910/9-80-077

United States
Environmental Protection
Agency

Region 10
1200 Sixth Avenue
Seattle WA 98101

Water | December 1980 | EPA-10-WA-KING-Metro-WWTW-80

EPA

# Environmental Impact Statement

Draft

## Wastewater Management Plan For the Lake Washington/Green River Basins

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION X
1200 SIXTH AVENUE
SEATTLE, WASHINGTON 98101

REPLY TO ATTN OF: M/S 443

DEC 1 1980

To: All Interested Government Agencies, Public Groups, and Citizens

I am forwarding for your review and comment this draft environmental impact statement (EIS) on the Wastewater Management Plan for the Lake Washington/Green River Basins. The Environmental Protection Agency (EPA) has given the Municipality of Metropolitan Seattle (Metro) a grant for planning needed facilities for treating wastewater from the Renton treatment plant study area. Metro is expected to apply to EPA for a grant for construction of approved facilities, under Section 201 of the Federal Clean Water Act. EPA is preparing this draft EIS on its proposed approval of Metro's facilities plan, pursuant to Section 102(2)(c) of the National Environmental Policy Act of 1969 and implementing Federal regulations.

EPA will announce the availability of this document in the Federal Register on Friday, December 19, 1980, beginning a 45-day review period. If you have any comments on this draft EIS or wish to provide additional information for inclusion in the final EIS, we would appreciate hearing from you before the close of the comment period on February 2, 1981. All comments will be used by EPA in evaluating the effects of approving the proposed plan. Please send your comments, or requests for additional copies of the draft EIS to:

Roger K. Mochnick M/S 443
Environmental Evaluation Branch
U.S. Environmental Protection Agency
1200 Sixth Avenue
Seattle, Washington 98101

Additional copies of this document and supporting appendices are available for review at the EPA Region 10 Library at the above address; at the Metro Library at 821 Second Avenue, Seattle; and at public libraries at Bellevue, Redmond, and Renton.

EPA and Metro will hold public meetings to discuss the draft plan and draft EIS at the following times and locations:

January 6 Alki-Congregational Community Church, 7:00 p.m.
January 7 Bellevue-Puget Sound Power and Light Auditorium, 7:30 p.m.
January 14 Seattle-Exchange Building 4th floor conference room 12:00 p.m.
January 15 Kent-City Council Chambers, 7:30 p.m.

In addition, EPA and Metro will hold public hearings to receive public comments on the plan and EIS at the following times and locations:

January 21 Seattle-Exchange Building 4th floor conference room, 12:00 p.m.
January 21 Bellevue-Puget Sound Power and Light Auditorium, 7:00 p.m.

I hope you will take the time to comment in writing or attend one of these public meetings or hearings.

Sincerely,

Donald P. DuBois
Regional Administrator

Attachment

DRAFT ENVIRONMENTAL IMPACT STATEMENT

# WASTEWATER MANAGEMENT PLAN FOR THE LAKE WASHINGTON/GREEN RIVER BASINS

Prepared by
U.S. Environmental Protection Agency
Region 10
Seattle, Washington 98101

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Donald P. Dubois
Regional Administrator

DEC 1 1980
Date

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## SUMMARY

(X) Draft Environmental Impact Statement

( ) Final Environmental Impact Statement

Type of Action: Administrative

### Purpose and Need for Action

The Municipality of Metropolitan Seattle (Metro) is expected to apply to the U. S. Environmental Protection Agency (EPA) for grant funds to design and construct improvements to the Metro Renton treatment plant sewerage system. Metro has prepared a Draft Wastewater Management Plan for the 620-square-mile Lake Washington/Green River Basins study area for three major reasons: (1) the Renton treatment plant and other facilities have reached their operating capacity and need expansion to accommodate future growth; (2) increasing quantities of secondary effluent from the Renton plant are being discharged to the Green/Duwamish River, and near-term ammonia, dissolved oxygen, temperature, and chlorine problems can be forecast during low flow periods; and (3) much new development within the study area will be using on-site technologies, and these systems have the potential to adversely affect water quality.

This EIS focuses on three major issues associated with the Metro plan:

Costs: What are the comparative costs and financial effects on users of the various near-term and long-term alternatives considered by Metro?

Water Quality: What are the water quality and biological trade-offs of continued discharge of Renton treatment plant effluent to the Green/Duwamish River compared to discharge to Puget Sound? What are the water quality impacts, if any, of on-site systems in the less developed portions of the study area?

Land Use: What are the land use impacts of wastewater management alternatives for the study area, and what impacts will growth accommodated by facilities expansion have on water quality, agricultural lands, sensitive areas, air quality, and public services and finance?

## Description of Alternatives

### Background

The Renton treatment plant has the capacity to treat an average of 36 million gallons per day (MGD). The treatment plant has been operating in a stressed mode for the past 2 years as wastewater flows have approached and exceeded the 36 MGD capacity; flows during the first quarter of 1980 were above 40 MGD. The plant is generally meeting its discharge limitations, however, because it was designed with several back-up measures which provide reliability during higher flows.

Flow projections for wastewater management planning were based on the "policy" population projection prepared by the Puget Sound Council of Governments (PSCOG). PSCOG projects that the study area population will increase from 537,087 in 1980 to 805,000 in the year 2000, of which 681,000 will be sewered. Allowing for domestic flow, industrial flow, and infiltration and inflow, Metro projects a year 2000 average wet weather flow of 101 MGD. This projection includes flows from the north part of the study area, which is currently served by Metro's West Point plant.

The proposed sewer service area for Metro's plan consists of those lands which are presently authorized to receive sewer service by local land use plans or policies. The remainder of the study area (the nonsewer area) consists of lands for which long-term land use is certain (where local policies indicate sewer service should not be provided), and lands for which long-term land use is uncertain (lands where there is no clear local policy guidance, treated as nonsewered for purposes of wastewater management planning). The proposed service area map is consistent with local land use plans and policies, according to an analysis done as part of this EIS.

### Long-Term Wastewater Management Alternatives

Metro initially developed 15 long-term alternatives, which are variations on three basic concepts: expansion of the Renton treatment plant to process all wastewater generated in the sewer service area (example Program A), expansion of the Renton plant and construction of a new plant in the Kenmore area (example Program B), and construction of six satellite plants in addition to the Renton expansion and Kenmore plant (example Program C). Variations on these concepts relate to level of treatment at the Renton plant (secondary vs. nitrification vs. advanced waste treatment) and to receiving water for Renton effluent (Green/Duwamish River vs. Puget Sound).

Four final alternatives were selected by Metro for further consideration following a screening process. These alternatives are Alternative A-1 (centralized processing at Renton plant with nitrification and continued discharge to the Green/Duwamish River), Alternative A-3 (centralized processing at the Renton plant with discharge of secondary effluent to Puget Sound off the Point Pulley area), Alternative A-5 (same as A-3, but discharge off Alki Point), and Alternative B-1 (similar to A-1, but with construction of a new secondary treatment plant in the Kenmore area to treat sewage from the north part of the study area).

Following further evaluation, Metro staff selected Alternative A-3 or A-5 as the preferred long-term wastewater management program (these alternatives differ only in the Puget Sound outfall location). Components of the preferred program include: collection system changes (construction of the Redmond connection and North Creek/Hollywood connection to convey wastewater from the north part of the study area to the Renton plant); expansion of the Renton treatment plant to 99 MGD; construction of a tunnel and outfall to convey effluent to Puget Sound; and installation of solids processing facilities at the Renton plant (Renton sludge is currently discharged via a force main to Metro's West Point plant). Construction of the preferred program projects would be phased; Phase 1 construction would occur between 1981 and 1985, and Phase 2 construction would occur between 1986 and 1993.

This EIS focuses on the impacts of the preferred program, Alternative A-1, Alternative B-1, and the no-project alternative; EPA regulations require the no-project alternative to be examined in EPA EISs.

## Other Aspects of the Draft Wastewater Management Plan

Near-Term Actions. Three groups of near-term actions are identified in the Metro plan: actions proposed for Phase 1 of the preferred long-term program, projects for which further planning is needed, and projects in progress. The first group of near-term projects is analyzed in this EIS as part of the preferred long-term program assessment; the latter two groups of projects are not assessed here since they are not related to decisions which currently must be made by EPA.

Nonsewer Area. The Draft Wastewater Management Plan recommends management options for on-site systems in the nonsewer area (the area for which sewers are not being planned over the next 20 years). These recommendations include: establishing a comprehensive program for design, construction, and maintenance of on-site and community systems; providing adequate staffing, funding, and enforcement of on-site wastewater management programs; encouraging experimentation with

alternative technologies; and establishing a public education program. These recommendations are incorporated within the mitigation measures identified in this EIS for reducing adverse secondary groundwater and surface water impacts caused by continued growth in the nonsewer area.

Triggering Mechanism. The Draft Wastewater Management Plan proposes a monitoring program, termed the triggering mechanism, to provide advance notice for expansion or additions to the Metro sewerage system, and to monitor performance of on-site systems in nonsewer areas. This mechanism is not separately analyzed in the EIS because it is itself a mitigation measure, and its impacts will be beneficial.

Sludge Disposal. The Metro plan assumes that long-term disposal for Renton sludge will be accomplished by application to forestlands, reclamation of marginal soils, and composting. This proposal and other long-term sludge disposal alternatives are currently being examined by Metro in a separate planning effort, which will be accompanied by a separate environmental review process.

### Alternatives Available to EPA

EPA may develop other structural (facilities) alternatives or administrative alternatives as part of its EISs on wastewater facilities plans. In the case of the Draft Wastewater Management Plan, EPA has determined that Metro has examined a full range of structural alternatives, and that new structural alternatives are not warranted as part of this EIS. EPA administrative alternatives are of two types: funding and grant conditions. EPA may decide to fund or not fund the selected program, to fund one or both of the project phases, and to fund or not fund capacity of facilities beyond the 20-year capacity. EPA may also place conditions on subsequent design and construction grants to mitigate adverse construction, operational, or secondary impacts.

## Assessment of Impacts

### Comparison of Alternatives

Table S-1 compares the costs, construction and site-related impacts, operational impacts, and secondary (growth-related) impacts of the preferred program, Alternative A-1, Alternative B-1, and the no-project alternative. Key trade-offs among the alternatives are described below.

Preferred Program. This alternative has higher present worth costs than Alternative A-1, but could result in smaller user charges if discharge off Point Pulley were selected.

Table S-1. Summary Comparison of Environmental Impacts: Wastewater Management Alternatives for the Lake Washington/Green River Basins

| Type of Impact | Impact of Preferred Program | Impact of Alternative A-1 | Impact of Alternative B-1 | Impacts of No Project | Available Mitigation Measures |
|---|---|---|---|---|---|
| **Costs** | | | | | |
| Present worth costs | $279,000,000 (A-3)<br>$357,000,000 (A-5) | $267,000,000 | $329,000,000 | - | None required |
| Increase in Metro monthly charge assuming various percentages of grant funding (1980 charge = $3.90/month) | $2.10/month (A-3)-75%<br>$2.60/month (A-5)-75%<br>$3.20/month (A-3)-50%<br>$4.00/month (A-5)-50%<br>$5.50/month (A-3)- 0%<br>$7.00/month (A-5)- 0% | $2.50/month-75%<br>$3.50/month-50%<br>$5.40/month- 0% | $2.60/month-75%<br>$3.70/month-50%<br>$6.10/month- 0% | Slight increase due to operation and maintenance cost increases | None required |
| **Construction and Site-Related Impacts** | | | | | |
| Construction and site-related impacts | Mostly minor, except for Renton tunnel/outfall alternatives, which could disrupt recreational uses, cause traffic disruption, and result in spoils disposal problems | Mostly minor | Mostly minor, except for Kenmore tunnel/outfall, which could disrupt recreational uses and result in spoils disposal problems | - | Recreational use impacts: Schedule construction during off-peak recreational periods<br>Traffic impacts: Reroute traffic around construction sites and provide flagmen<br>Spoils disposal impacts: Use spoils for fill or dispose of in acceptable location<br>Cultural resources: Conduct detailed archeological survey prior to construction |
| Construction employment | 6,290 job-years (A-3)<br>8,770 job-years (A-5) | 4,050 job-years | 5,450 job-years | - | None required (local construction labor force appears sufficient to meet project requirements) |
| **Operational Impacts** | | | | | |
| Water quality (also see aquatic biology impacts below)<br>-Green/Duwamish River | Short-term: Temperature, dissolved oxygen, and ammonia water quality standards would continue to be violated. DOE effluent dilution guidelines (20:1) would continue to be exceeded. | Short-term: Same as preferred program | Short-term: Same as preferred program | Short-term: Same as preferred program | To be implemented: 1) fast-track implementation of plant expansion; 2) diversion of flow via sludge force mains; and 3) reduction of summer flushing |

| Type of Impact | Impact of Preferred Program | Impact of Alternative A-1 | Impact of Alternative B-1 | Impact of No Project | Available Mitigation Measures |
|---|---|---|---|---|---|
| -Green/Duwamish River (cont'd.) | | | | | Additional measures available: 1) interim nitrification with existing facilities; 2) construct special nitrification facilities; 3) use of Kent/Auburn lagoons; 4) diversion of flow via Riverton/Renton pump station; 5) diversion of effluent for land disposal; 6) local agency infiltration control; 7) water conservation; 8) interim river flow augmentation; 9) fisheries resource protection; and 10) sewer moratorium |
| | Long-term: Future water quality problems in river avoided through removal of effluent. Salt wedge of estuary could move further upstream if DOE minimum flows not met. | Long-term: Ammonia and dissolved oxygen problems mitigated through nitrification. Temperature standards, DOE effluent dilution guidelines, and DOE estimated limitations for copper, mercury, and zinc would continue to be exceeded. | Long-term: Same as A-1, except that lower flows would cause problems to be less severe | Long-term: Major adverse ammonia and dissolved oxygen problems. Otherwise, same as A-1. | For Alternatives A-1, B-1, and no project, divert effluent to Puget Sound<br>For heavy metals, complete Metro toxicant study and implement recommendations<br>For all alternatives, improve chlorination system at Renton plant (improvements currently underway) |
| -Puget Sound | West Point discharge: Improved effluent quality due to sludge removal and flow diversion | West Point discharge: Same as preferred program | West Point discharge: Same as preferred program | West Point discharge: No change -- continued violation of NPDES permit suspended solids limit due to Renton sludge | For no project, remove sludge and divert effluent from West Point to Renton |
| | Renton discharge: No major impacts. Localized increases in turbidity, ammonia, and heavy metals near outfall. Alki Point (A-5) discharge preferable to Point Pulley (A-3) discharge due to shorter effluent residence time in Puget Sound. | Renton discharge: Renton discharge to Green/Duwamish River enters Puget Sound. No major impacts expected. | Renton discharge: Same as A-1<br>Kenmore discharge: No major impacts. Localized increases in turbidity, ammonia, and heavy metals near outfall. | Renton discharge: Same as A-1, except impacts not known | For heavy metals, complete Metro toxicant study and implement recommendations<br>For preferred program, complete detailed oceanographic and biological studies of outfall.<br>For all alternatives, improve chlorination system at Renton plant (improvements currently underway) |

| Type of Impact | Impact of Preferred Program | Impact of Alternative A-1 | Impact of Alternative B-1 | Impact of No Project | Available Mitigation Measures |
|---|---|---|---|---|---|
| Aquatic biology | | | | | |
| -Green/Duwamish River | Short-term: Increased risk of impaired salmonid migration or fish kills due to water quality degradation | Short-term: Same as preferred program | Short-term: Same as preferred program | Short-term: Same as preferred program | See water quality impacts |
| | Long-term: Future risks to aquatic life avoided through removal of effluent | Long-term: Increased temperatures could adversely affect salmonid migration | Long-term: Same as A-1, except that lower flows would cause less risk to salmonid migration | Long-term: Ammonia and dissolved oxygen problems would cause severe risks of impaired salmonid migration or fish kills. Continued existence of fishery would be threatened. | See water quality impacts |
| -Puget Sound | West Point discharge: Less risk to aquatic life due to improved effluent quality | West Point discharge: Same as preferred program | West Point discharge: Same as preferred program | West Point discharge: No change. | See water quality impacts |
| | Renton discharge: No significant impacts likely. Possible heavy metal accumulation in mussels and clams near outfall. | Renton discharge: No major impacts expected | Renton discharge: No major impacts expected<br>Kenmore discharge: No significant impacts likely. Possible heavy metal accumulation in mussels and clams near outfall. | Renton discharge: Impacts unknown | See water quality impacts |
| Resource use | | | | | |
| -Energy use | 87,000,000 Kwh/yr (A-3)<br>89,000,000 Kwh/yr (A-5) | 98,000,000 Kwh/yr | 75,000,000 Kwh/yr | Minor increases over present energy use | — |
| -Chemical use | 760 tons/yr chlorine<br>3.9 tons/yr ferric chloride | 760 tons/yr chlorine<br>240 tons/yr sulfur dioxide<br>4.3 tons/yr ferric chloride | 550 tons/yr chlorine<br>170 tons/yr sulfur dioxide<br>3.8 tons/yr ferric chloride | Minor increases over present chemical use | — |
| Growth-related impacts of project staging | Requires several nonmodular facilities (which cannot easily be expanded in modules): North Creek/Hollywood connection, Redmond connection, Renton tunnel/outfall. Latter two sized for 50-year projections not based on PSCOG projections or local land use policies. | Same as preferred program, except Renton tunnel/outfall not required | More flexible than preferred program or Alternative A-1. Only nonmodular facility is Kenmore plant tunnel/outfall. | Not responsive to future study area growth | Reduce staging period<br>Base 50-year flow projections on land use plans or PSCOG population projections |

| Type of Impact | Impact of Preferred Program | Impact of Alternative A-1 | Impact of Alternative B-1 | Impact of No Project | Available Mitigation Measures |
|---|---|---|---|---|---|
| Recreation | Potential for additional recreation opportunities | Potential for additional recreation opportunities | Potential for additional recreation opportunities | No effect | None required |
| Secondary Impacts of Growth Projected for Study Area | | | | | |
| Air quality | Population projections used for wastewater management planning consistent with those used for Puget Sound Air Quality Management Plan (AQMP). Therefore, increased emissions from study area growth have been accounted for in AQMP. | | | Lack of wastewater treatment capacity could encourage more growth outside study area and encourage lower density development within study area. Otherwise, secondary impacts similar to those described for other alternatives. | AQMP air quality control measures |
| Surface water and biology | Water quality deterioration and anadromous fish losses are occurring now because of urbanization, and could continue in the future. High-growth subdrainage basins will be particularly affected. | | | " | Metro 208 areawide water quality planning<br>Local nonpoint source control programs |
| Groundwater | Risks to groundwater (and surface water) from inadequately sited, operated, or maintained on-site systems in nonsewer area | | | " | Establish comprehensive on-site system management program<br>Provide adequate staffing, funding, and enforcement<br>Encourage experimentation with alternative technologies<br>Establish public education program<br>Determine groundwater carrying capacity<br>Establish institutional agreements for on-site system management |
| Land use<br>-Consistency with local land use policies | Proposed service area is consistent with local land use policies | | | " | None required |

| Type of Impact | Impact of Preferred Program | Impact of Alternative A-1 | Impact of Alternative B-1 | Impact of No Project | Available Mitigation Measures |
|---|---|---|---|---|---|
| -Prime farmland conversion | Between 3,950 and 5,213 acres of prime farmland could be converted to urban uses over the next 20 years in the Sammamish Valley, Lower Green River Valley, and Upper Green River Valley agricultural districts. This represents 21%-27% of the remaining prime farmland in these three districts. | | | " | King County Purchase of Development Rights (PDR) program<br>King County Sewerage General Plan (SGP) policies<br>Metro Resolution 3380 policies<br>King County modification of SGP and Metro modification of Resolution 3380 to include additional King County prime farmlands<br>City development of prime farmland protection policies for incorporated areas<br>Conduct detailed prime farmland assessments in future state-required EISs for Metro interceptor sewers. |
| -Sensitive areas | Study area growth could occur on soil-related sensitive areas, wetlands, and floodplains. High-growth subdrainage basins which contain relatively large acreages of these sensitive areas would be particularly affected. | | | " | King County ordinance and General Development Guide policies<br>Local floodplain management programs and federal Flood Insurance Program<br>Conduct detailed sensitive area assessments in future state-required EISs for Metro interceptor sewers |
| Public service systems | Study area growth will increase demands on public services such as wastewater management, water supply, drainage, solid waste management, recreation, social services, transportation, and electricity and gas | | | " | Implementation of existing comprehensive and special purpose plans and policies of local agencies |
| Public finance | Study area growth will increase both public costs and revenues, and could create fiscal problems for some local governments | | | " | Implementation of existing local measures for financing the costs of growth |

Construction of the Renton tunnel/outfall could have adverse short-term impacts on traffic, recreation, and spoils disposal, depending on the route selected. Future water quality problems and risks to salmonid migration in the Green/Duwamish River would be avoided. Discharge of Renton effluent to Puget Sound is not expected to create major water quality impacts; choice of the Alki Point discharge would result in shorter effluent residence time in Puget Sound, reducing water quality risks. The preferred program would require construction of several nonmodular facilities, which cannot easily be expanded in modules and are thus relatively inflexible; these are the North Creek/Hollywood connection, the Redmond connection, and the Renton tunnel/outfall. The latter two are sized based on 50-year flow projections.

Alternative A-1. This alternative has lower present worth costs than any of the alternatives (except no project) but could have higher user charges than the preferred program if discharge off Point Pulley were selected. Construction impacts of the Renton tunnel/outfall would be avoided. Current ammonia and dissolved oxygen problems in the Green/Duwamish River would be mitigated by nitrification, but temperature standards, Department of Ecology (DOE) effluent dilution guidelines, and DOE estimated limitations for certain heavy metals would all be exceeded. Salmonid migration could be affected, particularly by increased temperatures in the river. This alternative would require more energy and chemicals than either the preferred program or Alternative B-1. It would require construction of only two nommodular facilities: the Redmond connection and the North Creek/Hollywood connection.

Alternative B-1. This alternative has higher present worth and user costs than either the preferred program (if Point Pulley discharge were selected) or Alternative A-1. Construction of the Redmond connection, North Creek/Hollywood connection, and Renton tunnel/outfall would not be necessary; construction of the Kenmore treatment plant tunnel/outfall could have moderately adverse short-term construction impacts. Water quality and fisheries impacts in the Green/Duwamish River from discharge of nitrified effluent would be similar, but less severe, than those of Alternative A-1, because 20-year flows would be 72 MGD vs. 99 MGD for the preferred program. No major water quality impacts are expected from discharge of secondary effluent from the Kenmore plant to Puget Sound. This alternative is more flexible than either the preferred program or Alternative A-1 because it requires construction of only one nonmodular facility, the Kenmore tunnel/outfall.

No-Project Alternative. Under the no-project alternative, no capital improvements would be made to the Renton sewerage system, and the costs of the other long-term alternatives would be avoided. Major ammonia and dissolved oxygen problems would occur in the Green/Duwamish River with continued long-term discharge of secondary effluent; also, the additional water quality problems mentioned under Alternative A-1 would be

intensified. The ammonia and dissolved oxygen problems would cause severe risks of impaired salmonid migration and fish kills; the continued existence of the Green/Duwamish River fishery, which has a conservatively estimated value of about $5 million in 1976-77 dollars, would be threatened. The no-project alternative would not be responsive to study area growth; lack of sewerage capacity could encourage more growth outside the study area and more low density development using on-site systems within the area.

Impacts Common to All Alternatives

Any of the alternatives (except the no-project alternative) would take about 5 years to design and build. During this time, short-term deterioration in Green/Duwamish River water quality can be expected as sewage flows continue to increase beyond the Renton treatment plant's treatment capacity. Temperature, dissolved oxygen, and ammonia water quality standards would be violated, and DOE effluent dilution guidelines (20:1) would continue to be exceeded. Deteriorating water quality would increase the risks of impaired salmonid migration or fish kills. Mitigation measures to reduce these short-term impacts are listed in Table S-1.

The secondary impacts of growth projected for the study area are also common to all alternatives (except the no-project alternative). Neither EPA nor Metro is institutionally "responsible" for growth and secondary impacts. Because the planned wastewater facilities will assist in accommodating projected growth, the philosophy that EISs are full disclosure documents dictates that secondary impacts be examined in this EIS and mitigated where possible. As shown in Table S-1, projected growth in the study area will have a number of impacts on air and water quality, land use, and public services and finance; mitigation measures for these impacts are also shown in Table S-1.

Of particular concern to EPA are: (1) water quality deterioration and anadromous fish losses caused by urbanization-induced nonpoint source pollution; (2) risks to groundwater from inadequately sized, operated or maintained on-site systems; (3) conversion of prime farmlands (between 3,950 and 5,213 acres of prime farmland could be converted over the next 20 years in the Sammamish Valley, Lower Green River Valley, and Upper Green River Valley); and (4) development on wetlands and floodplains. EPA programs and policies require that these impacts be mitigated where possible. Mitigation measures listed in Table S-1 are not necessarily the responsibility of EPA or Metro, but are nevertheless presented for public review.

## Public Involvement

Public participation for this EIS has been coordinated and, where possible, integrated with the full-scale public participation program undertaken by Metro in preparing its Draft Wastewater Management Plan. Key EIS public participation activities have included publication and distribution of an EIS information brochure, conducting scoping meetings, an EIS presentation to the Renton 201 Citizens Advisory Committee, and attendance and participation in Metro public meetings on wastewater management alternatives and the preliminary wastewater management plan.

This Draft EIS has been forwarded to numerous federal, state and local agencies, special interest groups, private citizens, and public libraries to act as both an informational document and as an avenue to comment on the proposed wastewater project. (The Draft EIS mailing list is presented in Chapter 8.) Also, a separate public summary of the EIS has been mailed to over 1,200 individuals.

Individuals or groups that wish to comment on the EIS may forward written comments to:

U. S. Environmental Protection Agency
Region X
1200 Sixth Avenue
Seattle, Washington 98101
Attention: Roger Mochnick M/S 443

Comments should be sent by February 2, 1981.

Joint public workshops have been scheduled on the Draft Wastewater Management Plan and Draft EIS by Metro and EPA during January 1981. Citizens and agency representatives will have a chance to learn about the plan and EIS, and discuss their questions and concerns in an informal workshop atmosphere. Formal public hearings on the Draft Wastewater Management Plan and Draft EIS have been scheduled for late January 1981. During these public hearings, formal oral and written testimony will be received.

# Chapter 1

# INTRODUCTION

The Municipality of Metropolitan Seattle (Metro) has prepared a draft Wastewater Management Plan for the Lake Washington/Green River Basins. The boundaries of the study area for this plan are shown in Figure 1-1.

This Draft Environmental Impact Statement (EIS) has been prepared by the U. S. Environmental Protection Agency (EPA). The applicable EPA decisions are to approve the Wastewater Management Plan and to partially fund projects called for in the plan.

## Organization of EIS

The Draft EIS consists of this report and a series of limited-distribution technical appendices which are separately bound. This chapter, Chapter 1, discusses the purpose and need for Metro's Wastewater Management Plan; describes the context of the EIS and Wastewater Management Plan; lists major issues addressed by the EIS; summarizes EIS public participation activities; and lastly, reviews institutional considerations (laws and affected agencies) related to the EIS.

Chapter 2 of the EIS briefly summarizes the environment of the Lake Washington/Green River Basins and the existing Renton sewerage system. Chapter 3 describes Metro's wastewater management alternatives. The construction and site-related impacts of these alternatives are assessed in Chapter 4, and the operational impacts are assessed in Chapter 5. In Chapter 6, growth-related secondary impacts common to all alternatives are reviewed. Chapter 7 discusses administrative alternatives available to the EPA. Chapter 8 documents EIS coordination activities. In Chapter 9 the names and qualifications of persons who prepared the EIS are listed. Lastly, Chapter 10 lists references used in preparing the EIS.

Four technical appendices have been prepared which describe selected aspects of the study area and document selected impact analyses in greater detail. These appendices, which are available as a separately bound report, are: land use and socio-economics (Appendix A), air quality (Appendix B), water quality and biology (Appendix C), and groundwater and soils (Appendix D). The appendices are available at the EPA Region X library and the Metro library in Seattle, and at depository public libraries in Bellevue, Renton and Redmond.

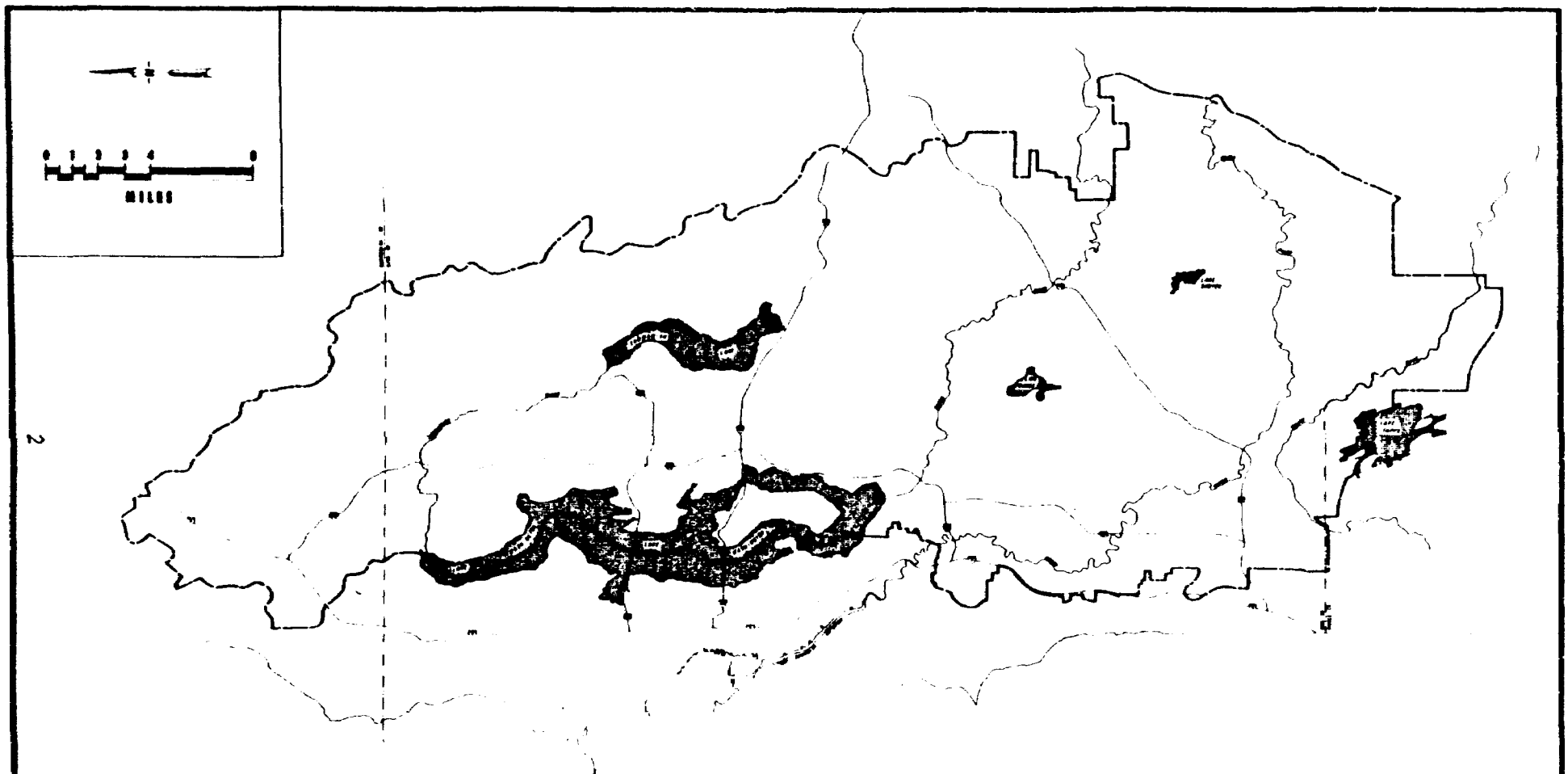



FIGURE 1-1. STUDY AREA BOUNDARIES

## Metro's Wastewater Management Plan

### Purpose and Need

Metro has prepared the Wastewater Management Plan for the Lake Washington/Green River Basins for three major reasons (Metro, 1980c):

1. The Renton treatment plant and several other sewerage facilities have reached their operating capacity and need expansion to accommodate future growth. Metro has selected a 20-year planning horizon to examine future treatment capacity needs, consistent with federal funding requirements.

2. Increasing quantities of secondary effluent from the Renton plant are being discharged to the Duwamish River, and near-term water quality problems can be forecast during low flow periods; constituents of concern include ammonia, chlorine, dissolved oxygen, and temperature.

3. Much new development within the study area will be using on-site or community wastewater management technologies, and these systems have the potential to adversely affect water quality.

### Development of the Wastewater Management Plan

Wastewater management planning for the study area has been influenced by several previous wastewater planning efforts. The most important of these are Metro's Comprehensive Plan (Metro, 1959); the RIBCO water quality management study (STR Inc., 1974b); Metro's Areawide Water Quality Plan (208 Plan) (Metro, 1978b); and Metro's wastewater facilities planning for its Puget Sound plants. The latter planning effort has influenced current planning for the Lake Washington/Green River Basins through recommending de-emphasis of the West Point treatment plant, thereby increasing the Renton treatment plant service area, and installing sludge handling facilities at the Renton plant.

The detailed process for preparing the current draft Wastewater Management Plan for the Lake Washington/Green River Basins is described in Metro's draft plan, and will only be summarized here. Between August 1979 and April 1980, Metro issued six technical memoranda serving as background data for the draft plan. These technical memoranda and their associated appendices are often used as sources of information for this EIS. The memoranda cover the following topics:

Memo #1: A description of existing wastewater facilities in the study area (Metro, 1979d)
Memo #2: A description of the environmental characteristics of the study area (Metro, 1979e).
Memo #3: An analysis of agency plans and policies affecting the wastewater plan (Metro, 1980a).
Memo #4: A description of alternative wastewater techniques (Metro, 1980b).
Memo #5: A discussion of facilities planning issues, objectives and screening criteria (Metro, 1980c).
Memo #6: An analysis of future wastewater flows and loadings (Metro, 1980d).

In early April, Metro issued its preliminary plan, which identified near-term and long-term wastewater management alternatives for the study area. Public meetings were held on the preliminary plan in May 1980. Metro's draft Wastewater Management Plan, which presents recommended near-term and long-term projects, was released in December 1980.

## EIS Context

### Major Issues Addressed by EIS

Preparation of a comprehensive wastewater management plan for the 620-square-mile study area raises a number of important and interesting issues. Based on public input and consultation with affected agencies, the following three issue groups have been determined to be of greatest importance to this EIS, and consequently are emphasized.

| | |
|---|---|
| Costs: | What are the comparative costs and financial effects on users of the various near-term and long-term alternatives considered by Metro? |
| Water Quality: | What are the water quality and biological trade-offs of continued discharge of Renton treatment plant effluent to the Green-Duwamish River compared to discharge to Puget Sound? What are the water quality impacts, if any, of on-site systems in the less developed portions of the study area? |
| Land Use: | What are the land use impacts of wastewater management alternatives for the study area, and what impacts will growth accommodated by facilities expansion have on water quality, agricultural lands, sensitive areas, air quality, and public services and finance? |

These three general issue groups have been recognized in Metro's preliminary plan by Metro as central to facilities planning decisions. The EIS, while emphasizing the above three issue groups, also covers the entire range of biophysical and socio-economic impacts related to Metro's near-term and long-term alternatives.

## National Environmental Policy Act of 1969 (NEPA) Requirements

Under NEPA, all federal agencies must build into their decision-making processes mechanisms for consideration of the environmental effects of proposed actions and mechanisms for minimizing adverse effects of these actions. The EIS required by Section 102(c) is the action-forcing mechanism of NEPA. EISs must include a detailed statement on the following:

1. The environmental impact of the proposed action.

2. Any adverse impacts which cannot be avoided should the project be implemented.

3. Alternatives to the proposed action.

4. The relationship between local short-term uses of man's environment and the maintenance and enhancement of long-term productivity.

5. Any irreversible and irretrievable commitments of resources.

In 1978, the Council on Environmental Quality (CEQ) issued regulations implementing NEPA. Significant requirements of these regulations include maximum opportunities for public participation (including EIS scoping meetings); page limitations for EISs; and an easy to understand writing style. Each federal agency is responsible for preparing its own procedures for implementing NEPA, which are to be consistent with the CEQ requirements. EPA issued its final regulations on November 6, 1979 (Federal Register, Vol. 44, No. 216, pg. 64174).

## EIS Chronology

The EIS for Metro's Wastewater Management Plan was initiated in August 1979. On September 26, 1979 and October 17, 1979, EIS "scoping" meetings were held in conjunction with Metro public information meetings, to obtain public input on important issues for the EIS. On October 2, 1979, EPA published in the Federal Register its Notice of Intent to prepare an EIS on Metro's Wastewater Management Plan.

In January 1980, the EIS consultant prepared a discussion paper on environmental screening criteria for use by Metro in screening preliminary wastewater management alternatives. Based on Metro's preliminary planning, a preliminary Draft EIS was prepared and the findings reviewed with key agencies prior to publication of the Draft EIS.

### Subsequent EIS Activities

Public workshops and hearings on the Draft EIS and Draft Wastewater Management Plan are currently scheduled for January 1981. Based on public input, agency policies, and legal requirements, the Draft EIS and draft plan will be revised and final versions of the documents will be released in the spring of 1981. A Metro decision on the final plan will then be made. Subsequently, EPA and the Washington Department of Ecology will take final action to approve or partially/conditionally approve the final plan. A Step 2 design grant would be made according to state funding priorities.

## Public Participation

The public participation program for this EIS has been coordinated and, where possible, integrated with Metro's extensive public participation program for its Wastewater Management Plan.

An initial informational brochure describing the EIS process and key issues was prepared by EPA in September 1979 and widely distributed. EIS scoping meetings held in September and October 1979 were a major opportunity for public input in determining issues to be emphasized in the EIS. Periodic presentations were subsequently made to the Citizens Advisory Committee for Metro's Wastewater Management Plan to advise the committee of EIS status and receive comments. Lastly, a public summary of this Draft EIS was prepared and distributed to an extensive mailing list.

The Draft EIS comment period, the public workshops and hearings to be held on the Draft EIS, and the response to comments to be included in the Final EIS will fulfill EPA's remaining formal public participation responsibilities under the National Environmental Policy Act.

## Institutional Considerations

This section summarizes laws, policies, and regulations affecting the EIS and identifies the roles of key agencies affected by the Wastewater Management Plan and EIS. A more detailed institutional overview of the study area is presented in Appendix A to the EIS.

Laws, Policies, and Agencies Affecting the EIS

Clean Water Act. The U. S. Environmental Protection Agency (EPA) is charged with administering the Federal Water Pollution Control Act, commonly referred to as the Clean Water Act. Section 201 of the Clean Water Act establishes a construction grants program for municipal wastewater facilities, wherein federal grants are offered for the planning (Step 1), design (Step 2), and construction (Step 3) of publicly-owned treatment works. Section 208 of the act establishes an areawide waste treatment management planning process. Section 208 plans must develop controls for both point and nonpoint sources of water pollution. Under Section 303 of the act, states are required to prepare and enforce ambient water quality standards and to prepare basin plans showing how these standards will be met. Lastly, under Sections 401 and 402 of the act, EPA or the states are required to issue National Pollutant Discharge Elimination System (NPDES) permits for all point sources of pollution.

Within the Lake Washington/Green River Basins, the State Department of Ecology (DOE) administers the construction grants program and the NPDES program, and sets water quality standards. In 1975, DOE prepared the 303(e) basin plan for the Cedar and Green River basins. Metro's water quality planning responsibilities in the study area include both areawide (208) and wastewater facilities (201) planning.

Clean Air Act. Under the Clean Air Act, states are required to prepare State Implementation Plans (SIPs) demonstrating means for achieving and maintaining national ambient air quality standards. The EPA procedures for implementing NEPA require formal consultation with state and regional air quality planning agencies to determine conformity of a proposed action with the SIP. The Draft EIS must include a statement indicating whether the project conforms with the SIP. If the project does not conform to the SIP, EPA will not give the project final approval.

Endangered Species Act. Under this act, federal agencies are prohibited from jeopardizing threatened or endangered species or modifying habitats essential to their survival. EPA procedures for implementing NEPA require formal consultation with the Fish and Wildlife Service or National Marine Fisheries Service, as appropriate, and subsequent development of mitigation measures if endangered species may be affected by a project.

Fish and Wildlife Coordination Act. Under this act, federal agencies involved in projects resulting in modifications of streams or other water bodies are required to protect fish and wildlife resources which may be affected by the project. EPA procedures for implementing NEPA require consultation with the Fish and Wildlife Service and appropriate state wildlife agencies to develop mitigation measures for adverse impacts.

National Historic Preservation Act. Under this law, if federal agencies undertake activities affecting sites of historic, architectural, archeological, or cultural value that are listed on the National Register of Historic Places, then the Advisory Council on Historic Preservation must be consulted and mitigation measures must be developed.

Archeological and Historic Preservation Act. This law requires federal agencies to undertake data recovery and preservation activities if federal activities may cause irreparable destruction of significant scientific, prehistoric, historic, or archeological data.

Coastal Zone Management Act. This act establishes funding and requirements for state coastal zone management programs; in Washington, shoreline management programs have been prepared to meet requirements of both the state Shoreline Management Act and the federal act. Under the EPA procedures for implementing NEPA, if EPA activities have significant coastal zone impacts, then a determiniation of consistency with the applicable coastal zone management program is required.

EPA Policy on Agricultural Lands Protection. In September 1978, EPA issued its policy, pursuant to Executive Order 11988, to protect environmentally significant agricultural lands. Under this policy, EPA is required to identify the direct and indirect impacts of its actions on environmentally significant agricultural lands, and to avoid or mitigate, to the extent possible, identified adverse impacts.

EPA Policy on Floodplain and Wetlands Protection. In January 1979, EPA issued its statement of procedures on floodplain management and wetlands protection, pursuant to Executive Order 11990. Under these procedures, EPA is required to assess floodplains and wetlands impacts of its actions, and to either avoid adverse impacts or minimize them if no practicable alternative to the action exists.

## Affected Agencies and Their Jurisdictions

Environmental management within the study area is carried out by a large number of federal, state and local agencies, many of which will be affected by Metro's Wastewater Management Plan. Table 1-1 is a matrix of agency responsibilities in the Lake Washington/Green River Basins. For each agency, responsibilities in each functional area are classified as either advisory, planning, regulatory, implementing (construction and operation), or funding. Not shown in this table are the numerous agencies engaged in research and monitoring activities. The responsibilities of key affected agencies are summarized below.

Environmental Protection Agency. The EPA has regulatory authority in the fields of water quality, wastewater management, water supply, solid waste management, and air quality.

Table 1-1. Institutional Overview:
Lake Washington/Green River Basins

| Agency | Public Service Systems | | | | | | Environmental Management | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Wastewater Management | Water Supply | Drainage/ Flood Control | Solid Waste Management | Recreation | Transportation | Water Quality | Fish and Wildlife | Air Quality | Land Use |
| **Federal** | | | | | | | | | | |
| EPA | R$ | R | $ | R$ | | | R$ | | R$ | |
| Army Corps of Engineers | | PI$ | PRI$ | | | | R | | | |
| Depart. of Housing & Urban Development | | | R | | | | | | | $ |
| USDA, Forest Service | | | | | PRI$ | | | | | |
| Heritage Conservation & Recreation Service | | | | | A$ | | | | | |
| Depart. of Transportation | | | | | | PI$ | | | | |
| Fish & Wildlife Service | | | | | | | A | A | | |
| **State** | | | | | | | | | | |
| Dept. of Ecology | R$ | PR$ | R | PR | | | R$ | | R$P | R$ |
| Dept. of Fisheries | | R | R | | | | R | R$I | | |
| Dept. of Game | | R | R | | RI$ | | R | R$I | | |
| Dept. of Natural Resources | | | R | | PRI$ | | R$ | | | PR |
| Parks & Recreation Commission | | | | | PI$ | | | | | |
| Dept. of Social & Health Services | R | R | | | | | R | R | | |
| Dept. of Transportation | | | | | | PI$ | | | | |
| **Regional/Local** | | | | | | | | | | |
| PSCOG | A | A | | | A | P | A | | P | P |
| Seattle-King County Dept. of Public Health | R | R | | R | | | R | | | |
| Metro | PI$ | | P | | | PI$ | PI$ | | | |
| Counties | P | P | PRI$ | PI$ | PI$ | PI$ | PRI$ | | | PRI$ |

Table 1-1 (cont.)

| Agency | Public Service Systems | | | | | | Environmental Management | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Wastewater Management | Water Supply | Drainage/ Flood Control | Solid Waste Management | Recreation | Transportation | Water Quality | Fish and Wildlife | Air Quality | Land Use |
| King County Soil Conservation District | | | A | | | | A | | | A |
| Cities | PI$ | PI$ | PRI$ | PI$ | PI$ | PI$ | PRI$ | | | PRI$ |
| Water and Sewer Districts | PI$ | PI$ | | | | | PI$ | | | |
| Sno-met | PI$ | | PI$ | | | | PI$ | | | |
| Puget Sound Air Pollution Control Agency | | | | | | | | | PR | |

CODE
A = Advisory
P = Planning
R = Regulatory
I = Implementing
$ = Funding

EPA water quality responsibilities are established in the Clean Water Act, the provisions of which have been previously reviewed. EPA responsibilities in water supply, solid waste, and air quality are established in the Safe Drinking Water Act, Resource Conservation and Recovery Act, and Clean Air Act, respectively.

Corps of Engineers. Under the federal Flood Control Act, the Corps of Engineers is responsible for flood control planning and implementation on major rivers and streams. Under Section 404 of the Federal Water Pollution Control Act, as amended, the Corps administers the national permit program for dredge and fill activities.

Department of Ecology. The DOE is the equivalent of EPA at the state level, having regulatory responsibility in the fields of water quality, wastewater management, solid waste management, air quality, and flood control. In addition, DOE administers the state Shoreline Management Act.

Departments of Fisheries and Game. The Department of Fisheries is responsible for managing food fish and shellfish, whereas the Department of Game is responsible for managing various game species, including game fish. These agencies advise DOE on water rights and allocation, and must jointly issue a hydraulics permit for alteration of natural streams and their uses.

Department of Natural Resources. This department is a natural resource agency within the state, with responsibility for state lands management, forest practices, geological services, and limited drainage and flood control activities.

Puget Sound Council of Governments. PSCOG is a voluntary association of local governments within King, Kitsap, Pierce and Snohomish Counties. PSCOG is responsible for developing advisory regional plans and policies, and is also responsible for conducting reviews of projects using federal assistance under Office of Management and Budget Circular A-95.

Metro. Metro is a regional service agency with planning, implementation, and funding responsibilities in the fields of water quality and transit. Metro's past water quality planning activities have included management of the River Basin Coordinating Committee (RIBCO) studies, preparation of the 208 areawide water quality management plan, and preparation of a facilities plan for its four Puget Sound plants. Metro acts as a "wholesaler" for wastewater services.

Counties and Cities. The Lake Washington/Green River Basins contain portions of three counties (King, Snohomish, and Pierce) and 18 cities. As general purpose governments, these counties and cities undertake a spectrum of public services and environmental management activities.

Special Districts. Numerous special purpose districts exist within the study area, providing key services such as water, sewers, and schools.

Chapter 2

# DESCRIPTION OF AFFECTED ENVIRONMENT AND EXISTING RENTON SEWERAGE SYSTEM

The first few sections of this chapter present an overview of the Lake Washington/Green River Basins study area. The following topics are covered: climate and air quality; soils, geology and groundwater; water resources and water quality; biology and fisheries; and land use and socio-economics. The intent of these sections is to acquaint readers unfamilar with the study area with its key biophysical and socio-economic features. Existing environmental conditions are further described in the appendices to the EIS and in Metro's Technical Memo #2. In addition, site-specific environmental features (e.g., the Green/Duwamish River) are described in the background sections of the impact assessments appearing in Chapters 4 and 5.

The last section of this chapter describes the existing Renton sewerage system. It describes the study area wastewater collection system, the Renton treatment plant, Renton wastewater and sludge characteristics, energy and chemical use, and costs of wastewater treatment.

## Climate and Air Quality

### Climate

The climate of the Lake Washington/Green River Basins study area is characterized by relatively cool, wet winters and warm, dry summers. The study area's close proximity to the Pacific Ocean, Puget Sound, and the Olympic and Cascade Mountains are major factors influencing the climate of the area.

Annual precipitation within the study area ranges from 35 inches in the lowlands to 100 inches or more in the surrounding mountains. Seventy-five percent of the annual precipitation occurs during the 6-month period from October through March. Only 5 percent of annual precipitation falls during July and August.

Local temperature conditions vary considerably in the study area according to elevation, solar radiation, and distance from Puget Sound. Temperatures during the summer months are generally in the 70s, with occasional temperatures in the 80s. Winter temperatures are typically in the 40s in the lowlands and decrease with increasing altitude -- approximately 3°F for every 1,000 feet of elevation.

Temperature inversions (an increase of temperature with height) have been recorded every month of the year in Seattle, but they are most common in October.

### Air Quality

The concentrations of ozone, carbon monoxide (CO), sulfur dioxide, and total suspended particulates (TSP) exceed National Ambient Air Quality Standards (NAAQS) within the central Puget Sound region. Because of these violations, portions of the region have been designated nonattainment areas with respect to these pollutants. In response to the Clean Air Act Amendments of 1977, an Air Quality Management Plan (AQMP) was prepared by the Puget Sound Air Pollution Control Agency (PSAPCA) and the PSCOG (Puget Sound Air Pollution Control Agency and PSCOG, 1978). The purpose of the AQMP is to present a coordinated, regional strategy for the attainment of NAAQS.

Vehicular traffic on paved and unpaved roads accounts for the majority of TSP emissions in both Renton and Kent (Figure 2-1). Other important sources include mobile emissions (tailpipe emissions) and fuel combustion.

CO emissions in Bellevue are almost exclusively from motor vehicles (Figure 2-1). No other sources contribute significant quantities of CO emissions.

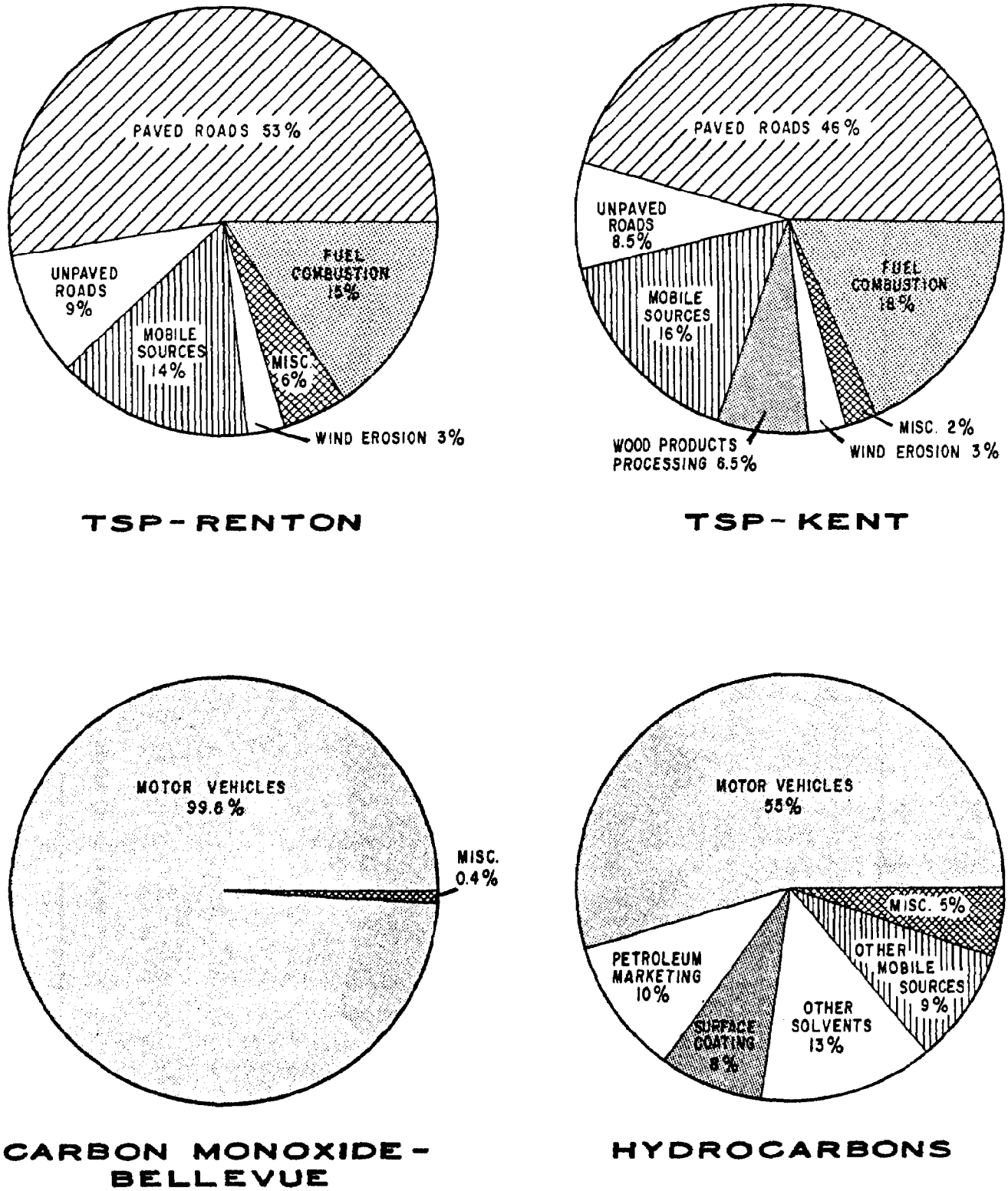
Hydrocarbon emissions contribute to the formation of ozone. Emissions from motor vehicles are the major source of hydrocarbons (55 percent) in the Puget Sound region. Other important sources include solvents, surface coating, petroleum marketing, and mobile sources other than motor vehicles (Figure 2-1).

## Soils, Geology, and Groundwater

### Soils

A map of regional soil associations in the study area is presented in Figure 2-2. Data on generalized capability class and typical land use of each major soil series and slope class are presented in Table 2-1. The degree of soil limitation for wastewater management is also indicated for on-site septic tank drain fields, sewage lagoons, and for effluent irrigation systems.

Most of the soils occurring in the study area have severe limitations for use as septic tank leach fields arising from their shallow depth, slow permeability or excessive slope. Moderate to severe soil limitations also exist for irrigation reuse of treated effluent.




