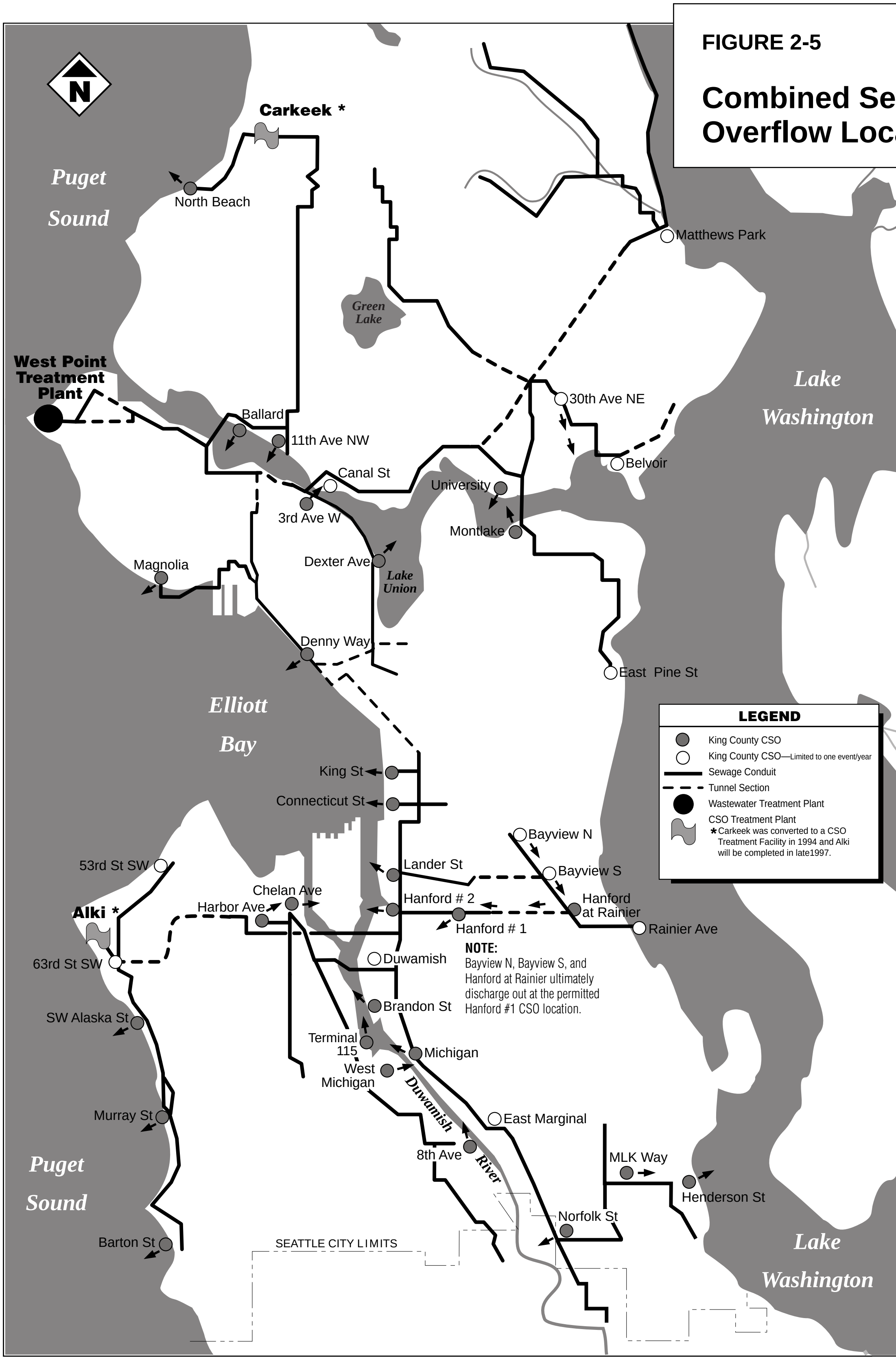


FIGURE 2-5

Combined Sewer Overflow Locations



80124BHGDd.FH7

detailed descriptions of the processes leading to the service strategies and service strategy options are provided in Chapters 2 and 4 respectively of the RWSP.

The service strategy development process involved three components:

- develop a wide range of alternatives for wastewater management that were consistent with citizen input, existing policies, and core objectives;
- select the most practicable alternatives by applying a ranking process using criteria and input from stakeholders and an expert panel;
- develop options that could modify the components of each service strategy, including facilities, programs, or assumptions guiding wastewater management practices.

Three important elements contributed to the development of a wide range of possible service strategies. These include: 1) direction from citizens and stakeholders; 2) consistency with existing policies; and 3) concurrence with planning objectives.

An extensive interview process was conducted at the outset of the planning process with citizens, wastewater customers, community and environmental advocates and local elected officials. Over 120 people were interviewed, and all expressed a strong interest in wastewater and water quality issues.

Additional guidance came from King County Wastewater Treatment stakeholders. Stakeholders included: 1) elected officials and staff from King County, Seattle, Bellevue, Renton, Shoreline, and a number of the other suburban cities; 2) the Citizens' Water Quality Advisory Committee (CWQAC); 3) the Metropolitan Water Pollution Abatement Advisory Committee (MWPAAC); 4) representatives of the Puget Sound Water Quality Authority; and 5) staff from the Washington State Department of Ecology. Together, citizens and stakeholders played a major role in laying the foundation for the service strategies presented in the RWSP.

Additional perspectives on the proposal and associated potential environmental impacts were gained through the SEPA scoping process conducted in the fall of 1994.

In 1994, all of the policies that had been developed over the years to plan, operate and maintain the regional wastewater treatment system were reviewed for pertinence to this planning effort. They are referred to in the RWSP as "framework policies" because they provide a framework, or context for operating and making decisions about the wastewater system. The policies were established by the former Metro Council and many are reflected in subsequent amendments to the King County Code.

In 1995 the King County Council Regional Water Quality Committee reviewed the framework policies and provided suggestions for new policies which should be considered in the RWSP.

Building on the framework policies and the direction received from citizens, wastewater service customers and local elected officials, seven planning objectives were prepared to guide the development of future wastewater treatment and conveyance strategies. Over 60 preliminary wastewater system alternatives were developed using this guidance.

Subsequently, a process for narrowing the expansive list of possibilities to a limited number of sound choices was conducted using a set of criteria.

Four potential service strategies were the outcome of this extensive planning process. Each of the four could provide wastewater services to meet the needs of the region through the year 2030.

After the four service strategies were developed and reviewed, it became apparent that they represented an approach that would meet all existing regulations and policy directions but did not provide the range of choice desired by stakeholders, nor provide a basis for challenging the strategies' underlying assumptions. As a result King County staff and consultants developed service strategy options that could modify the four service strategies in some way. Fourteen options were selected for discussion in the RWSP and this EIS. The options are described in Chapter 4 of the RWSP and their environmental impacts are discussed in Chapter 12 of this EIS.

This EIS identifies adverse environmental impacts and mitigating measures associated with each of the four service strategies and the service strategy options. The discussion of environmental impacts that could result from implementing the service strategies and service strategy options is at a general, programmatic level. Additional, project-level environmental review would be required before specific projects could be implemented. For many of the options, additional feasibility studies would be warranted before proceeding to the next stage of environmental review.

NOTE

Chapter 3 is as it appeared in the Draft EIS (May 1997) for the RWSP. References to the RWSP in Chapter 3 are to the draft Plan issued at the same time as the Draft EIS. Projections in this chapter are the ones used for the original four service strategies.

CHAPTER 3
DESCRIPTION AND COMPARISON OF SERVICE STRATEGIES AND SERVICE STRATEGY OPTIONS

This chapter describes the four service strategies and compares their potential environmental impacts. It also discusses how the service strategy options considered in the RWSP could affect these impacts. In addition, it briefly summarizes alternatives considered in the early stages of the planning process, but later eliminated from further consideration. For comparison purposes this summary includes the "no action" alternative (i.e., constructing no new facilities, undertaking no new programs). Brief cost comparisons are also provided at the end of the chapter. Detailed cost information is provided in the Draft Financing Plan.

DESCRIPTION OF SERVICE STRATEGIES

This section describes the four service strategies that form the core of the RWSP. Elements common to all service strategies are presented first, followed by descriptions of the individual service strategies. Each service strategy description begins with a short list of key defining features. Then system components are described, including the facilities needed to convey and treat wastewater and reduce the volume of combined sewer overflows. A summary of major components grouped by strategy is provided in Table 3-1.

Elements Common to All Strategies

Ongoing Projects

King County is currently in the process of planning, designing, and constructing several projects called for in previous comprehensive plan updates. These include the current expansion at the East Treatment Plant, as well as conveyance capacity improvements such as the North Creek diversion, the South Interceptor parallel, the Mill Creek relief sewer, and the Swamp Creek Interceptor extension. These treatment and conveyance improvements are needed to handle increasing wastewater volumes from the basins they serve, regardless of what service strategy the Council adopts. These projects have had or will have project-level environmental review.

Common Facilities and Programs

Several new facilities are proposed under all of the service strategies. These include expansion of the East Treatment Plant, parallel pipelines to sections of the Eastside and Bothell-Woodinville interceptors and a new 20-million gallon tank to store effluent entering the transfer system from the East Treatment Plant. These facilities are included in the list of capital facilities provided for each service strategy in this chapter. In addition, a number of capacity improvements to trunk sewers are proposed throughout the County's wastewater system over the next 30 to 40 years. These improvements are listed in more detail in Appendix E. All service strategies also include an inflow and infiltration

Summary of System Components by Strategy[1]
Table 3-1

Service Strategy	Treatment Plants			Conveyance System						Inflow and Infiltration	CSO[2]
	West Point (133 mgd existing capacity)	EDRP (115 mgd existing capacity)	North End	ETS Capacity Improve-ments	East Side Interceptor Parallel/ Storage	Parallel Kenmore Lakeline	North End Conveyance	Large Tunnel, Kenmore to Duwamish	Inflow and Infiltration Control	CSO North (Number of tanks shown in parentheses)	CSO South (Number of tanks shown in parentheses)
1	159 mgd (2020)[3]	154 mgd (2010) 191 mgd (2030) 235 mgd (2040)	--	3rd outfall leg (2000) 20 mg storage (2015)	Minor (2000) 5 mg storage (2005) Entire after 2030	Yes (2010)	--	--	Full scale I/I reduction (2010)	Store in 1 tank Store in 3 tanks Upgrade 2 storage tanks	Store & treat on site (6) Storage Only (1) Store & treat upgrades (4)
2	159 mgd (2010)	154 mgd (2023) 172 mgd (2042)	35 mgd (2018) 65 mgd (2032)	3rd outfall leg (2010) 20 mg storage (2015)	Minor (2000)	Yes (2003)	N. end plant conveyance (2018)	--	Minor scale I/I reduction (2010)	Store in 1 tank Store in 3 tanks & up-grade 2 tanks	Store & treat (6) Storage only (1) Store & treat upgrades (4)
3	Stays at 133 mgd	154 mgd (2020) 172 mgd (2040)	35 mgd (2010) 55 mgd (2020) 89 mgd (2030)	3rd outfall leg (2004) 20 mg storage (2007)	Minor (2000)	--	N. end plant conveyance (2010)	--	Minor scale I/I reduction (2010)	Store in 1 tank Store in 3 tanks Upgrade 2 Storage tanks	Store & treat on site (6) Storage Only (1) Store & treat upgrades(4)
4	159 mgd (2010)	154 mgd (2020) 191 mgd (2030) 235 mgd (2040)	--	20 mg storage (2030)	Minor (2000)	--	--	North (2005) Central (2010) South force main (2020)	Full scale I/I reduction (2010)	Store in Large Tunnel (2010)	Store in Central to South CSO Tunnel (2020) and tanks (7)

[1]Unshaded boxes indicate facilities expected to come into operation between 1998 and 2010. Light shading indicates facilities expected to come into operation between 2010 and 2030. Dark shading indicates facilities expected to come into operation after 2030.

[2]In addition to the CSO storage tanks and treatment facilities enumerated for each alternative, every alternative also includes 15 small CSO projects. All of these projects are scheduled for completion by 2010, although some could be delayed until as late as 2020.

[3]Unless otherwise indicated, numbers in parenthesis indicate years by which the associated facilities are expected to come into operation. Capacities for treatment plants (mgd) are total capacities for the year depicted (they are not in addition to previous capacities).

ea1002B9F2doc, p:\winword\waterpln\sscompnt.doc

(I/I) component that ranges between a very aggressive level and a maintenance level. The level of I/I control, as well as the timing required to achieve it, is included under each service strategy. The potential environmental impacts of these common proposed facilities are addressed in discussions of impacts common to all elements of the service strategies, provided in Chapter 5.

Biosolids Management

All of the service strategies assume that King County will continue to emphasize recycling of biosolids. Biosolids processing currently includes digesters and dewatering facilities at each treatment plant. Each service strategy describes the number of new digesters that would be needed and when they would need to come on-line.

King County will continue to maintain a high quality biosolids product, consider new technologies, and participate in regional collaboration and research.

Potential for Water Reuse

The use of reclaimed water to supplement water supply is of interest to a number of community members and local elected officials. While present costs for providing reclaimed water generally exceed those for development of a new potable supply, some reuse service proposals are economically viable and are being implemented, with several others potentially viable in the near-term. Examples of potential applications of reclaimed water include wastewater treatment plant process water, landscape irrigation, and industrial heating and cooling.

Both the East and West Treatment Plants have recently added reclamation facilities to produce Class A reclaimed water under the Washington State reuse standards. If an additional treatment plant were added to the regional system (the North Treatment Plant described in SS 2 and SS 3), it would be designed to include reuse production facilities. Reclaimed water produced at the treatment plants is available for landscape irrigation and as process water within the treatment plants, where water of less than potable quality is acceptable.

Service Strategy 1

Service Strategy 1 splits the northern flows between the two existing treatment plants, first expanding the East Treatment Plant (by 2010), then the West Treatment Plant (by 2020). Initially sending the flow to the East Treatment Plant requires expansion of the North Creek Pump Station near Bothell (in 2000), and constructing a parallel pipeline to the Kenmore Interceptor (by 2010) to send a portion of the northern flow to the West Treatment Plant. Sending additional flow to the East Treatment Plant in later years requires constructing a parallel pipeline along two-thirds of the Eastside Interceptor (ESI) by 2035, and the addition of storage for the Effluent Transfer System, which transports treated effluent to the outfall in Puget Sound, off Duwamish Head. See the Figure 3-1 for a graphic representation of the elements comprising SS1. The defining features of this strategy are presented in Table 3-2.

Table 3-2. Defining Features of Service Strategy 1
Maintain the existing two-treatment-plant system (West and East Treatment Plants).
Expand the East Treatment Plant capacity by 2010, with subsequent expansions required at the East and West Treatment Plants.
Parallel the Kenmore Interceptor by 2010.
Parallel two-thirds of the ESI by 2035 to carry flows to the East Treatment Plant.
Include a full-scale I&I reduction program.
Store CSOs along the Lake Union Ship Canal in large, underground storage tanks, and convey them to the West Treatment Plant after peak flows subside.
Store CSOs south of the Lake Union Ship Canal on-site and/or provide treatment at CSO locations.
Produce Class B Biosolids using anaerobic digestion at both plants pending analysis of other technologies.
Produce Class A reclaimed water at both treatment plants.

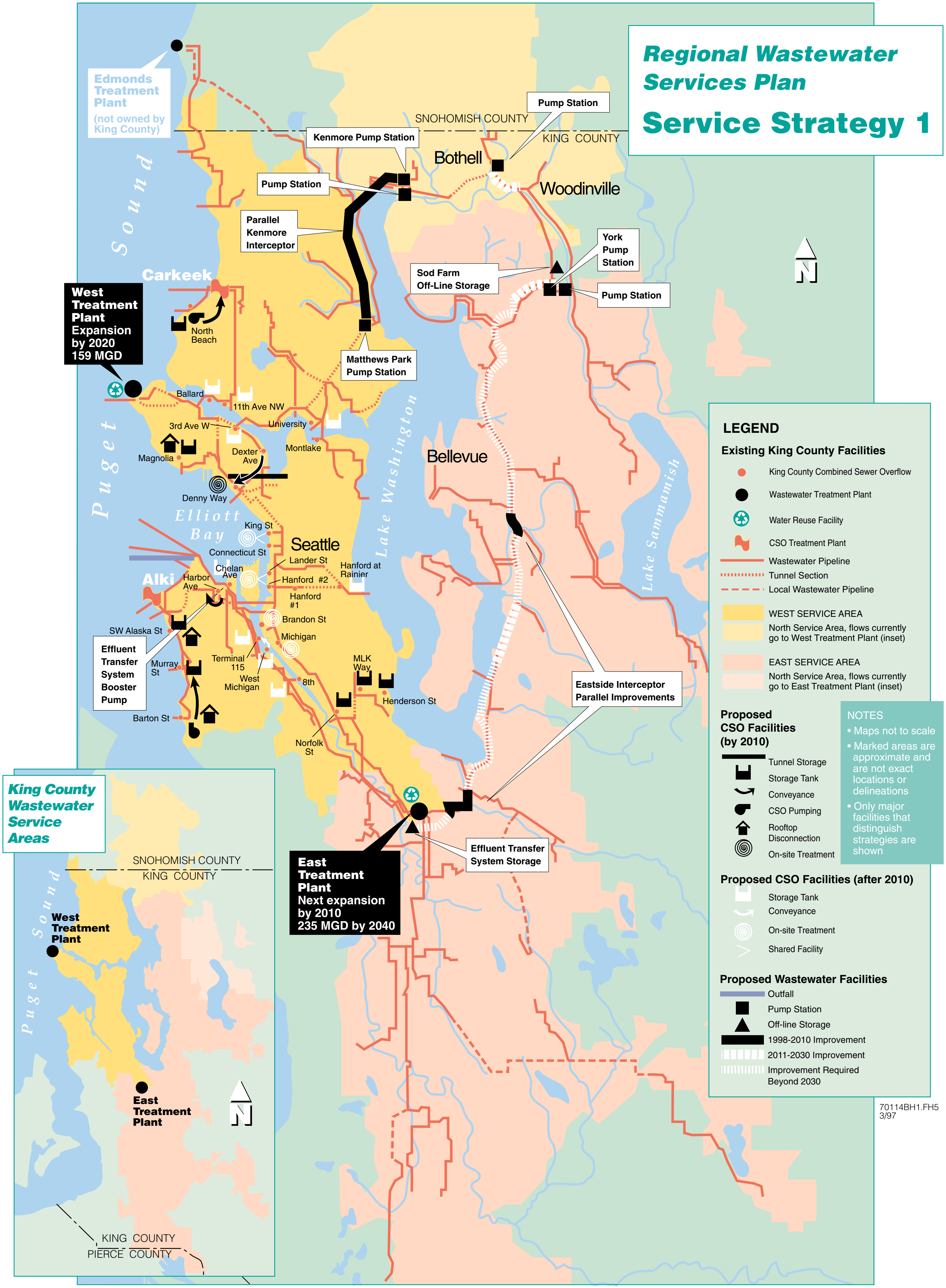
Wastewater Treatment and Conveyance

East Service Area. To accommodate the expected increase in flow, the East Treatment Plant would be enlarged from 115 to 154 mgd by 2010. Long-term capacity needs in the East Service Area would be met by subsequent expansions of the East Treatment Plant in 2030 and 2040 to an ultimate capacity of 235 mgd. The expansions of the East Treatment Plant would serve growth in south Snohomish and north King Counties, the Eastside, and the southern portion of the service area from Renton south to Auburn.

The need for additional conveyance capacity would be met by adding a third leg to the existing Effluent Transfer System outfall off Duwamish Head by 2000 and constructing 20 million gallons of storage at the East Treatment Plant site by 2015. If I/I reduction goals were not fully met, further expansion of Effluent Transfer System capacity would be necessary.

To accommodate the additional growth-related flow in the East Service Area, approximately 20 million gallons of storage would be needed along the Eastside Interceptor and it would be necessary to construct parallel pipes to portions of the Eastside Interceptor after 2030. Five million gallons of storage would be constructed by 2005 in the northern portion of the East Service Area to provide sufficient capacity to avoid overflows from the Eastside Interceptor and the Kenmore Interceptor through 2010.

West Service Area. Long-term treatment capacity needs in the West Service Area would be met by expanding the West Treatment Plant to its maximum capacity of 159 mgd in 2020.


Regional Wastewater Services Plan
Service Strategy 1
Edmonds Treatment Plant (not owned by King County)
SNOHOMISH COUNTY
KING COUNTY
Pump Station
Kenmore Pump Station
Pump Station
Parallel Kenmore Interceptor
Bothell
Woodinville
York Pump Station
Sod Farm Off-Line Storage
Pump Station
Matthews Park Pump Station
Puget Sound
Carkeek
West Treatment Plant Expansion by 2020 159 MGD
North Beach
Ballard
11th Ave NW
3rd Ave W
University
Magnolia
Dexter Ave
Montlake
Denny Way
Lake Washington
Bellevue
Elliott Bay
King St
Connecticut St
Seattle
Lander St
Chelan Ave
Hanford at Rainier
Alki
Harbor Ave
Hanford #2
Hanford #1
Brandon St
SW Alaska St
Michigan
Effluent Transfer System Booster Pump
Murray St
Terminal 115
West Michigan
MLK Way
8th
Henderson St
Barton St
Norfolk St
Lake Sammamish
Eastside Interceptor Parallel Improvements
Effluent Transfer System Storage
East Treatment Plant Next expansion by 2010 235 MGD by 2040
King County Wastewater Service Areas
SNOHOMISH COUNTY
KING COUNTY
West Treatment Plant
East Treatment Plant
KING COUNTY
PIERCE COUNTY
LEGEND
Existing King County Facilities
King County Combined Sewer Overflow
Wastewater Treatment Plant
Water Reuse Facility
CSO Treatment Plant
Wastewater Pipeline
Tunnel Section
Local Wastewater Pipeline
WEST SERVICE AREA
North Service Area, flows currently go to West Treatment Plant (inset)
EAST SERVICE AREA
North Service Area, flows currently go to East Treatment Plant (inset)
Proposed CSO Facilities (by 2010)
Tunnel Storage
Storage Tank
Conveyance
CSO Pumping
Rooftop Disconnection
On-site Treatment
NOTES
• Maps not to scale
• Marked areas are approximate and are not exact locations or delineations
• Only major facilities that distinguish strategies are shown
Proposed CSO Facilities (after 2010)
Storage Tank
Conveyance
On-site Treatment
Shared Facility
Proposed Wastewater Facilities
Outfall
Pump Station
Off-line Storage
1998-2010 Improvement
2011-2030 Improvement
Improvement Required Beyond 2030
70114BH1.FH5 3/97

Increased flows in the northern portion of the West Service Area would require that the Kenmore Pump Station be upgraded by 2010 in preparation for the parallel of the entire length of the Kenmore Interceptor by 2010.

In 2015, flows from south Snohomish and north King Counties would be transferred back to the West Service Area to coincide with the West Treatment Plant expansion, freeing up capacity at the East Treatment Plant to accommodate growth in the south and east. To minimize conveyance expansions, an I/I reduction program in local sewer systems would target 30 percent reduction of peak I/I by 2010.

Combined Sewer Overflows

The size and timing of construction of most of the CSO control facilities must be integrated with the service strategy conveyance system. For example, paralleling the Kenmore Interceptor eventually brings more flows to the West Treatment Plant, increasing the volume of CSOs along the way. To accommodate higher flows, CSO control facilities along the Lake Washington Ship Canal must be larger than if the Kenmore Interceptor was not paralleled and must be in place in time to offset any increase in overflows.

Proposed CSO projects include storage tanks and on-site treatment, as well as rooftop disconnection and implementing side-sewer repair programs in certain basins. The disconnection and repair programs would be most useful in reducing CSO volume at North Beach, Southwest Alaska, Southwest Murray, and Southwest Barton streets. These programs would also be helpful (but to a lesser extent) for South Magnolia and the CSOs located along Alki Beach in West Seattle. On a broader scale, these programs could be used to increase the effectiveness of the Martin Luther King, Jr. Way and Henderson CSO projects to completely eliminate CSOs at this location.

Some CSO projects may either be constructed directly to the state-mandated one-event-per-year control level, or phased to four events per year with additional capacity added at a later date to reach the one-event-per-year level. Additional improvements would be required at the West Treatment Plant for the additional CSOs conveyed there. These improvements should be on-line by 2017. See Table 3-3 for details.

I/I Program

The I/I reduction program for Service Strategy 1 would target all basins in the separated system for reduction activities. The program would investigate sources of I/I by using flow monitoring, smoke testing, video inspection, and existing component agency knowledge and focus on correcting problems with the projects that are most cost-effective to implement. The program would reduce inflow sources by disconnecting roof drains, sealing manhole covers, and removing storm drain cross connections. Infiltration would be reduced by lining or grouting mains, side sewers, and manholes. The program would also coordinate and improve local agency efforts to upgrade new sewer construction standards and practices. In addition, King County would work with local agencies to implement maintenance practices and construction techniques designed to ensure that newer systems contribute as little I/I as possible.

Table 3-3. Proposed CSO Projects for Service Strategy 1			
		CSO Control Date	
CSO Location	Project Description	4 Events per year	1 Event per year
North Beach	Storage tank and pump station enlargement		2009
Ballard	1.0-mg storage tank (40% King County)		2033
11th Ave. NW	2.0-mg storage tank		2034
University/Montlake	4.6-mg storage tank	2012	
University/Montlake Upgrade	7.4-mg additional storage		2039
Harbor	Conveyance		1998
Denny Way/Dexter	14.5-ft tunnel treatment facility		2006
Martin Luther King Jr. Way	6.2-mg storage		2006
Norfolk	0.8-mg storage		2007
Henderson	1.3-mg storage tank		2007
SW Alaska	0.7-mg storage tank		2008
Chelan	4.0-mg storage tank		2025
Connecticut	2.1-mg storage/treatment tank		2028
King Street	Conveyance to Connecticut treatment		2029
West Michigan	Conveyance enlargement		2030
Terminal 115	0.5-mg storage tank		2030
3rd Avenue West	5.0-mg storage tank	2033	
3rd Avenue West Upgrade	2.0-mg additional storage		2043
South Magnolia	0.9-mg storage tank	2008	
South Magnolia Upgrade	0.4-mg additional storage		2022
Murray	0.2-mg storage	2009	
Murray Upgrade	0.6-mg additional storage		2023
Barton	Pump station enlargement	2009	
Barton Upgrade	Pump station upgrade		2023
Lander	1.0-mg storage/treatment @ Hanford	2019	
Lander Upgrade	0.5-mg addition @ Hanford		2040
Hanford #2	3.0-mg storage/treatment tank	2015	
Hanford Upgrade	0.3-mg additional storage/treatment		2039
Hanford@Rainier	0.6-mg storage tank		2029
Brandon	0.4-mg storage/treatment tank	2022	
Brandon Upgrade	0.4-mg additional storage/treatment		2041
Michigan	1.1-mg storage/treatment tank	2021	
Michigan Upgrade	1.1-mg additional storage/treatment		2041
8th Avenue South	0.8-mg storage tank	2030	
8th Avenue South Upgrade	0.2-mg additional storage		2042
West Point Improvements	Primary and/or secondary enhancements		2017

Since inflow reduction is typically more cost-effective than infiltration reduction, it is likely that some level of inflow reduction would occur in all targeted basins. Infiltration reduction is targeted primarily for the north-end McAleer-Lyon basin tributary to the Kenmore Interceptor and the southern basins containing Eastside Interceptor Section l, the Cedar River Trunk, and the South Interceptor.

Achieving a target peak flow reduction of 30 percent would affect conveyance lines throughout the system. The size of future parallels to most of the Eastside Interceptor would be reduced, and the need for much of the costly capacity expansion of the Effluent Transfer System would be avoided. The service strategy description assumes that 30 percent I/I reduction will be achieved. Many of the smaller trunks and interceptor improvements, including parallels to the Issaquah Interceptor and Eastgate Trunk, would be either delayed or eliminated.

The total net present value of this program is estimated at $155 million (including both King County and local agency funding), with most spent by 2010. Since most I/I enters through the local systems, the component agencies would probably fund 30 to 40 percent of these costs, as was the case for two I/I reduction pilot projects completed with the cities of Kent and Issaquah.

If I/I control efforts were not effective, conveyance system capacity would have to be increased sooner, and the size of future parallel pipelines would be increased. The Effluent Transfer System capacity would have to be increased as well. This could add significant costs to this strategy. Service Strategy Option 4G addresses the implications of not (or of unsuccessfully) implementing I/I Control (see Chapter 12).

Biosolids

Under this strategy, the West Treatment Plant will need two digesters in addition to the six already in operation. The first will be needed by 2009, and the second by 2029. The East Treatment Plant will need two digesters in addition to the four already in operation. The first will be needed by 2009, and the second by 2029.

Schedule for Implementation

Table 3-4 lists the facility improvements necessary to accommodate current population and employment projections under SS1. The timing for facilities required before 2010 is more certain than for projects required after 2010.

Service Strategy 2

Service Strategy 2 splits the northern flows between the West Treatment Plant and a new treatment plant in north King or south Snohomish County. The flows are first sent to the West Treatment Plant. Until a new plant is constructed, therefore, all northern flows are conveyed through the Kenmore Interceptor, requiring it to be paralleled by 2003. The West Treatment Plant would be expanded by 2010, and the first phase of the new North

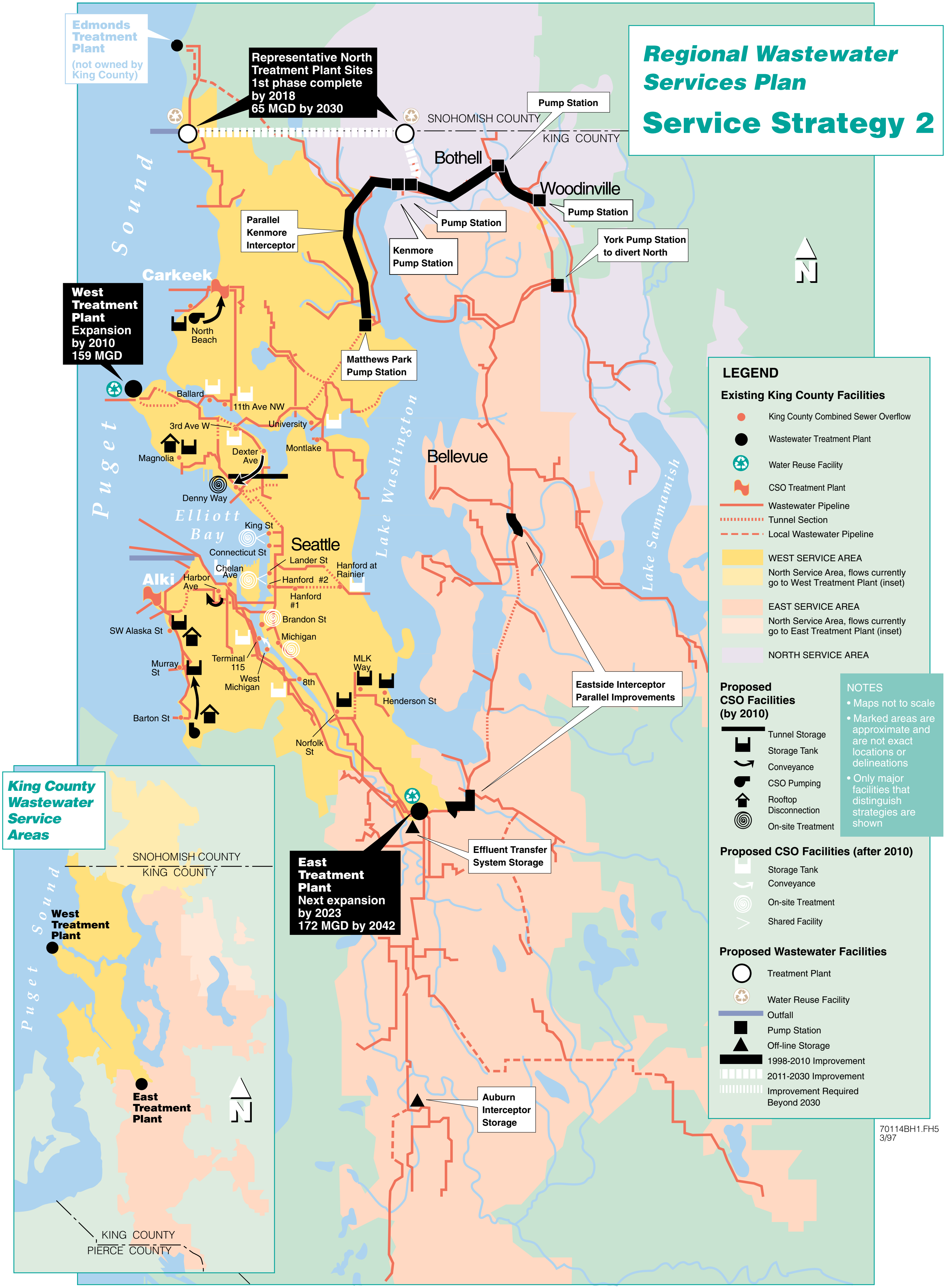
Treatment Plant would be constructed by 2018. The East Treatment Plant would be expanded to 154 mgd in 2023 and to 172 mgd in 2042. Proposed expansions and new facilities proposed for SS2 are shown in Figure 3-2. The defining features of this strategy are presented in Table 3-5.

Table 3-4. Service Strategy 1
List of Capital Facilities (by year required on-line)

1996 2000 2005 2010 2015 2020 2025 2030

- ESI - Wilburton Siphon
- Harbor Ave. CSO
- ESI - Section 1
- Increase North Creek & York Pump Station Capacities
- Inflow/Infiltration Reduction Program
- Off-Line Sod Farm Storage
- Denny & Dexter CSO
- South Henderson CSO Storage
- Martin Luther King Way CSO Storage
- S Magnolia CSO Storage
- Norfolk CSO Storage
- Murray CSO Storage
- Barton Pump Station
- SW Alaska CSO Storage
- North Beach CSO Storage
- Parallel Kenmore Interceptor
- Increase East Plant Capacity to 154 mgd
- Effluent Transfer System Third Outfall
- Increase Kenmore & Matthews Pump Station Capacities
- University & Montlake CSO Storage
- Bothell/Woodinville Interceptor Sections 1 & 2
- Effluent Transfer System Storage
- In-line Storage; Parallel Hazelwood Tunnel
- Hanford #2
- West Plant CSO Improvements
- Lander CSO Storage/Treatment
- Increase West Plant Capacity to 159 mgd
- Increase Kenmore Capacity
- Michigan CSO Storage/Treatment
- Brandon CSO Storage/Treatment
- South Magnolia Upgrade
- Murray Upgrade
- Barton Upgrade
- Chelan CSO
- King Street CSO
- Connecticut CSO
- Hanford @ Rainier CSO
- 8th Ave. S CSO Storage
- W Michigan Conveyance
- Upgrade E. Plant Cap (191 mgd)
- Terminal 115

1996 2000 2005 2010 2015 2020 2025 2030



Regional Wastewater Services Plan
Service Strategy 2
Edmonds Treatment Plant (not owned by King County)
Representative North Treatment Plant Sites 1st phase complete by 2018 65 MGD by 2030
SNOHOMISH COUNTY
KING COUNTY
Pump Station
Bothell
Woodinville
Pump Station
Pump Station
Parallel Kenmore Interceptor
Kenmore Pump Station
York Pump Station to divert North
Puget Sound
Carkeek
West Treatment Plant Expansion by 2010 159 MGD
North Beach
Matthews Park Pump Station
Ballard
11th Ave NW
University
3rd Ave W
Magnolia
Dexter Ave
Montlake
Lake Washington
Bellevue
Denny Way
Elliott Bay
King St
Connecticut St
Seattle
Lake Sammamish
Lander St
Hanford at Rainier
Alki
Chelan Ave
Harbor Ave
Hanford #2
Hanford #1
Brandon St
SW Alaska St
Michigan
Terminal 115
West Michigan
Murray St
MLK Way
8th
Henderson St
Barton St
Norfolk St
Eastside Interceptor Parallel Improvements
East Treatment Plant Next expansion by 2023 172 MGD by 2042
Effluent Transfer System Storage
Auburn Interceptor Storage
King County Wastewater Service Areas
SNOHOMISH COUNTY
KING COUNTY
West Treatment Plant
Puget Sound
East Treatment Plant
KING COUNTY
PIERCE COUNTY
LEGEND
Existing King County Facilities
King County Combined Sewer Overflow
Wastewater Treatment Plant
Water Reuse Facility
CSO Treatment Plant
Wastewater Pipeline
Tunnel Section
Local Wastewater Pipeline
WEST SERVICE AREA
North Service Area, flows currently go to West Treatment Plant (inset)
EAST SERVICE AREA
North Service Area, flows currently go to East Treatment Plant (inset)
NORTH SERVICE AREA
Proposed CSO Facilities (by 2010)
Tunnel Storage
Storage Tank
Conveyance
CSO Pumping
Rooftop Disconnection
On-site Treatment
NOTES
• Maps not to scale
• Marked areas are approximate and are not exact locations or delineations
• Only major facilities that distinguish strategies are shown
Proposed CSO Facilities (after 2010)
Storage Tank
Conveyance
On-site Treatment
Shared Facility
Proposed Wastewater Facilities
Treatment Plant
Water Reuse Facility
Outfall
Pump Station
Off-line Storage
1998-2010 Improvement
2011-2030 Improvement
Improvement Required Beyond 2030
70114BH1.FH5
3/97

Table 3-5. Defining Features of Service Strategy 2
Create a three-treatment-plant system (comprised of West Treatment Plant, the East Treatment Plant, and a new North Treatment Plant).
Expand the capacity at the West Treatment Plant to 159 mgd by 2010.
Construct a new North Treatment Plant in north King or south Snohomish County by 2018.
Expand the East and North Treatment Plants by 2023 and 2032, respectively.
Parallel the Kenmore Interceptor by 2003.
Construct a conveyance system to carry influent to the North Treatment Plant and an outfall from the North Treatment Plant to Puget Sound by 2018.
Include a small-scale I&I reduction program.
Store CSOs along the Lake Union Ship Canal in large underground storage tanks for conveyance to the West Treatment Plant after peak flows subside.
Store CSOs south of the Lake Union Ship Canal on-site and/or provide treatment at CSO locations.
Produce Class B biosolids by using anaerobic digestion at all three plants pending analysis of other technologies.
Produce Class A reclaimed water at all three plants.

Wastewater Treatment and Conveyance

East Service Area. Long-term treatment capacity needs in the East Service Area would be met by expanding the East Treatment Plant to 154 mgd by 2023 and 172 mgd by 2042. The expansions of the East Treatment Plant would serve growth on the Eastside and southern service area from Renton south to Auburn.

The need for additional conveyance capacity would be met by adding a third leg to the existing Effluent Transfer System outfall off Duwamish Head by the year 2000, and constructing 20 million gallons of storage at the treatment plant site by 2015.

West Service Area. Treatment capacity in the West Service Area would first be increased by expanding the West Treatment Plant in 2010 from 133 to 159 mgd. Expansion at the West Treatment Plant would serve growth in the western portion of north King and south Snohomish Counties.

To accommodate the additional flow going to the West Treatment Plant, the Kenmore Interceptor would have to be paralleled by 2003. This would require upgrades to the Kenmore, York, and Matthews Beach Park pump stations.

North Service Area. Long-term treatment capacity needs in the North Service Area would be met by constructing a new 35-mgd North Treatment Plant and marine outfall by 2018, and expanding the plant to 65 mgd by 2032. The northeastern portion of the West Service Area, including parts of south Snohomish County, would eventually be served by the new North Treatment Plant, along with the area north of Lake Sammamish.

New influent and effluent conveyance systems would be constructed for the North Treatment Plant. Part of the increased flow in the northern portion of the West Service Area would be sent to the plant. To transfer this flow, a tunnel would be constructed from the Kenmore Pump Station to the plant, along with a new pump station. Flows that could not be accommodated in the existing Bothell-Woodinville Interceptor would be conveyed to the Kenmore Pump Station with 20,000 feet of forcemain from the North Creek Pump Station. Finally, modifications to the York Pump Station in Redmond would also transfer some East Service Area flows to the North Creek Pump Station to be conveyed to the Kenmore Pump Station and then to the North Treatment Plant.

By sending a portion of the East Service Area flows to the new North Treatment Plant, sufficient capacity would remain in the Eastside Interceptor and the East Treatment Plant Effluent Transfer System to prevent the need for major capacity upgrades. This excess capacity would also reduce the scope of the I/I reduction program from a systemwide program to one that targeted localized problems.

If the new North Treatment Plant were located some distance from Puget Sound, a new effluent pipeline extending from the plant west to Puget Sound would have to be constructed by 2018. Conversely, if the plant were located near the Sound, an influent pipeline would have to be constructed to the plant from the Kenmore area by that year. A new effluent outfall would be constructed in either case.

Combined Sewer Overflows

SS2 is identical to SS1, both in total cost and the implementation schedule of CSO projects. The size and timing of construction of most of the CSO control facilities must be integrated with the service strategy conveyance system. For example, paralleling the Kenmore Interceptor eventually brings more flows to the West Treatment Plant, increasing the volume of CSO along the way. To accommodate higher overflows, CSO control facilities along the Lake Union Ship Canal must be larger than if the Kenmore Interceptor were not paralleled, and must be in place in time to offset any increase in overflows.

CSO projects include storage tanks and on-site treatment, as well as rooftop disconnection and side-sewer repair programs in certain basins. The disconnection and repair programs would be most useful in reducing CSO volume at North Beach, Southwest Alaska, Murray, and Barton. These programs would also be helpful, but to a lesser extent, for South Magnolia and the CSOs located along Alki Beach in West Seattle. On a broader scale, these programs could be used to increase the effectiveness of Martin Luther King, Jr. Way and Henderson projects to completely eliminate CSOs at this location.

Some CSO projects may be constructed either directly to the state-mandated one-event-per-year control level or phased to four events per year, with additional capacity being added at a later date to reach the one-event-per-year level. Additional improvements will have to be undertaken at the West Treatment Plant to treat additional CSOs conveyed to the treatment plant. These improvements should be on-line by 2017. A complete list of proposed improvements is presented in Table 3-6.

I/I Program

The proposed I/I program for SS2 would be smaller than for SS1, as there would be fewer economic benefits. While the scale of the program would be reduced, the type of activities would remain the same. The program would investigate for sources of I/I using flow monitoring, smoke testing, video inspection, and existing agency knowledge. It would reduce inflow sources by disconnecting roof drains, sealing manhole covers, and removing storm drain cross connections. Infiltration would be reduced by lining or grouting mains, side sewers, and manholes. The program would also coordinate and improve local agency efforts to upgrade new sewer construction standards and practices.

The King County facilities affected under this program would be primarily the Issaquah Interceptor, Eastgate Trunk, Lake Hills Interceptor, and Bryn Mawr Siphon. Some of the smaller trunks and interceptors in the southern portion of the East Service Area may also be affected, pending more detailed investigation.

The total net present value of this program is estimated at $23 million (including both King County and local agency funding), with most spent by 2010. Since most I/I enters through the local systems, the component agencies would probably fund 30 to 40 percent of these costs, as was the case for two I/I reduction pilot projects completed with the cities of Kent and Issaquah.

Biosolids

Under this strategy, the West Treatment Plant will need two additional digesters by the year 2009. The East Treatment Plant will also need two digesters: one by 2019, and the second by 2029. The North Treatment Plant will need three digesters by the year 2019.

Schedule for Implementation

Table 3-7 lists the facility improvements necessary to accommodate current population and employment projections. The timing for facilities required before 2010 is more certain than for projects required after 2010.

Table 3-6. Proposed CSO Projects for Service Strategy 2			
		CSO Control Date	
CSO Location	Project Description	4 Events per year	1 Event per year
North Beach	Storage tank and pump station enlargement		2009
Ballard	1.0-mg storage tank (40% King County)		2033
11th Ave. NW	2.0-mg storage tank		2034
University/Montlake	4.6-mg storage tank	2012	
University/Montlake Upgrade	7.4-mg additional storage		2039
Harbor	Conveyance		1998
Denny Way/Dexter	14.5-ft tunnel treatment facility		2006
Martin Luther King Jr. Way	6.2-mg storage		2006
Norfolk	0.8-mg storage		2007
Henderson	1.3-mg storage tank		2007
SW Alaska	0.7-mg storage tank		2008
Chelan	4.0-mg storage tank		2025
Connecticut	2.1-mg storage/treatment tank		2028
King Street	Conveyance to Connecticut treatment		2029
West Michigan	Conveyance enlargement		2030
Terminal 115	0.5-mg storage tank		2030
3rd Avenue West	5.0-mg storage tank	2033	
3rd Avenue West Upgrade	2.0-mg additional storage		2043
South Magnolia	0.9-mg storage tank	2008	
South Magnolia Upgrade	0.4-mg additional storage		2022
Murray	0.2-mg storage	2009	
Murray Upgrade	0.6-mg additional storage		2023
Barton	Pump station enlargement	2009	
Barton Upgrade	Pump station upgrade		2023
Lander	1.0-mg storage/treatment @ Hanford	2019	
Lander Upgrade	0.5-mg addition @ Hanford		2040
Hanford #2	3.0-mg storage/treatment tank	2015	
Hanford Upgrade	0.3-mg addition		2039
Hanford@Rainier	0.6-mg storage tank		2029
Brandon	0.4-mg storage/treatment tank	2022	
Brandon Upgrade	0.4-mg additional storage/treatment		2041
Michigan	1.1-mg storage/treatment tank	2021	
Michigan Upgrade	1.1-mg additional storage/treatment		2041
8th Avenue South	0.8-mg storage tank	2030	
8th Avenue South Upgrade	0.2-mg additional storage		2042
West Point Improvements	Primary and/or secondary enhancements		2017

Table 3-7. Service Strategy 2
List of Capital Facilities (by year required on-line)

1996 2000 2005 2010 2015 2020 2025 2030

- ESI - Wilburton Siphon
- Harbor Avenue CSO
- ESI - Section 1
- Increase York Pump Station Capacity
- Increase Kenmore & Matthews Park Pump Station Capacities
- Parallel Kenmore Interceptor
- Inflow/Infiltration Reduction Program
- S Henderson CSO Storage
- Denny & Dexter CSO
- South Magnolia CSO Storage
- Norfolk CSO Storage
- Murray CSO Storage
- Barton Pump Station CSO
- SW Alaska CSO Storage
- North Beach CSO Storage
- Bothell/Woodinville Interceptor 1 & 2
- Modify York Pump Station to Pump North
- Increase West Plant Capacity to 159 mgd
- North Creek Flows to Kenmore
- University & Montlake Storage
- Effluent Transfer System 3rd Outfall
- Hanford #2
- Effluent Transfer System Storage
- West Plant CSO Improvements
- Lander CSO Storage/Treatment
- North Plant On-Line (35 mgd)
- New Kenmore Pump Station
- Tunnel from Kenmore to North Plant
- North Plant Outfall
- Force Main from Kenmore PS to North Plant Tunnel
- Auburn Interceptor Storage
- Michigan CSO Storage/Treatment
- Brandon CSO Storage/Treatment
- South Magnolia Upgrade
- Murray Upgrade
- Barton Upgrade
- Increase East Plant Cap to 154 mgd
- Chelan
- Connecticut CSO
- King Street CSO
- 8th Ave. S CSO Storage
- W Michigan CSO Conveyance
- Hanford @ Rainier
- Terminal 115 CSO Storage
- Incr N Creek PS Cap
- Incr Kenmore PS Cap

1996 2000 2005 2010 2015 2020 2025 2030

Service Strategy 3

Service Strategy 3 treats all flows from the northern portion of the West Service Area at a new treatment plant in north King or south Snohomish County. The first phase of construction would be completed by 2010. This would eliminate the need to expand the West Treatment Plant or parallel the Kenmore Interceptor. The East Treatment Plant would eventually be expanded to handle the increased flows in the southern and eastern portions of the system. Proposed expansions and new facilities included in Service Strategy 3 are shown in Figure 3-3. The defining features of this strategy are presented in Table 3-8.

Table 3-8. Defining Features of Service Strategy 3
Create a three-treatment-plant system (West Treatment Plant, East Treatment Plant, and new North Treatment Plant).
Construct a new North Treatment Plant to accommodate 35 mgd by 2010.
Expand both the East and the North Treatment Plants by 2020 and 2030, respectively; no expansion is required at the West Treatment Plant.
Construct a conveyance system to carry influent to the new North Treatment Plant and an outfall from this plant to Puget Sound by 2010.
Initiate a smaller scale I&I reduction program.
Store CSOs along the Lake Union Ship Canal in underground storage tanks for conveyance to the West Treatment Plant after peak flows subside.
Store CSOs south of the Lake Union Ship Canal on-site and/or provide treatment at CSO locations.
Produce Class B biosolids by using anaerobic digestion at all three plants pending analysis of other technologies.
Produce Class A reclaimed water at all three plants.

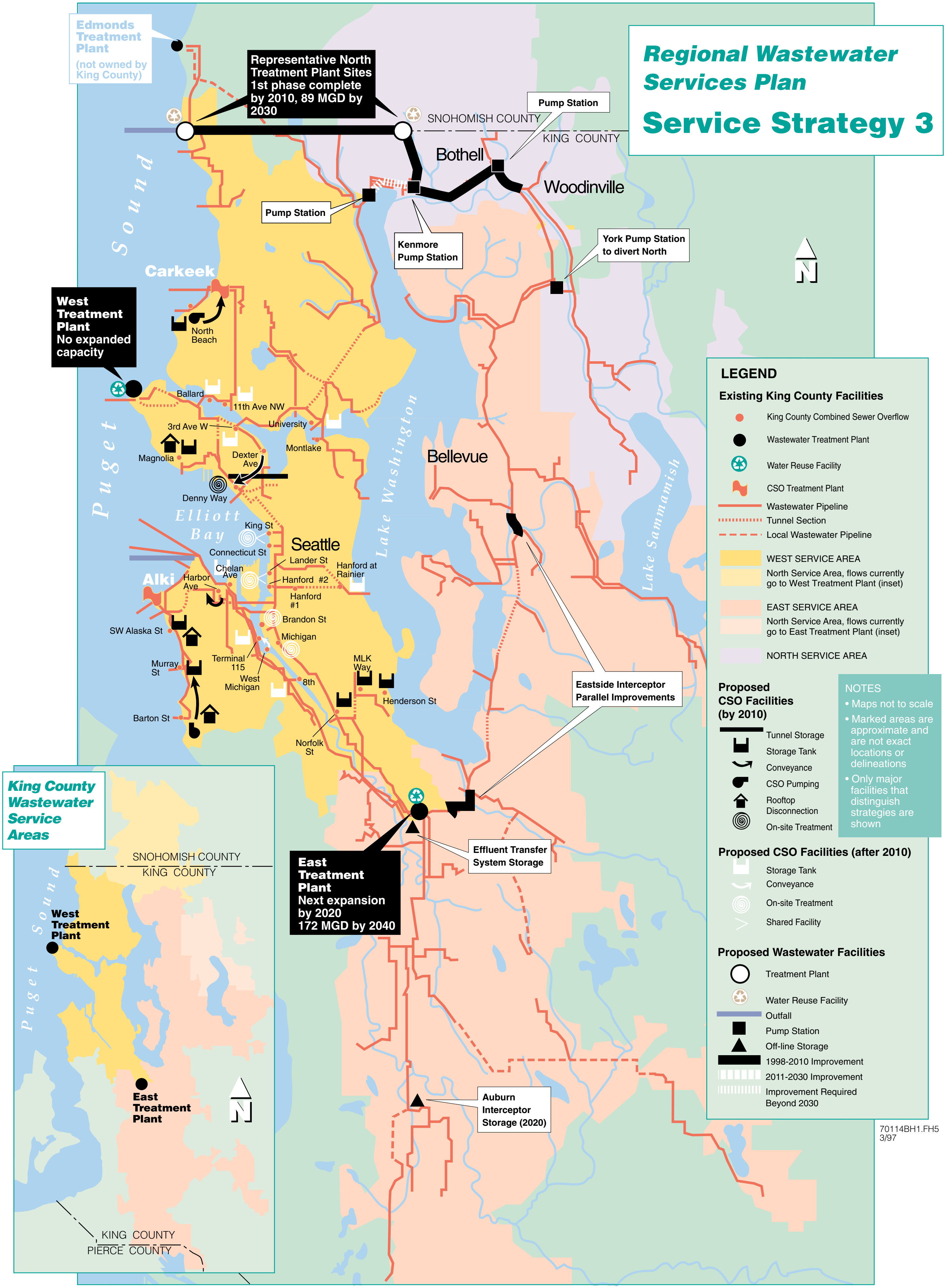
Wastewater Treatment and Conveyance

East Service Area. Long-term treatment capacity needs in the East Service Area would be met by expanding capacity at the East Treatment Plant to 154 mgd by 2020 and to 172 mgd by 2040. Expansions of the East Treatment Plant would serve growth on the Eastside and the southern portion of the East Service Area from Renton south to Auburn.

Additional capacity requirements for the Effluent Transfer System from the East Treatment Plant would be met by adding a third leg to the existing outfall at Duwamish Head in 2004 and constructing a 20-million-gallon, off-line storage tank in 2007.

West Service Area. The West Treatment Plant would not be expanded under this service strategy, and there would be no parallel of the Kenmore Interceptor.

North Service Area. Treatment capacity would be increased by constructing a new 35-mgd North Treatment Plant by 2010. Longer-term capacity needs would be met by expanding the North Treatment Plant to 55 mgd by 2020 and to 89 mgd by 2030. The North Treatment Plant would serve north King and south Snohomish Counties, along with the area north of Lake Sammamish. Transferring these flows to the North Treatment



Regional Wastewater Services Plan
Service Strategy 3
Edmonds Treatment Plant
(not owned by King County)
Representative North Treatment Plant Sites 1st phase complete by 2010, 89 MGD by 2030
SNOHOMISH COUNTY
KING COUNTY
Pump Station
Bothell
Woodinville
Pump Station
Kenmore Pump Station
York Pump Station to divert North
Puget Sound
Carkeek
West Treatment Plant No expanded capacity
North Beach
Ballard
11th Ave NW
3rd Ave W
University
Magnolia
Montlake
Dexter Ave
Denny Way
Elliott Bay
King St
Connecticut St
Seattle
Lake Washington
Bellevue
Lake Sammamish
Alki
Harbor Ave
Chelan Ave
Lander St
Hanford at Rainier
Hanford #2
Hanford #1
Brandon St
SW Alaska St
Michigan
Terminal 115
Murray St
West Michigan
8th
MLK Way
Henderson St
Barton St
Norfolk St
Eastside Interceptor Parallel Improvements
Effluent Transfer System Storage
East Treatment Plant Next expansion by 2020 172 MGD by 2040
Auburn Interceptor Storage (2020)
King County Wastewater Service Areas
SNOHOMISH COUNTY
KING COUNTY
Puget Sound
West Treatment Plant
East Treatment Plant
KING COUNTY
PIERCE COUNTY
LEGEND
Existing King County Facilities
King County Combined Sewer Overflow
Wastewater Treatment Plant
Water Reuse Facility
CSO Treatment Plant
Wastewater Pipeline
Tunnel Section
Local Wastewater Pipeline
WEST SERVICE AREA
North Service Area, flows currently go to West Treatment Plant (inset)
EAST SERVICE AREA
North Service Area, flows currently go to East Treatment Plant (inset)
NORTH SERVICE AREA
Proposed CSO Facilities (by 2010)
Tunnel Storage
Storage Tank
Conveyance
CSO Pumping
Rooftop Disconnection
On-site Treatment
NOTES
• Maps not to scale
• Marked areas are approximate and are not exact locations or delineations
• Only major facilities that distinguish strategies are shown
Proposed CSO Facilities (after 2010)
Storage Tank
Conveyance
On-site Treatment
Shared Facility
Proposed Wastewater Facilities
Treatment Plant
Water Reuse Facility
Outfall
Pump Station
Off-line Storage
1998-2010 Improvement
2011-2030 Improvement
Improvement Required Beyond 2030
70114BH1.FH5
3/97

Plant would make available sufficient capacity at the West Treatment Plant at its present size to treat projected flows on the west side.

New influent and effluent conveyance systems would be constructed for the North Treatment Plant. Part of the increased flow in the northern portion of the West Service Area would be sent to the plant. To transfer this flow, a tunnel would be constructed from the Kenmore Pump Station to the plant, along with a new pump station. Flows that could not be accommodated in the existing Bothell-Woodinville Interceptor would be conveyed to the Kenmore Pump Station with 20,000 feet of the force main from the North Creek Pump Station. Finally, modifications to the York Pump Station in Redmond would also transfer some East Service Area flows to the North Creek Pump Station to be conveyed to the Kenmore Pump Station and then to the North Treatment Plant.

By sending a portion of the East Service Area flows to the new North Treatment Plant, enough capacity would remain in the Eastside Interceptor and East Treatment Plant Effluent Transfer System to prevent major capacity upgrades. This excess capacity would also reduce the scope of the I/I reduction program from a systemwide program to one that targeted localized problems.

If the new North Treatment Plant were located some distance from Puget Sound, a new effluent pipeline extending from the plant west to Puget Sound would have to be constructed by 2018. Conversely, if the plant were located near the Sound, an influent pipeline would have to be constructed to the plant from the Kenmore area by that year. A new effluent outfall would be constructed in either case.

Combined Sewer Overflows

Without a parallel Kenmore Interceptor bringing more flows south into Seattle, CSO volumes north of the Lake Union Ship Canal would be smaller than under SS1 and SS2. This would allow for smaller CSO control facilities.

CSO projects include storage tanks and on-site treatment, as well as rooftop disconnection and side-sewer repair programs in certain basins. The disconnection and repair programs would be most useful in reducing CSO volume at North Beach, and Southwest Alaska, Murray, and Barton streets. These programs would be helpful (but to a lesser extent) for South Magnolia and the CSOs located along Alki Beach in West Seattle. On a broader scale, these programs could be used to increase the effectiveness of Martin Luther King, Jr. Way and the Henderson projects to completely eliminate CSOs at this location.

Some CSO projects may be constructed either directly to the one-event-per-year control level, or phased to four events per year with additional capacity being added at a later date to reach the one-event-per-year level. Additional improvements would be required at the West Treatment Plant for additional CSOs conveyed there. These improvements should be on-line by 2017. A complete list of proposed improvements is presented in Table 3-9.

Table 3-9. Proposed CSO Projects for Service Strategy 3			
		CSO Control Date	
CSO Location	**Project Description**	**4 Events per year**	**1 Event per year**
North Beach	Storage tank and pump station enlargement		2009
Ballard	1.0-mg storage tank (40% King County)		2031
11th Ave. NW	2.0-mg storage tank		2033
University/Montlake	2.6-mg storage tank	2012	
University/Montlake Upgrade	4.9-mg additional storage		2036
Harbor	Conveyance		1998
Denny Way/Dexter	14.5-ft tunnel treatment facility		2006
Martin Luther King Jr. Way	6.2-mg storage		2006
Norfolk	0.8-mg storage		2007
Henderson	1.3-mg storage tank		2007
SW Alaska	0.7-mg storage tank		2008
Chelan	4.0-mg storage tank		2024
Connecticut	2.1-mg storage/treatment tank		2027
King Street	Conveyance to Connecticut treatment		2028
West Michigan	Conveyance enlargement		2029
Terminal 115	0.5-mg storage tank		2029
3rd Avenue West	3.5-mg storage tank	2033	
3rd Avenue West Upgrade	1.5-mg additional storage		2040
South Magnolia	0.9-mg storage tank	2008	
South Magnolia Upgrade	0.4-mg additional storage		2021
Murray	0.2-mg storage	2009	
Murray Upgrade	0.6-mg additional storage		2022
Barton	Pump station enlargement	2009	
Barton Upgrade	Pump station upgrade		2022
Lander	1.0-mg storage/treatment @ Hanford	2018	
Lander Upgrade	0.5-mg addition @ Hanford		2037
Hanford #2	3.0 mg storage/treatment tank	2014	
Hanford Upgrade	0.3-mg addition		2036
Hanford@Rainier	0.6-mg storage tank		2028
Brandon	0.4-mg storage/treatment tank	2021	
Brandon Upgrade	0.4-mg additional storage/treatment		2038
Michigan	1.1-mg storage/treatment tank	2020	
Michigan Upgrade	1.1-mg additional storage/treatment		2038
8th Avenue South	0.8-mg storage tank	2029	
8th Avenue South Upgrade	0.2-mg additional storage		2039
West Point Improvements	Primary and/or secondary enhancements		2016

I/I Program

The proposed I/I program for SS3 is essentially the same as for SS2.

Biosolids

Under this strategy, both the East and West Treatment Plants will need one additional digester by the year 2009. The North Treatment Plant will need four digesters: two by 2009, one by 2019, and one by 2029.

Schedule for Implementation

Table 3-10 lists the facility improvements necessary to accommodate current population and employment projections. The timing for facilities required before 2010 is more certain than for projects required after 2010.

Service Strategy 4

Service Strategy 4 splits the northern flows between the two existing treatment plants, as in SS1. However, flows that exceed the capacity of the existing Kenmore and Eastside Interceptors are conveyed south through a new deep tunnel underneath the City of Seattle. Eventually, the tunnel would be operated to optimize efficiency by routing variable flows to the East and West Treatment Plants. The tunnel eliminates the need to parallel the Kenmore and Eastside Interceptors and provides storage capacity for CSOs. The West Treatment Plant would be expanded to 159 mgd by 2010. The East Treatment Plant would first be expanded to 154 mgd in 2020, with successive expansions to an ultimate capacity of 235 mgd in 2040. The facilities proposed for SS4 are shown in Figure 3-4. The defining features of this strategy are presented in Table 3-11.

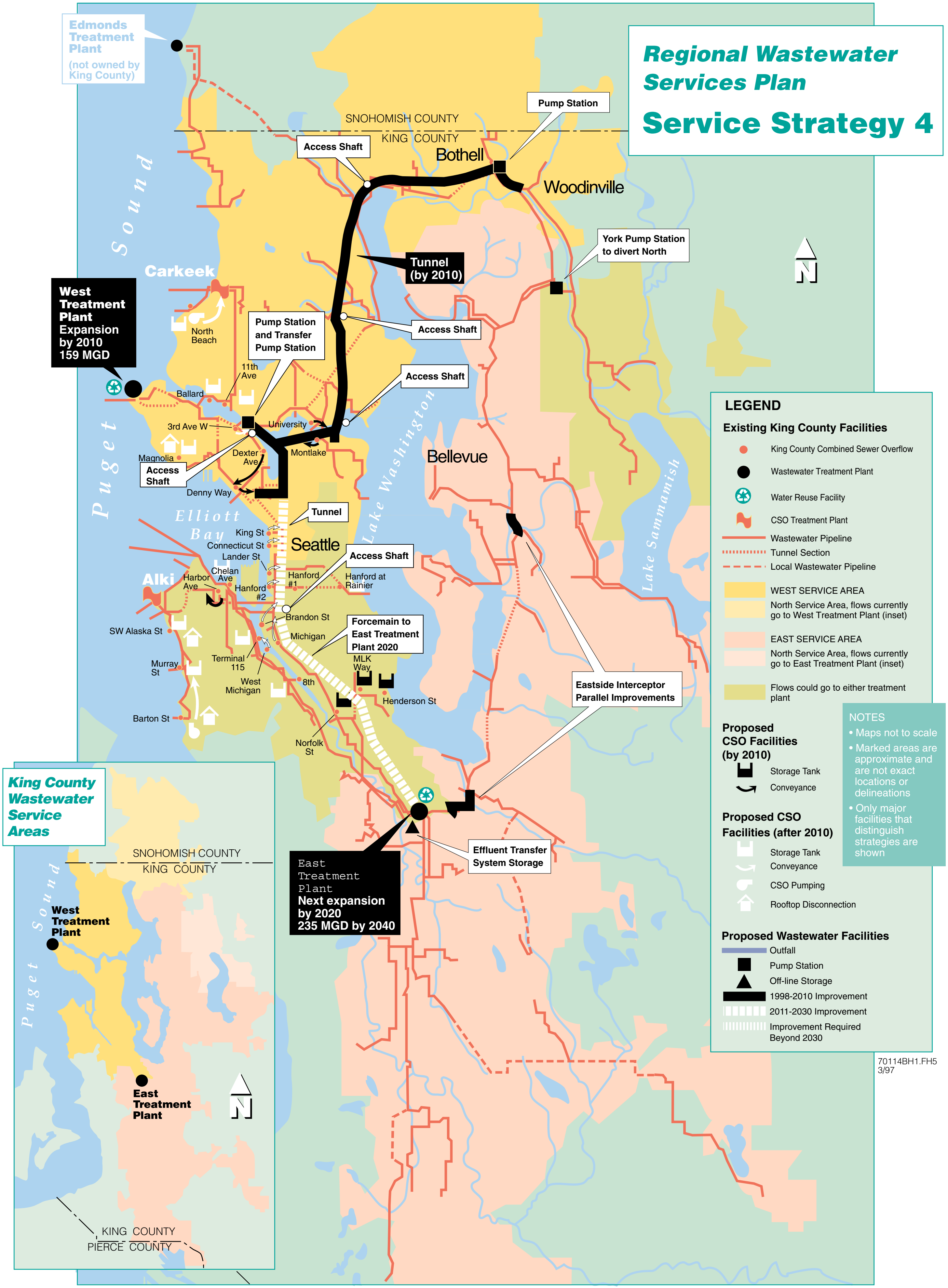
Table 3-10. Service Strategy 3

List of Capital Facilities (by year required on-line)

1996 2000 2005 2010 2015 2020 2025 2030

- ESI – Wilburton Siphon
- Harbor CSO
- ESI Section 1
- Increase York Pump Station Capacity
- Off-Line Storage at Sod Farm
- Effluent Transfer System Third Outfall
- Effluent Transfer System Storage to Reduce Peak Flows
- Inflow/Infiltration Reduction Program
- Denny Way and Dexter
- Martin Luther King Way CSO Storage
- S Henderson CSO Storage
- South Magnolia CSO Storage
- Norfolk CSO Storage
- Murray CSO Storage
- Barton Pump Station
- SW Alaska CSO Storage
- Bothell/Woodinville Interceptor 1 & 2
- North Beach CSO Storage
- Construct North Plant (35 mgd)
- Convey North Creek Flows to Kenmore
- Force Main from New Kenmore PS to North Plant Tunnel
- Modify York Pump Station to Pump 36 mgd North
- North Plant Outfall
- 85 mgd PS from Kenmore to Pump to Tunnel to North Plant
- Tunnel from Kenmore to North Plant
- Hanford at Rainier CSO Storage
- University and Montlake CSO
- Hanford #2 CSO Storage
- West Plant CSO Improvements
- Lander CSO Storage/Treatment
- Increase East Plant Cap to 154 mgd
- Increase North Plant Cap to 55 mgd
- Increase North Creek PS to 90 mgd
- Increase New Kenmore PS Cap to 185 mgd
- Michigan CSO Storage/Treatment
- Auburn Interceptor Storage
- Brandon CSO Storage/Treatment
- South Magnolia Upgrade
- Murray Upgrade
- Barton Upgrade
- Chelan CSO
- Connecticut CSO Storage
- King Street CSO Storage
- Hanford @ Rainier CSO
- 8th Ave. S CSO Storage
- W Michigan CSO Conveyance
- Terminal 115 Storage
- Increase North Plant Cap to 89 mgd
- Incr New Kenmore PS Cap to 240 mgd

1996 2000 2005 2010 2015 2020 2025 2030



Regional Wastewater Services Plan
Service Strategy 4
Edmonds Treatment Plant
(not owned by King County)
SNOHOMISH COUNTY
KING COUNTY
Pump Station
Access Shaft
Bothell
Woodinville
York Pump Station to divert North
Tunnel (by 2010)
Puget Sound
Carkeek
West Treatment Plant Expansion by 2010 159 MGD
North Beach
Pump Station and Transfer Pump Station
Access Shaft
Access Shaft
11th Ave
Ballard
3rd Ave W
University
Montlake
Magnolia
Dexter Ave
Access Shaft
Denny Way
Lake Washington
Bellevue
Elliott Bay
Tunnel
King St
Connecticut St
Lander St
Seattle
Access Shaft
Alki
Harbor Ave
Chelan Ave
Hanford #1
Hanford at Rainier
Hanford #2
Brandon St
SW Alaska St
Michigan
Forcemain to East Treatment Plant 2020
Terminal 115
MLK Way
Murray St
West Michigan
8th
Henderson St
Barton St
Norfolk St
Eastside Interceptor Parallel Improvements
Lake Sammamish
Effluent Transfer System Storage
East Treatment Plant Next expansion by 2020 235 MGD by 2040
King County Wastewater Service Areas
SNOHOMISH COUNTY
KING COUNTY
Puget Sound
West Treatment Plant
East Treatment Plant
KING COUNTY
PIERCE COUNTY
N
LEGEND
Existing King County Facilities
King County Combined Sewer Overflow
Wastewater Treatment Plant
Water Reuse Facility
CSO Treatment Plant
Wastewater Pipeline
Tunnel Section
Local Wastewater Pipeline
WEST SERVICE AREA
North Service Area, flows currently go to West Treatment Plant (inset)
EAST SERVICE AREA
North Service Area, flows currently go to East Treatment Plant (inset)
Flows could go to either treatment plant
Proposed CSO Facilities (by 2010)
Storage Tank
Conveyance
Proposed CSO Facilities (after 2010)
Storage Tank
Conveyance
CSO Pumping
Rooftop Disconnection
Proposed Wastewater Facilities
Outfall
Pump Station
Off-line Storage
1998-2010 Improvement
2011-2030 Improvement
Improvement Required Beyond 2030
NOTES
• Maps not to scale
• Marked areas are approximate and are not exact locations or delineations
• Only major facilities that distinguish strategies are shown
70114BH1.FH5
3/97

Table 3-11. Defining Features of Service Strategy 4
Maintain the existing two-treatment-plant system (West and East Treatment Plants).
Expand the treatment capacity at the West Treatment Plant by 2010.
Expand the treatment capacity at East Treatment Plant in 2020, 2030, and 2040.
Construct an 18-mile-long deep tunnel in phases from the Kenmore Pump Station to the Duwamish Pump Station for wastewater conveyance and CSO storage.
Include a full-scale I&I reduction program.
Produce Class B biosolids by using anaerobic digestion at both plants pending analysis of other technologies.
Produce Class A reclaimed water at both treatment plants.

Wastewater Treatment and Conveyance

East Service Area. Long-term treatment capacity needs would be met by expanding capacity at the East Treatment Plant to 154 mgd by 2020, to 191 mgd by 2030, and to 235 mgd by 2040.

The need for additional capacity in the Effluent Transfer System would be met in the long term by reducing peak flows through I/I control, adding 20 million gallons of storage, and by storing excess flows in the deep tunnel.

West Service Area. For treatment of wastewater flows from the West Service Area, this strategy assumes that the West Treatment Plant would be expanded to its maximum capacity of 159 mgd by 2010 and that no new plants would be constructed.

Increased flows in the northern portion of the West Service Area would be conveyed to the West Treatment Plant through an 18-foot-diameter, deep tunnel, constructed mainly under street rights-of-way from the Kenmore Pump Station to Westlake Avenue in Seattle. The northern tunnel would be built in two phases, with the first phase (Kenmore to Thornton Creek) completed by 2005 and the second phase (Thornton Creek to Westlake Avenue) completed by 2010. The northern tunnel would connect to a central, 24-foot-diameter deep tunnel to the Duwamish Pump Station to provide storage of stormwater flows (CSOs and I/I) in the system. To transfer flows from the tunnel to the West Treatment Plant, an 80-mgd pump station would be constructed near Third Avenue West.

Construction of the deep tunnel increases system capacity in several ways. First, it conveys north King and south Snohomish County flows to coincide with the expansion at the West Treatment Plant. In 2020, the tunnel would connect to the East Treatment Plant by a force main, allowing flows to be transferred to the East Treatment Plant west of Lake Washington, eliminating the need to parallel the Eastside Interceptor. Capacity requirements for the Effluent Transfer System would be met by temporarily storing peak flows in the tunnel until they could be treated and discharged at either the East or the West Treatment Plants. To minimize the size of the tunnel, an I/I reduction program would target a 30 percent reduction of peak I/I. Without the 30 percent peak I/I reduction, the force main connecting the Duwamish Pump Station to the East Plant would have to be replaced with another section of deep tunnel to provide necessary storage capacity.

Combined Sewer Overflows

Under SS4, most CSOs north and south of the Lake Union Ship Canal are stored in the series of connecting tunnels and treated at the West Treatment Plant. Due to the construction of the deep tunnel, only those overflows along the Alki beaches in West Seattle can be reasonably phased to control CSOs to four events each year as the interim step, with one event each year at a later date. CSOs at Ballard, North Beach, Magnolia, and Chelan would be controlled via off-line storage tanks.

In addition, treatment plant improvements would be instituted by 2040 to accommodate additional loadings at the West Treatment Plant resulting from CSOs conveyed to the plant after storage. A complete list of proposed improvements is presented in Table 3-12 below.

I/I Program

The I/I reduction program for SS4 is the same as for SS1.

Biosolids

Under Service Strategy 4, the West Treatment Plant will require two additional digesters: one by 2009 and one by 2019. The East Treatment Plant will require two additional digesters under this strategy.

Schedule for Implementation

Table 3-13 lists the facility improvements necessary to accommodate current population and employment projections. The timing for facilities required before 2010 is more certain than for projects required after 2010.

Table 3-12. Proposed CSO Projects for Service Strategy 4			
		CSO Control Date	
CSO Location	Project Description	4 Events per year	1 Event per year
North Beach	Storage tank and pump station enlargement		2032
Ballard	1.0-mg storage tank (40% King County)		2033
11th Ave. NW	2.0-mg storage tank		2034
University/Montlake	Increase Kenmore tunnel diameter		2010
Harbor	Conveyance		1998
Denny Way	18-ft tunnel with drop structure		2006
Martin Luther King Jr. Way	6.2-mg storage		2006
Norfolk	0.8-mg storage		2007
Henderson	1.3-mg storage tank		2007
SW Alaska	0.7-mg storage tank		2031
Chelan	4.0-mg storage tank		2036
3rd Avenue West	3rd W tunnel audit and pump station		2020
Connecticut	Drop structure to deep tunnel		2020
King Street	Drop structure to deep tunnel		2020
Lander	Drop structure to deep tunnel		2020
Hanford #2	Drop structure to deep tunnel		2020
West Michigan	Conveyance enlargement		2041
Terminal 115	0.5-mg storage tank		2042
South Magnolia	0.9-mg storage tank	2031	
South Magnolia Upgrade	0.4-mg additional storage		2042
Murray	0.2-mg storage	2032	
Murray Upgrade	0.6-mg additional storage		2043
Barton	Pump station enlargement	2032	
Barton Upgrade	Pump station upgrade		2043
Michigan/Brandon	84-inch conveyance to deep tunnel		2041
8th Avenue South	1.0-mg storage tank		2041
West Point Improvements	Primary and/or secondary enhancements		2020

Table 3-13. Service Strategy 4
List of Capital Facilities (by year required on-line)

1996 2000 2005 2010 2015 2020 2025 2030

- ESI - Wilburton Siphon
- Harbor Avenue
- ESI - Section 1
- Increase York Pump Station Capacity to 68 mgd
- North End of Kenmore to Thornton Creek Tunnel
- Convey North Creek Flows to Kenmore
- Inflow/Infiltration Reduction Project
- Modify York Pump Station
- Bothell/Woodinville Interceptor 1 & 2
- Denny Way Tunnel
- Martin Luther King Way
- Henderson CSO Storage
- Norfolk
- Complete Tunnel - Thornton Creek to Westlake including Montlake
- Increase West Plant Capacity to 159 mgd
- University and Montlake to Kenmore Tunnel
- Increase North Creek PS Capacity to 83 mgd
- Tunnel Storage - Westlake & Nickerson to Duwamish
- West Plant CSO Improvements
- Tunnel 3rd West Addition
- 3rd Ave. W Pump Station to West Plant
- Force Main from Duwamish PS to East Plant
- Increase East Plant Capacity to 154 mgd
- 3rd NW Transfer PS
- Incr East Plant Cap to 191 mgd
- ETS Storage

1996 2000 2005 2010 2015 2020 2025 2030

COMPARISON OF SERVICE STRATEGY IMPACTS

Table 3-14 provides a comparison of the potential environmental impacts of the four service strategies. These impacts are described in greater detail in Chapters 5 through 8, and 11 of this document.

Water Quality Comparison

While the collection, treatment, and discharge of wastewater affects many elements of the environment, a key environmental issue is the potential impact of each service strategy on the region's water quality. For this reason, an overview of the water quality issues raised by the RWSP and a comparison of water quality impacts by service strategy is presented below.

NOTE: This table compares impacts of the four service strategies as presented in the Draft RWSP. See Part I for this comparison table of revised service strategies.

TABLE 3-14, COMPARISON OF SERVICE STRATEGY IMPACTS

Elements of the Environment	Impacts Common to all Strategies	Service Strategy 1		Service Strategy 2		Service Strategy 3		Service Strategy 4		No Action	
		Construction	Operation	Construction	Operation	Construction	Operation	Construction	Operation	Construction	Operation
Earth	Biosolids application: Amending soils with biosolids improves soil tilth, reducing wind erosion. Federal regulations limit amount of biosolids applied, minimizing potential for metals buildup in soil. Reuse of reclaimed water: Constituents (e.g. metals) with the potential to build up in soils are not present in Class A reclaimed water in sufficient quantities to cause adverse impacts to soils.	Areas of high potential for contaminated soils: Duwamish valley, Kenmore, Montlake. Lesser potential along Eastside Interceptor.	CSO: Treatment of discharge and reduced frequency/volume of discharges overall will reduce deposition of contaminants in sediments near outfalls.	Same as SS 1 plus Pt. Wells, if used for North Plant or North outfall.	Same as SS1.	Same as SS 2.	Same as SS1.	Areas of high potential for contaminated soils: Duwamish valley, Kenmore, Montlake.	Greater improvement to sediments off CSOs than other service strategies because there would be fewer discharge events at many existing CSO points.	Least likelihood of impacts because only projects now planned or under development would be carried out.	Potentially greater impacts than SSs because CSOs and SSOs would increase over time, increasing soil and sediment contamination.
Air	Construction: Potential fugitive dust and exhaust emissions at construction sites and along associated haul routes for all construction sites. Operation: Emission of Volatile Organic Compounds from treatment plants would increase with wastewater flow. Odor emissions would occur at some points along pipelines and tunnels, and at treatment plants. Odor at treatment plants depends on liquids and solids processing technologies selected. Biosolids: Musty odor from Class B	No specific additional impacts.	Increased odor potential to sensitive odor receptors adjacent to West Plant (park, residences). This SS has the largest increase in capacity at East Plant, which would increase odor potential, but there are no adjacent sensitive odor receptors.	Same as SS 1	New North Plant and conveyance would generate odors; sites not known. Increased odor potential to sensitive odor receptors adjacent to West Plant (park, residences). Increase in East Plant capacity would increase odor potential, but there are no adjacent sensitive odor receptors.	Same as SS 1	Same as SS 2 except no expansion and increased odor potential at West Plant.	Same as SS 1	Same as SS 1.	No impacts beyond projects now planned or under development.	Sewer overflows would contain odorous materials. Odor potential would be greatest from separated sewer system overflows; odors could persist until cleanup was complete.

NOTE: This table compares impacts of the four service strategies as presented in the Draft RWSP. See Part I for this comparison table of revised service strategies.

Elements of the Environ-ment	**Impacts Common to all Strategies**	**Service Strategy 1**		**Service Strategy 2**		**Service Strategy 3**		**Service Strategy 4**		**No Action**	
		Construction	Operation	Construction	Operation	Construction	Operation	Construction	Operation	Construction	Operation
Air (cont'd)	biosolids for a short time after application. Less odor with aplication of Class A, although it may be more dusty. <u>Reuse</u>: Aerosols may be generated from spray applications; risks to health are negligible.										
Water	<u>Construction</u>: Impacts can include erosion from construction sites, causing sedimentation, increased turbidity, increased runoff, increased nutrients and chemicals in runoff and changes in receiving water temperature. <u>Treatment Operation</u>: Increased pollutant loading to Puget Sound, although all discharges would meet water quality standards, permit requirements and legal agreements. <u>CSO Operation</u>: Significant reduction in all pollutant loadings to receiving waters. <u>I/I Operation</u>: Small increases in surface water runoff and groundwater recharge. Slightly longer water residence times during wet weather in some areas that tend to accumulate water	Involves greatest potential extent of shallow conveyance construction, including Eastside Interceptor parallel & potential construction of parallel Kenmore Interceptor in Lake Washington. This could result in more widespread construction impacts on water than other service strategies due to several potential salmonid stream crossings (Eastside Interceptor) and in-lake construction (Kenmore Parallel). Routes and/or construction methods could be chosen that minimized these impacts.	<u>Treatment and Conveyance</u>: Involves greatest discharge from East Plant outfall, which discharges to south-ward-flowing water layer from which flushing from Puget Sound is slower than at West Plant or potential North Plant outfalls. <u>CSO</u>: Storage/ treatment improves water quality in Elliott Bay and Duwamish River. Improvement not as great as SS 4's storage and secondary treatment at East and West Plants. <u>I/I</u>: Larger-scale program would remove largest amount of water from sewers, displacing surface water and groundwater. Could exacerbate local flooding.	Less potential for water impacts than SS 1 because Eastside Interceptor paralleling is minimal. Potential impacts due to North Plant conveyance would be minor because much of this conveyance would be tunneled. Potential in-water construction of Kenmore Interceptor parallel, would impact Lake Washington water quality.	<u>Treatment and Conveyance</u>: More rapid flushing of effluent from Puget Sound than SS 1 and 4 because more flows routed through new North Plant outfall, which would discharge effluent flows into fast, northward-flowing upper water layer. <u>CSO</u>: Same as SS 1. <u>I/I</u>: Smaller-scale program would remove some water from sewers, displacing to surface water and ground-water. Could exacerbate local flooding, though to lesser degree than larger program.	Lack of Kenmore interceptor parallel would eliminate potential construction impacts to Lake Washington.	Same as SS 2, except North Service Area flows that would have gone to West Plant go through large North Plant. <u>CSO</u>: Same as SS1. <u>I/I</u>: Same as SS2.	Less potential impact on water than the other SSs because most construction impacts would be associated with tunnel portals, which would be located mainly in urban areas away from water bodies.	<u>Treatment and Conveyance</u>: About the same as SS 1. <u>CSO</u>: Greatest improvement to Elliott Bay and Duwamish River because CSOs given centralized treatment at regional treatment plants and are discharged through deep water outfalls. <u>I/I</u>: Larger-scale program as in SS 1.	No impacts beyond projects now planned or under development.	Least protection of Puget Sound water quality due to eventual occurrence of sewage overflows and increasing CSO discharges Overflows from separated sewer system would increasingly contaminate surface waters (streams and lakes) and ground waters. Increasing CSO discharges would contaminate Puget Sound and other surface waters such as the Duwamish River and the Lake Washington Ship Canal. Contamination would increase over time if no action were taken.

NOTE: This table compares impacts of the four service strategies as presented in the Draft RWSP. See Part I for this comparison table of revised service strategies.

Elements of the Environ-ment	Impacts Common to all Strategies	Service Strategy 1		Service Strategy 2		Service Strategy 3		Service Strategy 4		No Action	
		Construction	Operation	Construction	Operation	Construction	Operation	Construction	Operation	Construction	Operation
Water (cont'd)	Biosolids: Use of best management practices results in no probable adverse impacts to surface or groundwater quality. Reuse: By adhering to Washington interim standards, applying Class A reclaimed water would have no adverse impacts to water quality.										
Biological Resources	Construction: Adverse impacts on aquatic life through water quality effects described above. Adverse impacts on terrestrial life through habitat destruction or alteration associated with construction activities. Conveyance pipelines often located in lowland areas; could disturb streams or wetlands. Outfall construction in marine environment could disrupt marine habitat, including eelgrass beds, and associated biota. Biosolids: Generally increases plant productivity. No adverse impacts to wildlife anticipated. Reuse: Adverse impacts to wildlife unlikely with Class A reclaimed water. If	Involves greatest potential extent of shallow conveyance construction, including Eastside Interceptor parallel & potential construction of parallel Kenmore Interceptor in Lake Washington. This could result in more widespread construction impacts on biological resources (e.g., salmon, terrestrial wildlife) than other SSs. If parallel Kenmore Interceptor constructed in Lake Washington, in-water dredging would disturb fresh water biota.	Increasing flows from East and West Plant outfalls could have localized adverse impacts on benthic organisms. Reduced CSOs would improve local habitat quality in the Duwamish River, Elliott Bay, the Lake Washington Ship Canal, and Puget Sound off West Seattle and North Beach.	Less potential for biological impacts than SS 1 because Eastside Interceptor paralleling is minimal. Potential impacts due to North Plant conveyance would be minor because much of this conveyance would be tunneled; impacts of new conveyance from Kenmore Pump Station to new plant would depend upon treatment plant site selected.	Same as SS 1 plus the same types of impacts from new North Plant outfall. But since this SS would reduce flows through the East Plant outfall by routing flows through the North Plant outfall, and flushing from the Sound would be more rapid from the North Plant outfall (since discharges would be to upper water layers), overall Sound-wide impacts of this SS could be less than SS 1. CSO: Same as SS 1.	Same as SS 2 except no potential impacts to Lake Washington biological resources from Kenmore Interceptor parallel.	Same as SS 2.	Less potential impact on biological resources than the other SSs because most construction impacts would be associated with tunnel portals, which would be located mainly in already-developed urban areas. No new outfalls required, so no marine construction.	Greatest improvement to habitat quality in Duwamish River, Elliott Bay, the Lake Washington Ship Canal and Puget Sound beaches because CSOs would no longer be discharged there, but rather be treated and discharged from marine outfalls.	No impacts beyond projects now planned or under development.	Greatest potential for habitat degradation due to eventual occurrence of sewage overflows and increasing CSO discharges Overflows from separated sewer system would contaminate surface and ground waters. Increasing CSO discharges would contaminate Puget Sound and other surface waters such as streams and lakes. Contamination would increase over time if no action were taken. This contamination would degrade aquatic habitat value, adversely affecting plants and animals that use this habitat.

NOTE: This table compares impacts of the four service strategies as presented in the Draft RWSP. See Part I for this comparison table of revised service strategies.

Elements of the Environment	Impacts Common to all Strategies	Service Strategy 1		Service Strategy 2		Service Strategy 3		Service Strategy 4		No Action	
		Construction	Operation	Construction	Operation	Construction	Operation	Construction	Operation	Construction	Operation
Biological Resources (cont'd)	some constituents accumulate, could adversely affect growth and/or appearance of some plants.										
Public Services, Utilities and Energy	Construction: Construction of treatment and conveyance facilities would involve short-term increases in energy consumption (e.g.., fossil fuels and electricity). Operation: New or expanded facilities would increase electrical load demands. Reuse: Irrigation with reclaimed water places less demand on potable water supplies, extending those supplies particularly in drought periods.	No specific additional impacts.	Estimated additional electrical energy requirement for treatment (not including conveyance) in the year 2030 would be about 33.7 million kWh per year. There is no projection at this time for energy production to offset energy consumed.	Same as SS 1	Same as SS 1, except that the projected additional energy requirement for this service strategy is 32.4 million kWh per year.	Same as SS 1	Same as SS 1, except that the projected additional energy requirement for this service strategy is 35.6 million kWh per year.	Same as SS 1	Same as SS 1	No impacts beyond projects now planned or under development.	No impacts beyond projects now planned or under development.

NOTE: This table compares impacts of the four service strategies as presented in the Draft RWSP. See Part I for this comparison table of revised service strategies.

Elements of the Environ-ment	Impacts Common to all Strategies	Service Strategy 1		Service Strategy 2		Service Strategy 3		Service Strategy 4		No Action	
		Construction	Operation	Construction	Operation	Construction	Operation	Construction	Operation	Construction	Operation
Environ-mental Health	All service strategies would substantially reduce the volume of wastewater pollutants in the environment by controlling CSOs. Biosolids: Adherence to federal and state regulations for recycling of biosolids results in no probable adverse impacts to environmental health from exposure to pathogens, trace metals or organic compounds. Reuse: Treatment to Class A quality removes sufficient contaminants from wastewater such that reuse would pose a negligible risk to public health.	No specific additional impacts.	CSO storage/ treatment on Elliott Bay, Lake Washington Ship Canal and the Duwamish River improve protection of biological resources and human health. This protection not as great as centralized treatment and offshore discharge of CSO flows provided under SS 4. The Water Quality Assessment will determine the significance of this reduction in terms of benefits to Environmental Health.	Same as SS 1	Same as SS 1.	Same as SS 1	Same as SS 1.	Same as SS 1	All CSOs now discharging to Elliott Bay and the Duwamish River would be stored in the tunnel and routed to East or West Plant for treatment. This strategy would provide the greatest reduction in pollutant loadings to the Lake Washington Ship Canal, Elliott Bay and the Duwamish River compared to SSs 1, 2 and 3.	No impacts beyond projects now planned or under development.	Greatest potential for adverse impacts to human health through contact with or ingestion of pollutants, due to eventual occurrence of sewage overflows and increasing CSO discharges. Overflows from separated sewer system would contaminate surface and ground waters. Overflows could also release sewage to streets and basements. Increasing CSO discharges would contaminate Puget Sound and other surface waters. Increased contamination over time if no action were taken, increasing potential for human contact with disease-causing organisms in sewage.
Noise	Construction: Temporary localized noise impacts from operation of heavy equipment. Operation: Varying levels of operational noise at treatment plants and pump stations.	Construction noise at West Plant could affect sensitive noise receptors, including residences, park users.	Operational noise impacts at West Plant site should be minor due to ambient site background noise (water and wind). Truck noise would be heard in Discovery Park and at residences along Government Way. Landscape buffering would minimize operational noise impacts at East Plant.	Same as SS 1, plus potential construction noise impacts at new North Plant site. Potential impacts would depend on site chosen.	Same as SS 1 for West and East Plants. In addition, would add North Plant as potential new noise source, with potential impacts dependent on site chosen.	Same as SS2 except no construction at West Plant.	Same as SS 2 except fewer truck trips and less noise on West Plant access roads.	Same as SS 1.	Same as SS 1.	No impacts beyond projects now planned or under development.	No impacts beyond projects now planned or under development.

NOTE: This table compares impacts of the four service strategies as presented in the Draft RWSP. See Part I for this comparison table of revised service strategies.

Elements of the Environ-ment	Impacts Common to all Strategies	Service Strategy 1		Service Strategy 2		Service Strategy 3		Service Strategy 4		No Action	
		Construction	Operation	Construction	Operation	Construction	Operation	Construction	Operation	Construction	Operation
Land & Shoreline Use	Construction: Potential temporary impacts on access/use of some properties. Operation: Conversion of land to sewage treatment use (pipeline alignments, CSO tanks/treatment plants). Biosolids: Biosolids that are beneficially reused as a soil amendment/fertilizer are compatible with agricultural and forest land use. Composted Class A biosolids compatible with home garden and large scale landscaping use. Reuse: Reuse of Class A reclaimed water does not require land use restrictions although irrigated areas may be restricted to nighttime applications to reduce the potential for human exposure.	Construction of 3rd East Plant outfall & Kenmore Interceptor parallel could temporarily affect access to shorelines. This SS has potentially the most widespread impacts because it has the greatest potential extent of shallow conveyance construction.	Existing treatment plants would be expanded within existing property boundaries. West Treatment Plant is located in single-family zone. Some expansion facilities would be located in the conservancy management shoreline zone. Expansion would require a Council conditional use permit from the City of Seattle and adherence to 1991 West Point settlement agreement.	Less potential for widespread land use impacts than SS 1 because Eastside Interceptor paralleling is minimal. Similar to SS 1 for treatment plant construction, but adds impacts of North Plant construction. Land use impacts of North Plant conveyance would be less widespread because much of this conveyance would be tunneled, concentrating impacts at portals. Construction of parallel Kenmore Interceptor, third East Plant outfall and conveyance associated with the North End plant (including outfall) would have temporary shoreline impacts.	Relatively more impacts than SS 1. New North End plant would have long-term impacts on land use. Compatibility with zoning and shoreline regulations would depend on location selected for plant and outfall.	Similar to SS 2 but larger North Plant site. No impacts on Lake Washington shoreline because no Kenmore Interceptor parallel. No West Plant expansion.	Impacts similar to SS 2 but somewhat greater at North Plant because plant would be larger (89 vs 65 mgd). No West Plant expansion.	Treatment and Conveyance: Probably fewest impacts of the four SSs. Tunnel impacts would be temporary and at few locations (i.e., tunnel portals). CSO: Fewer CSO construction impacts because Elliott Bay and Duwamish CSOs would be routed through the large tunnel.	Existing treatment plants would be expanded within existing property boundaries as for SS1. No Kenmore Interceptor parallel or third East Plant Effluent Transfer System outfall.	No impacts beyond projects now planned or under development.	King County would fall out of compliance with the State Growth Management Act, which requires plans for capital facilities, including utilities, to meet projected demands of population growth. Building moratoria could be imposed if wastewater treatment capacity were insufficient, hampering future development in the region.
Recreation	Reuse: Class A reclaimed water is state-approved for irrigating parks, playfields and golf courses; potential adverse impacts are negligible. Beneficial impacts include enhanced plant (turf) growth and less reliance on existing water supplies, especially during drought when irrigation with potable water may be	Treatment and Conveyance: West Plant expansion would temporarily disrupt recreation on beach at West Point. East Plant third outfall construction could temporarily disrupt recreational boating and shoreline use at Duwamish Head. Kenmore Interceptor parallel could temporarily disrupt use of Burke-Gilman Trail,	Minimal long-term impacts on recreation. Some recreational space at Matthews Beach Park could be eliminated due to expansion of pump station associated with Kenmore Interceptor parallel. CSO: Some recreational space at Lowman Beach Park could be eliminated by Murray Avenue	Impacts would include those described under SS 1. Some additional temporary impacts could occur during construction of a North Plant and its conveyance, depending on sites selected.	North Plant is not expected to affect recreational uses but this won't be known prior to site selection. CSO: Same as SS1.	Fewer impacts than SSs 1 and 2 because West Plant wouldn't be expanded, and there would be no Kenmore Interceptor parallel. Other impacts of this SS would be same as SS 2.	Same as SS 2. CSO: Same as SS1.	Similar to SS 1 except no Kenmore Interceptor parallel and most impacts at tunnel portals.	Treatment and Conveyance: Probably involves the least impact because no Kenmore Interceptor parallel nor North Plant. East and West Plants remain within existing boundaries. CSO: Impacts may be less than under other SSs because fewer tanks/treatment facilities to be built.	No impacts beyond projects now planned or under development.	Greatest potential for adverse impacts to recreational resources due to eventual occurrence of sewage overflows and increasing CSO discharges Overflows and increasing CSO discharges would contaminate waters and beaches used for recreation, adversely affecting recreational

NOTE: This table compares impacts of the four service strategies as presented in the Draft RWSP. See Part I for this comparison table of revised service strategies.

Elements of the Environment	Impacts Common to all Strategies	Service Strategy 1		Service Strategy 2		Service Strategy 3		Service Strategy 4		No Action	
		Construction	Operation	Construction	Operation	Construction	Operation	Construction	Operation	Construction	Operation
Recreation (cont'd)	restricted or banned.	parks and some northwest Lake Washington boating areas. CSO: Storage tank/treatment facility construction could temporarily disrupt use of some playgrounds, ballfields or parks.	CSO control project.								use.
Aesthetics	Conveyance and Treatment: Temporary aesthetic impacts during construction (e.g., dust, noise, disruption). Biosolids: Biosolids applications typically occur on low visibility agricultural or forest land sites, so there would be little adverse impact. Biosolids applications support revegetation of logged areas, improving the aesthetic appearance.	No specific additional impacts.	This SS would result in few long-term aesthetic changes, except that the size of the developed areas within existing plant sites would be greater. Expansions of new facilities would not depart substantially from the aesthetic character of existing facilities. CSO facilities would have little aesthetic impact because most would be either underground or in industrial areas.	Same as SS 1.	The new North Plant would change the aesthetic character of its surroundings. The plant's aesthetic compatibility would depend on the character of surrounding land uses. Other impacts would be the same as for SS 1.	Same as SS 1.	Same as SS 2.	Probably the lowest magnitude of aesthetic impacts because impacts would be mostly at tunnel portals and at existing treatment plant sites. Most of the CSO facilities proposed under the other SSs would not be constructed, since the associated CSO flows would be directed to the large tunnel.	Same as SS 1.	No impacts beyond projects now planned or under development.	Greatest potential for adverse impacts to aesthetics due to eventual occurrence of sewage overflows and increasing CSO discharges Overflows and increasing CSO discharges would have adverse aesthetic impacts including odors and unsightly material deposited in streets, basements and water bodies.

NOTE: This table compares impacts of the four service strategies as presented in the Draft RWSP. See Part I for this comparison table of revised service strategies.

Elements of the Environment	Impacts Common to all Strategies	Service Strategy 1		Service Strategy 2		Service Strategy 3		Service Strategy 4		No Action	
		Construction	Operation	Construction	Operation	Construction	Operation	Construction	Operation	Construction	Operation
Transportation	Conveyance and Treatment: Temporary construction traffic at facility construction sites. Excavation and concrete pouring generate greatest concentrations of truck trips at treatment plant sites. Biosolids: Long-haul semi-trailer combinations are used to haul biosolids from treatment plants. This practice does not result in significant impacts to transportation.	More widespread localized construction traffic impacts than other SSs due to extensive conveyance construction (Eastside Interceptor and Kenmore Interceptor parallels) and more and/or larger I/I reduction projects.	Relatively small operation impacts due to small number of staffed facilities. Most trips to and from treatment plants occur outside of peak traffic hours. Biosolids haul trips would increase commensurate with flow increases. These comprise a small percentage of total treatment plant trips but typically use larger tractor/trailer combinations.	Relatively less conveyance construction impact than SS 1 because there would be only minor Eastside Interceptor paralleling and much of North Plant conveyance would be tunneled, with construction vehicle trips concentrated at portals. Smaller-scale of I/I construction impacts than SS1.	Larger operation impacts than SS 1 due to addition of staffed North Plant and biosolids-related traffic.	Same as SS 2.	About the same as SS 2. North Plant is larger, with increased trips generated, but West Plant isn't expanded.	Probably less widespread construction impact than the other three SSs. Construction vehicle trips would be localized at/near portals. Same I/I impacts as SS 1.	About the same operation impacts as SS 1.	No impacts beyond projects now planned or under development.	No impacts beyond projects now planned or under development.
Cultural Resources		Known cultural resources at West Plant, Lake Washington shoreline, East Plant, Elliott Bay shoreline and the Eastside Interceptor corridor. This SS has potentially the most likelihood of encountering cultural resources because it has the greatest extent of shallow conveyance construction.	No operational impacts to cultural resources.	Relatively less likelihood of encountering cultural resources than SS 1 because only minor Eastside Interceptor paralleling and much of North Plant conveyance would be tunneled.	Same as SS 1.	Same as SS 2 but also avoids known cultural resources at West Point.	Same as SS 1.	Probably least potential to encounter unknown cultural resources because the large tunnel is deep. Potential to encounter cultural resources at East and West Plants.	Same as SS 1.	No impacts beyond projects now planned or under development.	No impacts beyond projects now planned or under development.

Wastewater

Each of the four service strategies proposes to discharge all treated wastewater into the offshore marine environment via submerged outfall pipelines. The total volume of treated wastewater is assumed to be the same for all four strategies. While total volumes of treated wastewater would increase over current conditions because of anticipated population growth in the region, discharged effluent would meet water quality standards for all service strategies.

For effluent discharge, the water quality differences among the four service strategies are related primarily to the different locations of the submerged outfalls.

All existing and proposed outfalls are located in Puget Sound. How the effluent is dispersed after leaving the outfalls, and the resulting impacts on water quality, will depend on tidal and current influences and the location and depth of the outfalls.

Differences in water density occur within the Sound such that, in general, the upper layer of relatively less dense water tends to circulate northward, while the lower layer of denser, more saline water slowly moves southward. Other factors being equal, northward dispersion of the effluent is generally preferable, as it promotes more rapid flushing of the effluent from Puget Sound.

Outfalls for the two existing plants are located about two miles west of Duwamish Head (East Treatment Plant) and off West Point (West Treatment Plant). The outfall off Duwamish Head is located at about 600 feet of depth, in the denser lower water layer. The West Point outfall is located at a depth of approximately 240 feet, permitting effluent from the West Treatment Plant to enter the upper water layer and flow northward most of the year.

The four service strategies propose different combinations and discharge volumes from the system's outfalls. SS1 and SS4 would discharge effluent from locations off both Duwamish Head and West Point . SS 2 and SS3 would add a new, more northerly outfall associated with a North End Plant to the other two outfall locations. The new outfall would be located further north than the West Point outfall and would in general be considered a desirable location from a water quality perspective if it is placed to direct the effluent into the upper water layer. The complexity of the flow layering in this area of the Sound will require additional study to determine the best location for the new north outfall.

Preliminary Review of Current and Hydrographic Conditions (Ebbesmeyer, 1994) provides a more detailed discussion of these issues (included as Appendix G).
Pollutant loadings are predicted to increase under all four service strategies compared to existing conditions. This occurs as a direct result of increasing regional population. Pollutants that are discharged in treated effluent include nitrogen, lead, PAHs, fecal coliform, and total suspended solids (TSS). While the total volume of treated wastewater

is assumed to be the same for all service strategies, loadings associated with the system's individual outfalls vary by alternative; these differences are discussed below.

Although there are minor variations (due primarily to differences in the volume of CSO flows directed to the treatment plants), in general the differences in pollutant loadings at the outfall locations are proportional to the capacities of the wastewater treatment plants that discharge to them. For the outfall off Duwamish Head, for example, capacity at the East Plant would ultimately reach 235 mgd for SS1 and SS4, while SS2 and SS3 include a 172-mgd East Plant. Pollutant loadings from the Duwamish Head outfall discharge are thus predicted to be greater under SS1 and SS4 when the plant is operating at full capacity. Under all service strategies, effluent discharges would meet water quality standards and permit discharge limits.

For the outfall off West Point serving the West Plant, SS3 includes a plant capacity of 133 mgd, while SS1, SS2, and SS4 include a 159-mgd West Plant. Loadings from this outfall would thus be greater for SS1, SS2, and SS4 than for SS3. Under all service strategies, discharges would meet water quality standards and permit discharge limits. The plant and its discharge would also meet shoreline permit and Settlement Agreement requirements for all service strategies.

The new outfall serving the North Plant would be needed for SS2 and SS3. Because SS3 includes an 89-mgd plant, pollutant loadings from the north outfall would be greater for SS3 than for SS2 and its 65-mgd treatment plant. Under both service strategies, effluent discharges would meet water quality standards and permit discharge limits.

Figure 3-5 provides a comparison of outfall discharge volumes that illustrates the above discussion.

Combined Sewer Overflows

In addition to the discharge of treated effluent, direct discharge of CSOs occurs during heavy rains to the Duwamish River, the Lake Washington Ship Canal, and Elliott Bay. Each service strategy includes a CSO control program that would reduce the discharge of CSOs to once per year per CSO outfall. To minimize rate impacts, the full CSO program would be completed by 2043 (2040 for SS3).

In general, the four service strategies offer similar beneficial water quality impacts from the CSO program. All substantially reduce pollutant loadings compared to existing conditions. Figure 3-6 illustrates the estimated reductions in loadings for total suspended solids, one of the pollutants of concern in CSO discharges. The figure is representative of the pattern expected for reductions in other pollutants contained in CSOs as well; these include nitrogen, lead, PAH, and fecal coliform. As the bar chart indicates, loadings to all four near-shore waters (Duwamish River/Waterway, Elliott Bay, Puget Sound off West Seattle, and the Lake Washington Ship Canal) would decrease under all service strategies compared to existing conditions. Reductions would be particularly dramatic in the Duwamish, Elliott Bay, and the Ship Canal.

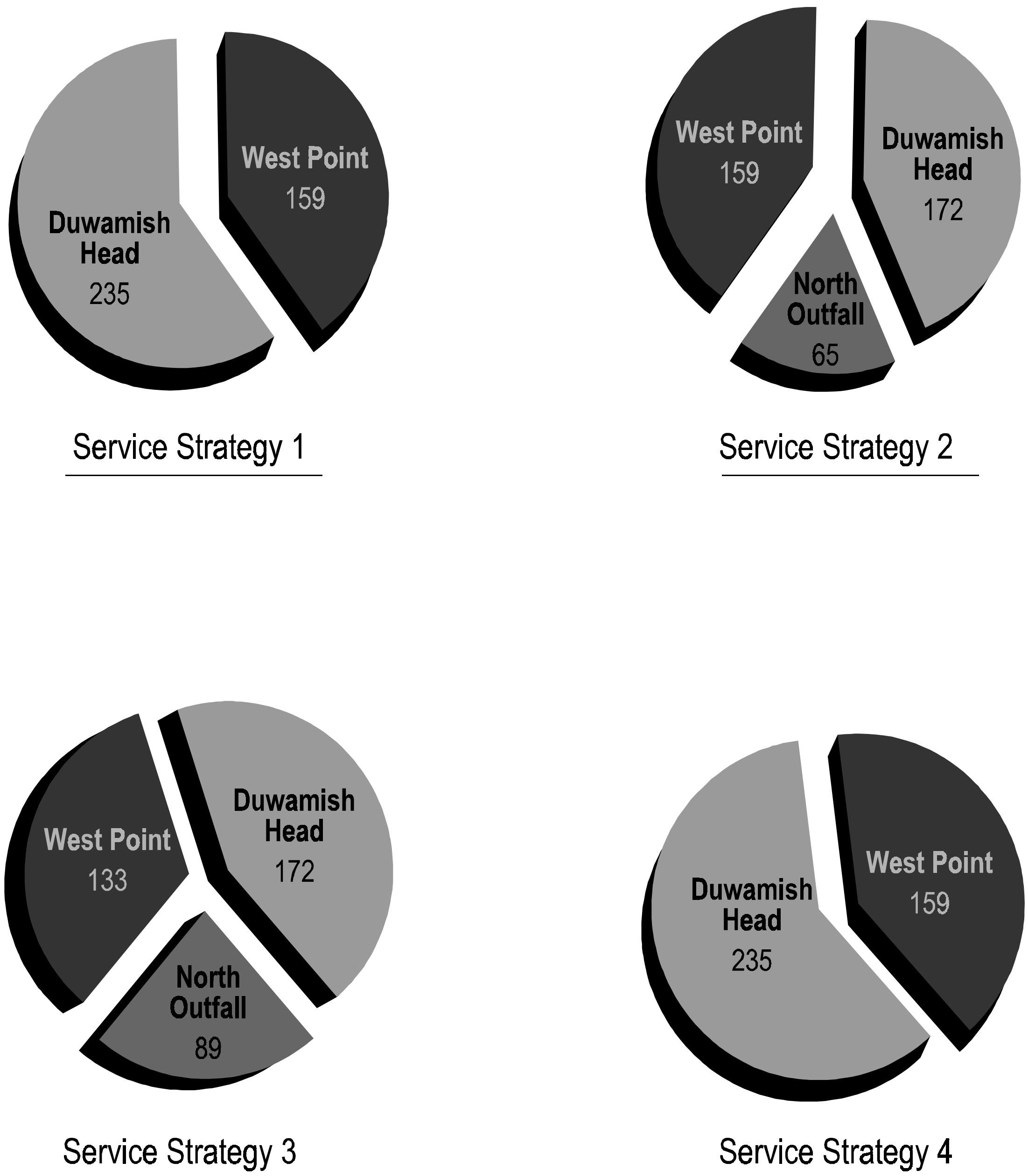
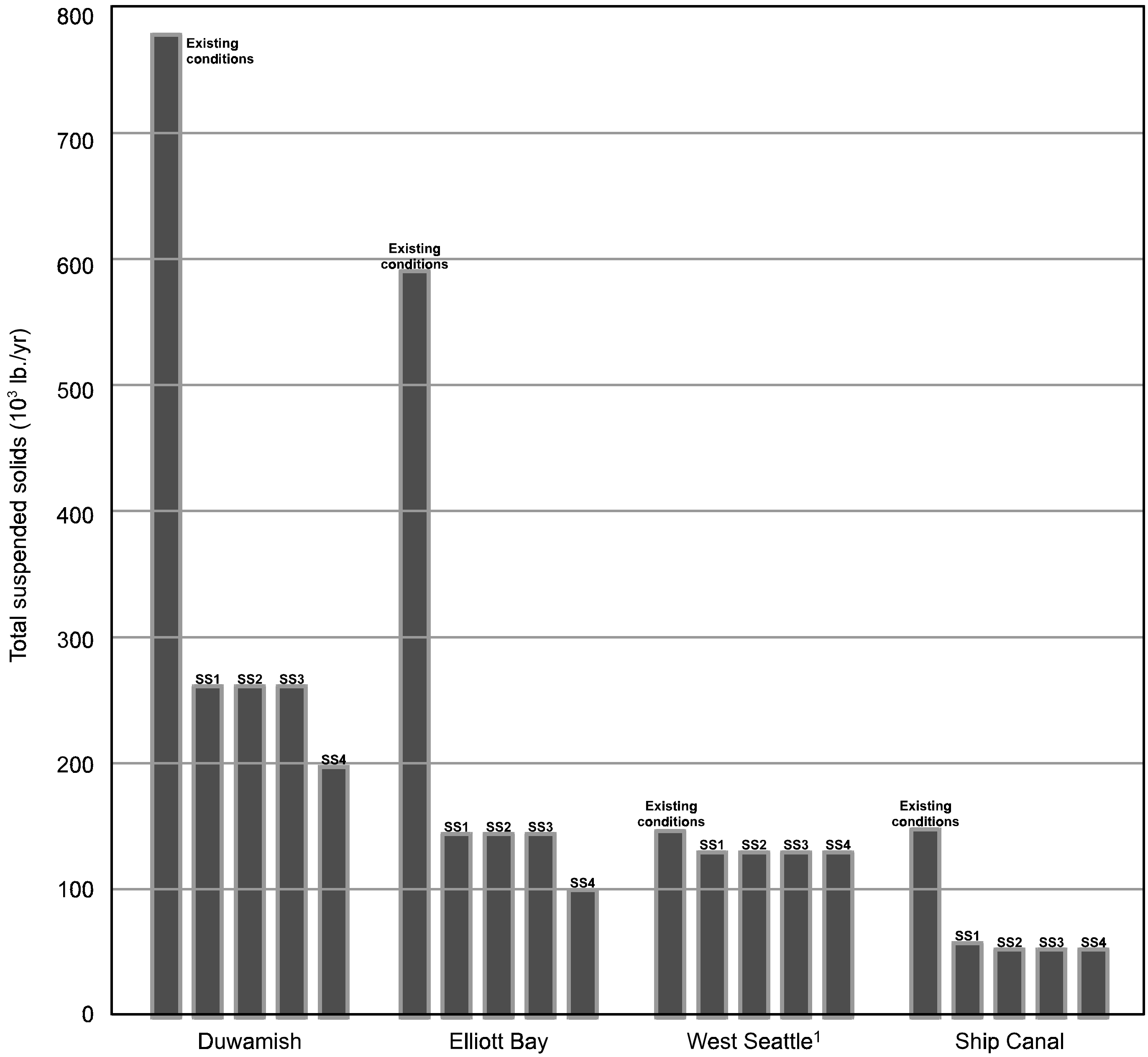


FIGURE 3-5

Comparison of Discharge Volumes (in mgd) **from King County's Puget Sound Outfalls**

(for average wet-weather flow)

NOTES:
1. East Plant discharges at Duwamish Head.
2. West Plant discharges at West Point.
3. North Plant would discharge from outfall somewhere off north King or south Snohomish County.
4. Numbers below discharge locations denote treatment plant capacity under that service strategy.



10754.AD.76/ total suspended CSO/ 4-22-97/GM/SEA

FIGURE 3-6
Pollutant loading of total suspended solids from CSO discharges by service strategy

1. "Existing conditions" are for 1999 Baseline and assume Alki Stormwater Plant is in operation.

As indicated in Figure 3-6, SS4 would provide somewhat greater water quality benefits in the Duwamish River and Elliott Bay than the other three service strategies. This is because SS4's deep tunnel would store more CSO volume for ultimate treatment at the West or East Treatment Plants, and rely on fewer individual CSO outfall locations in the Duwamish or Elliott Bay. While pollutant loadings would be somewhat higher from the West Point and Duwamish Head outfalls as a result, net water quality impacts of SS4's CSO program are projected to be somewhat more beneficial than those of the other service strategies for two reasons. First, CSO flows directed to the West or East Treatment Plants would be discharged into the offshore marine environment rather than the nearshore environment, as they would be for the other service strategies. Second, most CSO flows would also receive full secondary treatment prior to discharge. For very high flows associated with more severe storms, portions of the CSO flow that exceed the plants' secondary treatment capacity would receive primary treatment, similar to the treatment that would occur at CSO discharge locations for SS1, 2, and 3.

SUMMARY OF MITIGATION MEASURES

Table 3-15 summarizes the mitigation measures for the four service strategies.