SOURCE: PSAPCA & PSCOG, 1978

FIGURE 2-1. RELATIVE CONTRIBUTION OF EMISSION SOURCES - 1977 INVENTORY

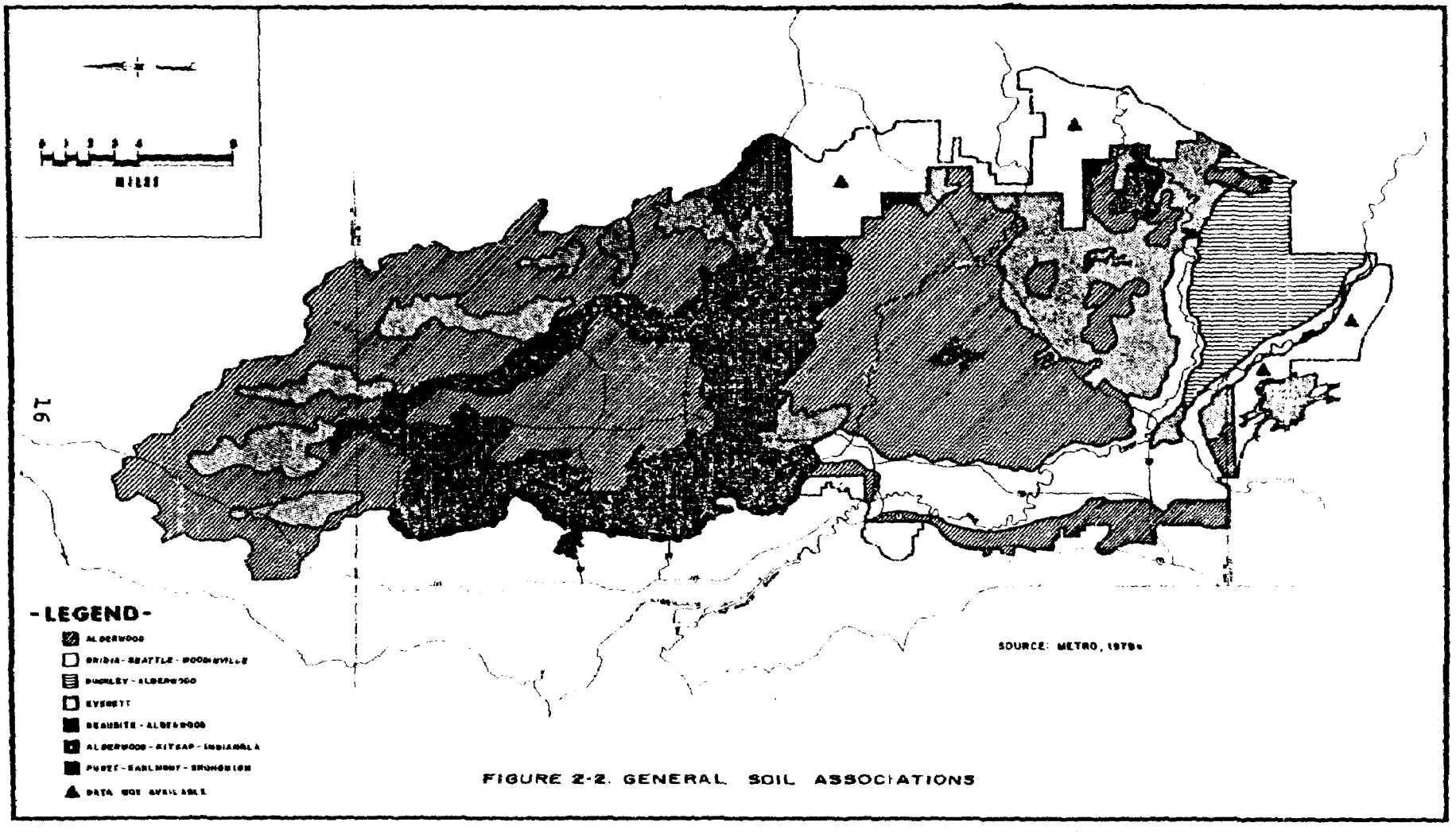



FIGURE 2-2. GENERAL SOIL ASSOCIATIONS

Table 2-1. Use and Limitations of Some Dominant Soils in the Renton Study Area

| | | | | | Limitations for Waste Disposal | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Septic Tank Leach Fields | | Sewage Lagoons Irrigation Reuse | | | |
| Series | Map Symbol[a] | Slope (%) | Agricultural Capability Class | Typical Usage[b] | Degree of hazard | Type of hazard[c] | Degree of hazard | Type of hazard[c] | Degree of hazard | Type of hazard[c] |
| Alderwood | AgB | 0-06 | IVe | TPRU | severe | d,p- | moderate | s | moderate | d |
| | AgC | 6-15 | IVe | TPRU | severe | d,p- | severe | s | moderate | s,d |
| | AgD | 15-30 | VIe | TP | severe | d,p- | severe | s | severe | s,d |
| | AkF | 25-70 | VIIe | T | severe | s,p- | severe | s | severe | s,d |
| Beausite | BeC | 6-15 | IVe | TPU | severe | d,p- | severe | s | moderate | s,d |
| | BeD | 15-30 | VIe | TP | severe | d,p- | severe | s | severe | s,d |
| | BeF | 40-75 | VIIe | T | severe | s,p- | severe | s | severe | s,d |
| Buckley | Bu | < 3 | IIIw | P,H | severe | w | severe | o | moderate | p-,w |
| Earlmont | Ea | < 1 | IIw | PR | severe | f,w | severe | f,o | moderate | f,w |
| Everett | EvB | 0-05 | IVs | TPU | moderate | p+ | severe | p+ | moderate | p+ |
| | EvC | 5-15 | VIs | TPU | moderate | p+ | severe | p+ | severe | p+ |
| | EvD | 15-30 | VIs | T | severe | s,p+ | severe | s,p+ | severe | s,p+ |
| Indianola | InA | 0-04 | IVs | TU | moderate | p+ | severe | p+ | severe | p+ |
| | InC | 4-15 | IVs | T | moderate | p+ | severe | p+ | severe | p+,s |
| | InD | 15-30 | VIe | T | severe | s,p+ | severe | s,p+ | severe | s,p+ |
| Kitsap | KpB | 2-08 | IIIe | TP | severe | p- | moderate | s | moderate | p-,d |
| | KpC | 8-15 | IVe | TP | severe | p- | severe | s | moderate | p-,s |
| | KpD | 15-30 | VIe | TP | severe | s,p- | severe | s | severe | s,p- |
| Oridia | Os | < 2 | IIw | RPU | severe | f,w | severe | f | moderate | w,f |
| Puget | Pu | < 1 | IIIw | RP | severe | p-,f,w | severe | f | moderate | w,f |
| Seattle | Sk | < 1 | IIw | PHR | severe | w,o | severe | o | severe | o,w |
| Snohomish | So | < 2 | IIw | RPH | severe | f,w,o | severe | f,p+,o | moderate | w,f |
| Woodinville | Wo | < 2 | IIw | RPU | severe | w,f | severe | f,o | moderate | w,f |

[a] refers to detailed soil survey map sheets

[b] T = timber
R = row crops
U = urban development
P = pasture
H = hay crops

[c] d = shallow depth
f = flooding
o = organic soil layers
p- = slow permeability
p+ = excessive permeability
s = excessive slope
w = high seasonal water table

Geology and Groundwater

The stratigraphy and occurrence of groundwater in surficial deposits and water-bearing units is described in this section. The principal water-bearing units in the project area include sand and gravel of the Salmon Springs drift, advance outwash (including the Esperance sand) and recessional outwash of Vashon drift, alluvial floodplain deposits and alluvial fan deposits. Figure 2-3 depicts a schematic hydrogeologic cross section of the Lake Washington/Green River Basins.

Salmon Springs drift deposits consist of up to 200 feet of sand and gravel with lesser amounts of silt and clay. These deposits generally form confined aquifers at varying depths below the ground surface and in many places are the principal source of groundwater for municipal wells. Vashon recessional and advance outwash glacial deposits consist dominantly of sand and gravel. Vashon recessional outwash deposits occur at the ground surface, are saturated locally, and are penetrated by many small domestic wells. Advance outwash deposits occur at or near the ground surface, are saturated throughout except at the edge of drift plains where they are typically well drained, and yield small to moderate amounts of water to wells. These deposits are highly developed for both domestic and municipal water supplies.

Alluvial floodplain and alluvial fan deposits of sand and gravel occur along the rivers draining the Cascade Mountains. These deposits form shallow aquifers which are in hydrologic continuity with surface water bodies, and yield moderate amounts of water to numerous small, shallow wells.

Vashon till is very widespread in the project area. These glacial deposits, with a thickness of about 50 feet, do not constitute major water-bearing aquifers because they are dominantly composed of clay and silt and are fairly compact throughout their thickness. The top portion, however, on which the Alderwood soil series is developed, is tapped by many small domestic wells, and is generally loosely compacted and susceptible to contamination.

Available data indicate that the quality of groundwater in the study area is good to excellent, although some wells yield water with objectionable concentrations of iron and/or chloride and dissolved solids that exceed the national drinking water standards. The concentration of orthophosphate is high throughout the study area and typically highest in the deep aquifers. This is generally attributed to inherent aquifer characteristics and not to human activities.

Groundwater with objectionable levels of iron is very common in the study area; however, no areal or stratigraphic pattern has been found in the occurrence of high iron concentrations. The solubility of iron in water increases with

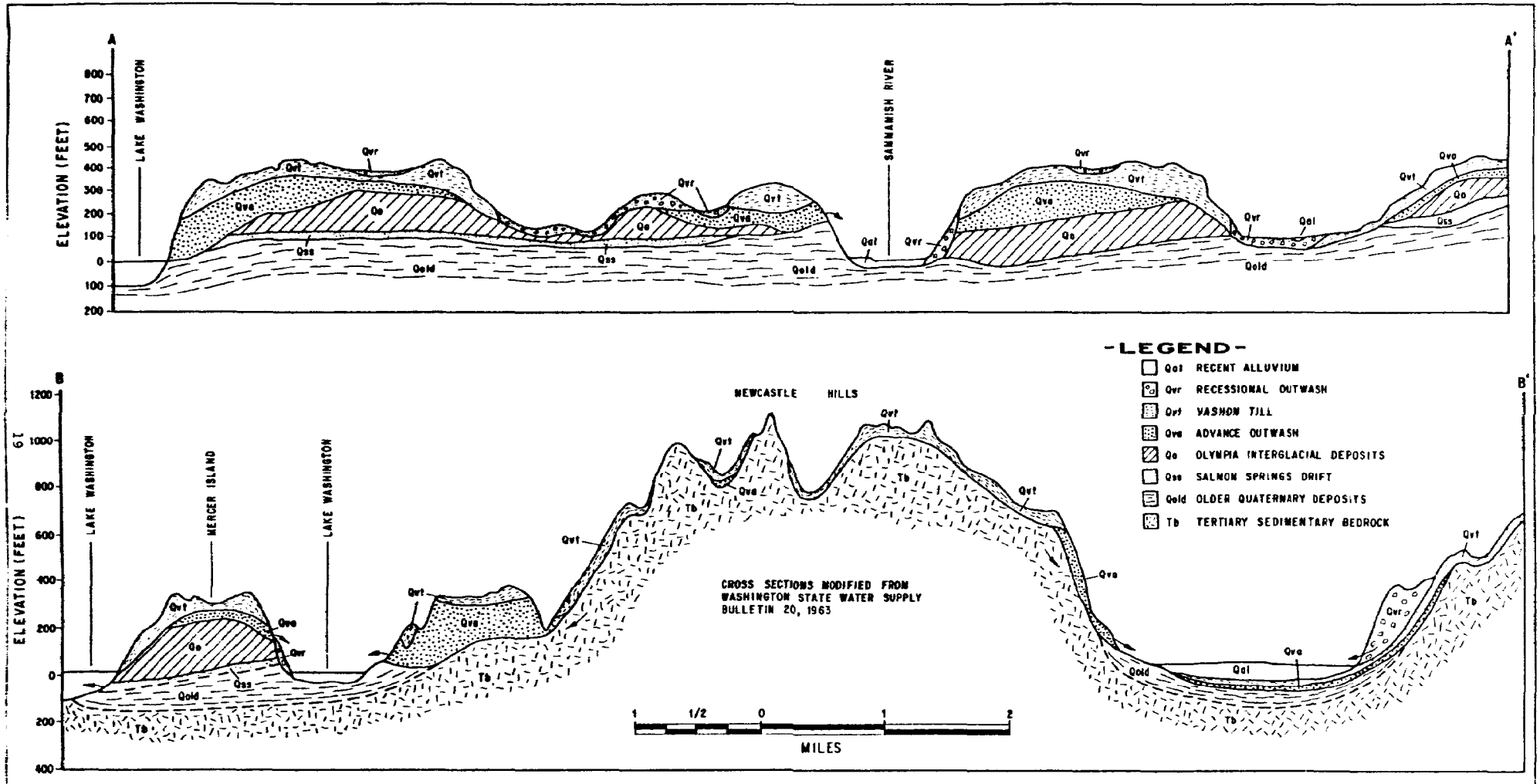



FIGURE 2-3. SCHEMATIC HYDROGEOLOGIC SECTIONS OF THE LAKE WASHINGTON / GREEN RIVER BASINS

increased levels of acidity. Widespread occurrence of acidic peat layers in the study area is usually cited as playing an important role in the occurrence of groundwater rich in iron.

Groundwater with chloride and dissolved solids concentrations exceeding the standards for drinking water occurs in two known wells in the study area. Both of these wells are deep (600 and 1,461 feet), but the specific aquifer tapped by the wells is not definitely known. Saltwater intrusion does not appear to be the cause for the poor water quality in these wells. Rather, the quality characteristics are more probably caused by connate waters trapped within the water-bearing strata.

Nitrate in groundwater is of particular interest as it can be considered as an indicator of contamination caused by excessive use of fertilizers, heavy concentration of septic tanks, or failing sewerage systems. The maximum allowable nitrate level (45 mg/l, $NO_3^-$) in drinking water is not exceeded in groundwater from wells in the study area. The nitrate level typically is less than 1 mg/l as $NO_3^-$. Nitrate ($NO_3^-$) level, however, is highest in the shallow unconfined aquifers and decreases progressively in the deeper, generally confined aquifers. This trend suggests that perhaps land use activities may be responsible for the higher nitrate levels in the shallow aquifers.

The contamination potential of the aquifers in the project area varies significantly and is summarized below:

1. There is little or no contamination potential, from normal land use practices, for aquifers that occur below the Vashon till. Shallow wells that tap perched water bodies in the upper, loosely compacted, portion of the till as well as wells that tap recessional outwash sand and gravel deposited on top of the till, however, must be viewed as susceptible to contamination.

2. Almost all municipal groundwater supplies are obtained from the deeper aquifers of deltas and alluvial fans. Contamination of these aquifers by normal land use practices is unlikely.

3. There are virtually thousands of small, shallow wells in the project area that are used for domestic purposes. Most of these domestic wells occur in nonsewered areas, and are subject to a high risk for contamination.

## Water Resources and Water Quality

### Inland Surface Water

The major surface water bodies in the study area are shown in Figure 2-4. The largest lakes are Lake Washington and Lake Sammamish. Lake Washington has a surface area of 32,000 acres and a watershed of 476 square miles, with the majority of inflow provided by the Cedar River and the Sammamish River. Lake Sammamish has a surface area of 4,900 acres and drains a watershed of about 98 square miles, with the majority of inflow provided by Tibbetts Creek and Issaquah Creek. Over 80 small lakes are dispersed throughout the study area, ranging in size from less than 5 to 150 acres.

The major rivers within the study area are the Green-Duwamish River, the Cedar River, and the Sammamish River. The Green-Duwamish River, which is about 91 miles long and drains 483 square miles, is regulated by the Howard Hanson Dam and Reservoir, with an active storage of 106,000 acre-feet; the Green-Duwamish River is primarily used for water supply, fisheries, recreation, and irrigation. The Cedar River, which is about 50 miles long and drains an area of 188 square miles, is regulated by Chester Morse Lake, with an active storage of 40,000 acre-feet; the Cedar River is primarily used for water supply, recreation and fisheries, and to prevent saltwater intrusion into Lake Washington at the Chittendon Locks. The Sammamish River is about 14 miles long and drains about 196 square miles; it is primarily used for fisheries and recreation. Numerous smaller streams within the study area provide inflow to the larger lakes and rivers, and serve as important fishery and recreational resources.

The quality of study area surface waters is generally good. Metro has rated lakes, rivers, and streams for beneficial uses based on its ongoing water quality monitoring programs. Table 2-2 presents a summary of Metro's lake use ratings, and Table 2-3 presents a summary of Metro's river and small streams use ratings.

Water quality of the Green-Duwamish River is of special importance for this EIS because it is the present discharge location for Renton treatment plant effluent, and because some long-term alternatives for the Renton plant involve continued river discharge. Details regarding water quality within the Green-Duwamish River are presented in Chapter 5 of the EIS.

### Puget Sound

Puget Sound is a semienclosed water body where sea water from the open ocean mixes with fresh waters from rivers and lakes draining the sound. The sound consists of a series of interconnecting deep basins separated by relatively shallow sills.

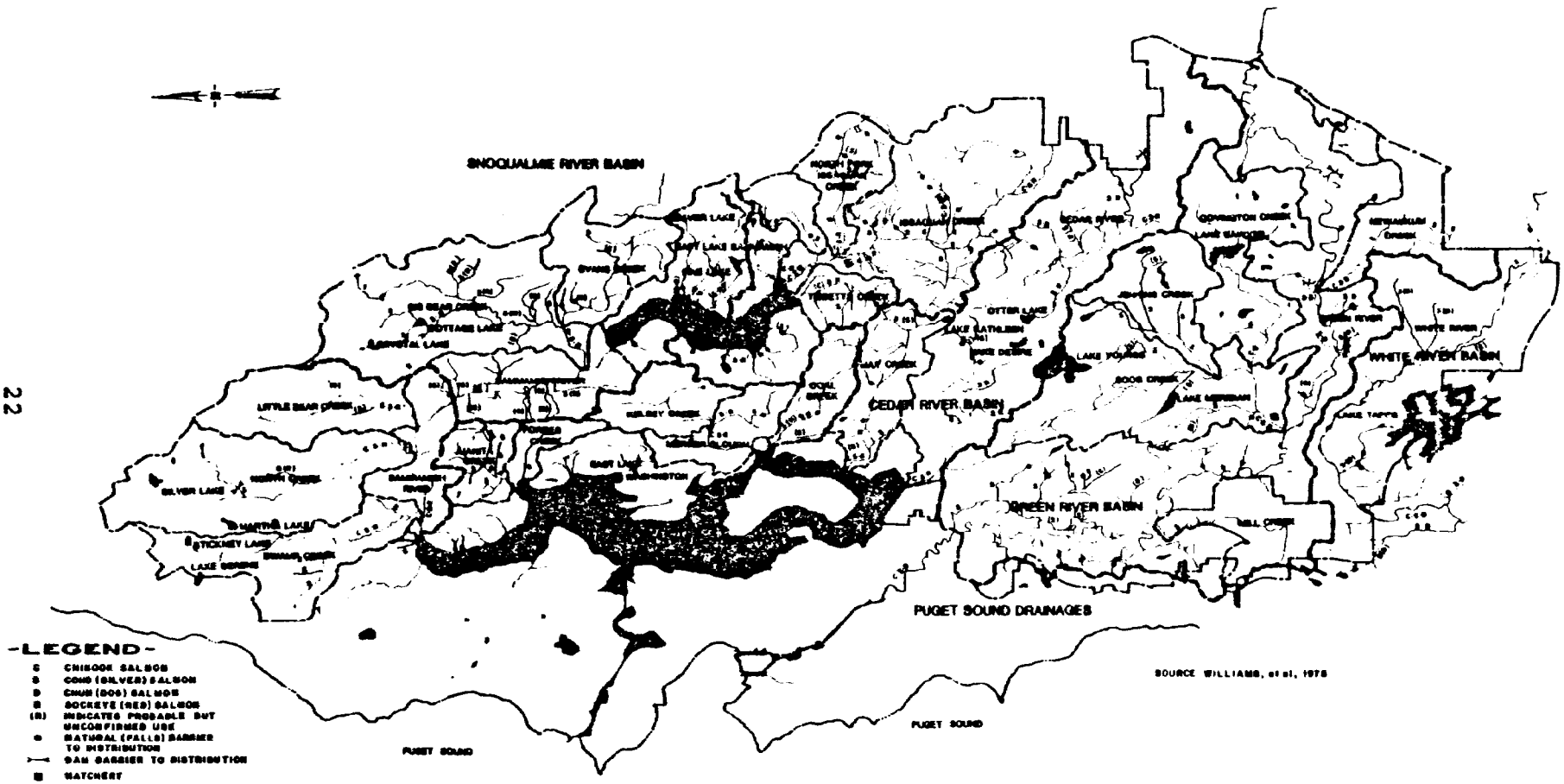



FIGURE 2-4. MAJOR SURFACE WATER BODIES IN THE STUDY AREA SHOWING SALMON USE

Table 2-2. Lake Use Ratings

| Lake | Aesthetics | Fishability: Trout Habitat | Fishability: Spiny Ray Habitat | Swimmability |
|---|---|---|---|---|
| Large Lakes | | | | |
| Sammamish | Fair | Good | Good | Good |
| Washington | Good | Good | Good | Good |
| Small Lakes | | | | |
| Bass | Fair | Insufficient Data | | Fair |
| Beaver | Good | Good | Good | Fair |
| Cottage | Poor | Fair | Fair | Fair |
| Deep | Good | Good | Good | Good |
| Desire | Poor | Fair | Fair | Poor |
| Dolloff | Poor | Insufficient Data | | Poor |
| Kathleen | Fair | Fair | Fair | Fair |
| Lucerne | Good | Insufficient Data | | Good |
| Meridian | Good | Fair | Good | Good |
| Moneysmith | Poor | Insufficient Data | | Poor |
| Morton | Fair | -- | Fair | Fair |
| Number Twelve | Fair | Good | Good | Fair |
| Panther | Poor | Insufficient Data | | Poor |
| Phantom | Fair | Insufficient Data | | Insufficient Data |
| Pine | Fair | Good | Good | Poor |
| Pipe | Good | Fair | Good | Good |
| Retreat | Good | Fair | Good | Good |
| Sawyer | Fair | Good | Good | Fair |
| Shadow | Good | Good | Good | Fair |
| Shady | Fair | Fair | Good | Fair |
| Spring/Otter | Fair | Fair | Fair | Good |
| Wilderness | Fair | Fair | Fair | Good |

SOURCE: Metro, 1979e.

Table 2-3. River and Small Stream Use Ratings

| River/Stream Station | | Fishability Rating | Swimmability Rating |
|---|---|---|---|
| Rivers | | | |
| Upper Green | B319 | Good | Excellent |
| | A319 | Good | Good |
| Lower Green | 315 | Excellent | Poor |
| | 311 | Fair | Poor |
| | 3106 | Fair | Poor |
| Duwamish | 309 | Fair | Fair |
| | 307 | Fair | Poor |
| | 305 | Good | Poor |
| Cedar | H438 | Good | Excellent |
| | A438 | Good | Good |
| | O438 | Good | Fair |
| Sammamish | O486 | Excellent | Good |
| | O480 | Excellent | Fair |
| | O450 | Excellent | Poor |
| Small Streams | | | |
| Mill Creek | A315 | Poor | Poor |
| | E315 | Poor | Poor |
| Spring Brook | O317 | Poor | Poor |
| | E317 | Poor | Poor |
| | H317 | Poor | Poor |
| McAleer Creek | A432 | Poor | Poor |
| | E432 | Fair | Good |
| Fairweather Creek | A499 | Fair | Excellent |
| Tibbetts Creek | A630 | Fair | Fair |
| | B630 | Poor | Poor |
| | U630 | Fair | Excellent |
| Issaquah Creek | O631 | Excellent | Fair |
| | A631 | Good | Fair |
| North Fork | A632 | Fair | Good |
| East Fork | O633 | Fair | Good |
| Mason Creek | O634 | Good | Poor |
| Holder Creek | A640 | Excellent | Good |
| Carey Creek | A650 | Good | Excellent |
| 15-Mile Creek | A660 | Fair | Excellent |
| Soos Creek | O320 | Fair | Good |
| | F320 | Fair | Good |
| Covington Creek | C320 | Fair | Excellent |
| Jenkins Creek | D370 | Good | Excellent |
| Little Soos Creek | G320 | Fair | Poor |
| West Branch | B320 | Fair | Fair |
| Swamp Creek | O470 | Fair | Fair |
| | B470 | Good | Fair |
| North Creek | O474 | Good | Poor |
| | D474 | Good | Fair |
| Little Bear Creek | O478 | Fair | Fair |
| | B478 | Fair | Poor |
| Bear-Evans Creek | O484 | Fair | Poor |
| | B484 | Good | Fair |
| | C484 | Fair | Poor |
| | G484 | Good | Poor |
| | J484 | Fair | Fair |
| | N484 | Fair | Fair |
| Coal Creek (Green River) | C325 | Good | Excellent |
| Longfellow Creek | C370 | Fair | Fair |
| Coal Creek (Lake Washington) | O442 | Fair | Good |
| | C442 | Fair | Excellent |
| | U442 | Poor | Excellent |
| Juanita Creek | O446 | Fair | Poor |
| | C446 | Good | Poor |
| | D446 | Excellent | Good |
| Thornton Creek | O434 | Poor | Poor |
| | K434 | Fair | Poor |
| | T434 | Fair | Excellent |
| Forbes Creek | O456 | Poor | Poor |
| | C456 | Fair | Poor |
| Yarrow Bay | O498 | Fair | Poor |
| Lyon Creek | O430 | Poor | Fair |
| | G430 | Fair | Poor |
| Newaukum Creek | O322 | Good | Poor |
| | F322 | Excellent | Poor |
| | T322 | Good | Excellent |
| Deep Creek | F723 | Fair | Excellent |
| May Creek | O440 | Fair | Good |
| | K440 | Fair | Fair |
| | X440 | Fair | Fair |
| Kelsey Creek | O444 | Fair | Poor |
| | D444 | Poor | Fair |
| Crisp Creek | O321 | Good | Excellent |

SOURCE: Summarized from Metro (1980f).

Four outfall locations are being considered in Metro's Wastewater Management Planning for the study area: Richmond Beach, Elliott Bay, Alki Point, and Point Pulley. All four potential discharge locations are located in Puget Sound's central basin, which averages about 660 feet in depth. Details regarding water circulation at the four potential discharge locations are presented in Chapter 5 of the EIS.

## Biology

### Terrestrial Biology

Figure 2-5 illustrates the main wildlife habitat types of the study area. The great majority of nonurban and nonagricultural lands, located in the eastern part of the study area, are in evergreen, deciduous, or mixed forest. Wetland habitats are widely dispersed throughout the study area.

### Aquatic and Marine Biology

The study area is rich in freshwater aquatic habitats. The numerous lakes and streams host a wide variety of freshwater and anadromous fishes, many of which are of commercial or recreational importance. Salmon use of study area lakes and streams is shown in Figure 2-4.

Within Puget Sound, three main habitat types can be differentiated: intertidal (between the higher high and the lower low tide lines), subtidal (bottom habitat below the low tide lines), and pelagic (open water regions above the sound's bottom). Each of these habitat types supports representative biota.

### Fisheries

The fishery resources of Puget Sound and the Lake Washington/Green River Basins are important economically, recreationally, culturally, and scientifically. The anadromous salmonids occurring in the study area include all five species of Pacific salmon (chinook, coho, red, chum, pink), searun rainbow (steelhead) trout, cutthroat trout, and Dolly Varden char. These species are found in Puget Sound, and, with the exception of pink salmon, spawn in study area streams. Pacific salmon are fished for both commercial and sport purposes, whereas the main use of anadromous trout and char is sportfishing only.

The fish resources of the Green/Duwamish River system are of particular importance for this EIS. Chinook, coho and steelhead runs of the Green River system are among the largest in the Puget Sound region. Most of the steelhead and coho are of hatchery origin, whereas the chinook run is the second

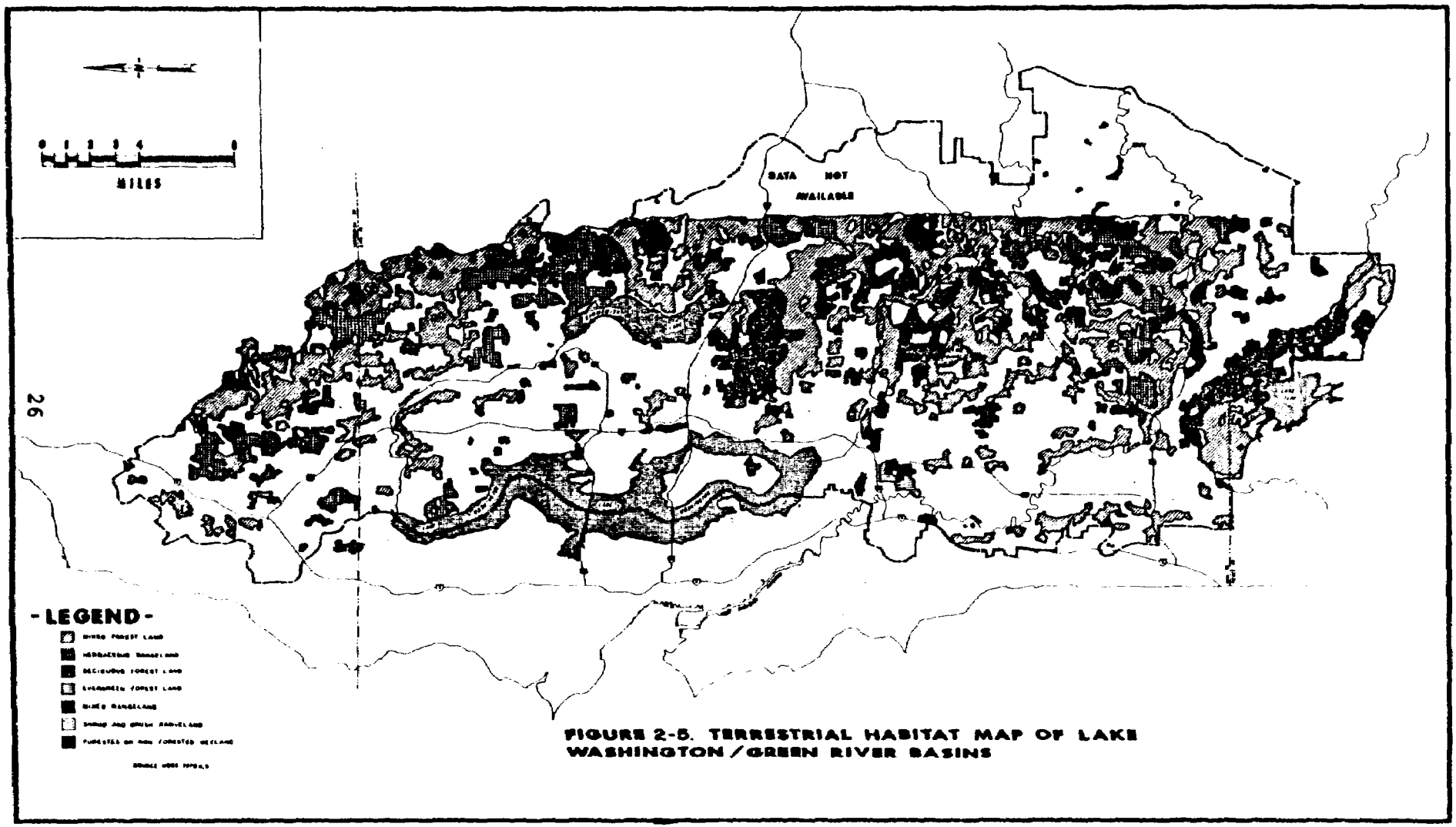



FIGURE 2-5. TERRESTRIAL HABITAT MAP OF LAKE WASHINGTON / GREEN RIVER BASINS

largest native run in Puget Sound, even though significant numbers of chinook are also of hatchery origin. Other less prevalent anadromous fish found in the Green River system include cutthroat trout, Dolly Varden char, chum salmon and pink salmon. The Muckleshoot Indian tribe propagates a relatively small hatchery run of chum salmon (U.S. Fish and Wildlife Service 1980).

A conservative estimate of the value of the approximately 220,000 salmon provided by the Green River system to sport and commercial fisheries is $2.6 million, in 1977 dollars. The net economic value of the Green River steelhead fishery was estimated to be $2-$3 million in 1976. (See Appendix C.)

Within Puget Sound, marine species as well as anadromous species, are important for commercial and sportfishing. English sole and hake are the main commercial species, and Pacific cod and copper rockfish are the main recreational species.

### Species and Habitats of Special Interest

Preservation of wetland habitats is of special concern due to the wide diversity of fauna supported by wetlands, and because they serve as sediment and nutrient traps. Wetland habitats within the study area are shown in Figure 2-5.

No plant or animal species that are permanent or regular inhabitants of the study area have been listed by the U. S. Fish and Wildlife Service as "threatened" or endangered. Listed species that are occasional visitors to the study area include the gray whale (*Eschrichtius robustus*), the peregrine falcon (*Falco peregrinus*), and the bald eagle (*Haliaeetus leucocephalus*). Species and habitats of special concern within the study area, as identified by the Washington Department of Game, are listed in Appendix C of the EIS.

## Land Use and Socio-Economics

### Land Use

The Lake Washington/Green River Basins study area covers approximately 620 square miles of plateaus, river valleys, and foothills of the Puget Lowlands. Existing urban land uses are concentrated in the western part of the study area, with major urban concentrations along the eastern shore of Lake Washington and in the Lower Green River Valley. Urban land uses as of 1975 are shown in Figure 2-6.

Land use planning is the responsibility of the counties and the cities within the study area, with planning coordination provided by PSCOG. Of particular importance in determining future land use policy within the study area are King

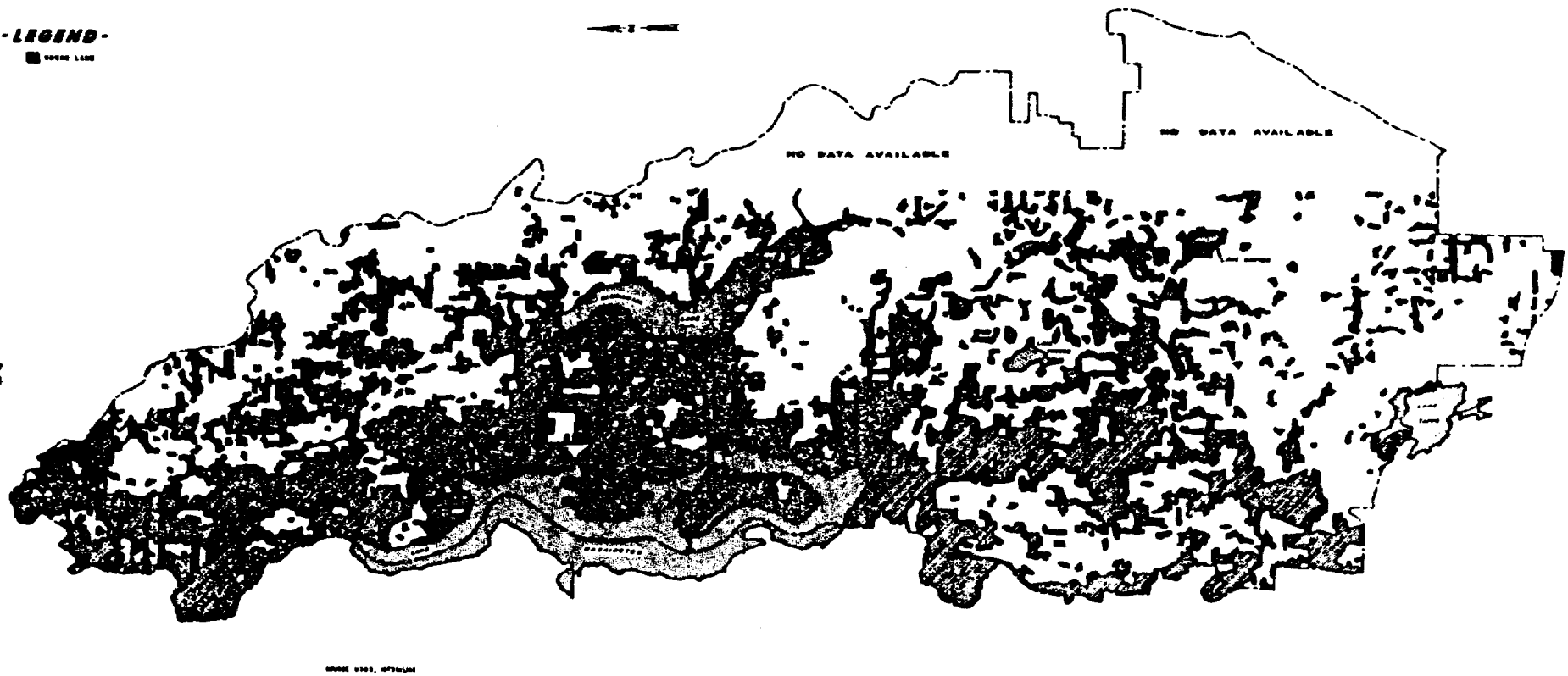



FIGURE 2-6. URBAN LAND USES IN THE LAKE WASHINGTON / GREEN RIVER BASINS, 1975

County's draft General Development Guide and the communities plans prepared by both King and Snohomish Counties for sub-county planning areas.

## Population and Housing

Historic population trends from 1930 to 1970 in King and Snohomish Counties, and in major cities within the study area, are shown in Table 2-4. Economic activity during World War II provided the impetus for initial rapid population growth in the Seattle region which, with periodic fluctuations, has continued until today.

An estimated 202,680 households are located within the study area, assuming an average household size of 2.65 persons. Most multifamily dwelling units in the study area are located within the incorporated cities. The vacancy rate in the study area region in 1976 was 5.0 percent, according to census bureau data; the 5 percent figure is considered to characterize a tight housing market.

## Regional Economy and Employment

The Seattle region as a whole found its early economic strengths in processing and shipping of lumber, fishing, mining and agricultural products. By the early 20th century the manufacturing and trade base of the economy was well-established.

The region enjoyed substantial growth with the coming of the aerospace industry in the 1940s when nonresource-based manufacturing outpaced the traditional regional industries. In the 1970s the region has further developed into a service-based economy with major growth in finance, insurance, real estate, trade, tourism, and other service industries.

The City of Seattle still contains the major concentrations of manufacturing jobs in the region, although certain of the outlying communities (particularly Renton, Bellevue, Kirkland and Redmond) have attracted production units and corporate offices of major manufacturers over the years.

Manufacturing employment is fairly highly concentrated: three firms (Boeing, Weyerhaeuser and PACCAR) employ half of the county's manufacturing labor force. This concentration has contributed to the pattern of boom and bust in the regional economy over time. The diversification of the regional economy - a trend of the 1960s that has continued through the 1970s - has strengthened the region's ability to withstand downturns in any one of its major industries.

Table 2-4. Historic Population Trends, Counties and Major Cities, 1930-1970

| Year | 1930 | 1940 | | 1950 | | 1960 | | 1970 | |
|---|---|---|---|---|---|---|---|---|---|
| Place | Population | Population | Percent Change | Population | Percent Change | Population | Percent Change | Population | Percent Change |
| King County | 463,517 | 504,980 | 9 | 732,992 | 45 | 935,014 | 28 | 1,156,633 | 24 |
| Snohomish County | 78,861 | 88,754 | 13 | 11,580 | 26 | 172,199 | 54 | 265,236 | 54 |
| Seattle | 365,583 | 368,302 | 1 | 467,591 | 27 | 557,087 | 19 | 530,831 | -5 |
| Bellevue | | | | | | 12,809 | -- | 61,102 | 377 |
| Mercer Island | | | | | | | | 19,047 | -- |
| Renton | 4,062 | 4,488 | 10 | 16,039 | 257 | 18,453 | 15 | 25,258 | 37 |
| Auburn | 3,906 | 4,211 | 8 | 6,497 | 54 | 11,933 | 84 | 21,817 | 83 |
| Kent | 2,320 | 2,586 | 11 | 3,278 | 27 | 9,017 | 175 | 21,510 | 139 |
| Kirkland | 1,714 | 2,084 | 22 | 4,713 | 126 | 6,025 | 28 | 15,249 | 153 |
| Redmond | 460 | 530 | 15 | 573 | 8 | 1,426 | 149 | 11,031 | 674 |
| Edmonds | 1,165 | 1,288 | 11 | 2,057 | 60 | 8,016 | 290 | 23,998 | 199 |
| Everett | 30,567 | 30,224 | -1 | 33,849 | 12 | 40,304 | 19 | 53,622 | 33 |
| Tacoma | 106,817 | 109,408 | 2 | 143,673 | 31 | 147,979 | 3 | 154,581 | 4 |

DATA FROM: U. S. Department of Commerce, Bureau of the Census.

SOURCE: Metro, 1979e.

## Public Services Provision

Public services within the study area are provided by the counties, cities, and numerous special districts. The counties are generally responsible for county roads, criminal justice, health services, and county parks. Cities are generally responsible for providing general government, water and sewer service, police and fire protection, parks, and libraries within their corporate limits; in unincorporated areas these services are the responsibility of either special districts (for fire protection, water and sewer) or the county. Educational services are provided by special districts in both incorporated and unincorporated areas.

# Existing Sewerage Facilities

## The Study Area

The study area encompasses 620 square miles north, east and south of Lake Washington (see Figure 1-1). About 25 percent of this land presently has access to sanitary sewer service; the balance of the area is rural and relies on septic tanks for sewage disposal. The study area includes 40 local sewering agencies (listed in Table 2-5 and mapped in Figure 2-7), 32 of which are sewered. The Renton division of Metro operates the wastewater collection and treatment system which collects wastewater from most of the study area and transports it to the Renton sewage treatment plant for treatment and disposal; the West Point division of Metro currently operates the collection system in the north part of the study area, where the wastewater is transported to the West Point treatment plant for treatment and disposal.

## Study Area Wastewater Collection Systems

The Metro collection system in the study area consists of approximately 116 miles of interceptors, trunks, force mains, inverted siphons, and tunnels as well as 20 pumping stations. Figure 2-8 shows the location of the Metro collection system, the existing service areas, and local service areas designated by King County's Sewerage General Plan as eligible for sewer service.

Where sewer lines cross waterways, flows typically are carried underneath the water channel in an inverted siphon, i.e., a pipe which is essentially always full of water and is capable of sustaining some internal pressure without leaking. Similar pressure pipes are called force mains when the pressure is produced by a pumping facility. The Renton division system currently incorporates approximately 5 miles of siphons, ranging from 8-54 inches in diameter, and a total of 10.1 miles of force mains, with diameters ranging from 12-20 inches.

Table 2-5. Renton Study Area Component Agencies

| No. | Agency | Sewered | Currently (1979) served by: |
|---|---|---|---|
| 1 | City of Everett | Yes | Everett |
| 2 | Fircrest Sewer District | Yes | Everett |
| 3 | Snohomish County | No | |
| 4 | Silver Lake Water District | No | |
| 5 | Alderwood Water District | Yes | Metro (West Point)/Lynnwood |
| 6 | City of Edmonds | Yes | Edmonds |
| 7 | City of Mountlake Terrace | Yes | Lynnwood |
| 8 | City of Brier | Yes | Metro (West Point) |
| 9 | City of Lynnwood | Yes | Lynnwood |
| 10 | Northeast Lake Washington Sewer District | Yes | Metro (West Point) |
| 11 | City of Bothell | Yes | Metro (West Point) |
| 12 | King County Water District No. 104 | Yes | Metro (West Point) |
| 13 | King County | No | |
| 14 | Holiday Lake Sewer District | No | |
| 15 | City of Kirkland | Yes | Metro (Renton) |
| 16 | City of Redmond | Yes | Metro (Renton and West Point) |
| 17 | City of Bellevue | Yes | Metro (Renton and West Point) |
| 18 | Sahallee Sewer District | Yes | Metro (West Point) |
| 19 | King County Water District No. 82 | Yes | Metro (West Point) |
| 20 | King County Water District No. 121 | No | |
| 21 | Shorewood Apartments | Yes | Metro (Renton) |
| 22 | East Mercer Island Sewer District | Yes | Metro (Renton) |
| 23 | Mercer Island Sewer District | Yes | Metro (Renton) |
| 24 | King County Water District No. 107 | Yes | Metro (Renton) |
| 25 | Eastgate Sewer District | Yes | Metro (Renton) |
| 26 | Lake Sammamish State Park | Yes | Metro (Renton) |
| 27 | City of Issaquah | Yes | Metro (Renton) |
| 28 | Bryn Mawr Sewer District | Yes | Metro (Renton) |
| 29 | City of Renton | Yes | Metro (Renton) |
| 30 | King County Water District No. 90 | No | |
| 31 | Val-Vue Sewer District | Yes | Metro (Renton and West Point) |
| 32 | City of Tukwila | Yes | Metro (Renton) |
| 33 | Cascade Sewer District | Yes | Metro (Renton) |
| 34 | King County Water District No. 108 | Yes | Metro (Renton) |
| 35 | City of Kent | Yes | Metro (Renton) |
| 36 | City of Auburn | Yes | Metro (Renton) |
| 37 | King County Water District No. 86 | No | |
| 38 | City of Black Diamond | No | |
| 39 | City of Algona | Yes | Metro (Renton) |
| 40 | City of Pacific | Yes | Metro (Renton) |

SOURCE: Metro, 1979d.

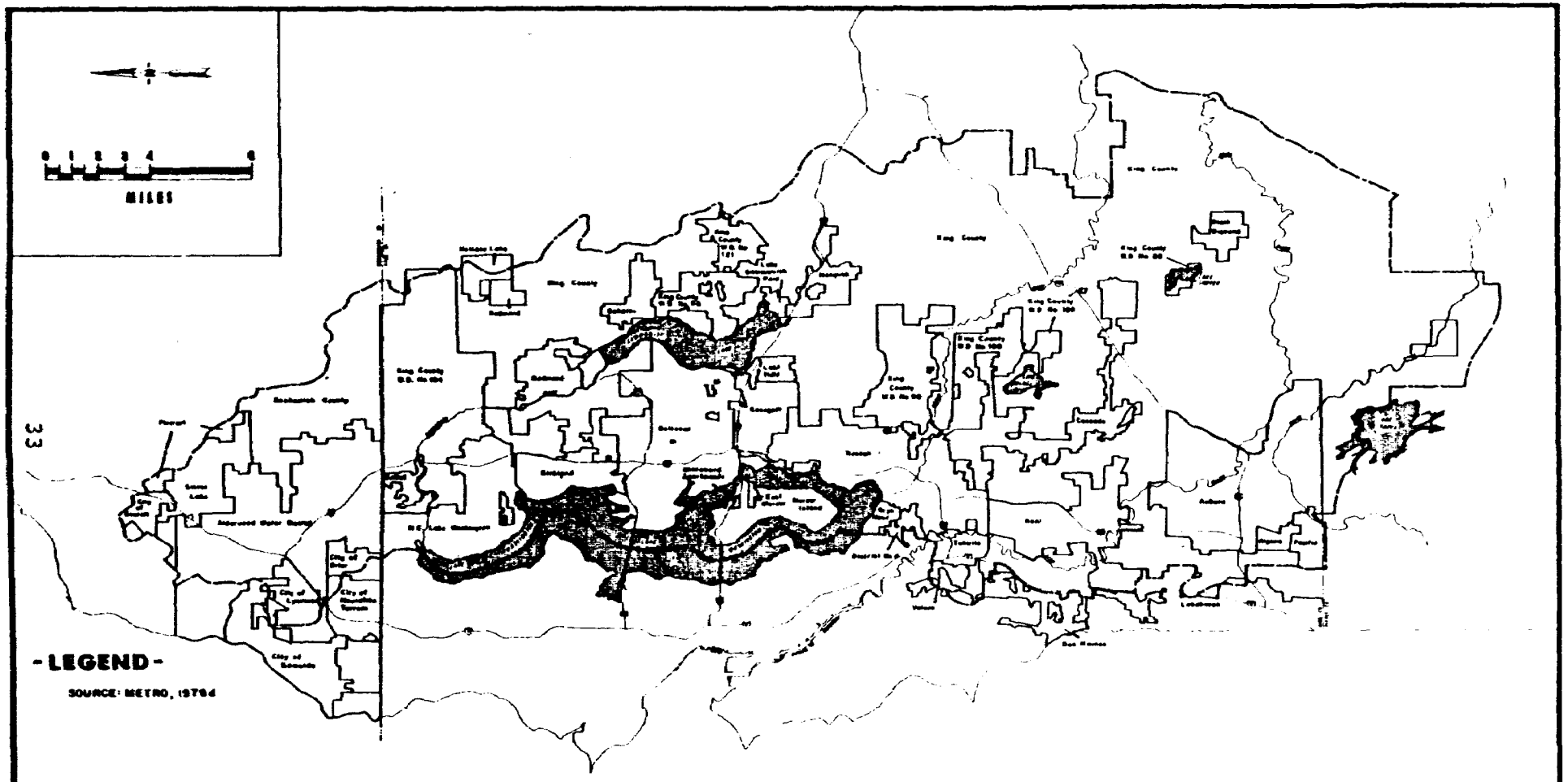



FIGURE 2-7. COMPONENT AGENCIES IN THE RENTON STUDY AREA

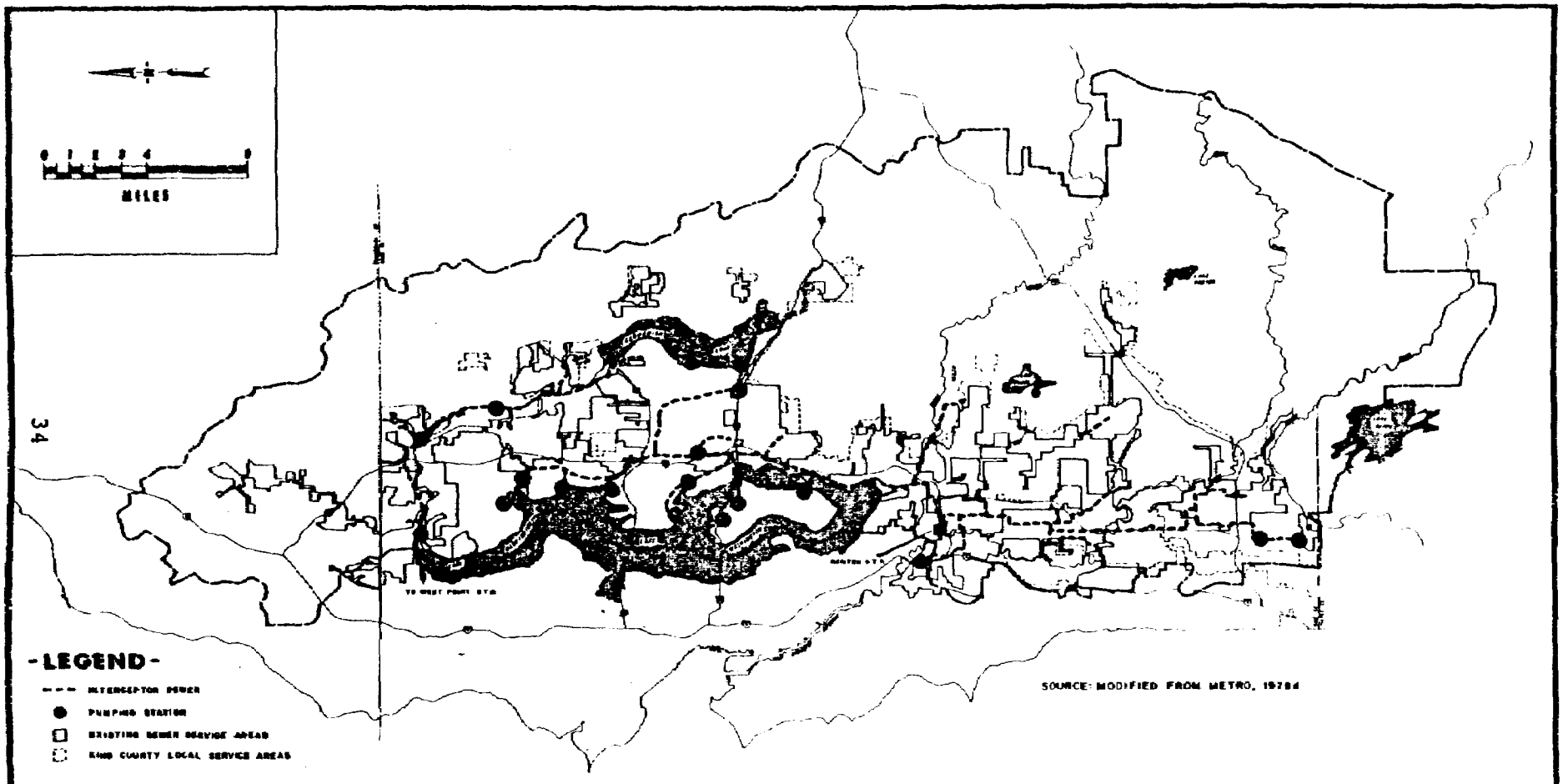



FIGURE 2-8. LOCAL SERVICE AREAS, EXISTING SEWER SERVICE AREAS & METRO COLLECTION SYSTEM

Almost all of the gravity lines are constructed of reinforced concrete pipe. The force mains and siphons are usually steel, cast iron, or reinforced concrete pipe.

Most of the Renton area sewerage facilities were constructed in the past 20 years; however, some were obtained by Metro from local agencies. With the exception of isolated problems, the sewer system, which is under continued surveillance, is basically in good repair and has rehabilitation plans underway for all known areas of leakage or deterioration. Capacity problems are more critical. Seven pumping stations are presently operating at or greater than 95 percent of firm capacity (pumping capacity with the largest pump out of operation). Three stations (Sunset, Heathfield, and Kenmore) have measured flows above their capacities, which is possible because peak flows are partially stored in the influent sewer.

## The Renton Treatment Plant

The Renton treatment plant is situated on the Green/Duwamish River about 13 miles from the location where the river enters Elliot Bay. A detailed description of the Renton plant may be found in Metro's Technical Memo No. 1, from which the following discussion has been summarized.

The plant is designed to treat an average of 36 million gallons per day (MGD) average dry weather flow (ADWF) and an average of 96 MGD peak wet weather flow (PWWF). The wastewater entering the plant is expected to bring about 75,000 pounds per day of biochemical oxygen demand (BOD) and 93,000 pounds per day of suspended solids (SS). This is equivalent to about 250 milligrams per liter (mg/l) of BOD and 310 mg/l SS. The treated wastewater entering the river is currently required to have no more than 15 mg/l of BOD and 15 mg/l SS.

To reduce pollutant loads to meet the discharge limitations (see Table 2-6), the Renton plant has several treatment steps as shown in Figure 2-9. Pollutant removal includes pretreatment, primary treatment (sedimentation), secondary treatment (activated sludge), and chlorination/dechlorination.

The pretreatment process settles coarse grit and uses bar screens to remove the materials larger than 0.75 inch. The objects captured by the screens are transferred hydraulically to a grinder which shreds and pulverizes the screenings so that they may be returned to the influent flow ahead of the bar screens. Raw sewage pumps lift the wastewater to two aerated grit removal channels where the water is aerated and fine grit is removed. The grit is dewatered and moved by a mechanical screw conveyor to storage hoppers. The coarse grit is periodically collected manually and placed in the hoppers. Grit is hauled to a sanitary landfill for disposal.

Table 2-6. Existing and Proposed Discharge Limitations for the Renton Wastewater Treatment Plant

| Parameter | Units | Existing Limit | Proposed Limit[1] | Typical Amount[2] |
|---|---|---|---|---|
| Flow | mgd | 38 | 48 | 39 |
| $BOD_5$ | mg/l | 15 | 10 | 9 |
| | lb/day | 4,755 | 2,900 | 4,990 |
| Suspended Solids | mg/l | 15 | 15 | 11 |
| | lb/day | 4,755 | 4,300 | 3,730 |
| Fecal Coliform | organisms per 100 ml | 200 | 200 | 57 |
| pH | units | 6.5-8.5 | 6.5-8.5 | 6.5-7.1 |
| Chlorine Residual | mg/l | 0.5 | 0.008 | 0.26 |
| Ammonia | lb/day | — | 2,700 | -- |
| Ammonia (unionized) | mg/l | -- | 0.08 | 16.6 |
| | lb/day | -- | 24.02 | -- |
| Nitrite | mg/l | — | 0.24 | -- |
| Oil and Grease | mg/l | — | 15 | 2.4-20 |
| Cadmium | mg/l | 0.004 | 0.0016 | <0.004 |
| Chromium (Total) | mg/l | 0.02 | 0.10 | 0.015 |
| Copper | mg/l | 0.04 | 0.008 | 0.03 |
| Lead | mg/l | 0.05 | 0.021 | 0.009 |
| Mercury | mg/l | 0.0015 | 0.0002 | 0.0013 |
| Nickel | mg/l | 0.03 | 0.10 | 0.019 |
| Zinc | mg/l | 0.09 | 0.004 | 0.05 |
| Silver | mg/l | — | 0.00068 | -- |

Source: 1 DRAFT NPDES Waste Discharge Permit for the Municipality of Metropolitan Seattle, Renton Sewage Treatment Plant (March 1980)

2 NPDES Discharge Monitoring Report for the Renton Treatment Plant (January 1979-March 1980). See Table 3-4 for changes in effluent quality.

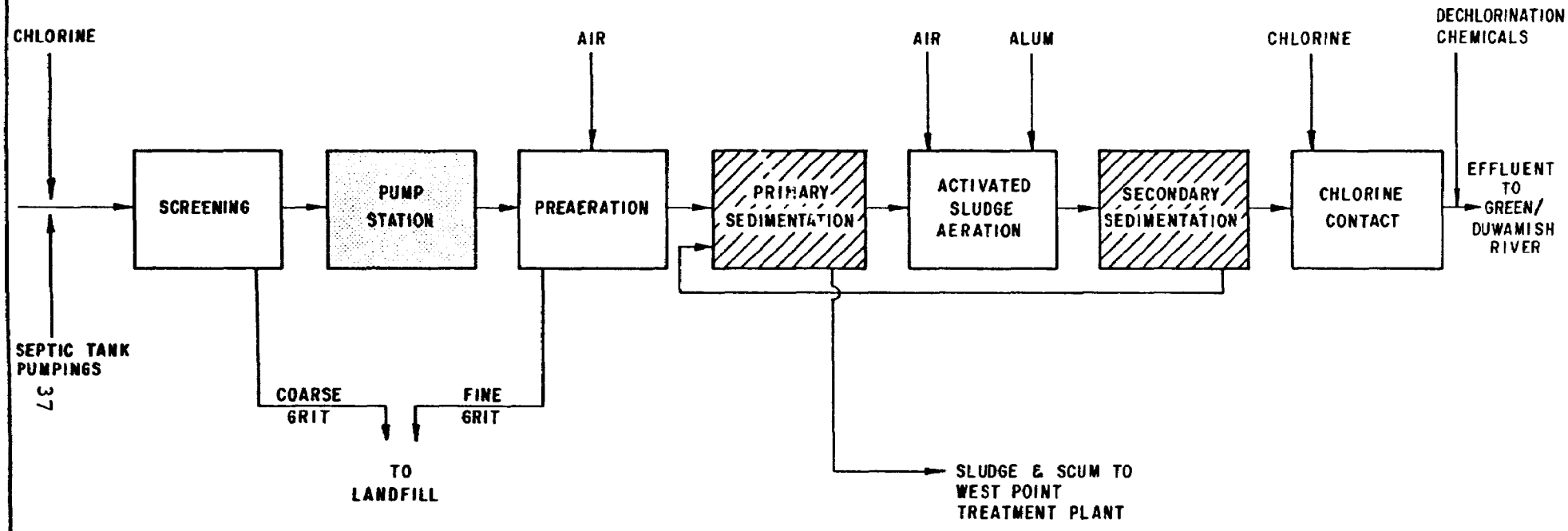



FIGURE 2-9. PROCESS SCHEMATIC OF RENTON TREATMENT PLANT

Water that has been screened and degritted flows by gravity through two aerated channels to the eight primary sedimentation basins (clarifiers). In primary treatment, the water velocity is slowed so that all of the heavy material (sludge) can settle and the light floatable material (scum) can rise to the surface. The primary sludge is collected by scrapers on the bottom of the sedimentation basins. Sludge is currently pumped and metered continuously into a force main for transmission to the West Point treatment plant. The scum is collected by skimmers and delivered to scum pumps where it is discharged to the sludge force main.