TABLE 3-15
SUMMARY OF MITIGATION MEASURES

Element of the Environment	Mitigation Measures
Earth	**Construction** • In areas of suspected contaminated soils, testing would be conducted to determine the extent of contamination before construction. • Contaminated soils from excavations would be disposed of in compliance with all applicable local, state and federal regulations. • Where contaminated soils and groundwater are found together, dewatering systems would be implemented to avoid discharging contaminated groundwater or letting soils leach to receiving surface waters. **Operations** • Adherence to state regulations and guidelines for the production and application of reclaimed water will ensure that potential adverse impacts to earth resources are minimal. • Biosolids are regulated by federal (part 503), state and local agencies. The 503 regulations limit the amount of biosolids that can be land applied in addition to limiting the level of constituents in the product.
Air	**Construction** To minimize blowing dust, implement best management practices such as watering exposed soil areas, covering soil stockpiles and minimizing areas of earth disturbed at any one time. **Operations** • King County will continue to seek practical technologies that will prevent odors from escaping wastewater facilities. • Using Class A biosolids would reduce odors from applied biosolids. • Avoid direct exposure of humans to reclaimed water by irrigating at night or in temporarily restricted areas. Integrate signage, training and appropriate

Element of the Environment	Mitigation Measures
	operations and maintenance procedures for equipment into health and safety program.
Water Resources	**Construction** • Include best management practices for erosion control in construction specifications to minimize sedimentation of water bodies. **Operations** • Select wastewater discharge outfall sites with strong currents and favorable circulation patterns that most rapidly move pollutants northward out of Puget Sound. Research indicates that the upper water layer best provides these conditions. Outfall locations that meet these criteria would reduce long-term operational impacts. • Infiltration and inflow control projects in flood-prone areas would include studies of local groundwater and surface water drainage patterns to avoid exacerbating local flooding and wet basements. • King County's Industrial Waste/Source Control Pretreatment Program reduces the levels of contaminants entering the sewer system and enhances both biosolids and reclaimed water products. • At biosolids application sites, use agronomic rates to maximize crop uptake of nutrients, maintain moderate pH and monitor for soil contaminant concentrations. Maintain buffers from surface water bodies. Adhere to federal, state and local regulations and permits. • Monitor reclaimed water quality. For dual distribution systems, incorporate safeguards to prevent cross connections between potable and reclaimed water. Adhere to state standards and guidelines.
Biological Resources	**Construction** • Routes would be selected to avoid sensitive riparian and wetland areas wherever possible. • Pipeline alignments would be designed to minimize destruction of existing vegetation and wildlife habitat. These resources would be restored after construction. • Construction in streams and nearshore areas would not occur during designated fishery closure periods. • Outfall alignments would be designed to minimize impacts to sensitive intertidal communities wherever possible. • During construction, King County staff and contractors would coordinate with Muckleshoot and Suquamish Tribes to reduce the potential for disruption of tribal fishing operations. • Wetland mitigation plans would be developed for wetland areas disturbed during construction. • King County would work with resource agencies to develop specific site restoration methods for affected sensitive areas. **Operations** • Mitigation measures to protect ecological health include monitoring the quality of reclaimed water to ensure that it consistently meets the Class A standard. • If high levels of mineral salts and inorganic compounds are known to be present in the reclaimed water, plant materials can be selected that are proven to be tolerant of these conditions. • Applying biosolids to the soil as an amendment improves tilth and increases plant productivity.

Element of the Environment	Mitigation Measures
Energy	**Construction** All equipment used during construction would meet applicable energy efficiency standards. **Operation** • Methane and other gases produced at treatment plants could be captured and sold to power companies or used to generate power to reduce demand on suppliers.
Environmental Health	**Construction** • Construction noise would be controlled wherever possible to avoid adversely impacting sensitive receptors such as residential neighborhoods and schools. **Operation** • Use appropriate procedures for handling chemicals and petroleum products during facility operation. • The State of Washington Water Reclamation and Reuse Interim Standards protect public health by requiring a specific level of water quality and treatment corresponding to each beneficial use of reclaimed water. King County's adherence to these standards produces the highest quality effluent designated by the state, Class A. • Potential risks to public health from use of reclaimed water can be reduced even further through the following measures: Irrigation could occur at night when public exposure is likely to be low; public education (e.g., posting of signs); environmental monitoring (e.g. soil and water sampling); appropriate irrigation design and operation (e.g., providing for emergency shut-off of the irrigation system in the event of a pipe rupture) and; implementation of appropriate irrigation system maintenance procedures. • The 503 Regulations for biosolids application specify strict "ceiling concentrations" on the amounts of these metals that are allowable in biosolids. King County's biosolids are well below this level. • Proper application of biosolids and adherence to permit and operations plan requirements protect public health such that no significant adverse impacts are likely to occur from biosolids applications.
Land & Shoreline Use	**Construction** • Refer to mitigation measures discussed under air, noise, aesthetics and transportation. **Operations** • To site new treatment facilities (i.e. plant, pipelines), high priority would be given to sites where such facilities would be compatible with surrounding uses.
Recreation	**Construction** • Where short periods of temporary construction impacts are expected at recreational facilities, construction could be scheduled to avoid the periods of highest recreational use. • Where trail use is disrupted, King County would provide a safe detour around the construction area wherever possible.
Aesthetics	**Operations** • To make treatment facilities more compatible, measures such as landscaped buffers and architectural treatment would be used in design.
Transportation	**Construction** • Traffic plans would be developed to ensure continued circulation and access during construction. • Open trench segments would be covered to allow residents and service vehicles to access driveways and loading areas.

Element of the Environment	Mitigation Measures
	• Temporary measures would be implemented along trails to separate pedestrians and bicyclists from vehicles.
Cultural Resources	**Construction** • Presence of known cultural resources would be taken into account when designing facilities and cultural resources will be avoided wherever possible. • If cultural resources are encountered during construction, construction would cease and a professional archaeologist will be consulted.

POTENTIAL IMPACTS OF SERVICE STRATEGY OPTIONS

Table 3-16 discusses how the service strategy options considered in the RWSP could affect the potential environmental impacts of the service strategies. For each option the table discusses potential impacts on water resources, biological resources, environmental health and land use. More detailed discussions of the impacts of the service strategy options are provided in Chapter 12 of this DEIS. More detailed discussions of the options themselves are provided in Chapter 4 of the RWSP. This table addresses only operating impacts. A programmatic discussion of construction impacts is presented in Chapter 11.

It should be noted that wherever a service strategy option could result in increased pollution, the potential environmental impacts of this pollution would be evaluated before the option would be implemented.

TABLE 3-16
EFFECTS OF SERVICE STRATEGY OPTIONS ON SERVICE STRATEGIES

Service Strategy Option	Effects
4A **Re-define Secondary Treatment (East and North Plants only)**	**Water** Advanced primary treatment would result in higher soluble biological oxygen demand (BOD) levels in discharged effluent and higher levels of bacteria if disinfection with chlorine were eliminated. Enhanced primary treatment using sand filtration technology could result in lower total suspended solids (TSS) and better organism removal (beneficial impact).

Service Strategy Option	Effects
	Biological Resources Potential impacts to marine biota resulting from discharge of lower quality effluent if it reduces receiving water quality.
	Environmental Health Potential adverse health effects from consumption of large quantities of marine animals if advanced primary treatment resulted in degraded water quality. Potential adverse health effects from contact with water receiving higher pollutant loadings. Reduced potential for exposure to chlorine if chlorine use is reduced.
	Land Use Positive land use impact resulting from smaller treatment plant "footprints".
4B **Re-rate Plant Capacities**	**Water** Higher BOD and TSS levels could reduce water quality. Increased risk of plant malfunctions leading to more potential adverse impacts to water quality.
	Biological Resources Potential for reduced water quality could adversely impact marine biota.
	Environmental Health Potential adverse health effects from contact with water receiving higher pollutant loadings from treatment plant discharges.
	Land Use Positive land use impact resulting from smaller treatment plant "footprints".
4C **Build in Smaller Increments**	**Water** Potential for adverse water quality impacts from increased sewer system overflows or treatment plant overloads if unexpectedly rapid population growth exceeded wastewater treatment and conveyance facility capacities before new facilities could be brought into service.
	Biological Resources If water quality reduced, biological resources could be adversely affected.
	Environmental Health Potential adverse health effects from consumption of large quantities of marine or freshwater animals if water quality reduced. Potential adverse health effects from contact with water receiving higher pollutant loadings from treatment plant discharges or from contact with wastewater or other polluted water if sewer overflows occurred.
	Land Use None
4D **Decrease Conveyance Design Standard (5-year size, 5-year overflow)**	**Water** Increased potential for overflows in separated sewer systems could adversely affect quality of surface and ground waters at and near overflow locations.
	Biological Resources If water quality reduced, biological resources could be adversely affected.
	Environmental Health Potential adverse health effects from consumption of large quantities of freshwater animals if water quality reduced. Potential adverse health effects if well water contaminated. Potential adverse health effects from contact with wastewater or with other polluted water if sewer overflows occurred.
	Land Use Somewhat smaller regional wastewater facilities needed, resulting in smaller "footprints."

Service Strategy Option	Effects
4E **Decrease Conveyance Design Standard (20-year size, 5 year overflow)**	**Water** Same as for 4D but once new facilities constructed potential for subsequent adverse impacts would be less.
	Biological Resources Same as for Water.
	Environmental Health Same as for Water.
	Land Use None
4F **Discharge to the Duwamish**	**Water** Discharges would increase pollutant loadings to the river, which would potentially create modest adverse water quality impacts. Most discharges would occur during high river flow periods, which would dilute effluent. Greatest potential for adverse impacts would occur from strong early fall storms, which can cause peak plant flows prior to significant increases in the flows in the river (less dilution). Low risk of this occurrence. Long-term implications of the implementation of this option on water are being studied (Water Quality Assessment).
	Biological Resources Risk of adverse impacts to biological resources commensurate with extent of water quality degradation described in Water section above. Long-term implications of the implementation of this option on aquatic habitat are being studied (Water Quality Assessment).
	Environmental Health Potential for human contact with effluent discharge during or shortly after storm events is low. Risk of adverse impacts to human health is commensurate with extent of water quality degradation. Long-term implications of the implementation of this option on environmental health are being studied (Water Quality Assessment).
	Land Use None
4G **No I/I Program**	**Water** None if adequate wastewater treatment and conveyance systems are brought into service in time to prevent treatment plant overloads or conveyance system overflows as wastewater system flows increase.
	Biological Resources Same as for Water.
	Environmental Health Same as for Water
	Land Use Somewhat larger regional wastewater facilities needed, resulting in larger “footprints.”
4H **Reduce CSO Control Goal**	**Water** Ultimate pollutant discharge levels from CSOs would be greater than now targeted under current Ecology regulations. Long-term implications of these greater discharges on water are being studied (Water Quality Assessment).
	Biological Resources Ultimate pollutant discharge levels from CSOs would be greater than now targeted under current Ecology regulations. Long-term implications of these greater discharges on aquatic habitat are being studied (Water Quality Assessment).
	Environmental Health Ultimate pollutant discharge levels from CSOs would be greater than now targeted under current Ecology regulations. Long-term implications of these greater discharges on environmental health are being studied (Water Quality Assessment).
	Land Use CSO facilities could be somewhat smaller, resulting in smaller “footprints.”

Service Strategy Option	Effects
4I **Alternative Biosolids Technologies**	**Water** None if regulatory requirements and best management practices adhered to.
	Biological Resources Same as Water.
	Environmental Health Same as Water.
	Land Use Would require additional land for biosolids processing facilities. Could emit more odors, depending upon technology chosen.
4J **Discharge at Hiram Chittenden Locks**	**Water** By replacing water otherwise released through the locks, would make Lake Washington water available for water supply (if withdrawals permitted by regulators) or help conserve existing upstream water supply. This enhancement of water supply would thereby help avoid or delay development of new water supplies (and the associated adverse water quality impacts). Could also allow for more flexible and efficient management of upstream flows for water quality beneficial uses. Additional outflow would facilitate containment of saltwater intrusion into the Ship Canal and Lake Union. Possible reduction in water quality in the vicinity and downstream of effluent discharge. Possible improvement in water quality because water that would otherwise have received secondary treatment at West Plant would be given advanced treatment before being discharged at the locks.
	Biological Resources Could help preserve existing streamflows for upstream fish and wildlife. Might also facilitate salmon passage through the locks. Conversely, might impede migration by introducing water with unfamiliar "smell" (further study needed). Possible adverse impacts of increased pollutants on biological resources in vicinity of discharge.
	Environmental Health None
	Land Use Advanced wastewater treatment plant would be needed near discharge point.
4K **Discharge to Lake Washington/Sammamish**	**Water** By adding to Lake Washington basin waters, would make Lake Washington water available for water supply (if withdrawals permitted by regulators) or help conserve existing upstream water supply. This enhancement of water supply would thereby help avoid or delay development of new water supplies (and the associated adverse water quality impacts). Could also allow for more flexible and efficient management of upstream flows for water quality beneficial uses. Potential additional outflow would facilitate containment of saltwater intrusion into the Ship Canal and Lake Union. Freshwater discharge would increase pollutant loadings to the Lake Washington drainage basin. Unknown environmental impacts resulting from discharge of excess reclaimed water into groundwater or Lake Washington drainage basin.
	Biological Resources Could help preserve existing streamflows for upstream fish and wildlife. Possible adverse impacts of increased pollutants on biological resources in vicinity of discharge (further study required).

Service Strategy Option	Effects
	Freshwater discharge would increase pollutant loadings to the Lake Washington drainage basin. Unknown effects to freshwater biota resulting from discharge of excess reclaimed water into Lake Washington drainage basin.
	Environmental Health Freshwater discharge would increase pollutant loadings to the Lake Washington drainage basin. Unknown impacts to environmental health resulting from discharge of excess reclaimed water into groundwater or Lake Washington drainage basin.
	Land Use Two sites converted to wastewater treatment use instead of one. May prompt changes in some land uses in the vicinity of the satellite plants due to the availability of reclaimed water.
4L **North Treatment Plant Discharge to Lake Washington (Service Strategies 2 and 3 only)**	**Water** Would delay potential water quality impacts of new secondary treated effluent discharge into Puget Sound. By adding to Lake Washington basin waters, would make Lake Washington water available for water supply (if withdrawals permitted by regulators) or help conserve existing upstream water supply. Would thereby help avoid or delay development of new water supplies (and the associated adverse water quality impacts). Could also allow for more flexible and efficient management of upstream flows for water quality beneficial uses. Potential additional outflow would facilitate containment of saltwater intrusion into the Ship Canal and Lake Union. Freshwater discharge would increase pollutant loadings to the Lake Washington drainage basin. Unknown environmental impacts resulting from discharge of excess reclaimed water into groundwater or Lake Washington drainage basin.
	Biological Resources Could help preserve existing streamflows for upstream fish and wildlife. Possible adverse impacts of increased pollutants on biological resources in vicinity of discharge (further study required). Freshwater discharge would increase pollutant loadings to the Lake Washington drainage basin. Unknown effects to freshwater biota resulting from discharge of excess reclaimed water into Lake Washington drainage basin.
	Environmental Health Freshwater discharge would increase pollutant loadings to the Lake Washington drainage basin. Unknown impacts to environmental health resulting from discharge of excess reclaimed water into groundwater or Lake Washington drainage basin.
	Land Use Could alter some land uses in the vicinity of the plant due to the availability of reclaimed water.
4M **Implement Pollutant Source Trading**	**Water** Could maximize benefits to water quality by carrying out most effective programs/projects first. Would be difficult to accurately identify tradeoffs on “apples-to-apples” basis and thus identify which are most effective projects.
	Biological Resources Similar to Water

Service Strategy Option	Effects
	Environmental Health Similar to Water
	Land Use Unknown
4N **Offer Siting Incentives**	**Water** Unknown
	Biological Resources Unknown
	Environmental Health Unknown
	Land Use Incentives could include measures that would have beneficial impacts on local land uses.

SUMMARY OF STRATEGIES CONSIDERED AND ELIMINATED FROM FURTHER CONSIDERATION

During the facility planning process, a number of other strategies for providing wastewater services were evaluated. Some of these strategies involved different environmental impacts than those retained for evaluation in the RWSP and this DEIS. Most of these strategies involved substantial drawbacks compared to those retained (i.e., higher cost, environmental impacts, or risks associated with implementation). The strategies eliminated from consideration due to these drawbacks are described in this section.

Eastside Advanced Wastewater Treatment Plant

This strategy would involve construction of a large advanced wastewater treatment plant east of Lake Washington. This plant would give wastewater advanced treatment (beyond secondary treatment) and would discharge directly to Lake Washington. This strategy was eliminated from consideration for cost and technical feasibility reasons.

Under Service Strategy Option 4K, two advanced wastewater treatment plants would be built near Issaquah and Woodinville. The two plants would each be smaller than the single large plant discussed above. This would enable them to be sited near potential customers for reclaimed water, both because of their relatively small footprint and because they would not have to be located at the lower end of a drainage basin to receive enough flow to operate efficiently (as the larger plant would). They also would not require the more extensive and costly conveyance facilities associated with the large plant. Option 4K is discussed in Chapter 12 of this document and in Chapter 4 of the RWSP.

Interbay Treatment Plant

This strategy proposed construction of a new 72-mgd-capacity treatment plant in the Interbay area. This plant would draw flow from the Elliott Bay Interceptor, which carries all wastewater from the southern part of the West Service Area to the West Treatment Plant. It was eliminated from further consideration because it was more costly than expanding the existing two treatment plants or building a North Treatment Plant, and it offered no overriding benefits.

Strategies Involving Both North End and Duwamish Plants

These strategies proposed constructing both a North End plant and a Duwamish area plant. Different options were explored for sizing of the new plants and the existing plants in the system. These strategies were eliminated from consideration because the two-new-plant concept would provide no advantage over the one-new-plant concept or expanding/maximizing existing plants, and would be much more costly.

Placement of All Capacity Increases at East Treatment Plant

Two strategies would have placed all capacity increases at the East Treatment Plant. Under these strategies no new treatment plants would be built, and the West Treatment Plant would remain at its current 133 mgd capacity. The East Treatment Plant would be expanded in stages to an ultimate capacity of 261 mgd. One strategy would involve transferring northern service area flows to the East Treatment Plant via the Eastside Interceptor, or transferring some flows from the West Treatment Plant's southern service area to the East Treatment Plant. These strategies were eliminated for technical and cost considerations, including loss of system flexibility and need for much more extensive conveyance improvements to and from the East Treatment Plant.

Placement of All Capacity Increases at North Treatment Plant

One strategy would have placed all capacity increases at a North Treatment Plant. Both the East and West Treatment Plants would remain at their current capacities. The North Plant would be expanded in stages to an ultimate capacity of 146 mgd. This strategy would involve construction of a new force main roughly paralleling I-405 from I-90 to Bothell to carry flows from the surrounding area to the new plant. Additional conveyance facilities would be constructed to bring flows from the northern part of the West and North Service Areas to the plant. This strategy was eliminated because of insufficient lead time to bring a North Treatment Plant into service before one of the existing treatment plants would have to be expanded and because it would involve substantial new conveyance on the Eastside, thus failing to meet one of the main objectives of the North Treatment Plant strategies.

Expansion of West and East Treatment Plants; Transfer of West Treatment Plant Southern Service Area Flows to East Treatment Plant

This strategy is similar to SS1 in that no new treatment plants would be built. The West Treatment Plant would be expanded to 159 mgd, and the East Treatment Plant would be expanded to 235 mgd. This strategy would differ in that a flow transfer from the West

Service Area would convey flows to the East Treatment Plant via a new pipeline from the Duwamish industrial area to the East Treatment Plant. It was eliminated from consideration because it did not offer any advantages over Service Strategy 1 and was not as cost-efficient.

Construction of New Duwamish Treatment Plant; Expansion of East Treatment Plant

Two other strategies considered would involve construction of a new treatment plant in the Duwamish area to accommodate the West Treatment Plant's southern service area flows, thus eliminating the need to expand that plant. The East Treatment Plant would also be expanded. The strategies differed in the size of the Duwamish plant and the amount of expansion of the East Treatment Plant. A new parallel to the Kenmore Interceptor would still be needed to convey more North Service Area flows to the West Treatment Plant. These strategies were eliminated because they did not offer cost benefits in terms of reduced conveyance needs and thus were not cost-effective.

Alternatives to Building Additional Wastewater Facilities

During early planning, the RWSP evaluated approaches that could reduce the need for building new facilities. Out of these, several have been carried forward as integral parts of the service strategies (e.g., I/I control) or options that could be implemented to alter the strategies (e.g., changing the design standard for sizing conveyance pipes).

Following is a list of the demand management approaches that have been set aside and are not being carried forward as parts of the strategies or options.

- Maximize use of on-site sewage systems for new development (e.g., composting toilets, septic tanks).
- Restrict or slow growth.
- Provide no wastewater treatment service to utilities outside King County
- Separate gray water from toilet water in a parallel plumbing/treatment/recycling system.
- Eliminate home and commercial garbage grinders as sources of wastewater solids.
- Build separate stormwater systems in parts of Seattle now served by combined sewers (service strategies propose to store and treat CSOs instead).
- In areas served by combined sewers, increase stormwater detention requirements.

Reasons for setting these measures aside include the following:

- Savings in infrastructure are outweighed by costs of implementation.

- Costs from the wastewater system are transferred to other governmental agencies, with no apparent benefit to the public.
- Measures would violate the adopted King County and other agency comprehensive plans.
- Measures would require changes to State health regulations due to potential for adverse public health impacts.

No-Action Alternative

Under the no-action alternative, no new facilities would be constructed and existing facilities would not be expanded. This alternative is discussed for comparison purposes only. It could not be implemented because the region's growing population will generate progressively larger amounts of wastewater and King County is legally required to treat this wastewater. King County is also legally required to reduce its CSO discharges. Consequences of the no-action alternative could include:

- Increased potential for sewage overflows into streets, homes, and businesses during heavy rain storms, threatening public health, degrading water quality and resulting in violation of government regulations.
- Closures of public swimming beaches and decertification of shellfish harvesting areas.
- Degradation of receiving water aesthetics and beneficial uses.
- Regulatory fines and enforcement orders for non-compliance with permit discharge limits.
- Regulatory sanctions such as building moratoria and bans on sewer hook-ups in designated growth areas.
- Liability for not fulfilling contractual obligations to receive wastewater flows from cities and sewer districts.

Additionally, under the State Growth Management Act, the adequacy of the King County Comprehensive Plan could be challenged if the capital facilities element, of which the RWSP will be a part, failed to support the adopted vision and land use in the plan by not accommodating the projected growth or providing an adequate level of service within the Urban Growth Area.

The impact comparison table, Table 3-14, compares impacts of No Action to the service strategies.

COST COMPARISONS

Tables 3-17 and 3-18 compare the costs of the service strategies. Table 3-17 compares overall capital, operating, and maintenance costs. Table 3-18 compares the rate impacts of the service strategies. A more detailed discussion of costs is provided in the financial plan that accompanies the RWSP.

Table 3-17. Service Strategy Cost Comparison
Capital, Operating, and Maintenance (in $ millions, 1997 net present value)

Service Strategy	Cumulative Costs, present through	
	2030	2050
1	876	1244
2	1128	1366
3	1235	1457
4	1398	1621

Reference: RWSP Financing Plan, May 1997.

Table 3-18. Comparison of Levelized (average) Monthly Rate Impacts,[a] 1997 to 2030 (in 1997 dollars)

Rates	Service Strategy:			
	1	2	3	4
Current	19.10	19.10	19.10	19.10
Average, 1997-2030	17.59	18.40	19.10	19.74
Maximum	19.60	19.60	21.45	21.57
Minimum	14.71	16.77	16.47	17.33

[a]Dollars/month for a single-family residence.

Reference: RWSP Financing Plan, May 1997

NOTE

Chapter 4 is as it appeared in the Draft EIS (May 1997) for the RWSP. References to the RWSP in Chapter 4 are to the draft Plan issued at the same time as the Draft EIS. Projections in this chapter are the ones used for the original four service strategies.

CHAPTER 4
AFFECTED ENVIRONMENT

INTRODUCTION

This chapter provides an overview of the region's environmental resources likely to be affected by implementation of the RWSP. It first addresses the four elements of the environment most directly affected (water resources, biological resources, land and shoreline use, and environmental health), and then provides a briefer discussion of other elements of the environment.

WATER RESOURCES

Fresh Waters

The King County wastewater service area includes two major drainage basins: the Cedar River-Lake Washington basin and the Green River basin. The Cedar River-Lake Washington basin includes Swamp and North Creeks (both originating in Snohomish County) and the Sammamish River, the Cedar River, and numerous small drainages flowing directly into Lake Washington. The Green River basin occupies much of the southern and southwestern portions of King County. In addition, there are many small drainages located along the saltwater margins of Puget Sound in the westernmost portions of Snohomish and King counties.

The State of Washington classifies surface waters of the state based on existing water quality and beneficial uses of the individual water bodies (Chapter 173-201A WAC). All rivers and streams in the King County wastewater service area are classified either AA (extraordinary quality) or A (excellent quality), with the exception of the Duwamish River from the confluence of the Green and Black rivers to Elliott Bay, which is classified B (good quality). In general, the lower portions of rivers and streams in the western, more heavily developed half of both counties are Class A waters, while the upper portions of major rivers and the tributaries of these upper portions are classified AA. Water quality criteria applicable to Class AA, A, and B surface waters are shown in Appendix F.

Approximately nine lakes with a surface area of 20 acres or more exist within the King County wastewater service area, or in areas potentially affected by proposed wastewater treatment or conveyance facilities. The two largest lakes, Lake Washington and Lake Sammamish, are located in the Cedar River-Lake Washington basin. The State of Washington classifies all lakes as Lake Class in Chapter 173-201A WAC . Water quality criteria applicable to lakes are also shown in Appendix F.

Metro conducted an ongoing freshwater assessment program of streams and lakes in the Seattle-King County metropolitan area between 1979 and 1993. The program focused on the Cedar River-Lake Washington and Green River basins. The most recent reports from that assessment (Metro, 1990, 1991; KCDMS 1994a) provide a current characterization of freshwater quality in those two basins. Overall, the assessment characterizes the quality of streams and rivers in the two basins as fairly good, although water quality in several sub-basins is characterized as fair to poor.

Marine Waters

Puget Sound is an estuary connected to the Pacific Ocean by the Strait of Juan de Fuca. The sound consists of several deep basins separated by shallow sills. The maximum water depth is 930 feet (in the central basin) with an average depth of 346 feet (KCDMS, 1994b). The depth of the shallow sills is approximately 150 feet (Metro, 1985). Circulation in the sound is driven by freshwater inputs, gravitational convection, tides, and wind. In general, seaward-flowing water of lower salinity and density remains on the surface, and landward-flowing ocean water with higher salinity and density occurs at depth. The relatively shallow underwater sills assist the tidal action in providing good vertical mixing throughout the water column. Puget Sound contains 26.5 cubic nautical miles of water, with a 12- to 14-foot tidal exchange in which 1.27 cubic nautical miles of water (on average) move in and out with each tidal cycle (KCDMS, 1994b).

The depth of Puget Sound and the extent of mixing and tidal exchange contribute to the good water quality found in offshore water samples. Near-shore waters and sediments, however, collect contaminants from a variety of sources including industrial and municipal discharges, rivers and streams, atmospheric deposition, and urban runoff. Generally, contaminants enter the sound either in a dissolved state or bound to particles. Some contaminants are concentrated in the surface layer; some remain in solution and are dispersed and diluted throughout the sound; some settle out into nearshore sediments; and some are transported far out into the sound before settling. The physical, chemical, biological, and hydraulic processes that affect the movement of pollutants within marine waters include solubility, sorption capacity, flocculation, resuspension and redissolution from sediments, bioaccumulation, biotransformation, current speed and direction, and mixing (Puget Sound Water Quality Authority, 1988b).

Embayments and deep areas of the sound are subject to lower current velocities and, therefore, act as depositional areas (i.e., sinks) in which particles tend to accumulate. Bottom sediment materials are generally silty and fine-grained. Narrower channels have strong currents and, consequently, are generally nondepositional areas with sand or gravel bottoms (Metro, 1985).

Most of Puget Sound is classified as Class AA (extraordinary quality) marine water by Ecology (Chapter 173-201A WAC). Certain embayments, such as inner Elliott Bay east of Pier 91 and Duwamish Head, are rated Class A (excellent quality). The water-quality standards set limits for fecal coliform bacteria, dissolved oxygen, temperature, pH, turbidity, radioactive substances, and a number of metals and organic compounds. Class AA and Class A waters differ in the specified temperature, pH, and dissolved oxygen levels to be maintained.

Another parameter used to gauge marine water quality is the frequency of depletion of dissolved inorganic nitrogen. Areas exhibiting periods of depletion of dissolved inorganic nitrogen are likely to be susceptible to phytoplankton blooms if influent nutrient loadings increase. Phytoplankton blooms are associated with oxygen depletion, possibly leading to fish kills and the occurrence of paralytic shellfish poisoning. A study conducted by the U.S. EPA ranks various areas of Puget Sound according to the frequency of dissolved inorganic nitrogen depletion and low dissolved oxygen concentrations (Rensel and PTI, 1991). Elliott Bay, the main channel of central Puget Sound, and the East Passage are identified as areas not likely to be sensitive (in the near future) to nutrient inputs from human sources.

Offshore sediments within the King County wastewater service area have recently met regulatory threshold toxicity limits for organic pollutants and metals. The only marine sediments within the King County wastewater service area that exceed these levels are located near present and historical industrial sources, storm drains, combined sewer overflows (CSOs), and municipal outfalls on Harbor Island and the Seattle waterfront (KCDMS, 1994b).

Appendix F includes a table indicating state marine sediment quality standards (Table F-3).

Groundwater

The most recent comprehensive surveys of groundwater in King County occurred in the 1960s (Liesch, et al., 1963; Luzier, 1969). Snohomish County groundwater was more recently surveyed (EES, 1991). At the time of the King County surveys, groundwater accounted for nearly one-third of total water use in the county (King County, 1987a). Groundwater use continues to be significant because several cities (Auburn, Issaquah, Kent, Redmond, and Renton, as well as the Seattle system's Highline wellfield) and most of the rural areas in the county obtain water from subsurface supplies. In accordance with the Growth Management Act, King County is developing policies and regulations to protect critical groundwater recharge areas and groundwater supplies, including the identification of groundwater management areas.

Major supplies of groundwater in the area are typically found in deposits of porous sediments. These deposits are most commonly sands and gravels associated with glacial outwash deposits including stream-laid deposits in major valleys (King County, 1987b; EES, 1991). Surface recharge of groundwater is most significant in areas of porous soils, particularly large river and stream valley floors underlain by porous alluvial deposits. In addition, although most of the upland drift plains in the King County wastewater service area are underlain by relatively impermeable till, significant portions of the upland areas are underlain by more porous soils (e.g., Everett soils formed in outwash sands and gravels) that are significant recharge areas.

Although no major overdrafts (unacceptable reductions in groundwater quantity) or human-caused occurrences of groundwater pollution have been identified in the King County wastewater service area, groundwater quality data are limited. However, recent studies in Snohomish County have identified localized problems, including elevated levels of nitrate, naturally elevated levels of arsenic, and sea water intrusion (EES, 1991).

BIOLOGICAL RESOURCES

This section provides a discussion of vegetation, important wetlands, wildlife species and habitat, and fish species and habitat present in the service area. State and federally listed sensitive species that have been documented in the service area are also discussed.

Vegetation and Wetlands

The King County wastewater service area includes fully developed urbanized areas (e.g., Seattle and the lower Duwamish Valley; less densely developed urban / suburban areas north, east, and south of Seattle (e.g., Bothell, Redmond, Kirkland, Bellevue, Renton, Kent, and Auburn); and suburban/rural areas (e.g., East Sammamish Plateau, and Maple Valley). Vegetative habitats in these areas are a function of the level of development and the nature of land use patterns. In more urbanized areas, native vegetation tends to be concentrated in areas difficult to develop, such as steep slopes and floodplains, or areas that have been set aside as parks or open space. In rural areas, native vegetation dominates the area, but is interspersed with agricultural and suburban residential land uses.

Wetland vegetation is usually present in areas where suitable soil and hydrologic conditions exist. Although not as widespread as they once were, important wetland systems still exist. The larger wetland areas are often associated with streams or are located where streams discharge to larger water bodies. Important wetland areas occur in the Duwamish/Green River Valley; Mercer Slough; Union Bay; Juanita Bay; the mouth of the Sammamish River in Lake Washington; the Sammamish River Valley and tributary streams of Swamp Creek, North Creek, and Bear Creek; the Snoqualmie River Valley; and Maple Valley. Common wetland species include red alder, black cottonwood, western red cedar, cascara, salmonberry, hardhack, devil's club, cattail, skunk cabbage, and various species of sedge and rush. Nonnative invasive species include reed canary grass, purple loosestrife, and Eurasian milfoil.

In their natural state, wetlands offer substantial biological, hydrological, cultural, and economic values. Wetlands provide food and cover for a variety of fish and wildlife including several threatened and endangered species. They also provide storage for stormwater runoff, releasing it gradually, which helps to maintain summer stream flows, replenish groundwater, and protect property from flood damage. Wetlands also improve water quality by trapping and filtering nutrients, sediments, and pollutants contained in runoff.

Wildlife

The type and condition of wildlife habitat vary widely throughout the RWSP service area, which includes heavily developed industrial/commercial areas, less developed suburban and rural environments, agricultural lands, and coniferous or deciduous forest. Species tolerant of urban environments are present, as well as species associated with relatively undisturbed habitats.

Heavily developed areas are generally of low habitat value to wildlife, containing little vegetation and subjecting wildlife to noise and disturbance from traffic and other human activity. However, several species have become tolerant of these conditions. Wildlife species common in such developed areas include house finch, house sparrow, common crow, European starling, American robin, mallard, Canada goose, opossum, raccoon, eastern gray squirrel, northwestern garter snake, and Norway rat. Within heavily developed areas, the most valuable wildlife habitat includes those areas which have not been developed or which have been dedicated to recreation and open space uses. Additional species that may be commonly found in more residential or rural areas include eastern cottontail rabbit, chickadee, California quail, pine siskin, Steller's jay, black-tailed deer, Douglas' squirrel, and long-tailed weasel.

Coniferous and deciduous forest habitats are found mainly in the eastern portions of the service area. Areas of continuous forest of various age classes provide primary breeding and feeding habitat for about 70 wildlife species. A similar number of species are expected to use the coniferous and deciduous forests located in habitat networks such as parks and greenbelts in more urban areas. Typical bird species found in forest habitats include red-tailed hawk, American robin, common crow, varied thrush, Swainson's thrush, black-capped chickadee, Steller's jay, downy woodpecker, and northern flicker. Common mammal species include deer mouse, mountain beaver, Townsend's chipmunk, coyote, and raccoon. Several amphibian species also inhabit forested environments including northwestern salamander, ensatina, and Pacific tree frog.

Riparian forests are found along streams and rivers throughout the service area. This habitat type is generally more productive than surrounding ecosystems, providing habitat diversity and a movement corridor for many species, particularly amphibians. Movement corridors are important in maintaining gene flow between otherwise isolated populations. They also are utilized as important stopover areas for migrating land birds, providing resting and foraging sites. Streams support fish and invertebrate populations, which are an important food source for terrestrial wildlife (including great blue heron, belted kingfisher, coyote, and raccoon).

Agricultural land is limited in the service area. This habitat is intensively managed. Birds such as common crows, European starlings, and house sparrows are the major wildlife species expected in this habitat.

Salt water beach areas in the service area, located along Puget Sound, are used by many species for foraging and resting (including gulls, Northwestern crows, and shorebirds). Harbor seals also use beaches as haulouts.

Fisheries

The abundant surface water resources in the King County wastewater service area provide a valuable habitat for a wide variety of resident and migratory finfish. In the past, these waters and tributary streams have supported five species of salmon (e.g., coho, chum, chinook, pink, sockeye), two species of trout (e.g., steelhead, cutthroat), char, and whitefish. These species have served as the basis for important commercial, tribal, and sport fisheries.

Three anadromous salmon species—chinook, coho, and sockeye—currently inhabit the drainages of the Lake Washington watershed. Chinook spawning occurs in much of the accessible stream area on the Cedar River and in portions of larger Lake Sammamish tributaries including Issaquah and Bear Creeks. Principal coho spawning habitat is located in portions of the Cedar River and its tributaries, major tributaries to Lake Sammamish, and eight independent Lake Washington drainages. Sockeye spawning occurs in virtually all of the accessible drainages of the Lake Washington basin.

With the exception of a large run reported in 1996, the sockeye fishery in Lake Washington has severely declined in the last 10 to 15 years. The cause of this decline is not clear but has been attributed to urbanization impacts on water and sediment quality. Washington Department of Fish and Wildlife (WDFW) rates salmon stocks as "healthy," "depressed," or "critical." Lake Washington sockeye stocks are currently rated as depressed, but they may be reclassified as critical. This designation requires the highest level of protection of spawning and rearing habitat. There is a similar concern for steelhead trout in the Lake Washington basin. This species has experienced a substantial decline, mostly because of excessive predation at the Hiram Chittenden Locks by California sea lions.

The three salmon species inhabiting the Green-Duwamish watershed include chinook, coho, and chum. Chinook spawning takes place in the Green River from the City of Tacoma diversion to the vicinity of Kent, with most intensive spawning in the Green River occurring in the 19 miles below Green River Gorge. Chinook also inhabit Newaukum and Soos Creeks. Coho and chum are found in virtually all accessible streams in the watershed; the more important spawning habitat includes Newaukum, Spade, Burns, Soos, Spring Brook, and Hill Creeks. Chum salmon are found in nearly all streams as well, but particularly downstream of the Green River Gorge.

In the past, shellfish resources along central Puget Sound shorelines have supported commercial, sport, and tribal fisheries. Where substrate is suitable, geoducks are present in central Puget Sound and Elliott Bay to a depth of 350 feet. There are commercial concentrations in some areas; however, this resource is closed along King County shorelines because of high coliform levels. Other shellfish resources present along King County shorelines are similarly closed to commercial harvest. For public health reasons, the Seattle-King County Health Department recommends against recreational harvesting of shellfish.

Sensitive Species

Under Section 7(c) of the Endangered Species Act of 1973, as amended, the U.S. Fish and Wildlife Service (USFWS) maintains a listing of "threatened" and "endangered" species. In addition, another listing of "candidate" species is maintained as advance notice to federal agencies regarding species proposed for listing or listed in the future. A Biological Assessment (BA) would be required by USFWS if the future environmental review for specific system components indicated a listed species is present in the project area. The BA would identify potential impacts to a listed species and require consultation with USFWS. Federally designated threatened species in the King County wastewater service area include the bald eagle (*Haliaeetus leucocephalus*) and the marbled murrelet (*Brachyramphus marmoratus*). The peregrine falcon (*Falco peregrinus*) is endangered at the federal level. One federal candidate species, the spotted frog, may occur in the project area.

The Washington State Department of Fish and Wildlife (WDFW) maintains files on the occurrence of special animals in the state. WDFW designates sensitive species as endangered, threatened, sensitive, candidate or monitor species, with definitions similar to those of the federal government. The bald eagle and the marbled murrelet are considered threatened at the state level. The peregrine falcon and western pond turtle (*Clemmys marmorata*) are designated endangered. Washington state candidate species that may occur include the spotted frog, western pond turtle, common loon, common murre, merlin, northern goshawk, Vaux’s swift, pileated woodpecker, purple martin, Townsend’s big-eared bat, and Pacific harbor porpoise. There are also several state candidate invertebrate species that may occur in the project area.

The Washington Natural Heritage Program of the Washington State Department of Natural Resources maintains an information system on significant vegetation in the state. This includes rare plants, high-quality native wetlands, and high-quality native plant communities. There are many high-quality native wetlands in the King County wastewater service area, frequently associated with streams and their discharges to larger water bodies. Plant species of concern in the service area may include the long-styled sedge, the choris' bog-orchid, and the swamp gentian.

LAND AND SHORELINE USE

Land Use Patterns

In the urban growth areas of King and Snohomish counties, the intensity of development generally increases from east to west. East of Lake Washington, land uses are principally residential although major areas of industrial and commercial development are located in large urban centers.

Except for downtown Bellevue, the most heavily urbanized portions of the King County wastewater service area are located west and south of Lake Washington. In addition to the downtown portions of major urban centers, such as Seattle, Tukwila, Renton, and Kent, areas dominated by commercial and industrial land uses include the large area extending south from downtown Seattle into the Duwamish and Green River valleys as far as Kent and Auburn, the area surrounding and including Sea-Tac Airport, and the area extending north from downtown Seattle to include areas in Interbay and along the Ship Canal.

Policies and Regulations

Growth Management Act

The Washington Growth Management Act (GMA) of 1990 requires the fastest growing counties and cities in the state to plan in accordance with the goals of the GMA. One goal of the GMA is outlined below.

> "Public facilities and services. Ensure that those public facilities and services necessary to support development shall be adequate to serve the development at the time the development is available for occupancy and use without decreasing current service levels below locally established minimum standards."

Implementation of this goal requires that King County, as a regional provider of wastewater services, coordinate with local jurisdictions to plan for long-term provision of its services at appropriate service levels. This Regional Wastewater Services Plan (RWSP) is intended to meet that requirement.

The GMA provides an orderly multistep process to implement its goals. A beginning step is for the counties or cities to establish "urban growth areas" where urban-level services (typically including sanitary sewers) will be provided. Outside these urban growth areas the same level of services will not be provided. Both King County and Snohomish County have delineated urban growth area boundaries to establish specific urban growth areas.

The established urban growth areas in King County generally include the western third of the county (excluding Vashon Island) extending east to include Woodinville, Redmond, most of the Sammamish Plateau, Issaquah, and the western portion of the Soos Creek plateau. In addition, urban growth areas have been established around the outlying towns of Duvall, Carnation, Snoqualmie, North Bend, Black Diamond, and Enumclaw.

Defined urban growth areas in the portion of Snohomish County inside or near the King County wastewater service area generally include the heavily developed southwestern portion of the county extending east to approximately the watershed boundary on the eastern side of the North Creek valley.

Comprehensive Plans

The GMA requires that cities and counties prepare comprehensive plans (or update their existing plans) to conform to GMA goals and urban growth area designations and population projections developed under the GMA planning process. Currently most jurisdictions have updated their comprehensive plans.

Local jurisdiction comprehensive plans establish land use policies and goals and designate specific geographic areas for future development within various land use categories such as industrial, commercial, and residential. Local land use designations in the King County service area broadly follow existing land use patterns.

Local Policies and Regulations

Zoning. Local jurisdiction zoning codes or ordinances include regulations that implement the policies of their comprehensive plans. Zoning codes also designate specific geographic areas that allow special land uses and establish regulations requiring land use compliance. In general, zoning designations within the King County wastewater service area conform to existing land use patterns.

Most local zoning codes define wastewater treatment plants, pump stations, conveyances, and related wastewater facilities as “utilities” or “public utilities.” Utilities are allowed in most residential, commercial, industrial, and other zones but usually require a public hearing and approval of a conditional use permit, special use permit, or similar land use permit before major wastewater facilities are allowed. Approval of such permits is usually granted only after the proponent of such a permit shows that the impacts on nearby properties and land uses are adequately mitigated.

Shoreline Management. According to the State Shoreline Management Act of 1971, local governments in Washington State are required to develop programs to regulate development and other activities along shorelines. Each local program includes goals, policies, and regulations applicable to specific shoreline designations and to land use activities such as utilities.

In general, local programs give preference to shoreline developments or uses that have water-dependent activities, such as boat marinas that cannot be located away from shoreline areas. In addition, local programs usually promote the maintenance and expansion of public access to shorelines. Most local programs prohibit or limit the location of large wastewater facilities, such as treatment plants, in shoreline areas. Some water-dependent wastewater facilities, such as outfalls, are usually permitted in some shoreline areas managed by local programs. All permitted uses and activities, except those that are quite minor, require either a substantial development permit or a shoreline conditional use permit. Depending on the jurisdiction involved, the review and approval process required for shoreline permits may involve a public hearing or may require only an administrative decision.

Regional Needs Assessment. In May 1994, King County, the City of Seattle, and the Suburban Cities Association began the Regional Needs Assessment, a collaborative process to identify critical surface water issues facing the region. As an outgrowth of the Regional Needs Assessment, the King County Council, on October 9, 1995, directed that watershed forums be created in the Cedar River/Lake Washington, Green/Duwamish River, Lake Sammamish/Sammamish River, and Snoqualmie/Skykomish River watersheds. The purpose of these forums is to:

- Set goals and strategies for surface water management issues
- Sort out overlaps and conflicts
- Develop funding sources for projects and forum coordination
- Encourage interlocal agreements
- Seek technical assistance and funding from external sources
- Share information with other watersheds

ENVIRONMENTAL HEALTH

This section discusses the three major environmental health issues commonly associated with wastewater collection and treatment systems. These issues include public health, noise, and the use of hazardous materials and chemicals.

Public Health

With the exception of occasional breaks or leaks in pipelines, most public health hazards associated with wastewater are the result of overflows of combined sewer systems. In a combined sewer system, stormwater runoff and sanitary wastes are conveyed to a treatment plant in the same pipes (e.g., West Treatment Plant). When the capacity of the conveyance system or the treatment plant is exceeded, the combined flow is routed directly to receiving waters instead of the treatment plant. This discharge is called a “combined sewer overflow (CSO)." The affected environment used in evaluating human health effects includes waterfront areas where people can come into contact with water or sediments influenced by the discharge of untreated sewage mixed with stormwater.

CSOs allow a wide range of pollutants to enter receiving waters. In addition to disease-causing microorganisms, fecal matter, toxic chemicals, and other materials found in sanitary waste, CSOs also contain pollutants picked up by stormwater as it travels over rooftops, yards, and paved surfaces. These pollutants include dirt, particles from smoke and automobile exhaust, eroded brake linings, fertilizers, pesticides, detergents, animal droppings, and many other contaminants.

Besides CSOs, there are other non-point sources of pollution upstream in the Green/Duwamish River Basin such as urban stormwater, industrial, agricultural and forestry practices. King County is currently conducting a water quality assessment to determine the importance of CSOs' contribution of contaminants to the Duwamish River and Elliott Bay relative to these other sources.

In the past, overflows resulting from excess stormwater in the combined sewers of the Seattle system have affected water and sediment quality along the shorelines of Lake Washington, Lake Union, the Ship Canal, the lower Duwamish River, Elliott Bay, and central Puget Sound. The locations, frequencies, and volumes of CSOs have been substantially reduced in recent years through the efforts of the City of Seattle and King County. CSO control measures have included sewer separation, construction of new storage facilities, new pumping stations, and computerized methods for maximizing in-line storage.

Although much progress has been made, CSOs continue to occur. As many as seven major King County outfalls convey CSO into each receiving water body, for a cumulative discharge of more than 1.5 billion gallons per year. Some of the waters receive only a few million gallons per year while others receive more than one-half billion gallons. Depending on the outfall, combined sewage and stormwater may be discharged less than one time per year to as often as 56 times per year (Brown and Caldwell, et al., 1995). The greatest density of CSOs is found in and south of downtown Seattle; receiving waters for these outfalls are the Duwamish River and Elliott Bay.

Control of public health in and around the receiving waters is shared by the Seattle-King County Health Department and the Washington State Department of Health. The local health department has jurisdiction over beach closures for mishaps such as excessive concentrations of fecal coliform bacteria. Bacterial contamination of fish and shellfish can be the result of stormwater runoff, failing septic systems where such systems are in use, and CSOs. The Health Department advises against consumption of bottom fish and shellfish in the Duwamish River and Elliott Bay. The State Department of Health has jurisdiction over commercial harvest and shellfish; it may close fisheries, close or decertify shellfish beds, or issue consumption advisories. The State of Washington has currently closed King County beaches to commercial shellfish harvest because of contamination by fecal coliform bacteria.

People routinely use areas that may be affected by CSOs. Recreational use of shoreline and near-shore environments in the King County wastewater service area is facilitated by public access points, beaches, parks, boat launches, fishing piers, marinas, rental shops, and other water-based facilities. Some of these facilities are near CSO outfalls:

- Elliott Bay Park and fishing pier at Pier 86, and Myrtle Edwards Park in the vicinity of the Denny Way CSO outfall, the largest in the King County system
- Public fishing piers near the Connecticut Street and King Street CSO outfalls in south Elliott Bay
- Public fishing piers near the Hanford and Lander CSO outfalls in the East Waterway of the Duwamish River (east of Harbor Island), and near the Chelan and Harbor CSO outfalls in the West Waterway of the Duwamish River
- Water access and park along the Duwamish River immediately downstream of the Brandon CSO outfall, and a few hundred meters upstream of the Michigan CSO outfall

For many years there has been fishing for crab and bottomfish in the Duwamish Estuary. Because of pollutants in the waterways and abnormalities present in certain demersal fishes, warnings about consuming fish and shellfish caught in these waters have been issued by the Seattle-King County Health Department.

Swimming, scuba diving, windsurfing, and other water contact activities occur in many areas despite the cool water temperatures of Puget Sound. The most popular saltwater beaches in the King County wastewater service area are Alki Beach between Duwamish Head and Alki Point, and Golden Gardens Park north of Shilshole Marina. There are many smaller beaches along Puget Sound as well as many waterways in the metropolitan Seattle area.

Noise

The human ear responds to a very wide range of sound intensities. The decibel scale used to describe sound is a logarithmic rating system that accounts for the large differences in audible sound intensities. This scale shows that loudness is doubled at each 10 dBA interval. Under normal listening conditions, a five decibel change could be perceived. Sound levels are also described by equivalent sound levels (Leq). This is the level of a constant sound that has the same sound energy as the actual fluctuating sound.

Factors affecting noise impact include distance from a source, frequency of the sound, absorbency of the ground, obstructions, and duration of the sound. The degree of impact also depends on the listener and on background sound levels.

King County and some municipalities in its wastewater service area (e.g., Seattle, Renton, Bellevue, and Bothell) have adopted noise ordinances. Many of the noise ordinances are similar to noise regulations developed by the State of Washington. Although there are some differences among noise ordinances, most address construction noise. The City of Seattle, for instance, has established maximum permissible sound levels based on the land use of the source and receptors, time of day, and duration of the sound (Table 4-1). Noise levels generated in industrially zoned areas ordinarily cannot exceed 60 dBA in neighboring residential areas or 65 dBA in neighboring commercial areas. These maximum sound levels may be exceeded during construction between 7 a.m. and 10 p.m. on weekdays and between 9 a.m. and 10 p.m. on weekends. Regulations further specify the degree and duration by which construction activities may exceed maximum levels. The city also regulates motor vehicle noise. For most heavy trucks (over 10,000 pounds gross vehicle weight), the limit is 86 dBA 50 feet from the source where speed limits are less than 35 miles per hour (mph) and 90 dBA where the speed limit is greater than 35 mph.

Table 4-1. City of Seattle Maximum Permissible Noise Levels

Zoning of Sound Source	Zoning of Receiving Property		
	Residential dBA	Commercial dBA	Industrial dBA
Residential	55	57	60
Commercial	57	60	65
Industrial	60	65	70
(Ord. 106360 302, 1977)			

King County noise standards (Table 4-2) are based on land use at the noise source, receiving property land use, and time of day.

Table 4-2. King County Environmental Noise Standards (dBA)

Land Use at Noise Source	Receiving Property Land Use			
	Rural Day/Night	Residential Day/Night	Commercial	Industrial
Rural	49 / 39	52 / 42	55	57
Residential	52 / 42	55 / 45	57	60
Commercial	55 / 45	57 / 47	60	65
Industrial	57 / 47	60 / 50	65	70

The U.S. Environmental Protection Agency evaluates noise impacts based on the relative change in sound because of a project. It classifies an increase of zero to 5 dBA as a "slight" impact, an increase of 5 to 10 dBA as a "significant" impact, and an increase of more than 10 dBA as a "serious" impact.

Hazardous Materials and Chemicals

There are several chemicals used in large quantities at wastewater treatment plants and conveyance facilities. Some of these are potentially hazardous to plant workers and to communities in the vicinities of the treatment plants and pump stations. Frequently used chemicals at plants and facilities in the King County wastewater service area include chlorine, sodium hydroxide, sulfur dioxide, polymers, alum, and activated carbon.

Chlorine

Chlorine is used for odor control as a disinfectant for influent at the headworks of a plant. It is also used as a disinfectant for effluent before discharge through an outfall to receiving waters. At normal temperatures and pressures, chlorine is in a gaseous state and is heavier than air. It is an asphyxiant and immediately dangerous to living organisms at levels of 25 ppm.

At the East Treatment Plant, chlorine is delivered to the plant in 90-ton rail cars that are specifically designed for the purpose of chlorine transport. Rail cars are unloaded in a contained chlorination building at the southeast corner of the plant site. Chlorine is piped directly from the rail car through feed equipment to the desired points of application at the plant. All chlorine is piped under partial vacuum in order to prevent leaks.

At the West Treatment Plant, chlorine is delivered to the plant by special semitrailer trucks carrying up to 12 one-ton cylinder containers. While in use, cylinders are stored in cradles in a contained, concrete storage building. The cylinders are connected to an evaporator that converts the liquid to a gas and then is distributed to various injection points throughout the plant through a vacuum piping system.

Safety features are incorporated into the entire chlorination system. Safety features include pressure and leak detection alarms, emergency use of sodium hydroxide to absorb chlorine in case of system malfunction, vacuum distribution systems and fail-safe shutdown in case of vacuum failure, full containment of the chlorination building in the event of a leak, pressure sensors and alarm systems, backup power supplies, and regular inspection of chlorination equipment.

Caustic Soda (Sodium Hydroxide)

Caustic soda (N_aOH) is used to neutralize chlorine in the event of an accidental release. It is extremely alkaline and can react explosively when mixed with organic chemicals. It can cause serious skin burns. Caustic soda is usually delivered in liquid form in a 4,000-gallon tank truck, under strict controls of the U.S. Department of Transportation. A pumping system on the truck delivers the caustic soda solution directly to onsite storage tanks.

At the East Treatment Plant, caustic soda is stored in aboveground outdoor storage tanks near the chlorination building. At the West Treatment Plant, caustic soda is stored in 10,000- and 5,000-gallon storage tanks. Both storage facilities include concrete berms to contain any release from potential leaks or ruptures. At both plants, venting systems direct any chlorine gas to the caustic soda tanks where it is absorbed and neutralized. The resultant solution becomes saltwater. Use of caustic soda in the past at the East Plant and the West Plant has been minimal.

Sulfur Dioxide

Sulfur dioxide was used in the past at the East Treatment Plant to dechlorinate effluent before discharge to the Duwamish River. Dechlorination was no longer needed when the discharge was shifted to central Puget Sound waters; however, the system has been maintained in case of emergency discharge to the river. Sulfur dioxide is stored as compressed gas in a 10-ton storage tank in a small building designed to contain possible leaks.

Other Chemicals

Polymers are long-chain, charged organic chemicals that are mixed with sludge to bind solids together. Polymers facilitate sludge thickening and dewatering. Activated carbon is used as a sorbent to remove odor-causing agents in many plant processes. Polymers and activated carbon are nontoxic.

A number of chemicals may be used at conveyance facilities (pump stations, force mains, gravity lines) in order to control odors and pipe corrosion. These chemicals may include sodium hypochlorite, potassium permanganate, hydrogen peroxide, and ferrous chloride. Some of these chemicals can be harmful, and special handling precautions are specified for their use.

Hydrogen sulfide and volatile organic carbon compounds (VOCs) are substances generated by wastewater under certain conditions. These are discussed in the air resources section of this chapter.

OTHER ELEMENTS OF THE ENVIRONMENT

Earth Resources

Geology and Soils

The geology and soils of the King County wastewater service area are mostly the result of long-term faulting, folding, and sedimentation. Recent glacial and post-glacial geologic events have also been instrumental in determining the geology and soils of the area. A significant geologic transition occurs in the vicinity of an east-west line running through Duwamish Head and Eastgate in Bellevue. North of this line, which approximates the trace of the Seattle fault, lies the downfolded Seattle basin where bedrock is more than 100 meters below the surface. South of the Seattle fault, upfolded bedrock rises to the surface in the Newcastle Hills, Beacon Hill-Rainier Valley, and Renton vicinities and lies within 100 meters of the surface including most of the service area east of Sea-Tac Airport and north of the city of Auburn (Yount et al., 1985; Galster and Laprade, 1991).

Recent glacial and post-glacial events have created a pattern of predominantly north-south valleys and ridges or drift plains on this older bedrock. The valleys, occupied by

Puget Sound, Lake Washington and Lake Sammamish, the Green and Snoqualmie rivers, and other major drainages, are primarily covered by fine-grained, silt-rich or clay-rich, poorly drained soils developed from deposits of rivers and lakes since the last glaciation. In many areas, these fine-grained valley soils have a high organic content.

The ridges and drift plains between the valleys are covered primarily with coarser-grained soils derived directly from glacial deposits. In many areas these glacially derived soils are underlain at depths of a few feet by a compacted layer of glacial material called till. Locally, finer-grained soils may occur in depressions occupied by lakes or wetlands, in ravine bottoms, and along the edges of ridges and drift plains (SCS, 1973, 1983).

Geological Hazards

Geological hazards include erosion, landslide, and seismic hazards. Erosion potential depends on soil type, slope, vegetative cover, and rainfall characteristics. In the King County wastewater service area, the potential for erosion is usually associated with slopes greater than 15 percent, with areas where the natural vegetation has been removed or with locations downstream of developed areas where a significant portion of the area is usually covered by impervious or slowly permeable surfaces. In addition, the potential for erosion is usually greater in the fall to spring wet-weather season during and immediately after periods of rainfall (King County, 1987).

The King County wastewater service area is located within a seismically active region. Based on the historical record of earthquakes, for planning purposes a "credible maximum [earthquake] event" for the King County wastewater service area is of a magnitude as high as 7.5 on the Richter scale (Galster and Laprade, 1991). Recent research indicates that earthquakes considerably more powerful than magnitude 7.5 have occurred in the past in the Puget Sound region, but the frequency of such earthquakes is less than once in several hundred years (Adams, 1992).

Contaminated Soils

There are contaminated soil sites throughout the King County wastewater service area. These upland and in-water sites are located primarily in areas of current or past industrial development. Some of the in-water sites are located adjacent to existing CSO outfalls, although the CSOs are not the only source of contamination at these sites. Commonly encountered contaminants at sites in the King County wastewater service area include petroleum products, metals, solvents, and polynuclear aromatic hydrocarbons (PAH) as well as other contaminants (Ecology, 1994).

Aesthetics

Within the Puget Sound basin, the Olympic and Cascade mountains, Puget Sound, and lakes Sammamish and Washington are the primary focus of most regional views. The linear crests of ridgelines visible throughout much of the Puget Sound basin along with the shorelines of major lakes and Puget Sound dominate many more local views.

In the plateau-and-valley topography that characterizes the Puget Sound basin, regional views typically extend over valleys toward distant physical features. The valley floors and sides are typically wide and visible from other locations. Valley floors are visually flat planes characterized by broad, visually uniform areas, and structures in these valley areas are typically widely visible. Conversely, sites away from valley floors and sides are typically visible from only a few other locations.

In general, the King County wastewater service area becomes more urban from east to west. East of the Sammamish and Green River valleys on the east Lake Sammamish and Soos Creek plateaus, land use is almost exclusively single-family residential. Residential structures are limited in scale and bulk (generally not exceeding three stories in height and a footprint of about 2,000 square feet). Substantial vegetation exists in and around the residential areas. The green, vegetated areas contrast with the built structures, creating a mosaic texture of green space interspersed with the simple geometric shapes and straight lines of buildings.

More and larger buildings exist in the more urbanized areas west of Lake Sammamish and Soos Creek plateaus. The simple geometric forms and straight lines of built structures are a defining visual element in the most heavily urbanized city centers. In these urbanized areas, there is less vegetation, and colors tend toward muted tones of grays and reds. In the most heavily urbanized areas, profiles of buildings often interrupt and obscure the natural irregular character of ridgelines and shorelines. Major highways and bridges are also visually prominent, linear features in the urbanized portion of the King County wastewater service area.

Recreation

The State of Washington, and cities and counties (except recently incorporated cities) provide parks and other public recreational facilities in the King County wastewater service area. There are more than 700 publicly owned formal recreational facilities located within the service area. These facilities include parks; school athletic facilities; biking, hiking, and equestrian trails; marinas; and golf courses. Most parks provide picnic, playground, ballfield, sport court, swimming, and/or boating facilities. In addition to providing recreational opportunities, most public parks located in urban areas provide open space and educational opportunities. There are also private recreational facilities located within the service area, such as exercise clubs, private golf courses, sailing and rowing clubs, and shooting ranges.

Data showing the amount of use of individual parks and other formal recreational facilities are extremely limited. In the King County wastewater service area, parks with developed facilities in urban areas are used most frequently, while parks in non-urban areas and those with undeveloped facilities are used less. Many jurisdictions in the service area classify parks as neighborhood, community, or regional parks. While regional parks are usually the largest parks with the most diverse facilities and the most visitors, individual facilities in large regional parks (e.g., ballfields) may not receive a substantially different level of use from that of comparable individual facilities in smaller neighborhood or community parks.

The most used large parks and other formal recreational facilities receive from 100,000 to more than 1 million visits a year. Formal recreational facilities are used most often on weekends, during the dry weather season, and during special events. Frequent use also occurs during other times for particular facilities (e.g., weekday evenings for soccer and softball fields at many parks).

In addition to formal recreational facilities, there are informal recreational activities throughout the King County wastewater service area. Informal water-related recreational activities include boating, swimming, beachcombing, fishing and clamming, diving, water-skiing, and boardsailing. Other informal recreational activities include bicycling on roadways not formally designated as bikeways, and backyard basketball. There is little data available on levels of informal recreation.

Recreational facilities adjacent to existing major wastewater facilities include Discovery Park, adjacent to the West Plant; Waterworks Gardens, adjacent to the East Plant; Carkeek Park, adjacent to the Carkeek stormwater plant; the public walkway and beach, across Beach Drive SW from the Alki stormwater plant; and Bar-S playfield, adjacent to the Alki stormwater plant. Discovery and Carkeek parks, the beach at Alki, and the Bar-S playfield are all heavily used facilities.

Cultural Resources

Cultural and historic resources located within the RWSP service area are discussed generally within this section. Additional discussion and detail on the history, ethnography, and archaeological resources of the service area (including locations of historic sites and structures) are included in a separate report on archaeological and cultural resources prepared for the RWSP; this report is available at the King County Wastewater Treatment Division offices.

Ethnography and Archaeology

The RWSP service area is located within the territory of the Duwamish Indians, a fishinggathering-hunting group who lived on the Duwamish, Green (formerly White), and Cedar Rivers, Elliott Bay, Lake Washington, Lake Union, and Salmon Bay (LAAS, 1995). Salmon was the primary source of food for the Duwamish and was harvested in local marine waters, rivers, lakes, and streams. Other food sources included nonsalmonid fish species, shellfish, waterfowl, and roots and berries.

Most of the archaeological research in the Seattle/Lake Washington area has been conducted for environmental compliance purposes associated with industrial development, sewer conveyance, and sewage treatment. The King County Wastewater Treatment Division (formerly part of Metro) has been responsible primarily for large projects on the Seattle and Elliott Bay shorelines and the Duwamish River and River valley. These areas have experienced closer scrutiny and more intensive cultural resource investigations than

Lake Washington, Lake Union, the Lake Washington Ship Canal, and North Beach. As river and lake shorelines were focal points for prehistoric settlement and commerce, archaeological sites may be discovered in these locations. In particular, Lake Washington is very likely to contain archaeological resources.

Based on ethnographic documentation, the King County wastewater service area may contain several kinds of archaeological resources including the following:

- Remnants of long-house and potlatch house structures
- Shell middens or refuse heaps associated with permanent settlements or camping sites
- Fire pits or hearths associated with resource processing stations
- Human remains and grave goods from burial grounds
- Lithic material from tool-making
- Bone and stone tools
- Remnants of fish weirs and traps
- Rock piles from sweat lodges

A review of site records for the RWSP service area identified 20 archaeological sites. All are hunter-fisher-gatherer sites except one, a historic dump at Fort Lawton. The sites are located primarily on the Sammamish River, the banks of the former Black River (which dried up when its source, Lake Washington, was lowered during construction of the Ship Canal), and the former mouth of the Duwamish River. Listings, descriptions, and evaluation status for the National Register of Historic Places (NRHP) are included in the archaeological and cultural resources report prepared for the RWSP.

In addition to land-based cultural resources described above, there is a strong probability that Elliott Bay contains unidentified shipwrecks on its bottom. Of 60 documented shipwrecks in Elliott Bay, only 18 have been recovered. Seven of the shipwrecks occurred off the Duwamish Head. More information of these shipwrecks and their locations is available in the background report referred to above.

Historic Resources and Structures

Historic resources in Seattle and its environs are primarily related to the history of settlement by non-native immigrants, beginning in the mid-nineteenth century, and its development as a center of commerce and shipping. Review of the literature suggests the service area may contain as-yet-unidentified historic resource materials, including materials related to the logging and lumbering industry, establishment of homesteads and farms, road building, railroad construction, and development of maritime industries.

There are numerous historic structures within one-quarter mile of potential RWSP facilities, as identified in surveys commissioned by local governments, recorded by local individuals, and/or nominated to the State or National Registers of Historic Places. A full listing of these structures is included in the background report on archaeological and cultural resources prepared for the RWSP (LAAS, 1995).

Air Quality

Regulatory Background and Regional Status

Under the authority of the federal Clean Air Act, the U.S. Environmental Protection Agency (U.S. EPA) sets standards for a number of air pollutants, known as "criteria pollutants." Within the state of Washington, Ecology and the regional air quality agencies have established standards for levels of criteria pollutants in ambient air and have been granted authority by U.S. EPA to issue certain air quality-related permits. The Puget Sound Air Pollution Control Agency (PSAPCA) has jurisdiction over air quality in the project area. At present, the Puget Sound region is classified as attaining all federal and local air quality standards.

PSAPCA also regulates new sources of toxic air pollutants (TAPs). New point sources (i.e., fixed facilities that will generate TAPs) are required to demonstrate that emissions will not exceed ambient source impact levels (ASILs), which have been established for over 600 TAPs. The source must also demonstrate that best available control technology (BACT) for toxic substances will be used. Both of these demonstrations must be presented as a part of the air permit application.

Air Emissions from Existing Treatment Facilities

Like all wastewater treatment facilities, King County's existing West and East Treatment Plants emit a number of substances that can affect air quality on a local or regional level. Emissions directly related to the operation of treatment facilities include volatile organic compounds (VOCs); odor; and combustion products, primarily oxides of nitrogen (NO and NO_2, referred to collectively as NO_x) and CO, from onsite biosolids handling facilities. CO is also released in emissions from vehicles associated with facility operations, particularly the transport of biosolids for recycling. These pollutants and the regulations pertaining to them are described below.

Volatile Organic Compounds

VOCs can be described, in general, as chemical compounds composed of carbon or carbon chains that are readily volatilized into the atmosphere. Their emission is subject to regulation in the Puget Sound basin because they interact with NO_x in the presence of sunlight to form ozone. Some VOCs are also regulated as toxic air contaminants (TACs) by Ecology and PSAPCA. Their source at wastewater treatment facilities is the influent wastewater streams. Residential, commercial, and industrial activities all contribute to concentrations of VOCs in wastewater; commonly identified contaminants include paint solvents, cleaning solutions, degreasing solutions, gasoline and other petroleum products, and pesticides. VOCs can be released through evaporative processes during both primary and secondary treatment. Source control measures, including King County's Industrial Pretreatment Program and education and outreach to businesses and the public, are effective ways of reducing VOC concentrations in influent.

Because of the practical difficulties of controlling their volatilization at treatment facilities, VOC emissions from such facilities are not regulated by air quality agencies. The most effective way of reducing VOCs at treatment facilities is to use source control measures to limit their concentrations in the influent stream; however, some level is likely to remain even with the most aggressive measures. Overall emissions of VOCs from wastewater treatment facilities (estimated conservatively at approximately 0.2 ton per mgd per year) are not considered to represent a substantial contribution to regional ozone formation.

Odor

Odors associated with wastewater treatment facilities are chiefly the result of biological activity in the collection and treatment systems. The anaerobic decomposition of compounds containing nitrogen and sulfur results in a number of gases, including hydrogen sulfide, ammonia, carbon dioxide, methane, nitrogen, hydrogen, and oxygen. Of these, hydrogen sulfide and ammonia are the primary sources of odors considered objectionable to nearby residents. The location of a treatment plant, the size of the plant site, the proximity of residential areas, the direction of prevailing winds and other atmospheric conditions, and the characteristics of the sewer system that conveys influent to the plant are all factors in determining whether the odors the plant produces are likely to have a significant effect on the surrounding community.

An increase in odor *potential* (i.e., treatment of higher volumes of wastewater) does not necessarily entail greater odor impacts, as the potential for odors can be offset by design and operation procedures incorporated into treatment plants. Typical technologies for controlling odor include covering as many process facilities as practicable (which will also reduce VOC emissions); scrubbing of air from the headworks, screenings building, solids facilities, and other odor-generating equipment; use of activated carbon vessels at digester vents; and establishment of buffer areas between odor-generating activities and nearby residential areas. Appropriate technologies are determined during detailed project design.

King County actively pursues measures to reduce odor emissions from its existing facilities. Because odor impacts are not quantifiable in the traditional sense (e.g., by measurements of odor-causing chemicals), they are typically regulated, if at all, by means of such methods as conditions on land use permits.

In 1997, an independent odor consultant will conduct comprehensive West Point Treatment Plant odor surveys to identify and characterize treatment plant odors and identify the most likely source(s) of the odors. Recommendations for prevention, containment or treatment of odors that could exceed permit levels, adversely impact visitors to Discovery Park or adversely impact onsite work conditions will be prepared. The survey could result in procedural changes and/or system modifications as needed to mitigate (reduce or eliminate) identified odors.

Combustion Pollutants

Combustion pollutants are produced by the burning of hydrocarbon fuels in combustion engines. They are generated by both point sources (e.g., large stationary engines used for industrial or other purposes) and mobile sources (primarily vehicles). The major combustion pollutants produced by treatment plant operations–oxides of nitrogen and carbon monoxide–are discussed in this section.

Oxides of nitrogen (NO_x) are produced during high-temperature combustion with excess air. NO_x is currently produced at the West Treatment Plant through the operation of engines that use digester gas to produce electricity. Because NO_x emissions contribute to the chemical reactions that form ozone, NO_x is controlled as a point-source pollutant (e.g., from vents and stacks). Measures to control NO_x emissions from point sources are typically specified as a condition of the Notice of Construction (NOC) permit, which requires a determination by PSAPCA that potential emission sources are designed to make use of best available control technology (BACT) and that no adverse air quality impact will occur as a result of project operation.

Like NO_x, CO is a product of combustion, and is emitted primarily by vehicle engines and stationary combustion sources. All vehicle activities associated with construction and operation of wastewater treatment, conveyance, and CSO facilities generate CO, which contributes incrementally to regional levels. It is regulated as a criteria pollutant by U.S. EPA and PSAPCA.

Transportation

Roadways

There are three interstate facilities in the King County wastewater service area: Interstate 5 (I-5), Interstate 90 (I-90), and Interstate 405 (I-405). The major north-south interstate is I-5, an important commuter route and a major facility for local, regional, and interstate truck service. I-5 links Seattle with Everett and Bellingham to the north and Tacoma and Olympia to the south. The major east-west facility is I-90, connecting I-5 just south of Seattle's urban core with communities east of Lake Washington (Bellevue, Issaquah, North Bend), Snoqualmie Pass, and eastern Washington. I-90 is also a major commuter route. I-405 is a major north-south facility on the east side of Lake Washington. It connects communities north, east, and south of Lake Washington, including Bothell, Woodinville, Redmond, Kirkland, Bellevue, Renton, and Tukwila. I-405 connects with I-5 just east of Lynnwood in Snohomish County and near Southcenter Mall in Tukwila south of Seattle. I-405 intersects with I-90 at Factoria in Bellevue. In addition, eight major state routes (SRs) in western King County provide linkages between interstates and are integral to the framework of King County's transportation system.

West Treatment Plant. The West Treatment Plant is accessed by roadways through the Interbay area and Magnolia neighborhood. A road through Discovery Park and Fort Lawton leads directly to the treatment plant, connecting to the city street system at W. Government Way. W. Government Way, Gilman Avenue W., and 20th Avenue W. connect to W. Dravus Street and 15th Avenue W. Fifteenth Avenue W. is designated a truck route and provides connections to SR 99 and I-5.

East Treatment Plant. The East Treatment Plant is accessed directly by the following roadways: SW 7th Street on the north , Longacres Drive S.W. on the south, and Monster Road S.W. on the northwest. Oaksdale Ave S.W. runs along the east side of the plant and intersects with S.W. 7th Street. S.W. Grady Way is a heavily traveled roadway on the south side of EDRP, and intersects with Longacres Drive S.W. and Oaksdale Avenue S.W. S.W. Grady Way provides access to I-5, I-405, and SR 181 (Interurban Ave S.).

Rail Transportation

Burlington Northern and Union Pacific own and operate rail lines and yards throughout the King County wastewater service area. Major rail lines run primarily north and south with connecting spurs serving the industrial areas in the Seattle waterfront and the Duwamish Valley.

Transit

King County Transit provides comprehensive bus and associated transportation services. Supporting facilities in King County include 7 operation centers, 8 vehicle maintenance centers, 10 regional and community transit centers, 42 park-and-ride locations, 37 leased parking lots, and approximately 1,200 bus shelters (King County, 1994). King County Transit also operates the Seattle Monorail and the Waterfront Streetcar system. In addition, Community Transit (Snohomish County) and Pierce County Transit operate routes which use roadways and some park-and-ride facilities within King County and the RWSP service area.

Pedestrian and Bicycle Transportation

The King County wastewater service area includes a number of off-street bicycle and multiuse paths, and numerous on-street bike routes and lanes. Major trails include the Burke-Gilman/Sammamish River Trail system, which extends from Ballard in Seattle along the west and north sides of Lake Washington and along the Sammamish River to Marymoor Park in Redmond, and the Duwamish Waterway Trail/Green River Trail system, which extends from near Duwamish Head in west Seattle and along Elliott Bay and the Duwamish/Green River to near SR 18 east of Auburn. Segments of this trail are incomplete.

Public Services, Utilities, and Energy

Public services in the King County wastewater service area include fire/emergency response, police, medical care, and education. Public utilities include wastewater disposal, water supply, solid waste disposal, electricity, natural gas, and communications. King County facilities place no significant demands on medical services, educational services, or communication utilities; therefore, these services and utilities are not discussed in this section.

Public Services

Approximately 25 fire districts or city fire departments provide fire and emergency services in the King County wastewater service area and the area potentially affected by proposed King County facilities. In addition to emergency aid services, most fire districts and fire departments provide hazardous materials containment services. Those fire districts without hazardous materials capabilities usually contract with adjoining districts or departments to provide these services. The response time for fire/emergency services in the King County wastewater service area is typically less than 10 minutes.

Each incorporated city in the King County wastewater service area provides police services within its municipal boundaries. King County and Snohomish County police departments provide police services in unincorporated portions of their counties. The response time for high-priority calls is usually less than 10 minutes for municipal police departments, and from 8 to 15 minutes for county police services because of the large geographic areas covered by county services.

Public Utilities

Wastewater Disposal. King County provides regional wastewater services within a 680-square-mile area referred to here as the King County wastewater service area. Existing and proposed wastewater facilities and services are described in the Regional Wastewater Services Plan and in Chapters 2 and 3 of this document.

Water Supply. In the King County wastewater service area 34 purveyors deliver water. Of these purveyors, 29 obtain all or part of their supply from the Seattle Water Department system. The Seattle system obtains surface water from two watersheds in the Cascade Mountains (South Fork Tolt and Cedar rivers) and groundwater from the Highline Wellfield south of Seattle. The Seattle Water Department delivers an annual average of about 175 mgd to residential, business, institutional customers, and the 29 purveyors purchasing water from the Seattle system. A small amount of the 175 mgd is used outside the King County wastewater service area, in the Edmonds, Duvall, and Des Moines areas. About half the 175 mgd is used in single-family homes; 15 percent is used in multifamily dwellings; 28 percent is used by commercial and industrial customers; and the remaining 7 percent is used by governmental and institutional customers (SWD, 1993).

Water in the Snohomish County portion of the King County wastewater service area is delivered primarily by the Alderwood Water District, which purchases water from the City of Everett system that serves a large area in south Snohomish County. *The Point Wells vicinity and Woodway obtain their water from the Olympic View Water and Sewer District.* Customers in King County on the eastern and southern sides of Lake Sammamish get their water from groundwater sources by the Union Hill Water Association, the Northeast Lake Sammamish Sewer and Water District, the Sammamish Plateau Water and Sewer District, and the City of Issaquah. The Renton, Kent, and Auburn Water Departments in the Green River Valley supply water in their planning areas primarily from groundwater (springs and wells).

Solid Waste Disposal. *Municipal and most demolition solid waste from the City of Seattle is collected locally and exported to a private landfill in Arlington, Oregon.*

Municipal solid waste in King County outside Seattle is collected locally for disposal at the Cedar Hills and Vashon landfills. Construction, demolition, and land-clearing waste is exported to Klickitat County and Arlington, Oregon, under county contracts with private vendors. King County's primary in-county landfill, Cedar Hills, receives over 97 percent of the county's municipal solid waste. The landfill's remaining capacity (as of 1996) was approximately 18-26 million tons through 2014 to 2020, depending on the level of waste reduction and recycling achieved in the county and future development at the landfill. Cedar Hills Landfill accepts mixed municipal solid waste including various special wastes such as asbestos and treated biomedical wastes (King County, 1993a). In the 1980s, biosolids generated by the Metro system were accepted at Cedar Hills Regional Landfill. Biosolids were stored and also used in final cover for completed areas.

Municipal and demolition solid waste in Snohomish County is collected locally and exported to Klickitat County for disposal at the Roosevelt Regional Landfill operated by the Regional Disposal Company. The Roosevelt landfill has a capacity of about 120 million tons for 40 years. The Roosevelt Regional Landfill is permitted to handle incinerator ash as well as municipal, construction, demolition, and other nondangerous, noninfectious solid waste (Klickitat County, 1992).

Energy. Seattle City Light provides electrical power to about 320,000 customers in Seattle and areas north and south of the city. Puget Sound Energy (formerly Puget Sound Power and Light and Washington Natural Gas) provides electrical power to customers elsewhere in the King County portion of the King County wastewater service area. Snohomish County Public Utility District No. 1 provides electrical power to the portion of the King County wastewater service area within Snohomish County. Puget Sound Energy also provides natural gas service within the King County wastewater service area.

The major facility consumers of energy in the King County wastewater service area are treatment plants and pump stations. Smaller facilities, such as regulators, storage systems, odor control units, and ventilation systems, have low energy requirements. Depending on the facility, King County uses a combination of energy sources that includes electrical power and natural gas, which are generated onsite using digestion of biosolids at treatment plants. Primary King County vendors are Seattle City Light (City Light), and Puget Sound Energy.

West Treatment Plant

The West Treatment Plant generates electricity for sale to City Light (Metro, 1988). This electricity is produced by using gases generated by the sludge stabilization process. In 1995, the West Treatment Plant purchased 38.8 million kWh of power from City Light while generating 9.2 million kWh.

East Treatment Plant

Electrical power is supplied to the East Treatment Plant by Puget Power by transmission lines located south of the site. A high voltage (115 kV) substation was constructed to serve the plant as part of the Phase II expansion in 1985. In 1995, the plant purchased about 64.9 million kWh of power.

All of the digester gas produced at the site is sold to Puget Sound Energy, formerly the Washington Natural Gas Company. Digester gas, about 65 percent methane and 35 percent carbon dioxide, is scrubbed to remove impurities and sold at a price equivalent to that paid to major pipeline suppliers. In 1995, Washington Natural Gas purchased 1.81 million therms (equivalent to about 53.1 million kWh). When the plant treats 115 mgd (capacity now under construction), the amount purchased is expected to increase to about 3.3 million therms (96.9 million kWh) per year.

Pump Stations

There are approximately 40 pump stations throughout the King County system. These pump stations require electrical energy for pump operation, electrical control systems, mechanical systems, and odor and corrosion control facilities. Total power consumption at the pump stations in 1994 was about 26,387,000 kWh. Of this total, pump stations within the West and East service areas consumed 16.7 million kWh and 9.7 million kWh, respectively.

NOTE

Chapter 5 is as it appeared in the Draft EIS (May 1997) for the RWSP. References to the RWSP in Chapter 5 are to the draft Plan issued at the same time as the Draft EIS. Projections in this chapter are the ones used for the original four service strategies.

CHAPTER 5

OPERATIONAL IMPACTS COMMON TO ALL SERVICE STRATEGIES AND IMPACTS AND MITIGATION MEASURES FOR SERVICE STRATEGY 1

Service Strategy 1 is described in Chapter 3 of this DEIS. The major features of SS1 are summarized as follows:

- Maintain the existing two-treatment-plant system (West and East Plants)
- Expand West Treatment Plant to planned capacity of 159 mgd (2020)
- Construct new parallel Kenmore interceptor (2010)
- Expand East Treatment Plant in increments to an ultimate capacity of 235 mgd (2040)
- Construct new third outfall off Duwamish Head (2000)
- Construct new parallel Eastside interceptor(2035)
- Implement CSO program to achieve one event per outfall per year by 2043
- Implement full-scale I/I reduction program

The important features of Service Strategy 1 are shown in the Figure 3-1.

CHAPTER ORGANIZATION

This chapter and the three that follow each focus on the operational impacts of one of the four service strategies, primarily treatment and conveyance and CSO control. These impacts, and proposed measures to mitigate them, are discussed under headings that correspond to SEPA "elements of the environment."

Impacts of using wastewater end products--reclaimed water and biosolids--are addressed in Chapters 9 and 10, respectively. A programmatic discussion of construction impacts is presented in Chapter 11.

The first four environmental elements discussed in each of Chapters 5 through 8 are water resources, biological resources, land and shoreline use, and environmental health.

These were determined to be the more critical environmental issues in comparing the long-term impacts of the service strategies. They are discussed in greater depth than the "Other Elements of the Environment" category in the latter part of the chapter (i.e., earth resources, aesthetics, recreation, cultural and historic resources, air quality, transportation, public services and utilities, and energy). More in-depth review of all applicable elements will be conducted when individual projects under the RWSP are implemented.

In addition to those impacts specific to SS1, this chapter provides information on impacts that are common to all four service strategies. This information provides context on the general nature and extent of impacts associated with the operation of wastewater treatment, conveyance, and CSO facilities. Discussions of common impacts precede the specific discussion of SS1 impacts under each element of the environment.

WATER RESOURCES

Impacts Common to All Service Strategies

Long-term operational impacts to the water quality of receiving water bodies from the four service strategies are discussed below. These impacts involve discharges from the treatment plants and CSO outfalls, conveyance system impacts, and infiltration and inflow impacts. This discussion assumes that all facilities proposed under each service strategy will reach capacity by the end of the planning period. This assumption enables comparing the various service strategies based on cumulative effects, regardless of implementation phasing.

Treatment Plant Discharges

Treatment plant discharges will increase, regardless of the service strategy, as a direct result of expected population growth in the region during this period. Based on the region's anticipated growth, for example, AWWF for the system is expected to grow from an estimated 190 mgd in 1990 to 273 mgd by 2020.

Total discharge volumes and pollutant loads will vary by outfall (and thus by location) in Puget Sound, as well as over time for the four RWSP service strategies. All new or expanded treatment plants will be designed to comply with federal Clean Water Act requirements and, thus, will meet all applicable federal and state water quality standards.

The effect of the combined total of future King County system discharges on overall Puget Sound water quality depends on the complex interaction of discharge composition, volumes, location and depth of discharge, receiving water characteristics (such as current direction and speed) at outfall locations, and other factors. In general, total discharge volumes and pollutant loadings are similar across all service strategies; the primary differences in impacts to water resources result from the characteristics of the different water bodies that receive the discharges and the specific discharge outfall locations (see comparison in Chapter 3).

The location and depth of treatment plant outfalls in Puget Sound influence the dispersion of the effluent plume and its water quality impacts. In Puget Sound, the upper layer of relatively less dense (less saline) water tends to circulate northward and out of Puget Sound, while the lower layer of denser (more saline) water slowly moves southward (Ebbesmeyer 1994). Flushing rates between the West Point and Duwamish Head outfalls also differ, based on their relative locations in Puget Sound. The West Point outfall discharges wastewater into the upper water layer; thus, it is flushed northward out of Puget Sound. The Duwamish Head outfall discharges into the lower water layer; thus, it takes longer to disperse as the layer moves southward (Ebbesmeyer 1994). Overall water quality impacts from treatment plant discharges to Puget Sound will vary somewhat among the four service strategies based on these differences in flushing rates. Generally, service strategies that direct more treated effluent into the upper water layer of the sound create less adverse impacts. To the extent that SS2 and SS3 redirect effluent away from the Duwamish Head outfall and to a new, more northerly outfall that discharges into the upper water layer, those service strategies would be preferable from a water quality perspective.

Pollutant loadings from treatment plant discharges are expected to increase as the population grows in the King County wastewater service area. The chemical constituents in these discharges include nutrients (nitrogen and phosphorous), metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel, silver, and zinc), organic compounds (total polycyclic aromatic hydrocarbons [PAH], benzyl butyl phthalate, bis/bi [2-ethylhexyl] phthalate, and benzoic acid), fecal coliform bacteria, and total suspended solids. King County's Industrial Waste Program monitors and controls the discharge of industrial wastes into the wastewater system to prevent the discharge of chemicals and other substances that may contaminate biosolids and treated effluent. In projecting pollutant loadings for the four service strategies, it has been assumed that the Industrial Waste Program will continue to operate much as it does now.

Water quality impacts near the wastewater outfalls have been evaluated for both CSO and treatment plant discharges (Hays et al., 1995). The effluent plumes from these discharges contain both dissolved ions and particulates. They are dispersed at varying distances. The heavier suspended particulates tend to settle out of the effluent plume immediately. Metals and organic compounds have a high affinity for adsorbing to sediment particles (Hays, et al., 1995). Therefore, the sediment layer near these outfall pipes may contain elevated concentrations of these metals and organic compounds. These sediments are of concern due to the environmental persistence, toxicity to aquatic life, and potential for bioaccumulation of those pollutants present (Hays et al., 1995). Dissolved ions and compounds which are adsorbed to lighter particulates tend to mix within the water column, are transported away, and do not contribute to localized impacts at the outfall (Hays, et al., 1995).

Conveyance System

Sewer systems are designed with redundancies to prevent failures. On the rare occasions when leaks or breaks occurred, potential impacts would depend on the type of pipe and the environment at the point of leakage. If the pipe was in water, sewage could escape and cause short-term, local water quality impacts. If the pipe was underground and was a gravity flow (i.e., not pressurized) pipe, little or no sewage would be likely to escape due to surrounding groundwater pressure. Groundwater would instead enter the pipe and be conveyed with the sewage. If the pipe was a force main (i.e., pressurized flow pipe) sewage could be forced out of the pipe and enter groundwater and potentially surface water. The resulting loss of pressure would be quickly detected at a pump station and repairs effected. Mechanical or electrical failures could also cause wastewater overflows to surface water. In all cases sewage spills would be detected and repaired quickly so any water quality impacts would be temporary and localized.

Impacts Specific to SS1

West Service Area Treatment and Conveyance

The volume of wastewater effluent discharged from the West Plant would increase under SS1 based on expansion of this facility to 159 mgd. This increased discharge would result in operational impacts on water quality in Puget Sound off West Point. Pollutant loading rates are expected to increase in Puget Sound for nutrients, metals, organic compounds, fecal coliform bacteria, and total suspended solids. As described above, the West Treatment Plant discharges effluent into the upper water layer, where it is flushed northward out of Puget Sound.

Operational impacts of conveyance pipelines would be limited to localized temporary water quality impacts associated with accidental leakage. See discussion under "Conveyance System," earlier in this chapter.

East Service Area Treatment and Conveyance

Expanding the East Plant to 235 mgd would approximately double the treated wastewater effluent discharged to Puget Sound off Duwamish Head. Pollutant loading rates are expected to increase for nutrients, metals, organic compounds, fecal coliform bacteria, and total suspended solids. As noted previously, because the East Treatment Plant outfall discharges into the deeper waters of Puget Sound, this effluent would tend to move southward farther into the sound. Thus, dispersion would take somewhat longer than for effluent discharged into shallower waters of the sound (e.g., the West Point outfall).

CSOs

The CSO program for SS1 would achieve the one-overflow-per-year goal by 2043. The program would be phased to complete projects on Puget Sound beaches and the East Ship Canal first, followed in later years by projects along the Duwamish River and the West

Ship Canal. The individual projects north of the Ship Canal would generally store CSO volumes for later conveyance to the West Treatment Plant for secondary treatment after peak flows subside. For CSOs south of the Ship Canal, the SS1 program would generally store CSOs and provide onsite treatment at CSO locations. The program would benefit water quality for Puget Sound beaches, the Ship Canal, and the Duwamish River.

Infiltration/Inflow

SS1 includes an aggressive program for I/I reduction. A 30 percent reduction in I/I for all basins of the service area would result in more efficient treatment of sanitary wastewater flows at the treatment facilities (i.e., less-diluted wastewater would enter the WWTP facilities). Groundwater which presently enters conveyance lines would be excluded with I/I control and, thus, might increase the local groundwater elevation in some areas.

Mitigation Measures

Potential adverse impacts to water resources from operation of all the wastewater facilities proposed under the RWSP could be avoided or minimized through careful design and maintenance. Based on identification of environmentally sensitive areas in the King County service area, impacts would be avoided wherever feasible. Where this was not possible, impacts would be minimized to the greatest extent practicable. The following mitigation measures could be used to avoid or minimize impacts to water resources.

- Select outfall sites with strong currents and favorable circulation patterns that most rapidly move pollutants northward out of Puget Sound. Research indicates that the upper water layer best provides these conditions. Outfall locations that meet these criteria would reduce long-term operational impacts.

- Infiltration and inflow control projects in flood-prone areas would include studies of local groundwater and surface water drainage patterns to avoid exacerbating local flooding and wet basements.

- King County’s Industrial Waste/Source Control Pretreatment Program reduces the levels of contaminants entering the sewer system and enhances both biosolids and reclaimed water products.

- Use appropriate procedures for handling chemicals and petroleum products during facility operation. This includes proper storage, use, and cleanup of these materials.

- Design and implement the CSO reduction program to maximize benefits to receiving waters.

- Maintain and operate treatment plants to meet permitted discharge requirements, including proper functioning of the outfall.

Unavoidable Adverse Impacts

The increase in volumes of wastewater treated under any of the service strategies would increase loadings in Puget Sound for pollutants from wastewater treatment plant discharges.

BIOLOGICAL RESOURCES

Impacts Common to All Service Strategies

Operational impacts to biological resources common to all four service strategies are generally related to population growth in the King County Service Area. Increased wastewater flows will raise pollutant loadings to marine waters from new or expanded treatment plants, as discussed in the previous section, “Water Resources.” These increased loadings, in turn, would result in generally localized impacts near the outfalls. The extent of adverse impact on the marine environment will depend on outfall discharge volumes and location. Biological resources, including fish and shellfish, can be affected either through physical changes in their environment (sediment size, water temperature, and levels of dissolved oxygen), or through chemical toxicity associated with contaminants in the water column and sediments. Some contaminants, including metals and toxic organics, can be conveyed through wastewater discharges. The complexity of aquatic ecosystems makes generalization difficult. Thus, additional baseline research would be needed, particularly during siting of potential new outfalls off Duwamish Head and the north King or south Snohomish County shoreline, before making final decisions on outfall locations and depths. This additional analysis would be conducted at the same time as the preliminary engineering design during project-level environmental review. Design and operation of the system's treatment plants and outfalls would comply with federal and state water and sediment quality standards. This would minimize impacts on the biological resources of the marine environment.

New or expanded treatment plants and their associated facilities could also result in some habitat loss or conversion, particularly for construction of a new North Treatment Plant at an inland undeveloped location (SS2 and SS3). Other wastewater treatment and conveyance facility impacts on biological resources are minimal.

Reduction or elimination of CSOs as part of service strategies would benefit fish and shellfish populations; improve foraging habitat for shorebirds, raptors, waterfowl, and other water-dependent birds; and improve conditions for other wildlife dependent on aquatic habitats. Cleaner water would contribute to productivity of food sources such as crustaceans, invertebrates, and aquatic plants. Chronic pollutant loadings to fish habitat, the potential exposure of fish to contaminants, ingestion of or entanglement in floatable material, and the likelihood of exposure to dissolved oxygen “sags” following CSO events would all be reduced.

Potential adverse operational impacts include accidental spills of diluted or undiluted sewage or other waste materials into water bodies if a pipeline or CSO storage facility leaked, particularly in cases where pipelines cross streams or pass through water bodies. Such accidental spills differ from CSOs in that they are rare and temporary and can be corrected quickly. If such spills do occur, they typically do not result in specific adverse impacts to biological resources because the waste is further diluted by entering a large body of water.

Impacts Specific to SS1

West Service Area Treatment and Conveyance

SS1 includes expansions of the West Plant, increased discharge volumes, and added pollutant loadings from the existing outfall off West Point. Impacts to biological resources near the outfall would be as described above. The increased discharge to Puget Sound would be designed to meet all applicable water quality and sediment standards. These standards have been developed to minimize adverse impacts on marine waters, including on fish, shellfish, eelgrass, kelp, and other marine resources in the waters of western Washington. Consequently, an increase in the discharge off West Point is not expected to result in significant adverse impacts on the biological resources of Elliott Bay and central Puget Sound.

East Service Area Treatment and Conveyance

SS1 includes construction of a new third leg of the outfall off Duwamish Head to accommodate increased discharges from the East Treatment Plant. Because this would entail siting a new outfall location, additional baseline studies would be required near the new outfall to identify fish and shellfish populations potentially at risk from discharge. Disturbance of identified fish and shellfish resources would have to be minimized. Increased discharge is not expected to have any direct impact on marine mammals. There may be minor impacts on fish that are prey species of marine wildlife; however, this would not be expected to affect marine wildlife population levels in the area. The outfall would be designed to allow tide and water currents to flush discharged effluent from the outfall area quickly. All state and federal chronic and acute water quality and sediment management standards for discharge would be met.

CSOs and Inflow/Infiltration

Impacts for CSO and I/I project operation on biological resources would generally be minimal. Aquatic resources in the vicinity of CSO outfalls would likely benefit from the reduction in contaminant discharges associated with CSO reductions (see Water Resources discussion above).

Mitigation Measures

- Where feasible, native vegetation would be planted around new facilities to provide noise and visual buffers between the facility and any adjacent wildlife habitat.

- Outfalls would be sited to minimize adverse impacts to biological resources.

Unavoidable Adverse Impacts

Increases in outfall discharges would unavoidably disturb or displace marine biota over a small area near the discharge point.

LAND AND SHORELINE USE

Impacts Common to All Service Strategies

All four service strategies would provide adequate wastewater conveyance and treatment capacity to accommodate the population growth anticipated in the King County Comprehensive Plan. Each strategy would provide capital facilities prior to or concurrent with growth occurring inside the County's designated Urban Growth Area. Changes to planned regional land use patterns would not be caused by implementation of any of the service strategies. Each strategy is consistent with the Comprehensive Plan and the Growth Management Act.

Impacts Specific to SS1

Consistency with Policies and Regulations

Growth Management Act and Local Comprehensive Plans. The State of Washington and King and Snohomish Counties have prepared population and employment projections as part of the growth management process. These projections, which include information on geographic distribution, have provided the basis in the RWSP to determine future flows into the King County system (refer to the RWSP for a detailed discussion of flow projections). The timing, sizing, and location of proposed facilities under SS1 were developed to provide adequate capacity to handle these expected wastewater flows. This service strategy does not include the capacity to handle wastewater flows generated outside the King County wastewater service area, including flows generated within isolated urban growth areas such as those in the Snoqualmie River Valley. For these reasons, SS1 is consistent with the GMA.

Local comprehensive plans for counties and cities within the King County wastewater service area have been prepared in conformance with the GMA. SS1, through conformance with the overall growth management process, is also consistent with the goals and policies for utility service levels in local comprehensive plans. In addition, because the timing, sizing, and location of proposed facilities are based on population and employment projections that are also used as a basis for development of local comprehensive plans, this service strategy is consistent with the growth management requirement for concurrency (i.e., the availability of necessary utilities and other infrastructure and services concurrent with development that depends on the infrastructure and services).

Shoreline Management Act. A number of major facilities, particularly CSO control facilities, proposed for SS1 are in designated shoreline areas and would require shoreline permits. In most jurisdictions and shoreline environments, wastewater treatment plants and associated conveyances and other facilities are not prohibited. However, because wastewater facilities (except for outfalls) are not considered water-dependent uses, a demonstration of public benefit and need for the particular shoreline location is typically required before a shoreline permit is granted. Such a demonstration of benefit and need would be required for in-water placement of the Kenmore Parallel Interceptor and expansion of the West Plant. In addition, conditions are usually attached to permit approvals specifying public access requirements, landscaping and visual mitigation, and other performance standards. These permit conditions would likely apply to facilities in the shoreline zone for SS1.

Zoning. The West Treatment Plant at West Point is located in a single-family zone (SF 7200) and requires a Council Conditional Use permit to be expanded. Land use and shoreline permits were obtained for the recently completed conversion of the plant to secondary treatment, but the process was difficult and lengthy. From a permitting perspective, expanding the plant's capacity to 159 mgd is likely to be complex and controversial, as well.

The East Treatment Plant is located in a Renton public zone, so plant expansion would be permitted subject to site plan review to ensure compliance with city zoning requirements and compatibility with surrounding land uses.

The numerous individual pump stations, conveyance lines, and storage facilities proposed under SS1 are usually classified as utilities. They are generally permitted, either outright, or by granting a special use, unclassified use, or similar land use permit. Where such a land use permit is required, landscaping or siting requirements and other performance standards are included as permit conditions to ensure compatibility with surrounding land uses.

Direct Land Use Impacts

West Service Area Treatment and Conveyance. SS1 would expand the West Treatment Plant at West Point from its current 133-mgd capacity to a proposed 159-mgd capacity by 2020. Compliance with the terms of the treatment plant's existing land use permit and the 1991 Settlement Agreement would require no expansion outside the plant's 32-acre footprint and no increase in pollutant loading to Puget Sound beyond the level permitted for a 133-mgd plant, even if plant capacity is increased.

Complying with those conditions, plant expansion would intensify the current land use, within existing plant boundaries. Facilities could be constructed closer to the site's perimeter, for example, or could be enlarged from their current size. Although the original treatment plant preceded the establishment of Discovery Park, many perceive the current plant as incompatible with surrounding recreational uses and would likely see an expansion as a worsening of current conditions.

Because of concerns about odors, noise, and visual character, nearby residents and businesses may perceive pumping stations as incompatible with surrounding land uses.

East Service Area Treatment and Conveyance. The expanded East Treatment Plant would be located in a highly urbanized industrial/commercial area. With continuation of the existing site design features and extension of perimeter buffering, the expanded plant would be compatible with surrounding land uses.

CSO and Infiltration/Inflow. Underground conveyances and storage facilities (both wastewater and CSO) would be compatible with surrounding land uses. CSO treatment facilities would be located along the Duwamish Waterway and the Elliott Bay shoreline in highly urbanized areas; therefore, these facilities are likely to be compatible with surrounding land uses.

No long-term land use impacts result from the I/I program.

Mitigation Measures

The nature of nearby land uses and natural environmental features would be considered during site selection and design processes to promote consistency with local comprehensive plans and compatibility with adjacent land uses. Land use consistency and compatibility would also be promoted by including appropriate design features (odor and noise control, for example), coupled with an appropriate degree of perimeter buffering.

Unavoidable Adverse Impacts

Expansion of the capacity of the West Treatment Plant within the existing plant boundary may be perceived by some as incompatible with surrounding recreational uses.

ENVIRONMENTAL HEALTH

As defined by SEPA, the term "environmental health" covers several types of impacts with the potential to affect human health and well-being. These impacts are those that are not covered under other areas of SEPA and/or are not specifically addressed by protective regulations. Water and air quality, for example, have the potential to affect human health; however, they are separate SEPA "elements of the environment" and are regulated by standards expressly designed to minimize possible health effects.

For the RWSP, this section covers three topics related to environmental health: public health, noise, and hazardous materials. Public health is specifically related to CSO discharges, which–though short-term and infrequent–are not subject to pollutant discharge limitations under state and federal water quality regulations.[5] Therefore, direct human contact with these discharges, as well as ingestion of shell-fish exposed to them, is a public health issue. Noise is generated by wastewater treatment facilities and pump stations, and is generally restricted to prescribed levels by local ordinances to protect receptors. Hazardous Materials (as specified by state and federal regulations) are used in various treatment processes and are transported to, and stored on, treatment plant sites.

Not all of these environmental health issues are applicable to all service areas or system components. Therefore, this section is organized to focus only on those service areas or components in which impacts may occur. In the case of noise, all impacts described are common to the four service categories.

Public Health

Impacts Common to All Service Strategies

King County will continue to plan and carry out CSO control projects to work toward achieving the EPA goal of four to six events per outfall per year and subsequently to achieving Ecology's standard of one event per outfall per year. CSOs would be stored and subsequently would undergo either secondary treatment at the West or East Treatment Plants or onsite treatment before direct discharge. Overflows at existing CSO locations along pipeline routes would not increase.

Direct human contact with the CSO pollutants can occur during water-based activities such as swimming, wading, boating, or scuba diving. Reduction in the frequency and volume of discharges would substantially lower the potential for human exposure to harmful bacteria, viruses, metals, and petroleum products contained in CSOs. CSO reductions could reduce human health risks in areas where overflows discharge near areas of heavy human use such as parks, beaches, and other public access points. The County is currently preparing a CSO water quality assessment to evaluate the human health benefits of CSO reduction.

Mitigation Measures

The proposed reductions in CSO discharge represent a substantial improvement over existing conditions and will reduce regional public health risks. No mitigation is necessary.

Unavoidable Adverse Impacts

No unavoidable adverse impacts would occur.

[5] Regulation of CSOs by Ecology and EPA limits the **frequency** of discharge rather than the pollutant levels, which may vary according to many factors. For further discussion of CSO issues see Chapter 2, Background.

Noise

Impacts Common to All Service Strategies

Operation of wastewater treatment plants, pump stations, and regulator stations creates varying levels of noise that can disturb adjacent properties, depending on the type and proximity of the receptor. All wastewater treatment plants would be designed to contain noise, particularly when there are nearby sensitive land uses (e.g., residential). Most noise-emitting equipment would be located in buildings, reducing noise levels to acceptable limits before reaching the property line. Fan openings could be directed away from sensitive receptors. Noise levels would be in compliance with the limits established by local jurisdictions.

If necessary, pump stations would be designed with noise baffles to supply enough dead air space between the noise and the outside wall of the building to minimize noise emissions to the exterior. Depending on project-specific design, pump stations could be equipped with emergency diesel generators for use in case of power outages. These generators have high noise levels and would be tested monthly for about 30 minutes. Pump stations served by dual power feeds do not usually have emergency generators. Any noise impacts would be temporary.

Impacts Specific to Service Strategy 1

Noise from trucks traveling to and from treatment plants may reach sensitive receptors, depending upon surrounding land uses. For example, the West Plant is accessed by a road that passes residences and through Discovery Park. The East Plant access road passes industrial and business park uses.

Mitigation Measures

With proposed noise reduction techniques, as described above, incorporated into facility design, no exceedances of local noise standards are expected to occur. No mitigation is required.

Unavoidable Adverse Impacts

No unavoidable adverse impacts would occur.

Hazardous Materials

Impacts Common to All Service Strategies

Providing secondary treatment for increased wastewater flows would require the use of more chlorine than is currently used at either the West or East Treatment Plants. Increased risks to environmental health are unlikely. Buildings at either plant where chlorine is stored are designed to contain spills and are equipped with automated alarm systems to minimize fire danger in accordance with the Uniform Fire Code. In addition, King County has extensive operating experience using chlorine and has developed safety measures and response plans to minimize risk to public health.

Chemicals used at pump stations to control odor and corrosion can be hazardous and require special storage and handling procedures. These chemicals are usually stored in containers, isolated from other areas within the pump station, and added to the wet well and/or force main under controlled conditions. Because of the safety features incorporated into the design of pump stations, control systems and alarms, and King County's experience with hazardous chemicals, impacts on environmental health associated with use of chemicals at pump stations are not expected to be significant.

Impacts Specific to Service Strategy 1

West Service Area. Chlorine is transported to the West Treatment Plant in 1-ton cylinders, typically in 12-cylinder lots, every 3 to 4 days. Chlorine use at the plant averages 3 to 4 tons per day. The Chlorine Institute reports that there have been no instances of chlorine emissions from 1-ton cylinders during delivery in over 40 years (Metro, 1988). There was an accidental leak of chlorine at the West Treatment Plant in 1966 before many of the current-day safeguards were instituted. Chlorine gas was dispersed over Puget Sound without adverse effects on environmental health. With the design and safety measures discussed above, there would be no substantial increase in environmental health risks associated with plant expansion.

Caustic soda is stored onsite for use as an absorbent for chlorine, should a leak occur. Venting systems direct any chlorine gas to caustic soda tanks where the gas is absorbed and neutralized. When combined, chlorine and caustic soda produce salt water. Caustic soda use is very low; between 1978 and 1988 there were only two deliveries to the West Treatment Plant. Caustic soda is stored in large storage tanks surrounded by concrete berms to contain any leaks or spills. The potential for adverse impacts to public health is low.

Chlorine is also used for disinfection at the Alki and Carkeek plants. These plants are used to store and treat CSOs during storm events and are also designed to contain accidental releases and equipped to minimize fires.

East Service Area. Chlorine is transported to the East Treatment Plant in rail cars. The risks associated with rail transport of chlorine were analyzed in a 1980 study for the U.S. Department of Energy. The annual risk of a fatality from a chlorine rail car accident nationwide is about 1 in 22 million. This compares to motor vehicle accident and fire fatality risks of one in 4,000 and one in 32,000, respectively. Tank car accidents have been reported in the State of Washington involving chlorine (Metro, 1991). The low risk of rail car accidents is further reduced by the safety features incorporated into onsite chlorine systems, including containment structures, leak detection and alarm systems, vacuum distribution systems, and emergency response plans.

Expansion of the East Treatment Plant would incorporate the same safety features, alarm systems, and response plans used at the existing plant. While chlorine use would increase, roughly in proportion to the size of the expansion, the risk to environmental health would remain low.

Caustic soda use at the East Treatment Plant is similar to that described above for the West Treatment Plant. The potential for impact on public health is similarly low.

Mitigation Measures

- At each wastewater treatment plant, safety plans would continue to be implemented to minimize risks associated with hazardous materials and chemicals. Emergency response plans detail measures to be taken in the event of an emergency involving hazardous materials or chemicals. Workers receive regular training in the use of these materials, as well as in emergency response procedures.
- All facilities would be designed to minimize the potential for leaks or breaks. To prevent pipeline or facility leakage, King County conducts periodic routine pipeline inspections to examine pipes for possible defects. Inspections detect potential for failures before the failure is imminent. Should a leak occur, an emergency response team is mobilized so that repairs and cleanup begin immediately. Appropriate regulatory agencies, including EPA, Ecology, and the local jurisdiction in which the spill occurs, are notified.
- Chlorine would continue to be stored in concrete storage buildings designed to fully contain chlorine in the event of a leak; pressure sensors and leak detection alarms would also be provided.
- Vacuum distribution systems would be used for chlorine; these systems include fail-safe shutdown in the case of vacuum system failure.
- Sodium hydroxide would be used in emergencies to absorb chlorine in case of system malfunction.
- Chlorinated systems would be inspected regularly.
- Caustic soda storage tanks would be provided with concrete berms to contain any releases from leaks or ruptures.
- Chemicals, paints, solvents, lubricants, etc. would be stored in structures designed to contain any leakage or rupture.

Unavoidable Adverse Impacts

None identified.

Other Elements of the Environment

Earth Resources

Impacts Common to All Service Strategies

All service strategies include projects that would convert existing native soils to impervious surface. Such conversion increases surface water flows and runoff rates and corresponding erosion; it also impedes local aquifer recharge. In general, however, overall increases in impervious surface would be small.

Major earthquakes occur in the Puget Sound region and could result in structural damage to treatment and conveyance facilities. All structures proposed in identified seismic risk areas would be designed to withstand earthquake effects to the levels identified in applicable policies and regulations.

Increased control of CSOs will reduce deposition of contaminants in sediments near outfalls.

Impacts Specific to Service Strategy 1

New conveyances and CSO facilities would contribute minor amounts of additional impervious surface area. Expanding the East and West Treatment Plants would result in the following estimated additional impervious surface areas:

- East Treatment Plant expansion—40 to 45 acres
- West Treatment Plant expansion—1.5 acres

Impacts on earth resources from proposed facilities would not be significant. A high magnitude earthquake could result in structural damage to the East Treatment Plant, which is located in an area subject to liquefaction during seismic activity.

Mitigation Measures

Structures located in high seismic risk areas would be designed to withstand 0.3-ground acceleration, consistent with current King County policy. Where practical, soils subject to liquefaction could be overexcavated down to firmer materials.

Unavoidable Adverse Impacts

None identified.

Aesthetics

Impacts Common To All Service Strategies

The construction of new aboveground facilities (primarily treatment plants and pump stations) would change the visual character of the surrounding landscape to a greater or lesser degree, depending on the nature of local land uses, the size of the facility in question, and the techniques (e.g., landscaping) used to screen and buffer the facility from its neighbors. Specific impacts are described for each service strategy in the applicable section.

Impacts Specific to Service Strategy 1

Additional facilities at the West Treatment Plant would be located within existing plant boundaries. Additional structures, which would be lower than most of the existing plant buildings, would result in an overall facility that is slightly more visible than the existing facility. Expansion of the East Treatment Plant would double the size of the existing plant. The expanded new plant, however, would have a visual character similar to the surrounding industrial and office development. The expanded plant size would make the facility more visible from nearby viewpoints and distant valley residences.

No adverse aesthetic impacts would result from the operation of underground facilities (i.e., conveyances and tunnels).

Pump stations are small structures similar to, or smaller in scale than, nearby residential, commercial, or industrial structures. They consist of several thousand square feet or less and are one to two stories high. Their utilitarian character and specialized odor equipment can make pump stations visually prominent. Because they are small structures, however, these facilities are usually seen only from nearby locations, so visual impacts are not expected to be significant.

Mitigation Measures

Existing berming, landscaping, and other visual mitigation measures at the West Treatment Plant would be sufficient to mitigate any adverse aesthetic impacts of an expanded facility.

To mitigate adverse visual impacts resulting from an expanded East Treatment Plant, the extensive mitigation measures employed at the existing treatment plant could be expanded to include the new structures. These mitigation measures include perimeter berming, perimeter and interior landscaping with native materials, and siting of facilities to direct views into the site toward open areas and away from structures.

For pump stations located at sites visible from nearby properties, landscaping could be provided to obscure the visibility of the facility.

Unavoidable Adverse Impacts

New pump stations would result in minor changes to the visual character of the immediate areas.

Recreation

Impacts Common to All Service Strategies

Operational impacts on recreation would occur if aboveground structures were located within or close to recreational facilities, such as parks. Such impacts could be direct (i.e., lost use of park lands or amenities) or indirect (e.g., aesthetic or noise impacts). Impacts of specific service strategies are discussed in the applicable chapters.

Impacts Specific to Service Strategy 1

The addition of 26 mgd of capacity to the West Treatment Plant would not result in new permanent wastewater facilities outside plant boundaries. However one plant area reserved for future facilities is currently in recreational use and that would be taken for the expanded plant. Expansion of the East Treatment Plant would not result in the loss of any land used for recreation. Adverse post-construction impacts on recreation resulting from treatment plant expansion would be minimal.

Underground facilities (conveyances and tunnels) would not result in any post-construction adverse impacts on recreation.

Expansion of the Matthews Beach pump station, in conjunction with construction of the Kenmore interceptor parallel, could result in the loss of minor areas in Matthews Beach Park. The Murray Avenue CSO control project could eliminate some recreational space at Lowman Beach Park.

Implementation of the I/I program would probably not result in any recreation impacts.

Mitigation Measures

No significant adverse impacts to recreation are expected, and no mitigation measures would be necessary.

Unavoidable Adverse Impacts

None identified.

Cultural and Historic Resources

Except for potential minor soil disturbances associated with system maintenance, no activities related to the operation of RWSP facilities are expected to result in impacts to cultural or historic resources under any of the service strategies. Potential construction impacts are discussed in Chapter 11.

Air Quality

Impacts Common to All Service Strategies

Volatile Organic Compounds. As described in Chapter 4, VOC emissions from treatment plants are essentially proportional to the volume of wastewater treated. In general, the VOC emission potential of enclosed treatment processes, such as high-purity oxygen treatment, is considerably less than that of unenclosed treatment processes because of the limited potential for VOCs to volatilize into the ambient atmosphere. However, enclosed processes are generally more expensive initially and may not be practical or cost-effective for many municipal treatment needs. Activated sludge and trickling filter processes are estimated to have about an equal potential for releasing VOCs from wastewater.

Handling biosolids on the treatment plant site also poses the potential for release of VOCs that remain after completion of the liquid process. Again, enclosed solids handling facilities minimize this potential, but the space required for dewatering, storage, and other activities may make this impractical. Where anaerobic digestion of solids is accompanied by combustion of resulting digester gas, VOCs can be emitted during combustion.

Because all of the system service strategies under consideration are based on the same set of population and demand projections, they all involve treating roughly equivalent volumes of wastewater at any point on the planning horizon. Concentrations of VOCs in influent are expected to remain relatively consistent from one treatment facility to the next, as has been the case in earlier test results. Although the specific treatment processes used for new or expanded facilities will, as discussed above, result in slight variations in VOC emission rates, the primary determinant of emissions will be the volume of wastewater treated. Since this volume is approximately equal for all service strategies, VOC impacts are expected to be similar for any service strategy chosen.

Combustion Pollutants. Burning of digester gas to produce electricity produces nitrogen oxides and carbon monoxide emissions at the West Treatment Plant. Increased production and digestion of biosolids would result in increased emissions of these pollutants if the additional digester gas were also used in electrical generation. Air quality impacts related to biosolids application are discussed in Chapter 10 of this DEIS.