Primary effluent from the sedimentation basins flows into collection channels that direct the water to either the activated sludge process or, in emergencies, directly to chlorination and discharge. In the activated sludge process, the wastewater is distributed into two horizontally baffled aeration tanks and mixed with the activated sludge. Six air blowers supply air to the aeration tanks, and the concentration of air is controlled by a system of dissolved oxygen probes, which measure the amount of oxygen in the aeration tanks. Dissolved oxygen allows the organisms present in the activated sludge to convert about 50 percent of the oxygen-demanding materials in the settled sewage to water and carbon dioxide, and to convert almost 50 percent more to more activated sludge organisms.

The mixture of sludge organisms and treated wastewater (mixed liquor) overflows from the aeration tanks into an aerated channel. The channel directs the mixed liquor into eight circular secondary sedimentation basins. During high wet weather flows, alum is added to the stream to enhance sludge removal. Sludge is collected at the bottom of the basin and scum is skimmed at the surface. Some of the sludge, return activated sludge (RAS), is returned to the aeration tank to maintain the activated sludge process. The remainder of the sludge, waste activated sludge (WAS), is mixed with the primary sludge and pumped to the West Point treatment plant. The scum collected from the secondary clarifiers is piped to the influent sewer.

Chlorine injectors and diffusers are located at the secondary effluent collection chambers. Following chlorination, the effluent flows along a chlorine contact channel; the long length of this channel provides sufficient time for the chlorine to disinfect the effluent. Some of the chlorinated effluent is used for in-plant process needs and landscape irrigation. Any floating material present in the chlorine contact channel is skimmed and returned to the plant influent.

Sulfur dioxide is injected into the effluent to chemically neutralize any toxic chlorine before disposal. From the chlorine contact channel, the effluent passes over a weir, where the rate of flow is measured; the effluent is then discharged to the Green/Duwamish River via an outfall diffuser located on the river bed.

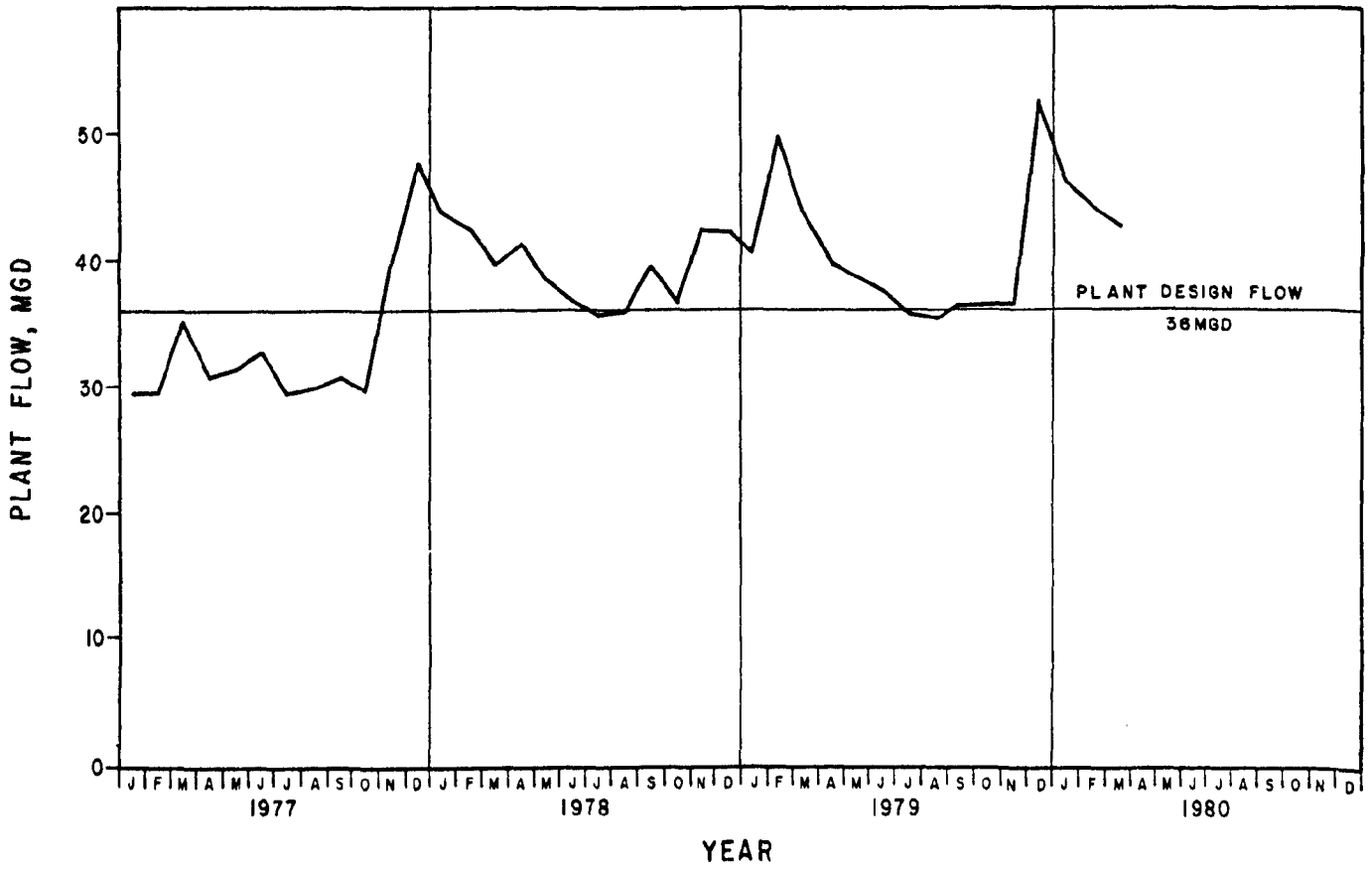
Wastewater and Sludge Characteristics

Wastewater. The Renton treatment plant was originally conceived to treat an ultimate flow of 144 MGD. Currently, the Renton treatment plant units are all conservatively sized to treat an average 36 MGD with the exception of the headworks, influent sewer, and influent pumping and screening structures, which can accommodate the ultimate ADWF of 144 MGD, and the primary units, which are designed to treat an average of 72 MGD. Hydraulically, the other processes in the plant may treat an ADWF of 48 MGD; however, BOD and solids concentrations limit the activated sludge processes to a capacity of 36 MGD.

Figure 2-10 and Table 2-7, which present historic flow and wasteload data, indicate that the monthly average flow was below the 36 MGD design flow in 1977. But, the flow increased to an average 39.4 MGD in 1978, to 38.4 MGD in 1979, and to 42.5 MGD during the first quarter of 1980. The BOD and SS loadings have also increased. The average BOD entering the plant increased from 84,900 pounds per day in 1979 to 141,800 pounds per day during the first quarter of 1980, significantly greater than the design BOD loading of 75,000 pounds per day. Similarly, the SS entering the plant increased from 103,900 pounds per day in 1979 to 117,100 pounds per day during the first quarter of 1980, significantly greater than the design SS loading of 93,000 pounds per day.

The Renton treatment plant has been operating in a stressed mode for nearly 2 years. However, the effluent BOD and SS leaving the plant and entering the river have generally been within the existing state discharge limitations (see Table 2-7). The requirements are 4,755 pounds per day of BOD and 6,338 pounds per day of SS. During 1979 the average effluent BOD loading was 5,200 pounds per day and the average effluent SS loading was 3,800 pounds per day. For the first quarter of 1980, the BOD loading was 3,700 pounds per day, and the SS loading was 3,200 pounds per day. The plant is meeting its discharge limits because it was designed with several back-up measures to provide reliability during higher flows. Among the back-up features are flow storage in the influent sewer, inherent resiliency of the activated sludge process, use of chemicals to improve sludge settling, providing secondary treatment to only part of the flow, and the capability of diverting 2-4 MGD to the West Point plant via the pressurized sludge line.

Besides BOD and SS, other characteristics of the wastewater have an influence on the quality of the discharge from the plant. Among those characteristics are nitrogen, phosphorus, pH, temperature, grease and metals. Typical concentrations of these other constituents during 1979-1980 are tabulated in Table 2-8.




SOURCE: RENTON TREATMENT PLANT MONTHLY REPORTS. REPRESENTS MONTHLY AVERAGES OF DAILY FLOW DATA.

FIGURE 2-10. HISTORICAL WASTEWATER FLOWS TO THE RENTON TREATMENT PLANT

Table 2-7. Influent and Effluent BOD* and SS* Quantities

| Month | Flow | BOD, 1000 lb/day | | SS, 1000 lb/day | |
|---|---|---|---|---|---|
| 1979 | mgd* | Influent | Effluent | Influent | Effluent |
| January | 39.33 | 105.4 | 5.4 | 142.7 | 5.1 |
| February | 48.51 | 123.4 | 13.0 | 204.3 | 13.9 |
| March | 41.90 | 141.5 | 6.9 | 208.6 | 4.2 |
| April | 38.12 | 137.6 | 4.2 | 169.7 | 2.5 |
| May | 36.86 | 105.1 | 5.5 | 130.0 | 2.3 |
| June | 35.50 | 86.1 | 4.4 | 103.6 | 1.6 |
| July | 33.55 | 81.1 | 3.6 | 99.1 | 1.6 |
| August | 33.22 | 73.4 | 3.3 | 83.4 | 2.4 |
| September | 34.08 | 79.6 | 3.5 | 96.6 | 2.0 |
| October | 34.61 | 73.6 | 3.7 | 97.9 | 2.7 |
| November | 39.55 | 87.9 | 3.7 | 108.1 | 2.9 |
| December | 50.84 | 95.8 | 5.4 | 127.2 | 4.8 |
| AVERAGE | 38.4 | 84.9 | 5.2 | 130.9 | 3.8 |
| 1980 | | | | | |
| January | 44.48 | 99.6 | 3.8 | 134.8 | 4.6 |
| February | 42.10 | 247.5 | 3.7 | 112.3 | 2.3 |
| March | 40.85 | 78.4 | 3.6 | 104.3 | 2.6 |
| AVERAGE | 42.50 | 141.8 | 3.7 | 117.1 | 3.2 |

*NOTE

BOD - Biochemical Oxygen Demand
SS - Suspended Solids
mgd - million gallons per day

Source: Metro internal memos: Renton Treatment Plant Monthly Process Analysis (for the above months).

Table 2-8. Renton Treatment Plant Effluent Characteristics

January 1979 - March 1980[1]

| Parameter | Units | Range | Average |
|---|---|---|---|
| Flow | mgd | 33-51 | 39 |
| $BOD_5$ | mg/l | 5-17 | 9 |
| | lb/day | 1,360-35,000 | 4,990 |
| SS | mg/l | 5-26 | 11 |
| | lb/day | 1,580-10,000 | 3,730 |
| $NH_3$-N | mg/l | 11.3-13.9 | 13.7 |
| Phosphorus[2] | mg/l | 3.2-7.1 | 4.3 |
| Temperature[2] | °F | 56-73 | -- |
| pH | units | 6.1-8.5 | 6.5-7.1 |
| Dissolved Oxygen[2] | mg/l | 4.5-8.9 | 7.0 |
| Grease[2] | mg/l | 2.4-20 | -- |
| Chlorine Residual | mg/l | 0.20-0.29 | 0.26 |
| Fecal Coliform | Organisms per 100 ml | 14-116 | 57 |
| Mercury | mg/l | 0.0003-0.0034 | 0.0013 |
| Cadmium | mg/l | 0-<0.004 | <0.004 |
| Copper | mg/l | 0.02-0.05 | 0.03 |
| Lead | mg/l | 0.001-<0.02 | 0.009 |
| Zinc | mg/l | 0.03-0.10 | 0.05 |
| Nickel | mg/l | 0.008-0.03 | 0.019 |
| Chromium (Total) | mg/l | 0.005-0.03 | 0.015 |

Source: 1 NPDES Discharge Monitoring Report for the Renton Treatment Plant

2 Metro, 1979d.

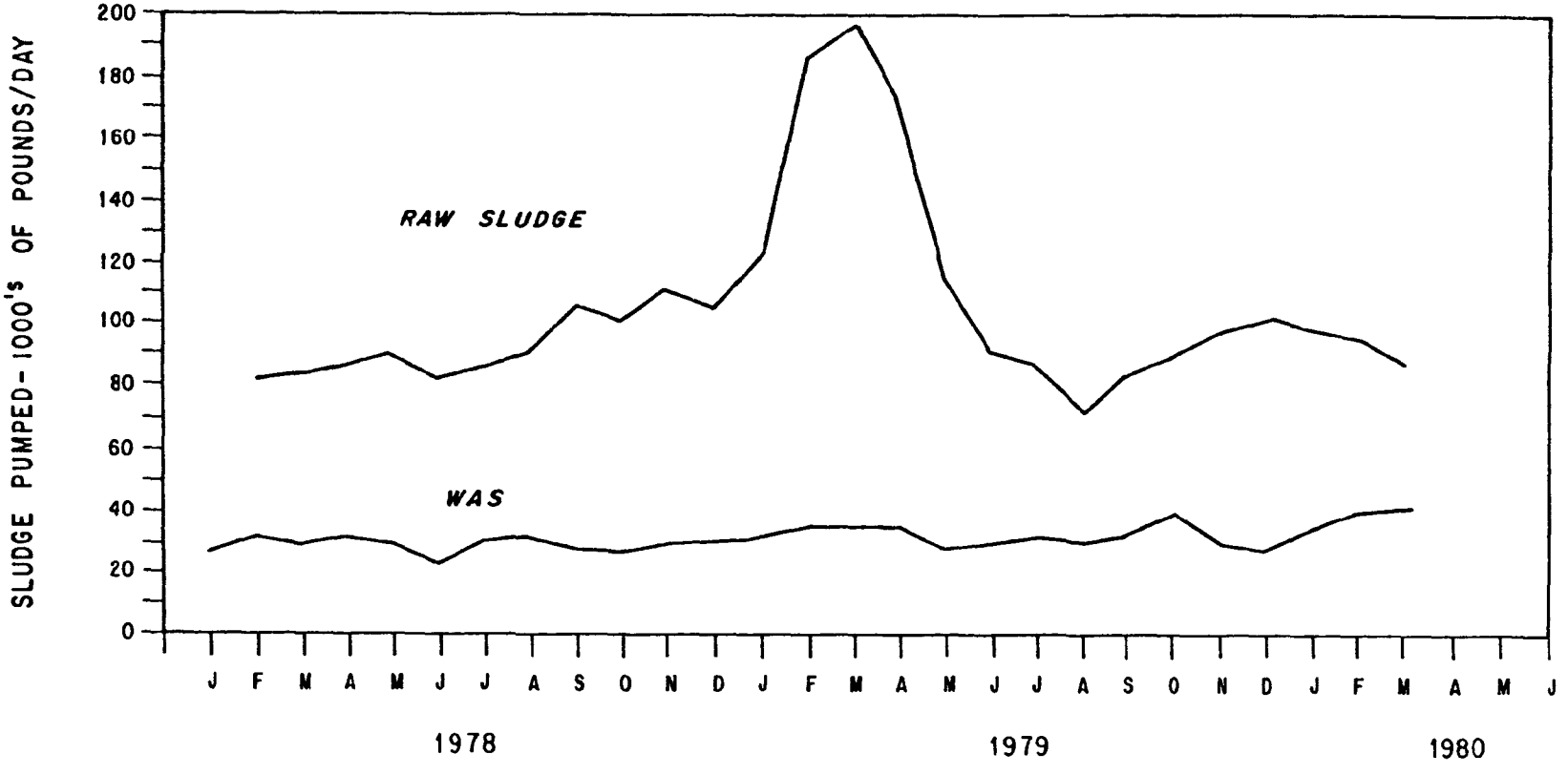
Sludge. The raw primary sludge and WAS collected during treatment at the Renton plant are pumped in a force main to the West Point plant for treatment. No sludge is currently treated at the Renton plant. Figure 2-11 shows the amounts of sludge that have been sent to the West Point plant for the period January 1978 through March 1980. Metro does not compile separate data on the quality of Renton plant sludge.

Renton treatment plant sludge makes up approximately 40 percent of the influent SS to the West Point plant, and is creating severe operational problems for the West Point plant. The sludge is pumped from the Renton plant as dilute as possible in order to keep the sludge force main detention times short, thus minimizing sulfide corrosion and odor problems at the force main discharge points and maintaining the flow in the gravity collection sewer as high as possible.

## Existing Chemical Consumption

Four chemicals are used in the Renton system: chlorine, sulfur dioxide, alum and hydrogen peroxide. Chlorine is used as a disinfectant to reduce the bacteria population in the effluent to a safe level. Sulfur dioxide is used to neutralize any of the residual chlorine not used up in the disinfection process, since residual chlorine discharged to the receiving water can be toxic to fish. Alum is used as a coagulant to enhance solids removal in the secondary sedimentation step; alum is used only when the flow in the plant is greater than the design capacity. Finally, hydrogen peroxide is introduced to the sludge force main to control the effects of corrosion of the sewer pipe by hydrogen sulfide.

Chlorine and sulfur dioxide are used in the greatest quantities because they are added continuously; alum and hydrogen peroxide are used in smaller amounts because they are used on an intermittent basis. During January 1979 through March 1980, chlorine was used at a rate of 27 pounds per million gallons (190 tons per year) and sulfur dioxide was used at a rate of 9 pounds per million gallons (67.5 tons per year). Alum is used intermittently during high flow periods, and during 1979 was used at an average rate of 9 pounds per million gallons (78 tons per year). Because flows are continually increasing, even greater quantities of alum will be required in the future; the estimated alum use in 1981 is about 28 pounds per million gallons (243 tons per year). About 9,000 gallons of hydrogen peroxide was required in 1979 and about the same amount should be required in 1980.




SOURCE: Metro, 1979d.

FIGURE 2-11. POUNDS OF SLUDGE PUMPED TO WEST POINT

## Existing Energy Use

In many wastewater treatment plants, energy needs are partially met by gas produced on-site by the digestion of sludge. Since the Renton treatment plant sludge is pumped to the West Point plant, the Renton plant's energy needs are met exclusively by purchased electricity. Figure 2-12 graphically depicts the energy use and costs at the Renton plant from 1971 to present. As shown in this figure, the electrical energy used has remained fairly constant through the years, due mainly to energy conservation efforts. In spite of these conservation efforts, rapid escalation in the unit power rate has resulted in a very significant increase in the total power bill. Figure 2-12 also illustrates that the power bill increased at a rate significantly greater than the plant flow. In the future, the plant power bill can be expected to generally increase in proportion to the power rate, because conservation efforts are reaching the maximum obtainable limits at the existing plant. Therefore, future increases in the plant power bill will be even more dramatic than in the past.

## Existing Costs of Wastewater Treatment

The cost of treating wastewater is generally proportional to the amount of wastewater treated: when more wastewater is treated, more chemicals are required, more labor and materials are needed to maintain the equipment, and more energy is needed to add air to the water. Table 2-9 displays the historic costs of wastewater treatment at the Renton plant.

## The Nonsewer Area

About 75 percent of the study area is not sewered. The residents of this area rely primarily on conventional septic tanks and drainfields for wastewater treatment and disposal. Authorities having the main responsibility for regulating on-site wastewater disposal are the health departments in King, Snohomish and Pierce Counties. King County health officials have estimated that from 50,000-100,000 such systems may be in use, with 80,000 a realistic number (Metro, 1979d). However, most of the soil types in the nonsewer area have severe wastewater disposal limitations due to insufficient depth, slow permeability, flood hazards, or high groundwater.

Septic tanks, as part of their regular maintenance, need to be pumped to remove the solids accumulation. If all on-site systems were being pumped on a once-in-three

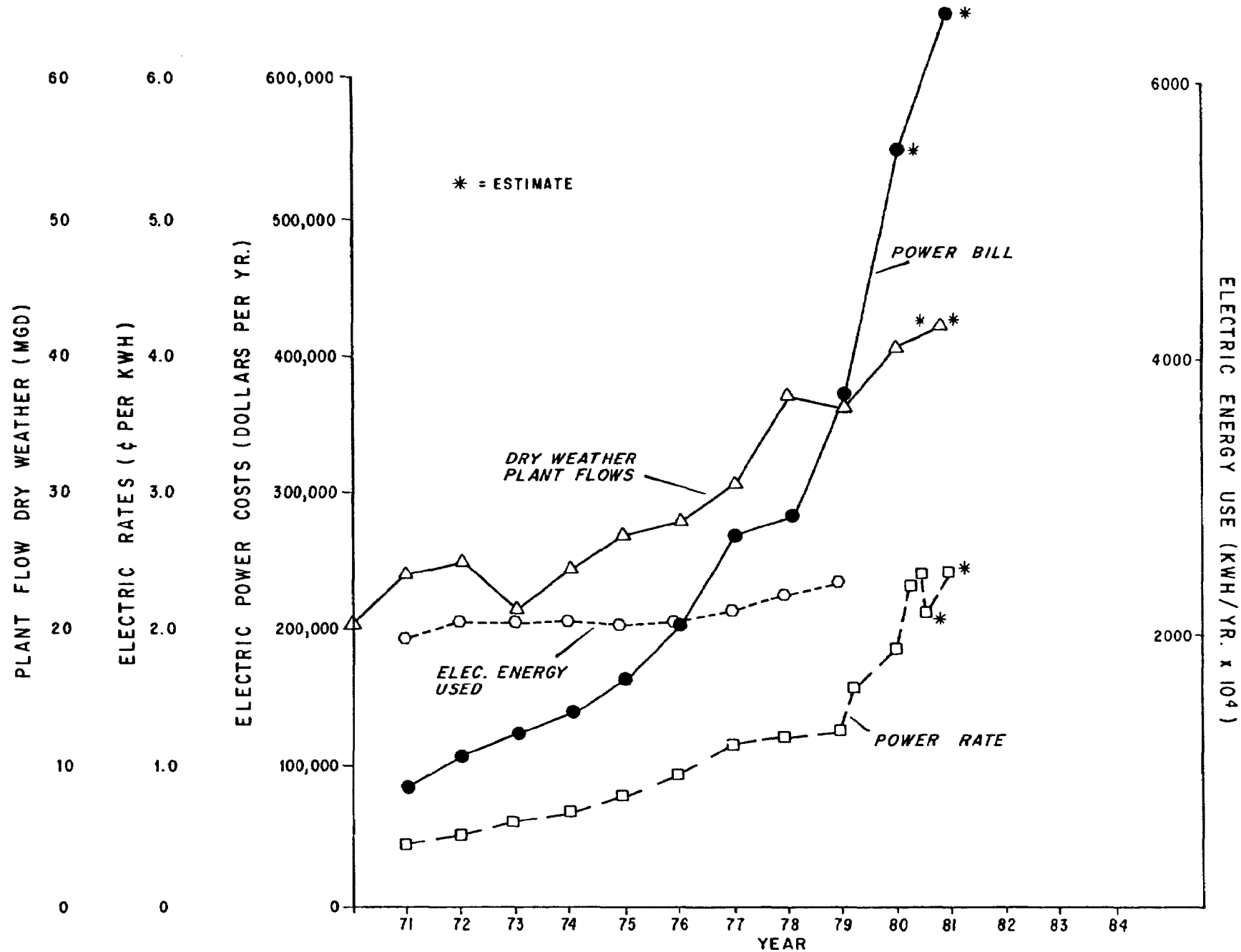



FIGURE 2-12. RENTON TREATMENT PLANT ELECTRIC POWER COST VS. TIME

Source: Metro, pers. comm., 1980.

Table 2-9. Costs of Wastewater Treatment at the Renton Plant

| Year | Average Daily Flow mgd | Operation & Maintenance $/mg | Depreciation $/mg | Estimated Transmission $/mg | Total Cost $/mg |
|---|---|---|---|---|---|
| 1974 | 28.42 | 76.70 | 29.14 | 27.80 | 133.64 |
| 1975 | 31.74 | 29.95 | 47.34 | 10.85 | 148.14 |
| 1976 | 30.84 | 90.99 | 47.50 | 32.97 | 171.46 |
| 1977 | 32.90 | 106.99 | 49.43 | 38.77 | 195.19 |
| 1978 | 39.45 | 112.62 | 49.43 | 40.81 | 202.86 |
| 1979 | 40.27 | 129.75 | 49.43 | 47.02 | 226.20 |

SOURCE: Metro, 1980, pers. comm.

year basis, approximately 27 million gallons of septage per year would be generated (Metro, 1980d). The Renton treatment plant receives most of the septage from the study area. Recent billing records at the Renton plant show that about 11 million gallons of septage are being treated on an annual basis. A full-scale septic tank maintenance program would therefore increase considerably the septage quantities received at the Renton plant.

Some "alternative" systems (other than septic tanks) have been installed in the study area. Those systems include composting toilet and mound systems. However, the alternatives are relatively new and their performance has not been fully evaluated.

# Chapter 3

# DESCRIPTION OF ALTERNATIVES

## Long-Term Alternatives for Sewer Service Area

### Flow Projections and Service Area

The quantity of wastewater that will need to be treated during the 20-year planning period is directly related to the number of people in the sewer service area. Population forecasts for the study area project that 805,000 people will live in the study area by the year 2000 (see Chapter 6). However, only 681,000 are projected for the sewered area. The wastewater flow from these 681,000 people was estimated by Metro using an average contribution of 80 gallons per capita per day.

Also, inflow and infiltration will increase the quantity of wastewater in the system. An extensive study of the inflow and infiltration problem has been prepared as part of Metro's wastewater planning (Metro, 1980d), indicating that about 1,200 gallons per acre per day would inflow into existing sewers and that approximately 500 gallons per acre per day would enter from new sewers.

Allowing for the domestic flow, industrial flow, and inflow and infiltration, Metro projects that an average wet weather flow (AWWF) of 101 MGD will occur in the year 2000. This projection has been prepared using the forecasts based on PSCOG's "policy" population projection (see Chapter 6), and the flow may be greater or less depending on actual growth rates.

The proposed sewer service area identified by Metro, based on local land use plans and policies, is shown in Figure 3-1. This figure identifies three types of land within the study area: the sewer service area (lands presently authorized for sewer service by local agencies), the nonsewer area/long-term land use certain (lands which local policies indicate should not be provided with sewer service), and the nonsewer area/long-term land use uncertain (lands where there is no clear local policy guidance, treated as nonsewer lands for purposes of wastewater management planning). The consistency of the proposed service area with local land use plans and policies is analyzed in Chapter 6 of this EIS.

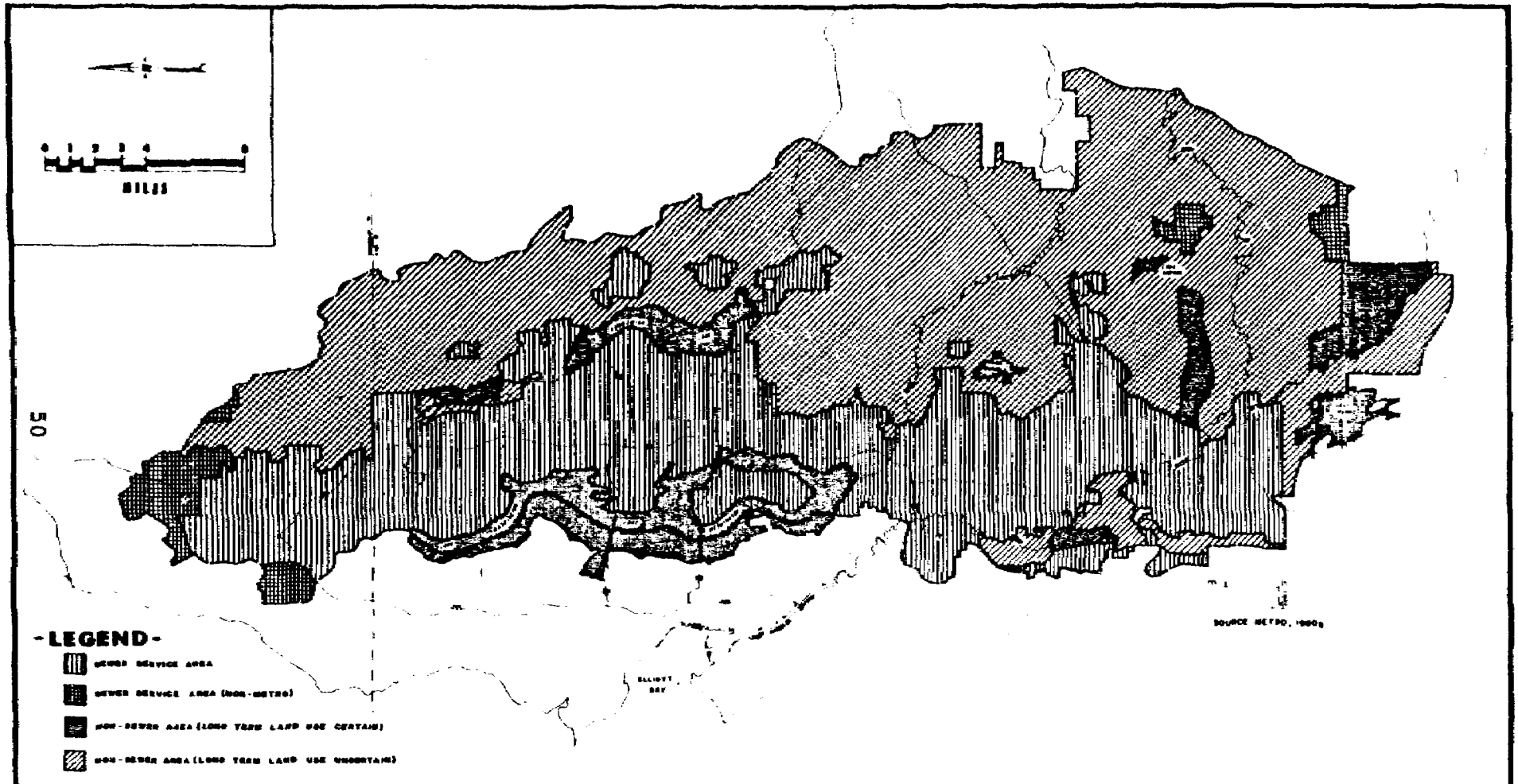



FIGURE 3-1. SERVICE AREAS

## Description of 15 Initial Alternatives

In its preliminary plan, Metro (1980e) presented 15 long-term alternatives for study area wastewater management. The 15 alternatives were variations of three basic concepts: (a) expansion of the Renton treatment plant to process all wastewater generated in the sewer service area (example program A), (b) expansion of the Renton plant and construction of a plant in the Kenmore area (example program B), and (c) construction of six satellite plants in addition to Renton plant expansion and new Kenmore plant construction (example program C). The 15 initial alternatives are summarized in Table 3-1.

## Comparative Costs of 15 Initial Alternatives

Table 3-2 compares the capital, annual operation and maintenance, and present worth costs of the 15 initial long-term alternatives. From the table it can be seen that the least cost (present worth) alternative is Alternative A-1, with a present worth cost of $267 million. The most expensive of the alternatives is C-2, with a present worth cost of $499 million.

The apparent least cost alternative (A1) provides minimum treatment to meet the requirements of the proposed NPDES permit for discharge to the Green/Duwamish River; operation and maintenance costs are moderately high compared to some other alternatives. The highest cost alternative (C-2) calls for construction and operation of eight treatment plants, one of which is a high-cost AWT plant, and also calls for construction of an outfall tunnel; operation and maintenance costs for Alternative C-2 are the second highest of all the alternatives because of the high chemical and energy costs of AWT and pumping to a Puget Sound outfall.

## User Costs of Long-Term Alternatives

A homeowner connected to a sewerage system within the Metro service area pays two separate charges for service. The first is for the local collection system to which his home is connected, and the second is for the Metro regional facilities. The local charge is paid to the local sewering agency. Local charges cover financing and maintaining local sewer lines and local pumping facilities, and hook-up charges for new connections.

Metro owns and operates major interceptor sewers, major pumping stations, and wastewater treatment plants. In essence, local collection systems discharge to the Metro system. Metro's present monthly charge is $3.90 per household per month, and this charge is additional to charges which the homeowner pays for the local collection system. (This charge will increase to $4.50 per month on January 1, 1981.)

Table 3-1. Description of 15 Initial Long-Term Alternatives

| Alternative | Configuration of Treatment Plants | Receiving Water | Level of Treatment | Total Cost (present worth, millions) |
|---|---|---|---|---|
| A-1 | CENTRALIZED - The entire sewer service area would be served by an expanded treatment plant at Renton. Flows from the North Lake Washington and North Lake Sammamish basins which now flow to West Point would be diverted to Renton via the Redmond connection and North Creek/Hollywood interceptor. | All treated effluent would continue to be discharged to the Green/Duwamish River. | The level of treatment would be increased to "advanced secondary" with nitrification. | $267 |
| A-2 | | All treated effluent would continue to be discharged to the Green/Duwamish River. | The level of treatment would be increased to "advanced wastewater treatment" with nutrient removal. | $428 |
| A-3 | | All treated effluent would be diverted via force mains and a tunnel to the Point Pulley vicinity for discharge to Puget Sound. | The level of treatment would be relaxed to "conventional secondary" (to a 30/30 level, i.e., 30 mg/l BOD and 30 mg/l SS). | $279 |
| A-4 | | All treated effluent would be diverted via a gravity sewer to Elliott Bay for discharge to Puget Sound. | The level of treatment would be relaxed to "conventional secondary" (to a 30/30 level). | $319 |
| A-5 | | All treated effluent would be diverted via a gravity sewer and tunnel to Alki Point for discharge to Puget Sound. | The level of treatment would be relaxed to "conventional secondary" (to a 30/30 level). | $357 |

Table 3-1 (cont.)

| Alternative | Configuration of Treatment Plants | Receiving Water | Level of Treatment | Total Cost (present worth, millions) |
|---|---|---|---|---|
| B-1 | DUAL CENTERS - 75 percent of the sewer service area would be served by an expanded treatment plant at Renton. The remaining 25 percent would be served by a new treatment plant in the Kenmore area. The new Kenmore plant would treat wastewater from that portion of the study area which now flows to West Point. | Renton effluent would continue to be discharged to the Green/Duwamish River.<br>Kenmore effluent would be diverted via a tunnel to Richmond Beach for discharge to Puget Sound. | At Renton the level of treatment would be increased to "advanced secondary" with nitrification.<br>At Kenmore the level of treatment would be "conventional secondary" (to a 30/30 level). | $329 |
| B-2 | | Renton effluent would continue to be discharged to the Green/Duwamish River.<br>Kenmore effluent would be diverted via a tunnel to Richmond Beach for discharge to Puget Sound. | At Renton the level of treatment would be increased to "advanced wastewater treatment" with nutrient removal.<br>At Kenmore the level of treatment would be "conventional secondary" (to a 30/30 level). | $469 |
| B-3 | | Renton effluent would be diverted via force mains and a tunnel to the Point Pulley vicinity for discharge to Puget Sound.<br>Kenmore effluent would be diverted via a tunnel to Richmond Beach for discharge to Puget Sound. | At both Renton and Kenmore the level of treatment would be "conventional secondary" (to a 30/30 level). | $357 |
| B-4 | | Renton effluent would be diverted via a gravity sewer to Elliott Bay for discharge to Puget Sound.<br>Kenmore effluent would be diverted via a tunnel to Richmond Beach for discharge to Puget Sound. | At both Renton and Kenmore the level of treatment would be "conventional secondary" (to a 30/30 level). | $397 |
| B-5 | | Renton effluent would be diverted via a gravity sewer and tunnel to Alki Point for discharge to Puget Sound.<br>Kenmore effluent would be diverted via a tunnel to Richmond Beach for discharge to Puget Sound. | At both Renton and Kenmore the level of treatment would be "conventional secondary" (to a 30/30 level). | $435 |

Table 3-1 (cont.)

| Alternative | Configuration of Treatment Plant | Receiving Water | Level of Treatment | Total Cost (present worth, millions) |
|---|---|---|---|---|
| C-1 | DECENTRALIZED - The sewer service area would be served by two major treatment plants at Renton and Kenmore (see "Dual Centers" configuration) with six small decentralized facilities to serve isolated sewered areas not contiguous to the major sewer service area. These small decentralized plants would be located in Sunrise, Sahalee, Pine Lake, Lake Desire, Pipe Lake and Timberlane and would serve approximately 2 percent of the sewer service area. | Renton effluent would continue to be discharged to the Green/ Duwamish River. Kenmore effluent would be diverted via a tunnel to Richmond Beach for discharge to Puget Sound. Effluent from the six decentralized plants would be stored during the wet season and used for "nonfood" crop irrigation during summer months on lands owned (or controlled) by Metro. | At Renton the level of treatment would be increased to "advanced secondary" with nitrification. At Kenmore the level of treatment would be "conventional secondary" (to a 30/30 level). At the six decentralized plants the level of treatment would be "conventional secondary". | $359 |
| C-2 | | Renton effluent would continue to be discharged to the Green/ Duwamish River. Kenmore effluent would be diverted via a tunnel to Richmond Beach for discharge to Puget Sound. Effluent from the six decentralized plants would be stored during the wet season and used for "nonfood" crop irrigation during summer months on lands owned (or controlled) by Metro. | At Renton the level of treatment would be increased to "advanced wastewater treatment" with nutrient removal. At Kenmore the level of treatment would be "conventional secondary" (to a 30/30 level). At the six decentralized plants the level of treatment would be "conventional secondary". | $499 |
| C-3 | | Renton effluent would be diverted via force mains and a tunnel to the Point Pulley vicinity for discharge to Puget Sound. Kenmore effluent would be diverted via a tunnel to Richmond Beach for discharge to Puget Sound. Effluent from the six decentralized plants would be stored during the wet season and used for "nonfood" crop irrigation during summer months on lands owned (or controlled) by Metro. | At Renton, Kenmore and the six decentralized plants the level of treatment would be "conventional secondary" (to a 30/30 level). | $386 |
| C-4 | | Renton effluent would be diverted via a gravity sewer to Elliott Bay for discharge to Puget Sound. Kenmore effluent would be diverted via a tunnel to Richmond Beach for discharge to Puget Sound. Effluent from the six decentralized plants would be stored during the wet season and used for "nonfood" crop irrigation during summer months on land owned (or controlled) by Metro. | At Renton, Kenmore and the six decentralized plants the level of treatment would be "conventional secondary" (to a 30/30 level). | $426 |

Table 3-1 (cont.)

| Alternative | Configuration of Treatment Plants | Receiving Water | Level of Treatment | Total Cost (present worth, millions) |
|---|---|---|---|---|
| C-5 | | Renton effluent would be diverted via a gravity sewer and tunnel to Alki Point for discharge to Puget Sound. Kenmore effluent would be diverted via a tunnel to Richmond Beach for discharge to Puget Sound. Effluent from the six decentralized plants would be stored during the wet season and used for "nonfood" crop irrigation during summer months on lands owned (or controlled) by Metro. | At Renton, Kenmore and the six decentralized plants the level of treatment would be "conventional secondary" (to a 30/30 level). | $465 |

SOURCE: Metro, 1980g.

Table 3-2. Comparative Costs of Renton Wastewater Treatment Alternatives

| | Alternative A - Centralized | | | Alternative B - Dual Centers | | | Alternative C - Decentralized | | |
|---|---|---|---|---|---|---|---|---|---|
| | Project Costs | O&M per year | Present Worth | Project Costs | O&M per year | Present Worth | Project Costs | O&M per year | Present Worth |
| Duwamish River Discharge | | | | | | | | | |
| 1. Nitrification | 262* | 12.6 | 267 | 323 | 11.4 | 329 | 329 | 11.9 | 359 |
| 2. AWT | 317 | 32.0 | 428 | 355 | 28.9 | 468 | 391 | 29.4 | 499 |
| Puget Sound Discharge | | | | | | | | | |
| 3. Point Pulley | 310 | 8.9 | 279 | 392 | 8.5 | 357 | 428 | 9.0 | 386 |
| 4. Elliot Bay | 362 | 9.0 | 319 | 444 | 8.6 | 398 | 481 | 9.1 | 426 |
| 5. Alki Point | 410 | 9.3 | 357 | 492 | 8.9 | 435 | 432 | 9.4 | 465 |

* All costs are in millions of dollars.

Source: Metro, 1980h.
ENR-CCI 3500, mid-1980 costs
U.S. WRC, 7-1/8 percent, 20 years

New regional facilities proposed by this project will be constructed using federal and state grant funds, with local funds being required for remaining costs not covered by grant funds. For most of the capital facilities, federal grants can pay 75 percent of the eligible cost, state grants 15 percent, and local funds 10 percent. If the project is classified as innovative and alternative by the EPA, the federal grant can increase to 85 percent, the state grant becomes 9 percent, and the local share decreases to 6 percent. In the past, Metro has sold revenue bonds to finance the local share of the capital costs, and then repaid these bonds using a portion of the Metro monthly charge.

Annual operation and maintenance (O&M) costs are paid for by Metro, and no grant funds are involved. O&M costs are paid for by a portion of the $3.90 monthly charge collected by Metro.

Projected monthly user costs to construct and operate the initial long-term alternatives are compared in Table 3-3, assuming 0, 50, and 75 percent grant funding of capital facilities. These various levels of grant funding were used because of uncertainties regarding grant eligibility of certain facilities and future availability of grant funds. Although some minor variations in estimated user costs occur due to levels of grant funding and staging of construction, the lowest user costs are for example program A and the highest user costs are for example program C. Overall, the lowest monthly cost would be $2.10 for Alternative A-3 with 75 percent funding, and the highest monthly cost would be $9.90 for Alternative C-2 with nutrient removal at the Renton plant and 0 percent grant funding. It should be emphasized that the costs shown in Table 3-3 do not include the present charge of $3.90 per month, and that actual future charges would be the costs shown in Table 3-3 plus the present $3.90 monthly charge.

## Other Long-Term Alternatives for the Sewer Service Area

### Alternatives Considered and Rejected by Metro

Other alternatives for meeting the long-term needs of wastewater management were considered and rejected by Metro early in the planning process. These include large-scale decentralized facilities, land application of Renton and Kenmore effluent, wasteload reductions, in-river actions, and alternative treatment plant layouts. These alternatives were considered by Metro to be incapable of meeting all the needs of a long-term project. The following discussion presents a summary of each of those alternatives.

Table 3-3. Total Project Costs and Projected Monthly Sewer Rate Increases for New Facilities

| Alternative | Total Project Cost* (million dollars) | Percentage of Grant Funding for Capital Facilities | | |
|---|---|---|---|---|
| | | 0% | 50% | 75% |
| Basic Program | | | | |
| A-1 | 267 | $5.40 | 3.50 | 2.50 |
| B-1 | 329 | 6.10 | 3.70 | 2.60 |
| C-1 | 359 | 6.70 | 4.10 | 2.80 |
| Basic Program and Nutrient Removal at Renton | | | | |
| A-2 | 428 | 9.20 | 6.90 | 5.70 |
| B-2 | 469 | 9.30 | 6.70 | 5.40 |
| C-2 | 499 | 9.90 | 7.00 | 5.60 |
| Basic Program-Renton discharge at Point Pulley | | | | |
| A-3 | 279 | 5.50 | 3.20 | 2.10 |
| B-3 | 357 | 6.70 | 3.80 | 2.40 |
| C-3 | 386 | 7.30 | 4.10 | 2.60 |
| Basic Program-Renton discharge in Elliott Bay | | | | |
| A-4 | 319 | 6.30 | 3.60 | 2.30 |
| B-4 | 397 | 7.40 | 4.20 | 2.60 |
| C-4 | 426 | 8.00 | 4.50 | 2.80 |
| Basic Program-Renton discharge at Alki Point | | | | |
| A-5 | 357 | 7.00 | 4.00 | 2.60 |
| B-5 | 435 | 8.20 | 4.60 | 2.80 |
| C-5 | 465 | 8.80 | 4.90 | 3.00 |

NOTE: Costs do not include the present charge of $3.90/month. A charge of $3.90/month must be added to the costs shown in the table to determine the total monthly charge after the construction of new facilities.

* Present worth of construction and O&M following EPA cost effectiveness guidelines (7-1/8 percent, 20 years).

SOURCE: Metro, 1980h.

Large-Scale Decentralized Facilities. Other possible sites for large plants considered in addition to Renton and Kenmore could be North Lake Sammamish or the Soos Creek Plateau. Additional plants could treat wastewater generated in those areas and discharge either to nearby bodies of water or to land.

These plants were not pursued because of high costs. Advanced wastewater treatment (AWT) would be required for a discharge to water, and land acquisition would be required for land application; both of these requirements are costly. Also, Metro determined that the risk of pollution of Lake Sammamish was too great from a nutrient contamination standpoint. Overall, it was determined that the transportation of those wastes to other areas is more cost-effective than local treatment and disposal.

Large-Scale Land Application. Land application of effluent from the study area could be considered as an alternative to disposal in either Puget Sound or the Green/Duwamish River. Metro (1980h) estimates that, to accommodate projected 20-year flows from the entire study area, 56,000 acres of land would be required for spray irrigation and 5,000 acres would be required for storage lagoons, based on a typical effluent application rate in the Seattle area of 5,000 gallons per acre per day, with a typical storage lagoon depth of 15 feet. Metro considers the purchase of such large amounts of land within a growing metropolitan area to be infeasible.

Wasteload and Flow Reductions. Wasteloads and flows to the Renton plant could be reduced by controlling infiltration/inflow (I/I) or reducing domestic or commercial/industrial flows. I/I offers the greatest potential for reduction of total flow in the Renton tributary system. For both the Renton and West Point systems, as much as 36 percent of the annual flow is due to I/I (Metro, 1980d). Although a potential of 29.5 MGD could be eliminated through correction of I/I problems, analysis by Metro showed that the cost of treating this flow is less than the cost of correcting I/I problems.

Potential treatment plant flow reduction measures identified by Metro are shown in Table 3-4. Reduction of other flows by retrofitting homes with watersaving features and appliances, and requiring them in all new construction, could achieve a 12 percent reduction in flow by the year 2000. Also, industrial wasteloads to the plant could be reduced; control of BOD, solids and heavy metals from industrial sources is being studied by Metro in its toxicant pretreatment planning study.

Table 3-4. Potential Treatment Plant
*Flow Reduction Measures*

| Flow reduction measures | Action required | Responsible agency[a] | Wastewater reduction, percent | |
|---|---|---|---|---|
| | | | Within category | Total flow |
| 1. Domestic watersaving devices | | | | |
| a. Existing homes | Public education, increase water costs | Water purveyor | 16 | 6[b] |
| b. New homes | Change building codes | City, counties | 39 | 6[b] |
| Rate structure | Increase water use costs over base rate | Water purveyor | minimal | minimal |
| Public education program | Purveyor action | Water purveyor | minimal | minimal |
| 2. Industrial pretreatment | Implement pretreatment program | Metro | Reduction will be in pollutant load, not flow | |

[a]List of water purveyors follows in Table D2-3.

[b]Percentage of total flow reduction, year 2000
Year 1980: existing--8 percent, new homes--0 percent
Year 1990: existing--6 percent, new homes--4 percent
Year 2000: existing--6 percent, new homes--6 percent
Assumes approximately 40 percent of existing non-sewer homes will be sewered by 2000.

SOURCE: Metro, 1980h.

Satellite Pretreatment. This is similar to Alternative C except that the effluent would be discharged to the Metro system. Metro analysis of this alternative indicates that the benefits do not appear to justify the cost.

In-River Actions. In-river actions were considered to reduce impacts of the Renton plant effluent. The alternatives considered were: (1) wet season retention at Howard Hansom Dam and dry season release, (2) in-river aeration, (3) chemical treatment, and (4) bank shading. These alternatives are considered by Metro to either be unrealistic (in the case of wet season retention) or ineffective as a long-term solution.

Alternative Treatment Plant Layouts. Several other possible layouts were considered by Metro but were not accepted for unspecified engineering and operational reasons.

Wastewater Reuse Alternatives. A portion of the Renton plant effluent could be reused for a variety of purposes, such as crop irrigation, landscape or golf course irrigation, industrial process water, industrial cooling water, or groundwater recharge. Wastewater reuse can reduce effluent wasteloads to receiving waters, at the same time augmenting existing freshwater supplies. In other more water-short parts of the country, wastewater reuse projects are being successfully implemented, and are encouraged by the higher level of EPA funding for innovative/alternative projects.

It has been pointed out by Metro (1980h) that demand for alternative sources of water in the Seattle area appears to be low. As growth in population and water demand continue, however, the market for reclaimed wastewater could improve. In fact, as discussed in Chapter 6, an additional source of water supply will be needed for the Seattle region in the not too distant future (Seattle Water Department, 1980). Development of this source will increase the future costs of freshwater supplies, making reclaimed wastewater more economically viable than at present. Within the next few years, detailed planning and marketing studies for the reuse of Renton plant effluent would appear to be appropriate.

## The No-Project Alternative

EPA procedures for implementing NEPA require that the impacts of a no-project alternative be examined in EISs. Under a no-project alternative, no new facilities would be constructed. Treatment capacity at the Renton plant would not be expanded. Discharge of the Renton plant effluent would continue to the Duwamish River. Solids would continue to be pumped to the West Point plant.

Under the no-project alternative, population growth within the study area would still be likely to continue, creating problems for Metro's wastewater facilities. The

pump stations that are not already overloaded would be eventually inundated by excess flow, with resultant overflow of the pump stations or backup in the interceptors until they overflow. The flow that did reach the plant would increasingly exceed the plant's capacity to completely treat it. Use of chemicals would increase in an effort to compensate for the high flows. But, over the long term, flow would increase until any "nonstructural" method of increasing the plant's treatment capability would be exceeded. Consequently, partially treated effluent would be discharged to the river, and Metro would be in violation of its discharge permit. Continued permit violations could result in daily fines or a sewer moratorium within the Renton plant service area.

If none of the facilities discussed in the facilities plan is constructed, current users would continue to pay the monthly charge of $3.90; this cost would be likely to escalate over time as Metro's O&M costs escalate. The biggest "cost" of a no-project alternative is the unquantifiable environmental cost which would result from decreased water quality in the Green/Duwamish River.

## Description of Screening/Selection Process and Final Alternatives

### The Selection Process

Metro's selection of alternatives for final consideration was accomplished by a three-stage screening procedure. The first stage in the selection process compared the attributes of each alternative to baseline criteria. The baseline criteria were water quality, cost and land use. The water quality standards consisted of Department of Ecology (DOE) receiving water standards (the Duwamish River is a Class A stream at the point of discharge); the DOE "nondegradation policy"; and the DOE "Lake Washington policy" (no discharge to Lake Washington). Other water quality criteria used as a baseline were the NPDES permits in effect and the EPA secondary treatment effluent limitations for surface water (30 mg/l BOD, 30 mg/l suspended solids). The baseline cost criterion was an EPA threshold for "high cost projects"; for King and Snohomish Counties the threshold is a monthly cost of $40. The baseline land use criterion was compatibility and consistency with applicable municipal and county land use plans and policies.

All 15 alternatives were acceptable when compared to the baseline criteria. The alternative which survived the first stage screening and which had the lowest project present worth cost is Alternative A-1; it is termed the acceptable least cost alternative (ALCA).

The second stage screening was used to determine how well the ALCA and the other alternatives met a more detailed set of benchmark criteria. The ALCA became a benchmark for comparison to the other alternatives. Table 3-5 displays Metro's rating of the 15 initial alternatives against 25 detailed water quality, cost, land use, and other benchmark criteria; these ratings are explained in the Draft Wastewater Management Plan.

The third and final stage of the screening/selection process evaluated alternatives which survived the second screening process; these "final" alternatives had possible overriding benefits justifying further detailed analysis in wastewater management planning. Three alternatives were considered to have possible overriding benefits. These alternatives, plus the ALCA, consist of: Alternative A-1 (the ALCA), Alternative A-3 (centralized treatment, discharge at Point Pulley), Alternative A-5 (centralized treatment, discharge at Alki Point), and Alternative B-1 (dual treatment centers, Renton discharge to the Green/Duwamish River).

## Expanded Description of Final Alternatives

Alternative A-1. With Alternative A-1, the Renton treatment plant would treat the combined flows of the entire service area, except the Swamp Creek drainage, which would continue to be served by the West Point treatment plant. Discharge of Renton plant effluent would continue to the Green/Duwamish River. Alternative A-1 is illustrated in Figure 3-2.

Under this alternative, the Renton plant would be expanded to 99 mgd capacity to treat projected 20-year flows. This requires expansion of the existing 72 MGD primary treatment facilities by 27 MGD using the existing treatment scheme and expansion of the activated sludge secondary system by 63 MGD. Expansion of the activated sludge process would include additional equipment and process modifications to provide nitrification. The current design of the Renton treatment plant lends itself to increases in capacity by increments of 18 mgd to keep the plant in hydraulic balance. Nine mgd increments may be used, but operationally the balance is considered by Metro to be more difficult.

All solids captured at the Renton plant would be treated at the Renton treatment plant site, and solids would no longer be pumped to the West Point plant. Proposed solids handling

Table 3-5. Metro Rating of Initial Alternatives Against the ALCA to Identify Potential Overriding Benefits

| Evaluation criteria | Alternative | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | A2 | A3 | A4 | A5 | B1 | B2 | B3 | B4 | B5 | C1 | C2 | C3 | C4 | C5 |
| Water Quality Criteria | | | | | | | | | | | | | | |
| DOE water quality standards | = | + | + | + | = | = | + | + | + | = | = | + | + | + |
| NPDES permit requirements | = | + | + | + | = | = | + | + | + | = | = | + | + | + |
| EPA effluent limitations | = | = | = | = | = | = | = | = | = | = | = | = | = | = |
| EPA/DSHS drinking water standards | = | = | = | = | = | = | = | = | = | - | - | - | - | - |
| Fisheries/shellfish protection | = | + | + | + | = | = | + | + | + | = | = | + | + | + |
| Reliability | - | + | + | + | + | - | + | + | + | - | - | - | - | - |
| Receiving water sensitivity | = | + | + | + | = | = | + | + | + | = | = | + | + | + |
| Consistency with 208 | = | = | = | = | = | = | = | = | = | = | = | = | = | = |
| Cost Criteria | | | | | | | | | | | | | | |
| Monetary costs: | | | | | | | | | | | | | | |
| Present worth | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Capital | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| O&M | - | + | + | + | + | - | + | + | + | + | - | + | + | + |
| Energy/chemical costs: | | | | | | | | | | | | | | |
| Electrical energy | - | + | + | + | + | - | + | + | + | + | - | + | + | + |
| Chemical | + | + | + | + | + | + | + | + | + | + | + | + | + | + |
| Labor staff costs | - | = | - | - | - | - | - | - | - | - | - | - | - | - |
| Reuse potential | = | = | = | = | = | = | = | = | = | = | = | = | = | = |
| EPA/DOE financing | - | = | = | = | = | - | = | = | = | = | - | = | = | = |
| Impact of inflation | - | + | + | + | + | - | + | + | + | + | - | + | + | - |
| User rates | - | + | - | - | - | - | - | - | - | - | - | - | - | - |
| Cost-sharing potential | = | = | + | + | = | = | = | + | + | = | = | = | + | + |
| Discount rate | = | = | = | = | = | = | = | = | = | = | = | = | = | = |
| Planning period | = | = | = | = | = | = | = | = | = | = | = | = | = | = |
| Land Use Criteria | | | | | | | | | | | | | | |
| Compatibility | = | = | = | = | = | = | = | = | = | = | = | = | = | = |
| Flexibility and staged construction | = | = | = | = | + | + | + | + | + | + | + | + | + | + |
| Site impacts | - | = | - | - | - | - | - | - | - | - | - | - | - | - |
| Site acquisition | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Other Criteria | | | | | | | | | | | | | | |
| Public input | = | + | + | + | + | + | + | + | + | + | + | + | + | + |
| Environmental | = | = | = | = | = | = | = | = | = | = | = | = | = | = |
| Compatibility with Puget Sound plans | = | = | + | + | = | = | = | + | + | = | = | = | + | + |

KEY: + Advantage compared with ALCA

- Disadvantage compared with ALCA

= No net advantage/disadvantage

SOURCE: Metro, 1980g.