The need to treat larger quantities of wastewater through the operation of new or expanded treatment facilities will result in the generation of additional traffic. Estimates of trip generation for each service strategy are provided in the chapter addressing that service strategy. Levels of ambient CO along local truck routes would increase as a result of the additional vehicle trips; impacts of the selected service strategy will be analyzed in greater detail in subsequent project-level environmental review. Overall, however, impacts of projects included in the plan will be minimal in relation to regional CO emissions from motor vehicles.

Odor. The factors influencing a treatment facility's odor impacts are similar in many ways to those that determine its level of VOC emissions. Elements of a facility most likely to generate odors typically are not enclosed and, thus, expose wastewater or solids to open air. The highest potential sources of odor include the screenings building, sludge digester, sludge thickener, and the septage receiving and loading areas. Primary clarifiers have a moderate odor potential, while aeration basins and secondary clarifiers tend to produce few odors. Also, as with VOCs, treatment processes vary in their odor-causing potential. Trickling-filter processes have the highest potential for odor, followed by activated sludge and oxidation ditch processes. Processes with the lowest odor potential include rotating biological contactors and high-purity oxygen-activated sludge. Specific facility elements and treatment processes for the selected strategy will be determined at the project level, with further environmental review occurring, as necessary.

Other facilities related to the conveyance of wastewater can generate odors similar to those experienced at treatment plants. Typically, odors are generated where wastewater becomes turbulent, such as at pump or regulator stations. Odors can also be present at high spots in conveyance pipelines, usually where force mains and gravity mains come together. Facilities can be designed to incorporate odor controls, such as carbon filters, to treat air before it is emitted to the environment.

Impacts Specific to Service Strategy 1

VOC impacts of SS1 would be essentially the same as described above under "Impacts Common to All Service Strategies."

SS1 includes expansion of the East Treatment Plant to 154 mgd by 2010. This expansion, along with successive expansions through 2040 and completion of the West Plant expansion in 2020, will present a greater potential for odor generation because of the larger volumes of wastewater treated. Since existing processes and operations are proposed to remain essentially the same, the sources and chemical constituents of potential odors would remain as they are now. This potential would be generally proportional to the volumes treated; however, since the treatment process currently used at the West Treatment Plant has less odor generation potential than the process used at the East Treatment Plant, impacts for equal volumes of wastewater would be somewhat higher at the East than at the West Treatment Plant. The West Plant is located near sensitive odor receptors including residential areas and Discovery Park. Future expansion of the East Treatment Plant would further increase the potential for odor generation, and infill of the area could increase the number of sensitive receptors.

New pump stations or increased flows through existing pump stations would also have the potential to result in odor emissions in the immediate vicinity. Odor impacts from pump stations are typically much less than those from treatment facilities, although odors can be associated with occasional venting that occurs from the pump stations.

Mitigation Measures

VOC (excluding toxic air contaminants (TAC)) and odor emissions from wastewater treatment facilities are not subject to regulation by PSAPCA or other agencies. However, King County actively pursues measures to reduce such emissions at its facilities. Ongoing source control efforts are the single most effective method of reducing the range and concentrations of VOCs in wastewater influent. Odor control at the expanded treatment facilities would involve extending technologies currently in use to the newly constructed expansion areas. Chapter 4, Affected Environment, describes some of the types of technologies currently used to control odor at King County facilities.

In addition, King County will continue to seek practical technologies that will prevent odors from escaping wastewater facilities.

Unavoidable Adverse Impacts

Regional levels of VOC emissions would increase slightly under any of the service strategies. Odor potential would increase in the immediate vicinity of the East and West Treatment Plants under SS1.

Transportation

Impacts Common to All Service Strategies

Operation of expanded treatment facilities would require several additional treatment plant operating staff members. Some staff members would be headquartered at the plant sites for functions such as facilities maintenance, administration, and site maintenance. Additional worker trips to and from the site would not occur during the morning and afternoon peak traffic periods. Most trips would occur during the day, although additional swing and graveyard shifts could be added at night.

The new and expanded pump stations proposed under each service strategy would not be staffed. Workers based at other facilities would visit each of them every 1 or 2 weeks. If repair or equipment replacement were needed, more traffic would be generated for the duration of those activities. Otherwise, very few additional trips would be generated by new or expanded pump stations. Other impacts of SS1 would be as described above under "Impacts Common to All Service Strategies."

Pipelines are inspected only periodically. Virtually no traffic would be generated by pipelines once construction was complete. Similarly, CSO control facilities would have no permanent staff. During some storm events, two to three staff based at either plant would make trips to the CSO facilities to ensure they were operating properly.

Impacts Specific to Service Strategy 1

For SS1, estimated vehicle trips generated by various operational activities are shown in Table 5-1. Projected numbers for future plant expansions have been scaled from current plant information and, in general, are considered conservative estimates. Other impacts of SS1 would be as described under "Impacts Common to All Service Strategies."

Mitigation Measures

No mitigation measures are proposed. However, King County continues to evaluate solids processing technologies that would reduce biosolids volumes and thus hauling trips.

Unavoidable Adverse Impacts

None anticipated.

NOTE: Table EP2-6, Chapter EP-2, provides operational trips for revised Service Strategy 1.

Table 5-1
Operational Trips (1)
Service Strategy 1

Vehicle Type	Facility					
	West Plant		**East Plant**			
	Existing, (133 mgd)	(159 mgd)	Existing, (115 mgd)	(154 mgd)	(191 mgd)	(235 mgd)
Septage Trucks	-----------	----------	60/day	85/day	100/day	120/day
Screen/Grit Trucks	12/week	15/week	8/week	11/week	13/week	16/week
Process Chemicals	40-50/month	50-60/month	0-10/month	0-14/month	0-17/month	1-20/month
County Trucks and Cars	8/day	10/day	60/day	85/day	100/day	120/day
Employees Shift Crew	80/day	100/day	70/day	100/day	115/day	145/day
All Others (Mon. - Fri.)	160/day	190/day	200/day	280/day	330/day	410/day
Visitors	50/month	60/month	NA[3]	NA	NA	NA
Biosolids Trucks (2) (7 days a week)	14/day (7 loads)	Maximum of (13 loads)	10/day (5 loads)	14/day (7 loads)	16/day (8 loads)	20/day (10 loads)
Chlorine Railroad Cars	--------	--------	7/year	10/year	12/year	14/year

Notes: (1) Trips are one-way; figures are rounded. "One-way" is defined as a single direction trip to a single destination.
(2) Biosolids truck trips are one-way. Final conditions to the Shoreline Substantial Development Permit for upgrade to secondary treatment at West Point state that "the number of loaded sludge trucks shall not exceed 13 per day on average over a year period (January through December)." Thirteen truck loads per day equals 26 one-way truck trips as defined in Note (1).
(3) Data not available.

Public Services, Utilities, and Energy

Impacts Common to All Service Strategies

The principal utilities affected by operation of proposed facilities would be electrical power and natural gas suppliers. Treatment plants and pump stations are the facilities that would consume most of the energy required for operation under any of the service strategies. Methane and other gases produced at treatment plants could be captured and sold to Puget Sound Energy or used to generate power to reduce demand placed on suppliers.

The additional amount of energy consumed would be minor in the regional context. Energy requirements of individual facilities would be evaluated in light of available power supply during facility design.

Operation is unlikely to have a significant impact on police, fire, and emergency services. Demands on water, telephone, and other utilities are unlikely to be significant.

Impacts Specific to Service Strategy 1

The additional electrical energy required to operate treatment plants in the year 2030 is estimated at 33.7 million kWh per year. The amount of energy produced to offset this demand has not been estimated.

Mitigation Measures

Local utilities attempt to meet the demands of their customers. More detailed environmental reviews of individual projects proposed as a result of this planning process would include assessments of possible impacts to services, utilities, and energy and any appropriate mitigation measures.

Unavoidable Adverse Impacts

None anticipated.

NOTE

Chapter 6 is as it appeared in the Draft EIS (May 1997) for the RWSP. References to the RWSP in Chapter 6 are to the draft Plan issued at the same time as the Draft EIS. Projections in this chapter are the ones used for the original four service strategies.

NOTE: This impact assessment is based on Service Strategy 2 as presented in the Draft RWSP. See Part I of this FEIS for revised strategy descriptions and analysis.

CHAPTER 6

IMPACTS AND MITIGATION MEASURES FOR SERVICE STRATEGY 2

Service Strategy 2 is described in Chapter 3 of this EIS. The major features of SS2 are summarized as follows:

- Create a three-treatment-plant system (comprised of West Plant, East Plant, and a new North Plant)
- Expand West Plant to planned capacity of 159 mgd (2010)
- Construct new parallel Kenmore Interceptor (2003)
- Expand East Plant in increments to 172 mgd (2042)
- Construct new third outfall off Duwamish Head (2010)
- Construct new 65-mgd North Plant in increments (2032)
- Construct a conveyance system to carry influent to the North Treatment Plant and an outfall from the North Treatment Plant to Puget Sound (2018)
- Implement CSO program to achieve one event per outfall per year by 2043.
- Implement small-scale I/I reduction program

The important features of Service Strategy 2 are shown in the Figure 3-2.

WATER RESOURCES

Impacts

West Service Area Treatment and Conveyance

Treatment plant discharges would increase for SS2 based on expansion of the West Plant to 159 mgd. This increased discharge of treated wastewater effluent would result in operational impacts to water quality in Puget Sound off West Point. The increase in pollutant loading to Puget Sound is expected to be similar to that noted for SS1.

East Service Area Treatment and Conveyance

Expansion of the East Plant to 172 mgd would result in the increase of treated wastewater effluent discharged to Puget Sound off of Duwamish Head. As noted for the West Plant, pollutant loading is expected to increase in Puget Sound for nutrients, metals, organic compounds, fecal coliform bacteria, and total suspended solids. As noted for SS1, because the East Plant outfall discharges into the deeper waters of Puget Sound, this effluent would tend to move southward farther into the sound. Thus, those pollutants present in the treated effluent would take somewhat longer to disperse than for effluent discharged into shallower waters of the sound (e.g., West Point outfall).

North Service Area Treatment and Conveyance

Operation of a North Plant with the capacity to treat 65 mgd would result in the discharge of wastewater effluent into Puget Sound from a new outfall off the north King County or south Snohomish County shore. Pollutant loadings would be expected to increase in Puget Sound as described for SS1. However, as described in Chapter 5, differences in flushing rates occur between the West Point, Duwamish Head, and potential North Plant outfalls based on whether they discharge to the upper or lower water layers in Puget Sound.

With discharge to the upper water layer, the North Plant outfall would be in a desirable location for flushing effluent out of Puget Sound because it would discharge to the main channel, where this layer is moving rapidly northward, out of the Sound. The strong currents in this channel would also maximize mixing and dispersion of the effluent. As noted in Chapter 3, the complexity of the flow layering in this area of the Sound will require additional study to determine the best location for the North Plant outfall.

To the extent that SS2 directed effluent away from the Duwamish Head outfall to a more northerly outfall that discharged into the upper water layer, it would be preferable from a water quality perspective to service strategies relying more heavily on treatment at the East Plant (i.e., SS1 and SS4).

CSOs

CSO discharges for SS2 would result in the same impacts as for SS1. Pollutant loading to receiving waters would be reduced for all pollutants of concern, with impacts similar to SS1.

CSO outfall sites that would be improved include discharges to the Puget Sound beaches, the East Ship Canal, the Duwamish River, and the West Ship Canal, as the CSO projects are phased over time.

Infiltration/Inflow

SS2 includes a maintenance level of I/I reduction, in contrast to the aggressive level of SS1. As a result, the reduction in infiltration and inflow for all basins of the service area would result in benefits to water resources as noted for SS1, although to a somewhat lesser degree.

Mitigation Measures

The mitigation measures for water resources identified for implementation in SS2 are similar to those identified for SS1.

Unavoidable Adverse Impacts

Increases in wastewater volumes under any of the Service Strategies would increase overall pollutant loadings in Puget Sound.

BIOLOGICAL RESOURCES

Impacts

West and East Service Area Treatment and Conveyance

Operational impacts at the West Plant would be the same as SS1. Operational impacts associated with a third outfall at Duwamish Head would be similar to SS1, but somewhat less, because the East Plant would only be expanded to 172 mgd under SS2 (compared to 235 mgd for SS1).

North Service Area Treatment and Conveyance

Additional baseline studies would be required for proper design and operation of a new North Plant outfall to identify aquatic biological resources potentially at risk from discharge. Potential impacts include both physical and chemical changes in the aquatic environment that may adversely affect biological resources, as discussed generally in Chapter 5. The outfall location at the northern edge of the service area is the most favorable for long-term impacts to Puget Sound-wide biological resources if effluent is discharged into upper water layers, because effluent would generally flow northward and out of Puget Sound more quickly than effluent from other outfalls (particularly the Duwamish Head outfall). The outfall and any associated mixing and sediment impact zones would be designed to meet all applicable water quality and sediment standards. These standards have been developed to minimize adverse impacts on beneficial uses of marine waters including fish, shellfish, eelgrass, kelp, and other marine resources, which occur in the waters of western Washington. Consequently, the North Plant discharge is not expected to result in significant adverse impacts on the biological resources of central Puget Sound.

CSOs and Infiltration/Inflow

Impacts would be the same as for SS1.

Mitigation Measures

Mitigation would be the same as for SS1.

Unavoidable Adverse Impacts

Unavoidable impacts would be the same as for SS1.

LAND AND SHORELINE USE

Consistency with Policies and Regulations

Growth Management Act and Local Comprehensive Plans

The consistency of SS2 with the GMA and local comprehensive plans would be similar to that described for SS1.

Siting of a new North Plant could potentially invoke Snohomish County's "common siting process" for essential public facilities at the county and local levels.
Consistent with the Growth Management Act (GMA) of 1990, countywide planning policies for King and Snohomish County include directives for development of a coordinated interjurisdictional approach to siting essential public facilities of a countywide or statewide nature, typically defined as difficult and controversial to site. These facilities include regional wastewater treatment plants.

Snohomish County adopted a comprehensive plan amendment that incorporates criteria for siting essential public facilities of a countywide or statewide nature in January 1996. In order for the process to be operational, two additional components require completion: (1) approval of operational guidelines for siting facilities; and (2) development of an Interlocal Agreement, to be approved by each jurisdiction within Snohomish County. Snohomish County is currently working toward completion of this process. King County has not yet begun to develop a common siting process.

Shoreline Management Act

For SS2, a number of major facilities are proposed for designated shoreline areas and would require shoreline permits. Impacts would be similar to those described for SS1.

Zoning

The zoning issues that apply to the West and East Plants were discussed under SS1, and expansion at those sites under SS2 would raise similar issues.

The zoning at the North Plant site would depend on its location. Shoreline areas in north King County and south Snohomish County typically have residential or other non-industrial/commercial zoning. Inland lowland areas north of Lake Washington, in south Snohomish County and north King County, have a mix of industrial, commercial, residential, and other zoning. Site plan review would be required for a treatment plant in any of these areas.

The numerous individual pump stations, conveyance lines, and storage facilities proposed under SS2 (usually classified as utilities) are generally permitted, either outright or by granting a special use, unclassified use, or similar land use permit. Where such a land use permit is required, landscaping or siting requirements and other performance standards are included as permit conditions to ensure compatibility with surrounding land uses.

Direct Land Use Impacts

West Service Area Treatment and Conveyance

Expansion of the West Plant and pump stations in the West Service Area would be the same as that described for SS1, and impacts would be the same.

East Service Area Treatment and Conveyance

Impacts would be similar to those described for SS1, except that the East Plant would occupy a smaller area of the site.

North Service Area Treatment and Conveyance

The compatibility of a new North Plant with adjacent land uses would depend on its location. A site of 25 to 35 acres would be required to accommodate the new plant facilities and a buffer. A North Plant could be located at a shoreline site or at an inland location. Regardless of the location chosen for a new North Plant, construction of a pipeline (either influent or effluent) from the area north of Lake Washington westward to the Puget Sound shoreline would be required. Additional facilities conveying influent to the plant would also be constructed. If SS2 (or SS3, which also includes a new North Plant) is selected, additional project-level site selection and environmental review studies would be needed before a final plant location would be determined. Criteria to screen potential sites would be developed, and a more complete review of land use compatibility, as well as other environmental and operational issues, would be undertaken.

Some general observations can be made about potential plant locations. In the general vicinity where a North Plant could be sited there are undeveloped areas designated for industrial and commercial land uses that would be more compatible with a new wastewater treatment plant. If the land was developed those industrial and commercial uses could be displaced. There are also areas of office park and other commercial development which would be potentially less compatible with wastewater treatment use and also could involve displacement if the land was already developed. Compatibility issues would be the greatest for areas in residential use.

Because of concerns about odors, noise, and visual character, nearby residents and businesses may perceive pumping stations as incompatible with surrounding land uses.

CSO and Infiltration/Inflow

Impacts would be the same as for SS1.

Mitigation Measures

For development of new aboveground wastewater facilities proposed under SS2 (including a new North Plant), the site selection and design processes would include consideration of the nature of nearby land uses and natural environmental features, and give high priority to consistency with local comprehensive plans and compatibility with adjacent land uses. For example, land use consistency and compatibility would be promoted through inclusion of appropriate design features (odor and noise control, for example) coupled with an appropriate degree of perimeter buffering.

Unavoidable Adverse Impacts

Expansion of the capacity of the West Treatment Plant within the existing plant boundary may be perceived by some as incompatible with surrounding recreational uses.

ENVIRONMENTAL HEALTH

Public Health

Impacts

Proposed CSO control projects and the associated beneficial public health impacts are the same as identified in Chapter 5 under "Impacts Common to All Service Strategies."

Mitigation Measures

No mitigation measures are required.

Unavoidable Adverse Impacts

No unavoidable adverse impacts are anticipated.

Noise

Impacts

Noise impacts under SS2 would be similar in nature, but slightly reduced, for the East Plant compared to SS1, because of the smaller plant size (172 mgd compared to 235 mgd). Impacts would be the same at the West Plant. A new North Plant would be designed to minimize noise impacts to surrounding areas and would meet all applicable local noise requirements. Because no site has been identified for a North Plant, it is unknown whether truck noise would affect sensitive receptors.

Mitigation Measures

Mitigation for noise impacts would be as described for SS1.

Unavoidable Adverse Impacts

No unavoidable adverse impacts are anticipated.

Hazardous Materials

Impacts

Hazardous materials impacts under SS2 would be similar to SS1 at the West and East Plant sites, but slightly less chlorine is likely to be used at the East Plant given the smaller plant capacity (172 mgd compared to 235 mgd). Chlorine would be used for disinfection at a new North Plant. It is anticipated that chlorine would be transported to the plant by truck or rail. Similar safety measures would be developed as are in place at the East and West plants to minimize environmental health risks.

Mitigation Measures

Mitigation would be the same as identified for SS1.

Unavoidable Adverse Impacts

No unavoidable adverse impacts are anticipated.

OTHER ELEMENTS OF THE ENVIRONMENT

Earth Resources

Impacts

New conveyances and CSO facilities would contribute minor amounts of additional impervious surface area. Expansion of the West Plant and the East Plant, and construction of a new 65-mgd North Plant would result in the following estimated additional impervious surface areas:

- East Treatment Plant expansion—32 to 35 acres
- West Treatment Plant expansion—1.5 acres
- North Treatment Plant—16 to 20 acres

Impacts on earth resources from proposed facilities would not be significant. A high-magnitude earthquake could result in structural damage to the East Plant, which is located in an area subject to liquefaction during seismic activity. Large earthquakes could also result in structural instability at a new North Treatment Plant, depending on final site selection.

Benefits to sediment quality from increased CSO control would be the same as described for SS1.

Mitigation Measures

Mitigation measures would be similar to those described for SS1.

Unavoidable Adverse Impacts

No unavoidable adverse impacts are anticipated.

Aesthetics

Impacts

Additional facilities at the West Plant under SS2 would be located within existing plant boundaries. Additional structures, which would be lower than most of the existing plant buildings, would result in an overall facility that is only slightly more visible than the existing facility. Expansion of the East Treatment Plant would result in approximately a 50 percent increase in the size of the existing treatment plant. Although the expanded plant would be similar in scale and visual character to the surrounding industrial and office development, its expanded size would make the facility more visible from nearby viewpoints and distant valley residences.

If a new North Treatment Plant were to be located at a shoreline location, adverse visual impacts of the facility could be significant. A new treatment plant would be a major visual element in an otherwise nonindustrial area on most shoreline sites. The visual impacts of a treatment plant at a lowland inland site north of Lake Washington would depend on site location. Most potential locations in this area are highly visible, and a treatment plant would be a new visual element in the landscape.

No adverse aesthetic impacts would result from operation of underground facilities (i.e., conveyances and tunnels).

Pump stations are small structures similar to or smaller in scale than nearby residential, commercial, or industrial structures. They typically consist of several thousand square feet or less and are one to two stories high. Their utilitarian character and specialized odor equipment can make pump stations visually prominent. However, because they are small, these facilities are usually seen only from nearby locations, so visual impacts are not likely to be significant.

Mitigation Measures

Existing berming, landscaping, and other visual mitigation measures at the West Plant should be sufficient to mitigate any adverse aesthetic impacts of an expanded facility. To mitigate adverse visual impacts resulting from an expanded East Plant, the extensive mitigation measures employed at the existing treatment plant should be expanded to include the new structures. These mitigation measures include perimeter berming, perimeter and interior landscaping, and siting of facilities to direct views into the site toward open areas and away from structures. Measures to mitigate adverse visual impacts from a North Plant would be similar to measures described for the East Plant.

For pump stations located at visible sites from nearby properties, landscaping could be provided to obscure the visibility of the facility.

Unavoidable Adverse Impacts

Construction of a new North Treatment Plant would change the visual character of the immediately surrounding area to some degree.

Recreation

Impacts

The addition of 26 mgd of capacity to the West Plant under SS2 would not result in new wastewater facilities outside plant boundaries. However, one area of the plant reserved for future facilities is currently available for recreational use and that would be taken for the expanded plant. Expansion of the East Plant would not result in the loss of any land used for recreation. A location for a new North Plant that avoided displacing existing recreational facilities would be sought. Consequently, the plant would be unlikely to result in the loss of recreational facilities. Adverse post-construction impacts on recreation resulting from North Plant expansion or construction would be minimal.

Underground facilities (conveyances and tunnels) would not result in any post-construction adverse impacts on recreation.

Expansion of the Matthews Beach pump stations in conjunction with construction of the Kenmore interceptor parallel may result in the loss of minor areas in Matthews Beach Park. The Murray Avenue CSO control project could eliminate some recreational space at Lowman Beach Park.
Implementation of the I/I program would probably not result in any recreation impacts.

Mitigation Measures

No significant adverse impacts to recreation are expected, and no mitigation measures would be necessary.

Unavoidable Adverse Impacts

No unavoidable adverse impacts are anticipated.

Cultural Resources

No cultural resource impacts would result from operation of SS2. Potential construction impacts are discussed in Chapter 11.

Air Quality

Impacts

Because VOCs are regulated as precursors to ozone, which is a regional pollutant, their impacts are not localized with respect to treatment facilities. A full discussion of VOCs is provided in Chapter 5.

Siting of a North Plant would play a large role in determining the probable extent of odor impacts and the appropriate mitigation. Predominant wind conditions are a determining factor in how severely odor impacts are experienced. However, if a new treatment plant were sited with potential to adversely affect a sensitive neighborhood, the plant would be designed with state-of-the-art odor control technology, to enclose the more odorous processes and remove odorous compounds from the air exiting those enclosures.

This service strategy would also expand the East Plant from 115 to 172 mgd. This expansion could result in some increase in odor emissions, though the potential significance would be less than for SS1 because of the lower ultimate flow volumes.

Pump stations would have impacts similar to those described for SS1.

Mitigation Measures

Mitigation measures would be as described for SS1.

Unavoidable Adverse Impacts

Unavoidable adverse impacts would be as described for SS1.

Transportation

Impacts

Operational impacts under SS2 are generally similar to SS1. A new North Plant would generate some additional traffic in a new location; however, the number of trips would be comparatively small. Biosolids truck trips are estimated at an average of six per day at 65-mgd capacity. Fewer trips would be generated by the proposed expansion of the East Plant to 172 mgd (compared to 235 mgd under SS1). Trips that would be generated by a new North Plant and the expanded East and West Plants are shown in Table 6-1.

Depending upon the site selected for a new North Plant, roads to the site might require improvements in order to accommodate plant traffic.

Mitigation Measures

Mitigation would be the same as identified under SS1.

Unavoidable Adverse Impacts

Unavoidable adverse impacts would be the same as identified under SS1.

NOTE: Table EP2-6, Chapter EP-2, provides operational trips for revised Service Strategy 2.

Table 6-1
Operational Trips (1)
Service Strategy 2

Vehicle Type	Facility						
	West Plant		**East Plant**			**North Plant**	
	Existing, (133 mgd)	(159 mgd)	Existing, (115 mgd)	(154 mgd)	(172 mgd)	(35 mgd)	(65 mgd)
Septage Trucks	-----------	----------	60/day	85/day	90/day	NA	NA
Screen/Grit Trucks	12/week	15/week	8/week	11/week	12/week	2/week	5/week
Process Chemicals	40-50/month	50-60/month	0-10/month	0-14/month	0-15/month	NA	NA
County Trucks and Cars	8/day	10/day	60/day	85/day	90/day	NA	NA
Employees Shift Crew	80/day	100/day	70/day	100/day	105/day	20/day	40/day
All Others (Mon. - Fri.)	160/day	190/day	200/day	280/day	300/day	60/day	115/day
Visitors	50/month	60/month	NA(3)	NA	NA	NA	NA
Biosolids Trucks (2) (7 days a week)	14/day (7 loads)	Maximum of (13 loads)	10/day (5 loads)	14/day (7 loads)	15/day (7.5 loads)	3/day (1.5 loads)	6/day (3 loads)
Chlorine Railroad Cars	----------	----------	7/year	10/year	11/year	NA	NA

Notes: (1) Trips are one-way; figures are rounded. "One-way" is defined as a single direction trip to a single destination.
(2) Biosolids truck trips are one-way. Final conditions to the Shoreline Substantial Development Permit for upgrade to secondary treatment at West Point state that "the number of loaded sludge trucks shall not exceed 13 per day on average over a year period (January through December)." Thirteen truck loads per day equals 26 one-way truck trips as defined in Note (1).
(3) Data not available.

Public Services, Utilities, and Energy

Impacts

The additional electrical energy required to operate treatment plants in the year 2030 is estimated at 32.4 million kWh per year. The amount of energy produced to offset this demand has not been estimated.

Mitigation Measures

Mitigation measures would be as described for SS1.

Unavoidable Adverse Impacts

Treatment of higher volumes of wastewater would result in increased energy usage.

Mitigation Measures

Local utilities attempt to meet the demands of their customers. Subsequent, more-detailed, environmental reviews of individual projects proposed as a result of this planning process would include assessments of possible impacts to services and utilities and any appropriate mitigation measures.

NOTE

Chapter 7 is as it appeared in the Draft EIS (May 1997) for the RWSP. References to the RWSP in Chapter 7 are to the draft Plan issued at the same time as the Draft EIS. Projections in this chapter are the ones used for the original four service strategies.

NOTE: This impact assessment is based on Service Strategy 3 as presented in the Draft RWSP. See Part I of this FEIS for revised strategy descriptions and analysis.

CHAPTER 7

IMPACTS AND MITIGATION MEASURES FOR SERVICE STRATEGY 3

Service Strategy 3 is described in Chapter 3 of this EIS. The major features of SS3 are as follows:

- Create a three-treatment-plant system (comprised of the West Plant, East Plant and new North Plant)
- Leave West Plant capacity at 133 mgd
- Expand East Plant in increments to 172 mgd (2040)
- Construct new third outfall off Duwamish Head (2004)
- Construct new 89 mgd North Plant in increments (2030)
- Construct a conveyance system to carry influent to the North Treatment Plant and an outfall from the North Treatment Plant to Puget Sound (2010)
- Implement CSO program to achieve one event per outfall per year by 2040.
- Implement small-scale I/I reduction program

The important features of Service Strategy 3 are shown in the Figure 3-3.

WATER RESOURCES

Impacts

Treatment plant discharges would increase for SS3 as a direct result of expected population growth in the region. Increased discharges would cause operational impacts on water quality in Puget Sound off West Point, Duwamish Head, and the North Plant outfall. Pollutant loading rates are expected to increase in Puget Sound similarly to those described for SS1 and SS2. However, as described in Chapter 5, differences in flushing rates occur between the West Point, the Duwamish Head, and potential North Plant outfalls based on the depth of the outfalls and their relative locations in Puget Sound. To the extent that SS3 directed effluent away from the Duwamish Head outfall to a more northerly outfall that discharges into the upper water layer, it would be preferable from a water quality perspective to service strategies relying more heavily on treatment at the East Plant (i.e., SS1 and SS4).

West Service Area Treatment and Conveyance

Under this service strategy, no change would occur in the discharge capacity for the West Plant (capacity would remain at 133 mgd). Impacts arising from the operation of conveyance systems that would serve the West Service area would be similar to those described for each of the other service strategies, except that the parallel Kenmore Interceptor would not be constructed.

East Service Area Treatment and Conveyance

Potential impacts to water resources from the expansion of the East Plant to 172 mgd under SS3 would be similar to those described for SS2.

North Service Area Treatment and Conveyance

Operation of a North Plant with the capacity to treat 89 mgd would result in the discharge of wastewater effluent into Puget Sound from a new outfall off the north King County or south Snohomish County shore. Pollutant loadings would be expected to increase in Puget Sound as described for SS1. However, as described in Chapter 5, differences in flushing rates occur between the West Point, Duwamish Head, and potential North Plant outfalls based on whether they discharge to the upper or lower water layers in Puget Sound.

With discharge to the upper water layer, the North Plant outfall would be in a desirable location for flushing effluent out of Puget Sound because it would discharge to the main channel, where this layer is moving rapidly northward, out of the Sound. The strong currents in this channel would also maximize mixing and dispersion of the effluent. As noted in Chapter 3, the complexity of the flow layering in this area of the Sound will require additional study to determine the best location for the North Plant outfall.

To the extent that SS3 directed effluent away from the Duwamish Head outfall to a more northerly outfall that discharged into the upper water layer, it would be preferable from a water quality perspective to service strategies relying more heavily on treatment at the East Plant (i.e., SS1 and SS4).

CSOs

CSO discharges for SS3 would result in improved water quality over existing conditions. Loading to receiving waters would be reduced for all pollutants of concern, with impacts similar to SS1 and SS2.

CSO outfall sites that would be improved include discharges to the Duwamish River (i.e., Michigan St., Brandon St., and Chelan Avenue), Elliott Bay (i.e., Denny Way, King St./Connecticut St., and Lander St./Hanford #2), the Ship Canal (University/Montlake), and Salmon Bay (i.e., 11th Avenue W. and Ballard).

Infiltration/Inflow

Operational impacts of a small-scale I/I program for SS3 would be similar to those identified for SS2.

Mitigation Measures

The measures identified for the mitigation of impacts on water resources are similar to those identified for SS1 and SS2.

Unavoidable Adverse Impacts

Increases in wastewater volumes under any of the service strategies would increase overall pollutant loadings in Puget Sound.

BIOLOGICAL RESOURCES

Impacts

Impacts to biological resources under SS3 would be similar to those under SS2. New outfalls off Duwamish Head and from the new North Plant would introduce effluent to new locations, affecting marine biological resources in the vicinity.

West Service Area Treatment and Conveyance

The West Plant would remain at its existing capacity. No impacts to biological resources would occur.

East Service Area Treatment and Conveyance

Impacts from operation of the expanded East Plant and additional Duwamish Head outfall would be the same as those for SS2.

North Service Area Treatment and Conveyance

Impacts from the proposed new North Treatment Plant outfall would be similar in nature, but slightly greater in magnitude, than for SS2. The new treatment plant would have a greater treatment capacity (89 mgd compared to 65 mgd) and, as a result, discharge-related impacts in the vicinity of the outfall would be slightly greater.

CSOs and Infiltration/Inflow

Impacts would be similar to those for SS1.

Mitigation Measures

Mitigation would be the same as identified for SS2.

Unavoidable Adverse Impacts

Unavoidable adverse impacts would be the same as those identified for SS2.

LAND AND SHORELINE USE

Consistency with Policies and Regulations

Growth Management Act and Local Comprehensive Plans

The consistency of SS3 with the GMA and local comprehensive plans would be similar to that described for SS2.

Shoreline Management Act

For SS3, a number of major facilities are proposed for designated shoreline areas and would require shoreline permits. Impacts would be similar to those described for SS1 except that the West Plant, which is located partially in the shoreline zone, would not be expanded *and the Kenmore Interceptor parallel project, also located partially in the shoreline zone, would not take place*.

Zoning

Zoning issues for SS3 would be similar to those described for SS2 for the East and North Plants. The West Plant would not be expanded under SS3, and the zoning issues raised by the other service strategies would not apply as a result.

The numerous individual pump stations, conveyance lines, and storage facilities proposed under SS3, which are usually classified as utilities, are generally permitted, either outright or by granting a special use, unclassified use, or similar land use permit. Where such a land use permit is required, landscaping or siting requirements and other performance standards are included as permit conditions to ensure compatibility with surrounding land uses.

Direct Land Use Impacts

West Service Area Treatment and Conveyance

Long-term land use impacts in the West Service Area as a result of this service strategy would be minimal.

East Service Area Treatment and Conveyance

The expanded East Plant would be located in a highly urbanized industrial/commercial area, and with continuation of the existing site design features and extension of perimeter buffering, the expanded plant would be compatible with surrounding land uses.

North Service Area Treatment and Conveyance

The compatibility of a new North Plant with nearby land uses would depend on its location. The size of site required to accommodate plant facilities and a buffer would be 35 to 45 acres. Impacts would be similar to those described for SS2.

CSOs and Infiltration/Inflow

Impacts would be the same as those for SS1.

Mitigation Measures

For development of new aboveground wastewater facilities proposed under SS3 (including a new North Plant), the site selection and design processes would include consideration of the nature of nearby land uses and natural environmental features, and place high priority on consistency with local comprehensive plans and compatibility with adjacent land uses. For example, land use consistency and compatibility would also be promoted through inclusion of appropriate design features (odor and noise control, for example) coupled with an appropriate degree of perimeter buffering.

Unavoidable Adverse Impacts

No unavoidable adverse impacts are anticipated.

ENVIRONMENTAL HEALTH

Public Health

Impacts

Proposed CSO control projects and the associated beneficial public health impacts are the same as identified in Chapter 5 under "Impacts Common to All Service Strategies." CSO control projects under SS3 would essentially achieve the same reductions as SS1, but would include smaller facilities at the University and 3rd Avenue West locations, and projects would be completed slightly earlier. SS3 achieves the one-per-year untreated overflow objective by 2040, 3 years earlier than the other three service strategies.

Mitigation Measures

No mitigation measures are required.

Unavoidable Adverse Impacts

No unavoidable adverse impacts are anticipated.

Noise

Impacts

Noise impacts under SS3 would be similar to those for SS2. Operational noise would be the same as existing conditions at the West Plant site with no expansion, while higher levels of noise could be expected at the North Plant compared to SS2, because of the larger plant size (89 mgd compared to 65 mgd).

Mitigation Measures

Mitigation for noise impacts would be as described for SS1.

Unavoidable Adverse Impacts

No unavoidable adverse impacts are anticipated.

Hazardous Materials

Impacts

Risks associated with the use of chlorine gas and other chemicals at the West and East Treatment plants would be lower compared to SS1, because capacity expansion would be less at the East Plant and would not occur at the West Plant. Impacts associated with the North Plant would be similar to, but slightly greater, than for SS2, because of the larger treatment capacity of the plant.

Mitigation Measures

Mitigation would be as described for SS1.

Unavoidable Adverse Impacts

No unavoidable adverse impacts have been identified.

OTHER ELEMENTS OF THE ENVIRONMENT

Earth Resources

Impacts

New conveyances and CSO facilities under SS3 would contribute minor amounts of additional impervious surface area. Expansion of the East Plant and construction of a new 89-mgd North Plant would result in the following estimated additional impervious surface areas:

- East Plant expansion—32 to 35 acres
- North Plant—25 to 30 acres

Impacts on earth resources from proposed facilities would not be significant. A high-magnitude earthquake could result in structural damage to the East Plant, which is located in an area subject to liquefaction during seismic activity. Large earthquakes could also result in structural instability at a new North Plant, depending on final site selection.

Benefits to sediment quality from increased CSO control would be the same as for SS1.

Mitigation Measures

Mitigation measures would be similar to those described for SS1.

Unavoidable Adverse Impacts

No unavoidable adverse impacts are anticipated.

Aesthetics

Impacts

Expansion of the East Plant could result in approximately a 50 percent increase in the size of the existing treatment plant. Although the expanded plant would be similar in scale and visual character to the surrounding industrial and office development, its expanded size would make the facility more visible from nearby viewpoints and distant valley residences.

Impacts of a new North Plant would be similar to those described for SS2, although the plant would be slightly larger.

No aesthetic adverse impacts would result from operation of underground facilities (i.e., conveyances and tunnels).

Pump stations would have impacts similar to those described for SS1.

Mitigation Measures

To mitigate adverse visual impacts resulting from an expanded East Plant, the extensive mitigation measures employed at the existing treatment plant should be expanded to include the new structures. These mitigation measures include perimeter berming, perimeter and interior landscaping, and siting of facilities to direct views into the site toward open areas and away from structures. Measures to mitigate adverse visual impacts from a North Plant would be similar to measures described for the East Plant.

For pump stations located at visible sites from nearby properties, landscaping could be provided to obscure the visibility of the facility.

Unavoidable Adverse Impacts

Unavoidable adverse impacts would be similar to those described for SS2.

Recreation

Impacts

Expansion of the East Plant would not result in the loss of any land used for recreation. A location for the a new North Plant that avoided displacing existing recreation facilities would be sought. Consequently, the plant would be unlikely to result in the loss of recreational facilities. Adverse post-construction impacts on recreation resulting from treatment plant expansion or construction would be minimal.

Underground facilities (conveyances and tunnels) would not result in any post-construction adverse impacts on recreation. The Murray Avenue CSO control project could eliminate some recreational space at Lowman Beach Park.

Implementation of the I/I program would not result in any recreation impacts.

Mitigation Measures

No significant adverse impacts to recreation are expected, and no mitigation measures would be necessary.

Unavoidable Adverse Impacts

No unavoidable adverse impacts are anticipated.

Cultural Resources

No cultural resource impacts would result from operation of SS3. Construction impacts are discussed in Chapter 11.

Air Quality

Impacts

Because VOCs are regulated as precursors to ozone, which is a regional pollutant, their impacts are not localized with respect to treatment facilities. For a full discussion of VOCs, please refer to Chapter 5.

Odor impacts would be similar to those for SS2, although odor-generating potential would be slightly higher at the North Plant given its larger capacity. West Point would remain unchanged from existing conditions.

Mitigation Measures

Mitigation would be as described for SS1.

Unavoidable Adverse Impacts

Unavoidable adverse impacts would be as described for SS1.

Transportation

Operational impacts under SS3 are generally similar to SS2. Under this service strategy, the West Plant would not be expanded, eliminating any significant increases to treatment plant traffic through Discovery Park. Expansion of a North Plant to 89 mgd (versus 65 mgd under SS2) would generate slightly increased numbers of employee and truck trips. Fewer trips would be generated by the proposed expansion of the East Plant to 172 mgd (versus 235 mgd). Biosolids truck trips to and from North Plant are projected to average up to approximately 8 per day. Operational trips are shown in Table 7-1.

Depending upon the site selected for a new North Plant, roads to the site might require improvements in order to accommodate plant traffic.

Mitigation Measures

Mitigation would be as identified for SS1.

Unavoidable Adverse Impacts

Unavoidable adverse impacts would be similar to impacts identified for SS1.

NOTE: Table EP1-3, Chapter EP-1, provides operational trips for revised Service Strategy 3 (the Executive's Preferred Plan).

Table 7-1
Operational Trips (1)
Service Strategy 3

Vehicle Type	**Facility**						
	West Plant	**East Plant**			**North Plant**		
	Existing, (133 mgd)	Existing, (115 mgd)	(154 mgd)	(172 mgd)	(35 mgd)	(55 mgd)	(89 mgd)
Septage Trucks	-----------	60/day	85/day	90/day	NA	NA	NA
Screen/Grit Trucks	12/week	8/week	11/week	12/week	2/week	4/week	6/week
Process Chemicals	40-50/month	0-10/month	0-14/month	0-15/month	NA	NA	NA
County Trucks and Cars	8/day	60/day	85/day	90/day	NA	NA	NA
Employees Shift Crew	80/day	70/day	100/day	105/day	20/day	35/day	55/day
All Others (Mon. - Fri.)	160/day	200/day	280/day	300/day	60/day	100/day	155/day
Visitors	50/month	NA(3)	NA	NA	NA	NA	NA
Biosolids Trucks (2) (7 days a week)	14/day (7 loads)	Maximum of (13 loads)	14/day (7 loads)	15/day (7.5 loads)	3/day (1.5 loads)	5/day (2.5 loads)	8/day (
Chlorine Railroad Cars	----------	7/year	10/year	11/year	----------	----------	----------

Notes: (1) Trips are one-way; figures are rounded. "One-way" is defined as a single direction trip to a single destination.
(2) Biosolids truck trips are one-way. Final conditions to the Shoreline Substantial Development Permit to upgrade to secondary treatment at West Point state that "the number of loaded sludge trucks shall not exceed 13 per day on average over a year period (January through December)." Thirteen truck loads per day equals 26 one-way truck trips as defined in Note (1).
(3) Data not available.

Public Services, Utilities, and Energy

Impacts

The additional electrical energy required to operate treatment plants in the year 2030 is estimated at 35.6 million kWh per year. The amount of energy produced to offset this demand has not been estimated.

Mitigation Measures

Mitigation would be as described for SS1.

Unavoidable Adverse Impacts

Treatment of higher wastewater volumes would result in increased energy usage.

NOTE

Chapter 8 is as it appeared in the Draft EIS (May 1997) for the RWSP. References to the RWSP in Chapter 8 are to the draft Plan issued at the same time as the Draft EIS. Projections in this chapter are the ones used for the original four service strategies.

NOTE: This impact assessment is based on Service Strategy 4 as presented in the Draft RWSP. See Part I of this FEIS for revised strategy descriptions and analysis.

CHAPTER 8

IMPACTS AND MITIGATION MEASURES FOR SERVICE STRATEGY 4

Service Strategy 4 is described in Chapter 3 of this EIS. The major features of SS4 are summarized as follows:

- Maintain the existing two-treatment-plant system (West and East Plants)
- Expand West Plant to planned capacity of 159 mgd (2010)
- Expand East Plant in increments to an ultimate capacity of 235 mgd (2040)
- Construct 18-mile-long deep tunnel for CSOs and wastewater
- Implement CSO program to achieve one event per outfall per year by 2043.
- Implement full-scale I/I reduction program

The important features of Service Strategy 4 are shown in the Figure 3-4.

WATER RESOURCES

Impacts

Treatment plant discharges would increase under SS4 as a direct result of expected population growth in the region. Increased discharges would cause operational impacts on water quality in Puget Sound off Duwamish Head and West Point. Pollutant loading rates for SS4 are expected to increase in Puget Sound similar to SS1, SS2, and SS3. Based on their depth and relative locations in Puget Sound, slower flushing rates occur at the East Plant outfall off Duwamish Head compared to the West Point and potential North Treatment Plant outfalls. In general, the greater an outfall's depth in the water column, the longer it takes for the effluent to be flushed north out of Puget Sound (Ebbesmeyer 1994). Thus, this service strategy would result in relatively higher water quality impacts, similar to SS1.

West Service Area Treatment and Conveyance

Operations impacts for the West Plant would be that same as those identified previously for SS1 and SS2. Impacts arising from the operation of conveyance systems that would serve the West Service area would be similar to those described for the other service strategies.

East Service Area Treatment and Conveyance

Expansion of the East Plant to 235 mgd under SS4 would result in operational impacts similar to those described for SS1.

North Service Area Treatment and Conveyance

No North Treatment Plant would be constructed under this service strategy.

CSOs

CSO discharges for SS4 would result in an improvement in water quality over existing conditions. Pollutant loading to receiving waters would be reduced for all contaminants of concern, with the same types of impacts as SS1, SS2, and SS3.

CSO outfall sites that would be improved include discharges to the Duwamish River (i.e., Michigan St., Brandon St., and the Duwamish regulator), Elliott Bay (i.e., Denny Way, and Lander St., and Hanford #2), the Ship Canal (University/Montlake, Canal St., and 3rd Ave. W), and Salmon Bay (i.e., 11th Avenue W. and Ballard).

SS4 would result in the greatest control of CSO pollutants of all service strategies for the Duwamish River and Elliott Bay because, instead of providing primary treatment and continued nearshore discharge of these CSOs as the other service strategies would, it would route these CSO flows through either the West or East Treatment Plants. As a result, the flows would receive secondary treatment (except during high flow conditions, when some flows would receive primary treatment) and would be discharged through an offshore marine outfall.

Infiltration/Inflow

An aggressive I/I reduction effort would be included for SS4. A 30 percent reduction in infiltration and inflow for all basins of the service area would result in impacts similar to those described for SS1.

Mitigation Measures

The mitigation measures suitable for water resources in SS4 are similar to those previously identified for SS1.

BIOLOGICAL RESOURCES

Impacts

Biological resource impacts under SS4 would be similar to those discussed for SS1. New outfalls would not be constructed off Duwamish Head or for a North Treatment Plant, but discharges and associated adverse biological resource impacts would occur at the existing outfalls at Duwamish Head and West Point. There would be no new parallel Kenmore Interceptor. As a result, potential impacts to biological resources associated with Lake Washington would not occur. Impacts from all other facilities would be the same as those for SS1.

Operation of the proposed tunnel from Kenmore to Duwamish would not have any biological resource impacts. This tunnel would be located well underground, would not disturb any wildlife habitat, and is unlikely to rupture, releasing wastewater that could migrate to surface waters.

Long-term positive impacts to water quality would be greater than under SS1, because most flows would be routed to the tunnel to undergo secondary treatment at the West or East Plants instead of being discharged at CSO outfalls. The Kenmore to Duwamish tunnel would be constructed to achieve a “once-per-year” CSO untreated discharge event standard over the long term. This untreated discharge event could result in localized, temporary impacts to fish and shellfish resources.

Mitigation Measures

Mitigation would be the same as identified for SS1.

Unavoidable Adverse Impacts

Unavoidable adverse impacts would be the same as those identified for SS1.

LAND AND SHORELINE USE

Consistency with Policies and Regulations

Growth Management Act and Local Comprehensive Plans

Impacts under SS4 are similar to those described for SS1.

Shoreline Management Act

For Service Strategy 4, demonstration of benefit and need would be required for expansion of the West Plant(see discussion of West Plant land use permit process and Settlement Agreement in Chapter 5 under Impacts Specific to SS1). A number of CSO facilities are proposed for designated shoreline areas, and they would require shoreline permits, however CSO treatment facilities would not be constructed along the Duwamish Waterway and the Elliott Bay shoreline.

Zoning

Zoning issues at the West and East Plant sites would be similar to those discussed for SS1, because plant expansions would achieve the same capacities. The proposed tunnel and associated portals would be considered utilities under local zoning regulations. Utilities are allowed in most zones, either as permitted uses or as uses requiring conditional or special use permits. A public hearing may be required before the local jurisdiction grants a conditional or special use permit.

Direct Land Use Impacts

West Service Area Treatment and Conveyance

Impacts from expansion of the West Plant to 159 mgd would be similar to those described for SS1 and SS2.

Because of concerns about odors, noise, and visual character, pumping stations may be perceived by nearby residents and businesses as incompatible with surrounding land uses.

Operation of the proposed tunnel would result in few land use impacts. The tunnel itself would be buried deeply underground and would not be visible or otherwise detectable at the surface. Tunnel portals would be contained within a small building at most two stories in height that would be similar in scale or smaller than typical buildings in surrounding areas. During tunnel operation, little activity would typically occur in the vicinity of the portals. They would be relatively unobtrusive land uses in most locations.

East Service Area Treatment and Conveyance

The expanded East Plant would be located in a highly urbanized industrial/commercial area, and with continuation of the existing site design features and extension of perimeter buffering, the expanded plant would be compatible with surrounding land uses.

CSO and Infiltration/Inflow

I/I control impacts would be similar to those of SS1. Impacts of CSO control facilities would be less because there would be fewer individual storage and treatment facilities.

Mitigation Measures

Mitigation measures would be similar to those described for SS1.

Unavoidable Adverse Impacts

Expansion of the capacity of the West Treatment Plant within the existing plant boundary may be perceived by some as incompatible with surrounding recreational uses.

ENVIRONMENTAL HEALTH

Public Health

Impacts

Over the long term, environmental health benefits of reductions in CSO volumes and the frequency of CSO events would be better than the other three service strategies because there would be less CSO discharged to waterways.

Mitigation Measures

No mitigation measures are required.

Unavoidable Adverse Impacts

No unavoidable adverse impacts are anticipated.

Noise

Impacts

Noise impacts associated with treatment plants would be the same as SS1.

Mitigation Measures

Mitigation would be the same as for SS1.

Unavoidable Adverse Impacts

No unavoidable adverse impacts are anticipated.

Hazardous Materials

Impacts

Hazardous materials impacts would be similar to SS1, except that SS4 does not include small CSO treatment plants, which would have disinfection chemicals stored onsite.

Mitigation Measures

Mitigation would be the same as for SS1.

Unavoidable Adverse Impacts

No unavoidable adverse impacts are anticipated.

OTHER ELEMENTS OF THE ENVIRONMENT

Earth Resources

Impacts

Operational impacts on earth resources under SS4 would be similar to those discussed for SS1. Discharges from CSOs would be reduced further under this strategy, with greater benefit to sediments. Construction impacts associated with the deep tunnel are discussed in Chapter 11.

Mitigation Measures

Mitigation measures would be the same in character as those identified for SS1. There would be fewer aboveground facilities (no CSO control facilities along Duwamish River and Elliott Bay).

Unavoidable Adverse Impacts

No unavoidable adverse impacts are anticipated.

Aesthetics

Impacts

Impacts to aesthetics are the same in character as identified for SS1. There would be fewer aboveground facilities (no CSO control facilities along Duwamish River and Elliott Bay).

Mitigation Measures

Mitigation measures are the same as identified for SS1.

Unavoidable Adverse Impacts

Unavoidable Adverse Impacts are the same as described for SS1.

Recreation

Impacts

Impacts to recreation are the same as identified for SS1, with the exceptions that impacts under SS1 related to the Kenmore interceptor parallel and the associated pump station in Matthews Beach Park would not occur under SS4.

Mitigation Measures

No significant post-construction adverse impacts to recreation are expected, and no mitigation measures would be necessary.

Unavoidable Adverse Impacts

No unavoidable adverse impacts are anticipated.

Cultural Resources

No cultural resource impacts would result from operation of SS4. Construction impacts are discussed in Chapter 11.

Air Quality

Impacts

Because volatile organic compounds are regulated as precursors to ozone, a regional pollutant, their impacts are not localized with respect to treatment facilities. For a complete discussion of VOCs, please refer to Chapter 5.

SS4 would have the same ultimate secondary treatment plant configuration as for SS1 (159 mgd at West Plant and 235 mgd at the East Plant), but expansion prior to 2010 would occur at the West Plant, as opposed to the East Plant, under SS1. Because the West Plant's high-purity oxygen treatment process has a very low odor-generation potential compared to other processes, and because of the relatively small increment of additional flow, any increases in odor levels are expected to be low. Expansions of the East Plant in 2020 and 2040 could result in higher odor impacts, because the increases would be larger in scale (39 and 81 mgd, respectively) and would likely use treatment processes with a higher potential for odor generation. Infill of the area surrounding the East Plant may also, in future years, create a higher level of sensitivity to odor impacts on the surrounding area.

Pump stations would have impacts similar to those described for SS1.

Mitigation Measures

Mitigation would be as described for SS1.

Unavoidable Adverse Impacts

Unavoidable adverse impacts would be as described for SS1.

Transportation

Impacts

Operational impacts to transportation from the expansion of the West and East Plants under SS4 would be the same as those described under SS1. Please see Table 5-2 (in Chapter 5) for a summary of these impacts.

Mitigation Measures

Mitigation would be the same as identified for SS1.

Unavoidable Adverse Impacts

Unavoidable adverse impacts would be as described for SS1.

Public Services, Utilities, and Energy

Impacts

Impacts would be similar to those described for SS1.

Mitigation Measures

Mitigation would be as described for SS1.

Unavoidable Adverse Impacts

Treatment of higher wastewater volumes would result in increased energy usage.

NOTE

Chapter 9 is as it appeared in the Draft EIS (May 1997) for the RWSP. References to the RWSP in Chapter 9 are to the draft Plan issued at the same time as the Draft EIS. Projections in this chapter are the ones used for the original four service strategies.

NOTE: This impact assessment is based on the Service Strategies as presented in the Draft RWSP. See Part I of this FEIS for revised strategy descriptions and analysis.

CHAPTER 9

Reclaimed Water Applications, Impacts And Mitigation Measures

INTRODUCTION

Wastewater reclamation and reuse is the practice of treating and managing wastewater to produce water of suitable quality for beneficial uses. All nonpotable uses of water can be supplied with properly treated reclaimed wastewater of less than drinking water quality.

In many parts of the world, properly treated wastewater has become an attractive option for conserving and extending available water resources. Reclaimed water may also present an opportunity for pollution abatement (a beneficial impact) when it replaces effluent discharge to sensitive surface waters or is of better quality than receiving waters.

The RWSP and this DEIS discuss the production of reclaimed water at the treatment plants as part of each service strategy, and as three service strategy options (DEIS Chapter 12). Environmental impacts associated with the application of reclaimed water for uses in close proximity to treatment plants and effluent transfer pipes is discussed in this chapter. There are no unique environmental impacts associated with the production and delivery of reclaimed water that are not covered by the discussion of treatment plant operations in Chapters 5-8.

The potential role of reclaimed water in meeting the region's future water supply demand is a major issue addressed in the RWSP. Three options to the service strategies have been developed to represent this large scale use of reclaimed water: Discharge at the Ballard Locks; discharge to Lake Washington/Sammamish; and North Plant Discharge to Lake Washington. Environmental issues that would need to be addressed prior to the implementation of the service strategy options are discussed in Chapter 12 of this DEIS.

This chapter of the DEIS (Chapter 9) provides a programmatic analysis of the potential environmental impacts of utilizing reclaimed water for two of the uses defined and allowed by the State of Washington's Interim Standards (Departments of Health and Ecology (DOH and DOE). Specifically, impacts and mitigation measures associated with irrigation and the use of reclaimed water for "process water" within the treatment plants (essentially an industrial use) will be the primary focus.

It is also a focus because these uses are representative of other allowable uses of reclaimed water. Irrigation with reclaimed water is representative of uses that involve exposure of the reclaimed water to the air (e.g. street cleaning, firefighting, decorative fountains, etc.) and where there is a high probability of public exposure. Using reclaimed water to undertake industrial processes in the treatment plants is representative of most other types of industrial uses (except those using mists for cooling). Reclaimed water is also suitable for use in recreational or landscape impoundments and may, in the future, be allowed to be discharged into constructed wetlands. Where these uses present different or unique environmental consequences, there will be a discussion also at a programmatic level.

For the purposes of this environmental analysis, it is assumed that reclaimed water will be treated to a "Class A" level as defined by the Washington Water Reclamation and Reuse Interim Standards (see Appendix D). Class A reclaimed water has the highest level of treatment and quality designated by the State of Washington. Treatment includes oxidation (secondary treatment), coagulation, filtration, and disinfection to a level resulting in a median number of total coliform organisms not to exceed 2.2 per 100 ml in seven consecutive daily samples, with no sample exceeding 23 per 100 ml.

In the future, there may be reasons to treat reclaimed water to higher than Class A quality (e.g., treated to a level meeting drinking water quality standards, Washington surface water standards, irrigation water quality guidelines or other relevant standards and/or guidelines). This may apply to uses involving replenishing groundwater supplies or discharging reclaimed water to surface water bodies. In any case, reclaimed water treated to a water quality standard above Class A would have virtually negligible adverse environmental impacts.

In the following discussion, environmental impacts are identified and mitigation measures for irrigation and industrial process use are suggested that are not site specific, but could potentially result from the use of reclaimed water within the service area. Individual site specific assessments or environmental analyses may be appropriate in the future to determine whether unique characteristics are present at locations where reclaimed water is proposed to be applied. Part of this programmatic impact analysis is based on conclusions reached through the following risk assessments conducted by King County: *Metro Effluent Baseline Risk Assessment* (April, 1993)and *Addendum to Metro Effluent Baseline Risk Assessment* (December, 1994). This study, evaluated the use of secondary effluent to irrigate a public golf course and a recreational park and to cool an industrial complex via a closed-loop, non-contact system. Although this use of less than Class A quality is not proposed for irrigation, this study represented a "worst case" scenario against which more highly treated effluent could be measured. In it, the constituents in King County's secondary effluent, the possible risks to humans and wildlife from reuse of King County's secondary effluent and the reduction of risks associated with several advanced treatment methods were studied. One other risk assessment was on a specific "representative site": *A Summary and Explanation of Risk Assessments Related to Potential Landscape Irrigation with Reclaimed Wastewater at the Boeing Longacres Park Office Complex*, (December 1994). The results of these risk assessments can be used to identify impacts and mitigation measures appropriate for other situations and similar sites.