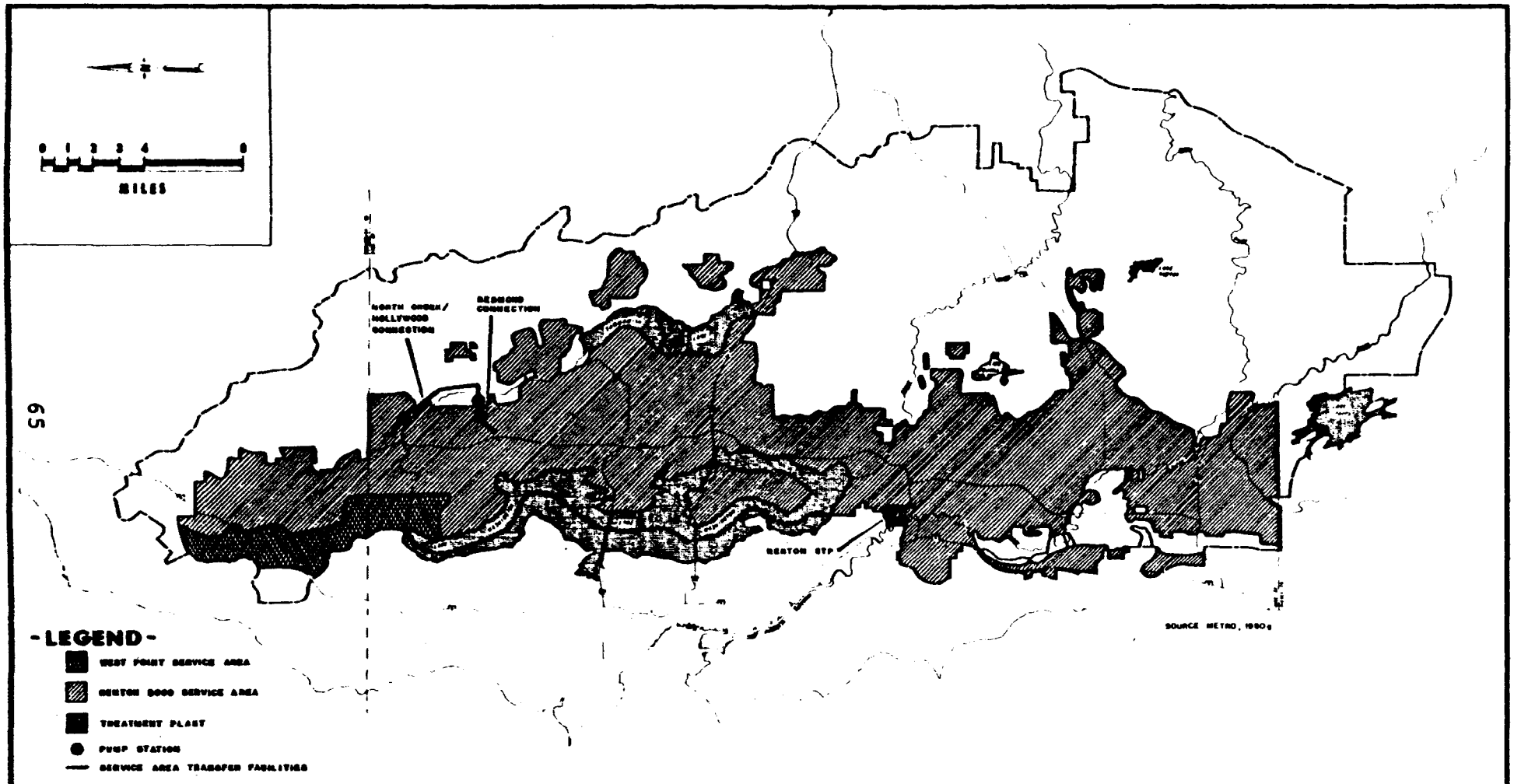



FIGURE 3-2. ALTERNATIVE A-1

facilities include gravity thickening for primary sludge, air flotation thickening for waste-activated sludge, and anaerobic digestion stabilization, followed by belt or filter press dewatering. The dewatered solids would be transported to final land disposal/reuse sites; the status of Metro's long-term solids management planning is discussed later in this chapter. Methane gas produced during anaerobic digestion would be utilized at the plant by gas engines, either directly driving process units or electrical generators.

Collection system modifications would be required for Alternative A-1. Construction of the Redmond connection and the North Creek/Hollywood connection would be required to route North Lake Sammamish and North Lake Washington flows to the Renton plant; these areas are currently served by Metro's West Point plant. The Redmond connection includes two pumping stations and force mains capable of transporting an ultimate capacity of 75 MGD. The North Creek/Hollywood connection consists of one pumping station and about 24,000 feet of interceptor piping.

The construction is proposed to take place in two phases. The first phase would bring the Renton treatment plant capacity up to 72 MGD, including solids handling, by 1985. The second phase would increase the plant capacity to 99 MGD by 1990. The Redmond connection would be completed by 1984, and the North Creek/Hollywood connection would be constructed concurrently with the second expansion of the plant. Those facilities that cannot easily be staged (e.g., tunnels and gravity sewers) would be sized for an ultimate planning period of 50 years.

The Phase 1 capital program is estimated to cost $164.1 million, of which $145.3 million is for plant expansion and $18.8 million for implementing service area changes. The Phase 2 capital program is estimated to cost $98.1 million, of which $77.9 million is for plant expansion and $20.2 million is for service area modification. The annual O&M cost, averaged over the planning period, is $12.6 million. The project's present worth is $267 million.

The impact on user rates is a function of the project costs, the level of grant support, and annual costs of O&M. If no grant funds were available the rate increase due to Alternative A-1 would be $5.40 per month; with 50 percent grant funding it would be $3.50 per month; and with 75 percent grant funding it would be $2.50 per month.

It is expected that about 98,000,000 Kwh per year will be required to treat the 99 MGD under Alternative A-1; this translates to about 2,710 Kwh per million gallons. Annual tons of chemicals used for Alternative A-1 can be anticipated to be 760 tons per year of chlorine, 240 tons per year of sulfur dioxide and 4.3 tons per year of ferric chloride.

Alternative A-3. Alternative A-3, like Alternative A-1, is a centralized treatment scheme. However, Alternative A-3 calls for discharge of treated effluent to Puget Sound in the Point Pulley area. The marine discharge allows a reduced level of treatment. The advanced secondary treatment of Alternative A-1 may be reduced to a basic secondary treatment scheme, as defined by EPA requirements (i.e., 30 mg/l BOD and 30 mg/l SS). Alternative A-3 is illustrated in Figure 3-3.

This alternative calls for treating an incoming liquid stream of 99 MGD to meet the 30/30 effluent requirements. Because the degree of treatment is less, the capacity rating on the existing secondary treatment elements may be uprated, thus reducing the size of additional needed facilities.

All solids collected at the Renton plant would be treated on the Renton treatment plant site, using the same sludge handling facilities as Alternative A-1. Since the amount of solids will be less than with Alternative A-1, the sludge treatment units may be downsized accordingly.

Effluent from the Renton plant would be discharged through a tunnel into the marine waters of Puget Sound in the vicinity of Point Pulley. Precise routing of the tunnel has not been determined, and would be based on further engineering and environmental investigations.

The collection system modifications proposed for Alternative A-3 are the same as those for Alternative A-1, the Redmond connection and the North Creek/Hollywood connection.

Project staging for Alternative A-3 is in two phases. Phase 1 calls for expansion of the treatment plant capacity to 72 MGD, with construction completed by 1985. Phase 2 would add 27 MGD capacity, with construction completed by 1990. Collection system modifications would be staged and sized as in Alternative A-1.

The Phase 1 capital program is estimated to cost $233.8 million, of which $74.8 million is for plant expansion, $140.2 million for the effluent outfall, and $18.8 million for service area changes. The Phase 2 capital program is estimated to cost $76.0 million, of which $55.8 million is for the plant expansion, and $20.2 million is for additional service area changes. The annual O&M cost, averaged over the planning period, is $8.9 million. The projects's present worth is $279 million.

The impact on user rates is a function of the project costs, the level of grant support, and annual O&M cost. If no grant funds are available the rate increase due to Alternative A-3 would be $5.50 per month; with 50 percent grant funding the rate increase would be $3.20 per month; and with 75 percent grant funding it would be $2.10 per month.

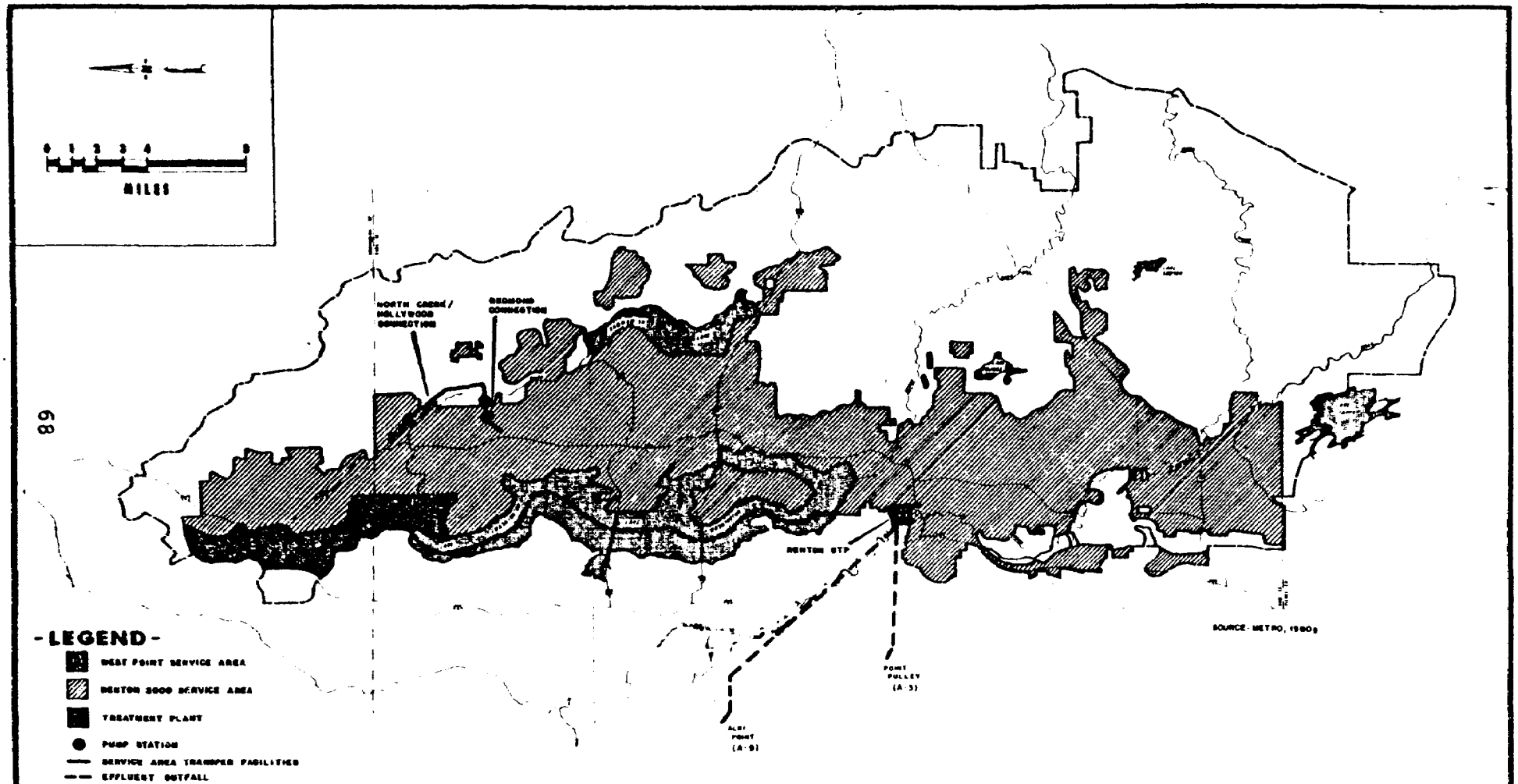



FIGURE 3-3. ALTERNATIVES A-3 & A-5 (PREFERRED PROGRAM)

It is expected that about 87,000 Kwh per year will be needed to treat the 99 MGD using Alternative A-3; this translates to about 2,410 Kwh per million gallons. Annual tons of chemicals used for Alternative A-3 can be anticipated to be 760 tons per year of chlorine and 3.9 tons per year of ferric chloride.

Alternative A-5. Alternative A-5 is identical in all respects to Alternative A-3, with the exception that plant effluent is transmitted to Alki Point for discharge to Puget Sound (see Figure 3-3). Effluent from the Renton plant would be discharged via conventional conduit and tunnel to marine water off Alki Point. Precise routing of the tunnel and pipe have not been determined, and would be based on further engineering and environmental investigations. The Phase 1 capital program is estimated to cost $333.9 million, of which $74.8 million is for plant expansion, $240.3 million is for the effluent outfall, and $18.8 million is for service area changes. The Phase 2 capital program is estimated to cost $76.0 million, of which $55.8 is for further plant expansion, and $20.2 million is for additional service area changes. The annual O&M cost, averaged over the planning period, is $9.3 million. The project's present worth is $357.0 million.

The impact on user rates is a function of the project costs, the level of grant support, and annual O&M cost. If no grant funds are available the rate increase due to Alternative A-5 would be $7.00 per month; with 50 percent grant funding, the rate would $4.00 per month; and with 75 percent grant funding, it would be $2.50 per month.

It is expected that about 89,000,000 Kwh per year will be needed to treat the 99 MGD using Alternative A-5; this translates to about 2,460 Kwh per million gallons. Annual tons of chemicals used in Alternative A-5 can be anticipated to be 760 tons per year of chlorine and 3.9 tons per year of ferric chloride.

Alternative B-1. Alternative B-1 is a dual treatment center alternative whereby the Renton plant would continue to serve the existing Renton service area and a new Kenmore treatment plant would serve the north part of the study area currently tributary to West Point. Under Alternative B-1, Renton treatment plant would be expanded to 72 MGD. The level of treatment would also be upgraded to an advanced secondary system with nitrification. Alternative B-1 is illustrated in Figure 3-4.

Under Alternative B-1 a new 27 MGD treatment plant would be constructed in the Kenmore vicinity. The plant's treatment processes would be similar to those of the existing Renton plant. It would utilize conventional primary sedimentation followed by an activated sludge secondary system, clarification chlorination and dechlorination. The Kenmore plant would be designed and operated to produce a 30/30 effluent (30 mg/l each of BOD and SS).

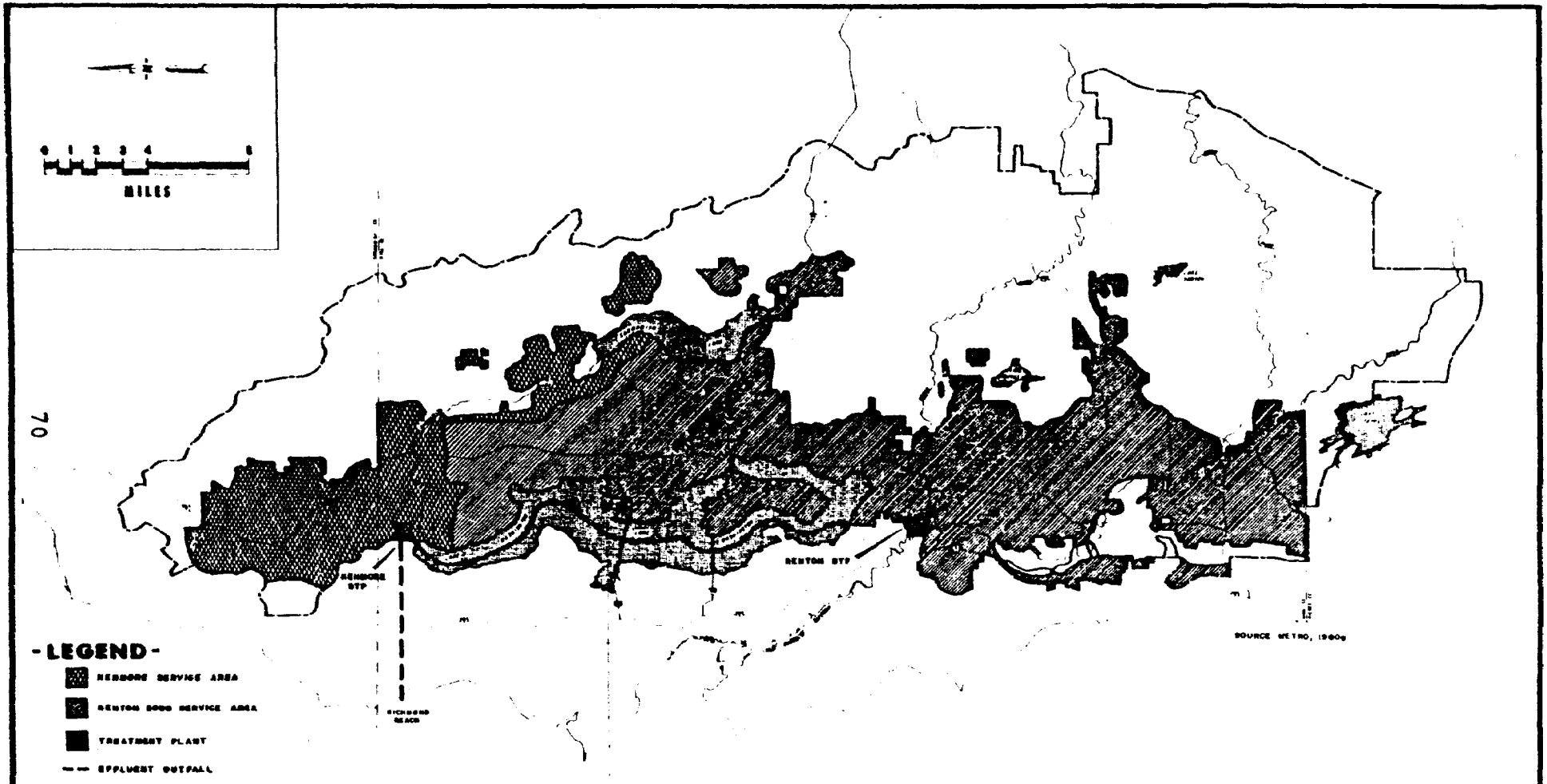



FIGURE 3-4. ALTERNATIVE 8-1

Solids handling processes for the 72 MGD Renton facility would be identical to Alternatives A-1, A-3, and A-5. The Renton plant, with its upgraded treatment, would discharge directly to the Green/Duwamish River. The Kenmore plant would require construction of a tunnel and outfall to Richmond Beach for discharge to Puget Sound.

Alternative B-1 does not require the construction of either the Redmond connection or the North Creek/Hollywood interceptor. No major collection system modifications are required for this option.

The staging for Alternative B-1 is also in two phases. Phase 1 calls for expansion of the Renton plant, construction of Renton plant solids handling facilities, and construction of 18 MGD capacity at the Kenmore plant, together with the tunnel and outfall for effluent disposal. All of the Phase 1 construction would be completed by 1985. Phase 2 construction, to be completed by 1990, calls for expansion of the Kenmore plant to 27 MGD.

The Phase 1 capital program is estimated to cost $294.8 million, of which $145.3 million is for the Renton plant, $51.3 million is for the Kenmore plant, and $98.2 million is for the Kenmore plant outfall to Richmond Beach. The Phase 2 capital program is estimated to cost $27.8 million for expansion of the Kenmore plant. The annual O&M cost, averaged over the planning period, is $11.4 million. The project's present worth is $329.0 million.

The impact on user rates is a function of the project costs, the level of grant support, and annual O&M cost. If no grant funds are available the rate increase due to Alternative B-1 would be $6.10 per month; with 50 percent funding, the rate increase would be $3.70 per month; and with 75 percent grant funds, it would be $2.60 per month.

It is expected that about 75,000,000 Kwh per year will be needed to treat the 99 MGD using Alternative B-1; this translates to about 2,080 Kwh per million gallons. Annual tons of chemicals used for Alternative B-1 can be anticipated to be 550 tons per year of chlorine, 170 tons per year of sulfur dioxide, and 3.8 tons per year of ferric chloride.

## The Preferred Long-Term Wastewater Management Program

### Selection of the Preferred Program

The final stage of the Metro selection process required description and comparison of the overriding benefits of the final alternatives to determine which one would be the preferred program. The areas deemed to have potential overriding benefit were water quality and O&M costs.

The water quality considerations addressed were the potential for deterioration of dissolved oxygen levels and elevated temperatures in the Green/Duwamish River during low-flow periods, which usually occur during the early fall salmon runs. Although Alternatives A-1 and B-1 involve discharge of an upgraded (nitrified) effluent, they do not solve the temperature problem. Metro determined that only Alternatives A-3 and A-5 could fully eliminate water quality concerns in the Green/Duwamish River.

In reviewing O&M costs Metro evaluated the effect of inflation on the present worth of each final alternative, and found that those alternatives with lower O&M costs were less susceptible to inflation. Metro found that if the inflation rate exceeded 3 percent, Alternatives A-3 and A-5 had a lower present worth (as much as 30 percent) than Alternative A-1. Metro also found that the extra cost in Alternative B-1 for the Kenmore treatment plant site and effluent tunnel did not compensate for the savings of eliminating the Redmond connection, eliminating the North Creek/Hollywood connection, and reducing Renton plant O&M costs.

Alternatives A-3 and A-5 were both selected by Metro staff as having sufficient overriding benefits to justify selection as the preferred program. Since Alternative A-3 has the lower cost, Metro determined that justification of Alternative A-5 would require evaluation of other "overriding factors" such as superiority of Alki Point as a discharge location, cost sharing potential, and easier implementation, which would justify the $78 million extra cost. No decision is made in the Draft Wastewater Management Plan regarding the location of the outfall (i.e., whether Alternative A-3 or A-5 is preferable). Before this decision is made, Metro proposes to: conduct additional studies to determine cost sharing potential, await results of its pretreatment and toxicant study, and obtain public and agency input on alternative outfall locations.

## Detailed Description of the Preferred Program

Collection System Changes. The Redmond connection and the North Creek/Hollywood connection are the primary changes in the collection system. Both include gravity sewers, pump stations, and force mains. Metro selected a 50-year staging period as most cost-effective for sizing gravity sewers, pump station structures, and purchase of land and rights-of-way. All other parts of the collection system are sized for 20 years.

The Redmond connection includes two pumping stations, the York station, with an ultimate capacity of 75 MGD and three force mains, and the Totem Lake station, with an ultimate capacity of 75 MGD with twin force mains. Costs and phasing of the Redmond connection are shown in Table 3-6. Previous Metro studies (Metro, 1978g) have identified the preferred route alignment, and Metro is currently securing needed rights-of-way. Metro projects that the Redmond connection should be ready for detailed design in 1981.

The North Creek/Hollywood connection would not be on-line until 1993. The North Creek/Hollywood connection would have an ultimate capacity of 37 MGD, and would include construction of one new pump station, the Woodinville station. Costs and phasing for this project are shown in Table 3-6. Metro has deferred detailed staging and alignment decisions for the North Creek/Hollywood connection until planning for Phase 2 is initiated.

Wastewater Treatment. The Renton plant would be expanded to treat a total capacity of 99 MGD and to produce an effluent that contains not more than 31 mg/l BOD and 30 mg/l SS. First phase expansion would increase the capacity of the secondary activated sludge units from 36 to 72 MGD. Second phase construction would increase the capacity of the entire plant from 72 to 99 MGD. Costs for Renton treatment plant liquid stream improvements with the preferred program are shown in Table 3-7.

Solids Handling. The proposed solids handling processes are based on Metro's assumption that the preferred solids disposal method will be land application. The proposed processing will utilize gravity thickening of waste activated sludge, anaerobic digestion and dewatering. Methane gas is proposed to be recovered from the anaerobic digestion process and used as a fuel for engine-driven pumps and blowers. Other waste heat recovery schemes are also proposed. Blend tanks are proposed as a method of controlling odors (if raw sludge bypasses the digesters) and equalizing the flow to the dewatering facilities. Belt filters are proposed for dewatering with the liquid filtrate recycled to the plant. The dry solids would be trucked or railed to a disposal site. Costs for solids handling facilities under the preferred program are shown in Table 3-7.

Effluent Disposal. Five alternative pipeline alignments are proposed to transport the effluent to either Point Pulley or Alki Point. Cost estimates and design parameters for the alternative alignments are shown in Table 3-8.

Table 3-6. Costs for Redmond Connection and North Creek/Hollywood Connection

| Facility | Item | Quantity | Estimated cost, million dollars[a] | |
|---|---|---|---|---|
| | | | Phase 1 | Phase 2 |
| Redmond Connection, 75 mgd[a] | | | | |
| North Lake Sammamish interceptor | 108-in. RCP | 2,600 ft | 2.34 | |
| York pump station | | | | |
| Phase 1, 30 mgd | Station | 3 pumps at 15 mgd | 3.40 | |
| | 30-in. force main | 2 at 1,400 ft | 0.26 | |
| Phase 2, 75 mgd | Pumps | 3 at 15 mgd | | 0.30 |
| | 30-in. force main | 1 at 1,400 ft | | 0.10 |
| Totem Lake interceptor | 84-in. RCP | 4,100 ft | 2.26 | |
| Totem Lake pump station | | | | |
| Phase 1, 30 mgd | Station | 3 pumps at 15 mgd | 3.40 | |
| | 36-in. force main | 1 at 3,100 ft | 0.44 | |
| Phase 2, 75 mgd | Pump | 3 at 15 mgd | | 0.30 |
| | 36-in. force main | 1 at 3,100 ft | | 0.37 |
| Redmond interceptor extension | 54-in. RCP | 1,300 ft | 0.39 | |
| Other costs[b] | | | 0.63 | |
| Subtotal | | | 13.43 | 1.07 |
| Engineering, taxes, contingencies at 40 percent | | | 5.37 | 0.43 |
| Redmond Connection, total project cost | | | 18.80 | 1.50 |

Table 3-6. Cont'd.

| Facility | Item | Quantity | Estimated cost, million dollars[a] | |
|---|---|---|---|---|
| | | | Phase 1 | Phase 2 |
| North Creek/Hollywood Connection, 37 mgd | | | | |
| North Creek/Woodinville | 60-in. RCP | 3,700 ft | | 1.44 |
| | 54-in. RCP | 1,700 ft | | 0.51 |
| Woodinville pump station | New 37-mgd station | 1 | | 3.60 |
| Woodinville/Hollywood | 60-in. RCP | 18,500 ft | | 7.22 |
| Other[b] | | | | 0.60 |
| Subtotal | | | | 13.37 |
| Engineering, taxes, contingency at 40 percent | | | | 5.35 |
| North Creek/Hollywood connection, total project cost | | | | 18.72 |
| Annual O&M[c] | | | 0.58 | 0.13 |
| Present worth | | | 19.10 | 6.30 |

[a]ENR-CCI 3500.

[b]Includes special construction requirements such as utility interference, railroad, highway, or river crossings, and land or easement purchases.

[c]Based on mid-point of planning period.

[d]Listed in this figure are the "firm capacities" for each of the pump stations. Firm capacity means the capacity of the pump station with one pump not operating and used as a reserve pump.

SOURCE: Metro, 1980g.

Table 3-7. Costs for Renton Treatment Plant Improvements

| Item | Project cost, million $ | | |
|---|---|---|---|
| | Phase 1 72 mgd | Phase 2 99 mgd | Total |
| Liquid Stream | | | |
| Primary | 0 | 19.6 | 19.6 |
| Aeration | 14.6 | 11.2 | 25.8 |
| Clarifiers | 11.2 | 8.7 | 19.9 |
| Chlorination and dechlorination | 0.4 | 0.3 | 0.7 |
| Subtotal | 26.2 | 39.8 | 66.0 |
| Solids Stream | | | |
| Gravity thickening | 3.1 | 0.9 | 4.0 |
| DAF | 6.7 | 2.4 | 9.1 |
| Anaerobic digestion | 22.7 | 7.4 | 30.1 |
| Dewatering | 8.4 | 2.8 | 11.2 |
| Gas recovery | 5.7 | 1.9 | 7.6 |
| Mechanical solids handling | 2.0 | 0.6 | 2.6 |
| Subtotal | 48.6 | 16.0 | 64.6 |
| Total | 74.8 | 55.8 | 130.6 |
| Annual O&M [b] | | | 6.8 |
| Present worth | | | 135.8 |

[a]Based on ENR-CCI = 3500, mid-1980 USWRC discount rate 7-1/8 percent.

[b]Average over the planning period.

SOURCE: Metro, 1980g.

Table 3-8. Cost Comparison of Alternative Effluent Discharge Routes

| Route | Item | Estimated size or number | Approximate length, ft | Cost, million dollars: Estimated cost by item: Phase 1 | Phase 2 | Total project cost[a] | Annual O&M | Present worth[b] |
|---|---|---|---|---|---|---|---|---|
| Route A: Seahurst Park | Outfall | 96 in. | 3,000 | 9.2 | | | | |
| | Tunnel | 120 in. | 27,000 | 102.2 | | | | |
| | Force main | Two at 72 in. | 4,000 | 7.6 | | | | |
| | Pump stations | Two | | 19.6 | 1.4 | | | |
| | Land and easements | | | 0.2 | | | | |
| | | | | | | 140.2 | 0.6 | 110.2 |
| Route B: Lake Burien | Outfall | 96 in. | 3,000 | 9.2 | | | | |
| | Tunnel | 120 in. | 29,000 | 109.6 | | | | |
| | Force main | Two at 72 in. | 4,000 | 7.6 | | | | |
| | Pump stations | Two | | 19.6 | 1.4 | | | |
| | Land and easements | | | 0.5 | | | | |
| | | | | | | 147.9 | 0.6 | 115.0 |
| Route C: Point Pulley | Outfall | 96 in. | 3,000 | 9.2 | | | | |
| | Tunnel | 120 in. | 33,000 | 124.7 | | | | |
| | Force main | Two at 72 in. | 4,000 | 7.6 | | | | |
| | Pump stations | Two | | 19.6 | 1.4 | | | |
| | Land and easements | | | 0.9 | | | | |
| | | | | | | 163.4 | 0.6 | 128.0 |
| Route D West Duwamish | Outfall | 96 in. | 2,200 | 6.8 | | | | |
| | Tunnel | 144 in. | 9,200 | 50.2 | | | | |
| | Gravity sewer | 144 in. | 51,000 | 139.8 | | | | |
| | Force main | Two at 72 in. | 4,800 | 9.0 | | | | |
| | Pump stations | Three | | 32.0 | 2.2 | | | |
| | Land and easements | | | 0.3 | | | | |
| | | | | | | 240.3 | 1.0 | 188.2 |
| Route E East Duwamish | Outfall | 96 in. | 2,200 | 6.8 | | | | |
| | Tunnel | 144 in. | 9,200 | 50.2 | | | | |
| | Gravity sewer | 144 in. | 55,000 | 148.7 | | | | |
| | Force main | Two at 72 in. | 8,000 | 13.1 | | | | |
| | Pump stations | Three | | 32.0 | 2.2 | | | |
| | Land and easements | | | 0.3 | | | | |
| | | | | | | 253.3 | 1.0 | 198.0 |

[a]Based on ENR-CCI 3500, mid-1980 costs.

[b]U.S. Water Resources Council discount rate: 7-1/8 percent. Present worth assumes single phase construction.

SOURCE: Metro, 1980g.

*Point Pulley*. Heading west from the Renton plant toward the Point Pulley-Seahurst area, three potential effluent disposal routes were selected. Route A follows South 146th Street, Route B follows South 152nd Street, and Route C heads directly to Point Pulley following no street alignment. Because right-of-way acquisition was an important consideration, attempts were made by Metro to follow existing public easements (i.e., roadways, utilities, etc.). Neither of the roadways mentioned is continuous and so each route would require additional purchase of right-of-way. Route C, however, would require right-of-way purchase along nearly its entire length.

All routes would cross the Green/Duwamish River and the City of Tukwila, and would require tunnels to carry effluent under the higher elevation areas of Riverton Heights and Burien. Route A would have a tunnel portal in Seahurst County Park and an outfall located off the beach there. Route B would require purchase of land in the residential area to the west of Lake Burien for a tunnel portal and construction of an outfall. Route C would cross under Sea-Tac Airport and continue to Point Pulley, with a tunnel portal and an outfall located near the point.

*Alki Point*. The routes to Alki Point would follow the Green/Duwamish River downstream to the vicinity of Spokane Street, and then cross under a narrower width of West Seattle through a tunnel. Two potential routes were selected. Route D would follow the west side of the Green/Duwamish River, traverse West Seattle under S. W. Hanford Street, and have an outfall jutting northwest from Alki Point. Route E would follow the existing sludge force mains (which transfer sludge from Renton to West Point) on the east side of the Green/Duwamish River, then follow East Marginal Way to South Idaho Street, and cross the river with the existing West Duwamish Siphon. Route E would then follow the same tunnel alignment as Route D, under S. W. Hanford Street, terminating with an outfall due west off Alki Point.

## Near-Term Actions

Metro has included in its Wastewater Management Plan a section titled Near-Term Actions (Chapter 4). The purpose of that section is to list and describe those projects that Metro deems should be undertaken as soon as possible. The section roughly categorizes 17 projects into three groups: (1) projects in the Renton Phase 1 capital program, (2) future planning projects, and (3) projects in progress. The 17 projects are listed in Table 3-9.

Table 3-9. Near-Term Actions

Phase 1 Capital Program

| Facility | Action |
|---|---|
| Renton Treatment Plant | Expansion to 72 mgd |
| Solids Handling Facilities | Develop solids handling facilities at Renton |
| Renton Tunnel/Outfall | Construct facilities to divert Renton effluent to Puget Sound |
| Kenmore Pump Station Upgrade | Construct interim facilities to alleviate capacity/ reliability problems |
| Redmond Connection | Construct facilities to alleviate capacity/ reliability problems |

Future Planning Projects

| Facility | Action |
|---|---|
| West Valley Interceptor | Contractual obligation to construct new interceptor |
| Eastgate Trunk | Construct facilities to alleviate capacity problems |
| Mill Creek Relief Sewer | Contractual obligation to construct facilities relieving capacity problem |
| Medina System Upgrade | Construct facilities to alleviate capacity/ reliability problems |
| Riverton Pump Station | Construct facilities to alleviate capacity/ reliability problems |

Table 3-9 (cont'd.)

Projects in Progress

| Facility | Action |
|---|---|
| Enatai Interceptor | Emergency repairs |
| Issaquah Creek Interceptor | Design/construct new facility to fulfill contractual obligation |
| Juanita System Upgrade | Construct facilities to alleviate capacity/ reliability problems |
| May Creek Interceptor | Construct new interceptor |
| Mercer Island Realignment/ Pump Station #6 | Design/construct new facilities necessitated by I-90 construction |
| Sunset/Heathfield System Upgrade | Construct facilities to alleviate capacity/ reliability problems |
| Sweyoloken Pump Station | Construct facility to alleviate capacity/ reliability problems |
| Wilburton Pump Station/Siphon | Construct facilities to alleviate capacity/ reliability problems |

SOURCE: Metro, 1980g.

## Projects in the Phase 1 Capital Program

The following previously described projects are included within the Renton Phase 1 capital program: Renton treatment plant expansion to 72 MGD, Phase 1 solids handling facilities, the Renton plant tunnel/outfall to Puget Sound, and the Redmond connection.

An additional Phase 1 project not previously described is upgrade of the Kenmore pump station. The Kenmore pump station, which serves the northern portion of the study area, has several operational, reliability and safety problems. Peak flows currently exceed the available capacity, pumps are frequently clogged, there is no back-up power, and no washroom facilities are available.

The purpose of the Kenmore pump station is to transfer sewage to the Kenmore interceptor from south Snohomish County, North Lake Washington and North Lake Sammamish. The flow to the pump station would be reduced by the construction of the Redmond connection and the North Creek/Hollywood interceptor. Swamp Creek flows would continue to be pumped by the station.

Phase 1 construction is intended to rehabilitate the structure and increase the capacity from 11 MGD to 16.5 MGD. The Phase 1 project costs are estimated to be $399,000. The changes are expected to be completed by mid 1982. Expansion for Phase 2 would be coordinated with the design of the North Creek/Hollywood interceptor.

## Future Planning Projects

Five near-term projects have been identified for future planning and implementation (see Table 3-9). These projects require additional planning prior to detailed design and construction.

## Projects in Progress

Metro has identified eight near-term projects as currently in progress. For each of those projects, planning has been completed and work is proceeding on design and construction. Because of the advanced status of those projects, they are proceeding independently of the Draft Wastewater Management Plan.

## Solids Disposal Alternatives and Costs

The purpose of this section is to describe the alternatives that Metro is currently considering for disposal of solids generated at its various wastewater treatment plants. Although, certain solids handling methods are being proposed for each of the long-term Renton wastewater management alternatives, ultimate solids disposal is not a part of any of the alternatives.

Metro is currently undertaking a planning study of long-term solids disposal options. As part of this study, a preliminary cost-effectiveness analysis of solids disposal options was conducted (Metro, 1980i); the cost estimates in this preliminary study may be modified as a result of further work. The goal of the cost-effectiveness study was to determine the sludge management program which would, for a 20-year planning period, accomplish specific objectives.

The results of the cost-effectiveness study are reviewed here to establish the relationship between the Renton treatment plant solids handling facilities described earlier and long-term solids disposal alternatives. Environmental assessment of the long-term solids disposal alternatives will, however, occur under separate NEPA and SEPA processes.

### Current Sludge Disposal Methods

Metro's sludge treatment and handling is centralized at the West Point treatment plant. Sludge treatment presently consists of conventional anaerobic digestion to stabilize the sludge and reduce the quantity of volatile solids. The digested sludge is dewatered to achieve a sludge cake that contains about 18 percent solids. The dewatered sludge is then transported to a disposal or reuse site.

Sludge disposal and reuse during the past 15 years have been oriented toward examining the advantages and disadvantages of alternative methods for disposal. The methods examined include deepwater disposal, soil rehabilitation, crop fertilization, energy recovery, and sanitary landfill disposal.

The quantity of sludge during the past 15 years has increased. During the period 1974 through 1979 the average dry tons produced per day ranged from 23 in 1974, to 28 in 1979, approximately a 4 percent increase per year. The recent use of alum to improve treatment process performance has

substantially increased the volume of sludge to be treated and continued use of alum will increase the volume of sludge above historic rates of increase. Sludge production for the Metro system is projected to increase from 28 dry tons per day in 1979 to 63 dry tons per day in 1985, to 83 dry tons per day in 2000.

## Identification of Options

Eleven options were considered by Metro for sludge utilization or disposal. The options were selected on the basis of: (1) previous operational experience in the Puget Sound area, or wide-scale implementation nationwide; (2) research on utilization options conducted by Metro; and (3) potential for energy recovery. Systemwide treatment of sludge at the West Point and Renton facilities was assumed for all disposal options.

Sludge treatment processes for all use or disposal options were the same, and were identical to the treatment processes proposed for the Renton plant as part of the Draft Wastewater Management Plan. It was assumed that anaerobic digestion would be the principal stabilization process. This process was selected because it is self-sustaining and produces methane gas for energy recovery. It was also assumed that the stabilized sludge could be dewatered by a method that would achieve 18 percent solids before disposal, if needed.

Ocean Disposal. Under this option, digested, liquid sludge would be barged to ocean waters off the Olympic Peninsula which have previously beem permitted as dump sites for munitions and ocean dredge spoils. A force main would be constructed from the Renton plant to a new barging site located either on the Green/Duwamish Waterway or Elliott Bay. This option would be inconsistent with federal policies which discourage ocean disposal of sewage sludge.

Conventional Incineration. Under this option, multiple-hearth incinerators would be installed at both the West Point and Renton treatment plants. Dewatered, undigested sludge would be incinerated on site, and the ash residue would be hauled by truck for final disposal to the King County landfill. Primary sludge at West Point would be put through clarifiers and then dewatered; at the Renton plant, waste-activated sludge would be thickened and then dewatered. Both would then be fed into incinerators. Emission control equipment would be installed to comply with air pollution requirements.

Coincineration. An alternative to conventional incineration would be codisposal of sludge with municipal solid waste. Although there is little operational experience in the U. S. with this technology, coincineration has the potential for significant energy recovery through the generation of steam. For this option, liquid sludge from both treatment plants would be transported by force main to a centralized handling facility in an industrial area for dewatering and combustion, and ash residue would be hauled by truck to the county landfill. The low-grade steam generated by the facility would be sold to local industrial users. Emission controls would be similar to conventional incineration.

Sanitary Landfill. Sanitary landfilling has occasionally been used by Metro in recent years. Under this option, digested and dewatered sludge would be truck-hauled to the county landfill. Landfilling could be implemented at any time; however, the long-term (or 20-year) availability and cost of sanitary landfilling in King County are considered highly uncertain.

Silviculture. Metro has undertaken extensive research on sludge application to forestlands as a soil and plant amendment to provide additional nutrients. The tree growth response to sludge application demonstrated by this research indicates its potential. Two approaches are considered as long-term options by Metro. The first involves hauling digested, dewatered sludge from both treatment plants to a small number of privately owned sites and application to second-growth timber stands. Sludge would be truck-hauled from the treatment plants to these sites and temporarily stored for final application. Spray pumpers would be used for actual application. Under the second approach, liquid sludge (4 percent solids) would be barged to sites on the Kitsap and Olympic Peninsula for spray application to second-growth sites in the same manner as dewatered sludge.

Soil Improvement. Metro has conducted a variety of soil improvement projects. Sludge has been applied to areas with poor soils to amend these soils to produce improved vegetation growth. The soil improvement option involves transporting the digested, dewatered sludge from the treatment plants to the site by truck, and either allowing it to dry on-site, or immediately spreading and tilling it into the soil by plowing, and then seeding. The sludge can be mixed with sand or sawdust at the point of application to improve the mixing process, depending on the condition of existing site soils. The application sites would include a portion of land to be purchased and maintained by Metro. The sites could be used for a variety of purposes following sludge application.

Composting. Composting digested, dewatered sludge could provide a nonagricultural fertilizer for use in parks, roadsides, recreation areas, and other publicly-controlled lands. This option consists of a central facility for sludge storage, composting, and stockpiling of the final product. Digested, dewatered sludge would be hauled by truck to this facility, and the composted product would be delivered by truck to the consumers. The composting method used would consist of large, static windrows similar to those being examined in an ongoing University of Washington demonstration project. Application of the compost product would be subject to regulation under provisions of the Resource Conservation and Recovery Act of 1976 (RCRA).

Agricultural Use. Two options were considered by Metro for agricultural use of digested, liquid sludge. In the first, the land required would be purchased, with possible leasing arrangement for tenant farmers; in the second, land use agreements would be developed with private farmers and Metro would assume application costs. The land considered appropriate for the agricultural application, based on agricultural use and proximity to the treatment plants, would be located in the Green River Valley and the Enumclaw Plateau. Sludge would be transported by force main to storage lagoons and then applied to the agricultural sites by tank trucks equipped with pumps. Application would be subject to regulation under RCRA.

## Selection of A Recommended Program

The advantages, disadvantages, and costs of each candidate program have been discussed in detail in Metro's sludge disposal cost-effective analysis. The costs of the options are tabulated in Table 3-10. Based on a comparison of each option's reliability, flexibility, environmental impact, reuse potential, public acceptance, and cost, Metro has developed a preliminary program design with the following elements:

- From 25-50 percent of Metro's sludge will be used as a forest and plant amendment for the 20-year planning period. The use of trucks versus barges has not been determined.

- About 45-75 percent of the sludge will be used for reclaiming marginal and poor soils. Between 2,800 and 5,250 acres of land will be purchased and leased for this purpose.

- Up to 10 percent of Metro's sludge will be composted sludge. The product will be made available for distribution to public agencies and commercial bulk users for public landscaping projects.

Table 3-10. Costs of Candidate Sludge Disposal Systems

| Candidate System | Annual Cost ($1,000) | Present Worth ($1,000) | Unit Cost ($/dry ton) |
|---|---|---|---|
| Puget Sound Outfall | 6,154 | 69,167 | 280 |
| Ocean Dispersal | 8,021 | 90,151 | 365 |
| Conventional Incineration | 12,205 | 137,177 | 554 |
| Co-incineration | 15,159 | 170,378 | 689 |
| Sanitary Landfill | 9,996 | 112,349 | 454 |
| Silviculture (18%) | 9,966 | 112,349 | 453 |
| Silviculture (4%) | 8,040 | 90,364 | 366 |
| Composting | 9,790 | 110,034 | 445 |
| Soil Improvement | 11,488 | 129,118 | 524 |
| Agriculture w/land | 18,722 | 210,424 | 851 |
| Agriculture w/o land | 13,552 | 152,316 | 616 |

SOURCE: Metro, 1980i.

It is estimated that the proposed program will require from $392-$505 per dry ton of sludge depending on the final program mix selected.

## Alternatives for the Nonsewer Area

Most residents in the nonsewer portion of the study area will continue to use on-site individual or small community wastewater treatment and disposal methods over the next 20 years. Although many of the soils in King County have been found to have severe limitations, on-site methods have been successfully used. The traditional septic tank/leach field system can be used, but diligence must be used in the design, construction, inspection, and maintenance of the systems.

Capital costs for a septic tank and absorption field in the study area typically range from $900-$2,100, depending on the size of the absorption field. If an initial $1,500 cost for a septic tank and drain field is capitalized over a 20-year period at an 8 percent interest rate, this is equivalent to an annual cost of $150, or about $12.70 per month. Adding a $15 per year ($1.25 per month) cost for septic tank pumping to the capitalized cost results in an estimated monthly cost of $13.95.

Other systems are available for on-site wastewater treatment and disposal as an alternative to septic tanks for use in the nonsewer area. Some of the methods identified by Metro, their approval status, potential impact on residential density, and costs, are listed in Table 3-11.

In the past, on-site systems have been viewed as a short-term solution for wastewater treatment. In 1977 the King County council called for the strengthening of regulations to improve performance of on-site systems, thus, moving in the direction of long-term use of on-site systems. The Seattle-King County Health Department in 1980 adopted revised regulations governing on-site systems which recognize these systems as long-term waste management options.

Metro's Draft Wastewater Management Plan sets forth a series of recommendations, to be implemented by local health and land use agencies, designed to protect water quality and public health in nonsewer areas. These recommendations, which assume that on-site methods will continue to be the preferred method of wastewater management in the nonsewer areas, may be summarized as follows:

- Establish a comprehensive program for design, construction, and maintenance of on-site and community systems.

## Table 3-11. On-Site and Community Wastewater Treatment and Disposal Technologies

| Treatment Technologies (must be coupled with a disposal technology) | Approved for Use by[a] | Potential Impact on Residential Densities[b] | Installation Costs[c] | Annual Operation and Maintenance Costs[c] |
|---|---|---|---|---|
| Septic Tank | DSHS, SKCHD, SHD | ---- | $ 400-600 | $ 10-15 |
| Aerobic Treatment | DSHS, SKCHD | same | $1,000-3,000 | $ 65-225 |
| Complete Recycling | ---- | significant increase | $8,000-10,000 | $510-540 |
| Composting Toilets[d] | DSHS, SKCHD | marginal increase | $ 700-3,200 | $ 50-100 |
| Granular Filtration | ---- | same | $1,500-3000 | $ 0-150 |
| Greywater Recycling | ---- | marginal increase | $ 600-2,100 | $ 40-500 |
| Incinerating Toilets[d] | ---- | marginal increase | $ 600-1,200 | $ 85-310 |
| Oil Recirculating Toilets[d] | ---- | marginal increase | $4,500-6,000 | $250-300 |
| **Disposal Technologies (must be coupled with a treatment technology)** | | | | |
| Absorption Fields | DSHS, SKCHD, SHD | ---- | $ 500-1,500[f] | none[e] |
| Leaching Chambers | ---- | same | $ 750-1,200 | none |
| Sheldon Network | ---- | same | $ 750-2,000 | none |
| Electro-Osmosis | ---- | same | $4,000-5,200 | none |
| Evapotranspiration | DSHS | marginal decrease | $4,000-5,000 | none |
| Mounds/Fills | DSHS, SKCHD | marginal decrease | $3,100-5,800 | $ 20-50 |
| Seepage Pits | ---- | marginal increase | $ 400-600 | none |
| Holding Tanks | SKCHD | significant increase | $ 300-2,000 | $.04-.10/gallon |

(a) DSHS = Department of Social and Health Services
SKCHD = Seattle/King County Health Department
SHD = Snohomish Health District

(b) Newer on-site technologies may have different spatial requirements than conventional septic tank and drainfield systems. Impacts on residential densities displayed above are based upon a comparison of the newer on-site technology against a conventional septic tank and drainfield.

(c) Due to extreme variability in site conditions, construction, and maintenance costs, these figures should be regarded as estimates. Costs are based on EPA literature values which are in 1978 dollars.

(d) Community systems having wastewater flows in excess of 14,500 gal/day must be approved by the Department of Ecology.

(d) Technology requiring construction of a greywater disposal system.

(e) The use of dosing equipment would result in operation and maintenance costs of $20-50 annually.

(f) Installation costs may be significantly higher if the absorption field requires an alternating or dosing design.

SOURCE: Metro, 1980g.

- Identify an areawide management agency and implement a program demonstrating long-term commitment to management of nonsewer areas.
- Establish on-site management zones in nonsewer areas where system performance or soil condition is poor.
- Establish a routine performance monitoring system.
- Further strengthen existing rules and regulations to emphasize proper design and construction.

- Provide adequate staffing and funding for on-site wastewater management programs, and provide adequate enforcement of rules and regulations.
- Encourage experimentation with alternative technologies.
- Establish public education program emphasizing the long-term nature of on-site systems and proper design, construction, and maintenance.

## Triggering Mechanism

The triggering mechanism is a monitoring program proposed by Metro's facilities plan to accomplish two purposes: (1) to provide advance notice for needed expansions or additions to the Metro sewerage system, and (2) to monitor the performance of on-site systems in nonsewer areas.

To accomplish the first purpose, monitoring of population, wastewater flow, and sewer service area changes is proposed. The triggering mechanism will act as a timing device to indicate when a decision must be made to construct an expanded or new treatment plant, pump station, or interceptor sewer. Possible courses of action include taking some nonstructural action (e.g., flow reduction, modifying facility operation), as well as structural alternatives.

Monitoring the performance of on-site systems is proposed to be the joint responsibility of local land use and health agencies, and Metro. It is assumed that local land use and health agencies will provide the necessary assessment of on-site system performance. Metro would identify existing or potential water quality problems through its lake and stream monitoring program. When a problem area is identified, appropriate local land use and health agencies would be asked to chair a meeting to verify the problem and choose an appropriate course of action. Alternative courses of action include establishing an on-site wastewater management district, developing a community wastewater system, installing a new on-site technology, connecting to the centralized sewerage system, or taking no-action other than further study or evaluation.

Metro proposes the preparation of an Annual Wastewater Management Plan update. This update would include a status report on the Renton sewerage system and nonsewer area monitoring.

## Approach to EIS Evaluation of Alternatives

Comprehensively evaluating the direct and secondary environmental impacts of long-term wastewater management alternatives for the 620-square-mile study area is a complex undertaking. The general approach taken here is to separately consider the construction and site-related impacts of components included in the four final long-term alternatives (Chapter 4); the operational impacts of these long-term alternatives (Chapter 5); and the secondary growth-related impacts common to all alternatives (Chapter 6). The assessments in Chapters 4 and 5 do not comprehensively consider all 15 initial alternatives, in order to simplify the analysis. The assessments do, however, shed light on the major facility-related issues of treatment plant configuration (centralized vs. dual treatment centers vs. decentralized plants) and level of treatment/receiving water (continued Duwamish discharge with upgraded treatment vs. Puget Sound discharge with secondary treatment).

The triggering mechanism, the near-term actions, and the nonsewer area alternatives proposed as parts of the Metro Draft Wastewater Management Plan are not separately assessed for impacts in the EIS. The triggering mechanism is essentially a mitigation measure for assisting in the implementation of the long-term program, and for monitoring the performance of on-site systems in nonsewer areas; thus, there are beneficial impacts, but no adverse impacts, attributable to the triggering mechanism. Near-term actions proposed for Phase 1 of the preferred program are not separately assessed here because they are assessed together with the entire preferred program. Other near-term actions (projects for which further planning is needed, projects in progress) are not part of the current decisions which are to be made a part of the Renton facilities plan; environmental review of these projects has or will be accomplished separately from this EIS process. Lastly, alternatives for the nonsewer area are not separately assessed here because they are not presented as grant-fundable projects by Metro at this time; however, environmental impacts of and mitigation measures for on-site systems in the nonsewer area are assessed in the secondary groundwater impacts section of Chapter 6 of the EIS.

## Chapter 4

## CONSTRUCTION AND SITE-RELATED IMPACTS OF ALTERNATIVES

### Overview

Each of the long-term wastewater management alternatives for the Lake Washington-Green River Basins has different components. Each of these project components will have different construction or site-related impacts on the environment.

Table 4-1 is a summary rating of the construction and site-related impacts of the components making up each alternative; the table also lists mitigation measures for each adverse impact. For the preferred program, all the project components are shown. For alternatives, only components in addition to those required for the preferred program are listed; it should be noted that implementation of these alternatives would also eliminate the need for construction of one or more preferred program components.

Table 4-1 indicates that, in general, construction and site-related impacts associated with project components are minor, except for certain impacts of constructing the effluent tunnel and outfall under the preferred program or Alternative B-1. None of the impacts shown in Table 4-1 would occur if the no-project alternative were implemented.

The remainder of the chapter expands upon construction and site-related impacts of each alternative. The last section is a comparative analysis of the construction employment impacts of the long-term alternatives.

### Impacts of Preferred Program

The preferred program includes construction of the following components: collection system changes (Redmond connection, North Creek/Hollywood connection, Kenmore pump station), Renton treatment plant expansion, solids handling facilities, and a tunnel and outfall to Puget Sound.

#### Collection System Changes

##### Redmond Connection.

*Description of Existing Environment*. The proposed Redmond connection would be located in the vicinity of N.E. 124th Street and a branch of the Burlington Northern Railroad system just east of Totem Lake, King County (Figure 4-1). Northeast

Table 4-1. Overview of Construction and Site-Related Impacts of Project Components

| Impacts | Preferred Program: Redmond Connection | Preferred Program: North Creek/Hollywood Connection | Preferred Program: Kenmore Pump Station | Preferred Program: Renton Treatment Plant Expansion | Preferred Program: Solids Handling Facilities | Preferred Program: Tunnel/Outfall | A1[a]: Nitrification at Renton Treatment Plant | B1[a]: Kenmore Treatment Plant | B1[a]: Kenmore Treatment Plant Tunnel/Outfall | Mitigation Measures |
|---|---|---|---|---|---|---|---|---|---|---|
| Potential incompatibility with adjacent land uses | x | x | o | o | x | ? | o | ? | o | Establish adequate buffer zones<br>Design treatment plant to blend with neighborhood<br>Adequate odor controls<br>Minimize night operations |
| Disruption of recreational uses | o | x | o | o | o | X | o | o | X | Schedule construction during off-peak recreation periods |
| Cultural resources | ? | ? | ? | o | o | ? | o | ? | ? | Conduct detailed archeological survey prior to construction<br>If resources found during construction, halt work and call in qualified archeologist |
| Traffic disruption | x | x | x | x | x | X | x | x | x | Reroute traffic around construction sites and provide flagmen |
| Visual aesthetics | x | x | x | x | x | x | x | x | x | Fence or otherwise screen construction maintenance areas<br>Revegetate denuded areas<br>Store equipment in areas that are not highly visible |
| Safety hazards | x | x | x | x | x | x | x | x | x | Keep curious bystanders away from construction sites<br>Minimize length of time trenches are left open |
| Noise and dust | x | x | x | x | x | x | x | x | x | Keep soil watered down<br>Require vehicle noise controls<br>Minimize night operations |
| Spoils disposal | x | x | o | x | x | X | x | x | X | Use spoils for fill or dispose in a an acceptable location |
| Construction equipment exhaust emissions | x | x | x | x | x | x | x | x | x | Keep engines in tune |
| Soils erosion | x | x | o | x | x | x | x | x | x | Confine soil and vegetation removal to smallest possible area<br>Reseed or replant disturbed areas as soon as possible |
| Loss of vegetation; wildlife disturbance | x | x | o | x | x | x | x | x | x | Minimize removal of native vegetation<br>Reseed or replant disturbed areas as soon as possible |
| Surface water quality and aquatic biology impacts | x | x | o | o | o | x | o | o | x | Construction should occur during low flow periods and when anadromous fish would be least affected |
| Disruption of benthic habitat | x | o | o | o | o | x | o | o | x | Limit areas of disturbance to immediate outfall location |
| Construction employment | + | + | + | + | + | + | + | + | + | None required |

Explanation of Impact Ratings:

- o - no impact
- x - minor adverse impact
- X - moderate adverse impact
- ? - uncertain impact
- + - beneficial impact

[a]Only project components in addition to those required for the preferred program are listed; these alternatives would also eliminate the need for construction of one or more preferred program components - see text. Alternatives A-1 and B-1 also require purchase of an additional 19 acres at the Renton treatment plant site; this is an adverse impact not shared by the preferred program.

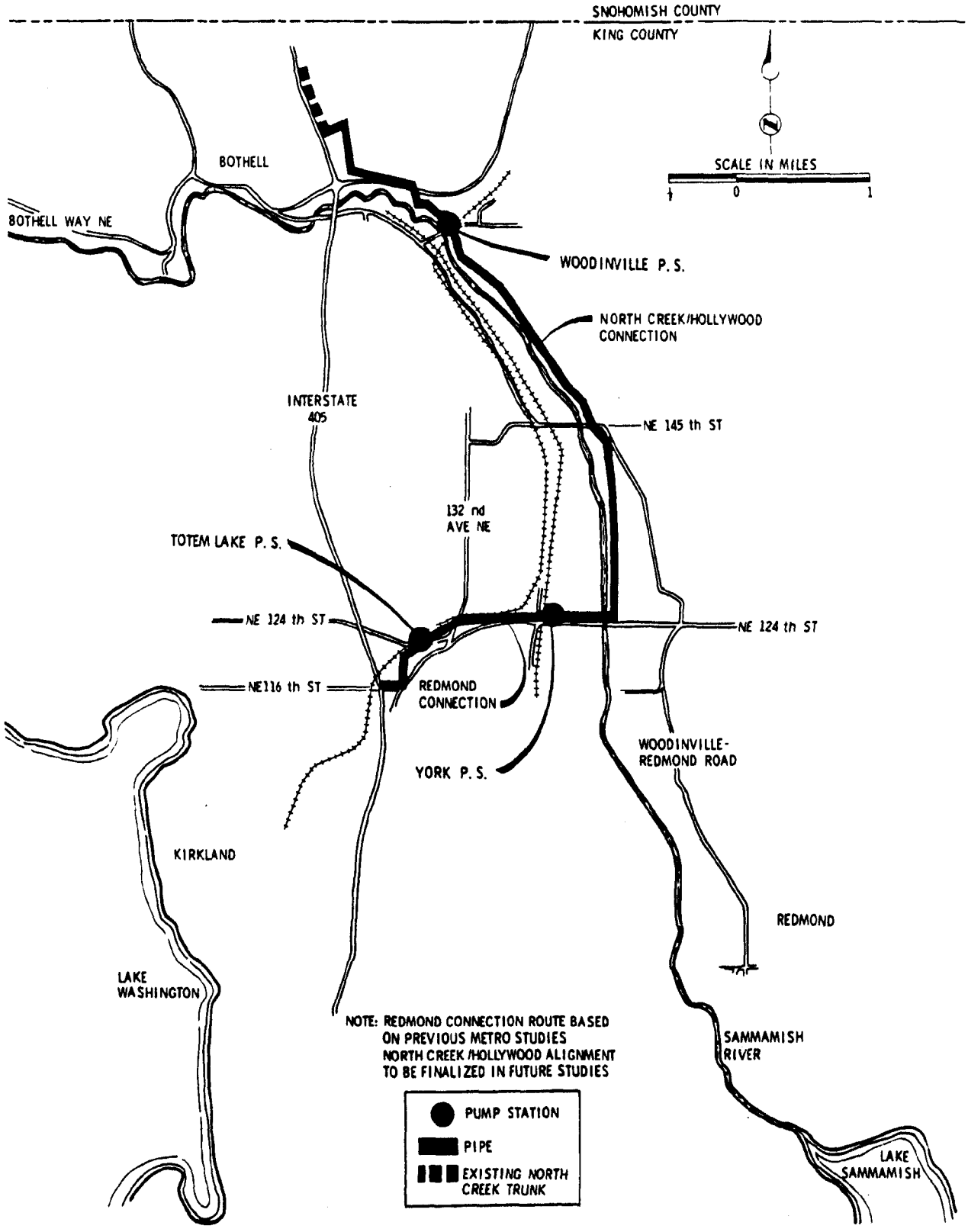



Figure 4-1. Alignment of Redmond Connection and North Creek/Hollywood Connection

SOURCE: Metro, 1980g.

124th Street provides access from Interstate 405 to State Route 202 and Avondale west of the Sammamish River. Land use along the 12,500-foot-long alignment is a mixture of industrial, commercial, transportation, agriculture (turf and pasture), and recreation (Sammamish River). Both the Totem Lake and York pumping stations would be located adjacent to the Burlington Northern Railroad tracks.

Topography along a major portion of the alignment is gently sloping, with a steep gradient between the western branch of the Burlington Northern Railroad and 142nd Avenue N.E. The steep portion (approximately 500 feet) is considered an erosion hazard area by King County (Department of Planning and Community Development (1980a).

Vegetation, for the most part, consists of herbaceous growth (grasses, forbs) scattered patches of second-growth (big leaf maple), and introduced species (in urban areas). Approximately 2,300 feet of the alignment is within the 100-year floodplain of the Sammamish River (Department of Planning and Community Development, 1980a).

Approximately 2,600 feet of the Redmond connection (the North Lake Sammamish interceptor and York pumping station portion) paralleling N.E. 124th Street will be constructed within the Sammamish Valley/Bear Creek Agricultural District (Class II soils).

*Assessment of Impacts*. Table 4-1 presents an overview of construction and site-related impacts of the Redmond connection and lists mitigation measures for adverse impacts. Virtually all features of the Redmond connection (pump stations, gravity pipes and force mains) will lie adjacent to existing transportation corridors (N.E. 116th Street, N.E. 124th Street and the Burlington Northern Railroad), and will be compatible with existing land uses and zoning. Easements will be required through or adjacent to 31 parcels. Some fill will be required in the vicinity of the York pumping station, near Slater Avenue N.E. (N.E. 124th Street) and at the Totem Lake pumping station.

The impact on cultural resources is uncertain at this time. Portions of the alignment (specifically the North Lake Sammamish Interceptor) will lie within an area of "high potential" for archeological resources (see Appendix A, Chapter 4). However, much of the alignment has been greatly disturbed by previous construction activities. Once the precise alignment is known an archeological survey will be conducted.

According to the King County sensitive areas map folio (1980), portions of the alignment will be within seismic and erosion hazard areas and within the 100-year floodplain of the Sammamish River. Furthermore, construction will be

necessary within the riverbed of the Sammamish River at one point. Special construction techniques would be necessary to prevent erosion problems on the steep slopes and major impacts on water quality and streambed conditions within the Sammamish River.

Construction of a portion of the York force mains may require removal of several big-leaf maple trees at the corner of N.E. 124th Street and Burlington Northern Railroad, and of an unoccupied structure on the northwest corner of the intersection.

North Creek/Hollywood Connection.

*Description of Existing Environment*. Much of the proposed North Creek/Hollywood connection will traverse agricultural land from Woodinville south to the existing Hollywood pumping station at N.E. 124th Street (see Figure 4-1). Scattered areas of transportation and commercial land uses occur in Hollywood and Woodinville near State Route 522.

Topography along the route is relatively flat, particularly from Woodinville south to the Hollywood pumping station. Some scattered wetlands occur along the east side of the Sammamish River, south of Woodinville (King County, 1980).

*Assessment of Impacts*. Table 4-1 presents an overview of construction and site-related impacts of the North Creek/Hollywood connection, and lists mitigation measures for adverse impacts. The North Creek/Hollywood connection is projected to be a Phase 2 project, and for that reason the exact alignment is not known at this time.

The alignment would pass through areas considered sensitive by King County. Most of the alignment from Bothell south to N.E. 124th Street would be within a Class III seismic hazard area and the 100-year floodplain of the Sammamish River and Bear Creek. The alignment would require one stream crossing (Bear Creek) and construction through several wetlands just sound of Woodinville (King County, 1980).

The proposed pipeline would also traverse land within the Sammamish Valley/Bear Creek Agricultural District and would parallel the Sammamish River Parkway.

Special construction methods will be necessary to handle potential seismic risks and to ensure the continued viability of the wetland areas.

Kenmore Pump Station.

*Description of Existing Environment*. The Kenmore pump station is an existing feature of Metro's sewerage system. The pump station is located at the north end of Lake Washington

near N.E. 175th Street and 68th Avenue N.E., and encompasses an area of approximately 2,000 square feet.

Existing land use in the area is commercial and services, bordered by industry. The pump station is fenced from N.E. 175th Street. The fenced area contains the existing pump station facilities and a large grassed area which could support future expansion.

*Assessment of Impacts*. Because the proposed action is to upgrade an existing facility, construction impacts would be minimal. Phase 1 (1981 construction) improvements would include the installation of new pumps, and safety and sanitation equipment for maintenance crews. All improvements would be at the existing station.

Phase 2 (1990 construction) would include construction of a new underground pump station and force main adjacent to the existing structure. Table 4-1 presents an overview of construction and site-related impacts of the Kenmore pump station improvements, and lists mitigation measures for adverse impacts. No cultural survey has been conducted at the pump station, but one may be required prior to the Phase 2.

The proposed near-term and future improvements to the pump station would be compatible with existing land uses. Sufficient land is available at the site to construct the proposed features.

## Renton Treatment Plant Expansion

Description of Existing Environment. The Renton treatment plant is located next to the Green/Duwamish River in a predominantly industrial area at the western edge of the City of Renton. The site is surrounded by industrial and railroad uses. A hill is located on the western edge of the property, and the right-of-way for a drainage channel to be constructed by the Soil Conservation Service borders the site on the north and east. The hill and drainage channel right-of-way constitute significant constraints on the location of planned improvements to the plant.

Figure 4-2 illustrates the Renton treatment plant layout and the proposed location of components of the preferred long-term wastewater management program. Construction of the proposed facilities will require fill to raise elevations on the undeveloped part of the site from 16 feet to between 26 and 34 feet. A flood hazard analysis presented in Metro's comparison document indicates that the treatment plant site will receive adequate protection from floods.

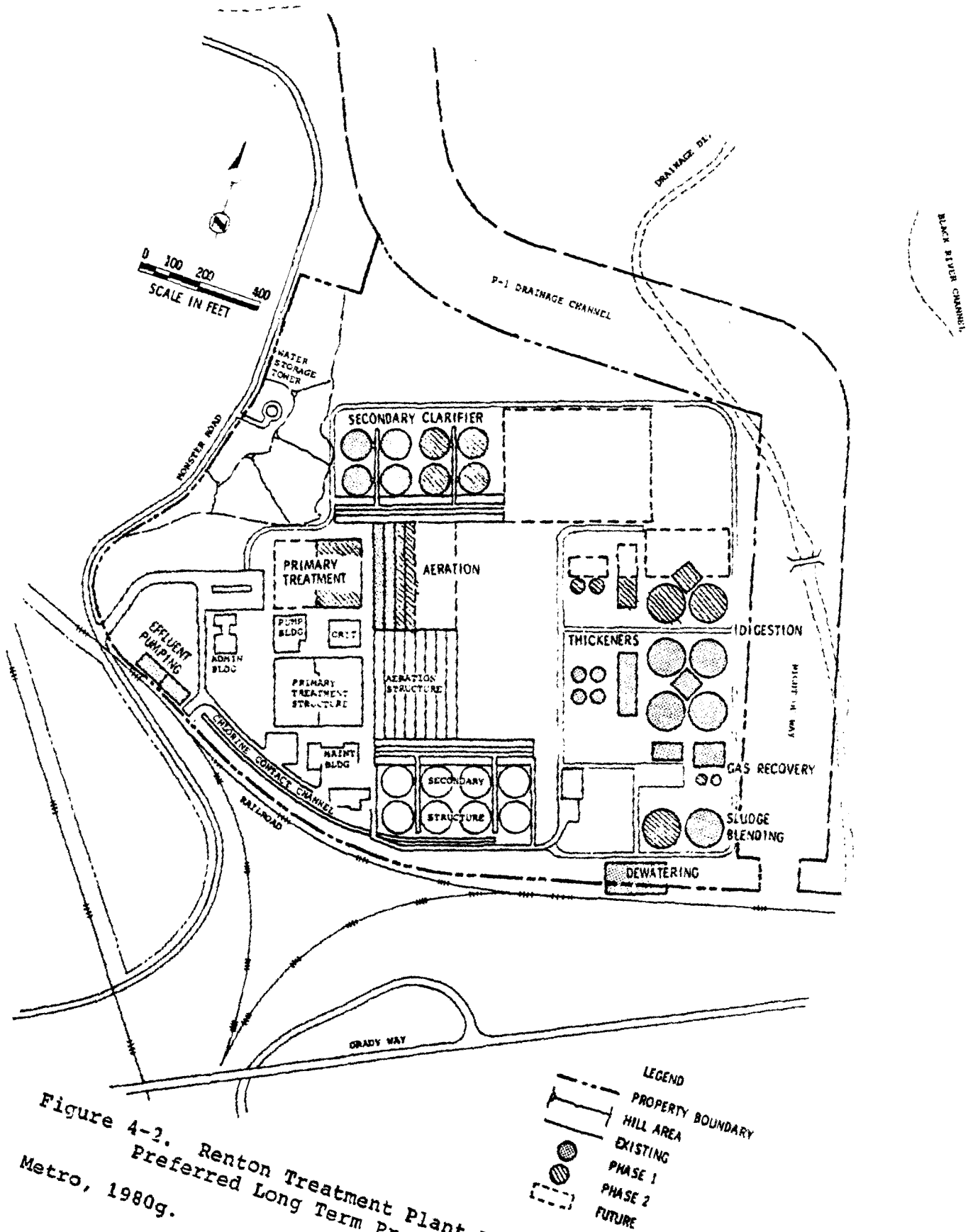



Figure 4-2. Renton Treatment Plant Layout: Preferred Long Term Program

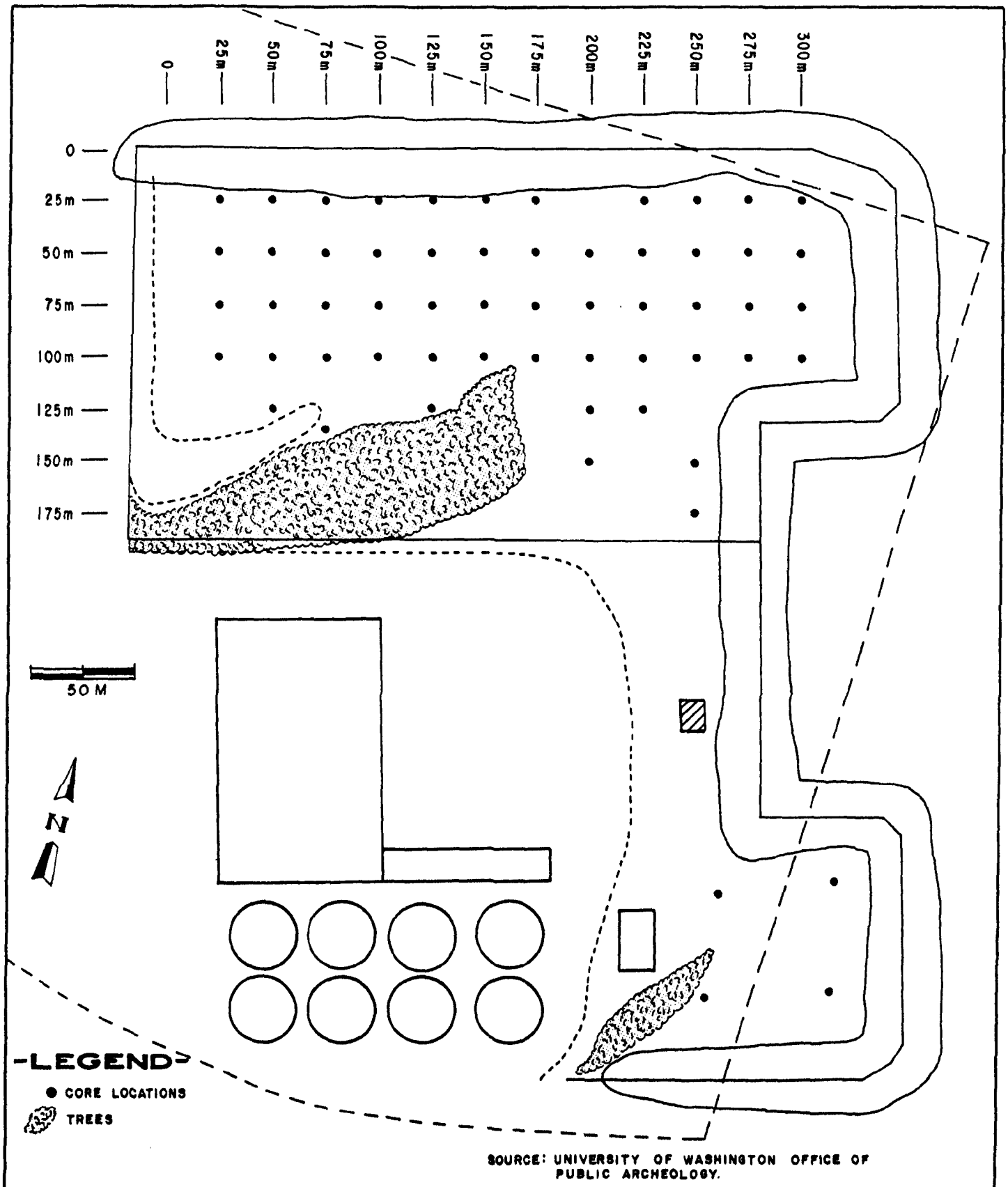
SOURCE: Metro, 1980g.

Much of the currently undeveloped area upon which new facilities are proposed for construction has been extensively modified due to fill activity undertaken at the time the treatment plant was initially constructed. Soil corings conducted as part of a cultural resources survey undertaken for this EIS (see below) indicate that surface soils in the undeveloped part of the site are primarily brown to grayish-brown clayey silt. Most of the undeveloped part of the site is vegetated with native grasses and weeds and occasional stands of trees.

Subsurface coring at the treatment plant site was undertaken by the University of Washington Office of Public Archeology as part of this EIS because a major archeological find had been discovered at the immediately adjacent Earlington golf course. (At the Earlington site, University of Washington archeologists discovered a prehistoric Duwamish Indian village thought to be between 400 and 1,000 years old.) A total of 59 core samples was taken at the treatment plant site to a depth of 1.8 meters; sample locations are shown in Figure 4-3. None of the 59 cores indicated the presence of subsurface cultural resources. In two of the cores, occasional flecks of charcoal were noted, but these were not considered significant. No stratigraphic bands were observed in any of the samples, and no artifacts were recovered.

Assessment of Impacts. Phase 1 of the preferred long-term program calls for expansion of the Renton treatment plant to 72 MGD by 1985; this requires construction of two additional aeration tanks, four secondary clarifiers, and additional disinfection facilities. Phase 2 calls for expansion of the plant to 99 MGD to serve 20-year flows; this requires the additional construction of four primary sedimentation tanks, two aeration tanks, four secondary clarifiers, and disinfection facilities. The proposed locations of these facilities are shown in Figure 4-2.

Construction and site-related impacts of treatment plant expansion are listed and rated in Table 4-1, which also lists mitigation measures to minimize adverse impacts. Land use incompatibility and cultural resource impacts, although potentially the most important of the site-related impacts listed in Table 4-1, do not appear to be major concerns. Land use incompatibility is not a major concern because industrial or railroad uses surround the site. To the east, beyond the drainage channel which borders the site, First City Equities has purchased the Earlington golf course and is planning to construct a manufacturing park containing warehouses, businesses, and offices. These uses should also be compatible with the proposed treatment plant improvements, provided that sufficient buffering is maintained between the two properties.




SOURCE: UNIVERSITY OF WASHINGTON OFFICE OF PUBLIC ARCHEOLOGY.

FIGURE 4-3. LOCATION OF SUBSURFACE CORINGS AT RENTON TREATMENT PLANT SITE

Because no cultural resources were found in the site investigation, it appears that the proposed expansion of the plant will not adversely affect cultural resources. However, it is possible that cultural resources may be present in areas not sampled or below 1.8 meters. If the ground is to be substantially disturbed below 1.8 meters, and if cultural resources are noted, then excavation work should be halted, and a qualified archeologist should be allowed to assess the significance of the resource.

Solids Handling Facilities

The preferred program requires facilities for anaerobic digestion, gravity thickening, dissolved air flotation, and dewatering. Phase 1 calls for the solids handling facilities to be designed for 72 MGD, and Phase 2 calls for expansion to 99 MGD.

Construction and site-related impacts of the solids handling facilities are listed and rated in Table 4-1, which also lists mitigation measures for adverse impacts. Land use incompatibility and cultural resource impacts are potentially the most important of the impacts listed in Table 4-1. Odors from the solids handling facilities could create conflicts with adjacent land uses (particularly the proposed Earlington manufacturing park), and are identified as a minor adverse impact in Table 4-1; however, the mitigation measures of adequate buffering and odor control technology are capable of mitigating this impact. Cultural resources precautions at the site have been previously reviewed.

This EIS does not consider the site-related impacts of ultimate disposal of sludge from the Renton treatment plant or other Metro treatment plants. These impacts, which are likely to be significant, will be assessed under separate NEPA and SEPA processes.

Tunnel/Outfall

The Metro Draft Wastewater Management Plan defines five alternative tunnel and outfall alignments for the disposal of secondary effluent from the Renton treatment plant. Three of the alternative alignments are in the vicinity of Point Pulley (Three Tree Point), and two are at Alki Point, approximately 9.5 miles north of Point Pulley. The following discussion analyzes the construction impacts of these alternatives; water quality impacts of alternative outfall sites are assessed in Chapter 5 of the EIS.

Description of Existing Environment.

*Point Pulley Alternatives.* Figure 4-4 depicts the three proposed tunnel/outfall routes in the Point Pulley area. Two of the alignments, Routes A (Seahurst Park) and B (Lake Burien), would be beneath existing roadways, whereas Route C (at Point Pulley) would be aligned "cross-country", primarily beneath residential land uses.

Table 4-2 shows the land uses along each alignment. The entire area from the Renton treatment plant to Point Pulley can be broadly classified as residential, with some commercial and transportation (Sea-Tac Airport) uses. Seahurst County Park (Ed Munro Park) is a major recreational area located 2.5 miles north of Point Pulley (USGS, 1979b).

Preliminary geologic information indicates that the soil materials underlying the Point Pulley alignments can be classified as a mixture of gravels, soft sandstone, shale and conglomerate; more detailed geological field work would be conducted once the final tunnel route is selected. Topography along the alignments varies from less than 10 feet near the treatment plant to over 400 feet near the Seattle/Tacoma Airport and Point Pulley.

The cultural resources along the alignments are unknown, at this time; however, a survey would be conducted once the tunnel route is defined.

*Alki Point Alternatives.* Figure 4-4 shows the two open cut/tunnel alternative routes to Alki Point. Routes D (West Duwamish) and E (East Duwamish) would follow the Duwamish River toward Elliott Bay before turning westward to Alki Point. The alignments would follow existing transportation corridors along much of their lengths. Table 4-2 depicts the land uses along each of the alignments.

Most of the existing land use is industrial on both sides of the Duwamish River from the Renton treatment plant north to Spokane Street. Some mixed urban and residential uses occur in the South Park area. Transportation corridors parallel the river on the east (East Marginal Way) and west (West Marginal Way) sides of the Duwamish River. Most of West Seattle is residential, with some scattered areas of commercial and recreational land uses.

The topography and geologic conditions in the West Seattle area are similar to those described for Point Pulley. Cultural resource studies have not been conducted along the alignments, but would be prior to construction.

Assessment of Construction Impacts. Table 4-1 presents an overview of construction and site-related impacts of tunnel/outfall construction, and lists mitigation measures for adverse impacts. Different impacts will be associated with the

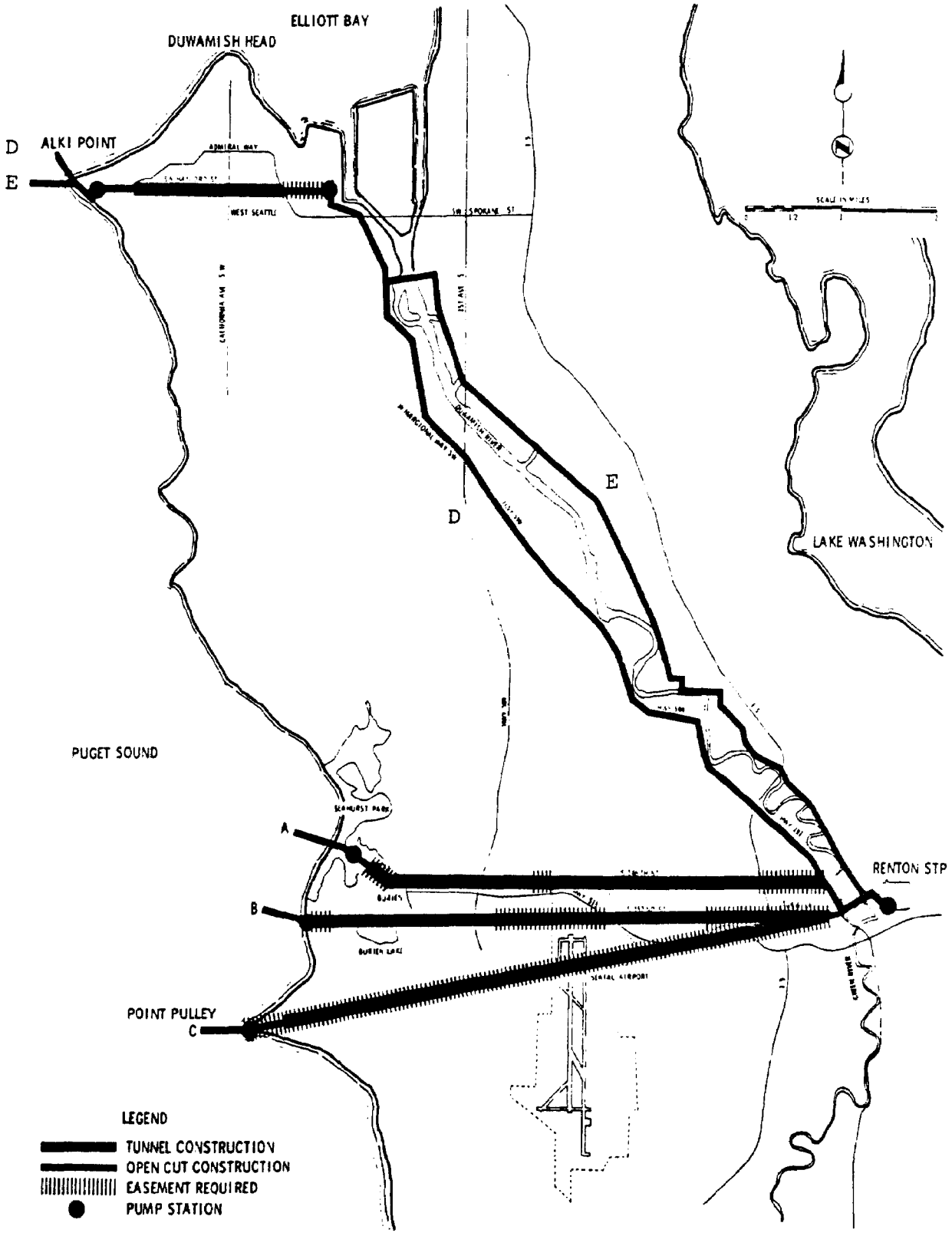



Figure 4-4. Alternative Effluent Discharge Routes for the Preferred Program

SOURCE: Metro, 1980g.

Table 4-2. Existing Land Uses for Tunnel and Open-Cut Alignments

| | Land Use | Route Alternative: Point Pulley A | Point Pulley B | Point Pulley C | Alki Point D | Alki Point E |
|---|---|---|---|---|---|---|
| Tunnel | Residential/Mixed Urban | 6,100 ft | 5,500 ft | 25,000 ft | 700 ft | 700 ft |
| | Roadway | 16,000 ft | 19,500 ft | 1,200 ft | 7,000 ft | 7,000 ft |
| | Sea Tac Airport | 3,200 ft | 4,000 ft | 5,500 ft | - | - |
| | Parkland | 1,700 ft | - | - | 1,500 ft | 1,500 ft |
| | Commercial | - | - | 1,300 ft | - | - |
| | TOTAL TUNNEL LENGTH | 27,000 ft | 29,000 ft | 33,000 ft | 9,200 ft | 9,200 ft |
| Open-Cut Construction | Parkland (Fort Dent Park) | 2,500 ft | Same as Route A | | 2,500 ft | - |
| | Industrial/Transportation | 1,500 ft | Same ad Route A | | 51,400 ft[a] | 61,100 ft[b] |
| | Residential | - | - | - | 1,900 ft | 1,900 ft |
| | TOTAL OPEN-CUT LENGTH | 4,000 ft | 4,000 ft | 4,000 ft | 55,800 ft | 63,000 ft |
| | TOTAL LENGTH OF ALIGNMENT | 31,000 ft | 33,000 ft | 37,000 ft | 65,000 ft | 72,200 ft |

[a]Route parallels the West Valley Highway (SR 181), West Marginal Way (Rt. 99) and the Burlington Northern Railroad.

[b]Route parallels the Burlington Northern Railroad, East Marginal Way, and Spokane Street.

construction of these components of the tunnel/outfall project: force mains or gravity lines, tunnels and pump stations.

The construction of force mains or gravity lines involves a linear open-cut trench and generates impacts typical of surface excavation (e.g., traffic disruption, noise, localized effects on air quality, loss of vegetation). On the other hand, tunneling would result in more localized construction impacts at the tunnel entrances (portals), staging areas, and truck routes; for this assessment, it is assumed that a tunnel boring machine will be used for construction.

*Point Pulley Alternatives.* The three alternative alignments (Routes A, B, and C) would require approximately 4,000 feet of open-cut construction for force mains, via a common route through Fort Dent Park, across the Duwamish River and the West Valley Highway (State Route 181) to 65th Avenue South. Each of the alternatives would require a new effluent pump station at the Renton treatment plant and a second pump station near each outfall location.

The key adverse impacts associated with construction of the force main will be: (1) disturbance of the Duwamish River bed and temporary degradation of surface water, (2) disruption of automobile traffic on Interurban Avenue South, (3) noise and dust from excavation and trucking, (4) disruption of recreational use of Fort Dent Park, and (5) potential for encountering archeological resources along the alignment (particularly in Fort Dent). The construction impacts specific to each of three tunnel routes are analyzed below.

*Route A (Seahurst Park).* The 27,000-foot-long Route A tunnel would be constructed immediately west of Interurban Avenue South, under South 146th Street to Seahurst Park. Major construction impacts would be at the tunnel entrance and exit points, and to a limited extent along the alignment. Two construction staging areas, one at Interurban Avenue and the other at Seahurst Park, would be used for stockpiling equipment, operating compressors and loading trucks with excavated material (spoil material). Each staging area would be approximately 3 acres. The staging area in Seahurst Park would probably be used as the location for the outfall pump station.

Table 4-3 shows the size of the tunnel, the projected quantity of spoil material and other features of construction. The major impacts associated with tunneling include: effects on traffic circulation; localized impacts on air quality, surface water, and groundwater; noise; and ground stability. These impacts would occur primarily at the tunnel portals on Interurban Avenue and at Seahurst Park. Traffic circulation and noise impacts would be associated with trucking construction materials to the staging sites and removing spoil material;

Table 4-3. Features of Tunnel Construction*

| | Route Alternative | | | | |
|---|---|---|---|---|---|
| | Point Pulley | | | Alki Point | |
| Feature | A | B | C | D | E |
| Tunnel Diameter, feet | 10 | 10 | 10 | 12 | 12 |
| Tunnel Length, feet | 27,000 | 29,000 | 33,000 | 9,200 | 9,200 |
| Spoil Material, cubic yards | 190,000 | 200,000 | 230,000 | 85,000 | 85,000 |
| Truck Trips[a] | 16,000 | 17,000 | 20,000 | 7,000 | 7,000 |
| Barge Trips[b] | 75 | 85 | 100 | 35 | 35 |
| Working Days[c] | 338 | 363 | 413 | 115 | 115 |
| Calendar Days | 450 | 495 | 565 | 160 | 160 |

*Note: Other impacts of construction of the tunnel/outfall, such as open-cut construction, are discussed in text.

[a]assumes 12 cubic yards capacity truck

[b]assumes 2,500 cubic yards capacity barge

[c]assumes two 8-hour work shifts per day, 5 days per week and tunneling at a rate of 5 feet per hour.

approximately 47 trucks per day (94 one-way trips) would be needed to remove spoils material from the staging areas to the disposal site, assuming three trucks per hour. The impact of transporting spoil material would be significantly less if barges were used at the west end of the tunnel alignment. The staging area and tunnel portals would also support the ventilation and dewatering system for the tunneling activities; the water removed while tunneling would be discharged into sediment basins (if necessary) prior to discharge into the Green/Duwamish River.

The cultural resources along the Route A alignment are unknown at this time. The most sensitive locations will be at the east portal (Interurban Avenue) and at Seahurst Park. More detailed cultural surveys will be scheduled once the alignment is chosen.

Stability of the ground during tunnel construction should not be a factor because of the deep alignment (maximum depth 450 feet).

*Route B (Lake Burien).* Route B would include a tunnel portal west of Interurban Avenue, a tunnel alignment beneath S.W. 152nd Street, and a second portal near the Puget Sound shore at the western end of S.W. 152nd Street. Table 4-2 shows the existing land uses for the Route B alignment, and Table 4-3 summarizes several of the alignment's construction features.

The impacts of Route B tunneling would be similar to those mentioned for Route A. The most sensitive construction areas would be the tunnel portals and staging areas, particularly at the western end of the alignment which will be located in a residential area.

*Route C (Point Pulley).* Route C would include a 33,000-foot tunnel "cross-country" from Interurban Avenue to Point Pulley (Three Tree Point) and tunnel portals at each end of the alignment. Tunneling would be conducted at varying depths under residential areas. Table 4-2 shows the existing land uses for the Route C alignment, and Table 4-3 summarizes some of the features of construction.

The other impacts of constructing Route C would be similar to those previously mentioned for Route A. The most sensitive locations along this route will be Point Pulley and Interurban Avenue. Some vibration may be felt by residents located above the alignment, particularly where the depth to the tunnel is shallowest.

*Alki Point Alternatives.* The two alternate Alki Point routes (Routes D and E) would require 56,000-63,000 feet of open-cut construction for force mains and gravity sewer along the Duwamish River from the Renton treatment plant

to S.W. Admiral Way. Each of the alternatives would require three pump stations; one at the Renton plant, a second near Harbor Avenue, and a third at Alki Point. The two alignments would have different routes for open-cut construction (east or west side of the Duwamish River) and a common tunnel portion from S.W. Admiral Way to Alki Point. Construction impacts specific to each of the alignments are analyzed below.

*Route D (West Duwamish).* Route D would require open-cut construction along Interurban Avenue, West Marginal Way S.W., Iowa Avenue S.W., and a short segment of the Burlington Northern Railroad tracks north of Spokane Street. The alignment would parallel existing rights-of-way. Table 4-2 shows the existing land uses for the Route D alignment, and Table 4-3 summarizes several of the alignment's construction features.

Because of the large size of the gravity sewer and force main, a wide construction trench would be excavated (15 feet or greater). Construction of such a large trench will have significant localized impact wherever the right-of-way is confined by existing structures or utilities.

It is anticipated that there would be a major impact on traffic circulation and use along portions of the heavily travelled alignment.

A preliminary evaluation of cultural resources (see Chapter 4 of Appendix A) indicates that there are numerous known archeological sites along the entire length of the Duwamish River, with one particularly large site located on both sides of West Marginal Way, in the vicinity of the proposed pipeline route. A more detailed cultural analysis would be conducted if this alternative is selected.

The tunnel alignment for Route D (and Route E as well) would begin near S.W. Admiral Way, following beneath S.W. Hanford Street, and terminate at a pump station on Alki Point. The portal and staging areas would be the most affected by construction activities. Since the existing land use of the staging and portal areas is primarily residential, construction activities would be particularly intrusive; these impacts would be intensified if trucking of spoil material occurs at Alki Point.

*Route E (East Duwamish).* The alignment for Route E would follow the Burlington Northern Railroad and East Marginal Way, S.W. to S. Idaho Street, where it would cross the Duwamish River to follow the same alignment as Route D for the remainder of the distance to Alki Point. Much of the open-cut alignment would be constructed through an industrial area and adjacent to Boeing Field. Table 4-2 shows the existing land uses for the Route E alignment, and Table 4-3 summarizes several of the alignment's construction features. Essentially

the same construction impacts may be expected as identified for Route D, except that the river crossing would occur near Kellogg Island instead of at Fort Dent Park.

## Impacts of Alternative A-1

### Differences from Preferred Program

Alternative A-1 includes construction of the following components, which are also required for the preferred program: Redmond connection, North Creek/Hollywood connection, Kenmore pump station, Renton treatment plant expansion and solids handling facilities. Impacts of constructing these components have been previously reviewed.

Alternative A-1 differs from the preferred program in the following respects:

- Nitrification facilities would be constructed at the Renton treatment plant site.
- Solids handling facilities could not be accommodated on site, and an additional 19 acres would be purchased.
- A tunnel and outfall would not be required.

Thus, compared to the preferred program, construction impacts at the Renton treatment plant site would be intensified, but impacts associated with tunnel and outfall construction would be avoided. Impacts of the nitrification facilities and of the additional land required for solids handling are reviewed below.

### Nitrification Facilities

Nitrification facilities would be constructed at the Renton treatment plant site (see Figure 4-5), whose existing environment has been previously reviewed. Construction impacts of the nitrification and mitigation measures are listed in Table 4-1; these are similar to the impacts of treatment plant expansion under the preferred program previously described.

### Additional Land Required for Solids Handling Facilities

The preferred site for the additional 19 acres required for solids handling under Alternative A-1 is shown in Figure 4-5. The need for purchase of an additional 19 acres is an adverse impact of Alternative A-1 not shared by the preferred program.

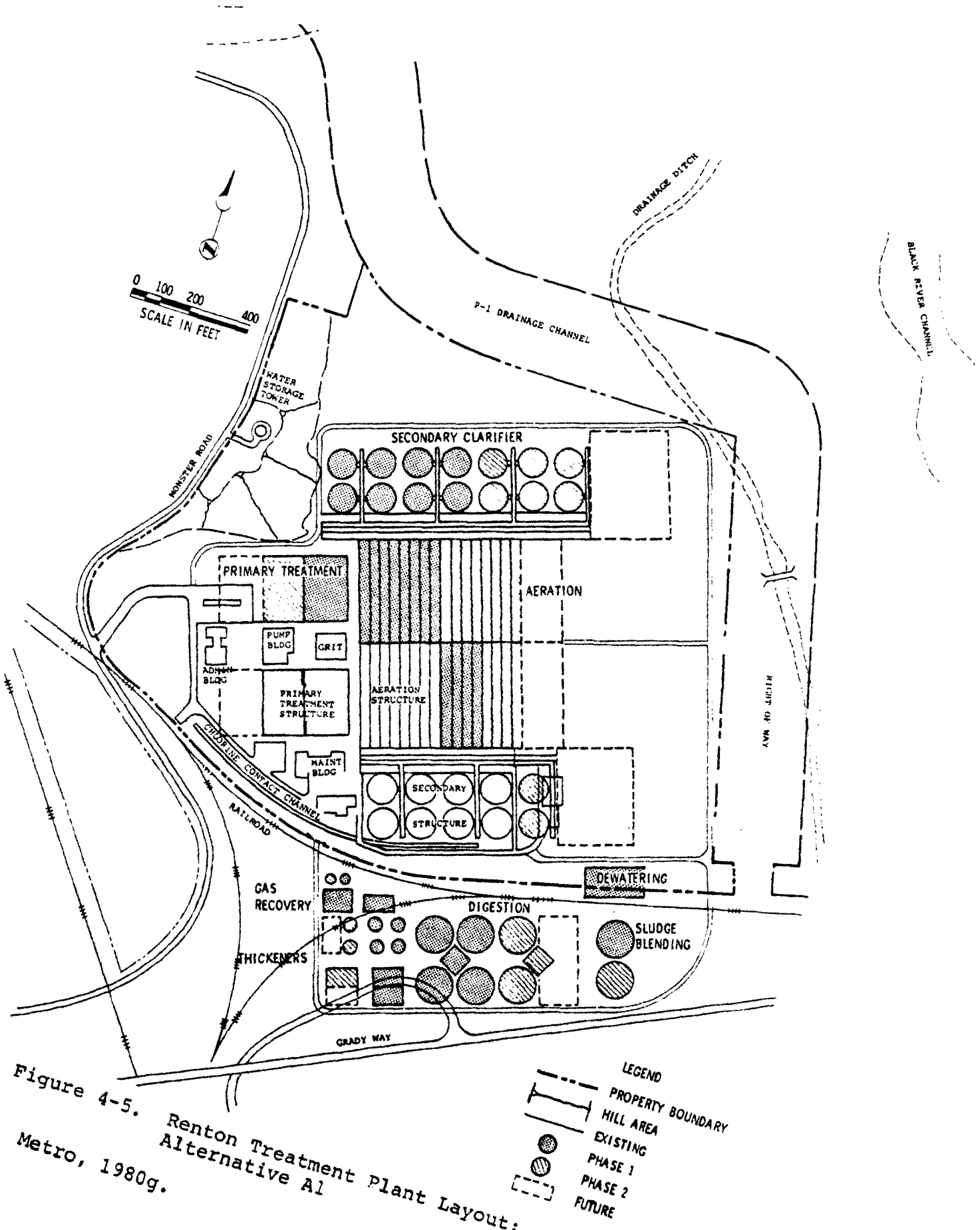



Figure 4-5. Renton Treatment Plant Layout: Alternative A1

SOURCE: Metro, 1980g.

Impacts of constructing the sludge handling facilities on the site shown in Figure 4-5 would be similar to impacts on construction at the existing treatment plant site. Most of the 19-acre site, zoned for light industrial use, is vacant, with the exception of a small warehouse; part of the site is used as a parking lot. Because the proposed site was not included in the cultural resources investigation conducted for this EIS, it is not known whether cultural resources are located there.

## Impacts of Alternative B-1

### Difference from Preferred Program

Alternative B-1 differs from the preferred program in the following respects:

- The Redmond connection and North Creek/Hollywood connection would not be required.
- The Renton treatment plant treatment and sludge handling facilities would be sized to only 72 MGD, as compared to 99 MGD, but an additional 19 acres of land would be purchased to maintain flexibility for future expansion.
- Nitrification facilities would be constructed at the Renton treatment plant site.
- A tunnel and outfall from the Renton treatment plant would not be required.
- A Kenmore treatment plant would be constructed.
- A tunnel and outfall from the Kenmore treatment plant to Puget Sound would be required.

Thus, compared to the preferred program, the construction impacts of the Redmond connection and North Creek/Hollywood connection would be avoided, impacts at the Renton treatment plant site would be intensified (based on the requirement for purchase of an additional 19 acres), the construction impacts of the Renton plant tunnel and outfall would be avoided, and additional impacts would result from construction of the Kenmore treatment plant and outfall. Construction impacts of changes at the Renton treatment plant site and of the Kenmore plant and outfall are reviewed below.

### Changes at the Renton Treatment Plant Site

Under Alternative B-1, the Renton treatment plant would be sized to 72 MGD, and nitrification facilities would be constructed. Impacts of constructing the facilities at the Renton plant site required for Alternative B-1 are similar

to those previously described for the preferred program and Alternative A-1. The need for purchase of an additional 19 acres is an adverse impact of Alternative B-1 not shared by the preferred program.

Kenmore Treatment Plant

No site has been selected for the Kenmore treatment plant. Additional site-specific environmental impact analysis would therefore be required if Alternative B-1 is selected. A Kenmore treatment plant would require about 19 acres for the 27 MGD capacity planned for Phase 2. Purchase of a 40-acre site has been proposed. The proposed layout for a Kenmore treatment plant is illustrated in Figure 4-6.

Construction and site-related impacts of a Kenmore treatment plant are listed and rated in Table 4-1, which also lists mitigation measures to minimize adverse impacts. Land use incompatibility and cultural resource impacts are potentially the most important of the impacts listed in Table 4-1. Neither can be fully assessed until specific sites for the Kenmore treatment plant are identified. Land use incompatibility may be a major factor because suitable industrial sites within the Kenmore area are limited.

Kenmore Treatment Plant Outfall

Alternative B-1 would include as a project feature an outfall tunnel from the Kenmore treatment plant to a point of discharge south of Richmond Beach County Park (see Figure 3-7). Two alternative alignments have been proposed: Route A, beneath N.E. 185th Street, and Route B, beneath N.E. 175th Street. Both alignments would originate near Bothell Way. (State Route 522).

The alignments would be located beneath existing roadways for much of their lengths. Existing land use on both sides of the roadways is primarily residential, with some commercial and service-related uses. Land use along Bothell Way is also a mix of residential and commercial. Richmond Beach County Park is a popular recreation area, as is Log Boom Park on Lake Washington (proposed site of a pump station).

Impacts of constructing force mains and tunnels to the outfall site near Richmond Beach would be similar to those defined for the tunnel alternatives to Point Pulley and Alki Point; see Table 4-1 for a summary of impacts and mitigation measures. Since neither of the tunnel alignments for this alternative has been clearly defined, a detailed analysis of construction impacts is not possible at this time. The most significant construction impacts would include noise

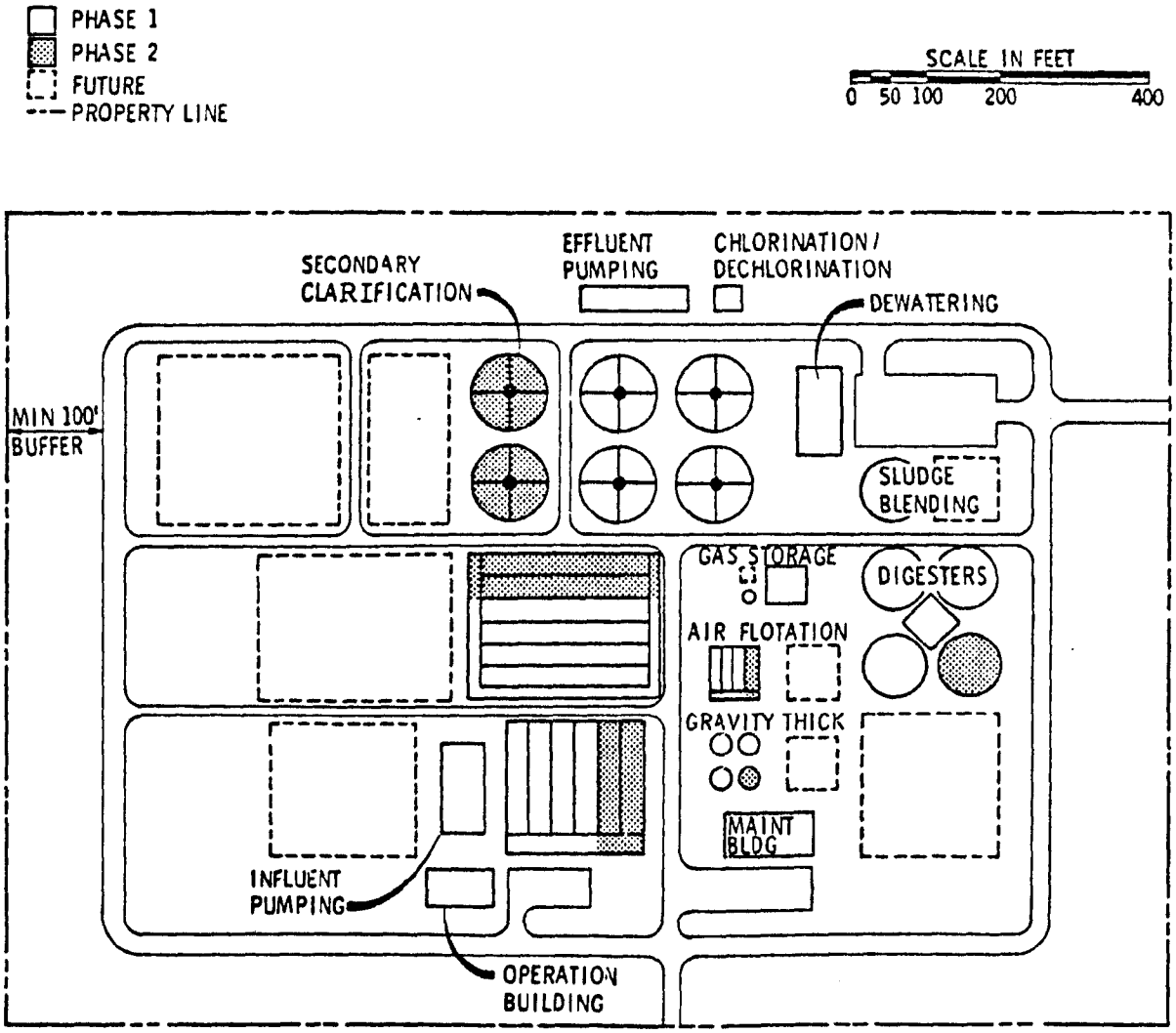



Figure 4-6. Kenmore Treatment Plant Schematic: Alternative B1 (Conceptual 40-Acre Site)

SOURCE: Metro, 1980g.

(from tunneling and staging activities), spoil disposal of materials excavated from the tunnel, and disruption of recreation uses at Richmond Beach.

## Construction Employment Impacts

Each of the final alternatives would be a major capital project, and consequently would employ a significant number of construction workers. The total construction costs of the alternatives range from $262,200,000 (Alternative A-1) to $409,900,000 (Alternative A-5). Of the total construction costs, between $112,200,000 and $243,400,000 would be spent on labor.

The number of jobs created by this labor expenditure may be estimated by considering the average hourly wage and the average number of hours worked in a year by a fully-employed construction worker. As shown in Table 4-4, the expenditure on labor may thus be expected to create between 4,050 and 8,770 total person-years of employment. The number of jobs actually created depends on the duration of construction; for example, if construction lasts 1 year, then 4,050-8,770 workers would be needed at one time, but if it lasts 2 years, then only half that number, 2,025-4,385, would be needed.

Because each alternative would be constructed in two phases, however, these jobs will not be created at the same time. Table 4-5 summarizes the employment effects of each alternative by phase. It shows, for example, that Alternative A-5 would create 7,480 job-years of employment in Phase 1 but only 1,290 in Phase 2. The number of people actually employed would, again, vary with the duration of the construction project as discussed above and shown in the table.

This analysis indicates that Metro's plan will create a large demand for construction workers. Because of the relatively large size of the construction labor force in the Seattle area, however, there will probably be little need for construction workers to temporarily move to the Seattle area to build the projects called for in the plan.

Table 4-4. Total Employment Impacts of Project Alternatives

| | Alternative | | | |
|---|---|---|---|---|
| | A1 | A3 | A5 | B1 |
| Total construction cost | $262,200,000 | $309,800,000[a] | $409,900,000[a] | $322,600,000[a] |
| Labor cost[b] | 112,200,000 | 174,400,000 | 243,400,000 | 151,400,000 |
| Hours of work[c] | 7,480,000 | 11,626,667 | 16,226,667 | 10,093,333 |
| Job years[d] | 4,050 | 6,290 | 8,770 | 5,450 |
| Number of jobs if construction lasts: | | | | |
| 1 year | 4,050 | 6,290 | 8,770 | 5,450 |
| 2 years | 2,025 | 3,145 | 4,385 | 2,725 |
| 3 years | 1,350 | 2,100 | 2,920 | 1,820 |
| 5 years | 810 | 1,260 | 1,750 | 1,090 |

Note: Figures may be slightly inconsistent because of rounding.

[a]More than one outfall/tunnel alignment is under consideration, and no preferred alternative has been identified. Therefore, this estimate includes the least cost alternative.
[b]Based on U. S. Environmental Protection Agency Construction Cost Indexes for Urban Sewers, Seattle, Washington, third quarter, 1979.
[c]Average hourly compensation (wage plus fringe) of $15.00.
[d]Average work year of 1,850 hours (37 hours per week, 52 weeks per year).

Source: David L. Clark, Associate Engineer, Brown and Caldwell, letter to Gruen Gruen + Associates, June 26, 1980; Washington, State of, Department of Labor and Industries, pers. comm. to Gruen Gruen + Associates, June 1980; U. S. Department of Labor, *Monthly Labor Review*, March 1980 (Table 14); Gruen Gruen + Associates.

## Table 4-5. Employment Impacts of Project Alternatives, by Phase

| | Alternative A1 | | Alternative A3 | | Alternative A5 | | Alternative B1 | |
|---|---|---|---|---|---|---|---|---|
| | Phase 1 | Phase 2 | Phase 1 | Phase 2 | Phase 1 | Phase 2 | Phase 1 | Phase 2 |
| Total construction cost | $164,100,000 | $98,100,000 | $233,800,000[a] | $76,000,000 | $333,900,000[a] | $76,000,000 | $294,800,000[a] | $27,800,000 |
| Labor cost[b] | 67,900,000 | 44,300,000 | 138,800,000 | 35,700,000 | 207,700,000 | 35,700,000 | 140,500,000 | 10,800,000 |
| Hours of work[c] | 4,526,666 | 2,953,333 | 9,253,333 | 2,380,000 | 13,846,667 | 2,380,000 | 9,366,667 | 720,000 |
| Job years[d] | 2,450 | 1,600 | 5,000 | 1,290 | 7,480 | 1,290 | 5,060 | 390 |
| Number of jobs if construction duration is: | | | | | | | | |
| 1 year | 2,450 | 1,600 | 5,000 | 1,290 | 7,480 | 1,290 | 5,060 | 390 |
| 2 years | 1,225 | 800 | 2,500 | 645 | 3,740 | 645 | 2,530 | 195 |
| 3 years | 820 | 530 | 1,670 | 430 | 2,490 | 430 | 1,690 | 130 |
| 5 years | 490 | 320 | 1,000 | 260 | 1,500 | 260 | 1,010 | 80 |

[a]More than one outfall tunnel alignment is under consideration; cost estimate included here is for the lowest cost alternative.
[b]Based on U. S. Environmental Protection Agency Construction Cost Indexes for Urban Sewers, Seattle, Washington, third quarter, 1979.
[c]Average hourly compensation (wage plus fringe) of $15.00.
[d]Average work year of 1,850 hours (37 hours per week, 50 weeks per year).

Source: David L. Clark, Associate Engineer, Brown and Caldwell, letter to Gruen Gruen + Associates, June 26, 1980; Washington, State of, Department of Labor and Industries, pers. comm. to Gruen Gruen + Associates, June 1980; U. S. Department of Labor, *Monthly Labor Review*, March 1980 (Table 14); Gruen Gruen + Associates.

# Chapter 5

# OPERATIONAL IMPACTS OF LONG-TERM ALTERNATIVES

## Introduction

This chapter describes the operational impacts of the long-term wastewater management alternatives for the Lake Washington/Green River Basins. The alternatives considered are the preferred program, Alternative A-1, Alternative B-1, and the no project. Separate sections cover impacts and mitigation measures for water quality, aquatic biology, and fisheries; resource use; growth-related impacts related to project staging; and recreation. A last section discusses potential impacts of the decentralized treatment plants under Alternatives C-1 through C-5; although these alternatives were not selected as one of the final alternatives, they are assessed here because one or more of the decentralized plants could be included within the long-term program eventually selected.

Most of the growth-related impacts associated with the long-term alternatives are common to all the alternatives. These growth-related impacts are covered in Chapter 6 of the EIS.

## Water Quality, Aquatic Biology, and Fisheries

### Introduction

This section describes the projected direct impacts of project alternatives on the Green/Duwamish River and Puget Sound. Surface and marine water quality impacts are discussed first, followed by biological and fisheries impacts. For detailed background information on the existing water quality and biological conditions of the Green/Duwamish River and Puget Sound, the reader is referred to Appendix C of this EIS.

The basis for predicting impacts on the Green/Duwamish River is existing knowledge of the effects of the Renton discharge on the river, extrapolated to future conditions of effluent flow and quality. The "extrapolation" process ranges in complexity from simple desk-top calculations to computer modeling performed by the Washington Department of Ecology (DOE).

The basis for predicting impacts on Puget Sound is the knowledge of the effects of Metro's West Point discharge on the sound. Much of this knowledge was derived from a series of Metro-sponsored studies conducted from about 1973-1977, the Puget Sound Interim Studies (summarized in Duxbury, 1976).