There are three other classes of reclaimed water as designated by the state of Washington that are lower quality than Class A. Reclaimed water Classes B, C and D require oxidation and disinfection with a median number of coliform organisms not exceeding 2.2, 23 and 240, respectively, per 100 ml. Appropriate uses of these reclaimed water products depend on the potential for exposure to humans or biota (see Appendix D).

In general, Class B reclaimed water uses are similar to Class A uses with a few exceptions. Class B reclaimed water must meet the same numerical standard for coliform as Class A (see Appendix D). The difference is that Class B reclaimed water is not required to undergo coagulation or filtering. The presumption is that these processes, in addition to oxidation and disinfection, remove a greater number of viruses and other organisms. Therefore, Class B uses are nearly identical to Class A uses except where there may be exposure to the public from sprays or mists (which could transmit viruses more readily than other exposure pathways).

Classes C and D have much lower coliform standards (does not exceed 23 per 100 milliliter (ml) for Class C and 240 per 100 ml for Class D). Both these classes of reclaimed water can be used for some irrigation purposes. Class C can be used for more industrial uses than Class D.

POTENTIAL RECLAIMED WATER APPLICATIONS

With feasible treatment technology and under appropriate conditions, reclaimed water may be used for virtually all nonpotable purposes for which potable water currently is used. The overriding consideration is that the quality of the reclaimed water be appropriate for its intended use. This includes an assessment of the potential for public exposure relative to the degree of disinfection and treatment that reclaimed water receives.

"Direct" use of reclaimed water requires pipelines or other conveyance facilities for delivering reclaimed water to the point of use. "Indirect" reuse, such as discharge of reclaimed water to a receiving water for assimilation and withdrawals downstream, is also recognized to be an important potential application. This "indirect" use of reclaimed water discharged to the Lake Washington drainage basin is not allowed at this time. General reclaimed water use categories currently possible in Washington State include:

- Landscape irrigation
- Agricultural irrigation
- Industrial use
- Groundwater recharge
- Nonpotable urban use
- Miscellaneous

Examples of water reuse applications included in each of these use categories are presented in Appendix D. Although the majority of uses are not part of the RWSP proposal, these activities and uses may be considered in the future.

RECLAIMED WATER FACILITIES

Reclamation facilities required to process treatment plant effluent and distribute Class A reclaimed water include chemical coagulation, filtration and disinfection processes (e.g. using chlorine, Ultraviolet light or ozonation), storage and distribution piping and pumping. The reclamation production facilities are above ground except possibly for summer storage in the chlorine contact channel.

Distribution to usage areas is through either gravity flow or pumped conveyance. Pipelines for a facility as described (1 mgd) would typically be between 10 and 24-inch diameter. Pipeline lengths and alignments would depend on project-specific application sites.

Both the East and West treatment plants have recently added reclamation facilities to produce Class A reclaimed water per the Washington State reuse standards.

RECLAIMED WATER USE IN KING COUNTY

MetroTherm

Non-consumptive use of effluent (where the entire quantity diverted for use is returned to its source) by King County can be traced to the mid-1980's when the East Treatment Plant began using secondary effluent in its heat pumps. The effluent, with a temperature up to 70 degrees Fahrenheit, is an ideal heat transfer medium between King County's effluent pipelines and the mechanical systems that heat and cool businesses or industrial facilities. Metro and the Washington State Energy Office began investigating use of the effluent from the proposed effluent transfer system for a district heating and cooling system. Seven taps along the Effluent Transfer System (ETS) were included in the initial construction. They remain available for customers along the Duwamish corridor to use for withdrawal of secondary effluent for heating and cooling purposes with subsequent discharge back into the ETS.

Reclaimed water is also available for use in the immediate vicinity of the East Treatment Plant in Renton. Chlorinated secondary effluent from the plant can be used without additional treatment as an energy source since it is delivered and returned with a once-through, closed-loop system. It is not "consumed" by the customers' process or product. A closed loop effluent line has been installed between the East Treatment Plant and a nearby industrial development. Such a system has not been developed at the West Treatment Plant because it is located at the point of effluent discharge, does not have an effluent transfer line available and there are no nearby customers at present.

Production and Consumptive Uses

In the summer of 1992, Metro and the City of Seattle designed a temporary reclamation facility in response to the emergency drought situation. This pilot project produced highly treated effluent which was available to be hauled by tanker truck from the site and used as appropriate. This pilot facility is no longer in use although some of the equipment has been incorporated into the West Treatment Plant reclaimed water facility.

King County's current reclaimed water program consists of producing "Class A" reclaimed water for use at, or in the vicinity of, the two regional treatment plants. The East Treatment Plant is capable of producing approximately 1.3 million gallons per day (mgd) of reclaimed water and the West Treatment Plant can produce 0.7 mgd. The current uses include landscape irrigation and use as process water within the treatment plants (a supply of water where less than potable quality is acceptable). In the near term, these applications are the most likely to be implemented although any of the uses described in the "Interim Standards" would be appropriate.

Although it has not yet occurred, there is interest in drawing secondary effluent off the effluent transfer system which runs from Renton through the Duwamish Industrial area to Duwamish Head. The effluent would receive additional on-site treatment to produce any class of reclaimed water, depending on the proposed application. Industrial uses of reclaimed water currently appear to be the most likely due to the land use character of the Duwamish area. The use of industrial process water of a Class A character is discussed in this chapter. If an industrial use of reclaimed water of less than Class A is proposed, it would have to comply with the Washington State Interim Standards. With the use of Class B reclaimed water, the risk of exposure to bacteria would be the same as for Class A although the risk of exposure to viruses and other organisms could be greater. The risk of exposure to bacteria would increase with the use of Class C and be the greatest with Class D reclaimed water. Environmental impacts associated with such a proposal would need to be evaluated on a case by case basis each time through SEPA environmental review.

RECLAIMED WATER AND THE REGIONAL WASTEWATER SERVICES PLAN

Service Strategies

Both the East and West treatment plants have recently added reclamation facilities to product Class A reclaimed water per the Washington state reuse standards. It is proposed that if an additional treatment plant is added to the regional system (north end plant described in Service Strategy 2 and Service Strategy 3) it would be designed to include reuse production facilities. It is also reasonable to assume that if a north end plant were located inland and some distance from the outfall, the pipeline transporting treated effluent could be tapped along its route to reuse part of the effluent.

Service Strategy Options

Three of the service strategy options considered in the RWSP involve the large scale use of reclaimed water. Potential environmental impacts associated with these service strategy options are discussed in Chapter 12 of this DEIS. Because they are service strategy options rather than specific proposals at this time, the level of analysis provided there is introductory and general.

IMPACTS AND MITIGATION MEASURES ASSOCIATED WITH APPLICATIONS AND USES OF RECLAIMED WATER

Construction of reclaimed water facilities includes installation of tanks, process equipment, and small underground pipelines. Environmental impacts resulting from the construction of reclaimed water production facilities are typical of those experienced during the construction of other wastewater facilities and are addressed in Chapter 11. Environmental impacts associated with operating reclaimed water facilities are very similar to those previously described for secondary treatment facilities only on a much smaller scale. These operational impacts have been discussed in Chapters 5-8. The following discussion pertains to impacts and mitigation measures associated with the application and use of Class A reclaimed water.

EARTH RESOURCES

Applications and Impacts

Reclaimed water has the potential to impact earth resources adversely when substances present in the reclaimed water are introduced into the soil. This could occur either directly, as in irrigation with reclaimed water, or indirectly, when runoff from activities using reclaimed water reaches the soil. The most likely activity to result in impacts to earth resources is irrigation where reclaimed water is sprayed on the landscape periodically during the summer months.

Constituents of potential concern include salts, metals, synthetic organic chemicals and certain long-lived pathogens that may be highly resistant to disinfection.

It is unlikely, however, that constituents in reclaimed water would accumulate rapidly in irrigated soils. Preliminary evaluations presented in the risk assessments conducted by King County found that, at the representative site studied, it would take at least 300 years of irrigation with Class A reclaimed water to cause an incremental accumulation of metals to levels above current Washington soil cleanup levels under the Model Toxics Control Act (MTCA).

For a discussion of impacts resulting from human contact with pathogens that could be present in reclaimed water, see Environmental Health section later in this chapter.

Mitigation Measures

Application of Class A reclaimed water at agronomic rates (matching crop uptake with water demand to minimize the potential for leaching) should not result in adverse impacts to earth resources. Reclaimed water undergoes several treatment processes prior to being distributed for irrigation purposes. Many of the constituents and levels of constituents that could adversely impact earth resources have been removed by the treatment processes prior to distribution and reuse.

In addition, application rates for irrigation can be controlled by calibrating the quantity of irrigation water used to the moisture content of soils so that over irrigation does not occur.

Pre- and post application monitoring of soils for the constituents described above could be conducted for each site using reclaimed water so that levels could be tracked and evaluated.

AIR RESOURCES

Applications and Impacts

The types of applications that could result in impacts to air resources generally fall into two main categories: those that have the potential to generate aerosols (i.e., tiny droplets of water formed by mechanical processes such as spraying or splashing) and those that have the potential to release volatile compounds (e.g., vapors of organic compounds such as chloroform). Odor impacts associated with air resources are generally related to the release of volatile compounds (gases and vapors).

Spray irrigation using reclaimed water is the application most likely to generate aerosols. Certain industrial processes involving spraying operations and operations that generate steam also generate aerosols. The most likely impacts to air resources would include the release of reclaimed water constituents to the air in either the environment or the workplace. Both aerosols and volatile compounds are easily inhaled by humans and animals. If sufficient quantities of chemicals and/or pathogens enter the body the result can be adverse health effects.

The results of the risk assessments conducted for a representative site in King County indicated that, for likely reuse applications, the risks from airborne chemicals and microorganisms from reclaimed water were negligible (i.e., within or below the range of risks considered to be “acceptable” by the U.S. Environmental Protection Agency).

For a more complete discussion of potential impacts to human health, see the section on Environmental Health later in this chapter.

Mitigation Measures

The primary means of mitigating potential adverse impacts resulting from applications of reclaimed water that produce aerosols (irrigation or spray, mist industrial operations) or vapors is avoidance of direct contact.

Irrigation with reclaimed water can be scheduled to occur only at night or during other times when human exposure would be unlikely or could be restricted.

Where reclaimed water is part of an industrial process, mitigation for adverse air impacts in the workplace, such as impacts resulting from a spill, include ventilation of enclosed spaces with adequate air exchange with outside air. Industrial exposure to airborne contaminants can also be avoided by conducting industrial processes using reclaimed water in enclosed tanks or other sealed vessels. Protective clothing and respiratory protection can be provided where exposure would be otherwise unavoidable.

Additional mitigation measures for the workplace include signage, training and appropriate operations and maintenance procedures for equipment, all of which can be integrated into the employer’s existing health and safety program.

WATER RESOURCES

Applications and Impacts

Based on conclusions reached in the risk assessments, irrigation with reclaimed water would be unlikely to degrade water quality. The site specific risk assessment predicted that there would be no adverse effects on groundwater quality from irrigation with reclaimed water for hundreds of years, if not more than 1,000 years.

Surface water resources could, however, experience adverse impacts if irrigation occurred at rates that allowed for overland runoff into surface water or because of overspray or spray drift onto nearby surface waters

Potential adverse impacts to water resources (surface and groundwater) could include contamination of these waters with constituents that may be found in reclaimed water (i.e., chemicals and pathogens). Possible results could include toxicity to humans, wildlife or plant species from chemical constituents, risk of infection to humans from pathogens, and eutrophication of surface water from nutrients (primarily phosphorus and nitrogen) in the reclaimed water. Nitrogen can also accumulate in groundwater if present in sufficient quantities in water used for irrigation.

Applications with potential adverse impacts to groundwater include (a) irrigation at rates that allow for dry weather percolation through soil to groundwater; and (b) irrigation at rates that allows accumulation of reclaimed water constituents in soil until such time as wet-weather precipitation drives the constituents downward into groundwater.

Potential beneficial impacts to water resources could occur when the quality of the treated effluent is higher than the receiving water. If the treated effluent was introduced in sufficient quantity, it would dilute the receiving water and provide an overall improvement to water quality.

Wetlands can also be affected by intentional or unintentional discharge of reclaimed water to wetlands or drainages leading to wetlands. The Departments of Ecology and Health are developing draft regulations for beneficial discharge of reclaimed water to wetlands for flow enhancement, water quality improvement and/or other beneficial impacts.

Potential adverse impacts to wetlands may include eutrophication due to excess nutrient loading, presence of constituents that are harmful to aquatic life (e.g., chemicals, potential pathogens, BOD) and other qualities and physical properties of the water that may be deleterious to plants and animals (e.g., temperature and rate of flow).

In the near future it may be permitted to intentionally discharge reclaimed water to groundwater through surface spreading or direct injection through subsurface wells. These practices would replenish dwindling groundwater supplies, prevent ground subsidence, and indirectly could increase streamflows for streams dependent on groundwater as a water source.

Constituents present in the reclaimed water could be introduced into groundwater as well. Reclaimed water can also extract or leach materials from the soil which then could be mobilized into groundwater. If these constituents are present in sufficient quantities, they could adversely affect the quality of groundwater.

Proposed regulations are considering the conditions under which groundwater recharge could be permitted using reclaimed water.

Mitigation Measures

King County has an Industrial Waste/Source Control Pretreatment Program that assists industrial and commercial enterprises in controlling their waste products and preventing wastes from entering the sewer system. Through this program, permits are issued limiting the amount and type of discharges that industries can release into the sewer. These permits require industries to monitor the quality of their discharges and to remove potentially hazardous materials before discharging into the collection system. The success of this program has resulted in significantly lower levels of many constituents, primarily metals, in wastewater. The improved quality of the influent entering the treatment plants also improves the quality of the secondary effluent that is discharged or treated to a higher reclaimed water standard.

The risk assessments cited previously found negligible potential for adverse impacts to surface water and groundwater for the likely reuse scenarios that were studied. This is because the quality of Class A treated effluent is high and the majority of potentially harmful chemicals and pathogens are substantially removed during the treatment process.

The Washington interim standards require monitoring of reclaimed water for quality for parameters that indicate the continued operational effectiveness of the reclaimed water treatment process. Compliance with these standards would be expected to prevent any significant risk to public health from pathogens. Where appropriate, additional monitoring could be conducted to ensure that reclaimed water constituents are not present at levels that could have adverse impacts to water resources.

In addition to the Class A quality requirements, the Washington reuse standards include requirements for treatment reliability to prevent the distribution of reclaimed water that may not be adequately treated because of a process upset, power outage, or equipment failure. Reliability requirements include provisions for alarms, standby power supplies, multiple or standby unit treatment processes, emergency storage or disposal provisions and standby replacement equipment.

The Washington standards also include operations, sampling and analysis, engineering reporting, and land use area requirements, as well as general design requirements. Dual distribution systems (i.e., reclaimed water distribution systems that parallel a potable water system) must also incorporate safeguards to prevent cross connections with reclaimed water. For example, piping, valves, and hydrants must be marked or color-coded (purple) to differentiate reclaimed water from potable water, and backflow prevention devices must be installed.

Wetlands standards have recently been proposed to amend the Washington interim standards. They are designed to protect wetlands from adverse impacts from the flow rate, water depth, and/or constituents that may be present in reclaimed water. When these standards are applied the potential for adverse environmental impacts to wetlands would be minimal.

According to the proposed regulations, mitigation to ensure groundwater quality is maintained may include treating the effluent to meet drinking water quality standards.

BIOLOGICAL RESOURCES

Applications and Impacts

Potential adverse impacts to biological resources from the use of reclaimed water could include potential exposure to and bioaccumulation of toxic chemicals and the potential for ingestion or inhalation of pathogens. Exposure to, or bioaccumulation of these constituents could affect animals directly exposed, and/or their offspring, or transfer them to a higher trophic level in the food chain. However, very few of these substances are detected in King County's secondary effluent and even fewer would remain after treatment to a Class A level.

The risk assessments previously cited included an "ecological health" element where potential impacts to biological resources were assessed. The ecological portion of the risk assessments concluded that risks to aquatic life were likely to be limited, even with a lower than Class A level of treatment. It was also predicted that the use of reclaimed water was unlikely to adversely affect terrestrial wildlife (such as moles and robins) that typically inhabit golf courses and parks, likely candidate sites to be irrigated with reclaimed water.

Plants are more likely to be affected by the use of reclaimed water than animals. Some inorganic compounds (e.g., sodium, chloride, boron) could accumulate and adversely affect the germination, establishment, growth, survival, and/or appearance of plants if present in high concentrations in the reclaimed water or if applied to soils in such a way as to allow for accumulation to high concentrations in the soil.

Mitigation Measures

Mitigation measures to ensure ecological health is maintained include monitoring the quality of the reclaimed water to ensure that it consistently meets the Class A standard (as required in the Interim Guidelines). Monitoring certain parameters at the application site as irrigation occurs could provide an additional safeguard.

If high levels of mineral salts and inorganic compounds are known to be present in the reclaimed water, plant materials can be selected that are proven to be tolerant of these conditions.

Some wetland plants are known for their ability to take nutrients and other constituents from the water into the plant tissue. If wetland discharge is considered in the future, incorporating these plants into the design of constructed wetlands could provide additional mitigation.

ENERGY

Applications, Impacts and Mitigation Measures

The closed-loop non-consumptive system provides effluent to be used be as an energy source for heating or an energy sink for cooling processes used by businesses and industrial facilities (MetroTherm). By using the heat from the effluent (usually at 70 degrees) as a source of energy, the demand on other consumptive energy sources (oil, natural gas, etc.) can be avoided resulting in beneficial impacts. Using the heat contained in treated effluent as an energy source can be considered to mitigate adverse impacts associated with developing and using many other sources of energy.

ENVIRONMENTAL HEALTH

Applications and Impacts

Applications of reclaimed water with the potential for human exposure to the water include (1) irrigation of areas accessible to the public (e.g., golf courses, recreational parks and public playfields); (2) charging of recreational impoundments and augmentation of streamflow in water bodies used for fishing, boating and water contact sports; (3) industrial reuse, especially in situations where workers could come into direct contact with reclaimed water or be exposed to aerosols and/or vapors in confined spaces or other poorly ventilated areas.

Potential pathways and routes of exposure include: direct skin contact with reclaimed water; accidental ingestion of reclaimed water; inhalation of spray (e.g., from irrigation and/or inhalation of dust) from resuspended soils irrigated with reclaimed water); and direct skin contact with or ingestion of irrigated soils.

Potential health effects are directly related to the level of contaminant removal and microbiological inactivation provided to the wastewater before reuse and the level of human contact associated with the water reuse system. As the level of treatment increases and the level of human contact decreases, the possibility of adverse public health effects related to water reuse is decreased.

The factors which influence the level of health risk of infectious disease from waterborne transmission include the identity of the specific infectious agent, the reservoir of the agent, the mode of transmission and the susceptibility of the host. In determining potential health risks, infectious agents are evaluated based on their potential to produce disease (virulence), the stability in the environment and their size. Not all infectious agents have equal potential for causing human illness.

There is ample evidence that most bacterial, parasitic, and viral agents can be removed from wastewater effluent by the current filtration and disinfection methods. The absence or significant reductions of total coliform and turbidity are considered to be reliable indicators of a well-operated plant and highly treated reclaimed wastewater. These indicators are monitored to ensure the virtual absence of detectable wastewater related pathogens in reclaimed water.

The absence of potential health risks associated with the reuse of reclaimed water have been well documented nationwide as water reuse projects are implemented and carefully monitored by health authorities and water quality control agencies. This has resulted in findings that the risk of infection and disease are negligible.

King County has recently studied the potential risks associated with using reclaimed water. The *Metro Effluent Reuse Baseline Risk Assessment* (April 1993) characterized the chemical and biological constituents in the secondary effluent produced at the East and West treatment plants, the possible risks to humans and wildlife from reuse of this secondary effluent, and the reduction of risks associated with several advanced treatment methods.

The risk assessment evaluated the use of secondary effluent to irrigate a public golf-course and a recreational park and to cool an industrial complex via a closed-loop, non-contact system. By considering worst-case scenarios, a baseline was established to identify potential problems with reuse and ways to manage associated risks. Similar evaluations were conducted for each of the advanced treatment methods to identify the degree of further risk reduction.

The public health portion of the risk assessment concluded that even reuse of secondary effluent has limited potential to adversely affect human health. The use of Class A reclaimed water for irrigation would pose negligible risk to public health and the environment.

Mitigation Measures

The State of Washington Water Reclamation and Reuse Interim Standards protect public health by requiring a specific level of water quality and treatment corresponding to each beneficial use of reclaimed water. King County's facilities produce the highest quality effluent designated by the State of Washington, i.e., Class A. There are numerous safeguards to ensure that the system is operating safely and reliably. These standards are among the most stringent in the world.

Treating wastewater to a Class A standard provides the greatest safeguard towards protection of public health; however, any potential risk to the public could be lowered even further by implementing some or all of the following measures:

- Irrigation could occur at night when public exposure is likely to be low,
- public education (e.g., posting of signs)
- environmental monitoring (e.g., soil and water sampling)
- appropriate irrigation system design and operation (e.g., providing for emergency shut-off of the irrigation system in the event of a pipe rupture) and;
- implementation of appropriate irrigation system maintenance procedures.

If necessary and appropriate, reclaimed water could be treated to a level higher than the current Class A water quality standards (e.g., treated to a level meeting drinking water quality standards, Washington surface water quality standards, irrigation water quality guidelines or other relevant standards and/or guidelines).

RECREATION

Reclaimed water is approved for use in irrigating recreational sites including parks, playfields and golf courses. The potential for adverse impacts resulting from this use of reclaimed water is negligible. Sections on Biological Resources, Water Quality and Environmental Health include more specific information.

UTILITIES AND PUBLIC SERVICES

Applications and Impacts

Irrigation or other use of reclaimed water relieves some demand on potable water supplies, extending those supplies, particularly in drought conditions.

Also, there is the potential for a reclaimed water delivery line to leak or rupture under certain circumstances. The uncontrolled release of reclaimed water could contaminate a potable water supply system if it was located in the immediate vicinity.

Mitigation Measures

There are requirements governing the siting and construction of reclaimed water lines, particularly as they relate to proximity to potable water lines. Reclaimed water distribution systems that parallel a potable water system must also incorporate safeguards to prevent cross connections of reclaimed water and potable water lines and misuse of reclaimed water. In general, reclaimed water pipes must be located at a prescribed minimum vertical distance and depth. Purple is the color used to designate reclaimed water pipes and sprinklers.

NOTE

Chapter 10 is as it appeared in the Draft EIS (May 1997) for the RWSP. References to the RWSP in Chapter 10 are to the draft Plan issued at the same time as the Draft EIS. Projections in this chapter are the ones used for the original four service strategies.

NOTE: This impact assessment is based on the Service Strategies as presented in the Draft RWSP. See Part I of this FEIS for revised strategy descriptions and analysis.

CHAPTER 10

BIOSOLIDS RECYCLING PROGRAM IMPACTS AND MITIGATION MEASURES

This chapter describes King County's existing programs for biosolids recycling and the likely markets for future recycling of larger quantities of biosolids under the RWSP system strategies. Biosolids are the semisolid material that remains after wastewater treatment has been completed and the treated liquid effluent is discharged into receiving waters. With further processing, they constitute a rich source of nutrients for plants that can augment or replace chemical fertilizers. King County has been a leader in developing biosolids recycling programs and is committed to supporting its existing markets and developing new markets for beneficial uses of biosolids products.

This chapter provides an environmental analysis of impacts that may occur as a result of applying biosolids to the land through recycling programs. This chapter focuses on King County's current program utilizing biosolids as a soil amendment in both eastern and western Washington. Environmental impacts associated with the existing methods of processing solids at the wastewater treatment facilities are discussed in the chapters describing the Service Strategies (Chapters 5-8). Chapter 12 of this DEIS presents options for alternative means of producing biosolids accompanied by a discussion of environmental impacts.

EXISTING BIOSOLIDS PRODUCTION

Biosolids Facilities and Operations

The County currently processes wastewater solids at two treatment facilities: the West Treatment Plant and the East Treatment Plant. Wastewater solids represent the beneficial residuals from the wastewater liquid stream which were separated during primary and secondary treatment. After liquid is removed from the solids through thickening, the solids are further reduced in volume through a process called anaerobic digestion. This process reduces volatile solids and pathogens. Following digestion, water content is additionally reduced through dewatering. The resulting substance is called biosolids "cake". A number of processes are available to create different products from the biosolids cake. These processes are described in Chapter 12.

Biosolids are transported by long-haul trucks to recycling sites or to a private local firm utilizing the biosolids to produce a commercial compost.

The biosolids consist primarily of a rich organic material mixed with a small amount of sand, grit, microorganisms, trace amounts of metals, and synthetic and naturally occurring chemicals. The rich organic content of biosolids make it highly desirable as a soil amendment. Biosolids products can be used in forestry, agriculture, landscaping and gardening applications.

Volumes Generated

In 1996, King County produced 26,000 dry tons of biosolids in conjunction with the operation of its treatment facilities. The West Treatment Plant has recently been upgraded to provide secondary treatment and the expansion of the East Treatment Plant is nearing completion. Biosolids production is expected to increase over time in relation to population growth and is expected to reach *just under 40,000* dry tons per year by 2030.

Biosolids Products

Summary of Products and Regulations

Biosolids recycling is regulated according to 40 CFR (Code of Federal Regulations) Part 503, Standards for the Use or Disposal of Sewage Sludge. These standards, commonly known as the "503" regulations, are promulgated by the US Environmental Protection Agency (US EPA). The regulations recognize that biosolids, by nature of their origin, have the potential to contain appreciable concentrations of contaminants that may adversely affect human health and/or the environment. The three categories of potential concern identified by the regulations are (1) pathogens, or disease organisms, (2*) vector attraction reduction,* and (3) trace metal content.

Federal, state, and local agencies regulate the production, application and marketing of biosolids. There are two classifications of biosolids based on pathogen content: 1) Class A biosolids have been treated to reduce pathogens to a level where *there are no site access or crop restrictions. Class A designation is required for use on lawns and gardens.* 2) Class B biosolids have been treated to reduce pathogens to a level that is safe for application on land with an initial period of limited public access *and crop restrictions*. Treatments to produce a Class A biosolids do not affect the metals or organic chemicals in the biosolids; odor may or may not be affected. Federal regulations also set maximum limits on trace metal content in biosolids. *All biosolids to be land applied must be under the maximum limits; biosolids meeting a second (lower) set of metal standards (i.e. are of consistently higher quality) have fewer restrictions for use.* The County's biosolids consistently exceed the metals standards and are classified as "highest quality". The state and local health departments may impose stricter standards. (See Table 10-1 for typical biosolids metals content).

The federal regulations on biosolids processing and use and the analogous state regulations mandate that biosolids be applied at agronomic rates to balance uptake of nitrogen by crops with the potential for nitrate leaching to ground water. The maximum rate and the cumulative amount of biosolids that can be applied to a particular parcel of land are intended to limit the concentrations of contaminants in soil, crops, and receiving waters. These regulations limit the accumulation of contaminants in biosolids-amended soil to levels that are not harmful to the health of humans and other biota.

When biosolids are applied in compliance with federal, state and local regulations and permitting requirements, there are no probable significant adverse environmental impacts associated with this practice.

Some Class B cake is composted with sawdust to form a Class A biosolids compost marketed as GroCo. GroCo is sold to commercial landscapers and home gardeners and its use is unrestricted. In 1996 GroCo received 2,587 dry tons or 10% of King County's biosolids production. In 1996, a small portion of GroCo's annual production, 1600 cubic yards, was used by volunteers as part of the Mountains to Sound Greenway regreening project along Interstate 90.

Currently, King County is conducting a pilot program with a private firm, PCL/SMI to dry undigested solids at the West Treatment Plant. In 1996 PCL/SMI received 4,864 dry tons or 19% of King County's production. PCL/SMI is a fully privatized operation and that contractor is solely responsible for the marketing of its product.

Table 10-1
Typical Biosolids Metals Content in 1996

Metal (mg/kg)	40 CFR 503 Limits	West Plant	East Plant
Arsenic (As)	41	8.30	8.99
Cadmium (Cd)	39	6.53	8
Chromium (Cr)	1,200	74.5	91.8
Copper (Cu)	1,500	510	831
Lead (Pb)	300	217	81.3
Mercury (Hg)	17	3.91	3.09
Molybdenum (Mb)	18	11.5	17.4
Nickel (Ni)	420	44.3	25.9
Selenium (Se)	36	5.66	6.67
Zinc (Zn)	2,800	1,080	952

Current Markets

Western Washington

In western Washington, biosolids are used primarily for silviculture (i.e., forestland application) and compost. Weyerhaeuser's Snoqualmie Tree Farm in Snoqualmie has been the major recipient, with an average annual usage of approximately *3,000* dry tons of Class B cake between 1087 and 1994. In 1995, Weyerhaeuser committed to use *5,000* dry tons a year for the next 6 years. In addition, the Washington State Department of Natural Resources (DNR) agreed in 1995 to a 50-year contract for biosolids use on forestlands, with a maximum annual usage of 6,000 dry tons. This agreement is a part of the Mountains-to-Sound Greenway program, which involves the transfer of land between King County and DNR.

The compost marketed by GroCo is also marketed in the Puget Sound region. The current GroCo contract is for delivery of *a minimum of* 2,000 dry tons of Class B digested cake per year, with an option to increase to up to 3000 dry tons per year.

Eastern Washington

Biosolids markets in eastern Washington use Class B cake as a soil amendment for a variety of crops. In Douglas County, approximately 5,900 dry tons of biosolids were applied to 1,536 acres of wheat fields in 1996. Farmers in Yakima County used 4,760 dry tons for hop production on 1,332 acres during the same period. Biosolids in Yakima County can be applied to irrigated hops, grapes, orchard fruit, corn, hay, alfalfa, hybrid poplars, dryland grain and rangeland. Small quantities of a dried Class A biosolids product were used by eastern Washington farmers over the past several years. Farmers in both counties have indicated a desire for larger quantities of biosolids, with potential usage of 20,000 dry tons per year or more. King County's current production cannot satisfy this demand in addition to that of western Washington markets; furthermore, the higher expense of transport over Snoqualmie Pass makes the handling of biosolids less cost effective. Some Eastern Washington farmers have received approval to store biosolids over the winter which provides greater flexibility by making biosolids available virtually year-round.

Other Potential Biosolids Recycling Sites

Because biosolids are an important soil amendment product, there are other suitable applications other than silviculture or agriculture. Biosolids have been used to improve soil conditions in disturbed areas, such as at Discovery Park in Seattle. In this case, Class B cake was used as a soil amendment to establish grasses and native vegetation and eliminate Scots Broom on fourteen acres within the park where the public access restriction conditions could easily be met. There may be similar projects in the future where applications of Class B may occur subject to compliance with permit conditions. Other projects may be undertaken where a soil amendment would be beneficial but a Class A material would be more suitable.

This market is currently very small but has the potential to expand in the future using either a Class A or B product.

BIOSOLIDS APPLICATIONS

The method of applying biosolids varies according to the crop and local conditions. For eastern Washington agricultural uses, the application equipment may vary, but it must be able to uniformly apply biosolids at the desired rate and be suitable for the terrain and crops. Incorporation follows application and is done with a disc, rake/harrow, or other means as appropriate for the soil conditions of the field. The practice of leaving biosolids unincorporated in rangeland areas is preferred to help control soil erosion.

Part of the permitting process involves the approval of an "Operations Plan" for each project that specifies site operations, management and environmental monitoring.

For silvicultural operations in western Washington, the application process begins with site selection. Candidate sites have the following characteristics:

- Terrain suitable for ground application of biosolids.
- Stands of trees or other vegetation capable of utilizing the added nutrients.
- Well drained soil, and
- Streams and other waterways which can be protected by required setbacks or buffers.

In forestry sites, biosolids dewatered to approximately 20 percent solids, are applied using the "AeroSpread" throw applicator. Mounted on the chassis of a log forwarder (equipment designed to carry logs in a harvesting operation), paddles of the AeroSpread can throw the biosolids up to 200+ feet. The distance the biosolids are thrown is controlled by changing the angle of ejection and velocity of the rotator blade.

After biosolids are delivered to the site by truck, they are usually applied the same day although longer term storage may be permitted.

The rate of application depends on an approved site-specific prescription for nitrogen calculated by a soil and forest fertilization specialist. This prescription is an agronomic rate, designed to meet the nitrogen needs of the crop yet minimize possible production of excess nitrate. Re-applications of biosolids may occur as needed, usually every four years.
All applications of biosolids require monitoring of surface and well water (if present) to ensure compliance with environmental and public health standards and meet permit requirements.

EXISTING CONDITIONS, IMPACTS, AND MITIGATION MEASURES

This section contains the environmental analysis for the application of Class B cake and Class A products including composted biosolids. Each element of the environment is divided into three headings: eastern Washington markets (primarily agricultural), western Washington markets (primarily silviculture), and other potential biosolids recycling markets . Environmental impacts for eastern and western Washington environments are discussed separately because the environmental conditions and the methods of biosolids application and markets or end users differ between the two areas. Within each element of the environment, impacts are described in terms of product type (Class A or Class B, dewatered cake or other).

Earth Resources

Eastern Washington Markets

Existing Conditions. Eastern Washington soils are primarily silty and sandy loams formed from alluvium and loess (fine-grained material deposited by wind). These soils are usually moderately permeable (percolation occurs at 0.6 to 6.0 inches per hour) and are mildly acidic to mildly alkaline (about pH 6.5 to 8.0). Soils in major river valleys are typically deep. Outside of major river valleys, soils are underlain by basalt or, in northern Douglas County, glacial till at depths less than about 60 inches.

Impacts and Mitigation Measures. Biosolids are used primarily as a soil amendment and fertilizer in eastern Washington agricultural areas, and earth impacts from agricultural application of either Class A or Class B biosolids would be similar. The 503 Regulations limit the amount of biosolids that can be applied over a given period of time to a specific piece of land. This regulatory requirement minimizes the potential impact by reducing the metals buildup in the soil over time. Because King County biosolids meet the lowest limit for metals, cumulative loading is not of concern. The application of either Class A or Class B biosolids in eastern Washington is unlikely to result in significant contaminant loading to soils, and any adverse earth impacts would be minimal. Monitoring for constituents of concern is performed as required by federal and state regulations.

Amending agricultural soil with a biosolids cake product (either Class A or B) has a number of beneficial impacts to earth resources. Soil tilth is improved as organic matter in the biosolids is incorporated into the soils. This provides increased moisture retention and reduced wind erosion. Biosolids are tilled into the soil to create improved soil conditions to support the growth of plant materials.

Biosolids are stored for up to six months near the sites of application. To reduce the potential for erosion of the stored material, storage areas can be located in areas sheltered from the wind. If a dried product is being stored, the storage sites can be surrounded with plowed furrows and/or berms and possibly covered with plastic materials. No additional mitigation measures are necessary.

Western Washington Markets

Existing Conditions. Soils on potential silviculture sites are primarily gravelly loams and gravelly sandy loams typically underlain by glacial till or bedrock at depths of about 40 inches or less. These soils are moderately to strongly acidic with pH values of 6.0 or lower. Permeability is typically fairly rapid (0.6 to 6.0 inches per hour) near the surface but quite slow (less than 0.06 inch per hour) below a depth of about 24 to 40 inches.

Sites selected for biosolids applications are usually flat, although slopes of up to 30 to 40% may be suitable if other permit requirements can be met.

Impacts and Mitigation Measures. The application of biosolids to forest soils reduces the potential for soil erosion while improving site nutrient status by restoring plant nutrients to the soil. Impacts and mitigation measures are described above except that silvicultural applications are not tilled into the ground. Biosolids applications avoid periods of heavy precipitation, saturated soils, frozen ground or snow to reduce the potential for the biosolids to move beyond the application area.

The regulatory environment described above for eastern Washington agriculture applies to silviculture in western Washington.

Other Potential Biosolids Recycling Sites

Existing Conditions. Soil conditioning projects are most likely to occur in urban or semi rural parts of western Washington such as parks, highway medians, or other previously disturbed or high intensity use areas where a soil amendment would improve the quality of the soils. Soils in the more urban areas are likely to have been heavily modified by past development.

Impacts and Mitigation Measures. In this market, biosolids used would be Class A products, typically compost or Class B products where access can be restricted temporarily. Class A compost is used primarily as a soil amendment in gardens and larger landscaped areas. Potential impacts to earth resources would be beneficial by improving the nutrient value of soils. Any constituents of concern, (e.g. metals), are regulated and levels controlled through monitoring biosolids quality so potential adverse impacts to earth resources through the build up of contaminants is very unlikely.

Air Quality

Eastern and Western Washington Markets (All Markets)

Existing Conditions. Air quality at existing and potential agriculture and silviculture application sites is generally good because these sites are usually located away from urban areas and have minimal concentrations of ambient air pollutants. Activities in agricultural areas are sometimes the source of localized odors associated with livestock management and crop fertilization using organic materials.

Urban or urbanizing areas where biosolids may be applied may have more concentrations of ambient air pollutants and localized odors associated with specific uses.

Impacts and Mitigation Measures. Odors may result from biosolids applications to agricultural and forest lands because numerous organic and inorganic volatile compounds are present in biosolids products, particularly in Class B biosolids.

Class B cake biosolids used in forestry and agricultural applications may emit a musty organic or ammonia-like odor when freshly applied. It diminishes rapidly as the biosolids application dries out or is tilled into the soil. Odor associated with biosolids is very localized and also dissipates quickly with distance.

There is less odor associated with some Class A biosolids products, such as a dried product, than with Class B cake. The application of dried biosolids may be more dusty than the dewatered product when stored or applied. Some Class A products may produce more odor than others and is specific to the technology used in production. However, there are usually no populated areas in the vicinity of the application areas. Therefore, no significant odor impacts are generated by the application of biosolids.

Volatile compounds in biosolids are the source of odors. The more stabilized the biosolids the fewer odor-causing compounds are contained in the product. The use of Class A biosolids, particularly biosolids that have been composted, would reduce odors further.

Applying biosolids to topsoil under predominantly aerobic conditions facilitates the decomposition of odorous compounds while preventing their formation. Most agricultural crops are grown in topsoil that is kept aerobic through tilling, aerating, and other practices. This mitigation measure is already implemented at all eastern Washington agricultural projects.

Water Resources

Eastern Washington Markets

Existing Conditions. The climate in eastern Washington is dry, with annual precipitation at lower elevations less than 20 inches and many areas receiving less than 10 inches per year. Because of these dry conditions many agricultural areas depend on irrigation, although non-irrigated dryland farming does occur. Because of the dry climate, perennial streams and rivers are confined to major valleys, with most smaller drainages carrying only intermittent streams.

The Columbia River downstream from Grand Coulee Dam and the lower portions of major tributaries such as the Yakima, Wenatchee, and Entiat rivers are classified by Ecology as Class A (excellent) waters. The Columbia River water quality has been characterized as high with generally low suspended loads, low nutrient levels, and low levels of microbial contaminants. Several tributaries of the Columbia have lower water quality. The nature of these problems, which include elevated nutrient and microbial levels in part, reflect inputs from adjacent agricultural land uses.

Groundwater under the Columbia Plateau and the Yakima River valley is found within the three principal basalt formations underlying these areas as well as within the sediments (referred to as “overburden” when more than 50 feet thick) that overlie the basalt formations. Depth to groundwater in these areas varies from less than 20 feet to more than 200 feet. About 200,000 acre-feet of water are pumped from the overburden aquifer annually with about 600,000 additional acre-feet pumped from aquifers in the underlying basalt formations. Between 85 and 90 percent of the total water pumped is used for irrigation. Groundwater quality has been characterized as good although levels of some constituents are above state groundwater quality criteria in some areas. For example, nitrogen concentrations in excess of state standards were found in some irrigated areas, and these high concentrations have been attributed to agricultural practices.

Impacts and Mitigation Measures. The federal biosolids regulations (40 CFR 503) and the associated proposed state regulations limit the rate and total amount of biosolids applied to a given site. These best management practices include maintaining buffers between surface waters and biosolids application sites, applying biosolids at agronomic rates to maximize crop uptake of available nutrients in biosolids, maintaining moderate soil pH to limit mobilization of metals, and periodic monitoring to determine actual concentrations of contaminants in soils. These best management practices are intended, in part, to ensure that the quality of receiving waters are not impaired. By implementing these best management practices, no significant adverse impact to surface or ground water quality should occur as a result of application of either Class A or Class B biosolids to agricultural lands.

Western Washington Markets

Existing Conditions. The climate at potential silvicultural sites in western Washington is generally humid, with annual precipitation in excess of 50 inches. Most precipitation occurs during the fall, winter, and spring.

Potential silvicultural sites in western Washington are usually located outside developed areas. Most major drainages (e.g., Tolt River, and three forks of the upper Snoqualmie River) and their tributaries in the vicinity of potential silvicultural sites are designated by the state as Class AA (extraordinary) and have correspondingly good water quality. Observed water quality problems in some areas, including elevated levels of nutrients, suspended solids, or microbes, are usually localized and related to specific adjacent land use activities.

The glacial deposits that underlie many of the potential silvicultural sites in western Washington consist of a layering of permeable strata separated by slowly permeable materials. The permeable strata are typically sources of groundwater, with perched, near-surface groundwater layers found in many areas above the uppermost slowly permeable strata (King County, 1987). There are few recent comprehensive studies of groundwater quality in western Washington; however, groundwater quality appears to be generally good. Groundwater quality problems are, in many cases, the result of misuse or over application of nutrients, pesticides, and feed in agricultural operations, noncompliant landfills, and inadequate or failing domestic septic systems. These problems are unlikely to occur in the forested areas supporting silvicultural activities, and groundwater quality in these areas is probably very good.

Impacts and Mitigation Measures. The discussion of best management practices applicable to the protection of surface and ground waters in eastern Washington also applies to silviculture in western Washington. The high rainfall and typically acidic soils on potential western Washington silvicultural sites makes the potential for transport of contaminants from biosolids application sites to surface waters greater in western Washington than in eastern Washington where the soil is more alkaline and rainfall is significantly less. Prior to application of Class B biosolids, local and state regulations require preparation of a site operations plan and water quality monitoring plan that must be approved by the local health district and the State Department of Ecology. The site operations plan must specify management practices to be used that are based on a site evaluation, tailored to the specific site conditions, and designed in part to minimize impacts to water resources. With implementation of these requirements, impacts to surface and ground waters should not be significant.

There is even less potential for surface or groundwater to be affected by constituents present in Class A biosolids due to the reduction in pathogens achieved by additional processing.

Other Potential Biosolids Recycling Sites

Existing Conditions. Use of biosolids products is likely to occur in areas more urban than those surrounding silvicultural sites. These more urban areas, which are clustered around Puget Sound, have lower precipitation amounts and intensities than do typical silvicultural sites. Annual precipitation amounts in most urbanized areas surrounding Puget Sound are less than 50 inches. These urbanized areas often have existing stormwater systems to control runoff, and topography is typically less severe.

The quality of receiving waters in urbanized areas is usually lower than the quality of receiving waters in areas supporting silviculture. Many drainages in the Seattle metropolitan area are classified by Ecology as A (excellent) or, for some drainages, B (good) or lower. Observed surface water quality problems in many urbanized drainages include high temperatures and low dissolved oxygen, particularly during low-flow periods, and high levels of some contaminants such as fecal coliform bacteria.

Impacts and Mitigation Measures. Use of biosolids for other types of soil amendment projects would probably occur on a smaller, less intensive scale than silviculture or agricultural applications due to the urbanized character of the land. If Class B biosolids were used as a soil amendment, all of the best management practices noted above would be implemented and environmental impacts would not be adverse.

Class A biosolids with low levels of pathogens would have minimal effect on water resources if agronomic rates and other best management practices are followed.

Aesthetics and Land Use

Eastern Washington Markets

Existing Conditions. Potential application sites in eastern Washington are used exclusively for agricultural crops or rangeland. This land is located mostly in areas with little topographic relief--relatively flat areas on the Waterville Plateau and adjoining lands east of the Columbia River or in the Yakima River valley downstream of Union Gap. Apart from agricultural crops, vegetation is sparse, and most potential application sites are very visible from surrounding areas. Land uses on and surrounding potential application sites are primarily agricultural. Few residences or other sensitive land uses occur near potential application sites.

Impacts and Mitigation Measures. Activities associated with biosolids applications are similar to activities associated with other soil amendment procedures. Most eastern Washington agricultural areas also contain few land uses that would be as sensitive to aspects of biosolids application, such as odor. For these reasons, adverse aesthetic impacts would be minimal. Biosolids application can create a richer more fertile appearance to the land, resulting in a beneficial impact.

Land uses in the vicinity of biosolids application sites are primarily agricultural, and biosolids application would be compatible with these uses. All application of biosolids is required to meet federal, state, and local regulations.

There is no distinction between the use of Class A and Class B biosolids with regard to aesthetics and land use.

Western Washington Markets

Existing Conditions. Topographic relief on and in the vicinity of application sites is mostly moderate to substantial. Sites and their surroundings are usually heavily forested, and views of and from sites are limited except where clearings provide territorial vistas or where major highways are present (Mountains to Sound I-90 corridor).

Land use activities on and in the immediate vicinity of potential application sites are primarily associated with forest resource management and some recreation. In most cases, few residences or other potentially sensitive land uses occur near potential application sites.

Impacts and Mitigation Measures. Because of the *relative* low visibility of potential silvicultural sites and the typical lack of nearby sensitive land uses, aesthetic and land use impacts from application of either Class A or Class B biosolids would be minimal. Where biosolids are used to restore previously logged areas or logging roads, the aesthetic appearance of the forested area would be improved through the use of biosolids as it would support revegetation

Other Potential Biosolids Recycling Sites

Existing Conditions. There are projects or programs where biosolids are considered for use in primarily urban and suburban areas. Surrounding land uses could be residential, recreational, commercial, and industrial. In most cases, potential application sites would be visible from surrounding properties.

Impacts and Mitigation Measures. A Class A product, typically compost, or Class B product would be applied, generally as a substitute for fertilizers or other soil amendment products. The typical Class A product is stabilized with little distinguishing odor. Given that the types of activities involved with these applications would occur with other soil amendment products and the biosolids used would probably be indistinguishable from other soil amendment products by adjacent land uses, no significant aesthetic or land use impacts would result. Class B product can be considered for use in areas where site access restrictions can be easily implemented (such as fences installed and areas posted).

Impacts associated with the use of biosolids as a soil amendment can be considered beneficial as it encourages the growth of vegetation in often previously disturbed areas.

Energy

Western and Eastern Washington Markets

No significant energy impacts are expected to result from the recycling of biosolids in western or eastern Washington. Some energy would be saved by a reduction in demand for commercially produced chemical fertilizers, which require energy to manufacture. Energy, primarily diesel fuel would be expended during transportation of biosolids products to the site where they would be used.

No adverse impacts to energy resources are likely to occur as a result of biosolids transport or application. No mitigation measures are necessary.

Environmental Health

Biosolids contain micro-organisms which may include pathogenic bacteria and viruses, trace metals such as zinc, lead and cadmium, and trace amounts of organic compounds. Environmental health issues include human exposure to pathogens, nitrate leaching into groundwater used for human consumption and potentially uptake of trace metals and organic compounds by plants consumed by humans or by animals.

The 503 regulations rank biosolids into two categories based on pathogen content.Biosolids contain micro-organisms which may include pathogenic bacteria, viruses, protozoa, helminths and fungi. Class A biosolids products have significantly lower numbers of pathogens than Class B biosolids products.

All biosolids must meet either Class A or Class B standards before they can be applied to land. Class A biosolids can generally be used on any site and without restrictions as long as metal concentrations are below those mandated by the 503 Regulations. Class B biosolids can be used with temporary public access restrictions.

Like other fertilizers, biosolids contains nitrogen, some of which can become mobile in the soil column (nitrate) if applied at rates that exceed plant requirements for growth. By calculating the appropriate agronomic application rate for the crop, the risk of excess nitrate reaching groundwater is reduced or eliminated. Nitrate is of concern because high levels violate the state drinking water standards.

Eastern Washington Markets

Existing Conditions. At the present time, King County provides biosolids to farmers in Douglas and Yakima counties. There is the potential for this market to increase if sufficient interest exists in the farming community. Farmers in these counties apply Class B biosolids to hops, orchards, grapes, wheat fields and rangeland. These farms lie in agricultural areas of rural counties.

Impacts and Mitigation Measures. Pathogen survival in biosolids-amended soil is influenced by soil temperature, moisture, pH, and the presence of predatory microbes. While the potential exists for many pathogens to be present in biosolids, most are not detected in King County's products through routine monitoring. Several studies designed to detect potential health problems associated with land application of biosolids have shown no evidence of adverse health effects, even in highly exposed individuals or in populations near biosolids recycling areas.

Trace metals are naturally occurring in nearly all soils. Some of these elements may be important micronutrients for plants and some animal species. However, if present in large concentrations, these metals have shown toxic effects on plants, animals, and humans. Specifically, copper and nickel have been shown to commonly have phytotoxic effects; arsenic, mercury, and especially lead and cadmium are of greatest concern on human health. Many trace metals, particularly lead, are not readily mobilized in the soil environment. Others, such as cadmium, can be taken up by plants and therefore have the potential to be ingested either directly by humans and animals or indirectly by humans who eat livestock fed on metal-contaminated vegetation.

The 503 regulations specify strict "ceiling concentrations" on the amounts of these metals that are allowable in biosolids, and biosolids cannot be applied to land if they do not fall within these concentrations. The regulations also specify standards required for unrestricted use.

The final public health consideration is organic compounds. Many organic compounds, most of them synthetic, are discharged into municipal wastewater systems. These compounds usually decompose slowly in the treatment process and often adsorb onto the organic components of biosolids products. The U.S. EPA has identified 11 types of compounds of concern in waste products. All of these chemicals may be toxic; they also tend to accumulate and translocate within the food chain. Examples of these compounds include polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons (PAHs), pesticides, and solvents.

Of the 11 types of organic compounds identified by the U.S. EPA, only PCBs are found in detectable concentrations in King County biosolids. However, the levels of PCB contamination in these products are well below the criteria established by the Department of Ecology and no adverse health effects are likely to result from exposure to biosolids or plants grown in biosolids amended soil.

The following mitigating measures are taken to reduce further or control potential environmental health risks. All of these measures help to minimize human exposures and potential risks associated with biosolids application projects. These measures are discussed below:

- King County's wastewater is treated to significantly reduce pathogenic bacteria and viruses. King County maintains active industrial pretreatment and source control programs which help produce a high quality biosolids by minimizing discharges of metals and organic compounds to the wastewater system. In addition, small business and household hazardous waste programs have also been instituted.

- When applied to land, biosolids are exposed to sunlight (ultraviolet light) and the elements (desiccation, temperature, natural soil microorganisms) which further reduce the number of viable pathogens remaining. Dewatered biosolids dry and stabilize quickly, within days.

- Class B biosolids are isolated from humans because application sites in eastern and western Washington are relatively remote, signs are posted indicating the application of biosolids (and with the duration of public access restrictions) and setbacks (buffers) from residences, roadways, wells and surface waters are established.

- In eastern Washington, inherent site characteristics tend to further isolate biosolids by preventing or retarding the movement of biosolids constituents. These include adequate depth to groundwater, large distance to surface water, adequate soil cation exchange capacity and neutral or nearly neutral soil pH.

- Biosolids are applied at agronomic rates (rates designed to match crop uptake with nitrogen loading and minimize the potential for leaching into groundwater).

- Site soil and groundwater are monitored, as required, to make sure prescribed levels of the constituents in biosolids (e.g. metals) are not exceeded.

Western Washington Markets

Existing Conditions. *Currently, King County's silviculture markets are the forest landowners in the Mountains to Sound Greenway Biosolids Forestry Program-the Weyerhaeuser Company and Washington State Department of Natural Resources. King County applies Class B biosolids at the Weyerhaeuser Snoqualmie Tree Farm and on state forests such as Tiger Mountain and Marckworth State Forest. Other western Washington forest producers have expressed interest in King County biosolids but have not yet used them. Forestry research conducted by the University of Washington at Pack Forest in Pierce County has been ongoing since 1973 and continues to explore issues of interest to present and potential users.*

Impacts and Mitigation Measures. There are few differences between eastern and western Washington regarding potential adverse public health impacts for pathogens, trace metals, and synthetic organics. Generally, silvicultural land application has fewer potential impacts on environmental health because silvicultural products are not directly consumed by humans and are rarely directly consumed by livestock. Further, silvicultural lands are generally managed less intensively than are agricultural properties, thus further reducing potential human exposure to pathogens, metals, and organics.

Mitigation measures for potential environmental health impacts from biosolids application on forestlands are similar to those for agricultural lands. Because forested lands are often used for recreation, additional mitigation measures are utilized. Any forest users will be isolated from biosolids by setbacks/buffers from recreational trails and posting of signs identifying the time public access restrictions are in place.

Other Potential Biosolids Recycling Sites

Biosolids used as a soil amendment for more urban or suburban environments would have similar environmental health impacts and mitigation measures as those described above. Class B biosolids have a greater potential for adverse impacts to environmental health than Class A biosolids and require more restrictive measures to protect the public (fencing and posting information more frequently).

Vegetation

Eastern Washington Markets

Existing Conditions. In eastern Washington, biosolids are applied to soils to grow irrigated and dryland crops such as hops, orchards, and wheat. Biosolids may also be applied to rangeland to improve soil conditions and increase the vegetative cover, primarily native dry grasses.

Impacts and Mitigation Measures. The nutrients and soil conditioning properties associated with the application of biosolids that meet regulatory requirements have been shown to enhance plant growth and vigor. Research has demonstrated both regionally and nationally that plants grown in biosolids amended soil pose no greater health risk than those without.

In addition, livestock cannot be grazed on land where Class B biosolids have been applied until thirty days after the application.

Western Washington Markets

Existing Conditions. Silvicultural applications of biosolids in western Washington are made in the forests of the Puget lowlands and the foothills of the Cascades, primarily in King County. These areas of the state, in their native condition, were dominated by coniferous forest, with Douglas-fir and western hemlock the major species. Almost none of the original forests remain and the landscape is now covered with younger coniferous forests of the same species. These young forests are highly productive and capable of great accumulations of biomass by trees and vegetation under the tree canopy.

The current markets for biosolids in forestry are the Weyerhaeuser Company and the state Department of Natural Resources under the Mountains to Sound Greenway Biosolids Forestry Program. The Weyerhaeuser Company uses biosolids on its Snoqualmie Tree Farm, located north and east of Snoqualmie in eastern King County. The forests on the tree farm are second- and third-growth stands which are actively managed for timber production. They are regularly harvested and replanted. The primary species planted is Douglas-fir (Pseudotsuga menziesii), but plantations also include natural western hemlock (Tsuga heterophylla) and western red cedar (Thuja plicata), with Pacific silver fir (Abies amabilis) and noble fir (Abies procera) in the higher elevations.

The state Department of Natural Resources uses biosolids in King County at Marckworth State Forest, east of Duvall, and Tiger Mountain State Forest near Issaquah. Both state forests are dominated by older second-growth stands of Douglas-fir and hemlock, with some third-growth plantations. Although the state forests have been less intensively managed than the Weyerhaeuser lands, plant communities are generally the same in both ownerships.

Vegetation at all King County biosolids forestry sites is typical of plant communities in the Douglas-fir, hemlock and western red cedar zones. Drier sites typically have a shrub understory of salal, Oregon grape, bracken fern and vine maple with sword fern and salmonberry on more mesic sites. Biosolids are not applied in stands at the wetter end of the moisture gradient, for example, those typified by skunk cabbage or Devil's club. The dry to mesic community types in this zone also contain a variety of herbaceous plants and mosses: twinflower, foamflower, oxalis, trailing blackberry, lady fern and many others. Riparian areas, which are buffered and do not receive biosolids, often contain a mixture of red alder, big leaf maple, western redcedar, salmonberry, and moisture-loving herbs and mosses.

Impacts and Mitigation Measures. The use of biosolids as a soil amendment or fertilizer has the potential to affect plants and plant communities. Biosolids generally condition soils and improve properties that promote crop growth. But a variety of trace elements can be undesirable when they are present in soil at higher concentrations. Biosolids contain low but measurable concentrations of copper and cadmium, which are known to be toxic to plants. However, because biosolids are applied specifically at rates determined to be beneficial, plant toxicity due to trace metals or organics has not been documented. Application of biosolids generally increases plant productivity because of increased nutrient availability and, in some cases, improves soil physical properties. In general, the total nutrient content, as well as the water-holding and nutrient-holding capacities, of soils is increased.

Nitrogen has traditionally been considered the most important nutrient for fertilization because it is needed by plants in greater amounts than phosphorus or potassium. Nitrogen is also the limiting constituent for land application of biosolids, because when excess nitrogen is applied it can result in nitrate leaching through the soil profile and into ground water. Trace elements in biosolids, such as metals and organic chemicals, are not used to determine application rates. EPA's risk assessment models were used to set limits for metals and chemicals in biosolids so that even 100 years of annual applications would still not expose humans or animals to harmful levels of these elements.