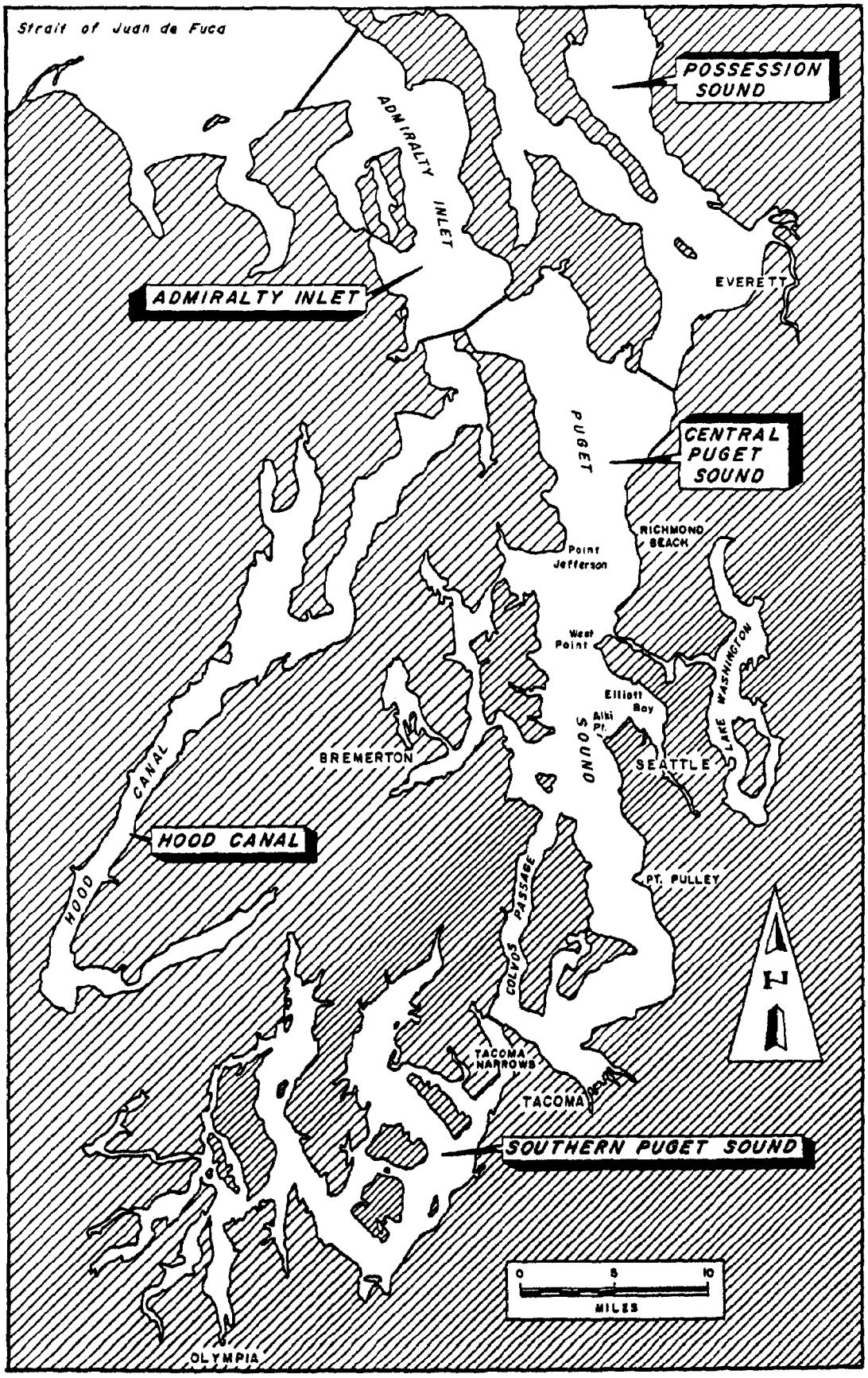
The effects of the West Point discharge can reasonably be used to predict the effects of Renton discharge locations on Puget Sound if the proper qualifications are made to account for differences in effluent flow and quality, and differences in current and circulation patterns at the different discharge locations. Effluent flow at West Point was about 120 MGD when the Puget Sound Interim Studies were performed, and treatment consisted (as it does presently) of only primary treatment. Effluent flow from a Renton discharge to Puget Sound would be about 100 MGD in the year 2000, and treatment would consist of both primary and secondary processes. Thus, other things being equal, the flow and quality aspects of the year 2000 Renton discharge can be expected to produce lesser effects than the present West Point discharge. Differences in currents and circulation patterns between West Point and the alternative Renton discharge locations are obviously important in using the West Point discharge as a model for a Renton-Puget Sound discharge; these differences will be further studied by Metro in detailed oceanographic studies prior to outfall construction.

## Surface and Marine Water Quality

Background. The following discussion summarizes the water quality conditions of Puget Sound and the lower Green/Duwamish River, and the effects of present treated sewage discharges.

Although this section focuses on potential adverse impacts of the alternatives on either Puget Sound or the Green/Duwamish River, it should be noted that all the alternatives, except the no-project alternative, will result in improved effluent quality at the West Point treatment plant. All project alternatives include construction of solids handling facilities at the Renton plant, eliminating the current practices of transporting solids to the West Point plant, where the solids cause dry season violations of the plant's NPDES permit limitations for suspended solids. Additionally, all the project alternatives would divert current and projected flows from the north part of the study area from the West Point plant to either the Renton plant or the Kenmore plant, where the effluent will receive secondary (or higher) levels of treatment prior to discharge.

*Puget Sound*. Puget Sound is a large inland sea consisting of a series of deep (about 600 ft) basins separated by relatively shallow (about 150 ft) sills (Figure 5-1).




SOURCE: DUXBURY, 1976

FIGURE 5-1. SUBDIVISIONS OF PUGET SOUND

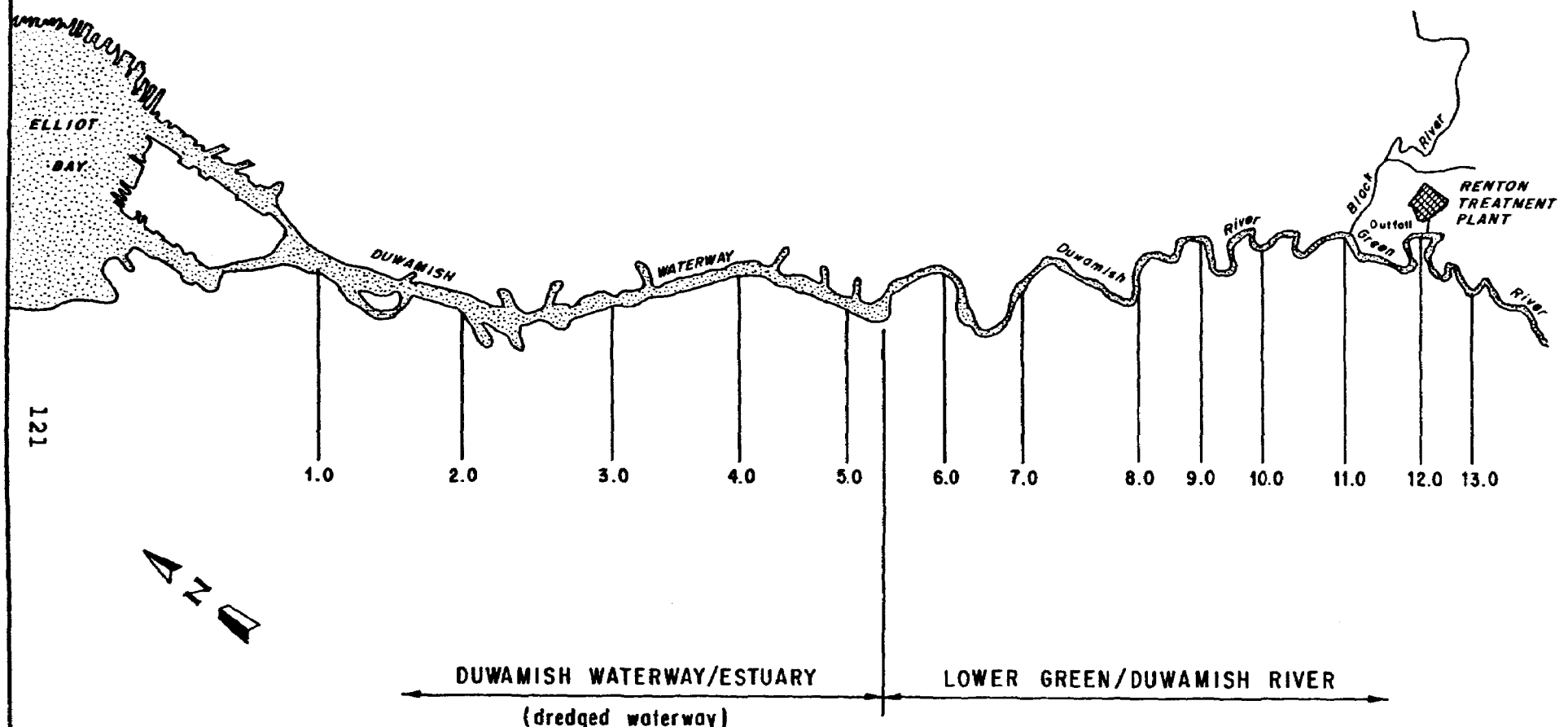
Point Pulley has net circulation in a southerly direction, whereas Richmond Beach has net circulation in a northerly direction (Metro, 1979e). Alki Point is near the divergence of northerly and southerly net flows.

Puget Sound has generally good water quality. Relatively small drops in dissolved oxygen concentration (differences of about 0.5 mg/l) have been detected in the immediate vicinity of the West Point outfall (EPA, 1977a). Local increases in nitrate, ammonia, and phosphate, and local changes in temperature, dissolved oxygen, salinity, and density, have been observed directly over the West Point effluent plume (Duxbury, 1976). None of these changes is detectable along the central axis of Puget Sound. No changes in heavy metals concentrations are detectable in waters near the West Point outfall (Schell, et al., 1977).

Concentrations of heavy metals in Puget Sound bottom sediments have been increasing for about the last 50 years (Schell, et al., 1977). Urban runoff and rivers are probably the major sources of heavy metals. However, a relatively high increase in lead was found near the Alki Point outfall, and relatively high increases in mercury and zinc were found near the West Point outfall. High fecal coliform levels in waters of east Puget Sound beaches prohibit commercial shellfishing there, but recreational shellfishing is popular, and there have been no reported adverse public health effects. The relative contributions of Metro outfalls and other sources (urban runoff, combined sewer overflows) to coliform violations have not been identified.

*Green/Duwamish River*. The Duwamish River is the reach of the Green/Duwamish River between Tukwila (confluence of the Black River) and Elliott Bay. The portion upstream of the confluence is called the Green River (Figure 5-2). The Renton sewage treatment plant discharges into the Green River at River Mile 12, about 1 mile upstream of the confluence. The river water is fresh year-round at the discharge location, but current reversals due to tidal influence occur during low flow periods. Salinity from Puget Sound becomes an important water quality parameter at about River Mile 6 during summer low flows (Figure 5-2). The lower 5 miles of the river are dredged for ship navigation.

The Duwamish River is located in a heavily industrialized area, and has several water quality problems. Un-ionized ammonia, dissolved oxygen, temperature, and residual chlorine in the river have exceeded water quality criteria or standards. Ammonia from the Renton plant is a major cause of low dissolved oxygen concentrations, according to modeling studies (Yake, 1980). The temperature of the Renton effluent increases the frequency of violations of temperature standards in the river. Although coliform bacteria standards are violated




SOURCE: YAKE, 1980

FIGURE 5-2. LOWER GREEN-DUWAMISH RIVER WITH RIVER MILE INDEX

frequently, Renton effluent does not appear to be implicated (Bernhardt, 1980). Polychlorinated biphenyls (PCBs) are present in high concentrations in Duwamish River sediments, particularly near the mouth of the west waterway (Metro, 1979e). The Renton plant is not a major contributor of PCBs.

The DOE has recently adopted administrative rules setting minimum instream flow standards in the Green/Duwamish River (DOE, 1980). Minimum flows near Auburn (River Mile 32) are proposed to be 650 cfs for most of the year, and 300 cfs in summer.

Impacts of Preferred Program. The following discussion evaluates the water quality impacts of the preferred wastewater management program. Impacts on effluent dispersion, turbidity, un-ionized ammonia, dissolved oxygen, nutrients, chlorine toxicity, bacteria, and toxic substances in Puget Sound are considered. Also, briefly considered are the potential impacts of the Redmond connection emergency bypass sewer on Sammamish River water quality.

*Effluent Dispersion.* Two main phases of effluent dispersion should be considered. The first phase is initial dilution of the effluent in the immediate vicinity (about 1 mile) of the diffuser. Initial dilution is controlled by the velocity of daily tidal currents in the discharge area and also by design details of diffusers depth, length, and number of ports. The second phase is transport of the diluted effluent to the open ocean, which is a function of net (long-term) circulatory patterns at the discharge location and in Puget Sound as a whole.

Preliminary designs specify discharge depths of 200 feet at Alki Point (A-5) and Point Pulley (A-3). Metro's West Point outfall (about 120 MGD) discharges at a depth of 230 feet and achieves an initial dilution of about 100:1, as cited by Schell, et al. (1977). The West Point effluent plume is virtually untraceable at distances more than about 1 mile from the diffuser.

Of the two alternative Puget Sound discharge locations, Alki Point would probably give the best dispersion performance because it is the northernmost location (closest to the mouth of Puget Sound), so effluent residence time in the sound would be shortest. An adequate diffuser design should give initial dilution comparable to the West Point outfall. The performance of the present small (7.5 MGD) Alki outfall is poor, due to poor initial dilution (10:1) and shallow discharge depth (80 ft) (EPA, 1977b).

Tidal eddies exist on both sides of Alki Point. These eddies have currents which may draw diluted effluent toward shore. Information to date indicates that the diffuser must be located at least 1,500 feet offshore to be beyond the influence of these tidal onshore currents (Metro, pers. comm.); current plans are for the diffuser to be located 2,200 feet offshore.

At Alki Point, some effluent may be drawn south by net southerly water circulation patterns due to tidal "pumping" action. Alki Point is near the zone where northerly and southerly net flows diverge. Precise placement of the diffuser in an area where net flows are predominately in a northerly direction (possibly in Route D northwest of Alki Point) may maximize northerly transport of the effluent and minimize residence time in the sound.

Information to date indicates that a Point Pulley outfall would probably also give satisfactory initial dilution performance. Tidal eddies form on both sides of the point during higher tidal ranges. The diffuser would have to be placed far enough offshore to escape the influence of onshore tidal currents. Current plans are to locate the diffuser 3,000 feet offshore.

Point Pulley is an inferior discharge location to Alki Point with respect to effluent residence time in the sound. Net circulation patterns would draw the diluted effluent south and around Vashon Island in a clockwise direction. The diluted effluent would then be drawn up Colvos Passage, back into the central basin. Most of the diluted effluent would then be carried toward the open ocean. Perhaps 20-25 percent of the diluted effluent would be recycled again around Vashon Island (Metro, pers. comm.). Again, net circulation considerations may not be of great importance because the effluent will probably be virtually untraceable more than about 1 mile from the diffuser. This is due to the great volume of diluting water in the sound.

At present there is no basis for preferring any one of the three Point Pulley discharge locations with respect to effluent dispersion and transport out of Puget Sound. Additional studies are needed to determine local tidal current patterns and risks of shoreward transport of diluted effluent. With respect to net circulation patterns, effluent residence time in Puget Sound may not vary significantly among the three locations; they are all well south of Alki Point, which is near the divergence of northerly and southerly net flows.

*Turbidity*. Suspended organic solids are the main component of turbidity in treated sewage effluent. Turbidity can potentially affect light penetration, algal production, and aesthetic values in receiving waters.

Discharge to Puget Sound may cause measurable local turbidity changes. Turbidity is the most detectable water quality parameter of the West Point discharge (Environmental Quality Analysts, 1974). The wastewater field and its associated turbidity are present at subsurface depths ranging from 20-50 meters. The turbidity is not associated with any known adverse impacts.

Because of a higher level of treatment, the turbidity effects of a Renton plant discharge to Puget Sound would probably be considerably less than at West Point. The West Point plant discharges primary effluent with a suspended solids concentration of about 75 mg/l. A Renton outfall would discharge secondary effluent with a suspended solids concentration of about 30 mg/l. There are no apparent advantages or disadvantages associated with any of the alternative Puget Sound discharge locations with respect to turbidity.

*Un-ionized Ammonia*. Ammonia is a characteristic product of treated sewage formed by the decomposition of nitrogenous organic compounds. The un-ionized form of ammonia, $NH_3$, is of concern for its potential toxicity to aquatic life. Un-ionized ammonia is toxic (LC50) to salmonid fishes at concentrations of about 0.2-0.7 mg/l (Willingham, et al., 1979). The 96-hour LC50 for coho salmon in Renton effluent is 0.45 mg/l $NH_3$-N (Buckley, 1978).

The State of Washington has not set numerical receiving water standards for ammonia. The EPA (1976) criterion for un-ionized ammonia is 0.02 mg/l for fresh water. Little information exists on ammonia toxicity under marine and estuarine conditions, and EPA has not established a criterion for these conditions.

The preferred program discharge to Puget Sound would not have denitrification in the process train, and effluent concentrations of ammonia nitrogen would be about 15 mg/l. Because no ammonia toxicity problems have been found with the West Point discharge, no problems are expected to develop for the Renton plant; rapid initial dilution would probably prevent ammonia toxicity.

*Dissolved Oxygen*. Based on data from the West Point plant, dissolved oxygen (DO) problems are not foreseen with the preferred program. A local DO sag of about 0.5 mg/l has been found in the West Point plume (EPA, 1977a). The West Point discharge is primary effluent, with a biochemical oxygen demand (BOD) of about 100 mg/l, and flows were about 120 MGD when the DO sag was observed. In contrast, the Renton discharge would be secondary effluent, with a BOD of about 30 mg/l and flows would be about 100 MGD in the year 2000. Thus, very little, if any, DO sag should be noticeable with a Puget Sound discharge of Renton effluent.

*Nutrients*. Nutrients in sewage effluent are of concern because they can stimulate algal growth to levels that are visually offensive, or that cause DO sags through algal respiration or death. Nutrients typically of concern in sewage effluent are phosphorus (as orthophosphate) and nitrogen (as ammonia, $NH_3$; nitrite, $NO_2$; or nitrate $NO_3$). There are no numerical state or federal standards for phosphorus or nitrogen with regard to algal growth stimulation because levels which would cause adverse effects vary greatly among water bodies.

Discharge of effluent to Puget Sound would result in local increases in ammonia, nitrate, and phosphate. Increases in ammonia are detectable within a radius of about 1 mile of the West Point outfall (Collias and Lincoln, 1977). Nutrient concentrations discharged from a Renton plant with secondary treatment discharging to Puget Sound would be somewhat less than those from West Point due to the higher degree of treatment involved.

*Chlorine Toxicity*. Chlorine could be one of the greater toxicity components of a future Renton discharge into Puget Sound, as indicated by bioassay tests of the West Point effluent (Stober, et al., 1977) and of the Renton effluent (Buckley and Matsuda, 1973). The Renton effluent was found toxic to coho salmon (96-hour LC50) at a chlorine residual concentration of 0.20 mg/l (Buckley and Matsuda, 1973).

The preferred program discharge will have a chlorine residual concentration of 1.5 mg/l prior to dechlorination; after dechlorination, the level is planned to be lower than 0.015 mg/l (Metro, pers. comm.). This would meet the EPA (1976) criterion of 0.002 mg/l following 100:1 dilution. The actual concentration may be less, however, depending on the amount of chlorine loss in transport from the Renton plant to the diffuser in Puget Sound.

*Bacteria*. Violations of coliform standards at east Puget Sound beaches have not been attributed to existing treated sewage discharges. There appear to be no direct advantages at any alternative Puget Sound discharge site with respect to maintaining coliform standards.

One benefit associated with the Alki Point discharges is that combined sewer overflows (CSOs) to the Duwamish estuary could be intercepted and routed to a discharge point offshore. The water quality benefits may be marginal. CSOs occur during or shortly after winter storms, when river flow is high, and CSO effluent is probably rapidly diluted and carried into Puget Sound with the high flows.

*Heavy Metals*. Heavy metals are of concern for their acute toxicity to aquatic life, and also for their tendency to accumulate over time in the flesh of organisms and in sediments. In one sense, the environment has no assimilative capacity for heavy metals, since they accumulate in the environment and they do not detoxify or break down.

Table 5-1 shows the effect that a Renton discharge to Puget Sound would have on background heavy metals concentrations after initial dilution (100:1) and dilution after tidal cycle (500:1). These dilution values are approximations for the West Point discharge from Schell, et al. (1977).

Table 5-1. Effect of Renton Effluent on Heavy Metals Concentrations in ug/l, in Puget Sound

| | Background Concentration[1] | Renton Effluent (Jan 1978-Sep 1979)[2] | | Receiving Water Concentration | | EPA (1976) Criterion |
|---|---|---|---|---|---|---|
| | | Average | Range | After Initial Dilution (100:1) | After 1 Tidal Cycle (500:1) | |
| Cadmium | 0.36 | < 4 | < 4 | < 0.40 | < 0.37 | 5.0 |
| Chromium | - | 20 | 10-30 | - | - | 100 (freshwater) |
| Copper | 0.57 | 30 | 20-60 | 0.86 | 0.63 | - |
| Lead | 3.68 | < 20 | < 20 | 3.84 | 3.71 | - |
| Mercury | - | 1.4 | 0.3-2.8 | - | - | 0.1 |
| Nickel | 1.33 | 30 | 10-40 | 1.61 | 1.39 | - |
| Zinc | 2.3 | 40 | 30-60 | 2.67 | 2.38 | - |

[1]SOURCE: Huntamer, 1976 in Schell, et al., 1977.

[2]SOURCE: Metro, 1979d.

Table 5-1 also shows numerical EPA (1976) receiving water criteria. It is evident from Table 5-1 that the Renton discharge would increase heavy metals concentrations in Puget Sound by a small amount.

Table 5-2 compares projected copper, lead, and zinc loading to Puget Sound from the Renton discharge to other sources of these metals. The Renton contribution would again be relatively small.

Although a Renton discharge to Puget Sound would contribute some heavy metals, no direct adverse effects are expected in light of the great dilution that would occur in Puget Sound and the relatively small portion of the total metals load that the Renton discharge would contribute.

*Toxic Organic Substances.* The potential effect of toxic substances in Renton effluent on Puget Sound water quality is unknown. There is little existing information on either toxic organic substances in Puget Sound or the effects of chlorination of Metro discharges on the formation of toxic organisms.

In 1979, organic compounds were sampled in Hylebos Waterway near Tacoma (Riley, et al., 1980). Six chlorinated compounds and five aromatic compounds identified were on EPA's list of priority pollutants. In the same study sampling in Elliott Bay revealed relatively small or undetectable amounts of saturate and aromatic hydrocarbons, and there was no attempt to identify them. Metro is presently starting a 3-year toxicant study which will study toxicant sources, treatment processes, and fates in the environment.

*Impacts of Redmond Connection Emergency Bypass.* One feature of the Redmond connection, proposed as part of the preferred program, could adversely affect water quality. This is an emergency bypass from the York pump station discharging to the Sammamish River. The emergency bypass would be designed to operate in the event of failure at the Totem Lake pumping station, which is considered by Metro to be an event of remote probability. Sewage would be bypassed to the Sammamish River in such an event.

If such an emergency event were to occur, untreated sewage would enter the Sammamish River near N.E. 124th Street. Depending upon the quantity and duration of the discharge, such an event could cause a DO sag and an increase in ammonia, phosphate, and nitrate. The significance of the reduction in dissolved oxygen would depend on the BOD loading and rate of flow in the river.

An uncontrolled discharge during the low-flow summer months would have a greater impact on water quality than if such an event occurred during the winter or early spring.

Table 5-2. Estimate of Yearly Copper, Lead, and Zinc Input to Puget Sound for a Renton Plant Discharging at 100 MGD, Compared to Other Sources at Present Levels

| | Copper | | Lead | | Zinc | |
|---|---|---|---|---|---|---|
| | Metric Tons | Percent | Metric Tons | Percent | Metric Tons | Percent |
| Renton-Year 2000 | 6 | 1 | 3 | 0.1 | 10 | 0.6 |
| Rivers | 787 | 92 | 2,032 | 84 | 1,624 | 92 |
| Seattle Urban Runoff | 15 | 2 | 350 | 15 | 50 | 3 |
| Metro West Point Plant | 29 | 3 | 9 | 0.4 | 56 | 3 |
| Other Municipalities | 22 | 3 | 16 | 0.7 | 26 | 1 |
| Total | 859 | | 2,410 | | 1,766 | |

SOURCES: Metro, pers. comm.; Schell, et al., 1977.

It is during those summer months that water quality conditions in the Sammamish River are most critical. Under normal conditions water temperatures and DO levels often violate the standards due to the low flows and velocity of the river. A discharge of untreated sewage would also cause an increase in coliform bacteria and nutrients which could cause nuisance problems or possible health hazards.

If the discharge of untreated sewage into the Sammamish River was substantial enough, aquatic species would be adversely affected. The most likely effect of nutrient loading would be a stimulation of algae or rooted aquatic plants in the sluggish portions of the river and where the river enters Lake Washington. A substantial inflow of sewage could cause mortality to invertebrate and fish populations downstream of the Hollywood pump station.

Alternative A-1. The following discussion evaluates the water quality impacts of Alternative A-1, which calls for installation of nitrification processes at the Renton plant and continued discharge to the Green/Duwamish River. Effluent dispersion, turbidity, un-ionized ammonia, DO, nutrients, heavy metals, chlorine toxicity, bacteria, toxic substances and temperature are considered. When relevant, water quality improvements that would result from installation of advanced waste treatment under Alternative A-2 are noted.

*Effluent Dispersion*. Initial dispersion of effluent from a continued Green/Duwamish River discharge would be poor. Presently, river-to-effluent dispersion ratios in the Green/Duwamish River are as low as 4:1, and "slugs" of river flow can be as high as 58 percent effluent due to repeated passage of a block of water past the discharge area due to oscillating tidal action. A general rule-of-thumb guideline promulgated by the Washington Department of Ecology for an acceptable river-to-effluent ratio is 20:1 (Bernhardt, 1980).

In the year 2000, with a minimum summer instream flow of 225 cfs and a Renton effluent flow of 100 MGD, the river-to-effluent ratio would be reduced to 1.5:1. Thus the river would average 40 percent effluent in the freshwater reach (about 6 miles) below the discharge during summer low-flow periods. "Slugs" of river water with effluent concentrations as high as 70 or 80 percent would probably exist.

The DOE (1980) has recently adopted rules calling for minimum flows of 300 cfs in the Green River at Auburn. Present low flows are about 200 cfs. There is not yet any clear agreement on how additional flows will be gained.

Effluent residence time in Puget Sound for a Green/Duwamish discharge would probably be about the same as for the preferred program with an Alki Point discharge.

*Turbidity*. Recent data indicate that turbidity from the Renton plant has a "slight impact" on the Green/Duwamish River (Bernhardt, 1980), though no beneficial use is affected. Turbidity from an expanded plant with nitrification (Alternative A-1) would probably continue to have a slight affect. Alternative A-2 would probably produce a very clear effluent with minimal turbidity impacts due to the granual media filtration process to be used.

*Un-ionized Ammonia*. The Renton discharge presently causes violations of the EPA 0.02 mg/l criterion in the Green/Duwamish River. Sampling in September 1979 showed values as high as 0.105 mg/l (Bernhardt, 1980).

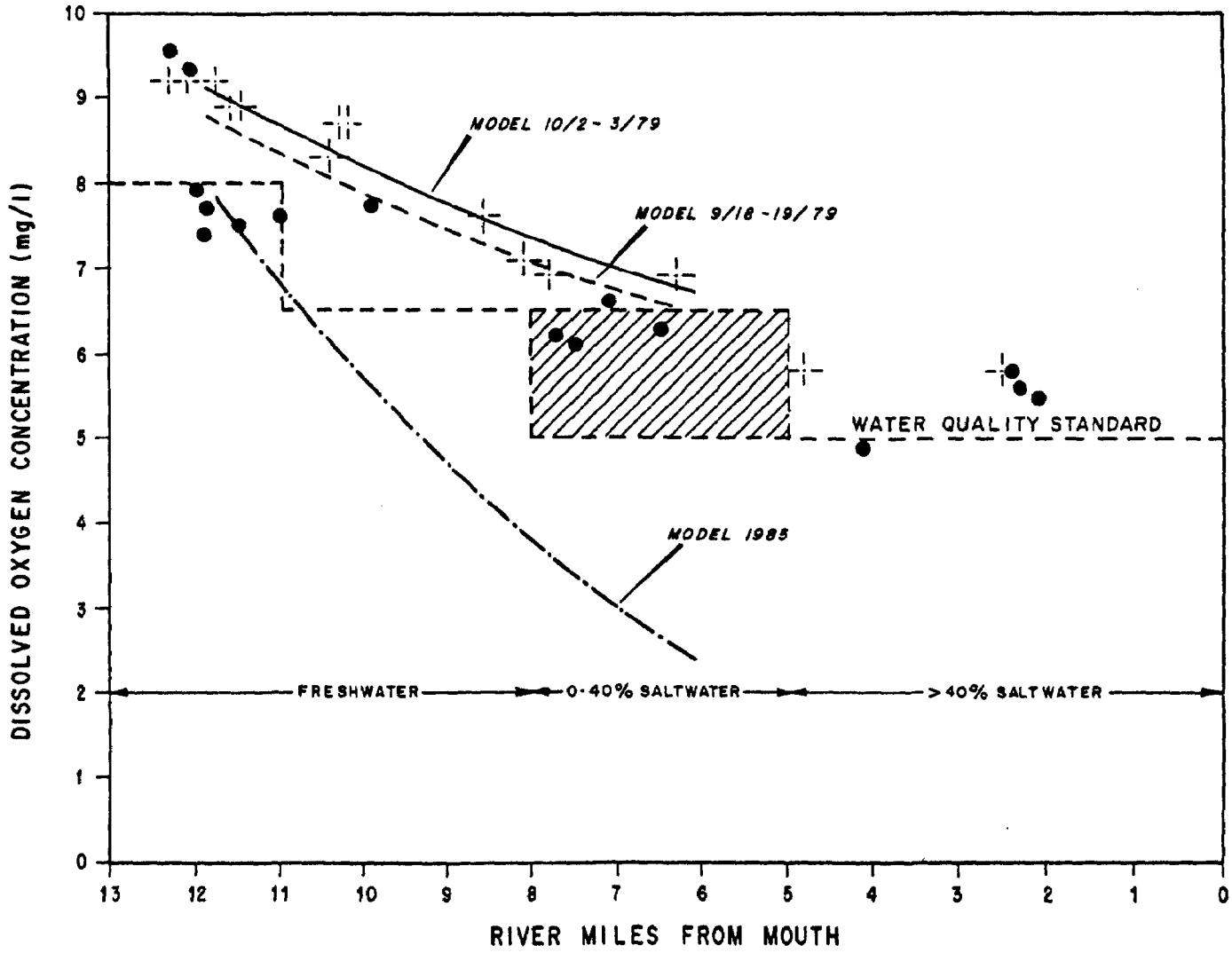
Nitrification of the discharge into the Green/Duwamish River would reduce the effluent concentration of total ammonia nitrogen from present levels of about 15 mg/l to 1 mg/l. This decrease would probably eliminate the present violations of un-ionized ammonia criteria in the Green/Duwamish River.

The nitrification process in sewage treatment can be difficult to initiate and maintain. Any upset in the nitrification process could create toxic conditions in the Duwamish River, due to high ammonia loads and poor dilution ratio, or cause BOD and SS violations due to poor settling. Maintenance of only seasonal nitrification might be especially difficult.

*Dissolved Oxygen*. Adequate levels of DO are essential for fishes and other aquatic organisms to survive. The state DO standard in the tidally influenced reach of the lower Green/Duwamish River is 8.0 mg/l above the Black River (Class A). Below the Black River (Class B), the standard is 6.5 mg/l or 70 percent saturation, whichever is greater. DO standards are 6.0 mg/l in Elliott Bay and 7.0 mg/l in central Puget Sound.

Present discharges from the Renton plant are at least partially responsible for DO standard violations in the lower Green/Duwamish River. Organic matter from plankton blooms has been thought to be the source of oxygen demand which has caused oxygen sags (Welch, 1969; Welch, et al., 1972; and Welch, 1980; in Welch and Trial, 1979). Recent modeling studies (Yake, 1980) concluded that instream nitrification due to ammonia in the Renton effluent is a principal contributor to the DO sag. Carbonaceous BOD from the Renton plant apparently is relatively unimportant in the DO sag problem (Yake, 1980).

Figure 5-3 shows field DO concentrations taken in fall 1971, mathematical modeling curves simulating those conditions, and a mathematical modeling curve for DO under 1985 conditions (upriver flow - 210 cfs; effluent flow - 63 MGD) with no nitrification (effluent ammonia - 15.2 mg/l). The 1985 modeling results indicate that without nitrification, DO




-LEGEND-

● 9/18 - 19/79 } FIELD DATA

10/2 - 3/79

SOURCE: YAKE, 1980

FIGURE 5-3. FIELD DATA & MATHEMATICAL MODELING RESULTS FOR DISSOLVED OXYGEN IN GREEN-DUWAMISH RIVER

standards violations would be more severe than they are presently, with values as low as about 3 mg/l in the brackish water reach. Metro (pers. comm.) has performed calculations showing DO as low as 1.5 mg/l in the year 2000 without nitrification.

Continued discharge to the Green/Duwamish River with nitrification (Alternative A-1) would probably alleviate any DO sag due to ammonia in the effluent. Under this alternative, the ammonia nitrogen concentration in the Renton effluent would be reduced from about 15 mg/l to 1 mg/l.

*Nutrients*. A nitrified discharge to the Green/Duwamish River (Alternative A-1) would continue to discharge nutrients to the river at present concentrations (about 15 mg/l N; about 7 mg/l total P), but effluent flows would be higher (about 100 MGD in the year 2000 vs. about 40 MGD today).

Effluent with advanced waste treatment (Alternative A-2) would have lower nutrient concentrations (about 2 mg/l N; about 0.5 mg/l P) than the present discharge.

*Heavy Metals*. Input of heavy metals to the Green/Duwamish River under Alternative A-1 would be about the same as the input to Puget Sound under the preferred program. Most of the quantities of heavy metals discharged to the river would be transported to Puget Sound by river flow. Some may settle out due to flocculation processes in the Duwamish estuary.

There have been no studies of effects of heavy metals on Duwamish River sediments or biota. However, the DOE recently estimated heavy metals effluent limits which it believes are necessary for receiving water aquatic life based on a 20:1 effluent dilution ratio. Table 5-3 compares these limits to existing discharge levels. Existing effluent levels considerably exceed the copper, mercury, and zinc limitations. Continued discharge under Alternative A-1 would continue this situation.

Advanced waste treatment (Alternative A-2) would reduce effluent concentrations of chromium, copper, and zinc by about half compared to the other alternatives (Metro, pers. comm.). Data for other metals are currently unavailable.

*Chlorine Toxicity*. Although dechlorination has been added to the Renton plant (1973), violations of the EPA (1976) water quality criterion of 0.002 mg/l have been found. In November 1979, values as high as 0.19 mg/l were found in the immediate vicinity of the discharge, and values as high as 0.07 mg/l were found about 1 mile downstream (Bernhardt, 1980).

Table 5-3. Effluent Limits Estimated by DOE to be Necessary to Protect Water Quality and Average Existing Effluent Concentrations For The Renton Discharge

| | Estimated Effluent Limits | Existing Effluent Average[1] (January 1978-September 1979) |
|---|---|---|
| Cadmium ug/l | 1.6 | < 4 |
| lb/day | 4.8 | .18 |
| Chromium ug/l | 10.0 | 20 |
| lb/day | 30.02 | 5.9 |
| Copper ug/l | 8 | 30 |
| lb/day | 2.40 | 10.3 |
| Lead ug/l | 21 | < 20 |
| lb/day | 6.31 | 3.8 |
| Mercury ug/l | 0.2 | 1.4 |
| lb/day | 0.06 | 0.47 |
| Nickel ug/l | 100 | 30 |
| lb/day | 30.02 | 8 |
| Zinc ug/l | 4 | 40 |
| lb/day | 1.20 | 12.2 |

[1]SOURCE: Metro, 1979d.

Part of the chlorine toxicity problem may stem from the type of dechlorination system at the Renton plant. The plant has a "feedback" system, which, in order to function properly, cannot totally dechlorinate the effluent (DOE, pers. comm.).

Continued discharge to the Duwamish River could result in continued residual chlorine violations, unless better dechlorination or alternative effluent disinfection processes were installed. Metro is presently investigating different methods to improve the Renton plant's chlorination system.

*Bacteria*. Coliform standards are frequently violated in the lower Green/Duwamish River. Nonpoint source pollution and CSOs appear to be the main contributors. Continued Renton discharge to the Green/Duwamish River would probably not cause violations unless temporary failures in the chlorination process occurred.

*Toxic Organic Substances*. High levels of polychlorinated biphenyls (PCBs) have been found in Duwamish estuary sediments and fishes (Metro, 1979e). The major sources appear to be accidental spills, and nonpoint source runoff. The Renton plant is probably not a significant contributor of PCBs to the estuary. Continued discharge to the estuary would probably have little or no effect on PCB concentrations. There is little information on other toxic organic substances in the estuary, such as the effects of chlorinating the Renton effluent on the production of trihalomethanes and other organochlorine compounds. Metro is now starting a 3-year toxicant study which will investigate toxicant sources, treatment processes, and fates in the environment.

*Temperature*. State temperature standards are violated annually in the Duwamish River estuary and about 1 year in 2 in the lower Green River. The temperature and flow of the Renton effluent probably increases the frequency and magnitude of temperature standard violations. Continued discharge to the river under increasing effluent flow conditions would cause the frequency and magnitude of violations to increase in the future.

The temperature standards of the Washington DOE for the freshwater portion of the lower Green/Duwamish River are:

- Confluence of Black River upstream to the limit of tidal influence (Class A): temperatures shall not exceed 18.0°C (due to human activities). Temperature increases shall not, at any time, exceed $t=28/(T+7)$. When natural conditions exceed 18.0°C, no temperature increase will be allowed which will raise the receiving water temperature by greater than 0.3°C.

- Confluence of Black River downstream to mouth (Class B): temperature shall not exceed 21°C due to human activities. Temperature increases shall not, at any time, exceed $t=34/(T+9)$. When natural conditions exceed 21.0°C, no temperature increase will be allowed which will raise the receiving water temperature by greater than 0.3°C.

To determine the frequency of background water temperature violations and to evaluate the potential effects of the Renton discharge on the frequency and magnitude of present and future violations, river flow and temperature data, and Renton effluent flow and temperature data, were obtained and analyzed. The impact of present and year 2000 Renton effluent flows on river temperature was estimated based on conservation of heat between the effluent and river flows. This method is rough, and does not account for the dynamic processes of evaporation, shading, advection, conduction, and radiation that may occur in the water masses.

The time period selected for analysis was the month of August, for the years 1967, 1970, 1971, 1972, and 1974-1978. Daily Green/Duwamish River flow data were from the USGS gage at Tukwila. Daily maximum temperature data were from Metro station 311, at the same location. Daily temperature and flow data were obtained from Metro. The results of the temperature analysis are described below:

- Background temperature exceeded the 18°C standard on 77 percent of all August days.

- Addition of the Renton effluent caused the standard to be exceeded an additional 4 percent of all days, for a total of 81 percent.

- Effluent temperatures were generally 20-22°C. On days when the maximum background temperatures approached effluent temperatures, the effects of the effluent lessened. On 24 percent of all days, effluent temperature was actually cooler than background river temperature. These were generally days when background river temperatures exceeded 20-22°C.

- At year 2000 effluent flow levels, the standard would be exceeded an additional 12 percent of all days, for a total of 89 percent.

*Impacts of Redmond Connection Emergency Bypass*. Under Alternative A-1, Redmond connection emergency bypass discharges to the Sammamish River would occur. The impacts of these emergency discharges have been described in the water quality analysis of the preferred program.

Impacts of Alternative B-1. Alternative B-1 includes dual treatment centers: the existing Renton plant, and a new Kenmore plant which would discharge to Puget Sound via a Richmond Beach outfall. This discussion will focus on how the impacts of dual treatment centers would differ from those of centralized treatment.

A Richmond Beach outfall 200 feet deep would probably give adequate initial dilution, as suggested by studies of the West Point discharge at a similar depth (Environmental Quality Analysts, 1974). Viewing Puget Sound as a whole, Alternative B-1 would achieve better dispersion of Renton service area effluent than the preferred program or Alternative A-1 because the effluent would enter from two widely separated sources rather than from a single source. Residence time of the diluted effluent in Puget Sound would be shorter for Richmond Beach than for any of the other discharge locations.

Another advantage to Alternative B-1, compared to Alternative A-1, is that of reduced water quality impacts on the Green/Duwamish River. Under Alternative B-1, year 2000 flows to the Green/Duwamish River would be 72 MGD, vs. 99 MGD for Alternative A-1. Even with this reduced flow, however, the water quality problems predicted for Alternative A-1 would occur with Alternative B-1, with a lesser degree of severity.

Impacts of No Project. Major adverse ammonia and DO impacts would occur in the Green/Duwamish River if no project is constructed and flows continue to increase. Without nitrification, un-ionized ammonia would probably exceed by far the EPA (1976) criterion of 0.02 mg/l. Welch and Trial (1979) found that, even at present levels of ammonia discharge, the un-ionized ammonia concentration would exceed 0.5 mg/l if pH were 9.0 and temperature were 20°C (conditions observed in the river in 1966).

DO levels in the estuary would decrease due to increasing ammonia and BOD loadings. BOD would especially increase because the present treatment facilities could not adequately treat year 2000 flows. Present effluent BOD concentration is about 15 mg/l at 36 MGD during dry weather conditions. This loading may increase to 30 mg/l by 1985 and would become considerably greater by the year 2000. The Renton plant could probably give essentially primary treatment to year 2000 flows. DO levels in the estuary during dry weather would probably approach 0, as they did in past decades before direct pollutant sources to the estuary were abated.

## Aquatic Biology and Fisheries

Background. The biological resources of Puget Sound and the lower Green/Duwamish River and the known impacts of Metro wastewater facilities on those resources are summarized below.

*Puget Sound*. Puget Sound can be separated into intertidal (the shore between high and low tide lines), subtidal (the bottom below the low tide line), and pelagic (open water) habitats. The most definite effect of existing Metro discharges found to date on the biota of Puget Sound is a trend toward higher lead and mercury concentrations in mussels and clams near the West Point outfall; levels found were within toxicity guidelines (Schell, et al., 1977). Harman, Stober, et al. (1977) found no statistically significant effects of the West Point discharge on benthic invertebrate distribution, but their data do suggest some subtle changes in species composition. Campbell, et al. (1977) found no changes in phytoplankton production or standing stock due to the West Point discharge.

Miller, et al. (1977) found differences in species composition and abundance in the nearshore fish fauna between areas off West Point, Alki Point, and Point Pulley. They attributed the differences to habitat differences (eelgrass) not related to wastewater outfalls. In their study of demersal (bottom) fishes, high incidences of Dover sole, rex sole, and quillback rockfish near West Point were noted as possible beneficial effects of the West Point discharge. Acoustical (sonar) tracking surveys indicated no effect of the West Point outfall on pelagic fish distribution of abundance (Duxbury, 1976). The acute toxicity of the West Point effluent (LC50) ranged from 15.4 percent effluent in 96 hours for shiner perch to 50 percent effluent in 120 hours for shore crabs (Stober, et al., 1977).

*Green/Duwamish River*. The fish resources of the Green/Duwamish River system are of particular importance for this EIS. Chinook, coho and steelhead runs of the Green River system are among the largest in the Puget Sound region. Most of the steelhead and coho are of hatchery origin, whereas the chinook run is the second largest native run in Puget Sound, even though significant numbers of chinook are also of hatchery origin. Other less prevalent anadromous fish found in the Green River system include cutthroat trout, Dolly Varden char, chum salmon and pink salmon. The Muckleshoot Indian tribe propagates a relatively small hatchery run of chum salmon (U. S. Fish and Wildlife Service, 1980).

A conservative estimate of the value of the approximately 220,000 salmon provided by the Green River system to sport and commercial fisheries is $2.6 million, in 1977 dollars. The net economic value of the Green River steelhead fishery was estimated to be $2-$3 million in 1976. (See Appendix C.) In addition, significant public expenditures are being made to operate and maintain the fish hatcheries in the system and to implement watershed improvement projects that maintain or enhance fisheries.

The river and estuary below the Renton plant discharge is a migratory route for anadromous species. Spawning habitats do not occur near or below the Renton outfall. The estuary may also be of importance as a rearing habitat for juvenile chinook salmon. Use of estuaries by anadromous salmonids is a relatively unresearched field. Myers (1980) found that chinook salmon use the Yaquima Bay, Oregon estuary for rearing.

Although water quality standards violations have occurred, no obvious effects on fish or other biota in the lower Green/ Duwamish River directly attributable to the Renton discharge have been recorded at effluent discharge levels to date. Matsuda and Domenowske (1971) found that fish avoided areas in the estuary where DO approached 1 mg/l in the mid-1960s, but the low DO was due mainly to sources that have since been controlled. Low DO concentrations in summer are now about 4 mg/l, which is marginal for survival of salmonids.

Fujioka (1970) found that at DO levels as low as 3 mg/l, adult chinook salmon were still able to migrate through the Duwamish estuary. He did find a positive correlation between the amount of fall precipitation and the percentage of fish tagged in the estuary that make it to the Green River Hatchery. This may be an indication that low DO concentrations in the estuary affect the survival of fish upstream.

Buckley and Matsuda (1973) found that nondechlorinated Renton effluent was toxic (96-hour LC50) to fingerling coho salmon at 29 percent effluent, with a residual chlorine concentration of 0.20 mg/l. With chlorine removed, no mortalities occurred with effluent concentrations as high as 100 percent.

Impacts of Preferred Program. In the discussion below the preferred program is assessed for potential impacts on algal production, invertebrates, and fisheries.

*Algal Production.* Since nitrogen is limiting to algal growth for brief periods in some years in central Puget Sound, effluent discharge under the preferred program may have occasional, local biostimulatory effects. These effects would not be adverse, since algal standing crop levels in Puget Sound do not presently approach nuisance levels. Small increases in algal production may actually benefit Puget Sound fisheries due to a greater primary food source.

*Invertebrates.* Present discharges at West Point have not created any measured significant adverse changes in invertebrate distribution or abundance. A Renton discharge to Puget Sound will probably likewise have no effect on invertebrate occurrence. Removal of the Renton discharge from the Green/Duwamish estuary would alter the late summer and fall distribution of salt-sensitive estuarine zooplankton species in response to the altered salinity gradient.

A discharge to Puget Sound could cause small increases in heavy metals accumulation in mussels and clams near the outfall, as found near West Point. However, the heavy metals in Renton effluent would be lower than in the West Point effluent because there are fewer industrial sources in the Renton service area, and because the Renton plant has a higher degree of treatment.

*Fisheries*. In the water quality impacts section of this chapter, it was predicted that the near-field (within about 1 mile of the diffuser) chlorine concentration with a Puget Sound discharge (Alternatives A-3 through A-5) could be as high as about 0.015 mg/l before dilution. Exposure of fingerling coho salmon for 12 weeks in chlorine residual concentrations of 0.009-0.03 mg/l resultin in symptoms of hemolytic anemia (Buckley, et al., 1976). Such effects may not occur near the proposed outfall, however, due to dilution and the long exposure time required to produce symptons.

The presence of a Renton effluent plume in Puget Sound is not expected to adversely affect fish distribution, based on studies of fish near the West Point plume (Duxbury, 1976). The diffuser may actually attract some species, as does the West Point diffuser (Mieler, et al., 1977).

Impacts of Alternative A-1. In the discussion below, Alternative A-1 is assessed for potential impacts on algal production, invertebrates, and fisheries, and relevant improvements that would result from advanced wastewater treatment under Alternative A-2 are noted.

*Algal Production*. Renton effluent nutrients probably do not control algal growth in the Duwamish estuary (Welch, 1969; Welch, et al., 1972; and Welch, 1980 in Welch and Trial, 1979). Nutrients from the plant under Alternative A-1 will therefore probably have no effect on algal production in the Duwamish estuary, and nutrient removal under Alternative A-2 may be of limited value. However, algal-nutrient relationships in the estuary are not well understood.

*Invertebrates*. There have been no studies of the effects of the Renton discharge on invertebrates in the Green/Duwamish estuary. It is not known whether continued discharge would have any adverse effects on invertebrates.

*Fisheries*. Fish migration could be affected by Renton effluent impacts on dissolved oxygen, temperature, and toxicity. Each of these factors is reviewed below.

Present DO levels in the Duwamish estuary are as low as 4 mg/l in summer (Welch and Trial, 1979), a level which can effectively block the upstream migration of adult salmonids. The DO sag in the estuary has been attributed largely to ammonia from the Renton plant (Yake, 1980). This would cease to be a concern under Alternative A-1 due to nitrification.

A second concern regarding the Renton discharge to the Duwamish is high water temperatures blocking the upstream migration of adult salmonids in late summer and early fall. Temperature standards would be violated about 77 percent of all days in August without a Renton discharge to the river, but the discharge would increase the frequency of violations to about 89 percent of all August days in the year 2000. It is not known whether present delays in upstream migration of chinook salmon in late summer are caused by low DO concentration, high temperature, or some other flow-related factor. Therefore, the incremental thermal effects of discharge to the Green/Duwamish River on migratory salmon cannot be predicted at this time.

Effluent toxicity could also affect fish migration. The main acute toxicity component of the Renton effluent is residual chlorine. Despite dechlorination to 0.25 mg/l, the Renton plant discharge results in chlorine levels as high as 0.19 mg/l in the immediate vicinity of the discharge, and 0.07 mg/l about 1 mile downstream (Bernhardt, 1980). These concentrations approach levels toxic to fish. The lethal (96-hour LC50) concentration to coho salmon fingerlings of residual chlorine in the Renton effluent was found to be 0.20 mg/l in 29 percent effluent (Buckley and Matsuda, 1973). The reported value of 0.20 is actually a 48-hour LC50, since no fish died after 48 hours in the tests.

Under Alternative A-1 adverse effects on fish due to chlorine toxicity may occur if more effective dechlorination is not implemented. If residual chlorine continues to be discharged in present concentrations, future river and effluent flow conditions may result in "slugs" of effluent in the river with chlorine concentrations of 0.20 mg/l or above in the immediate vicinity of the discharge. Metro is presently looking into ways to lower the residual chlorine concentration in the Renton effluent. Ammonia toxicity would not be a long-term problem because nitrification would be in the Renton treatment train.

High incidences of fin erosion and liver tumors have been found in starry flounder and English sole in the Duwamish estuary. The causes of these diseases are unknown. Fin erosion diseases have been associated with areas of heavy wastewater discharge in the ocean off southern California and in the New York Bight (Miller, et al., 1977). In addition,

Metro studies (pers. comm.) have found that long-term (91-day) exposure of coho salmon to 30% Renton effluent produced a dysfunction of carbohydrate metabolism unrelated to chlorine or ammonia; such effects could also occur to resident non-anadromous fish living in the estuary.

Miller, et al. (1977) suggests that the diseases are actually two manifestations of a single systemic disease caused by one or more chemical contaminants, possibly PCBs. The Renton discharge has not been associated with high levels of PCBs. Continued discharge to the Green/Duwamish River is not expected to contribute to adverse pathological effects on fish.

Impacts of Alternative B-1. The aquatic biology and fisheries impacts of Alternative B-1 would stem from water quality impacts of the alternative. As previously discussed, the Richmond Beach outfall is unlikely to create measurable adverse water quality impacts in Puget Sound. Therefore, no corresponding biological impacts in Puget Sound are expected.

Impacts on aquatic organisms and fisheries in the Green/Duwamish River under Alternative B-1 would be similar in kind to those previously described for Alternative A-1. Because effluent flows to the river would be reduced under Alternative B-1, potential adverse biological impacts would be less severe than under Alternative A-1.

Impacts of No-Project. Major adverse impacts on the fishery of the Green/Duwamish River may occur if no project is built and new sewer hook-ups are not restricted. The effects would stem from the water quality impacts on the river. Un-ionized ammonia would exceed levels toxic to coho salmon during periods of high pH due to algal blooms. DO levels would be far below levels necessary for diverse populations of fish, especially salmon and steelhead. The continued existence of the fishery would be threatened. The most severe effects would occur during the low flow periods of summer and early fall.

Mitigation Measures. This section presents mitigation measures for the long-term water quality and biological impacts of Metro's wastewater management alternatives. Mitigation measures for short-term water quality impacts are discussed in the following section.

*Oceanographic and Biological Studies.* Although the preceding impact analysis concludes that there is little possibility that Renton plant discharge to Puget Sound will adversely affect the sound's water quality or ecology, additional scientific work is necessary to verify this conclusion and to design the outfall so as to minimize impacts on the sound. Additional detailed oceanographic studies are proposed by Metro to determine optimal outfall alignment,

depth of discharge, and diffuser design parameters, and to predict plume locations, mixing, and dilution. Metro has also proposed to undertake biological studies to establish baseline data and monitor biological responses once the outfall is in operation. These oceanographic and biological studies, which are described in further detail in the Draft Wastewater Management Plan, are necessary to more precisely predict and mitigate the impacts of Renton plant discharge to Puget Sound.

*Heavy Metal and Toxic Substances Impacts*. Although the contribution of heavy metals to Puget Sound from the Renton plant will be small compared to other sources, control of heavy metals and toxic substance discharges is desirable because of the potential for long-term irreversible impacts. Metro has adopted an industrial pretreatment program and is currently pursuing a comprehensive program concerning heavy metals and other toxic constituents in its wastewaters. The toxicant study will identify toxic constituents and sources within Metro's service areas, propose pretreatment alternatives, propose centralized treatment alternatives, and research the distribution, inputs and chemical and biological fates of toxicants in Puget Sound.

*Chlorine Toxicity*. Chlorination and dechlorination are the final steps of wastewater treatment under the preferred program. Improvements are needed to the Renton plant's chlorination system to prevent toxicity problems, and are proposed as part of the preferred program. Metro has proposed near-term improvements in the chemical feed system to reduce residual chlorine levels in Renton effluent. Once the tunnel and outfall to Puget Sound is operational, it may be used for chlorine contact. The Draft Wastewater Management Plan indicates chlorine doses can be reduced compared to present practices because contact time will be increased; if the contact time is long enough, chlorine residuals may decay, thereby reducing sulfur dioxide requirements for neutralization.

Short-Term Water Quality and Aquatic Biology Impacts During Project Design and Construction.

*Impacts*. Under any of the alternatives, short-term deteriorations in Green/Duwamish River water quality will occur between the present time and 1985, when the planned additional facilities are on-line. The expected short-term impacts, and mitigation measures for these impacts, are discussed by Metro in its Draft Wastewater Management Plan and summarized here.

Metro projects that during the 1980-1985 construction period, average wet weather flows will increase from 41 to 50 MGD, excluding the Redmond connection flows. If the Redmond connection were brought on-line by 1985, 4 MGD would be added.

As noted in the previous analysis of water quality impacts, water quality standards in the Green/Duwamish River downstream of the Renton discharge are being violated for temperature, DO, ammonia and chlorine. Increased flows between 1980 and 1985 will increase the frequency and degree of these violations (with the exception of chlorine, which is expected to be brought down to acceptable levels in the near future). In addition, the DOE recommendations for 20:1 effluent dilution will continue to be exceeded.

The short-term deterioration in water quality would probably cause adverse changes in the biology of the Green/Duwamish River. No effects on fish or other biota directly attributable to the Renton discharge have been measured at current discharge volumes, but particular concerns exist regarding Renton effluent impacts on ammonia toxicity and DO, as they affect salmonid rearing and migration, other fish species, and the river's ecology in general. Further ihcreases in ammonia and decreases in DO will create increased risks that fisheries will be adversely affected.

*Mitigation Measures*. Metro has identified several measures currently available to reduce BOD and SS levels during periods of excessive flows. These measures are 1) storage of excess flows in the Renton plant influent sewer, 2) "stressing" of the secondary treatment process, 3) alum addition, and 4) giving primary treatment to excess flows, and blending the secondary effluent prior to discharge.

These measures, however, address neither the ammonia toxicity problem nor the oxygen demand from the un-ionized ammonia. Metro has identified two groups of mitigation measures for these problems: measures to be implemented, and additional measures available. These mitigation measures are listed in Table 5-4, which also presents Metro's evaluation of the effectiveness and costs of each measure. Metro believes that, although few of these measures alone can solve the ammonia problem, combinations of these measures can adequately protect fishery resources over the short term.

## Table 5-4. Interim Measures to Reduce Ammonia Loading to the Duwamish River

| Measures to be Implemented | Potential Reduction of Current Ammonia Load | Capital Costs to Metro | Incremental O/M Costs to Metro | Comments |
|---|---|---|---|---|
| 1) Fast Track Implementation of Plant Expansion | high | high | moderate | Implementation of this alternative would require 3 to 4 years. |
| 2) Diversion of Flow via Sludge Force Mains | slight | slight | slight | Modifications currently being made to implement this diversion. |
| 3) Reduced Summer Flushing | slight | none | slight | Requires implementation of some form of effluent diversion to achieve a slight amount of ammonia removal. |
| **Additional Measures Available** | | | | |
| 1) Interim Nitrification with Existing Facilities | moderate | moderate | high | This alternative could seriously impact treatment plant operations thus jeopardizing overall effluent quality. |
| 2) Construct Special Nitrification Facilities | | | | |
| a) Ammonia Stripping | high | high | high | High capital cost alternatives which could completely remove ammonia in the effluent. The facilities would have little or no use upon completion of the Phase 1 program. |
| b) Roughing Filters | high | high | high | |
| c) Breakpoint Chlorination | high | high | high | |
| 3) Use of Kent/Auburn Lagoons | moderate | moderate | moderate | Use of this alternative is dependent upon the availability of the existing Kent and Auburn Lagoons. |
| 4) Diversion of Flow via Riverton/Renton Pump Station | moderate | high | moderate | High capital cost project which could allow up to 10 mgd to be diverted to West Point. Would take 2 years to implement and would be of limited usefulness once Phase 1 expansion is completed. |
| 5) Diversion of Effluent for Land Disposal | high | high | high | Large amount of land area required near the treatment facility may not be available. |
| 6) Local Agency Infiltration Control | slight | none | none | Requires implementation of some form of effluent diversion to achieve a slight amount of ammonia removal. |
| 7) Water Conservation | slight | none | none | Requires implementation of some form of effluent diversion to achieve a slight amount of ammonia removal. |
| 8) Interim River Flow Augmentation | high | none | unknown | The success of this alternative is dependent upon the cooperation of the U.S. Army Corps of Engineers in operating the Howard Hanson Dam, and the availability of stored water. |
| 9) Fisheries Resource Protection | none | moderate | moderate | Requires the cooperation of the Department of Fisheries. |
| 10) Sewer Moratorium | none | none | none | The effectiveness of this alternative is questionable. Should it prove effective, its impact would be in the reduction of future ammonia levels. |

*SOURCE: Metro, 1980g.*

## Resource Use

### Energy Use

Each alternative significantly increases energy consumption for study area wastewater management, primarily due to the treatment stage of each alternative. Other energy uses are for sludge treatment, influent pumping stations, effluent pumping (for marine discharges) and disposal (for land application). The overall energy requirements of each of the 15 initial alternatives are tabulated in Table 5-5. Also shown are the energy requirements for treating each million gallons of wastewater.

From Table 5-5 it appears that of the initial 15 alternatives, Alternatives B-3, B-4, or B-5 offer the least energy consumption, using about 66,000,000 Kwh per year, or 1,830 Kwh/mg, primarily due to the lower degree of treatment required compared to nitrification and AWT alternatives. Insufficient information is available to determine which of the three is the most energy efficient. The highest energy requirement (4,070 Kwh/mg) is for AWT and discharge to the Duwamish River (Alternative A-2); this high energy cost can be attributed to the high degree of treatment and the high energy requirements for recalcination of lime sludge and regeneration of activated carbon.

Of the four final alternatives, Alternative B-1 has the lowest energy requirement, 2,080 Kwh/mg. Alternative A-1 has the highest energy requirement, 2,710 Kwh/mg. The no-project alternative would not change energy consumption above the present rate of increase.

Energy cost is expected to be the highest portion of the O&M costs, and since energy use is high for each alternative, energy efficiency is expected to be a critical design criterion. Maximum use of digester gas recovery is to be pursued in the alternative selected, and energy-efficient processes and equipment are anticipated for selection during the design of the selected project.

### Chemical Use

The evaluation of long-term alternatives should consider the required use of chemicals. Especially important are lime and activated carbon, which both require regeneration. As energy costs rise, so will the cost of using these chemicals. The use and recalcination of lime not only add a cost for direct chemical purchases, but also greatly increases the on-site energy use. Activated carbon also creates high costs

Table 5-5. Estimated Energy Requirements for Proposed Alternatives

| Alternative | 1,000 Kwh/yr | Kwh/mg* |
|---|---|---|
| Basic Program | | |
| A-1 | 98,000 | 2710 |
| B-1 | 75,000 | 2080 |
| C-1 | 76,300 | 2080 |
| Basic Program and Nutrient Removal at Renton | | |
| A-2 | 137,000 | 3790 |
| B-2 | 104,000 | 2880 |
| C-2 | 105,300 | 2870 |
| Basic Program-Renton discharge at Point Pulley | | |
| A-3 | 87,000 | 2410 |
| B-3 | 66,000 | 1830 |
| C-3 | 67,300 | 1830 |
| Basic Program-Renton discharge in Elliott Bay | | |
| A-4 | 87,000 | 2410 |
| B-4 | 66,000 | 1830 |
| C-4 | 67,300 | 1830 |
| Basic Program-Renton discharge at Alki Point | | |
| A-5 | 89,000 | 2460 |
| B-5 | 68,000 | 1880 |
| C-5 | 69,000 | 1880 |

* mg = million gallons

Source: Metro, 1980h.

for energy because of the periodic regeneration requirements. Therefore, alternatives which use lime and activated carbon are substantiallly more energy-intensive and expensive than other alternatives, other things being equal.

Table 5-6 displays the chemical requirements for each of the 15 initial alternatives. Lime, methanol and activated carbon are only used in the AWT proposals (Alternatives A-2, B-2, C-2) which discharge to the Duwamish River; the AWT alternatives require more chemical use than any of the other proposed alternatives. The marine discharge alternatives do not require dechlorination for discharge and therefore require the least amount of chemicals. The alternatives which have nitrification and discharge to the Green/Duwamish River require sulfur dioxide to dechlorinate the effluent. All alternatives require chlorine to disinfect the effluent before disposal. The six small satellite plants, under Alternatives C-1 - C-15, require more chlorine because the risk of human contact is greater. Ferric chloride is used to enhance dewatering of solids processed at all proposed plants.

If the AWT alternatives were to be selected, careful consideration should be given to large bulk purchases (allowing lower per unit cost) and energy efficient methods of lime and activated carbon treatment. Methanol cost may not rise as fast as the cost of other chemicals because of the fuel potential and possible greater future supplies of methanol.

Of the four final alternatives, the preferred program (Alternatives A-3 and A-5) requires the least amount of chemicals. Therefore, the risk of cost escalation due to increased energy costs and chemical use is the lowest.

### Mitigation Measures

In the design and operation of the selected alternative efforts should be made to minimize energy and resource use. This is an important principle, one which Metro is committed to, from both resource conservation and cost standpoints.

## Growth-Related Impacts Resulting from Staging of Alternatives

### Background

Most of the growth-related impacts of the long-term wastewater management alternatives for the study area are common to all the alternatives, and these impacts are assessed

Table 5-6. Estimated Chemical Requirements
(tons per year)

| Alternative | Lime[1] | Methanol[2] | Activated[3] Carbon | Chlorine[4] | Sulfur[5] Dioxide | Ferric[6] Chloride |
|---|---|---|---|---|---|---|
| Basic Program | | | | | | |
| A-1 | — | — | — | 760 | 240 | 4.3 |
| B-1 | — | — | — | 550 | 170 | 3.8 |
| C-1 | — | — | — | 580 | 170 | 3.8 |
| Basic Program and Nutrient Removal at Renton | | | | | | |
| A-2 | 13,550 | 6,870 | 540 | 760 | 240 | 3.2 |
| B-2 | 9,860 | 4,990 | 390 | 550 | 171 | 2.8 |
| C-2 | 9,860 | 4,990 | 390 | 580 | 171 | 2.8 |
| Basic Program-Renton discharge in Puget Sound | | | | | | |
| A-3, 4, 5 | — | — | — | 760 | — | 3.9 |
| B-3, 4, 5 | — | — | — | 550 | — | 4.2 |
| C-3, 4, 5 | — | — | — | 580 | — | 4.2 |

Assumptions

1. 750 pounds lime/million gallons (lb/mg)
2. 380 lb methanol/mg
3. 30 lb activated carbon/mg (make-up)
4. 42 lb chlorine/mg for discharge to water
   83 lb chlorine/mg for discharge to land
5. 13 lb sulfur dioxide/mg for discharge to Duwamish River only
6. 60 lb ferric chloride/ton of solids processed for disposal

SOURCE: Brown and Caldwell, pers. comm., 1980.

in Chapter 6 of the EIS. However, each of the alternatives has one or more nonmodular facilities; the sizing and staging of these nonmodular facilities has important growth implications.

As a general rule, in order to minimize potential growth-inducing or growth-inhibiting effects of wastewater facilities, it is desirable to design the facilities so that they can be added to in modules, allowing flexibility in response to changes in population projections or land use plans. However, some facilities are considered nonmodular, because adding additional modules of capacity is not cost-effective or creates major adverse construction impacts.

Interceptor sewers are a common example of a nonmodular facility. Trade-offs always exist in the sizing of interceptors between providing a large initial excess capacity, which may be cost-effective and minimize construction disruptions, and providing a smaller initial excess capacity, which creates less risk of growth inducement. EPA cost-effectiveness analysis guidelines (40 CFR, Part 35, Subpart E) provide that federally-funded interceptor sewers should not be designed for a staging period of longer than 20 years, unless the long-term growth projections are consistent with planned land uses in 208 plans and the longer staging period would reduce both primary and secondary environmental impacts. Although these guidelines do not apply if the interceptor is locally-funded, they do indicate EPA's concerns related to adverse impacts of interceptor staging periods longer than 20 years.

In the analysis that follows, the flexibility of each long-term alternative is assessed by considering the extent to which it relies on nonmodular facilities. In addition, for the preferred program, potential impacts of sizing the Renton outfall tunnel and Redmond connection for 50-year flows are discussed.

## Impacts of Preferred Program

Overall Flexibility. Because this alternative involves the construction of several nonmodular facilities (Redmond connection, North Creek/Hollywood connection, and the Renton outfall tunnel), it is probably the least flexible of any of the long-term alternatives being considered, other than the no-project alternative.

Potential Impacts of the Renton Outfall Tunnel and Redmond Connection. The method for sizing and staging components of the preferred program is described in Section D6j

of the companion document to the Draft Wastewater Management Plan. The basic approach used was to select the staging period which has the least cost present worth. Based on this approach, it was decided to expand the Renton treatment plant into two phases to meet flows projected for the year 2000, but to construct the Renton outfall tunnel and Redmond connection in single stages to meet projected year 2030 flows.

Peak flow projections used to size the Renton outfall tunnel and Redmond connection are shown in Table 5-7. Methods for developing the year 2030 flows are unclear, but appear to derive from the long-term population projections in Metro's 1958 comprehensive plan.

Constructing the Renton outfall tunnel and Redmond connection in single, 50-year stages results in the least present worth cost, delays the potentially major impacts of constructing new or parallel facilities, and reduces the risks of running out of capacity if PSCOG's population projections err on the low side. This approach also has several disadvantages. First, the projected year 2030 population that underlies the calculations of year 2030 peak flows is not recognized by land use planning agencies or PSCOG; this means that the Redmond connection and tunnel/outfall are being planned in advance of land use planning for the study area. Second, if the Metro year 2030 population projections err on the high side, unneeded capacity would be funded and built. Third, unless a "bottleneck" exists elsewhere in the sewerage system, capacity will be available for 20-year flows in excess of those based on the PSCOG population projections. The Renton treatment plant capacity acts as a bottleneck for the Renton outfall tunnel, but it does not appear that such a bottleneck exists for the Redmond connection, other than the York and Totem Lake pump stations. If Redmond connection flows were to exceed the PSCOG-based flow projections, potential treatment plant capacity problems could result.

## Impacts of Alternative A-1

This alternative offers slightly more flexibility than the preferred program because it does not require construction of an outfall and tunnel to the sound. The Redmond and North Creek/Hollywood connection would still be required.

## Impacts of Alternative B-1

This alternative is more flexible than the preferred program or Alternative A-1 because construction of the Kenmore treatment plant eliminates the need for the Redmond and North Creek/Hollywood connection. The Kenmore treatment plant

Table 5-7. Long-Term Peak Flow Projections Used to Size Renton Outfall Tunnel and Redmond Connection (MGD)

| Facility | 1980 | 2000 | 2030 |
|---|---|---|---|
| Renton Outfall Tunnel[a] | 144 | 238 | 325 |
| Redmond Connection[b] | 16.9 | 40.4 | 75.0 |
| - North Lake Sammamish Service Area | 8.2 | 17.7 | 38.0 |
| - North Lake Washington Service Area | 8.7 | 22.7 | 37.0 |

[a]SOURCE: Metro, 1980h.

[b]SOURCE: Metro, 1980h.

is more capable of responding to changes in population projections or land use plans in the north part of the study area than are the nonmodular effluent lines; the Kenmore treatment plant is thus less likely to be growth-inducing or growth-inhibiting. However, a tunnel and outfall to Richmond Beach would be required under this alternative, raising the same sorts of sizing and staging concerns as presented by the Renton outfall tunnel.

Impacts of No Project

The no-project alternative is less flexible than any of the long-term alternatives being considered by Metro, because it is the least responsive to future growth. By not expanding the Renton plant, capacity would not be available to serve planned-for growth within the study area.

Mitigation Measures

The main adverse impacts identified in this section are the disadvantages associated with sizing and staging the Renton outfall tunnel and Redmond connection for 50-year peak flows. Two mitigation measures are available to mitigate this impact.

Reduce Staging Period. The staging period for the Renton outfall tunnel and the Redmond connection could be reduced from 50 years to 40 years or 20 years. The disadvantages of this measure are that the potentially major construction impacts of parallel facilities would occur sooner, that a shorter staging period would have a higher present worth cost, and that capacity limits may be reached sooner than expected if PSCOG's population projections err on the low side.

Base 50-year Flow Projections on Land Use plans or PSCOG Forecasts. Metro could work with local governments and PSCOG to arrive at 50-year population and peak flow projections that are more firmly based on current land use policies. For example, PSCOG in 1978 developed very long-term (to the year 2075) population projections for Seattle water planning (Seattle Water Dept., 1980). Perhaps Metro could employ these projections for 50-year flow projections. To the extent this is possible, the potential growth-inducing impacts of the outfall tunnel and Redmond connection would be reduced. In its Draft Wastewater Management Plan, Metro suggests that local agencies review the 50-year flow projections; perhaps a more formalized process of local agency and PSCOG input to the 50-year projections could be implemented.

## Recreation Opportunities

Pursuant to EPA's facilities planning requirements, Metro has prepared a comprehensive assessment of recreation opportunities associated with wastewater treatment alternatives; this assessment appears in Section J of the companion document to the Draft Wastewater Management Plan (Metro, 1980h). Based on this assessment, Metro has identified several recreation opportunities for possible eventual implementation. These opportunities, which are listed in Table 5-7, apply largely to the preferred program, although some could be implemented with Alternative A-1 or B-1 as well; recreation opportunities additional to those shown in Table 5-7 would be created by construction of the Kenmore treatment plant and the tunnel/outfall to Richmond Beach under Alternative B-1.

All the long-term wastewater management alternatives create the potential for additional recreation opportunities within the study area. It appears unnecessary to determine which alternative is "best" from a recreation perspective. Rather, recreation opportunities should be an important consideration in the planning and design of whatever alternative is selected.

Metro (1980h) notes that the recreation opportunities listed in Table 5-8 have the potential for eventual implementation, depending on precise project definitions, site locations, and alignments. Metro recommends continued coordination with EPA, the Heritage Conservation and Recreation Service, the King County Parks Department, the Seattle Parks and Recreation Department, and other local parks and recreation agencies, in order to realize the recreation opportunities identified as part of wastewater management planning.

## Impacts of Decentralized Facilities Under Alternatives C-1 - C-5

Alternatives C-1, C-2, C-3, C-4, and C-5 have not been selected as final alternatives by Metro. Nevertheless, the possibility exists that one or more of the decentralized treatment plants included in these alternatives could have sufficient environmental advantages to be included with the long-term program eventually selected. This chapter assesses the following selected impacts of the decentralized plants: impacts on soils, crops, groundwater, and surface water; and growth-related impacts.

Construction impacts of the decentralized plants are not discussed here, nor are they mentioned in Chapter 4 (Construction and Site-Related Impacts), since that chapter focuses on the final selected alternatives. In general, construction impacts at the sites of the decentralized plants would be similar in land, but less severe, than those identified in Table 4-1 for construction of the Kenmore treatment plant.

Table 5-8. Potential Recreation Opportunities Provided by Long-Term Alternatives

| Recreation Opportunity | Preferred Program | Alternative A-1 | Alternative B-1[a] | No-Project |
|---|---|---|---|---|
| Interconnection of the Tolt Pipeline Trail, Sammamish River Trail, and the Bridle Crest Trail via an adjacent linkage of a trail system provided through the North Creek/ Hollywood connection and Redmond connection. These trail linkages provide direct and indirect access to the water bodies of Totem Lake, Sammamish River and Lake Sammamish. | x | x | | |
| Through Renton treatment plant expansion, provisions are possible for a public information network located throughout the plant components as an environmental education feature. | x | x | x | |
| Potential trail access to the Green/Duwamish River adjacent to the existing Renton treatment plant site, with linkage to the Interurban Trail System and Fort Dent Athletic Center. | x | | | |
| Potential design features for proposed pump stations to include provisions for multiple use, e.g., designing pump stations to include an observation platform. | x | | | |
| Mitigation of disruption to existing park facilities by integrating existing park amenities with a potential trail system provided by outfall lines. | x | | | |

[a]Additional recreation opportunities would also be created by construction of the Kenmore treatment plant and the tunnel/outfall to Richmond Beach.

SOURCE: Metro, 1980h.

Impact on Soils, Crops and Groundwater

The satellite treatment plants proposed for the decentralized alternatives could have impacts on soils, crops, or groundwater. As the discussion below suggests, the likelihood for such adverse impacts is small. A more detailed analysis of these impacts may be found in Appendix D.

Impact on Soils. Existing water supplies in the Renton study area are of excellent chemical quality and the wastewaters expected to be produced in the service area of the proposed satellite treatment plants will be predominantly of domestic nature. Due to these factors the effluent from these plants is not expected to contain significant concentrations of toxic or hazardous elements. The major contaminants of concern will consist of inorganic nitrogen compounds and, potentially, dissolved phosphorus compounds and pathogenic bacteria. Heavy metals, boron, PCBs, and chlorinated hydrocarbons are not expected to pose any problems in nonindustrialized areas. Due to these factors no adverse soil impacts are anticipated from irrigation reuse of effluent from these plants under properly managed land application operations.

Impact on Crops. It is expected that a pasture crop would be used at the proposed land application sites. As stated previously the effluents are not expected to contain any elements which may preclude their use for irrigation of forage crops. It is anticipated that effluent from the satellite plants will contain about 50-70 pounds of nitrogen per acre-foot. Varying amounts of other plant nutrients will also be present in these effluents. Application of the effluent would probably supply most of the nutrient requirements of an irrigated pasture crop.

No adverse impacts are anticipated on the quality and food value of a forage crop grown through the use of the proposed satellite treatment plant effluents.

Impact on Groundwater Resources. In this project, nitrate would be the major constituent of concern with regard to groundwater pollution potential. Due to the small size of the proposed land application facilities, and because most of these facilities would be located on Alderwood soils overlying Vashon till, no significant adverse impacts on groundwater quality are anticipated. In order to prevent any contamination of domestic water supply wells, it would be advisable to select a site that is not in the vicinity and upgradient from such wells. This is especially important for any site located on Everett Soils which are underlain by recessional outwash or other highly permeable formations. Bacterial or viral contamination of shallow domestic wells would also be of concern under these conditions.

## Impact on Surface Water Quality

Some risks to water quality and aquatic biology would result from runoff from the land application sites. If improper land application practices are used, nutrients may enter streams and lakes. Small amounts of nutrients entering streams would probably have no adverse effect, and may actually enhance anadromous fish productivity. However, if an enriched stream is tributary to a lake, or if the land application site drains directly to a lake, nuisance growths of algae or rooted aquatic plants may be stimulated. These risks can be minimized by proper effluent application rates and installation of appropriate drainage facilities at the land application site.

## Growth-Related Impacts

Alternatives C-1 through C-5 provide decentralized treatment facilities for six decentralized communities: Sunrise, Sahalee, Pine Lake, Lake Desire, Timberlane, and Pipe Lake. The main rationale for selecting these sites is that they are not contiguous to the central portion of the Metro service area, so that local land use goals could be enhanced by separate land-intensive systems. Two types of potential land use benefits of the decentralized sites have been identified by Metro: open space benefits from acquisition of land treatment sites, and reduction of the growth-inducing role of interceptor sewers connecting the decentralized communities to the central Metro system.

Open Space Benefits. In theory, acquisition of land treatment sites could support King County open space policies. A total of 1,164 acres (almost 2 square miles) would be needed for land treatment, and this land would be assured of long-term use as agricultural open space. (This estimate of acreage may be low -- refer to Appendix D.) Because specific land treatment sites have not been identified by Metro, it is not possible to determine the importance of these potential open space benefits. Open space benefits of land treatment would be most apparent if the sites were components of larger regional open space networks or if the sites were in immediate danger of being converted to other less desirable uses.

Interceptor Corridor Land Use Benefits. For some of the decentralized communities, construction of decentralized facilities could lessen development pressures in interceptor sewer corridors. The potential for interceptor corridor land use benefits is assessed below for each community.

It should be noted that in most of the decentralized communities, uncertainties exist as to whether the community should be served or how large the local service area should be. These issues would not, however, be affected

by selection of Alternatives C-1 through C-5, since all long-term alternatives assume both an identical initial service area and an identical process for modifying the service area.

*Sunrise*. Sunrise is a 207-acre planned residential subdivision located in the northshore communities planning area. It is planned for sewer service by County Water District 104.

To serve the Sunrise development, a trunk sewer is planned to connect to Metro's Sammamish Valley interceptor. The trunk sewer corridor passes through open space lands, including valuable Sammamish Valley agricultural lands. Recognizing the potential growth-inducing impacts of this trunk sewer, King County Water District 104 has formally committed to a hook-up ban along the trunk sewer corridor. Assuming this agreement is enforced, construction of decentralized facilities at Sunrise in lieu of the trunk sewer would not be expected to lessen development pressures along the trunk sewer corridor.

*Sahalee*. Sahalee is a large residential development of several hundred acres located in the east Sammamish communities planning area; as of 1978, 106 acres have been developed. Sahalee is provided sewer service by the Sahalee Water and Sewer District.

Sahalee is presently hooked up to Metro's North Lake Sammamish interceptor via a trunk sewer which passes through predominantly open space land. The existing local service area has been proposed for expansion to the north and east in the East Sammamish Communities Plan. If the LSA expansion necessitates expansion of the Sahalee Water and Sewer District trunk sewer, construction of decentralized facilities in lieu of the expanded trunk sewer could lessen development pressures along the trunk sewer corridor.

*Pine Lake*. The Pine Lake community, located within the East Sammamish communities planning area, is primarily rural, with dispersed-low-density residential uses. The south portion of the community is served by a limited pressure sewer system operated by County Water District 82, connected to Metro's Issaquah interceptor.

The existing local service area has been proposed for expansion to the north in the East Sammamish Communities Plan. Because this would require a new trunk sewer connecting to the Metro system, which would pass through open space lands, construction of decentralized facilities at Pine Lake in lieu of the expanded trunk sewer could lessen development pressures along the trunk sewer corridor.

*Lake Desire*. Lake Desire is a low density lakeshore community located in the Soos Creek communities planning area. Although the community is presently unsewered, a

local improvement district has been proposed to provide a local collection system; this proposal has created considerable controversy.

If the sewering proposal is implemented, a trunk sewer would be needed which would ultimately connect to Metro's Madsen Creek interceptor or to the Cedar River interceptor. Because this trunk sewer would pass through predominately open space lands, construction of decentralized facilities at Lake Desire in lieu of the expanded trunk sewer could lessen development pressures along the trunk sewer corridor.

*Timberlane and Pipe Lake*. Timberlane is a single-family residential development located in the Tahoma-Raven Heights communities planning area. Pipe Lake, located in the same planning area, is a low-density residential community immediately east of Timberlane. Both communities are currently served by the Cascade Sewer District.

A trunk sewer currently connects the two communities to Metro's Clark Fork trunk sewer. Portions of this local trunk pass through open space areas. The Cascade Sewer District has indicated to King County planners that the trunk has sufficient capacity to serve projected growth over the next 6-10 years (King County Planning Division, pers. comm.). Because this trunk sewer is in place and has available capacity, construction of decentralized facilities at Timberlane or Pipe Lake would not be expected to lessen development pressures along the trunk sewer corridor.

Summary. Acquisition of land treatment sites could support King County open space policies by assuring that 1,164 acres would remain in long-term agricultural use; because specific sites have not been identified by Metro, it is not possible to determine the importance of these open space benefits.

In three of the six decentralized communities (Sahalee, Pine Lake, and Lake Desire), construction of decentralized facilities could lessen development pressures in trunk sewer corridors. Lake Desire is currently unsewered, and decentralized facilities would preclude the need for hook-up to the Renton system. Although Sahalee and Pine Lake are currently connected to the Renton system, expansion or paralleling of existing trunk lines from these communities is contemplated in the near future, so that decentralized facilities would substitute for expanded or parallel trunk lines.

The lessening of development pressures along trunk sewer corridors is not a major land use benefit of the decentralized plants, however, because of the short distance between the decentralized communities and the central Renton service area. Also, other controls are in place (King County Sewerage General Plan, Metro Resolution 2933) to assist in assuring that the trunk sewers will not be growth-inducing.

Chapter 6

# SECONDARY IMPACTS COMMON TO ALL ALTERNATIVES

## Introduction

This chapter assesses the growth-related secondary environmental impacts common to all wastewater management alternatives considered by Metro. These impacts derive from the common population and land use projections used to project wastewater flows for all the alternatives. Growth-related impacts are of major importance for this EIS, since the Lake Washington/Green River Basins study area represents the major growth area for metropolitan Seattle over the next 20 years.

EPA policies require the agency to consider the secondary environmental impacts of wastewater projects receiving federal construction grants. These secondary impacts are primarily caused by the growth which expanded wastewater facilities are typically constructed to accommodate. The secondary impacts of a project may often be more significant than the project's direct impacts.

Because Metro has relied on local land use policies to designate the sewer service area, and on PSCOG population projections to project wastewater flows, the proposed wastewater system improvements will not "cause" the growth projected by other agencies, but rather will assist its accommodation. Although neither Metro nor EPA is institutionally "responsible" for growth and its accompanying secondary impacts within the study area, the philosophy that EISs are full disclosure documents dictates that such secondary impacts be examined in this EIS, and that mitigation measures be identified for EPA, Metro, or other public agencies when appropriate. This is particularly important in the case of air quality, agricultural land, wetlands, floodplains, and cultural resources impacts, for which EPA has developed explicit policies to mitigate adverse secondary impacts. Those measures identified for Metro may be the basis for grant conditions.

## Relation of Wastewater Alternatives to Growth and Secondary Impacts

Local Recognition of Relationship Between Sewerage Availability and Growth. The important relationship between sewerage availability and growth has been formally recognized by King County's Sewerage General Plan and General Development Guide (first draft) policies, and by Metro's Resolution 2933. (It should be noted that the General Development Guide (first draft) is currently being revised.) The King County Sewerage

General Plan identifies local service areas (the only areas eligible to receive sewerage service), and establishes a local service area amendment process to assure consistency of sewering decisions with the county's growth policies. The county's General Development Guide (first draft) has development policies recommending that subdivisions with densities of three dwelling units per acre or more be served by sanitary sewers; these policies effectively limit development in areas without available centralized sewerage service to densities of less than three dwelling units per acre.

Metro, in its Resolution 2933, requires affected local agencies to certify that trunk or interceptor sewers and sewer hook-ups are consistent with applicable local land use plans before it will construct the sewer. Through this resolution Metro is limited to constructing only those sewers which are consistent with local land use policies.

Growth and Secondary Impacts of a No-Project Alternative. Technically, the most accurate method for assessing the secondary impacts of a wastewater treatment expansion project is to compare the impacts of growth patterns, in the absence of the project, with those that would occur if the project is implemented. Unfortunately, it is not possible to follow this procedure in this EIS because PSCOG's regional growth projections assume major increases in sewered population, thereby assuming that necessary wastewater treatment capacity will be available in the future. No regional growth projection exists which assumes no further increases in sewered population within the study area, and the generation of such a projection is a very complex process beyond the scope of this EIS.

In the absence of a sewerage-constrained growth projection, this EIS assumes that since expanded wastewater treatment facilities will play some role in accommodating the population growth projected by PSCOG, it is appropriate to examine the environmental impacts of the PSCOG growth projections and consider these as the secondary impacts of Metro's Wastewater Management Plan. It is possible, however, to make some generalizations related to the growth impacts of a no-project alternative. Lack of expanded wastewater treatment capacity would be unlikely to affect the Puget Sound regional growth rate, which is largely determined by birth rates, death rates, and net in-migration (the latter strongly influenced by job opportunities and lifestyle preferences). However, lack of sufficient wastewater treatment capacity could have major effects on the distribution of new development, by (1) encouraging development within other portions of the Puget Sound region with adequate wastewater treatment capacity, and (2) encouraging lower density development within the study area more compatible with the use of on-site systems, which would require additional acres to be urbanized.

Assumptions for Secondary Impact Assessment

Several assumptions have been made in preparing the following analysis of growth-related secondary impacts.

- Availability of expanded treatment plant capacity within the study area will assist in accommodating additional population growth.

- Availability of expanded treatment plant capacity is only one of many factors (such as employment growth, market forces, lifestyle preferences, local land use policies, and infrastructure decisions) that together operate to influence growth patterns.

- The population growth and land use changes that will occur in the study area are those projected by PSCOG in its "policy" projection.

- The adverse secondary impacts of growth have been recognized by responsible agencies having jurisdiction within the study area; these agencies have developed plans, policies and regulations to mitigate such impacts, and the effectiveness of these measures depends on their implementation.

- Sewer service will be provided outside of the initial sewer service area as a result of incremental local service area changes after 6 to 10 years.

Because of this last assumption, the assessment of secondary impacts is not limited to the identified sewer service area, but also takes into account growth impacts outside the service area but within the Wastewater Management Plan study area. Although the nonsewer area will generally not be served within the next 6-10 years, amendments to the King County Sewerage General Plan and future Metro interceptor sewer decisions will eventually expand the service area for the Renton plant beyond the present boundary. Expansion beyond the current sewer service area can occur before all projected sewered population occurs within the current service area. This would have the effect of increasing the study area sewered population beyond that projected by PSCOG, thereby accelerating the rate at which capacity is used at the Renton plant.

Future EPA decisions related to the Renton sewerage system may involve incremental expansion of the current service area boundary. It is therefore important that the secondary impact analysis in the EIS examine the impacts of growth throughout the study area in a regional, comprehensive manner. With this approach, the EIS can serve as the basis for assessment of the cumulative impacts of future sewerage projects tributary to the Renton plant.

## Contents of Chapter

The next section of this chapter describes and assesses the PSCOG population forecasts which underly the Metro Wastewater Management Plan. The remaining sections of the chapter describe impacts and mitigation measures within the following areas: air quality, surface water and biology, groundwater, land use, public services, and public finance.

## Description and Assessment of PSCOG's Population Projection

### Method

To project the geographic distribution of total population, employment and land use change within the planning area, PSCOG used a computer-assisted model called the Activity Allocation Model (AAM). This model seeks to answer the question, "What significant relationships can be found between the 1960 census data set and the 1970 census data set which can be used to account for the changes in households and employment which occurred over that 10-year interval?" It formulates the answer in a series of ten simultaneous equations which produce projected changes in the number of households and number of employees in each defined district. Land use changes are derived by applying density factors to projected numbers of households and employees. The AAM operates in 10-year forecast increments, and policy assumptions and model results are evaluated for each increment.

The model's ten equations require two types of inputs: data inputs and policy inputs. The data inputs describe the number and distribution of households in various income categories, the household density, the amount of employment in various economic sectors, the relative location of employment opportunities (expressed as highway travel times), land use for various economic activities and a "composite amenity index". The policy inputs include travel time to future housing and employment locations, water and sewer service availability, the relative location of households in other income categories and the amount of vacant land available.

PSCOG has derived two distributions of population, housing and land use for the study area. One is a trends allocation, which is characterized by the primary importance of market demand in determining patterns of land use. For that allocation, only the limitations on development inherent in the current regulatory context were imposed; they included zoning, subdivision regulation, land costs, availability of services, existing tax laws and the availability of funds to build new infrastructure such as highways, sewers and water supply systems. The other distribution is the policy allocation, which is characterized by restrictions on the conversion of land from rural to urban use. The policy allocation

therefore provided that only low density uses would be allowed in unsewered areas, that decisions regarding sewer and water line extensions would be made by local governments rather than by sewer and water districts, and that sewer service areas would be expanded only by small amounts by 1990. In addition, it contained "a significant increase" in incentives for infill and compact development.

## Projected Population

PSCOG projects that population in King and Snohomish Counties will increase from 1,575,000 in 1980 to 2,112,500 in the year 2000, an average annual growth rate of 1.5 percent. The projection for the Renton 201 study area, which includes portions of King, Snohomish and Pierce Counties, varies between the policy allocation and the trends allocation. In the policy allocation, area population would grow from the 1980 level of 537,087 residents to a total of 805,248 residents, an average annual increase of 2.0 percent. This growth would be concentrated in the western portions of the study area, with the largest shares of the total increase occurring in the North Lake Washington, Green River and East Lake Washington basins. In the trends allocation, the population of the study area would grow to a total of 858,450 residents, an average annual increase over 1980 of 2.4 percent. This growth would spread out more completely over the study area; the largest shares would locate in the Green River, North Lake Sammamish and North Lake Washington basins. The distribution of new population in the study area projected under the two allocations is compared in Table 6-1.

## Critique

The AAM used by PSCOG to develop its population projections relies on trends observed between 1960 and 1970 to predict changes that will occur in the future. It distills the observed trends into a series of equations that describe changes in population and employment factors as well as land use and transportation conditions and policies.

This approach is subject to question on several grounds, some of which were noted in a PSCOG information item dated March 9, 1977. First, because it relies on data from 1960 and 1970, it cannot account for influences on urban form not present during that decade, such as gasoline and housing prices and interest rates, that are significantly higher relative to real income than they were during that period.

Second, because the model predicts on the basis of observed trends rather than the underlying reasons for those trends, it is susceptible to the statistical problem known as covariance; this problem occurs when variation in one

Table 6-1

PROJECTED POPULATION INCREASE BY DRAINAGE BASIN,
RENTON STUDY AREA, 1980-2000

| | Policy Allocation | | | | Trends Allocation | | |
|---|---|---|---|---|---|---|---|
| Basin | 1980 | 2000 | Increase | % of Study Area Increase | 2000 | Increase | % of Study Area Increase |
| North Lake Washington | 99,611 | 167,702 | 68,091 | 25 | 153,650 | 54,039 | 17 |
| North Lake Sammamish | 47,140 | 81,312 | 34,172 | 13 | 101,972 | 54,832 | 17 |
| East Lake Washington | 121,142 | 180,694 | 59,552 | 22 | 151,258 | 30,116 | 9 |
| South Lake Washington | 63,601 | 77,158 | 13,557 | 5 | 105,217 | 41,616 | 13 |
| South Lake Sammamish | 38,024 | 51,863 | 13,839 | 5 | 59,340 | 21,316 | 7 |
| Green River | 133,075 | 193,877 | 60,802 | 23 | 230,053 | 96,978 | 30 |
| White River | 13,804 | 29,244 | 15,440 | 6 | 33,299 | 19,495 | 6 |
| Mercer Island | 20,690 | 23,398 | 2,708 | 1 | 23,661 | 2,971 | 1 |
| TOTAL | 537,087 | 805,248 | 268,161 | 100 | 858,450 | 321,363 | 100 |

Source: Puget Sound Council of Governments

condition appears to cause variation in a second, but in reality the variation in both results from the activity of a third factor. Finally, problems could result from the availability of local data and the consistency of data measurement, a factor of particular importance in land use information.

The accuracy of any forecast, regardless of the method or model used to develop it, may be expected to diminish as its distance into the future increases because there may be influences on development patterns that could not be foreseen or incorporated into the forecasting process. Examples of such influences are changes in technology, changes in family structures, changes in economic conditions and changes in government policies. These factors may affect both the overall level and type of development within a geographic region and the distribution of that development among subareas of that region.

A more detailed analysis and discussion of the demographic forecasts prepared by PSCOG may be found in Appendix A of the EIS.

## Comparison of PSCOG Forecast to Other Forecasts

EPA Grant Regulations Relating to Population Forecasts. In 1978, EPA established requlations for population forecasts to be used in facilities planning. The forecasts are to be based on state projections prepared for EPA by the Bureau of Economic Analysis (BEA) of the Department of Commerce in 1977. BEA is the federal agency responsible for most economic forecasting, and is known in particular for its OBERS (Office of Business Economics/Economic Research Service) series of forecasts, on which the projections prepared for EPA were, in part, based.

EPA has determined that its funding decisions will be based on BEA's state totals, which each state is required to disaggregate to water quality planning areas. There are two exceptions to the mandate to use the BEA projections: (1) in the event either a state, or a water quality planning area, had completed its own population forecast prior to June 26, 1978, that forecast can be used instead of the BEA-based projection if the state projection does not exceed by more than 5 percent the BEA state total, and the regional projection does not exceed by more than 10 percent the regional total determined by disaggregating the BEA state projection; or (2) the BEA projection may be appealed to EPA in Washington.

The Bureau of Economic Analysis (BEA) Projections. The BEA approach is "top down", based on analysis of the national economy and of each state's economy in relation to the nation as a whole. For all states, including Washington, BEA developed projections for 1980, 1985, 1990, and 2000. Because no adopted

Washington state forecast predates June 1978, these BEA projections would normally serve as the basis of EPA funding decisions in the State of Washington.

Status of BEA Projections in the State of Washington. The State of Washington Office of Financial Management (OFM) had undertaken its own population forecasting at the time BEA's work for EPA was proceeding, and in 1979 the state published that forecast. Because the state's forecast deviated sharply from the BEA projection (exceeding the BEA figures by about 20 percent) a resolution of the difference was sought by EPA in order to make clear the basis on which the agency's funding decisions in the State of Washington would rest.

After reviewing a request by OFM for acceptance of the 1979 state forecast in lieu of the BEA projection, EPA headquarters instead authorized interim use of a forecast based on the BEA projection increased by 10 percent in the year 2000. Table 6-2 presents a comparison of the forecasts mentioned so far: the initial BEA projection, the adjusted BEA projection authorized for EPA use in funding decisions, and the OFM 1979 forecast rejected by EPA for funding purposes. A fourth forecast presented in the table represents OFM's most recent revised state forecast.

The four projections presented in Table 6-2 show a wide range in year 2000 population levels. Only a small amount of this difference is attributable to different 1980 bases; most of it arises from differences in rates of growth. The State of Washington forecast represents about 24 percent more people in the state in the year 2000 than the 4,858,000 level acceptable to EPA.

There has been considerable discussion between EPA and the state about the differences in their forecasts, and EPA has indicated procedures for challenges to the projections EPA has proposed to use for funding decisions. It is not known whether the State of Washington plans further challenges, nor is it yet known how the anticipated publication of new OBERS state projections or the actual 1980 census enumeration (when published) could affect the ultimate population figures applied in EPA's funding decisions.

Multiplicity of County and Regional Forecasts. Disagreement about the future population is not confined to state-level projections. There is also lack of agreement about regional forecasts. At the regional level, the disparity is of concern not only because it affects funding levels but also because it suggests contradictory guidance to the regional wastewater agency, Metro. That is, Metro is required to both use the allocations of state population projections to regions in its wastewater facilities planning

Table 6-2

WASHINGTON STATE POPULATION FORECASTS AND PROJECTIONS
(000s)

| | | 1980 | 1985 | 1990 | 2000 |
|---|---|---|---|---|---|
| 1. | BEA 1977 Projection for EPA | 3,738 | 3,908 | 4,076 | 4,417 |
| 2. | BEA Adjusted Projection Approved for Interim EPA Use in Funding Decisions | 3,926 | 4,159 | 4,392 | 4,858 |
| 3. | OFM August 1979 Forecasts | 4,036 | 4,490 | 4,836 | 5,345 |
| 4. | OFM December 1979 Revised Forecasts | 4,068 | 4,619 | 5,090 | 6,024 |

Sources:

1. U. S. Department of Commerce, Bureau of Economic Analysis: *Population, Personal Income and Earnings by State, Projections to 2000*, October 1977.

2. U. S. Environmental Protection Agency, Region X, Craig Partridge, pers. comm., April 2, 1980.

3. Washington, State of, Office of Financial Management: *Recommended Washington State Population Forecasts for Use in Municipal Wastewater Treatment Construction Grants Program*, September 1979.

4. Washington, State of, Office of Financial Management: *State and County Population Forecasts by Age and Sex: 1980-2000* (Special Report No. 30), January 1980.

according to state law, and to abide by regional planning criteria according to the charter of the agency and according to the Metro 208 plan. Where state and regional agencies disagree on the future growth of the region, Metro cannot follow both paths simultaneously. Table 6-3 compares the most recent allocations for the Puget Sound region and King County, including the DOE allocation of the EPA-approved state population projection. Also shown is the proposed revision to the PSCOG regional projection, which had not been adopted as of late 1980.

As shown by Table 6-3, for King County, the DOE allocation is similar to the PSCOG projection, whereas for the Puget Sound region, the DOE allocation is significantly lower than the PSCOG projection. This does not appear to be a major problem, since most of Metro's study area is within King County, where the projections generally agree. It should be noted that the DOE allocation will apply only to grants issued after January 1981, and that the allocations will be revised after 1980 census data become available.

## Secondary Air Quality Impacts

### Background

Under Section 316 of the Clean Air Act Amendments of 1977, the EPA is authorized to withhold, condition, or restrict any grant for construction of sewage treatment facilities if the proposed project will accommodate a larger increase in air pollutant emissions than provided for under the local portion of the State Implementation Plan.

The Washington State Implementation Plan, which includes the air quality management plan (AQMP) for the central Puget Sound region, was conditionally approved by the EPA on June 5, 1980. Details of the central Puget Sound AQMP, which is a plan for attaining federal standards for ozone, carbon monoxide, sulfur dioxide, and particulates, may be found in Appendix B of this EIS.

### Assessment of Impacts

To determine whether Metro's wastewater management plan will accommodate a larger increase in emissions than provided for in the local AQMP, the population projections underlying both plans are compared here. Although the AQMP region consists of four counties (King, Pierce, Snohomish, and Kitsap) only portions of the first three are within the wastewater plan study area; therefore, Kitsap County has been excluded from the comparison of population projections.

Table 6-3. Comparison of Regional and King County Population Forecasts (000s)

| Area | Projection by | 1980 | 1990 | 2000 |
|---|---|---|---|---|
| Puget Sound Region | PSCOG - 1977 | 2,137 | 2,570 | 2,974 |
| | PSCOG - Proposed 1980 revision | 2,188 | 2,632 | 3,073 |
| | OFM (8-79) | 2,190 | 2,655 | 2,935 |
| | OFM (12-79) | 2,210 | 2,798 | 3,326 |
| | DOE Allocation of EPA Projection | - | - | 2,679 |
| King County | PSCOG | 1,235 | 1,400 (Policy) | 1,575 |
| | | | 1,429 (Trends) | N.T. |
| | OFM (8-79) | 1,268 | 1,530 | 1,707 |
| | OFM (12-79) | 1,280 | 1,611 | 1,928 |
| | DOE Allocation of EPA Projection | - | - | 1,551 |

N.T.: Not tabulated.

Sources:

1. Puget Sound Council of Governments, Mayor Beth Bland: *Memorandum to King Subregional Council regarding Forecasts*, February 13, 1980.

2. Puget Sound Council of Governments, Tim Watterson: *Memorandum to PSCOG staff regarding regional population, employment, income forecast revision.*

3. Washington, State of, Office of Financial Management: *1979 Revision of County Population Forecast for Washington State: 1980-2000 (Table 1)*, August 1, 1979. December 1979 forecasts from PSCOG memo cited in (1) above.

4. Department of Ecology: *Letter to EPA Region X*, September 4, 1980.

Emission forecasts for population-dependent source categories were developed for the AQMP by utilizing the September 1978 PSCOG population projection. In contrast, the Lake Washington/ Green River Basins wastewater management plan is based on PSCOG's 1979 population projection. As indicated in Table 6-4, there is less than 1 percent difference between the September 1978 and May 1979 PSCOG population projections for the three counties. This difference is not considered significant, since emissions forecasts for population-dependent source categories are based upon emission factors which exhibit larger margins of error than 1 percent.

From the comparison in Table 6-4, it can be concluded that the proposed plan is consistent with the Central Puget Sound AQMP; a re-evaluation of consistency would be required if either the local portion of the State Implementation Plan or the facilities plan are amended to incorporate updated population forecasts. Since the population projections used in Metro's wastewater management plan are consistent with those used in the AQMP, the secondary air quality impacts of growth accommodated by the wastewater plan have been examined in the AQMP.

It should be noted that population growth is only one factor affecting ambient air quality. Some of the interrelationships between growth and air quality are explored in a recent PSCOG study (PSCOG, 1980).

### Mitigation Measures for Air Quality Impacts

The AQMP air quality control measures act as mitigation measures for the wastewater plan's secondary air quality impacts; no additional mitigation measures are needed for this EIS. The AQMP control measures are intended to attain and maintain federal air quality standards in the central Puget Sound basin.

## Secondary Surface Water and Biological Impacts

This section describes the generalized secondary impacts of study area population growth on surface water quality, aquatic ecosystems, and terrestrial ecosystems. Details regarding existing biological and water quality conditions within the study area may be found in Appendix C of the EIS.

### Secondary Surface Water Quality Impacts

Background. The many lakes and streams in the study area generally have good chemical water quality, in terms of conventional toxic or oxygen-depleting pollutants. The main types of water quality problems in the study area are

Table 6-4. Comparison of September 1978 and May 1979 PSCOG Population Forecasts for the Three-County Puget Sound Air Quality Planning Region

| County/PSCOG Forecast Year | Year 1980 | Year 1990 |
|---|---|---|
| Pierce | | |
| September 1978 | 405,870 | 499,348 |
| May 1979 | 414,998 | 516,092 |
| Difference | 9,128 | 16,744 |
| Percent Difference | 2.3 | 3.4 |
| Snohomish | | |
| September 1978 | 291,266 | 361,418 |
| May 1979 | 291,266 | 375,076 |
| Difference | 0 | 13,658 |
| Percent Difference | 0 | 3.8 |
| King | | |
| September 1978 | 1,203,756 | 1,378,111 |
| May 1979 | 1,207,756 | 1,367,440 |
| Difference | 4,000 | 10,671 |
| Percent Difference | 0.3 | -0.8 |
| Three-County Total | | |
| September 1978 | 1,900,892 | 2,238,877 |
| May 1979 | 1,914,020 | 2,258,608 |
| Difference | 13,128 | 19,731 |
| Percent Difference | 0.7 | 0.9 |

generally high coliform bacteria levels caused by malfunctioning septic tank systems, or by pet, livestock, or wild animal wastes; and erosion and sedimentation caused by land disturbance and impervious surfaces that accompany urbanization.

Water Quality Impacts of Urban Runoff. The land use changes that accompany population growth alter the runoff characteristics of land. The general effect is to increase the amount of immediate surface runoff for a given amount of rainfall. Higher runoff rates are caused by impervious surfaces (rooftops, driveways, streets) and other factors such as decreased raindrop interception by vegetation and lower moisture-retention capacity of disturbed soil.

Runoff coefficients (the ratio of runoff to rainfall) chosen by Metro for use in runoff modeling studies (Buffo, 1979) illustrate the great effect urbanization can have. The runoff coefficients for different land uses are as follows:

| | |
|---|---|
| Industrial | .95 |
| Commercial | .90 |
| High Density (multifamily) | .60 |
| Medi Density (multifamily) | .35 |
| Low Density (single family) | .20 |
| Open Space - Rural | .05 |
| Agricultural | .01 |
| Forest | .005 |

Urban runoff can cause adverse water quality impacts in streams and lakes. Study area streams are probably most affected by sedimentation caused by raindrop impact on disturbed soils, increased runoff rates, and streambank erosion. Study area lakes are probably most affected by nutrient enrichment, primarily phosphorus.

Metro has developed suspended solids, phosphorus, and lead loading rates for various land use types within the study area (Buffo, 1979); similar loading rates for other nonpoint source pollutants are not available. Table 6-5 presents some of these loading estimates and indicates the great increases in nonpoint source pollutants that occur with urban vs. nonurban uses, and with stable vs. unstable (recently disturbed) sites.

Table 6-5. Nonpoint Source Pollutant Loading Estimates for Land Use Types in Locations near Kent, Washington

| | Site Characteristics | Total Phosphorus (lb/acre/yr) | Total Suspended Solids (lb/acre/yr) | Lead (lb/acre/yr) |
|---|---|---|---|---|
| Industrial | Stable | 1.1 | 356.3 | 0.98 |
| | Unstable | 3.2 | 1,500.4 | |
| Commercial | Stable | 0.8 | 161.4 | 1.4 |
| | Unstable | 3.6 | 921.6 | |
| High Density Multifamily | Stable | 0.9 | 369.3 | 0.2 |
| | Unstable | 2.7 | 421.9 | |
| Medium Density Multifamily | Stable | 0.1 | 31.2 | 0.1 |
| | Unstable | 1.8 | 286.8 | |
| Low Density Single family | Stable | 0.08 | 8.2 | 0.2 |
| | Unstable | 0.5 | 93.8 | |
| Open Space Rural | Stable | 0.01 | 1.4 | 0.001 |
| | Unstable | 0.07 | 1.5 | |
| Agricultural - Pasture | Stable | 0.38 | - | - |
| Agricultural - Farming | Stable | 0.0002 | - | - |
| Forest - Douglas-fir | Stable | 0.00002 | - | - |

SOURCE: Buffo, 1979.

It should be noted that pollutant loading rates are only a rough indication of potential nonpoint source water quality impacts. Of greater importance are the actual effects of nonpoint source pollutants on specific receiving waters. Such an analysis can only be done by considering each water body individually.

Metro has used the phosphorus loadings in Table 6-5 to estimate the phosphorus loading to Lake Washington under future year 2000 conditions of increased urbanization (Figure 6-1). Because the population and land use projections used by Metro are similar to those used in this EIS, it can be assumed that the phosphorus loading increase shown in Figure 6-1 is similar to that which can be expected using the current PSCOG projections.

Water Quality Impacts of On-Site Systems. One possible significant impact of urbanization is nutrient impact to lakes from septic tank seepage. For example, Davis, et al. (1978) estimated that 14 percent of the annual phosphorus loading to Lake Meridian was from the 65 active septic tanks in the watershed, as compared to 3 percent from storm runoff and inlet flow, and 16 percent from nonstorm runoff and groundwater. Also, Metro is presently attempting to define the role of septic tank seepage in Pine Lake in a special lake restoration study.

Within the drainage of a particular lake, water quality trade-offs can exist at the time that sewering decisions are made. The potential for nutrient enrichment from septic tanks must be balanced with the potential for nutrient enrichment and sedimentation from the increased impervious acreage that would occur if sewers are installed.

A more detailed analysis of on-site system problems is presented in a later section of this chapter discussing secondary groundwater impacts. Mitigation measures for potential adverse water quality impacts caused by failing on-site systems are also discussed in the groundwater impacts section.

## Secondary Impacts on Aquatic Biology and Fisheries

Background. The inland lakes and streams of the study area are complex ecosystems that include a variety of freshwater and anadromous fishes, which are of economic, recreational, and cultural importance. Common anadromous fishes in the study area include coho salmon, red salmon, chum salmon, steelhead, and sea-run cutthroat trout.

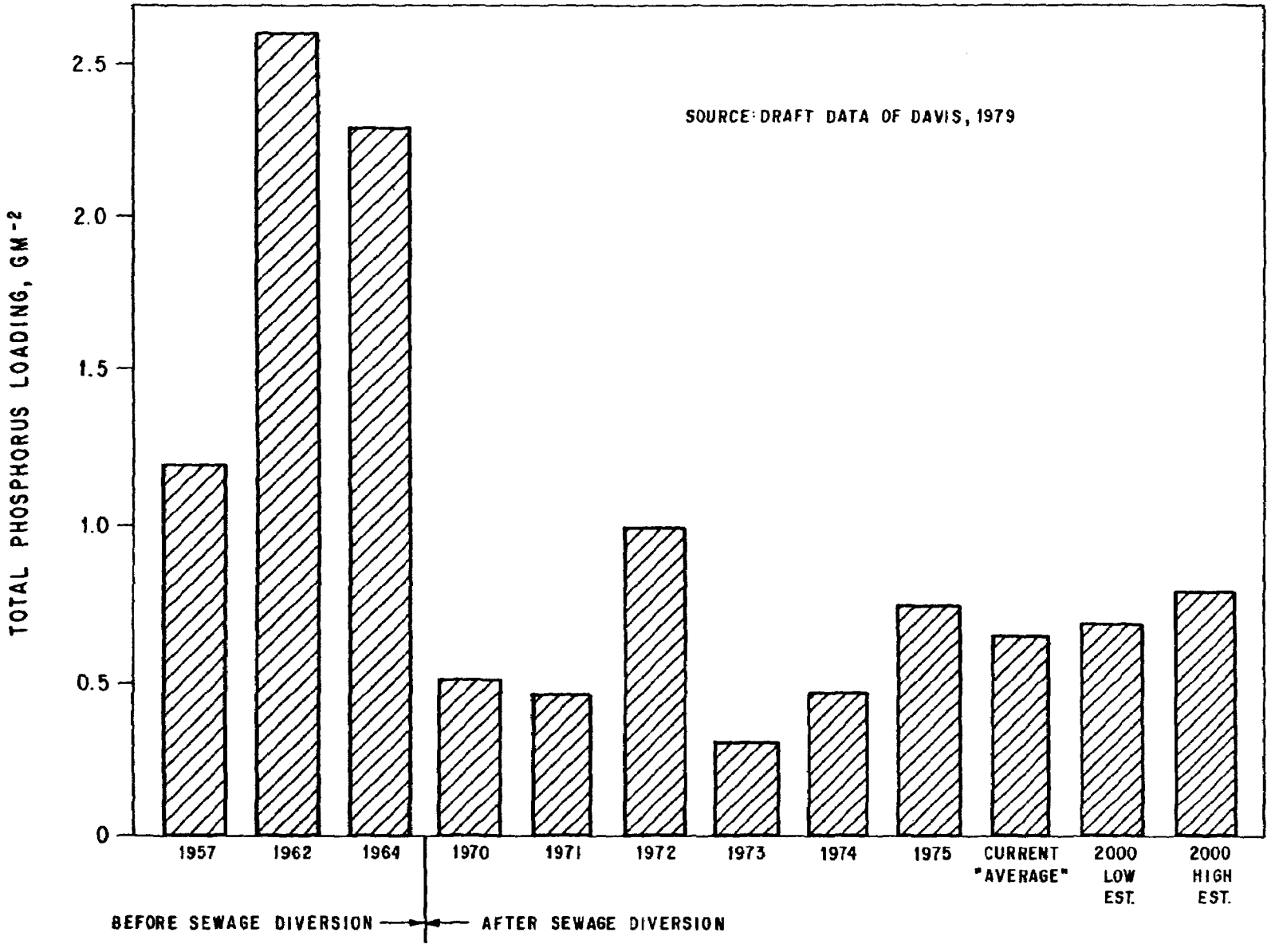



FIGURE 6-1. HISTORICAL, CURRENT & PROJECTED PHOSPHORUS LOADING TO LAKE WASHINGTON

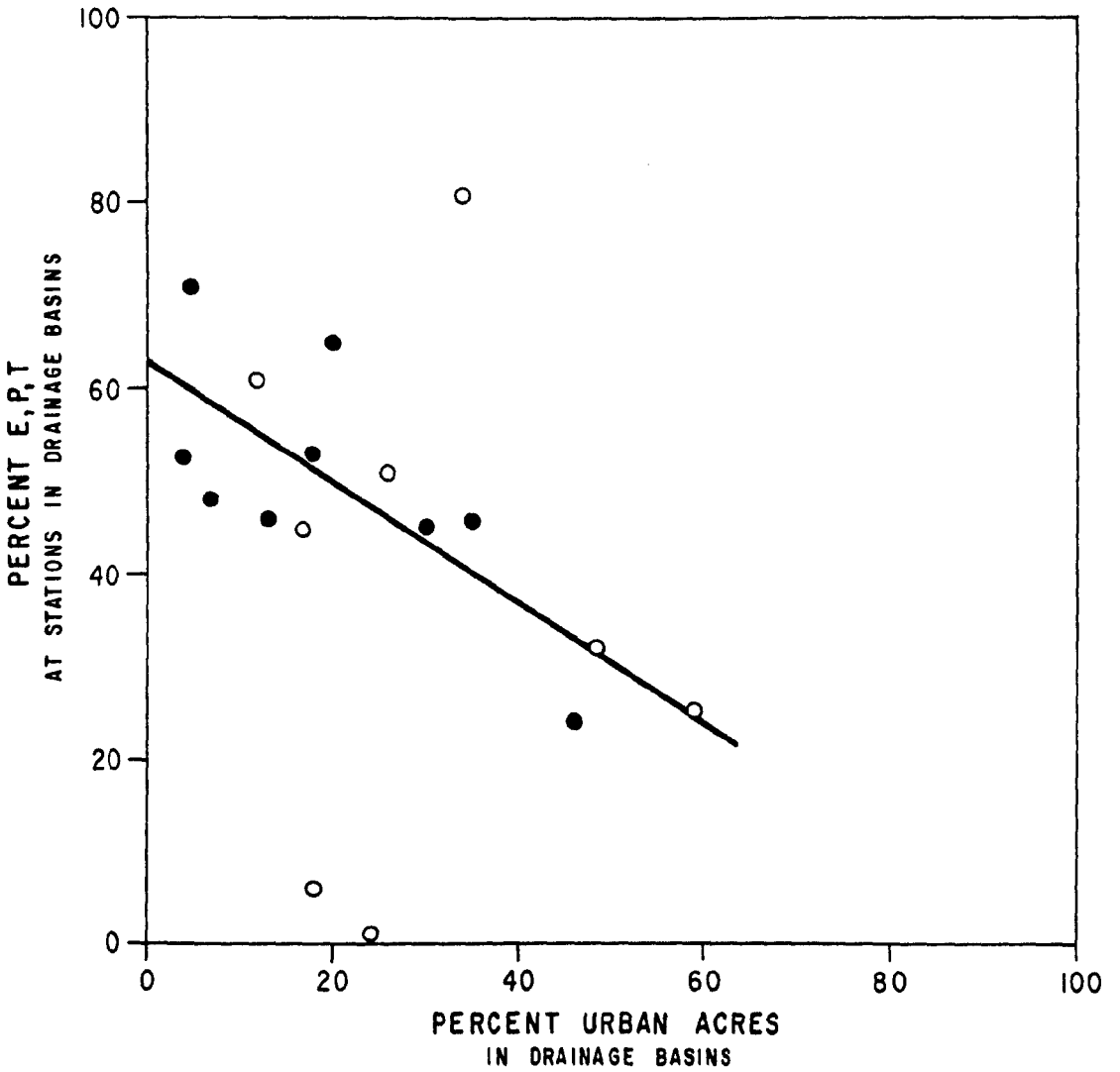
Streams. The following discussions describe expected effects of increased runoff or nonpoint source pollution loadings on stream flora, invertebrates, and fish.