Each forest site has a unique prescribed application rate of biosolids. First, uptake requirements of the forest stand are determined by the amount, kind, and vigor of trees and understory vegetation growing on the site. A site that is well-stocked with trees and has a dense understory requires more nitrogen than less vegetated sites. After the nitrogen needs of the stand are determined, the amount of nitrogen available from the biosolids is calculated. The available nitrogen comes from two sources in the biosolids: ammonia, which can be taken up by plants immediately, and organic-N, which must be mineralized to ammonium for plant use. By subtracting the amount of nitrogen that will be lost to the plants (through ammonium volatilization and immobilization in the soil) from the amount of nitrogen that will be available from the soil and biosolids, an appropriate application rate can be designed.

Animals

Eastern and Western Washington Markets

Existing Conditions. Animals that could be subject to adverse impacts associated with the application of biosolids are those that inhabit agricultural and forested areas. These include such large mammals as deer, rabbits, squirrels, mountain beaver, elk and bear and smaller animals may inhabit eastern Washington fields and rangeland or, Western Washington forests, such as mice and voles. Birds may include resident and migratory birds such as hawks, songbirds, Canada geese, and pheasants.

Impacts and Mitigation Measures. The application of biosolids to land can affect wildlife by direct contact or can affect wildlife by alterations in vegetation. Wildlife populations may be affected as a result of the bioaccumulation of metals and trace organics or from vegetative changes caused by the nutrient enrichment from biosolids application. However, the application of biosolids does not appear to affect wildlife populations significantly.

Accumulation of trace metals by wildlife varies, depending on the species, habitat and food source. In general, metal accumulation is low and not harmful to individuals or populations. Concentrations are highest in animals that consume invertebrates directly.

Based on the available studies of biosolids recycling impacts on wildlife, no significant adverse impacts are anticipated as a result of any biosolids applications.

Under the 503 regulations, biosolids cannot be applied on any site where they are likely to *adversely* affect endangered or threatened species. Although it is unlikely that general land application practices would have an adverse affect on these species, King County must document the presence of any of these species when applying for permits for biosolids land applications. No additional mitigation is required.

Transportation

Eastern and Western Washington

Existing Conditions. Biosolids are transported from treatment plants to recycling sites by long-haul trucks capable of 5.8 dry tons per truck. The West Treatment Plant produced a total of 14,069 dry tons of biosolids in 1996. The West Plant is projected to produce approximately 14,331 dry tons for 1997. One-way biosolids truck loads in 1996 totaled 1,613, or approximately 6 loads per working day.[6] Based on biosolids projections for 1997, with King County secondary treatment facilities on line, the total will increase to 2,472 one-way truck loads or approximately 7 trips per working day.

The existing truck route from the West Plant is through Fort Lawton and Discovery Park and along West Government Way, Gilman Avenue West, and 20th Avenue West. At West Dravus Street, the route turns east to 15th Avenue West. The route continues south on 15th Avenue West to Elliott Avenue West, and then Highway 99.

The East Plant produced a total of 10,873 dry tons of biosolids in 1996. East Plant biosolids production was projected at 10,758 dry tons for 1997. One-way biosolids truck loads totaled 1,950 in 1996 (approximately 5.5 trips per day). Based on biosolids projections for 1997, there will be 1,855 annual one-way truck trips (5 trips per day). The existing truck route from the East Plant runs along Oaksdale Avenue S.W. to S.W. Grady Way, and then west along S.W. Grady Way to I-405 and I-5.

In 1994, 43 percent of the biosolids were distributed to Douglas and Yakima Counties for agricultural application. Twenty percent of the biosolids were delivered to PCL/SMI, a privately owned drying facility at the West Treatment Plant. Twenty percent of the biosolids were delivered to Weyerhaeuser Company forestland, and 10 percent of the biosolids were delivered to GroCo Compost. The remaining 7 percent was distributed to State DNR forestland and to other research projects that are administered by Washington State University and the University of Washington.

Impacts and Mitigation Measures. Biosolids production will increase commensurate with wastewater treated as the population in the service area grows. Depending on the service strategy and options selected in the RWSP planning process, the truck trips will be distributed between the two existing treatment plants or three plants if one is sited in the north end. Transportation routes associated with service strategies requiring a third treatment plant are currently unknown.
As a result of the City of Seattle's Department of Construction and Land Use (DCLU) project level permit conditions for the upgrade of the West Treatment Plant, no more than 13 truck loads can be generated by the treatment plant even if it is built out to a maximum capacity of 159 mgd.

---

[6] Biosolids truck trips are calculated as the number of "biosolids loaded" truck trips leaving the treatment plants per day or year. This is how the truck trips were calculated in the DCLU project level permit for the upgrade of the West Treatment Plant (limiting biosolids truck trips to a maximum of 13 per day). Elsewhere in the EIS, truck trips are calculated as "one-way" trips, that is, one empty truck in to a site and one loaded truck leaving the site would constitute 2 truck trips. If this approach were used for to describe transportation impacts in this chapter, truck trip numbers would be doubled to represent one empty truck and one loaded truck. All of the projected loaded biosolids truck trips described in this chapter (10) meet the permit conditions (maximum of 13 loaded trucks per day).

NOTE

Chapter 11 is as it appeared in the Draft EIS (May 1997) for the RWSP. References to the RWSP in Chapter 11 are to the draft Plan issued at the same time as the Draft EIS. Projections in this chapter are the ones used for the original four service strategies.

NOTE: This impact assessment is based on the Service Strategies as presented in the Draft RWSP. See Part I of this FEIS for revised strategy descriptions and analysis.

CHAPTER 11

CONSTRUCTION IMPACTS AND MITIGATION MEASURES

INTRODUCTION

This chapter describes impacts associated with the construction of facilities proposed in the RWSP. These are typically temporary, short-term impacts. They can include such impacts as temporary traffic congestion, reduced access to properties, noise, dust, and erosion and sedimentation. These impacts are discussed in this chapter along with mitigation measures that could be used to minimize them.

The chapter begins with a discussion of the methods typically used in the construction of wastewater facilities. This discussion provides background for the following analysis of environmental considerations, which are organized by elements of the environment. Each element begins with a discussion of impacts common to all service strategies and then describes the impacts of specific facilities.

The facilities proposed in the RWSP would be constructed in phases over relatively long periods of time. This means that construction would occur incrementally. Where possible, the impacts of construction are described in terms of each development phase by facility. However, in cases where overall environmental impacts are small or are not easily quantified, the discussion is focused on the effects of constructing the entire facility, regardless of phasing. As with operational impacts, construction impacts will be analyzed in greater detail during project-level SEPA analysis when specific alignments or sites are under consideration and design details are better developed.

GENERAL CONSTRUCTION METHODS

Treatment Plants, Pumping and Regulator Stations, Storage Tanks

Most of the proposed facilities are underground, requiring large-scale excavation. Because existing treatment plants and potential new treatment and conveyance facilities are located at relatively low elevations, it is likely that excavation will extend below the groundwater table, requiring dewatering to achieve and maintain dry foundation excavations. The excavation depth (up to 50 feet for some types of facilities) requires shoring to support the sides.

Pipelines

The quantities of earth excavated for conveyance systems depend on pipe size, depth, and type of flow (i.e., force main vs. gravity main). Pipelines are usually constructed using the “cut-and-cover” method, where a length of trench is excavated, the pipe is placed and connected to the previous section, and the trench is backfilled with material excavated from the trench, if suitable, or with clean imported materials. Cut-and-cover construction typically involves deep excavations requiring a support system (e.g., sheeting and shoring or use of a trench box) to prevent soils from slumping into the trench and to maintain a narrow construction corridor. After excavation, the area would be restored to its previous condition (e.g., paved areas would be repaved and landscaped areas would be replanted).

So-called trenchless technologies are alternatives to cut-and-cover pipe installation. These include several methods, such as boring, jacking, tunneling, and microtunneling to install a portion or all sections of underground pipe, while minimizing surface disruption.

Jacking and tunneling provide a continuous lining as the tunnel advances, reducing or avoiding above-ground disturbance. Pipes can be installed under highways and railways without interrupting services and can be placed under environmentally sensitive areas without disturbing the site. All underground construction methods reduce disruption by confining surface work to a few shafts or portals.

The tunnel boring machine (TBM) is practical only with larger-diameter pipes (10 feet or more). To use this method, a large working portal area is prepared at one end of the tunnel for staging of equipment and removal of spoils. A retaining wall is constructed to support the soils above the tunnel at the portal and soils are excavated down to the design elevation of the tunnel. A digging apparatus at the front of the tunnel shield deposits the spoils onto a conveyor belt, which moves them to the rear of the machine where a rail cart collects and transports them back to the portal. From the working portal, trucks haul the spoils away to an approved disposal site. As the machine moves forward, supports are placed behind to support the excavation. When the boring machine has completed digging the tunnel length, a hole (the receiving portal) is dug at the end, and the machine is removed. Long tunnels may required access/air shafts to the surface located at specific distances along the routes.

The shields and TBMs used at the leading end of the tunnel are virtually the same for jacking; the only difference is in the way the tunnel is lined. Jacking is often used for installing short, straight lengths of pipe (for example to cross under a road or railroad tracks). A pit is dug at either end of the section and a hydraulic jack is placed in the drive pit at one end. The jack forces sections of pipe casing into the hole formed by the cutting shield and an auger is used to remove soil within the casing. Spoils are moved from the jacking end. When the casing is placed, the sewer pipe is placed inside it and the annular space is filled with light concrete mix.

Microtunneling is pipejacking of smaller-diameter pipes that are too small for workers to enter, and is used to install pipes by remote control.

Directional drilling can be used for smaller-pressure pipe diameters where the segment is not straight. For example, it is often used for placing a siphon under a water body. Directional drilling uses a drilling head or auger rather than a tunneling machine or cutting shield to drill a hole and remove the spoils. Once the drill is removed, the pipe is inserted into the hole.

WATER RESOURCES

Impacts Common to All Service Strategies

Treatment, Conveyance, and CSO Projects. Construction impacts on water resources from all four of the service strategies would occur during implementation of the following: expansion of the treatment plants and installation of major conveyance lines including pump stations, CSO conveyance lines, CSO storage tanks, deep tunnels, and associated facilities. Short-term construction impacts would occur periodically over the life of the project, as facilities are developed in various locations. For this analysis, cumulative water quality impacts are considered for each facility, regardless of whether phased construction is planned.

Construction of treatment plants, pump stations, pipelines, and other wastewater facilities on land could affect the quality of those receiving waters at or near construction sites. Construction activities could include clearing vegetation, removing soil, importing fill, and the physical, chemical, and biochemical changes associated with bulldozing, grading, and soil compaction. These activities can alter a site's ability to absorb and retain water, which can cause erosion and sediment loading to surface waters. Increased sediment loading could increase nutrient concentrations, harm benthic biota, reduce fish habitat, and, depending on the organic content of suspended sediment, decrease dissolved oxygen levels in receiving waters. In addition, construction runoff may include debris from demolition such as lime and cement, petroleum fuels, and construction chemicals. Accidental spills of petrochemicals and construction chemicals could also occur, although there is little likelihood of such spills because of normal precautions taken to prevent them. (See Mitigation Measures section for information on construction best management practices.)

Construction activities within riparian and wetland zones may cause the destruction or alteration of the site's hydrology, vegetation, and hydric soils. Impacts to wetlands and riparian corridors may impair water quality by influencing varying degrees of one or more of their hydrologic, edaphic (physical and chemical characteristics of soil), and biotic (living organisms) functions. Loss of and/or reduction of wetlands and riparian corridors would cause erosion, decreased ability to store storm and flood waters, decreased ability to recharge groundwater, and reduced ability to filter and purify surface water.

The placement of pipelines across rivers and streams could have similar impacts to riparian corridors and fisheries (although open "cut-and-cover" crossing of streams would be avoided wherever possible). These impacts include increasing the amount of sediment suspended in the water during construction through erosion and the discharge of pumped groundwater. Contamination of surface water and groundwater by construction-related chemicals is another potential impact. Erosion of stream banks and subsequent sedimentation in stream channels can also harm both rearing and spawning habitat of fish. Clearing riparian vegetation from stream banks can increase water temperatures, alter the recruitment of large woody debris into the channel for use as fish cover, and change substrate composition.

In-water construction activities such as trench excavation and placement of bedding material for outfalls or conveyance pipelines would have short-term impacts on water quality. Installation of outfall pipes in Puget Sound and conveyance lines along the shorelines of Lake Washington would require in-water construction. Excavation of pipe trenches and sidecasting dredge spoils would release sediments into the water column. These sediments would temporarily increase turbidity and would decrease light transmission in the water near excavation sites. Substances in the excavated sediment could also be resuspended in the water. These could include nutrients, organic materials, pollutants, and sulfides (which would exert an oxygen demand in the water column).

The relative magnitude of water quality impacts on both freshwater and marine water bodies would vary, depending on the extent or area of construction and proximity to receiving water bodies. Other construction activities, such as installation of regulators and pumps, and tunnel access roads, are considered to have minor water quality impacts and are not addressed further here.

I/I Reduction Projects. Direct impacts of I/I reduction activities could include temporary increases in traffic congestion in some locations because of construction work in streets. The extent and duration of activities in streets would be kept to a minimum to keep these impacts as small as possible. Trenchless technologies (e.g., lining, grouting) for I/I control would be used wherever feasible. These approaches typically involve construction equipment mainly at manholes, which would minimize congestion between manholes.

Construction equipment, particularly pumps used to route sewage flows around construction areas, would produce noise. In most cases, any resulting noise impacts would be of short duration for particular noise receptors, given the short duration of most I/I control activities along individual sections of sewer pipe. Where necessary, noise mitigation measures would be implemented. These could include placing pumps in boxes or behind noise barriers. For small pipes, another approach might be to place pumps in manholes. Use of electric rather than gasoline-powered pumps would also help reduce noise levels.

Temporary minor erosion and sedimentation could occur if trenches are dug or other excavation is carried out. Best management practices would be used to minimize these impacts (e.g., silt fencing, street sweeping, straw bales, etc.). The trenchless technologies mentioned above would also reduce these impacts.

Service Strategy 1

Treatment Facilities

SS1 involves completion of the West Plant to a capacity of 159 mgd and expansion of the East Plant to a capacity of 235 mgd. Based on preliminary calculations about 1.4 acres would be affected by construction at the West Plant. Expansion at the East Plant would affect about 46 acres. The West Plant is located near Puget Sound. Part of the East Plant's eastern boundary adjoins Springbrook Creek and the Green/Duwamish River is located a few hundred feet west of the plant. Water quality impacts from stormwater runoff at the construction sites during expansion of the plants would vary. Although there is a potential for runoff to occur, best management practices will be used during construction to avoid or minimze runoff. Localized sedimentation impacts to intertidal and subtidal habitat could occur in the West Point area if stormwater runoff was not sufficiently treated prior to discharge. Similarly, localized sedimentation impacts could occur in waters near the East Plant if best management practices were not followed.

Conveyance Facilities

Major conveyance line installation would result in stormwater runoff, discharge of turbid water from dewatering trench excavations, crossing of stream channels and wetlands, and accidental spills of hydrocarbons and construction chemicals. Individual conveyance lines would generally disturb between 5 and 9 acres. The exception would be the parallel Eastside interceptor, which could affect water quality in a number if creeks, (Lake Washington, Juanita Creek, Forbes Creek, Yarrow Bay tributaries, Kelsey Creek, Coal Creek, May Creek, the Cedar River, and Springbrook Creek) disturbing an estimated 31 acres.

CSO Facilities

CSO conveyance lines would be installed in a variety of locations in West Service Area. Excavation of contaminated sediments could occur in several areas, and there is the potential for stormwater runoff from this material to reach receiving waters. CSO conveyance line impacts are based on calculations of acreage for a 20-foot-wide disturbed area along the length of the pipeline. Given the relatively short length of these CSO conveyances, the overall acreage disturbed is a minor amount (0.5 to 3.0 acres).

CSO storage tanks and, in some cases, primary treatment facilities would be installed at a variety of sites in conjunction with CSO conveyance improvements. Each of these facilities would disturb about an acre

Service Strategy 2

Treatment Facilities

At the West Plant, impacts of SS2 would be similar to those of SS1. Impacts at the East Plant would be somewhat less than in SS1, based on an estimated 15 acres of disturbance. Construction of a new 65-mgd North Plant would disturb a total of 16 to 21 acres. Potential receiving waters for construction-related stormwater runoff would vary, depending on the location of the plant, but could include Puget Sound, Swamp Creek, the Sammamish River, and Lake Washington, or other waterbodies in Snohomish County.

Conveyance Facilities

Major conveyance facility impacts would generally be similar to those of SS1. Construction of the parallel Eastside Interceptor would not be required under this service strategy. The new outfall for the North Plant could result in water quality impacts to receiving waters depending on the plant location and outfall alignment.

CSO Facilities

CSO facility impacts would be similar to those described under SS1.

Service Strategy 3

Treatment Facilities

SS3 would not involve expanding the West Plant. Impacts to water resources resulting from the East Plant expansion would be the same as for SS2. Construction of a new 89-mgd North Plant would disturb approximately 28 acres. Similar to SS2, potential impacts on receiving waters would vary, based on the site chosen.

Conveyance Facilities

Impacts of conveyance facilities would be similar to those identified for SS2.

CSO Facilities

Impacts of CSO facilities would be similar to those identified for SS1 and SS2.

Service Strategy 4

Treatment Facilities

Impacts of SS4 on the West and East Plants would be the same as for SS1.

Conveyance Facilities

Impacts would be similar to those of SS1. In general, construction of the deep tunnel would occur primarily underground, with surface disturbance limited to areas around tunnel portals and access shafts.

CSO Facilities

Construction impacts of CSO storage tank and conveyance facilities would be similar to those of SS1. One of the functions of the deep tunnel proposed under this service strategy is to store, convey and treat CSOs. The construction impacts of the tunnel are described in the preceding section.

Mitigation Measures

Potential adverse impacts to water quality resulting from construction of all the wastewater facilities and conveyances proposed under the RWSP can be avoided or minimized through careful design, proper construction practices, and maintenance of the stormwater facilities. Based on the identification of environmentally sensitive areas in the King County service area, efforts have been focused on avoidance of impacts. Where avoidance is not possible, impacts will be minimized to the greatest extent possible. Whenever unavoidable adverse impacts occur, the use of compensatory mitigation is appropriate. The following mitigating measures are proposed to avoid, minimize, and compensate for these impacts. Impact avoidance strategies include:

- Construction activities would comply with the most recent *King County Surface Water Design Manual* (King County, 1996) guidelines for erosion and sediment control features and procedures. This construction work should also be conducted in accordance with the Ecology guidelines.
- Best management practices would be followed to avoid accidental spills of fuel oils, chemicals, concrete leachate, and sediments into aquatic habitats. These practices include proper storage, use, and cleanup of all construction-related chemicals. Erosion and sediment control features may include silt fences, straw bales, hydroseeding of exposed soils, and mulching.
- Routes would be carefully selected to avoid sensitive riparian and wetland areas.

Impact minimization strategies include:

- Minimize construction impacts on receiving water bodies by implementing an erosion and sediment control plan and following best management practices.
- Limit vegetation clearing to what is necessary to construct the wastewater facilities. Only trees and shrubs within the limits of construction and tree limbs extending into the clearance area should be removed. Using and maintaining vegetative cover appropriately during construction will minimize erosion of excavated soil and sediment loading to surface waters.
- Limit grading, excavation, and filling activities to what is necessary to construct the wastewater facilities. Limit the size of all excavations within the 100-year floodway of streams, lakes, and marine waters, and perform this work during summer low flows.
- Construct stream and river crossings during low-flow periods in accordance with recommendations from the Washington Department of Fish and Wildlife (WDFW) and other agencies to minimize impacts on salmonids and other fish and invertebrate species.
- Limit impacts from in-water construction by depositing excavated sediments in barges for on-land disposal or in near-shore diked areas rather than sidecasting them. Such measures could be required if the excavated sediments were contaminated. If they were contaminated and had to be hauled offsite, clean fill material would be used to refill the trench around the pipe.
- Avoid using open, "cut-and-cover" construction in crossing water bodies wherever possible; use tunneling or other "trenchless technology" construction methods (especially in areas with contaminated sediments) to minimize sediment disturbance.
- Use sedimentation basins to reduce discharge of water high in suspended solids.
- Use appropriate "housekeeping" procedures for handling chemicals and petroleum products during construction.

- For outfalls, minimize water quality impacts by selecting an outfall site with strong currents, favorable circulation, gentle slopes and suitable foundation material. The first two factors would reduce long-term operational impacts, while the last two would reduce short-term construction impacts.

Compensatory mitigation for unavoidable adverse construction impacts includes:

- Revegetation of disturbed areas with native trees, shrubs, and herbaceous plants. This would compensate for impacts and minimize colonization by invasive species. A diverse mixture of vegetation in three canopy layers would stabilize soils, minimize erosion, and eventually shade aquatic habitats. Sediment control features would be retained until the plants cover the site.

Unavoidable Adverse Impacts

Construction of proposed treatment, conveyance, and CSO facilities for the selected service strategy would result in some level of erosion and sedimentation into nearby receiving waters. If construction best management practices are employed, impacts are not expected to result in long-term impairment of water resources or significant adverse impacts to water quality.

BIOLOGICAL RESOURCES

Impacts Common to All Facilities and Service Strategies

Because of the urbanized condition of much of the service area, construction of most facilities would have no large-scale impacts to biological resources. Most pipelines and tunnels would be constructed in existing road rights-of-way. The East and West treatment plant expansions and CSO storage facilities would be constructed in areas that are already developed or have been cleared of native vegetation. Impacts to vegetation, fish, or wildlife are most likely to be isolated to where facilities disturb patches of vegetation in public parks or greenbelts, or where facilities are located in or across shorelines, streams, and wetlands. A possible exception would be construction of a new North Plant. Impacts to biological resources would depend on plant locations, which could include, for example, undeveloped and/or wooded areas for an inland site.

Constructing facilities along marine shorelines could potentially result in adverse impacts to both marine habitat and biota (plants and animals), depending on the specific locations. Adverse impacts could result from direct or indirect disruption of habitat. Direct impacts to marine habitat and biota could result from trenching through the intertidal zone, which can displace benthic plants and animals, or noise from construction equipment, which can temporarily disturb or displace wildlife. Indirect short-term construction impacts could result from increased erosion and sedimentation in shoreline areas, as well as increased turbidity during in-water construction. The degree of impact is related primarily to the location of the facility, the construction method used, and whether pipeline is laid on the bottom or trenched below the surface of the substrate. The impacts of sidecasting excavated material could be avoided by storage on barges for later use as backfill or land disposal. Benthic populations are usually able to recolonize an impacted area after construction and return to pre-construction levels in a short period of time.

Construction in the marine environment could disrupt eelgrass beds in the nearshore area if they are located in the outfall alignment. If this aquatic habitat cannot be avoided, mitigation measures such as replanting the area after construction would be implemented, as required by jurisdictional regulatory agencies.

As described in the Water Resource section above, impacts to fresh water resources could also occur where pipelines cross streams or disturb wetlands (although open, “cut-and-cover” construction would be avoided wherever possible). Increased sedimentation could disrupt or destroy spawning habitat and adversely impact freshwater fisheries resources without appropriate mitigation. Erosion and sedimentation control measures include planning construction activities during less sensitive times (i.e. summer low flows, typically July 15 to September 30) and providing physical structures such as silt fences and retention basins to control sedimentation and runoff. Such measures would be consistent with statutory requirements and guidelines for WDFW Hydraulic Project Approvals (HPAs). Riparian corridors would be preserved to provide streamside cover and maintain the integrity of stream banks. Corridor widths would be maintained in accordance with HPA requirements and pertinent zoning ordinances.

Construction activities have the potential to disturb bald eagles and great blue heron if these species are located in proximity to construction projects. These species may alter perching and foraging habitats during the construction period. However, experience at the West and East plants indicates that these species have developed some tolerance of human activity including construction. While some alteration of behavior may occur, significant adverse impacts on these species are unlikely.

Conveyance pipelines that flow by gravity or a gravity-and-pumping system are often located in lowland areas and may result in disturbance to wetlands. Disturbance of wetlands is regulated though both local ordinances and federal permits. Disturbance of wetlands or wetland buffers in many cases can be avoided through modification of facility design and location. Where disturbance is unavoidable, compensatory mitigation through wetland enhancement or creation is often required.

West Service Area

West Plant (SS1, SS2, SS4)

Expansion of the West Plant would occur within the existing DCLU permitted footprint of the plant. The total area required for expansion of the West Plant is estimated to be about 1.4 acres; no significant impacts on plant and animal resources during plant expansion are expected. Because the West Plant site has been altered and designed for potential future expansion, the areas where construction of additional facilities would take place do not provide important habitat for wildlife. Construction activities may, however, disrupt mitigation areas developed as part of the most recent plant upgrade. Depending on construction methods, beach and bluff plantings could be disturbed. Elimination of an onsite wetland, created as part of the prior mitigation plan, would occur. Additional mitigation, such as onsite or offsite wetland creation, would be required. Potential impacts are more likely to occur during construction of the new aeration tanks at the northeast corner of the site where access is more limited.

Impacts on sensitive species during construction are not anticipated. During the recent construction activities at the plant, the eagles that nest in Discovery Park above the treatment plant have continued to breed and rear their young and do not appear to have been displaced by construction noise. Because of the relatively small scale of the proposed expansion, no impacts on nesting eagles are expected.

Parallel Kenmore Interceptor (SS1, SS2)

If the parallel interceptor were constructed within Lake Washington, in-water dredging activities would result in direct disturbance to or displacement of a number of macrophytic plant species, including milfoil, present to depths of about 20 feet. Turbidity also could result in short-term impacts to macrophytic vegetation and may result in a decrease of light and a temporary decrease in photosynthesis and plant growth. Release of nutrients in sediments may temporarily result in increased growth of nuisance macrophytes such as milfoil after construction is completed. The connection of the new parallel Kenmore Interceptor to the Matthews Park Pump Station would be made offshore; therefore, no impacts to the riparian habitat along Thornton Creek are expected.

Dredging for the pipeline would result in the direct loss of macrophytes and benthic invertebrates along the trenching corridor. This situation would result in a temporary reduction in prey organisms for finfish. Turbidity could also affect migrating salmonids and siltation could adversely affect spawning and rearing areas. The magnitude of impacts would depend on the timing of construction. Adherence to WDFW closure periods would substantially reduce potential impacts to fisheries in the lake.

Other than the shoreline of Lake Washington, which is a lacustrine wetland, in-water construction of the Kenmore Interceptor would not disturb any other major wetlands along the pipeline route. A small, seasonally flooded wetland is located just west of Tracy Owen Park in Kenmore, but this wetland is not likely to be affected.

There would be fewer impacts to biological resources if the pipeline were routed along an inland corridor. Two potential routes include the Lake Sammamish/Burke-Gilman Trail or a route along Bothell Way N.E. An inland route would most likely be located in an existing road or trail right-of-way, minimizing disturbance to any wetlands, vegetation, or wildlife habitat. Microtunneling would minimize open-cut excavation and reduce the potential for erosion. Minor increases in turbidity and sedimentation could occur where the pipeline crossed streams, but these impacts would be temporary and highly localized.

Deep Tunnel, Kenmore To Duwamish (SS4)

Impacts on biological resources from construction of the deep tunnel would be primarily related to activities at the tunnel portals and intermediate construction portals. The tunnel would typically be about 100 feet below grade and, consequently, would not result in the types of impacts associated with conventional cut-and-cover construction techniques. Although specific locations have yet to be determined, portals and drop shafts would likely be located in fully developed, urbanized locations where habitat is limited and the wildlife species present have developed a high tolerance for human activity (e.g., University Regulator, Kingdome area, Duwamish Pump Station). In some locations, construction may occur in the vicinity of shoreline areas, undeveloped greenbelts, small wetland areas, and/or parks. Depending on specific construction sites, portions of these habitats may be temporarily lost. Noise, dust, lighting, and activity from construction could temporarily disrupt wildlife using these areas.

East Service Area

East Plant (SS1, SS2, SS3, SS4)

The most recent construction activities at the East Plant will increase plant capacity to 115 mgd. The proposed expansion of this plant would occur on 46 acres of the 85-acre site located within the existing boundary (38 acres for the initial expansion to 172 mgd and 8 acres for the subsequent expansion to 235 mgd). Some of the new facilities would be constructed on a portion of the plant site that is already developed; no impacts would occur on this portion of the project. Undeveloped areas consist of open, grassy, and landscaped areas with plantings of trees, shrubs, and groundcover. These areas are used by waterfowl (including Canada goose and American widgeon) typically during non-breeding seasons, because flightless offspring cannot easily access the site. With the exception of an enhanced wetland area in the extreme northern portion of the site, wildlife habitat at the treatment plant site is very limited. These wetlands were enhanced during the most recent plant expansion.

The Black River great blue heron rookery is located approximately 1,350 north of the plant boundary, several hundred feet beyond the buffer areas recommended by state and federal agencies. Although occupied in the past, it is unknown if herons are present this season. The herons have developed a tolerance for human activity in the area, including rail traffic, quarry activity, local vehicular traffic, I-405, and air traffic. While construction at the plant would temporarily increase the level of human activity in the area, it is not expected to be at a scale above existing activity, so that significant impacts on herons would not occur.

Eastside Interceptor (SS1)

The proposed Eastside Interceptor (ESI) would generally parallel the existing Eastside Interceptor and would be constructed using a combination of open-cut and tunneling methods. Impacts on biological resources are most likely to occur at stream crossings and in wetland areas. The route of the new, parallel Eastside Interceptor would cross about 12 streams that provide some level of support for migratory salmonids and resident fish. Temporary increases in sedimentation and some disturbance to riparian vegetation could occur where the pipeline crossed these streams. Several large riparian/wetland complexes are also located in the vicinity of the proposed pipeline corridor. The nature and magnitude of impacts in these locations would depend on construction methods, duration, timing, and adherence to best management practices. In some locations, it is likely that stream and wetland mitigation would be required to compensate for temporary disruption and/or loss of resources along the pipeline corridor.

Eastside Interceptor (SS2, SS3, SS4)

Smaller portions of the Eastside Interceptor would be paralleled under these service strategies, resulting in substantially less construction (approximately 1 mile versus approximately 15 miles under SS1). Construction would occur in the vicinity of the Mercer Slough in Bellevue, and the Cedar River in Renton. Depending on the construction methods used, temporary increases in sedimentation and some disturbance to riparian vegetation could occur where the pipeline crosses these streams.

Effluent Transfer System (SS1, SS2, SS3, SS4)

Impacts associated with the 20-mg storage facility that would be built under SS1, SS2, SS3, and SS4 would be similar to those associated with East Plant expansion because the storage facility would likely be located on the East Plant site.

Construction of a third outfall (SS1, SS2 and SS3) would result in temporary impacts to marine habitat and biota in the Duwamish Head area. The shoreline consists of riprap or bulkhead in the backshore and upper intertidal zones, extensive sand beach, and eelgrass in the lower intertidal and subtidal zones. Eelgrass occurs in a band from Duwamish Head to near Alki Point, generally between 0 and -15 MLLW (mean lower low water). Many small invertebrates inhabit eelgrass habitat and provide a food source for larger invertebrates and finfish. Eelgrass and associated invertebrates would be lost along the outfall corridor, but could recolonize the area after construction is completed. With avoidance of construction during outmigration periods, impacts to juvenile salmonids are not expected to occur. Mitigation could also be required for the loss of eelgrass and geoducks (see the Inter-Agency Permit Streamlining Document, *Shellfish and Domestic Wastewater Discharge Outfall Projects)*. Potentially affected upland areas are highly developed and provide limited wildlife habitat.

North Service Area

North Plant (SS2, SS3)

Although specific sites for a North Plant have not been identified, some possible areas include lowlands near the north end of Lake Washington and lowland or Puget Sound shoreline areas in north King or south Snohomish Counties. Approximately 25 to 45 acres would be needed for a site that would accommodate a 65- to 89-mgd wastewater treatment facility and a landscape buffer. The major lowland areas near the county boundary are the valleys of the Sammamish River, Little Bear Creek, North Creek, and Swamp Creek. There are large, diverse wetland areas in these valleys, which are located within floodplains or have otherwise been difficult to develop. If the North Plant site included wetlands, some wetlands could be lost through site development and would require permitting and mitigation in accordance with local, state, and federal requirements.

The Sammamish River, North Creek, and Swamp Creek support important migratory and resident fish populations, including chinook, coho, and sockeye salmon, steelhead trout, and cutthroat trout. Depending on location of a North Plant, there is some risk that construction activities would introduce contaminants to major streams or tributaries, which could, in turn, affect resident and migratory fish species and critical spawning habitats. The degree of adverse impact to biological resources would depend on location and timing of construction activities, and the degree to which contractors followed best management practices.

Each of the streams and associated natural areas provide support for a wide variety of wildlife species including the bald eagle (state and federal threatened species) and great blue heron. Potential impacts on these species would be assessed as part of subsequent site selection and environmental investigations.

Depending on the specific location, there may be impacts on eelgrass from construction of the North Plant outfall. These impacts would occur primarily in the +1 foot to -15 foot MLLW elevation. Intertidal and shallow subtidal areas are primarily sandy flats with scattered concentrations of eelgrass and lesser amounts of kelp where substrate is suitable. Detailed surveys of the benthic community along the north King/south Snohomish County shoreline have not been conducted. However this community is thought to be similar to that found at Richmond Beach. Generally, the benthic community in the Richmond Beach area is dominated by polychaetes and mollusks, with relatively fewer species of crustacea. Intertidal and subtidal areas support a number of species of clams, including geoduck and Dungeness crab, which could be directly displaced or disturbed by outfall construction. Shoreline areas include a variety of shorebirds, waterfowl, raptors, and seabirds that would likely be temporarily displaced by construction.

During outfall construction, turbidity and siltation associated with pipe installation have the potential to adversely affect fisheries resources. However, the proposed outfall would not be located near important salmonid streams. Construction is likely to be restricted during the salmon outmigration period, roughly March 15 to June 15. Geoducks along the outfall corridor are likely to be lost, although surveys have shown that concentrations in this general area of Puget Sound are low. Additional geoduck surveys would be required in order to comply with Ecology's Interagency Streamlining Agreement.

Conveyance Facilities

There are a number of important aquatic resources and wetlands along the corridor of proposed routes of the Woodinville-to-Bothell pipeline. Subsurface tunneling as a construction method would minimize adverse impacts to these resources. Impacts from North Plant conveyance facilities would depend on its location; potential affected resources for an inland site could include Swamp Creek, North Creek, Bear Creek, the Sammamish River, and associated wetlands. See the Biological Resources and Impacts Common to All Facilities sections for a discussion of impacts associated with stream crossings.

CSO Facilities

In general, areas proposed for CSO facilities are developed, and construction activities would probably not result in significant disruption of biological resources. A possible exception would be the cormorants that roost on the large poplars that line the Ship Canal near Seattle Pacific University. These birds may be temporarily disturbed during construction at sites along the canal; however, there are no nests in the area and the birds appear to have a high level of tolerance for waterfront activities such as boat traffic, ship repair, and ship building. Some open excavation would also likely be required, but construction would largely occur in existing road rights-of-way and would not result in any significant disturbance to biological resources.

Mitigation Measures

- Pipeline alignments would be designed to minimize destruction of existing vegetation along conveyance routes and at facility sites. When disturbance could not be avoided, sites would be revegetated as soon as possible after construction.

- Wherever possible, pipelines would be located to avoid sensitive marine vegetation such as eelgrass and kelp. Trenchless technology and/or sheetpiling methods can be employed to minimize the amount of eelgrass lost. King County would coordinate with the WDFW regarding construction methods and the best measures for site restoration. Site restoration would include backfill of sediments, similar to those removed, and possible replanting of the disturbed area.

- As far as possible, excavation and other site work at facilities and along conveyance routes would be scheduled during the dry season to avoid potential erosion and sedimentation of natural areas. When wet season construction could not be avoided, sedimentation control measures, including hay bales, sedimentation basins, silt fences, sprinkling, and street cleaning would be employed at particular sites.

- Construction in streams and nearshore areas would not take place during designated fishery closure periods to protect migratory and resident fishery resources. Closure periods would be established by the WDFW.

- Open, "cut-and-cover" construction in crossing water bodies would be avoided wherever possible through use of tunneling or other "trenchless technology" construction methods, especially in areas with contaminated sediments. This would minimize sediment disturbance.

- During construction, King County staff and contractors would coordinate with appropriate Point Elliott Treaty Tribes to reduce the potential for disruption of tribal commercial fisheries in Lake Washington, the Lake Washington Ship Canal, the Duwamish River, and Elliott Bay.

- Where possible, construction site drainage would be routed through grass-lined swales or treated through other mechanisms to reduce silt loading to nearby wetlands and streams.

- Wetland mitigation plans would be developed for those wetland areas that cannot be avoided during construction. Mitigation would be provided at suitable sites and ratios to comply with local jurisdictional requirements. Mitigation plans would be negotiated with and permitted by the U.S. Army Corps of Engineers, Ecology, WDFW, and local jurisdictions.

- King County would work with resource agencies to develop specific site restoration methods for affected sensitive areas. The County would also develop appropriate mitigation measures for potential loss of wildlife or habitat during construction. These measures could include replacing lost habitat onsite, providing or restoring habitat offsite, or contributing to the restoration or enhancement of other species habitat.

- Use of heavy equipment on shorelines or in other sensitive areas would be minimized.

- Material excavated from streams, lake bottoms, and nearshore marine areas as part of pipeline trenching operations would not be sidecast. The material would be stored and used for backfill of the trench as appropriate. Contaminated material would be disposed of at approved upland or confined sites.

- Vegetated areas disturbed during construction would be replanted, if possible, to restore habitat and provide noise and visual buffers for wildlife.

- Construction would be timed to avoid and/or minimize impacts to sensitive species during breeding seasons.

- Refer to the Water Resources section for additional mitigation measures.

Unavoidable Adverse Impacts

Temporary displacement or disturbance to vegetation, wildlife, or fish in the direct path or vicinity of construction activities is largely unavoidable; however, these would be short-term impacts and would be appropriately mitigated.

LAND AND SHORELINE USE

Impacts Common to All Facilities and Service Strategies

Construction-related impacts would be temporary and primarily would affect areas on and immediately adjacent to construction sites. Duration of construction would vary from 5 to 7 years for a new treatment plant to only a few weeks for pipeline placement in a specific local area. Pumping and regulator stations would take about one and one-half years to construct. Tunnel construction portals would operate for several months, depending on the size and length of the tunneled section.

Temporary construction activity for any of these proposed facilities may be somewhat incompatible with surrounding land uses because of noise, dust, and traffic. These impacts are discussed in the Environmental Health (Noise) and Other Elements of the Environment (Air Quality and Transportation) sections. In addition, the Recreation section discusses impacts on recreational facilities.

Construction easements from property owners would be required for many of the proposed conveyances and CSO facilities. Utilities easements are required for pipeline construction. Pipelines are, most often, buried under streets where they are clearly allowed in virtually all cases.

If construction occurs in shoreline environments, staging areas would be located away from the shoreline, when feasible, to minimize disruption to beach access. If public access to beaches is disrupted, staging of construction may allow for beach access in other locations. Refer to the Other Elements of the Environment (Recreation) section for a discussion of recreational impacts associated with bicycle paths, pedestrian trails, etc.

Mitigation Measures

Mitigation measures would be selected during the design phase of the proposed facilities to reduce odor and noise impacts to the neighboring properties. Measures to lessen any disruption of recreational activities near construction areas include standard best management practices and timing of construction. For construction in shoreline districts, such as for an outfall, King County would apply for project-specific shoreline permits, when necessary, and would comply with specific permit provisions. King County would restore disturbed areas after construction in compliance with local jurisdictional requirements. Additional measures to minimize construction impacts are discussed in the Environmental Health (Noise) and Other Elements of the Environment (Air Quality, Aesthetics, Recreation and Transportation) sections.

Unavoidable Adverse Impacts

Temporary construction-related impacts (noise, dust, and traffic) would affect land uses adjacent to proposed facilities.

Environmental Health

Public Health

No public health impacts are expected to result from construction of projects under the RWSP.

Noise

Impacts Common to All Facilities and Service Strategies

Construction of all wastewater facilities (treatment plants, pipe systems, etc.) would involve the use of heavy equipment. Such equipment can create a high level of noise, which can be disruptive to people nearby. Table 11-1 lists many types of equipment commonly used in wastewater system construction, and shows the expected range of noise levels and average noise levels at a distance of 50 feet.

Table 11-1. Typical Construction Equipment Noise (dBA)

Task	Type of Equipment	Range of Noise Levels at 50 ft.[a]	Average Noise Level at 50 ft.
Earth Moving	Compactors (rollers)	73-75	na[b]
	Front Loaders	73-84	na
	Backhoes	73-93	85
	Tractors	76-96	na
	Scrapers, Graders	80-94	na
	Dump Trucks	82-94	88
Materials Handling	Concrete Mixers	75-87	85
	Concrete Pumps	81-83	na
	Cranes (movable)	76-87	83
	Cranes (derrick)	86-88	88
Stationary Equipment	Pumps	69-71	76
	Generators	71-82	78
	Compressors	74-87	81
Impact Equipment	Pneumatic Wrenches	83-88	85
	Jackhammers and Rock Drills	81-98	88
	Impact Pile Drivers (peaks)	95-106	101(peak)
Clearing	Bulldozer	77-96	87
	Dump Truck	82-94	88
Grading	Scraper	80-93	87
	Bulldozer	77-96	87
Paving	Paver	86-88	na
	Dump Truck	82-94	88

Source: U.S. Environmental Protection Agency, 1971
[a]The upper ends of these ranges are higher than typically observed for equipment today.
[b]na = data not available.

Mitigation Measures

- Construction vehicles and equipment noise would be reduced using properly sized and maintained mufflers, engine intake silencers, and engine enclosures. Equipment could also be turned off when not in use and activities could be confined to between 7 am and 7 pm.

- Where sheet piles are needed and soil conditions allow, vibratory pile drivers would be used instead of impact pile drivers.

- Stationary construction equipment would be located away from sensitive receptors, such as residences, where possible. Where this is not possible or where noise impacts are still substantial, portable noise barriers could be placed around equipment with the opening directed away from sensitive receptors.
- Construction specifications would provide that noise levels for scrapers, pavers, graders, and trucks should not exceed 90 dBA, and pile drivers should not exceed 95 dBA at 50 feet as measured under the noisiest operating conditions. For all other equipment, specifications would provide that noise levels should not exceed 85 dBA.
- Substituting hydraulic or electric models for impact tools such as jack hammers and pavement breakers would further reduce construction noise.

Unavoidable Adverse Impacts

Construction would unavoidably require short-term increases in noise levels associated with construction equipment.

Hazardous Materials

Impacts Common to All Facilities and Service Strategies

If siting and construction of new or expanded wastewater treatment facilities requires the demolition of an existing building, materials or products may be encountered containing asbestos, PCBs, or other hazardous materials. These materials would be handled, transported, and disposed of in accordance with applicable regulations and permits. Any hazardous materials encountered during excavation would also be handled, transported and disposed of in this manner.

Mitigation Measures

No mitigation would be required for hazardous materials handled in accordance with regulations.

Unavoidable Adverse Impacts

No unavoidable adverse impacts are anticipated.

OTHER ELEMENTS OF THE ENVIRONMENT

Earth Resources

Impacts Common to All Facilities and Service Strategies

Treatment Plants, Pumping and Regulator Stations, Storage Tanks. Most of the components of these facilities are located underground, and often in low areas. For these reasons, construction would likely require large-scale excavation and dewatering to achieve and maintain dry foundation excavations. The excavation depth (up to 50 feet for some types of facilities) would typically require shoring to support the sides. Reuse of excavated soils as backfill depends on the quality of the material. Unusable soils would be hauled away for disposal at a permitted facility. Contaminated soils would be tested and handled appropriately, depending on the levels and types of contaminants present. Table 11-2 provides estimates of areas disturbed and volumes of material excavated for treatment plant projects.

Conveyances. Cut-and-cover and trenchless technology are the two main categories of pipeline construction. These methods are described in the General Construction Methods section above. Tunneling would reduce the volume of soils excavated for any given pipe size because the soils between the pipe and ground level would not be removed. Subsidence of surrounding ground surfaces could occur during tunneling, and geologic conditions would be studied before and during tunneling. Soil stabilization measures such as soil grouting would be employed to prevent ground subsidence.

Construction of conveyances under the four service strategies would result in the general construction impacts described above. Table 11-2 provides estimates of areas disturbed and volumes of material excavated during construction of major conveyances. Minor areas of contaminated soils may also be encountered during construction of these facilities.

CSO Facilities. Construction of CSO facilities for the four service strategies (e.g., conveyance lines, storage tanks, and storage tunnels) would result in the general construction impacts described above. Table 11-2 shows estimates of areas disturbed and volumes of material excavated for major CSO facilities. There would be a higher likelihood of encountering contaminated soils during site preparation for facilities located in industrial areas.

Impacts Specific to Service Strategies. SS2 and SS3 are similar in the volume of material that would be excavated over the planning period as a whole. SS4 would result in substantially more excavation; SS1, somewhat more excavation than SS2 or SS3. Differences in earth impacts among the four service strategies primarily reflect differences in the timing of construction and location of facilities. No significant change in topography is expected to result from construction of any of the proposed facilities.

NOTE: Table EP2-5, Chapter EP-2, provides approximate areas disturbed and volumes of excavated material for the revised service strategies.

Table 11-2
Approximate Areas Disturbed and Volumes of Excavated Material

Type of Facility	**Service Strategy 1**		**Service Strategy 2**		**Service Strategy 3**		**Service Strategy 4**	
	Area Disturbed (acres	Volume Excavated (cubic yards)*	Area Disturbed (acres	Volume Excavated (cubic yards)*	Area Disturbed (acres)	Volume Excavated (cubic yards)*	Area Disturbed (acres)	Volume Excavated (cubic yards)*
Treatment Plants	47	1,680,000	47	1,380,000	55	1,580,000	47	1,680,000
Conveyance Lines	47	1,000,000	43	855,000	35	670,000	12	2,681,000
CSO Projects	5	1,280,000	12	720,000	9	830,000	1	1,200,000
Total	**99**	**3,960,000**	**102**	**2,955,000**	**99**	**3,080,000**	**60**	**5,561,000**

*Volumes excavated includes estimated volumes of preload material

Mitigation Measures

During construction, erosion and sedimentation control measures would be implemented as required by Ecology's *Stormwater Management Manual for the Puget Sound Basin* and applicable local stormwater regulations.

In areas of suspected contaminated soils, testing would be conducted to determine the extent of contamination before construction. Any excavated contaminated soils would be disposed of in accordance with the Washington State Dangerous Waste Regulation, WAC 173-303, and the Washington State Model Toxics Control Act, WAC 173-340.

Where contaminated soils and groundwater are found together, dewatering systems would be implemented to avoid discharging contaminated groundwater or soils to receiving surface waters.

Unavoidable Adverse Impacts

No unavoidable adverse impacts on earth resources are expected to result from construction of RWSP facilities.

Aesthetics

Impacts to All Facilities and Service Strategies

Treatment Plants. The West Plant is located within Discovery Park. Construction activity associated with plant expansion (SS1, SS2, SS4) would most likely be evident from the beaches and bluff bordering the treatment plant site.

The East Plant is located within an existing industrial and business park area. Construction associated with plant expansions (SS1, SS2, SS3, SS4) would be evident from the upper floors of nearby office buildings, portions of I-405, and some residences located on valley sides about one-half mile from the site.

Construction of a North Plant would occur on either an inland site or a shoreline site in north King or south Snohomish County. Impacts to aesthetics would depend on plant location. Construction of the North Plant would take place in up to three stages.

Conveyance Facilities. Construction of major wastewater conveyance lines, including the deep tunnel and new pump stations, would result in temporary aesthetic impacts because of the presence of construction equipment and excavation activity. These changes to visual character would be localized and would not be evident for more than several hundred yards of the conveyance route or shaft openings. Duration of impact from construction of deep-tunnel segments and pump stations would be longer than for other pipeline conveyances, on the scale of several months compared to several weeks.

CSO Facilities. Construction of CSO facilities (conveyance lines, storage tanks, and storage tunnels) would result in temporary aesthetic impacts similar to those described above for conveyances. Proposed CSO facilities would be located in highly urbanized areas, and aesthetic impacts during construction of these facilities are not expected to be significant.

Mitigation Measures

Where necessary to reduce adverse aesthetic impacts associated with construction of proposed facilities, measures such as screening and buffering could be implemented during early stages of construction. However, construction requirements may constrain the use of screening and buffering during later construction stages.

Unavoidable Adverse Impacts

There are no known unavoidable adverse impacts to aesthetics resulting from construction of wastewater facilities.

Recreation

Impacts to All Facilities and Service Strategies

Treatment Facilities. Construction of the West Plant expansion (SS1,SS2, SS4) would disrupt use of the adjacent shoreline portions of Discovery Park for up to one year. The specific nature of the impacts would, in part, depend on whether construction transportation used the park roadway or water access. Water access would disrupt use of the North Beach, whereas road access would disrupt pedestrian traffic between the upland portion of the park and the North and South beaches. A temporary construction easement would probably be required along the property line with the Seattle Parks Department. Construction of the East Plant expansions would not result in any impact to recreation as the perimeter trail along Springbrook Creek can remain open during all construction activities at the treatment plant site. Impacts to recreation resulting from construction of a North Plant would depend on its location. Siting could likely avoid major recreational areas.

Conveyance Facilities. Construction of the deep tunnel (SS 4) may require an access shaft or portal in the vicinity of Logboom Park and/or the Burke-Gilman trail in Kenmore. Use of these facilities may be disrupted for a period of one to several years.

Construction of the parallel Kenmore Interceptor (SS1,SS2) could result in recreation impacts. If the parallel interceptor is located along the Burke-Gilman trail, the use of microtunneling would likely minimize recreation impacts, except at the tunnel exit and entry locations. If the parallel interceptor were located underwater, adjacent and parallel to the Lake Washington shoreline, boat access from individual properties along the lake shore would be interrupted.

Expansion of the existing Kenmore and Matthews Beach pump stations would cause disruption to Logboom and Matthews Beach parks for up to several months. Depending on the specific route, the parallel Eastside Interceptor could temporarily disrupt access to and use of the Gene Coulon Park in Renton for a period of up to several weeks. Depending on its location, construction of the North Creek to North Plant conveyance could also temporarily impact existing recreational facilities. Vehicular access to other recreational facilities could be impacted during construction of these conveyances, but these impacts would be brief and minor.

CSO Facilities. Construction of storage tanks at Lowman Beach Park, both in Seattle, could affect recreational use in the park for a period of up to several months.

Mitigation Measures

Where short periods of temporary construction impacts are expected at recreational facilities, construction could be scheduled to avoid the periods of highest recreational use.

Unavoidable Adverse Impacts

Construction of the proposed facilities would temporarily restrict the use of certain recreational areas for varying periods of time.

Cultural Resources

Impacts Common to All Facilities and Service Strategies

As described in Chapter 4, Affected Environment, the King County wastewater service area contains a number of documented cultural and historic resource sites, and the potential for unidentified sites to exist in the vicinity of RWSP facilities is generally high. Although specific alignments, sites and/or layouts for proposed facilities have not yet been developed, it is assumed that known sites would be avoided. Thus, the primary potential for impacts under any of the service strategies would be the discovery of a previously unidentified site during project construction. The discussion of impacts below describes the relative magnitude of this potential, as well as the known sites in the project vicinity. Methods for addressing the discovery of unidentified resources during construction are described under Mitigation Measures. For all proposed facilities, a cultural resources assessment would be conducted after project designs have been developed and prior to any subsurface disturbance, including geotechnical testing.

West Service Area

West Plant (SS1, SS2, SS4). Excavation could adversely affect cultural resources. Cultural deposits were identified across the West Point landform in 17 areas exposed during construction of the West Plant secondary sewage facilities and were classified as the West Point sites 45KI428 and 45KI429 (Larson and Lewarch, 1994).

The locations of known cultural deposits, areas with probable cultural deposits, and areas with a potential for cultural deposits within the existing footprint of the plant have been identified and mapped. Because the West Point site is an NRHP (National Register of Historic Places) property, a professional archaeologist must be contacted in the planning stages if any proposed construction excavation is in an area with known or potential cultural deposits to determine whether an adverse effect would occur. King County would consult with the Office of Archaeology and Historic Preservation (OAHP) and affected federally recognized Tribes regarding any impacts to the archaeological property.

The West Point Light Station (45KI175H) is also listed on the NRHP and is adjacent to the existing West Plant footprint. Any modifications to the historic structure and/or the grounds of the historic property would be assessed for their impacts by a historical architect through consultation with the OAHP.

Kenmore Interceptor (SS1, SS2). Construction of the Kenmore interceptor may directly affect unidentified archaeological resources associated with Lake Washington. The level of probability for encountering archaeological resources during construction is variable, depending on the location of the conveyance facility relative to the historical Lake Washington shoreline. The probability for archaeological resources along the historical, or pre-1916, shoreline and the ancient shoreline is high. Also, a pipeline route that approaches the former mouths of McAleer and Lyon Creeks—salmon-bearing tributaries with ethnographically associated use—suggests a probability for encountering archaeological resources. The proposed route for the interceptor would include an archeological assessment in areas where subsurface disturbance, including geotechnical testing and dredging, will be undertaken.

Deep Tunnel, Kenmore Duwamish (SS4). The potential for cultural and historic resource impacts from the deep tunnel depends on the depth of the tunnel, the subsurface geology, and the numbers and location of surface access points. In general, impact potential would be highest under the following conditions:

- Relatively shallow pipeline depths (i.e., less than 20 feet below ground surface)
- Alluvial (river-deposited) soils
- Areas of open surface excavation for tunnel portals, access shafts, and adits

Because no design yet exists for the tunnel, the extent to which these conditions would be experienced is difficult to predict. On the whole, however, the tunnel would likely have a lower potential for resource impacts than other conveyance facilities because of its relatively greater depth and lack of open-cut construction. The general portal areas in Kenmore and near the Duwamish River, as well as some of the access shaft locations, have known cultural resource sites nearby and a high potential for undocumented sites. However, it is assumed that known sites would be avoided. As with other proposed facilities, a cultural resource assessment would be prepared before starting construction.

East Service Area

East Plant (SS1, SS2, SS3, SS4). Construction that requires penetration of fill to native soils for proposed expansions of the East Plant might affect unidentified archaeological resources. The existing plant is adjacent to a recorded archaeological site (45KI267) and is within 1 mile of four other sites (45KI51, 45KI438, 45K159, and 45KI438). The East Plant is in an area of high probability for cultural resources because of its proximity to the former Black, White, and Duwamish River confluence. No identified historic structures or traditional cultural resources potentially eligible for listing on the NRHP are on or near the East Plant (Larson, 1994).

Plant expansion plans would include an assessment for potential impacts on archaeological resources through consultation with the OAHP, King County, and affected federally-recognized Tribes.

Effluent Transfer System (SS1, SS2, SS3, SS4). Construction of the third leg of the ETS outfall into Elliott Bay has the potential to encounter undocumented cultural or historic resources, particularly the remains of shipwrecks in Elliott Bay. As with other proposed facilities, a cultural resource assessment would be prepared before starting construction.

Eastside Interceptor. Construction of new storage facilities and placement of new pipe for the Eastside Interceptor may directly affect unidentified archaeological resources, particularly under SS1. The character of the landforms, previous aboriginal occupation, and the abundance of salmon resources suggest this route is very likely to encounter such resources. The conveyance currently traverses the eastern shoreline of Lake Washington and twice approaches the southeast shore of the lake. Before the 1916 lowering of Lake Washington, its shoreline was higher than the current shoreline, increasing the probability of disturbance to archaeological resources along the historic shoreline. A fishing place and village site have been ethnographically documented near the proposed route, and an NRHP archaeological site (45KI9) was excavated near Lake Sammamish. The Eastside Interceptor route also crosses several salmon-bearing streams entering Lake Washington that were used for salmon fishing by aboriginal people. Proposed locations for storage facilities and any conveyance facilities that require subsurface disturbance, including geotechnical testing, would include an assessment prior to project construction.

The proposed Eastside Interceptor improvements may affect structures with potential historical significance. The Kennydale Methodist Church has not been evaluated for its significance and may be eligible for listing as a King County Landmark. If plans that include modifications to this property are proposed, it would be evaluated for its significance. One property, the Wilburton Trestle, is listed on the State Register of Historic Places; any modifications to the structure would be assessed for their impacts by a qualified historical architect in consultation with the OAHP.

North Service Area

North Plant (SS2, SS3). Construction of the proposed North Plant could directly affect unidentified archaeological or traditional cultural resources. With respect to a potential inland site, Swamp Creek is a salmon stream that has supported runs of chinook, coho, and sockeye salmon, and is near an ethnographic village at the mouth of the Sammamish River, strongly suggesting that it was an aboriginal fishing place. Any construction activities that involve subsurface ground disturbance, including geotechnical testing, would include a cultural resources assessment of the project area conducted to determine the effects of construction on cultural resources.

CSO Facilities (SS1, SS2, SS3, SS4). The construction of CSO facilities is proposed primarily within urban Seattle and in several incorporated suburban cities and unincorporated neighborhoods. Several of these areas contain hunter-fisher-gatherer and historic archaeological sites, traditional cultural resources, historic districts, historic buildings, roads, and/or other historic features that have local, state or national recognition or significance. Unidentified hunter-fisher-gatherer and/or historic archaeological resources may lie in undisturbed soils beneath fill or other landform alterations such as roads or buildings. All proposed CSO facility locations would receive a cultural resources assessment prior to any subsurface disturbance, including geotechnical testing. Areas that contain standing structures may also require assessment for impacts by a qualified historical architect.

Mitigation Measures

Mitigation measures for archaeological resources cannot be determined until a resource has been identified and its eligibility for listing on the NRHP has been determined. If a site is determined eligible for listing on the NRHP through evaluation by a professional archaeologist and consultation with the lead agency, the State OAHP, King County , and the affected federally-recognized Tribes, and if the site cannot be avoided, mitigation measures would be required. Mitigation for impacts to hunter-fisher-gatherer and historic archaeological sites is nearly always accomplished through data recovery or pipeline realignment to minimize site disturbance.

Standing structures that are eligible for listing on the NRHP, and that may be adversely affected by any of the proposed actions may be mitigated by research and/or photographic documentation developed by a qualified historical architect, the lead agency, the State Office of Archaeology and Historic Preservation, and King County.

Unavoidable Adverse Impacts

If a facility proposed under one of the service strategies encroaches on an archaeological or historic site and cannot be rerouted, the site could be demolished or otherwise removed in accordance with applicable guidelines and regulations.

Air Quality

Impacts Common to All Facilities and Service Strategies

Construction of facilities proposed under the RWSP would result in the disturbance of varying amounts of soil on construction sites, as described in the Earth section. Areas of exposed soil can generate fugitive dust emissions, which can cause air quality impacts in the immediate vicinity of the site. These impacts would be temporary and would be kept to a minimum through use of the best management practices described below.

Mitigation Measures

Construction best management practices used to minimize fugitive dust impacts include:

- Water-exposed soil areas
- Cover soil stockpiles and haul truck loads
- Minimize areas of earth disturbed at any one time; revegetate as soon as possible after construction is complete

Unavoidable Adverse Impacts

Temporary, localized dust emissions would likely occur occasionally during construction of larger treatment, conveyance, and storage facilities.

Transportation

Impacts Common to All Facilities and Service Strategies

Short-term construction transportation impacts are substantially greater than long-term operational transportation impacts because of the excavation required to prepare a site for installation of facilities. Dump trucks with capacities ranging from 10 to 18 cubic yards would be used to remove soil from pipeline trenches, treatment plant sites, and pump station excavations. For the purposes of this analysis, a capacity of 16 cubic yards was assumed. The excavated material that is not suitable to be reused at the construction site (e.g. to backfill a pipeline trench) would be hauled away, using major streets in the vicinity and regional highways. The excavation phase would occur early in construction.

Nearly all structures associated with wastewater facilities are constructed of reinforced concrete, which requires concrete trucks for intermittent and sometimes extended "pours." These pours occur as a succession of facility elements are prepared for the concrete (e.g. floors, walls, separate buildings, paving, etc.).

Besides these periods of heavy truck traffic, other trips are generated over the duration of construction. These trips include workers traveling to and from work, delivery of equipment and supplies, and miscellaneous inspector trips.

Table 11-3 provides a summary of transportation impacts for treatment plants. Included are estimates of excavation volumes, total one-way-haul truck trips, average-daily-haul truck trips, and total daily construction-related trips. Principal roadways these trips could affect are also listed. Impacts associated with individual system components are discussed below.

Pipelines are constructed in segments, so traffic impacts in any one area (for instance, a city block) would be most intense during construction in that area. Pipelines are most often constructed in public rights-of-way, so it is common for one or more traffic lanes to be temporarily blocked in the stretch of road immediate to the open trench segment. In those cases, traffic management plans would be developed to ensure the movement of goods and people through the area, usually by employing flaggers to maintain traffic flow in at least one direction at all times. Access to properties adjoining the blocked-off portion of the roadway would be maintained to the maximum extent possible.

NOTE: Table EP2-7, Chapter EP-2, provides a treatment plant construction transportation impact summary for the revised service strategies.

Table 11-3. Treatment Plants
Construction Transportation Impact Summary

Facility	Potentially Affected (1) Roadways	Excavation Volumes (2) (cubic yards)	Total One-Way (3) Haul Truck Trips (16 cy/load)	Maximum Daily Haul Truck Trips (16 cy /load)	Total Construction (4) Related Trips (average/maximum per day)
West Plant to 159 mgd (26 mgd expansion)	• 15th Ave W • W Dravus St • 20 Ave W • Gilman Ave W • W Government Wy • Discovery Pk/Fort Lawton roadways	100,000	12,500	150-200	150-200/300-350
East Plant to 154 mgd (39 mgd expansion)	• SW 7th St • Longacres Drive SW • Monster Rd SW • Oaksdale Ave SW • SW Grady Wy	530,000	33,125	250-300	220-320/450-500
East Plant to 172 mgd (18 mgd expansion)	Same as East Plant (154 mgd)	300,000	18,750	100-150	100-150/200-250
East Plant to 235 mgd (from 154 mgd) (81 mgd expansion)	Same as East Plant (154 mgd)	1,050,000	65,625	NA (5)	NA
North Plant, 35 mgd	Dependent on location	200,000-300,000	25,000-37,500	200-250	200-300/400-450
North Plant to 55 mgd (20 mgd expansion)	Dependent on location	100,000-200,000	12,500-25,000	100-150	100-150/200-250
North Plant to 65 mgd (30 mgd expansion) North Plant to 89 mgd (from 55 mgd) (34 mgd expansion)	Dependent on location Dependent on location	100,000-200,000 200,000-300,000	12,500-25,000 25,000-37,000	100-150 200-250	100-150/200-250 200-300/400-450

Notes: (1) Roadways listed are principal affected roadways.
(2) Excavation volumes include a 30% swell factor.
(3) A one-way truck trip is defined as a single direction trip to a single destination.
(4) Construction related trips include haul truck, delivery, inspection, and worker trips.
(5) Expansion would be phased; information on magnitude of phases is currently undetermined.

After the trench has been backfilled and the road pavement replaced, the construction "train" moves on to the next segment. The most intensive traffic impact moves along with the construction. Spoils and equipment hauling trucks and workers would use major roadways to access and egress the construction site, so impacts would occur distant from the actual construction as well. For pipeline construction, these impacts are usually minor.

Table 11-4 provides a summary of impacts for major conveyance facilities.

CSO Facilities. Although the size, type, and configuration of CSO control facilities would vary under each service strategy, construction would occur in similar locations under all service strategies and is likely to add construction traffic to major area roadways. Disruptions would most likely not be widespread, as most facilities are small in area, and in most cases construction of each project would be separated from the others by one to several years.

Infiltration/Inflow. No significant adverse transportation impacts would be expected from I/I control projects. These projects would include some minor, highly localized in-road work that could cause temporary, minor disruptions in neighborhood traffic. Advancements in "trenchless" technologies allow relining and replacing of pipes with only minor excavation. The locations requiring excavation would be determined by future studies.

West Service Area

West Plant (SS1, SS2, SS4). Expansion of the West Plant would require comparatively minimal excavation and site work. An estimated 100,000 cubic yards of excavated material would require an average of between 150 and 200 one-way truck trips per day (Table 11-3) over a period of several months. Roadways through the Interbay area, Magnolia neighborhood, Discovery Park, and Fort Lawton would experience temporary increases in construction-related truck traffic.

Kenmore Interceptor (SS1, SS2). The Lake Sammamish/Burke-Gilman Trail system is a major bicycle and pedestrian trail that parallels the Lake Washington shoreline along the entire length of the proposed Kenmore Interceptor. The trail runs directly adjacent to Tracy Owen Station Park and Matthews Beach Park. If a land route were selected along this trail system, alternative routing around construction would likely be required for trail users. This option may be difficult in some areas because of residential development on the lakeside and steep slopes on the upland side of the trail.

Possible in-water construction of the Kenmore Interceptor (SS1, SS2) would likely be accomplished primarily with floating equipment (i.e., barge-mounted crane, equipment and material barges, tugs, skiffs). This equipment would probably be mobilized in a temporary staging area at the Kenmore Navigation Channel. An estimated 200,000 cubic yards of material would have to be dredged. Dredged material would be placed on a barge for backfill or disposal at an approved site. An estimated 18 percent of the 200,000 cubic yards to be dredged may be contaminated. This dredged material would have to be hauled by barge to an approved disposal site.

NOTE: Table EP2-8, Chapter EP-2, provides a major conveyance facilities construction transportation impact summary for the revised service strategies.

Table 11-4. Major Conveyance Facilities Construction Transportation Impact Summary

Conveyance	**Affected Roadways** [1]	**Excavation Volumes** [2] **(cubic yards)**	**Total One-Way** [3] **Haul Truck Trips (16 cy/load)**	**Average Daily** [4] **Haul Truck Trips (16 cy /load)**	**Total Construction** [5] **Related trips (average per day)**
Parallel Kenmore Interceptor	• SR 522 • NE 175th St • 61st Ave NE • Sand Pt Wy NE	<u>Land Route</u> Excavation volumes are undetermined <u>In-water</u> 200,000	------- <u>In-water</u> (majority of material to be hauled by barge)	------- <u>In-water</u> NA[6]	------- <u>In-water</u> NA
Parallel Eastside Interceptor (ESI)	• I-90 • I-405 • SR 522 • SR 520 • SR 202 • SR 908 • SR 900 • SR 169 • SR 167 • SR 181	<u>Service Strategy 1</u> 700,000 <u>Service Strategy 2</u> 45,000 <u>Service Strategy 3 and 4</u> 60,000	<u>Service Strategy 1</u> 87,500 <u>Service Strategy 2</u> 2,800 <u>Service Strategy 3 and 4</u> 3,800	50-100	100-150
Deep Tunnel (Kenmore/Duwamish)	• I-90 • I-5 • SR 522 • SR 520 • SR 99 • SR 167	2,600,000	325,000	50-100	100-150

Notes: (1) Roadways listed are major and/or principal affected roadways.
(2) Excavation volumes include a 30% swell factor.
(3) A one way trip is defined as a single direction trip to a single destination.
(4) Numbers for daily truck trips assume a single construction site.
(5) Construction related truck trips include haul truck, delivery, inspection, and worker trips.

Deep Tunnel—Kenmore to Duwamish (SS4). Construction traffic would increase on some of the major roadways along the proposed deep tunnel route from Kenmore to the East Plant at various times corresponding to construction timing. Transportation facilities most affected would be those in the immediate vicinity of construction portals, access shafts, and drop shafts. Roads near construction portals would be affected for a number of months each. The tunnel would be constructed in segments in several blocks of time over the planning period. One or two construction portals would be open during each of these blocks. Total excavation volumes and one-way truck trips are listed in Table 11-4. Other facilities that could be affected include rail lines, pedestrian/bicycle trails, and boat traffic.

East Service Area

East Plant (SS1, SS2, SS3, SS4). Expansion of the East Plant would occur in several phases over the planning period, as shown in Table 11-3. The initial expansion of the East Plant from 115 mgd to 154 mgd (all Service Strategies) would generate approximately 250-300 maximum daily one-way haul truck trips during an approximate six month excavation period. Further expansion of the East Plant from 154 mgd to 172 mgd (18 mgd) (SS2, SS3) would generate 100-150 maximum daily one-way haul truck trips during an approximate six month excavation period. Subsequent expansions of 37 mgd and 44 mgd (SS1, SS4) to reach an ultimate East Plant capacity of 235 mgd would generate impacts similar in magnitude to the initial 39 mgd expansion. Roadways affected would include SW Grady Way which provides direct access to I-405 in Tukwila.

Eastside Interceptor (SS1, SS2, SS3, SS4). Construction of a parallel Eastside Interceptor under SS1, or paralleling or replacing smaller sections of the Eastside Interceptor under SS2, SS3, and SS4, would generate an average of 50 to 100 one-way-haul truck trips per day. Impacts to traffic would be greater under SS1, where paralleling of consecutive segments of the Eastside Interceptor could affect area traffic patterns for longer periods of time.

North Service Area

Construction of a new North Plant would occur in phases, as shown in Table 11-3. The initial 35-mgd construction phase would generate an estimated maximum of 200-250 daily one-way haul truck trips during an approximate six-month excavation period. Subsequent second-phase expansions of 20 mgd (SS3) or 30 mgd (SS2) would generate an estimated 100-150 daily one-way haul truck trips over a period of approximately 3 to 6 months. A third expansion of 34 mgd to a total plant capacity of 89 mgd (SS3) would generate impacts similar to the initial construction phase. Roadways affected would depend on plant location, as yet undetermined. A transportation impact assessment would be conducted for the selected site.

Mitigation Measures

- Construction activity would be phased, and traffic would be rerouted during construction. Traffic plans would describe traffic operations in detail during the construction period. Construction would be scheduled to minimize disruption of existing traffic patterns to area residents and businesses. Affected neighborhoods would be provided with appropriate information.
- Open trench segments would be temporarily covered to allow residents and service vehicles to access driveways and loading areas. Trench segments would be excavated and closed promptly, minimizing the time that trenches are open in front of residence driveways and businesses. Construction vehicles would not be parked in front of access points and/or business parking areas.
- *For pipelines, trenchless technologies and/or alternative routes could be used where appropriate to minimize or avoid impacts.*
- Temporary measures would be implemented along trails to separate pedestrians and bicyclists from vehicles and to promote safety along the construction routes.
- Materials delivery or removal during peak traffic hours along major arterials would be avoided when possible. Flaggers would be present to direct traffic around the construction site.
- Temporary parking facilities would be provided where possible for businesses that lose parking and access during construction.
- Onsite construction crew parking would be provided wherever possible.
- Excavation material, fill, aggregate, and other bulky items could be transported by barge or rail where feasible.
- Construction of a temporary concrete batch plant at a treatment plant site to avoid concrete truck trips could be possible.
- Truck traffic could be reduced during construction through stockpiling excavated earth onsite for use as backfill.

Unavoidable Adverse Impacts

Construction activities would unavoidably require short-term increases in truck traffic along major arterials, highways, and other primary roads in the vicinity of construction sites. Treatment plant construction could affect traffic for up to 5 years, with the highest concentrations occurring in the beginning phases.

Public Services, Utilities, and Energy

Impacts Common to All Facilities and Service Strategies

In general, construction of wastewater facilities would create minimal demand on fire, emergency, and police services. During construction of some conveyances within public rights-of-way, police services may be required to provide traffic control. However, the overall impact on demand for police services is expected to be insignificant.

Construction of wastewater facilities may require relocation of existing utilities. This is most likely to be the case with conveyances, which are often placed within rights-of-way where other utilities are likely to be located. Utility relocations could require temporary disruptions of service of several hours to several days. In general, however, conveyance lines would be located to avoid existing utilities.

Construction of treatment facilities, pump stations, and pipelines would involve short-term increases in energy consumption. During construction, fossil fuels (e.g. diesel fuel, gasoline, natural gas) would be used to operate construction equipment and vehicles hauling materials to and from construction sites. Electrical energy may be used to operate construction equipment such as generators and dewatering pumps.

Mitigation Measures

No specific measures to mitigate construction impacts to public services appear to be necessary. Any utility likely to be affected by construction activity would be contacted, as required, prior to work commencing. All equipment used during construction would meet applicable energy-efficiency standards.

Significant Unavoidable Adverse Impacts

No significant unavoidable adverse impacts to public services, utilities, or energy are anticipated.

NOTE

Chapter 12 is as it appeared in the Draft EIS (May 1997) for the RWSP. References to the RWSP in Chapter 12 are to the draft Plan issued at the same time as the Draft EIS. Projections in this chapter are the ones used for the original four service strategies.

NOTE: This impact assessment is based on the Service Strategies as presented in the Draft RWSP. See Part I of this FEIS for revised strategy descriptions and analysis.

CHAPTER 12

SERVICE STRATEGY OPTIONS

INTRODUCTION

The four service strategies developed in the RWSP are each designed to provide adequate capacity to collect and treat the region's wastewater for the next 30 years and beyond. The total volume of wastewater that the service strategies are designed to accommodate has been estimated based on the population projections contained in the King County Comprehensive Plan, and the assumption that current county-wide policies for growth management, level-of-service standards, and compliance with state and federal water quality regulations will continue to be applied. The potential long-term environmental impacts of the service strategies are discussed in Chapters 5 through 8 of this document.

While the service strategies represent four clear options for the future of wastewater treatment in King County, the RWSP also envisions some ways in which the strategies might be modified to provide improved cost control, operational efficiencies, regional water quality benefits, or other advantages. These service strategy options, described more fully in Chapter 4 of the RWSP, are not full-fledged alternatives in themselves, but are potential options for increasing the flexibility of the four service strategies. While some of the service strategy options would have few or no adverse environmental impacts, a number do have implications for the natural or built environment. This chapter briefly describes the service strategy options identified in the plan and provides an overview of the types of environmental impacts that might result from their implementation. Because the service strategy options are conceptual in nature, the discussion of their impacts here is designed only to provide the public and decisionmakers with a broad sense of their environmental implications. Full programmatic or project-specific analysis would occur at the time individual options were incorporated into the plan or facilities were proposed for construction.

Each option is presented according to one of five categories representing the major elements of a comprehensive wastewater strategy, including: 1) Treatment; 2) Conveyance; 3) Combined Sewer Overflows; 4) Biosolids; and 5) Water Reuse. A sixth category, "Other" contains two options that are independent of these categories.

ANALYSIS OF SERVICE STRATEGY OPTIONS

TREATMENT

The three options included under the treatment category include: 1) negotiating to lower treatment requirements for wastewater discharged from the East and North Treatment Plants; 2) operating the treatment plants at their maximum capacity to delay construction of additional wastewater treatment facilities, and 3) planning, designing, and constructing new facilities to meet five year increments of growth of wastewater flow and solids instead of ten-year increments. All three options provide cost savings, but may result in less treatment of wastewater, increase the risk of treatment plant upsets and sewer back-ups, and non-compliance.

Service Strategy Option 4A: Redefine Secondary Treatment

The four service strategies were developed to comply with all applicable federal, state, and local regulations, including the requirement that all wastewater treatment plants provide secondary treatment (85 percent removal of BOD and TSS to less than 30 mg/L of each) before discharge. This option proposes designing treatment facilities at the North Treatment Plant and any new treatment facilities at the East Treatment Plant to provide advanced primary treatment when flows are discharged to marine waters. Advanced primary treatment would be defined as adding chemicals such as alum and polymers to enhance physical settling of primary treatment. At the East Treatment Plant flows from the old secondary treatment units would be blended with those from the new advanced primary units before discharge. Disinfection of treated effluent with chlorine before discharge to surface waters may be eliminated.

This service strategy option would result in changes to the effluent stream in several ways. Enhanced primary treatment using sand filtration technology could actually result in lower TSS and better organism removal, for example, reducing water quality impacts from these constituents. Higher soluble BOD levels would be present in the effluent, as well as higher levels of bacteria if disinfection with chlorine is eliminated causing somewhat greater adverse impacts to water quality. Studies would need to be conducted to evaluate the significance of these higher levels of BOD and bacteria for marine discharges. Positive environmental impacts could include smaller treatment plant footprints and associated land impacts and a reduction in the use of chlorine.

Existing state and federal regulations requiring secondary treatment and chlorination would need to be modified before this option could be implemented.

Service Strategy Option 4B: Rerate Plant Capacities

A full description of this service strategy option is included in the companion document to this EIS, the Regional Wastewater Services Plan. The West and East Treatment Plants could be rerated by applying less-conservative design criteria; the plants could be operated nearer to their design limits. Systemwide capacity expansions would be delayed.

Rerating the treatment plants would increase the potential for violating effluent permit limits because of the chance of increased BOD and TSS concentrations in discharges. Those increased concentrations could reduce water quality and have adverse impacts on biological resources and environmental health. There would be an increased risk of plant malfunctions, which could lead to violations of effluent permit limits and adverse water quality and biological resource impacts. Operating the West Treatment Plant closer to design limits would need to be studied for its consistency with the 1991 West Point Settlement Agreement’s pollution discharge limits.

Service Strategy Option 4C: Build in Smaller Increments

The schedule for completion of the new facilities described in each of the four service strategies is based on accommodating 10-year increments of growth in wastewater flow and solids. It also assumes that design and other pre-construction activities begin in time to complete each facility when it is needed. This option involves planning, designing and constructing new facilities to accommodate five-year increments of growth in wastewater flow and solids instead of 10-year increments. A planning schedule would be developed that would accommodate a higher than anticipated growth rate, but then, delay actual construction to correspond to the actual growth experienced through the completion of design.

Building in smaller increments could result in reduced impacts for each construction project, but the impacts would be spread over a longer period of time. For example, there would be fewer trucks hauling construction materials for each project, but the hauling would occur over a greater number of years. In addition, in the event of a sudden large growth surge, the wastewater system would be less able to accommodate and treat the new flows, potentially resulting in sewer overflows and resulting adverse impacts to water quality. Biological resources and environmental health could also be adversely affected. The effects on the latter could take the form of potential adverse health effects to those who consumed large quantities of marine or freshwater animals, to those who came into contact with water receiving higher pollutant loadings or to those who came into contact with sewage from overflows.

CONVEYANCE

The four options included under the conveyance category include: 1) designing the wastewater system to handle five-year instead of twenty-year storms; 2) continuing to size new pipes to handle a twenty-year storm, but wait until existing pipes reach capacity before constructing new pipes; 3) discharging treated wastewater to the Green/Duwamish River from the East Treatment Plant under peak winter flow conditions; and 4) removing the I/I program from the four service strategies.

Service Strategy Option 4D: Decrease Conveyance Design Standard

All facilities in the four service strategies are sized to accommodate the peak flows generated by a storm of the intensity our region experiences approximately once every 20 years (the current design standard). In addition, new facilities are scheduled to be in place when predictions indicate the peak flow will exceed existing capacity. Under this option, all facilities would be designed to accommodate a once every five years storm. This design storm standard results in smaller, less expensive facilities but decreases the amount of I/I that can be conveyed and increases the risk of overflows from the sanitary sewer system following heavy storms. For example, instead of having sewer overflows, flooding and back-ups once every 20 years, there would be a higher likelihood of these occurring once every 5 years. This option could be implemented with all four service strategies.

The primary benefit associated with using a five-year storm design standard is a reduction in the length, size, and relative costs for construction of trunk and interceptor sewer parallel and replacement projects. Service Strategy 1 would have the greatest cost reduction because it has the most conveyance improvements.The distribution of sanitary sewer overflows varies substantially from drainage basin to drainage basin. This unequal distribution results in some areas receiving a lower level of service than others.

Sewer overflows could reduce the quality of surface waters if the overflows occured in proximity to water bodies. Reduced water quality could, in turn, adversely affect biological resources. Adverse impacts on environmental health could also result. These could include potential adverse health effects to those who consumed large quantities of freshwater animals, to those who came into contact with water receiving higher pollutant loadings or to those who came into contact with sewage from overflows. The significance of these environmental impacts and potential for detrimental human health effects would need to be evaluated. The experience of other jurisdictions in developing similar design standards will be a valuable resource for information to help make these evaluations. Benefits of this option would result from delaying and reducing the magnitude of construction impacts.

Figure 12-1 shows 44 locations where a King County trunk and interceptor are near the ground surface. Flows in excess of the pipe capacity will likely result in sanitary sewer overflows nearby. These overflows could have an average of a 20 percent chance of occurring in any one year if the 5-year peak-flow design criteria is used and a 5 percent chance of occurring in any one year if the 20-year peak-flow design criteria is used.

Service Strategy Option 4E: Decrease Conveyance Design Standard

This option is similar to 4D because new pipes would not be constructed until existing pipes showed reached capacity in a 5-year storm. However, the option differs from 4D in that conveyance pipes would be designed to accommodate the current 20-year design storm standard instead of a 5-year standard. Like 4D, both options differ from the four service strategies in which new facilities are constructed when predictions indicate peak flows will exceed available capacity. This option could be implemented with all four service strategies.

Implementation of this option increases the risk of overflows, backups, and flooding from 5-year storms during that period of time when pipes are beginning to reach their capacity. However, the risk of overflows, backups, and flooding is less than for 4D because pipes in this option are constructed to meet the 20-year design storm standard. As with option 4D, the distribution of sanitary sewer overflows varies substantially from drainage basin to drainage basin so that areas where capacity had been identified as inadequate in 5-year storms, but where installation of new pipes had not yet occurred, will experience more sewer overflows and problems.

Environmental impacts related to Option 4E would be similar to 4D, although the potential for detrimental human health effects would be somewhat less.

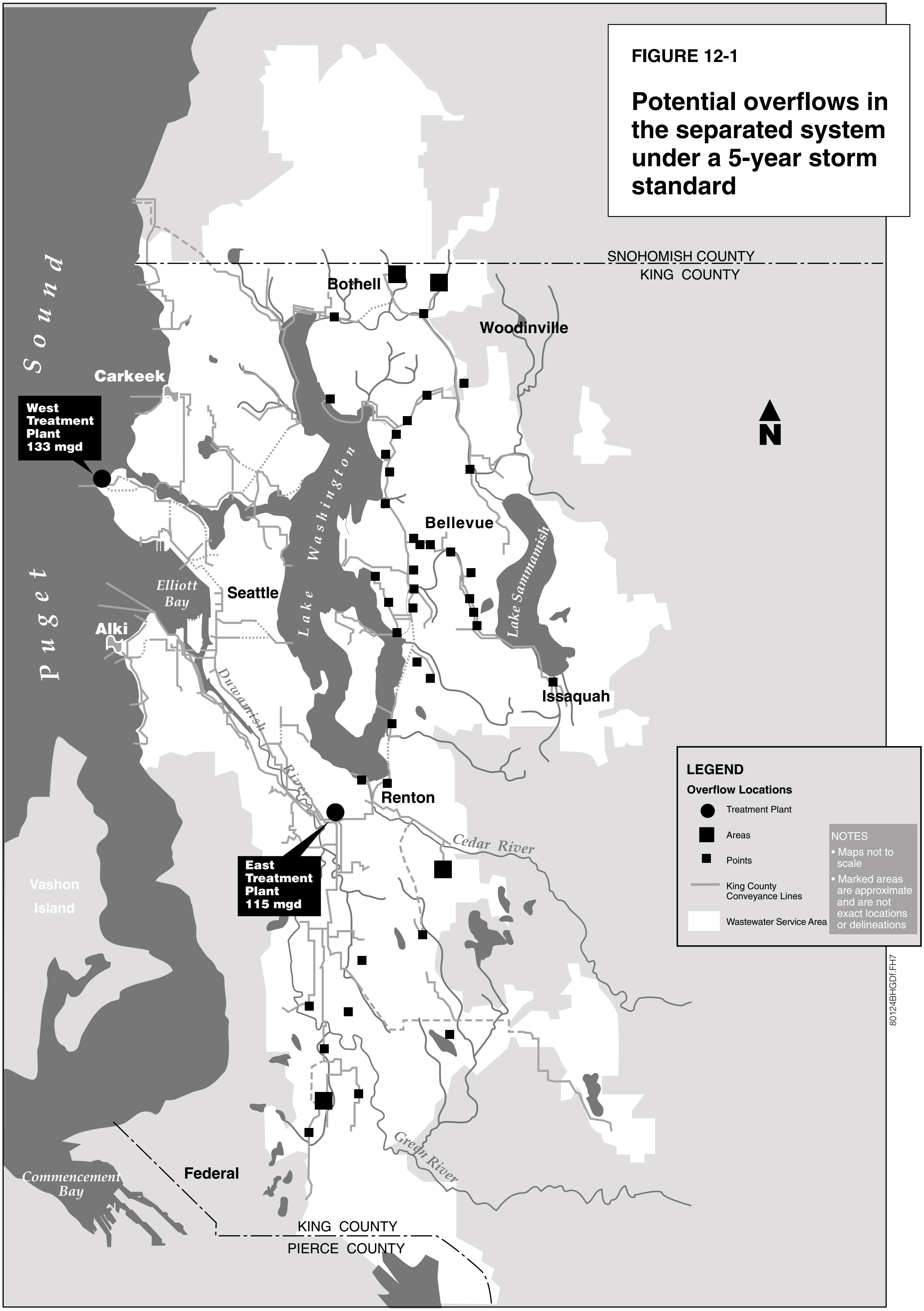


FIGURE 12-1

Potential overflows in the separated system under a 5-year storm standard

Service Strategy Option 4F: Discharge to the Duwamish River

Currently all four service strategies provide marine discharge of all treated effluent. This option includes discharge of treated effluent to the Green/Duwamish Rivers through an existing, but no longer used, outfall at the East Treatment Plant. Prior to the completion of the East Area effluent transfer system (ETS) in 1987, the effluent treated at the East Treatment Plant was discharged to the Green/Duwamish River year round.

This option calls for periodic discharge of peak winter flow to the river. During these events, most of the East Treatment Plant effluent would still be discharged through the ETS to Puget Sound. Unlike the previous year-round discharge to the river, proposed discharges would primarily occur during correspondingly high river flows when maximum dilution would occur.

Environmental impacts to water resources and biological resources would be likely from implementation of this option. Secondary effluent discharges contain nutrients, metals, organics, TSS, and fecal coliform bacteria, as described in Chapter 5 of this EIS. Preliminary information on this option suggests that adverse water quality impacts would be modest; discharges would occur only at peak flows, so they would likely be greatly diluted by high river flows. As a result, the potential for human contact with effluent discharge during or shortly after storm events would be low. The risk of adverse impacts to human health from this option would be commensurate with the extent of water quality degradation.

The greatest potential for adverse impacts would occur from strong early fall storms, which can cause peak plant flows prior to substantial increases in the flows in the river. The probability of this occurring is very low since a separated collection system would not experience peak flows until well into the wet weather season when river flow is also higher. Also, since this option calls for diverting only peak plant flow for discharge to the Green/Duwamish River during high river flows, period of low flow mixing should be limited.

Additional study would be needed before implementing this option. Better understanding of the loadings, volumes, frequency of discharges, and success of the I/I reduction program is needed. The county is currently conducting a Water Quality Assessment that may help answer some of these questions; results are expected in 1998.

This option would require revisions to the East Plant's permit conditions, which currently prohibit any discharges on a regular basis from the existing outfall to the Green/Duwamish Rivers.

Service Strategy Option 4G: No Inflow/Infiltration Program

Each service strategy was developed assuming an I/I reduction program to achieve the most cost-effective reduction in I/I from the local agencies. While recent experience both nationally and locally supports the cost-effectiveness of the I/I reduction program, much of the early experience with I/I reduction was less successful. If the I/I program was not implemented, or was unsuccessful in reducing I/I, additional pipes in the East Service

Area would need to come online sooner or be larger in order to accommodate all I/I that would occur without an I/I reduction program. This option would change the relative difference in cost between the service strategies.

The environmental impacts of building additional facilities would include increased levels of the construction impacts already identified in Chapter 11 of this DEIS. These impacts include traffic disruption, noise, dust, and increased traffic from trucks hauling excavated materials. In addition, impacts from implementation of the I/I program would be avoided by this option. These impacts would be caused either by temporary construction impacts in affected areas (e.g., traffic, landscaping disruption), or effects on groundwater and surface water runoff.

COMBINED SEWER OVERFLOWS (CSO)

This option requires approval by the Washington State Department of Ecology and revisions to the Washington Administrative Code (WAC). It entails that smaller CSO facilities be constructed, which lowers wastewater system costs, but increases the amount of CSO discharge to area waterbodies over what is allowed presently under the WAC.

Service Strategy Option 4H: Reduce CSO Control Goal

All four service strategies are based on the assumption that all King County CSOs will eventually be controlled to one untreated overflow per year as prescribed in state code. This option sets the ultimate goal to match the federal requirement (U.S. Environmental Protection Agency) of four to six untreated overflows per year for each CSO location and could be applied to any of the four service strategies.The environmental impacts of adopting the EPA policy would include increased pollutant discharge levels. Receiving-water bodies include Puget Sound off of West Seattle, Elliott Bay, the Ship Canal, and the Duwamish River. The total overflow volumes would be approximately 33 percent higher per year under this option than with any of the service strategies (170 mg/year compared to the one-per-year volume of 127 mg/year). Total pollutant removal would be somewhat lower during larger storm events. Total suspended solids (TSS) removal would be approximately 3 percent less than with any of the service strategies. The long-term implications of these intermittent discharges on water quality and aquatic habitat are being studied.

The Water Quality Assessment will provide information about the significance of a reduced CSO standard to protect water quality and public health.

BIOSOLIDS

Currently, King County's solids are processed using anaerobic digesters, which produce a Class B biosolids product that is transported to farms and forests for fertilizer. While producing a quality product suitable for land application, anaerobic digestion has inherent drawbacks. These include odor, bulky digesters, truck traffic, and product market limitations. The purpose of this option is to explore alternative technologies to anaerobic digestion in order to enhance the solids handling process in King County. This section will present information about eight alternative technologies, along with a comparison of limitations, or tradeoffs of each technology as compared with anaerobic digestion. This information is intended to help citizens prioritize the tradeoffs so that further research and testing on biosolids technologies can occur.

Service Strategy Option 4I: Alternative Biosolids Technologies and Recycling

This option presents a range of technologies that could be used at any of existing treatment plants, and could be included in any of the service strategies. In addition, regardless of which technology is ultimately used, King County will explore ways to increase efficiencies, recycle locally, generate revenue, and reduce costs through the development of projects that compost or mix biosolids and other waste products.
The alternative biosolids technologies include a combination of existing and new approaches that represent a wide range of processes for producing both Class A (treated to reduce pathogens below detectable levels) and Class B (treated to reduce pathogens to levels safe for land application) biosolids. Each biosolids technology alternative is described briefly below, followed by a comparison of the tradeoffs of each technology and a general discussion of the environmental considerations of the technologies as a group.

Dual Digestion: Dual digestion is a two step digestion process using two sets of digesters. The first set of digesters use high temperature aerobic digestion assisted with high purity air or oxygen. The second set uses medium temperature anaerobic digester (the same as in existing King County digesters) to stabilize wastewater solids. toThe heat generated during the aerobic process raises the temperature of the solids to 60 degrees centigrade (about 140 degrees Fahrenheit), high enough to achieve considerable pathogen kill and produce a Class A biosolids cake at 20 percent solids and 80 percent water. This technology would require the construction of additional aerobic digesters and heat exchangers, thus expanding the current plant footprint.

Long-term Storage & Drying: King County has been investigating low cost, low technology methods of producing a Class A product. One such method is long term storage and air drying. Long-term storage consists of dedicating quantities of biosolids to "sit" for up to three years. Air drying is accomplished by applying thin layers of biosolids and turning them frequently. Testing determines when the biosolids meet the pathogen requirements for a Class A product. This process would occur off-site from the treatment plant, thus requiring additional land area. Possible locations include agricultural lands in Eastern Washington. This option would not reduce the number of digesters needed nor the number of truck trips for hauling biosolids.

Thermal Drying: Thermal drying is the process of using heat to remove the water from thickened or partially dewatered solids. Thermal drying can achieve a dry product with solids content up to 95 percent, and can achieve a Class A level of pathogen reduction. The extent to which the product is dried is dependent primarily upon its ultimate end use or market. Thermal drying could reduce the size of a plant's footprint and number of truck trips but would increase odors.

Composting: Composting is defined as a biological decomposition process or series of processes which produces a stabilized end product satisfying EPA's 503 Regulations for Class A biosolids composting. Biosolids alone are generally too wet and consolidated to allow development of the proper conditions for composting. A bulking material, such as sawdust, is required to develop aerobic conditions and high energy agitation may be necessary for physical breakdown of the material. Composting would not eliminate any digesters or reduce truck trips and would require an off-site composting facility.

Thermophilic Digestion: Thermophilic anaerobic digestion is similar to the existing anaerobic process currently used. The difference is that thermophilic digesters use microorganisms that digest wastes most effectively at higher temperatures, resulting in shorter holding times and ultimately fewer digesters. Thermophilic digestion is capable of producing a Class A biosolids product while reducing the plant footprint and reduce the number of truck trips. Odors associated with this process are unknown.

VerTad: The VerTad process is being pilot tested at the East Treatment Plant. The process uses a 350-foot vertical underground shaft acting as an aerobic thermophilic digester increasing volatile solids reduction and producing a Class A biosolids product. Because most of the digester is below ground, this process, if successful, could replace conventional anaerobic digesters and reduce truck trips. Impacts associated with odor are unknown.

Anoxic Gas Flotation: Anoxic Gas Floatation is an enhancement to existing digesters. This process involves separating and thickening the biosolids after digestion using methane gas floatation and then returning the thickened solids back to the digester. This results in a reduction in the amount of biosolids produced and truck trips required. This technology minimizes the number of digesters required in the future. Since this technology uses the anaerobic digestion process, it is assumed to produce a Class B biosolids product.

Digesters & Drying (Centridry): This process is another thermal drying technology that uses high speed centrifuges and heat to dry the biosolids to 60 percent solids and 40 percent water content (the current process yields about 20 percent solids/80 percent water content). Solids concentration of up to 90 percent can be reached by modifying operating procedures. Pilot testing of this process began in April 1997. It is anticipated that a Class B product will be produced.

It is important to note that no one biosolids technology can minimize negative impacts such as odor, truck trips, noise, and footprint, and maximize positive attributes such as low cost, high quality, and high marketability. Each technology has associated tradeoffs. Table 12-1 compares the tradeoffs for each technology against a baseline scenario of anaerobic digestion. Tradeoffs include product class (A or B), footprint (amount of land required for the process), truck trips, odor, noise, reliability of the process, rate impacts, and product marketability.

Table 12-1
Comparison of Biosolids Technologies against anaerobic digestion

Biosolids Technology	Product Class	Footprint	Truck Trips	Odor	Noise	Reliability	Rate Impacts	Markets
Dual Digestion[1]	A	>	nc	>	nc	nc	>	>
Long-term Storage & Drying[1, 2]	A	nc	nc	off site	nc	u	nc	>
Thermal Drying[1]	A	<	<	>	nc	u	>	u
Composting[1]	A	nc	nc	off site	---	nc	>	nc
Thermophilic Digestion[1 2]	A	<	<	u	nc	u	>	>
VerTad[2]	A	<	<	u	nc	u	>	u
Anoxic Gas [1,2]	B	<	<	u	nc	u	u	nc
Digesters & Drying (Centridry)[1, 2]	B	<	<	u	nc	u	>	nc

1 requires the use of digesters.

2 process not tested at full scale

> = greater impact than existing condition
< = less impact than existing condition
nc = no change from existing condition
u = unknown impact

Environmental Considerations

All of the technologies except Anoxic Gas Floatation and possibly VerTad require additional land for the structures. Dual digestion requires the largest amount of additional space. Odor will occur with every technology, though in varying degrees. Thermal drying and thermophilic digestion are known to create a greater level of odor than the other technologies. Odor control will be necessary for any of the processes. There also may be environmental concerns if the biosolids product is too dry and blows away easily. The product may have to be reformed into a product that is easier to apply and less likely to form dust clouds.

WATER REUSE

Any of the service strategies can supplement regional water supply by providing reclaimed water for direct, non-potable uses like irrigation and industrial processes. The following three options provide additional opportunities to supplement regional water supply through the development of indirect potable reclaimed water. The concept of indirect potable reuse involves discharging highly treated (e.g., tertiary) reclaimed water into a large body of water such as Lake Washington. This waterbody would act as a reservoir, supplementing water supply for lock operation, stream flow for fisheries, and withdrawal for treatment as drinking water. The concept of indirect potable provides a greater number of benefits than direct non-potable reuse, but also raises many issues related to receiving water quality, public health, public acceptance, water resources management, and institutional arrangements. This concept also requires a high level of coordination with regional water supply planning efforts. One of the primary potential benefits of making a large scale indirect potable reclaimed water supply available, is the avoided environmental impacts that occur with developing new upstream water supplies.

Three options are included under the water reuse category: 1) discharging treated wastewater to operate the Hiram Chittenden Locks; 2) building two medium-sized advanced treatment plants on the east side for discharge into Lake Washington and Lake Sammamish; and 3) building the North Treatment Plant initially as a reclaimed water facility for discharge in Lake Washington. These options are summarized below along with environmental considerations for each. Finally, in order to develop these options, King County is pursuing rights to the water it reclaims and will collaborate on water supply planning with the region's water purveyors to bring this new source to the region in an economical way.

Service Strategy Option 4J: Discharge at Hiram Chittenden Locks

This option would supplement flows in the Lake Washington Ship Canal with treated wastewater. The implementation involves conveying secondary-treated effluent from the West Treatment Plant to a proposed reclamation facility located in the Ballard-Interbay area. Here, the effluent would undergo additional advanced treatment prior to discharge upstream of the Hiram Chittenden Locks into the Lake Washington Ship Canal. This option could be implemented as part of any of the four service strategies.

On an average summer day, approximately 300 million gallons of water from Lake Washington is channeled down the Ship Canal and through the Hiram Chittenden Locks. The proposed reclamation plant at Ballard could discharge between 30 and 60 million gallons of reclaimed water to the Ship Canal daily. (See Figure 12-2). The supplemental flows would "free up" some water in Lake Washington for other uses, such as additional potable water withdrawal, without lowering the summer lake elevation. The discharge would occur over the four to six month summer period, coincident with seasonal peak water supply demand.

Beneficial environmental impacts could include saltwater intrusion control, enhanced fish migration, and replacement of potable water supply. The option would most likely target the summer period for the discharge, coincident with salt water intrusion management concerns, low lake levels, and seasonal peak water demand. The potential 30- to 60-mgd discharge would help control the summertime intrusion of salt water through the locks during the boating season, and could facilitate both salmon and boater passage as well. The discharge would represent 10 to 20 percent of the estimated 300 mgd existing Ship Canal average flow through the locks from Lake Washington.

The option could indirectly help with regional water supply concerns, typically most serious during the late summer and early fall. If water withdrawals commensurate with the effluent volumes were allowed from Lake Washington, the option would, in effect, enhance the capacity of the region's potable water supply system without the need to develop new supply reservoirs in the Cascades. Reservoir construction and upstream water withdrawals would be delayed or avoided along with their associated environmental impacts, preserving existing stream flows for fish, wildlife and other beneficial uses. It could also allow more flexible and efficient management of existing regional water supply facilities upstream on the Cedar River for both water supply and fishery enhancement purposes.

Finally, Puget Sound water quality impacts would be generally beneficial, because 30 to 60 mgd of discharge from the West Treatment Plant would receive advanced treatment, replacing the discharge of an equivalent volume currently receiving secondary treatment and discharge via the outfall off West Point. However, the water quality impacts of the change in location of discharge, into the nearshore marine waters of Shilshole Bay, would need further study, for instance, to determine nitrogen loadings in this embayment and impacts on fish migration. Potential negative environmental impacts include the possible reduction of water quality in waters receiving reclaimed water discharge. Sufficient levels of treatment would be required to ensure there is no significant impairment of beneficial receiving water uses, such as salmon migration, aesthetics, human health and recreation, and others. There might also be environmental impacts associated with the construction and operation of the reclamation facilities, including land use impacts.

At this time, discharge of an effluent product, even treated to an advanced level, is not permitted in the Lake Washington drainage basin. The State is reevaluating this, but has not yet promulgated a revision. Such a revision may still require rigorous effluent treatment levels and facility redundancy requirements as part of permit conditions to provide assurance of dependable high quality facility performance. The discharge of even a highly treated wastewater effluent to Lake Washington or other fresh waters is counter to long time wastewater management policy and existing state pollution control regulations. There may also be public concerns regarding the advisability of changing this policy, regardless of technical assurances of acceptable environmental protection.

Service Strategy Option 4K:Discharge to Lake Washington/Sammamish

This service strategy option, which would apply to Service Strategy 2 and Service Strategy 3, is described as an opportunity to supplement the region's potable water supply by locally treating wastewater for uses such as irrigation, groundwater recharge, freshwater flow augmentation, and wetlands improvements. This would conserve potable water currently used for these purposes. Two medium-sized multi-purpose wastewater treatment plants could be constructed on the east side of the Lake Washington drainage basin to meet the wastewater needs of local communities.

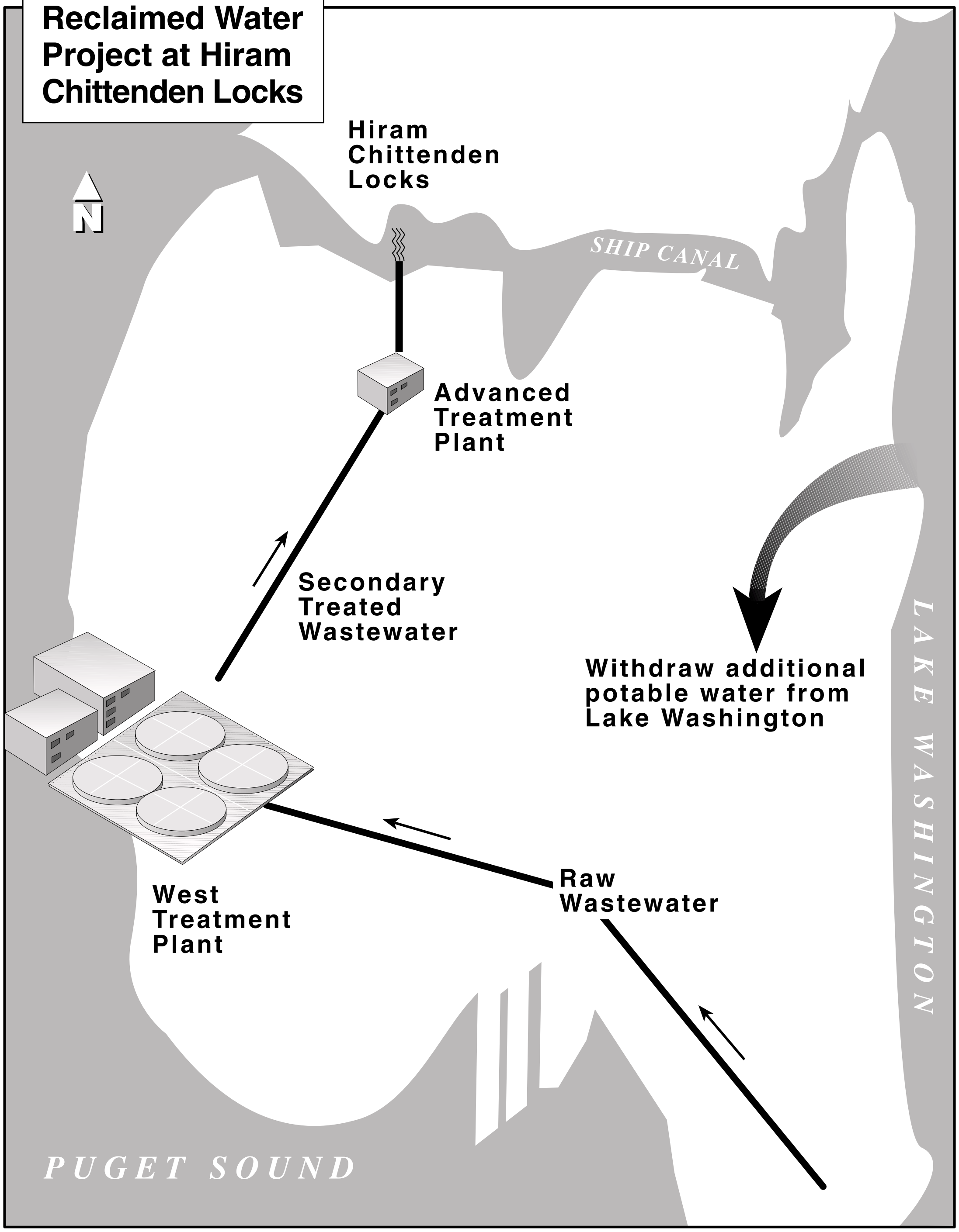
One plant would have a capacity of 12 mgd and another plant would be built in two phases--first at 35 mgd capacity, and later expanded to 58 mgd. The construction of these two plants, instead of a North Treatment Plant, would eliminate the need for a tunnel, a marine outfall, piping improvements, and a pump station.

These plants would produce an effluent which could be used for nonpotable purposes such as landscape irrigation and could also indirectly supplement local potable water supplies by discharging highly treated wastewater to Lake Sammamish, the Sammamish River, or to Lake Washington. The option would avoid the adverse impacts of wastewater discharges at a new location in Puget Sound.One environmental benefit of "indirectly" adding potable water supply to the Lake Washington drainage basin is to minimize the development of potable water supply sources upstream in the western Cascade drainage basins. This would preserve existing stream flows for fish, wildlife, and other beneficial uses. In addition, the surplus volume of water beyond what is recovered for potable water supply could augment potential lake outflow. This would support a number of other summer volume-dependent benefits, such as fish passage through the locks, containment of saltwater intrusion into the Ship Canal and Lake Union, maintenance of a stable summer lake elevation, and efficient management of existing regional water supply facilities in the Cedar River watershed. Another environmental benefit is reduced discharge of pollutants to Puget Sound.

Treated effluent would need to be discharged to groundwater or to surface waters in the Lake Washington drainage basin during periods when the demand for reclaimed water was low. Adverse impacts to water resources could occur if the reclaimed water was not treated sufficiently. Groundwater recharge regulations are being developed by the state with adoption scheduled in 1997. These regulations will set water quality standards. Currently, discharge of reclaimed water into the Lake Washington drainage basin is prohibited. Potential negative environmental impacts include the possible reduction of water quality in waters receiving reclaimed water discharge. Sufficient levels of treatment would be required to ensure there is no significant impairment of beneficial receiving water uses, such as salmon migration, aesthetics, human health and recreation,

FIGURE 12-2

Potential Reclaimed Water Project at Hiram Chittenden Locks



80124BHGDe.FH7

and others. There might also be environmental impacts associated with the construction and operation of the treatment plants or reclamation facilities, including land use impacts.

At this time, discharge of an effluent product, even treated to an advanced level, is not permitted in the Lake Washington drainage basin. The State is reevaluating this, but has not yet promulgated a revision. Such a revision may still require rigorous effluent treatment levels and facility redundancy requirements as part of permit conditions to provide assurance of dependable high quality facility performance. The discharge of even a highly treated wastewater effluent to Lake Washington or other fresh waters is counter to long time wastewater management policy and existing state pollution control regulations. There may also be public concerns regarding the advisability of changing this policy, regardless of technical assurances of acceptable environmental protection.

Service Strategy Option 4L: North Treatment Plant Discharge to Lake Washington

This service strategy option, which would apply to Service Strategy 2 and Service Strategy 3, calls for the construction of the North Treatment Plant as an advanced wastewater treatment plant producing an effluent that could be reused for non-potable purposes, discharged to groundwater to replenish the aquifer, or discharged to Lake Washington during periods of low or no reclaimed water demand.

This service strategy option has the benefit of delaying or eliminating the need for an effluent conveyance line and marine outfall, along with their capital costs. From an environmental perspective, the option would delay or avoid the adverse impacts of wastewater discharges at a new location in Puget Sound. It would also have the beneficial environmental impacts associated with delaying the construction of additional water supply facilities upstream, to the extent that the reclaimed water produced by the plant substituted for current uses of potable water.

Treated effluent would need to be discharged to groundwater or to surface waters in the Lake Washington drainage basin during periods when the demand for reclaimed water was low. Adverse impacts to water resources could occur if the reclaimed water was not treated sufficiently. Groundwater recharge regulations are being developed by the state with adoption scheduled in 1997. These regulations will set water quality standards. Currently, discharge of reclaimed water into the Lake Washington drainage basin is prohibited.

This option involves building and operating the North Treatment Plant initially as a small advanced wastewater reclamation facility.The reclamation facility would be brought online in 2005 as a 0.5-mgd demonstration facility and would be later expanded to 7.5 mgd by 2018 for Service Strategy 2 and by 2010 for Service Strategy 3. The 35-mgd North Treatment Plant, the tunnel, and the marine outfall construction as described in the two service strategies could be delayed five or more years.

One environmental benefit of “indirectly” adding potable water supply to Lake Washington is to minimize the development of potable water supply sources upstream in the western Cascade drainage basins. This would preserve existing stream flows for fish, wildlife, and other beneficial uses. In addition, the surplus volume of water beyond what is recovered for potable water supply could augment potential lake outflow. This would support a number of other summer volume-dependent benefits, such as fish passage through the locks, containment of saltwater intrusion into the Ship Canal and Lake Union, maintenance of a stable summer lake elevation, and efficient management of existing regional water supply facilities in the Cedar River watershed. Another environmental benefit is reduced discharge of pollutants to Puget Sound.

Potential negative environmental impacts include the possible reduction of water quality in waters receiving reclaimed water discharge. Sufficient levels of treatment would be required to ensure there is no significant impairment of beneficial receiving water uses, such as salmon migration, aesthetics, human health and recreation, and others. There might also be environmental impacts associated with the construction and operation of the treatment plants or reclamation facilities, including land use impacts.

At this time, discharge of an effluent product, even treated to an advanced level, is not permitted in the Lake Washington drainage basin. The State is reevaluating this, but has not yet promulgated a revision. Such a revision may still require rigorous effluent treatment levels and facility redundancy requirements as part of permit conditions to provide assurance of dependable high quality facility performance. The discharge of even a highly treated wastewater effluent to Lake Washington or other fresh waters is counter to long time wastewater management policy and existing state pollution control regulations. There may also be public concerns regarding the advisability of changing this policy, regardless of technical assurances of acceptable environmental protection.

OTHER

The last category contains two options. The first involves developing alternataive programs that substitute capital sewer utility projects with other types of projects to improve water quality. The second offers incentives to communities to accept wastewater facilities at the front end of siting wastewater treatment facilties as opposed to mitigating the impacts of wastewater facilities after they have been sited and constructed.

Service Strategy Option 4M: Implement Pollutant Source Trading

This service strategy option would introduce a new process to compare county expenditures across all water quality capital projects. The expenditures would be looked on as “investments” in the region’s water quality, and those projects with the best water quality, sediment quality, or habitat improvement “return” on the investment dollar would be favored during the prioritization process. The program could be used, for example, to fund a stormwater control project or to purchase critical upstream habitat instead of funding a sewer utility project if it was determined that greater water quality benefits would accrue. Such a point-nonpoint trading program has the potential for substantial cost savings, because it sets the stage for focusing funding on projects that have the greatest water quality benefits to waterways. It could also be tailored to those waterways most in need of restoration or protection.

Difficulties to be overcome before such a tradeoff program could be implemented include developing a methodology to compare different water quality investments on an "apples-to-apples" basis; collecting a reliable database that accurately categorizes the county's water, aquatic, and other biological resources; and revising regulations that would not currently permit the program. There is no existing methodology to compare, on a water quality or "value" basis, such alternative projects as the purchase of riparian/wildlife habitat and a capital project that reduces discharge at a CSO outfall to one event per year. While the potential to improve the return on each dollar of water quality investment is great, the difficulty of quantifying potential tradeoffs could delay program implementation.

One risk of a point/non-point source trading program is that there is no certainty regarding future regulatory requirements and constraints, and full implementation of wastewater projects to meet current regulations could be required after funds are already spent on offsetting water, sediment and habitat improvement projects. A point/non-point source trading program could potentially provide greater environmental benefits to area receiving waters than would be realized through the construction of additional capital facilities by the sewer utility. It could also reduce the construction and operating impacts associated with those facilities.

At this time, there is no legal basis for point/non-point trading, which is inconsistent with provisions of state and federal laws, existing contracts, and the King County Charter. The King County Charter currently limits the expenditure of sewer revenues for non-wastewater projects, even if the projects would achieve the same purpose as a wastewater project. However, there is nationwide interest in investigating effluent trading within watersheds. The EPA recently published a document entitled EPA, Office of Water, Watershed Approach Framework (June 1996).

Implementing this option would involve renegotiating existing contracts with the 35 component sewage agencies.

Service Strategy Option 4N: Offer Siting Incentives

The typical method for selecting sites for major wastewater facilities such as a treatment plant or a large CSO facility is to: 1) identify as many sites as possible which meet the physical requirements for the facility, 2) solicit public input, and 3) work with the surrounding communities to develop the appropriate mitigation measures. This option suggests an alternative method of providing incentives to communities to participate in the process of siting wastewater facilities, especially treatment plants, within their jurisdictions. This compensatory mitigation could occur prior to facility site selection, easing the siting process for both King County and the potential host community by initiating a positive dialogue. This option could be implemented with all four service strategies.

This service strategy option would be designed to facilitate the often-controversial process of siting a major new wastewater facility.

An incentive program in and of itself would not have direct environmental consequences. It would influence the siting of new facilities, but the siting, construction and operation of any wastewater facilities would be subject to environmental review under the requirements of the State Environmental Policy Act (SEPA). Any significant adverse environmental impacts would be identified at that time along with appropriate mitigating measures. Projects proposed by the host community would also be subject to SEPA environmental review.