*Flora*. Increased algal and aquatic plant growths in streams due to higher nutrient loadings may occur (this can be counteracted by the scouring effects of higher storm peaks). The most likely areas for increased plant growth would be backwater areas and the lower, slow-flowing reaches of streams. The effects of increased plant growths in streams could be adverse if biomass reaches levels that actually physically choke the stream or cause dissolved oxygen depletion, or if growth in rooted plants along stream margins slows stream flows, causing increased sedimentation. Moderate increases in plant growth could actually enhance invertebrate and fish production.

*Invertebrates*. The data plotted on Figure 6-2 illustrate how urbanization is affecting stream invertebrate communities in the study area. This figure shows the average "percent EPT" for stream invertebrate samples gathered in a subdrainage basin as a function of the percentage of the subdrainage basin that is urbanized. The percent EPT is the percent of stream invertebrates in a sample that belongs to the insect orders emphemeroptera (mayflies), plecoptera (stoneflies), or trichoptera (caddisflies). These insect groups are generally regarded as good fish food. Furthermore, these insect groups are relatively intolerant of sediment or organic pollution, as opposed to some forms of oligochaete worms and fly larvae. Thus, the percent EPT is a "living index" of physical and chemical stream quality.

Figure 6-2 is a scientific indication that urbanization is having adverse impacts on stream habitat quality in the study area. Sedimentation is probably the main factor causing this general decline. The study area as a whole is currently 19 percent urbanized, which would result in an average EPT index of 51 percent, according to the regression line. With the study area 28 percent urbanized in the year 2000 (projected in the PSCOG policy projection), the average EPT index would be reduced to 45 percent, which is a significant reduction.

*Fish*. The hydrologic, water quality, invertebrate community, and other changes accompanying urbanization will adversely affect stream salmonid (salmon and trout) populations through a variety of interacting pathways. Figure 6-3 illustrates some of these pathways. Increased runoff and soil erosion from urbanization can induce flooding, streambank erosion, scouring, stream channelization (a human response), sedimentation, and adverse effects on stream invertebrates and fishes. Among fishes, salmonids are particularly sensitive to sedimentation and scouring because they bury their eggs in stream gravels.




-LEGEND-

○ ≤ 3 SAMPLES/BASIN

● >3 SAMPLES/BASIN

—— $y = 62.9 - 0.65X$
$r = 0.71$
$r^2 = 0.50$
$p < 0.05$

NOTE: REGRESSION CALCULATIONS EXCLUDED BASINS WITH 3 OR FEWER SAMPLES.

FIGURE 6-2. RELATIONSHIP BETWEEN URBANIZATION AND CLEAN-WATER STREAM INSECTS (PERCENT Ephemeroptera, Plecoptera, Trichoptera) IN RENTON STUDY AREA.

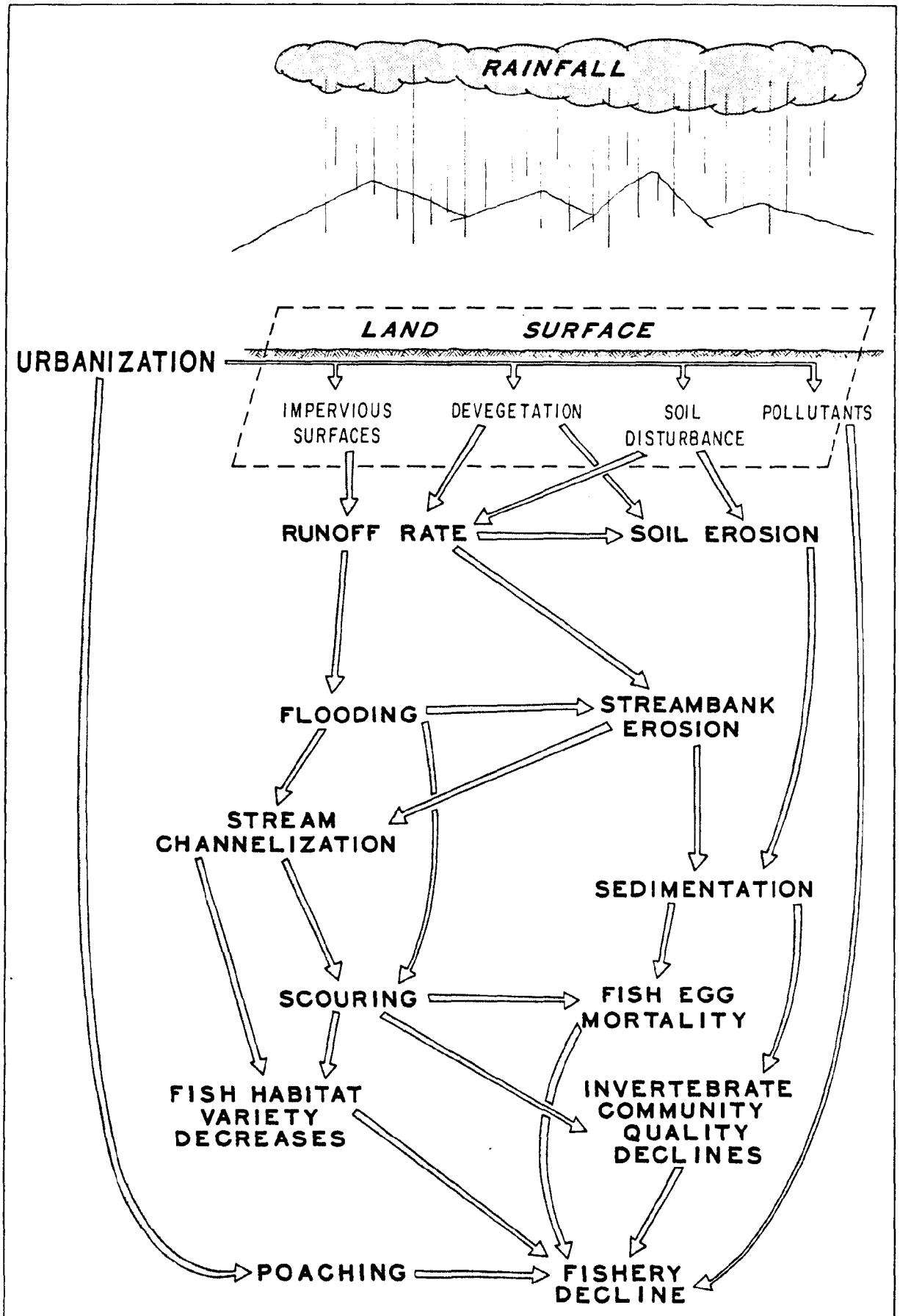



**FIGURE 6-3. URBANIZATION IMPACTS ON SALMONID FISHERY RESOURCES**

The relationship between the percentage urbanization of a subdrainage basin and the degree of overall aquatic habitat degradation in the basin's streams appears to be direct as suggested by Figure 6-2. Therefore, one way to analyze the impacts of future growth on fishery resources is to simply look at the increase in urban acres within subdrainage basins.

Table 6-6 shows the increase in urban acres between 1980 and 2000 for subdrainage basins within the study area, as projected in PSCOG's policy projection. Subdrainage basins with percentage increases in urban acres in excess of 40 percent (the study area average) are considered "high growth" for purposes of the EIS secondary impact analysis.

Of the subdrainage basins considered high growth, Mill Creek, Swamp Creek, and North Creek have the greatest potential for fishery declines due to urbanization because of their dramatic increases in urban acreage (greater than 50 percent increase in urban acres between 1980 and 2000). Evans Creek and the White River basin also show increases in urban acres of greater than 50 percent, but these percentage increases are misleading because the number of urban acres in 1980 is relatively small, and the basins will remain relatively unurbanized through the year 2000.

By the year 2000 Swamp Creek is projected to become 55 percent urbanized, North Creek is projected to become 46 percent urbanized, and Mill Creek is projected to become 40 percent urbanized; present levels of urbanization for these three basins are 35 percent, 30 percent, and 18 percent, respectively. As the level of urbanization exceeds 40 percent, natural reproduction contributing to the fisheries in the subdrainages could be totally lost; for example, Juanita Creek is presently 46 percent urbanized and its natural fishery has been essentially eliminated. Fishery losses due to urbanization will occur in other high growth subdrainage basins, but probably not to the extent of Swamp Creek, North Creek, and Mill Creek.

North Creek and Swamp Creek support primarily coho salmon; in 1976 there were about 2,200 spawners in North Creek and 1,700 spawners in Swamp Creek (Metro, 1978c). Numerical estimates are not available for Mill Creek. The coho runs in Swamp Creek and North Creek have a net economic value (1976 dollars) of about $102,000 annually, based on a catch/escapement ratio of 2.0; a commercial harvest/sport harvest ratio of 3.1; a commercial value of $4.88 per fish; and a sport value of $92.40 per fish (Miller, 1976).

Lakes. Population growth accommodated by expansion of Metro's wastewater facilities may affect study area lakes due to sedimentation and nutrient enrichment. Possible general effects on lake flora and fishes are reviewed below.

Table 6-6. Increase in Urban Acres by Subdrainage Basin, 1980-2000

| Major Basin / Subbasin | Estimated Total Acres | Urban Acres 1980 (percent) | Urban Acres 2000 (percent) | Additional Acres Urbanized 1980-2000 | Percent Increase in Urban Acres 1980-2000 |
|---|---|---|---|---|---|
| North Lake Washington | 149,645 | 14,086 (28) | 21,590 (43) | 7,504 | 53 |
| Swamp Creek* | 15,738 | 5,572 (35) | 8,668 (55) | 3,096 | 56 |
| North Creek* | 21,062 | 6,386 (30) | 9,808 (46) | 3,422 | 54 |
| Little Bear Creek* | 12,845 | 2,128 (17) | 3,114 (24) | 986 | 46 |
| North Lake Sammamish | 51,188 | 8,658 (17) | 12,233 (24) | 3,575 | 41 |
| Sammamish River | 11,738 | 3,534 (30) | 4,744 (41) | 1,210 | 34 |
| Evans Creek* | 31,533 | 4,111 (13) | 6,160 (20) | 2,049 | 50 |
| Pine Lake | 7,917 | 1,013 (13) | 1,329 (17) | 316 | 31 |
| East Lake Washington | 33,728 | 16,346 (48) | 19,702 (58) | 3,356 | 21 |
| Juanita Creek | 16,851 | 7,759 (46) | 9,612 (51) | 1,853 | 24 |
| Kelsey Creek | 4,973 | 2,922 (59) | 3,398 (68) | 476 | 16 |
| Coal Creek | 11,904 | 5,665 (48) | 6,692 (56) | 1,027 | 18 |
| South Lake Washington | 41,120 | 89,044 (22) | 11,165 (27) | 22,021 | 25 |
| May Creek | 10,669 | 2,744 (26) | 3,553 (33) | 809 | 29 |
| Cedar River | 30,451 | 6,200 (20) | 7,612 (25) | 1,412 | 23 |
| South Lake Sammamish | 51,104 | 5,896 (12) | 7,324 (14) | 1,428 | 24 |
| Tibbetts Creek | 9,165 | 3,145 (34) | 3,478 (38) | 330 | 11 |
| East Lake Sammamish | 4,736 | 724 (15) | 968 (20) | 244 | 34 |
| Issaquah Creek* | 37,203 | 2,009 (5) | 2,878 (8) | 869 | 43 |
| Green River Basin | 136,869 | 18,293 (13) | 28,681 (21) | 10,388 | 57 |
| Mill Creek* | 28,460 | 5,234 (18) | 11,310 (40) | 6,076 | 116 |
| Green River | 18,406 | 4,458 (24) | 5,888 (32) | 1,430 | 32 |
| Soos Creek* | 17,414 | 3,199 (18) | 4,613 (27) | 1,414 | 44 |
| Lake Young | 3,309 | 463 (14) | 563 (17) | 100 | 22 |
| Jenkins Creek | 12,160 | 1,524 (12) | 1,867 (15) | 343 | 23 |
| Covington Creek | 35,859 | 2,488 (7) | 3,172 (9) | 684 | 27 |
| Newaukum Creek | 21,261 | 927 (4) | 1,268 (6) | 341 | 37 |
| White River Basin* | 27,475 | 2,701 (10) | 4,940 (18) | 2,239 | 83 |
| Mercer Island | 4,109 | 2,560 (62) | 2,878 (70) | 318 | 12 |
| TOTAL | 395,238 | 77,484 (20) | 108,513 (27) | 31,029 | 40 |

*Denotes subdrainage basins with urban acre increase greater than 40 percent, considered "high growth" for purposes of secondary impact analysis.

*Flora*. Nutrient enrichment due to higher nutrient loadings may increase algal and aquatic plant standing crops. However, this may be offset in some locations by nutrient diversion due to sewering of septic tank areas; for example, nutrient concentrations in Lake Meridian decreased immediately following installation of sewers in 1973 (Davis, et al., 1978). Future nutrient loadings will depend on the degree of urbanization and sewering decisions. Excessive algal and plant growth would have adverse impacts on recreation (swimming, boating, waterskiing) and aesthetics.

*Fish*. The impacts of additional algal or aquatic plant growth on fish depend on the degree of such growth. Moderate algal or plant growth could increase lake fish productivity by providing more energy at the base of the food web. Also, aquatic plants provide small fish protection from predators. If aquatic plant or algal growth results in dissolved oxygen levels below approximately 6 mg/l in the deep portions of lakes then the value of the lake as fish habitat would decrease.

## Mitigation Measures for Water Quality and Fisheries Impacts

The preceding analysis has attempted to identify the streams in which fisheries will be most affected. Inaccuracies undoubtedly exist due to the uncertainty associated with PSCOG's land use projections, and the imperfect nature of the correlation between urbanization, water quality impairment, and habitat degradation. The important point is that water quality impairment and anadromous fish losses are occurring due to urbanization and could continue to occur in the future.

Metro and other local agencies are conscious of this problem and have initiated steps to mitigate it. As Figure 6-3 shows, the key to mitigating fishery losses, as well as mitigating flooding, streambank erosion, and sedimentation problems caused by urbanization, lies in controlling runoff rates and soil erosion. Consequently, these problems have been addressed comprehensively in drainage planning studies, in particular the RIBCO drainage studies, Metro's 208 plan, and local drainage planning.

RIBCO Studies. The 1974 RIBCO studies (STR, 1974a; U. S. Army Corps of Engineers, 1974) identified present and future water quality and drainage problem areas in the Cedar and Green River basins, and proposed institutional and structural solutions. Alternative solution plans were prepared for each subdrainage basin. The RIBCO studies recommended that coordinated drainage management programs be worked out among the various jurisdictions in each subdrainage. Recommended RIBCO policies call for retention of the natural open drainage system, wetlands protection, and floodplain zoning, with local government being responsible for detailed facilities planning.

Metro 208 Plan. The RIBCO studies were followed by Metro's 208 areawide water quality planning. As the designated 208 agency for the Cedar-Green River basins, Metro is responsible for areawide water quality management planning, partially funded by EPA under the Clean Water Act. The Metro 208 plan's primary objective is the development of adequate surface drainage control programs. The plan reiterated RIBCO's emphasis on developing cooperative local government agreements for drainage control in each basin.

Progress in implementing the 208 plan, as of June 1980, has been summarized by Metro (1980i). Metro reports that roughly two-thirds of the assigned local responsibilities are either completed or in progress. Significant local actions have included: 1) completion of a Union Bay demonstration project by Seattle, King County and Metro; 2) adoption of a Surface Water Master Plan and a revised clearing grading ordinance by Bellevue; 3) approval by Bellevue voters of an advisory ballot issue representing a strong local commitment for purchase of wetlands and open space; 4) development of a draft Drainage Management Plan by Seattle; and 5) development of options for a coordinated surface water management program by King County staff. Metro has also made substantial progress in developing an agressive water quality planning and management approach.

Areas of least accomplishment by local jurisdictions reported by Metro are 1) development and implementation of local water quality enforcement programs; 2) development of water quality expertise in local staff as part of the ordinance process; 3) funding for surface water programs; and 4) implementation of best management practices for nonpoint source pollution control.

Of course, even full implementation of 208 plan recommendations would not completely eliminate nonpoint source impacts. Also, not all jurisdictions are moving forward to implementation as quickly as was hoped. For example, although creation of a surface runoff utility for King County was identified in the 208 plan as an important method to control runoff from urbanization, such a utility has yet to be created, due to budgetary and other constraints.

Local Plans and Policies. The Juanita Creek Basin Plan (King County, 1977), the Green River Basin Program, and the City of Bellevue comprehensive drainage plan are examples of more local drainage basin planning for solution of drainage problems. However, in many of the subdrainage basins projected for large increases in urban acres, local drainage planning has not been undertaken.

King County has proposd many policies relating to drainage in its General Development Guide (first draft). Among these are:

- Controls on development adjacent to water bodies
- Maintenance of natural watercourses
- Preservation of wetlands

Shoreline Management Act. Another possible means of protecting water quality and fisheries from effects of urbanization is the Shoreline Management Act of 1971. Implementation depends greatly on local formulation and implementation of shoreline management plans.

Summary. In summary, several institutional mechanisms are currently in place to address fisheries and other drainage-related impacts caused by urbanization. Although these programs are not comprehensive and their success cannot be assumed, EPA is providing funding for 208 continuing planning. Additional mitigation measures other than continued funding for 208 planning do not appear appropriate at this time as part of this EIS.

### Secondary Impacts on Terrestrial Ecosystems

The principal secondary impact of growth on terrestrial ecosystems will be conversion of coniferous and deciduous forests, and agricultural and rangelands, to urban uses. Secondary impacts on agricultural and forestlands, wetlands, and floodplains are discussed later in this chapter under secondary land use impacts.

It can generally be stated that urban development has adverse effects on natural terrestrial ecosystems, primarily through destruction or extensive modification of habitat. Given the regional nature of the growth projections examined in this EIS, it is not reasonable to further assess the impacts of urbanization on terrestrial wildlife and ecosystems, largely because these differ with different urban land uses. In general, industrial and commercial land uses have substantially less value to wildlife than low density residential uses. The degree of impact on wildlife depends on mitigation measures implemented as part of site planning, particularly retention of tracts or corridors of open space. No new mitigation measures for secondary impacts on terrestrial ecosystems are proposed as part of this EIS.

## Secondary Groundwater Impacts

### Background

A substantial proportion of the population growth projected for the Lake Washington/Green River Basins will rely on on-site systems as a long-term waste disposal option. For the year 2000, PSCOG projects the unsewered population within the study area to be 124,078.

Treatment Capability of Local Soils. Most of the soils in the Renton study area have moderate to severe limitations for use as septic tank leach fields. In particular, the Alderwood and Beausite soil series which cover most of the nonsewer area have severe limitations due to shallow depth and an extremely slow permeability in the subsoil. Everett soil series have moderate limitations due to the extremely high permeability of the entire soil profile. Additional data on soil limitation ratings for septic tank leach fields are presented in Appendix D.

Major Contaminants of Concern. The contaminants of concern with respect to domestic on-site disposal systems consist of those elements that can degrade the quality of surface or groundwater resources, thereby creating direct and indirect health hazards to human beings relying on such sources of supply. These contaminants consist of nitrogen compounds and pathogens. If effluent from on-site systems enters surface water bodies, other elements such as phosphorus may also create water quality problems.

## Assessment of Impacts

Analysis of Septic Tank Failure Data. Individual septic tanks/soil absorption systems operate at a high failure rate in the Renton study area. The King County Health Department estimates that between 5 and 10 percent of such systems may be experiencing failure at any one time. Failures result from the often unfavorable site conditions, inadequate design of the system, poor quality construction, and lack of regular maintenance. Two social causes may also contribute significantly to these problems. First, the traditional view toward on-site systems is that they are temporary solutions for the waste disposal problem. Thus, until recently, there was little motivation to spend more than the minimum amount of resources in design and construction of on-site units. Second, because septic tanks are low visibility, they are often ignored by the homeowner, who may not even be aware of septic tank and drain field locations.

A small survey of home loan certification forms in King County found that 36 out of 92 systems surveyed (40 percent) were either failing or showed signs of a potential failure (Metro, 1980g). Common problems found included:

- Construction of driveways, garages, patios, decks, or other structures over the drain field;
- Diversion of surface water runoff to the drain field area;
- Compaction of the drain field by parking cars over the field or pasturing of animals on the field;

- Irregular or nonexistent septage pumping and provision of other maintenance.

In addition, when no reserve drain field area is available, repair of a failing system becomes extremely difficult. New regulations of the Seattle/King County Health Department require a reserve drain field area of either 50 or 100 percent, depending upon the system's location.

When on-site systems fail and effluent surfaces, potential risks to public health are created. In addition, the septic tank effluent can cause nutrient enrichment problems if it reaches streams and lakes. A less visible, but equally serious impact, can result if septic tank effluent reaches groundwater. Risks to groundwater from on-site systems in the study area are reviewed below.

Risks to Groundwater. "Groundwater failure" occurs when inadequately treated effluent reaches groundwater bodies. Groundwater failure may result from drain field installation on excessively permeable material offering inadequate biochemical renovation capability, or where effluent is discharged directly into a shallow water table, receiving inadequate treatment due to the saturated conditions. Phosphorus, bacteria, and viruses are known to migrate over long distances under conditions of saturated flow.

Groundwater failure of an individual septic tank system can affect the quality of water pumped from a shallow downgradient well, depending on the distance between the site and the well, and on the local aquifer's hydraulic conditions. On a broader scale, groundwater failure can seriously pollute a regional aquifer if many systems are installed on excessively sandy or gravelly material; this type of hazard results from system design and site selection. Because it is extremely difficult to locate, document or evaluate groundwater failure, only recently have regulatory agencies recognized such failure as a pollution hazard.

Although accurate estimates of pollutant loadings to groundwater aquifers cannot be developed at this time due to the lack of data on distribution pattern and density of on-site disposal systems in nonsewered portions of the study area, rough estimates are possible. It is generally agreed that there are 65,000 septic tanks currently in use in the study area. If it is assumed that average household size is 2.7 people per dwelling and total annual wastewater flow and nitrogen emissions in the study area can be calculated as follows:

annual effluent discharge = 13,000 acre-feet
estimated nitrogen concentration = 40 mg/l
annual nitrogen load = 700 tons

These areawide loading data may exaggerate the importance of groundwater quality impacts, because on-site systems may be widely scattered and not all the effluent discharged from these systems reaches the groundwater body. More importantly, the loading from the on-site systems is diluted by natural recharge and by mixing with large volumes of high quality groundwater.

On a local basis, however, emissions from even a few on-site disposal systems could be a major concern for protecting the quality of existing water supplies. Thousands of shallow domestic wells are in use in the Renton study area. Unfortunately, data are generally not available on the chemical characteristics of water pumped from these wells. Data that are available generally do not indicate contamination of groundwater from on-site systems, with the possible exception of nitrate, which tends to be of greater concentration in shallow, unconfined aquifers than in deeper, more confined aquifers; observed nitrate levels in shallow wells are, however, well below drinking water standards.

Generally, under optimal conditions, shallow wells drilled in Vashon till would have relatively little risk of groundwater failure. If drain fields are installed at high densities, or if inadequate distance is allowed between drain fields and water supply wells, groundwater contamination would result even in the Vashon till. For wells constructed in recessional outwash and other highly permeable deposits, the risk of groundwater contamination from on-site disposal systems increases significantly, even though no evidence of surface failure of septic tank drain fields may be detected.

## Mitigation Measures for On-Site Systems

Metro-proposed Measures. In its Draft Wastewater Management Plan, Metro has proposed the following recommendations for on-site systems management in the nonsewer area:

- Establish a comprehensive program for design, construction, and maintenance of on-site and community systems.
    - Identify an areawide management agency and implement a program demonstrating long-term commitment to management of nonsewer areas.
    - Establish on-site management zones in nonsewer areas where system performance or soil condition is poor.
    - Establish a routine performance monitoring system.
    - Further strengthen existing rules and regulations to emphasize proper design and construction.

- Provide adequate staffing and funding for on-site wastewater management programs, and provide adequate enforcement of rules and regulations.

- Encourage experimentation with alternative technologies.

- Establish a public education program emphasizing the long-term nature of on-site systems and proper design, construction, and maintenance.

Determine Groundwater Carrying Capacity. The emphasis in the Metro recommendations is on solving the problems created by poorly functioning or failing on-site disposal systems, in the context of traditionally accepted definition of septic tank failure. Attention should also be directed to the groundwater impacts of such systems, even where apparent system failure, such as surfacing of wastewater, may not have been observed. In the context of this objective, it is recommended that the following additional measures be undertaken to: 1) determine groundwater quality impacts of on-site disposal systems, and 2) evaluate the carrying capacity of various hydrologic or drainage units:

- Selected shallow domestic water supply wells in areas of the Alderwood soil series on Vashon till deposit should be monitored. These wells should be selected in subareas with low, medium, and high densities of on-site disposal systems. (Details of a proposed monitoring program are given in Appendix D of the EIS.)

- A similar groundwater monitoring program should be carried out in areas of the Alderwood soil series on alluvial deposits and Everett soil series on recessional outwash deposits for zones of low, medium, and high septic tank densities.

- If the results of the shallow domestic well monitoring programs indicate the occurrence of groundwater contamination, the density of the monitoring network should be increased and wells of medium and high depth should also be included in the sampling program.

- Results of the monitoring program should be used to identify areas of potential groundwater contamination in the study area.

- Data on groundwater carrying capacity of hydrologic units or drainage basins should be developed prior to establishing allowable development density levels in nonsewer areas. The carrying capacity can be determined on the basis of geologic, hydrologic, and aquifer hydraulic conditions.

EPA Role. EPA encourages the implementation of the previously-listed mitigation measures for on-site system management. Without such improved management, groundwater or surface water quality problems may result from continued use of these systems in the nonsewer portion of the study area.

The main responsibility for implementing improvements on on-site system management rests with local land use and health agencies; nonetheless, Metro has the responsibility for water quality management in the nonsewer areas. As an additional mitigation measure for this EIS, EPA could request, or require as a grant condition, that Metro and the appropriate local agencies enter into an agreement to cooperatively coordinate on-site systems management and water quality management in the nonsewer areas. This agreement, at a minimum, could be an agreement to implement the triggering mechanism proposals for nonsewer areas (see Chapter 3).

## Secondary Land Use Impacts

Study area population growth will be accompanied by changes in land use patterns within the study area. This section assesses three land use impacts of special importance to EPA: the consistency of Metro's proposed service area with local plans and policies, the conversion of prime farmland to urban uses, and the impacts of development on environmentally sensitive areas.

### Consistency of the Metro Service Area with Local Land Use Policies

EPA requires that wastewater facilities plans be consistent with applicable land use plans and policies. The major aspect of Metro's facilities planning with land use implications, aside from the population and land use projections, is the service area map.

Metro's service area map (Figure 3-1) delineates three categories of land within the study area: the sewer service area, the nonsewer area (long-term land use certain), and the nonsewer area (long-term land use uncertain). The sewer service area consists of those lands which known local land use policies suggest should be sewered; King County's Sewerage General Plan, which is not a 20-year plan but is subject to periodic amendment, provided the major basis for mapping of service areas within King County. The nonsewer area (long-term land use certain), consists of those lands which local policies suggest should not be sewered over the 20-year planning period; these lands consist of small pockets of agricultural land

in unincorporated King County and Redmond. The nonsewer service area (long-term land use uncertain) consists of lands for which there is no present land use policy guidance; these lands are treated as nonsewer lands in the Metro Wastewater Management Plan, and would be included within the sewer service area once local governments designate these lands for sewer service. Therefore, the 20-year service area for the Renton sewerage system is likely to be larger than that shown on Figure 3-1, since it is likely that additional lands will be designated for sewer service by local governments within the next 20 years.

Metro's intent is to show as a designated sewer service area only those areas which local policies dictate should be sewered. The service area map appearing in Metro's preliminary plan was assessed for potential inconsistencies with local policies by the consulting firm Kahn/Mortimer Associates as part of the EIS effort. As a result of that assessment (which appears in full in Appendix A of the EIS) revisions were made to produce the service area map appearing in the Draft Wastewater Management Plan. It appears that the revised service area map appearing in the Draft Wastewater Management Plan is now consistent with known land use plans and policies of local jurisdictions. The review process of the draft plan and EIS provides an opportunity for identifying any remaining inconsistencies.

## Prime Farmland Conversion

Background. An important issue in this EIS is the effect of growth projected for the study area on prime farmlands. This background section summarizes the following topics: definitions of agricultural lands, rationale for protection of agricultural lands, agricultural land resources within King County, the economics of agriculture in King County, and existing King County policies for agricultural land protection. Further background information on agriculture in King County may be found in Appendix A of the EIS.

*Definition of Agricultural Lands*. The terms prime farmland, cropland, and important farmland are important to distinguish for purposes of this analysis. The following definitions will be used:

> Prime farmland: Land suitable for farming or silviculture with "soil quality, growing season, and moisture supply needed to economically produce sustained high yields of crops when treated and managed, including water management, according to acceptable farming methods" (Lee, 1978). Prime farmlands are the "most efficient, energy conserving, environmentally stable lands available for meeting food needs" (CEQ, 1978).

Cropland: Land in cropland use. Not all cropland is prime farmland.

Important farmland: Important farmland is that farmland being mapped by the SCS under its current (LIM-3) mapping program. It consists of the following categories: prime farmland, unique farmland (additional farmland used for the production of specific high value crops), additional farmland of statewide importance (to be determined by state agencies), and additional farmland of local importance (where appropriate, to be determined by local agencies).

*Rationale for Protection of Agricultural Lands*. Between 1967 and 1975, about one million acres of prime farmland in the United States were converted to nonfarm use (Diderikson, 1977). This amounts to a loss of more than 3 square miles of farmland per day. The conversion of prime farmland to urban uses is essentially an irreversible change. National policies to slow the conversion of prime farmland have been developed for several reasons:

- It is increasingly important to preserve those lands best able to produce crops because the rate of farm productivity growth has been decreasing and export demands are increasing.
- Farmland preservation provides open space, aesthetic, and environmental benefits.
- In some areas, consumers benefit from lower food prices when commodities are produced locally.

Due to these factors, EPA in 1978 established an agency-wide policy to assure that its actions, regulations, and programs reinforce the retention of environmentally-significant agricultural land (EPA, 1978a).

*Agricultural Land Resources Within King County*. Agriculture played an important role in the history of King County, in that early settlers were attracted to the county's agricultural potential and accessibility to markets. Urbanization of the county since 1950, and development of irrigated agriculture in eastern Washington, have reduced the importance of King County agriculture to the local, state, and national economies. Nevertheless, preservation of remaining prime farmland in King County is important for the economic and environmental reasons listed previously.

The SCS has recently completed its inventory of important agricultural lands in King County. These lands are mapped in Figure 6-4. The prime farmlands shown on this map consist of Class II and Class III soils. The additional farmland of statewide importance shown on this map consists of certain

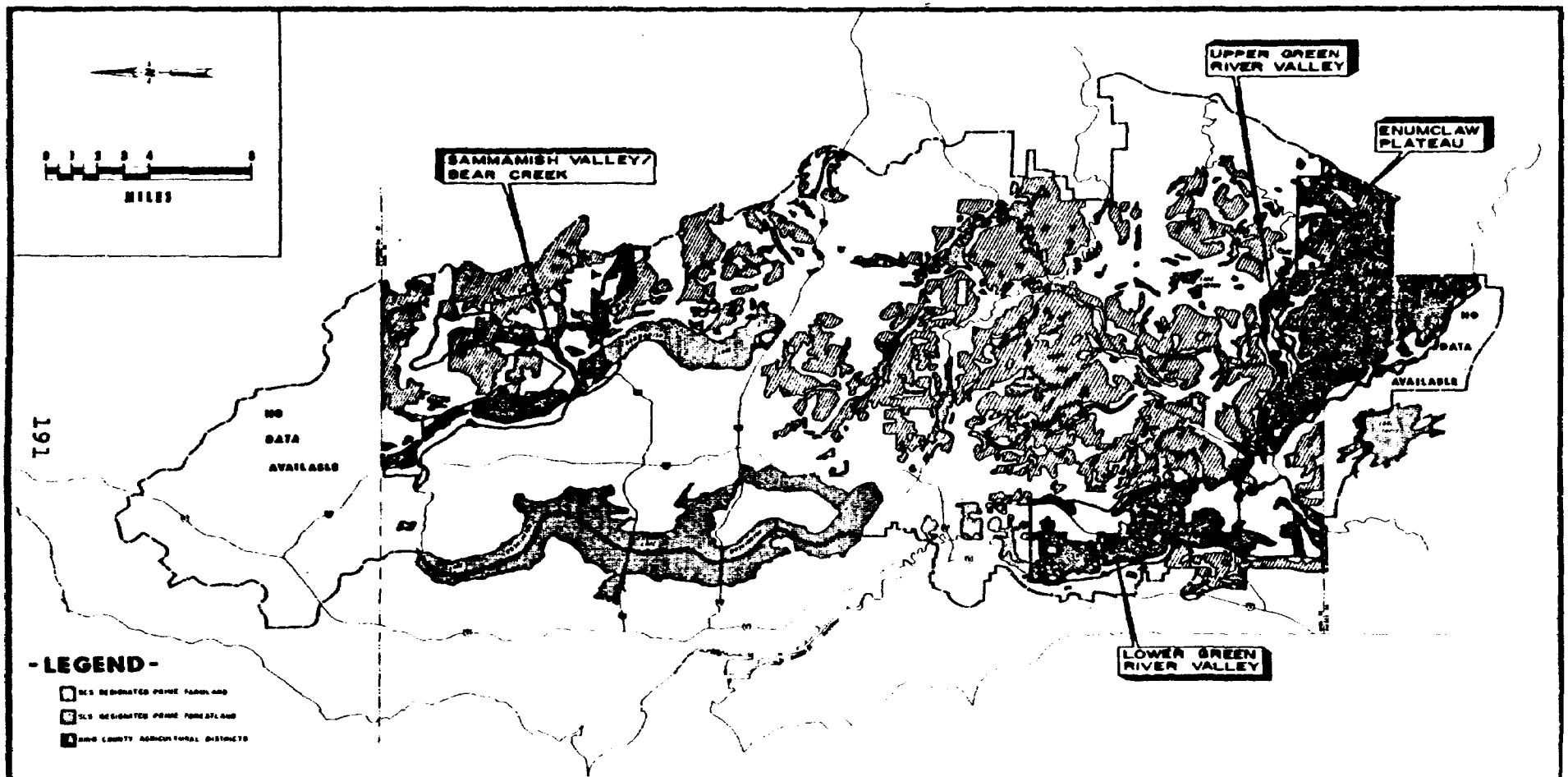



FIGURE 6-4. MAP OF SCS IMPORTANT FARMLANDS & OF KING COUNTY AGRICULTURAL DISTRICTS

Class IV soils considered to be prime forestland. The SCS map of important farmlands must be used with caution for planning purposes, because development has occurred on some of the lands designated as important farmlands (King County Office of Agriculture, pers. comm.).

King County Ordinance 3064, adopted in 1977, establishes eight agricultural districts (areas where agricultural activities are concentrated) and designates certain lands to be agricultural lands of county significance. Agricultural lands of county significance are defined by Ordinance 3064 to include: 1) unincorporated lands with Class II, III and (under some circumstances) IV soils, 2) lands not in wooded or urban uses, 3) lands where urban-level water or sewer lines are not in place, and 4) lands with contiguous parcels greater than 20 acres.

Four King County agricultural districts are located within the Lake Washington/Green River Basins. (See Figure 6-4.) These are Sammamish Valley/Bear Creek, Lower Green River Valley, Upper Green River Valley, and Enumclaw Plateau. These four districts cover 70,635 acres (65 percent of the land in agricultural districts) and contain 22,475 acres of agricultural lands of county significance (69 percent of the lands so designated).

*Economics of Agriculture in King County*. King County gross farm receipts increased from $20.5 million in 1959 to $40.5 million in 1974. When accounting for inflation, real increases in farm sales amounted to about 17 percent (John M. Sanger Associates, 1978). Farm income in 1978 for King County is estimated at $50-55 million. The 270 commercial farms in King County account for 92 percent of this farm income (John M. Sanger Associates, 1978).

Dairy products have been and continue to be the single largest sector of King County agriculture, accounting for 46 percent of the county's gross farm receipts in 1974. Other important sectors are ornamental horticulture (20 percent), poultry and poultry products (16 percent), cattle and calves (9 percent), vegetable and berries (6 percent), and other livestock (3 percent).

In 1974, agricultural employment within King County was estimated to be about 2,300 full-time equivalent jobs (John M. Sanger Associates, 1978). The actual number of farm job positions is considerably higher (about 5,600 during peak months) due to part-time and seasonal help.

From an employment perspective, King County agriculture is generally not considered to be economically significant to either the regional or the local economies of King County; agricultural employment is less than 1 percent of the total employment of the King-Snohomish-Pierce Counties region. However, local agriculture does result in consumer savings for consumers who purchase products at farm stands or farmers markets, or who pick these crops themselves.

*Existing Policies for Agricultural Land Preservation in King County.* King County has sought to preserve its agricultural land through a series of increasingly stronger policies and programs. These include policies in the King County Comprehensive Plan and communities plans, agricultural policies adopted in 1972 and 1974 (Ordinances 1096 and 1839), policies establishing agricultural districts and agricultural lands of county significance adopted in 1977, and policies limiting the sewering of significant agricultural lands found in the county's Sewerage General Plan (under revision as of early summer 1980). The latter policies have been adopted by Metro as well.

The main agricultural land preservation program currently in effect in King County is the purchase of development rights (PDR) program (Ordinance 4341). Under this program, a $50 million bond issue has been approved to acquire the voluntarily-offered development rights for priority farmlands. The PDR program, as well as the policies listed above, are reviewed further in the following discussion of mitigation measures for prime farmland conversion.

Assessment of Impacts. To assess the impacts of the growth projected for the study area on prime farmland conversion, a prime farmland conversion forecast was prepared.

*Methods.* Although the SCS mapped "important farmlands" (Figure 6-4) consist of both prime farmland and prime forestland, the EIS forecast of agricultural land conversion considers prime farmland only; it should be noted, however, that conversion of forestland to urban uses in western Washington is also an issue of economic and environmental concern. Also, the EIS forecast does not consider agricultural land conversion within the Enumclaw Plateau, since little urban growth is projected for this region.

The forecasting method employed assumes that within each of the remaining three agricultural districts within the study area (Sammamish Valley, Lower Green River Valley, Upper Green River Valley), prime farmland will be converted to urban uses at the same rate that suitable vacant land will be converted to urban uses; the vacant land conversion rates were in turn calculated based on PSCOG land use projections for AAM districts. Low conversion and high conversion scenarios were developed to establish a forecast range. The low conversion scenario uses the PSCOG policy land use projection, and assumes that agricultural lands of county significance will be protected. The high conversion scenario uses the PSCOG trends land use projection, and also assumes that county significant lands will be converted at the same rate as noncounty significant prime farmlands.

*Results and Discussion*. Table 6-7 presents forecasts of conversion of prime farmland between 1980 and 2000. The total prime farmland converted ranges between 3,950 acres (low scenario) and 5,213 acres (high scenario) over the 20-year period, representing a loss of 21 percent to 27 percent of the remaining prime farmland in the three districts. In the Sammamish Valley district, forecast conversions range from 698 acres to 1,464 acres; in the Lower Green River Valley district, from 3,252 acres to 3,600 acres; and in the Upper Green River Valley district, from 0 acres to 149 acres.

These findings must be qualified by the limitations of the forecasting methods employed. These include the assumptions that prime farmland will be converted at the same rate as suitable vacant land; the exclusion of hobby farms and vacant land held for speculation from the conversion forecast; and the lack of an up-to-date statistical inventory of prime farmlands.

Several factors will influence whether the low conversion scenario or the high conversion scenario is more likely to occur. These include the county's PDR program, the King County Sewerage General Plan process, urbanization trends, and existing zoning constraints.

Of these factors, the success of the PDR program is perhaps the most critical. As shown in Table 6-7, lands eligible for Priority 1 of the PDR program include all the prime farmland in the Upper Green River Valley, about 36 percent of the prime farmland in the Sammamish Valley, and only 10 percent of the prime farmland in the Lower Green River Valley. Therefore, if the development rights of 100 percent of the Priority 1 lands were to be purchased by King County in all three districts, prime farmland in the Upper Green River Valley district would be completely protected, whereas most prime farmlands in the Sammamish Valley and the Lower Green River Valley districts would not be protected.

Prime farmland conversion will have environmental and economic impacts which will depend largely on the size and productivity of the prime farmland parcels converted. Under either scenario, much of the acreage converted is prime farmland that is not of county significance and not included in Priority 1 of the PDR program. Although some of the non-county significant and non-Priority 1 prime farmland is productive land within municipal boundaries, much of it is of limited productivity because it is in small parcel sizes, or not being actively farmed. Conversion of these noncounty significant and non-Priority 1 prime farmlands, nevertheless, represents the irreversible loss of a nonrenewable resource.

Table 6-7. Forecast of Prime Farmland Conversion*

| Item | Agricultural Districts | | | |
|---|---|---|---|---|
| | Sammamish Valley | Lower Green River Valley | Upper Green River Valley | Study Area Total |
| Total acres | 11,535 | 18,840 | 2,965 | 33,340 |
| Prime acres | 6,100 | 12,000 | 865 | 18,965 |
| Agricultural land of county significance (acres) | 1,735 | 1,510 | 865 | 4,110 |
| Land eligible for priority 1 of PDR program (acres) | 2,193 | 1,518 | 2,180 | 5,891 |
| Vacant land conversion rate, 1980-2000 (policy) | 16% | 31% | 6% | - |
| Vacant land conversion rate, 1980-2000 (trend) | 24% | 30% | 17% | - |
| Prime farmland conversion, 1980-2000 (low forecast) | | | | |
| - acres | 698 | 3,252 | 0 | 3,950 |
| - % of total prime farmland | 11 | 27 | 0 | 21 |
| Prime farmland conversion, 1980-2000 (high forecast) | | | | |
| - acres | 1,464 | 3,600 | 149 | 5,213 |
| - % of total prime farmland | 24 | 30 | 17 | 27 |

*Excludes Enumclaw Plateau.

Mitigation Measures for Prime Farmland Conversion.

*Overview of Types of Mitigation Measures.* Measures to mitigate the loss of agricultural lands to urban uses have been comprehensively reviewed in a recent EPA (1979b) EIS for wastewater facilities improvements in Modesto, California, located in the highly-productive San Joaquin Valley. Table 6-8 lists and evaluates the mitigation measures developed for that EIS.

*Mitigation Measures for Metro Wastewater Management Plan.* Of the general types of mitigation measures shown in Table 6-8 several are already in place in King County. For purposes of this EIS, the most important of these include the PDR program, King County's Sewerage General Plan, and Metro Resolution 3380 adopting the Sewerage General Plan. The effectiveness of these measures in mitigating the conversion of prime farmland is assessed below, and additional mitigation measures are then identified.

*PDR Program.* The PDR program has established three priority levels for acquisition of development rights. The first priority consists of 6,000 acres of lands most threatened by urban development in the Sammamish River Valley, the Lower Green River Valley near Kent, and the Upper Green River Valley, and 1,700 acres of farmland producing food for human consumption. The second priority consists of farmlands in the lower Snoqualmie Valley and Enumclaw Plateau, mostly dairy farms. The third priority consists of all other farmlands located within the county's agricultural districts.

Although it is not possible to predict exactly how much acreage that will be protected by the PDR program, the PDR program cannot offer complete protection for prime farmlands threatened by development because: 1) some landowners will refuse to participate in the program, and 2) the initially authorized $50 million is inadequate to purchase development rights for the third priority lands which constitute most of the prime farmland within the study area. As of late 1980, the initial $50 million in bonds had not been sold due to litigation. Though the possibility exists that more funds will be authorized, the PDR program can be considered only a partial mitigation measure for the loss of prime farmland within the study area, since it is unlikely that development rights for the third priority lands will be purchased.

*King County Sewerage General Plan.* As initially adopted, the King County Sewerage General Plan excluded designated agricultural lands of county significance as defined in Ordinance 3064 from local service areas, thereby prohibiting the sewering of these lands. A proposed amendment to the county's Sewerage General Plan (which has been adopted by Metro - see below), establishes the Priority 1 lands in the

Table 6-8.

## PRIME AGRICULTURAL LAND MITIGATION MATRIX

| | MEASURE PROPOSED | IMPLEMENTATION | | | TYPE OF MEASURE[1] | | ORIENTATION | | APPROACH | | WHEN IMPLEMENTABLE[2] | | LIKELY EFFECTIVENESS | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | LOCAL | STATE | FEDERAL | REGULATION | INCENTIVE | URBAN | AGRICULTURAL | DIRECT | INDIRECT | SHORT RUN | LONG RUN | STRONG | SLIGHT | UNKNOWN |
| A | *Affect the amount of urban development* | | | | | | | | | | | | | | |
| 1 | Limit the amount of land zoned for urban development | ● | | | ● | | ● | | ● | | ● | | ● | | |
| 2 | Limit number of building permits issued | ● | | | ● | | ● | | ● | | ● | | | | ● |
| 3 | Limit industrial growth generators | ● | | | ● | | ● | | | ● | ● | | | | ● |
| B | *Affect the density of development* | | | | | | | | | | | | | | |
| 1 | Low minimum lot sizes in urban areas | ● | | | | ● | ● | | ● | | ● | | | | ● |
| 2 | High minimum lot sizes in rural areas | ● | | | ● | | | ● | ● | | ● | | ● | | |
| 3 | Maximum lot sizes in urban areas | ● | | | ● | | ● | | ● | | ● | | ● | | |
| 4 | Minimum neighborhood densities in urban areas | ● | | | ● | | ● | | ● | | ● | | ● | | |
| 5 | Infill development in urban areas | ● | | | ● | ● | ● | | ● | | ● | | ● | | |
| 6 | Cluster development in urban areas | ● | | | | ● | ● | | ● | | ● | | | | ● |
| 7 | Cluster development in rural areas | ● | | | ● | | | ● | ● | | ● | | | ● | |
| C | *Affect the location of urban development: control urban locations* | | | | | | | | | | | | | | |
| 1 | Growth on or toward non-prime lands | ● | | | ● | | ● | | ● | | ● | | | | ● |
| 2 | Prohibition of subdivision on unincorporated lands | ● | | | ● | | ● | | ● | | ● | | ● | | |
| 3 | Eligibility for housing programs | | ● | ● | ● | ● | ● | | | ● | | ● | | | ● |
| 4 | Eligibility for community development/redevelopment aid | | ● | ● | ● | ● | ● | | | ● | | ● | | | ● |
| 5 | New towns or satellite towns | | ● | ● | | ● | ● | | | ● | | ● | | | ● |
| 6 | Urban Strategy | | ● | | ● | ● | ● | | | ● | ● | | | | ● |
| | *Affect the location of urban development: maintain agricultural locations* | | | | | | | | | | | | | | |
| 7 | General plans | ● | | | ● | | | ● | ● | | ● | | | | ● |
| 8 | Federal (and/or state) review of general plan elements | | ● | ● | ● | | | ● | ● | | ● | | | | ● |
| 9 | Agricultural reserves | | ● | | ● | ● | | ● | ● | | ● | | | | ● |
| 10 | State regulation of agricultural land | | ● | | ● | | | ● | ● | | | ● | | | ● |
| 11 | Federal designation of exclusive agricultural districts | | | ● | ● | | | ● | ● | | | ● | | | ● |
| 12 | Condemnation or transfer of development rights | ● | ● | | ● | ● | | ● | ● | | | ● | ●[3] | | ●[3] |
| 13 | Compensable regulation | | ● | | ● | | | ● | ● | | | ● | ● | | |
| 14 | Outright purchase of prime agricultural land | | ● | | ● | | | ● | ● | | | ● | ● | | |
| 15 | Purchase of remainder interest | | ● | ● | ● | | | ● | | ● | | ● | | | ● |
| D | *Limit the availability of urban infrastructure* | | | | | | | | | | | | | | |
| 1 | Establish an urban service area for short-term growth | ● | | | ● | | ● | | ● | | ● | | ● | | |
| 2 | Establish an urban expansion area for long-term growth | ● | | | ● | | ● | | ● | | ● | | ● | | |
| 3 | EPA clean water grants | | ● | ● | ● | | ● | | | ● | ● | | | | ● |
| 4 | Restrict state and federal highway aid | | ● | ● | | ● | ● | | | ● | | ● | | | ● |
| 5 | Federal Regional Council coordination | | | ● | ● | | ● | ● | ● | ● | | ● | | | ● |
| E | *Promote agricultural uses* | | | | | | | | | | | | | | |
| 1 | Bring new agricultural lands into production | | ● | | ● | ● | | ● | ● | | | ● | ● | | |
| 2 | Put purchased agricultural land to agricultural use | | ● | | ● | ● | | ● | ● | | | ● | ● | | |
| 3 | Growth of cooperatives | | ● | ● | | ● | | ● | | ● | | ● | | ● | |
| 4 | New merchandising methods | | ● | ● | | ● | | ● | | ● | | ● | | | ● |
| 5 | Intermediate technology for agricultural production | | ● | ● | | ● | | ● | | ● | | ● | | | ● |
| 6 | National (and/or state) prime agricultural land policy | | ● | ● | ● | ● | | ● | ● | | ● | | | | ● |
| 7 | Assure adequacy of future water supplies (conservation, reclamation, new projects) | | ● | ● | | ● | | ● | | ● | | ● | | | ● |
| F | *Use tax policy to protect or encourage agricultural activity* | | | | | | | | | | | | | | |
| 1 | Differential assessments for property tax purposes | | ● | | | ● | | ● | | ● | ● | | | ● | |
| 2 | Defer taxation of agricultural lands | | ● | | | ● | | ● | | ● | ● | | | | ● |
| 3 | Apply value capture techniques to land benefiting from public investment | ● | ● | | | ● | | ● | | ● | | ● | | | ● |
| 4 | Finance agriculture with non-agriculturally derived capital | | | ● | | ● | | ● | | ● | | ● | | | ● |
| 5 | Alter tax rules for industrial investment | | ● | ● | | ● | | ● | | ● | | ● | | | ● |
| 6 | Restructure formula for distributing sales tax revenue | ● | ● | | | ● | ● | | | ● | | ● | | | ● |
| G | *Needed studies* | | | | | | | | | | | | | | |
| 1 | Cost/benefit analysis of national prime agricultural land preservation | | | ● | | | | | | | ● | | | | |
| 2 | Comparative inter-city analysis of prime agricultural land retention | | | ● | | | | | | | ● | | | | |
| H | *Performance standards for local growth* | | | | | | | | | | | | | | |
| 1 | Threshold conditions | ● | ● | ● | ● | | ● | | ● | | ● | | ● | | |
| 2 | Conversion coefficients | ● | ● | ● | ● | | ● | | ● | | ● | | ● | | |

[1] The implementation of some measures could be accomplished via either regulation or incentive.

[2] Assumes feasibility. Assignment to a column reflects judgment of time needed to establish operation/administration. "Short run" includes state and federal measures already in effect.

[3] Condemnation strong; transfer unknown.

Source: Gruen Gruen + Associates

SOURCE: EPA, 1979b.

PDR program as the "designated" lands to which sewer service will not be provided. Once this amendment is adopted, its main effect will be to make it more difficult to convert Priority 1 lands to urban uses, regardless of whether the development rights to these lands have been purchased. As previously discussed, the Priority 1 lands include all the prime farmland in the Upper Green River Valley district, 36 percent of the prime farmland in the Sammamish Valley district, and only 16 percent of the prime farmland in the Lower Green River Valley district. Because the Sewerage General Plan affords no protection to non-Priority 1 prime farmlands, it can be considered only a partial mitigation measure for prime farmland conversion.

*Metro Resolution 3380.* Metro's adoption of King County's Sewerage General Plan (Resolution 3380) prohibits Metro's sewering of unincorporated "designated agricultural lands", defined as Priority 1 lands under the PDR program. Because Resolution 3380 affords no protection to non-Priority 1 farmlands (like the Sewerage General Plan), or to Priority 1 lands within the city limits of Kent and Redmond, it can be considered only a partial mitigation measure for prime farmland conversion.

*Additional Mitigation Measures.* Within the existing institutional framework in the study area, several additional mitigation measures exist which could more completely mitigate the loss of prime farmland.

- Metro could conduct detailed prime farmland assessments in future state-required EISs for interceptor sewer projects where these projects could adversely affect prime farmlands. These EISs would focus on more location-specific impacts and mitigation measures, as compared to the more regional approach taken in this EIS.

- King County could modify its Sewerage General Plan. The proposed amendment to the Sewerage General Plan could be strengthened by broadening the definition of designated farmland to include some or all prime farmland within King County agricultural districts that is not designated Priority 1 in the PDR program.

- The Cities of Kent and Redmond could adopt policies similar to King County to protect Priority 1 farmland located within municipal boundaries. Metro could then modify Resolution 3380 to reflect these policies.

## Impacts on Sensitive Areas

Background. An important issue in this EIS is the effect of study area projected growth on environmentally sensitive areas. Environmentally sensitive areas, as defined by King County, consist of soil-related sensitive areas, floodplains, and wetlands. EPA policy requires that an assessment of floodplains and wetlands impacts be made and that adverse impacts be avoided or minimized if no practical alternative to the action exists. At the local level, King County has recognized the importance of environmentally sensitive areas by mapping those areas considered sensitive to development and by strengthening its policies for protection of these lands.

Assessment of Impacts. In this analysis, the locations of high growth subdrainage basins and sensitive areas are mapped. Impacts of projected urbanization on soil-related sensitive areas, wetlands, and floodplains are then discussed.

*Identification of High Growth Subdrainage Basins*. Eight high growth subdrainage basins within the study area were identified earlier in the secondary impacts analysis (see Table 6-6); these subdrainage basins are projected to show increases in urban acres greater than 40 percent (the study area average) between 1980 and 2000. Figure 6-5 shows the location of the high growth subdrainage basins.

The generalized locations of environmentally sensitive areas are shown in Figure 6-6. The original mapping of sensitive areas was done by King County (King County Department of Planning and Community Development, Planning Division, 1980); the composite map of sensitive areas was prepared by Metro (1979a). Comparison of Figures 6-5 and 6-6 can indicate which subdrainage basins have the greatest potential for secondary adverse impacts on sensitive areas. These subdrainage basins are identified in the following sections.

*Soil-Related Sensitive Areas*.

*Characteristics and Potential Impacts of Urbanization*. Areas identified on Figure 6-6 as soil-related sensitive areas include: Class III slide and slippage (landslides) areas, Class III seismic areas, erosion areas and coal mine areas.

Landslide hazards are commonly associated with the hillsides of many of the major valleys. These areas are characterized by steeply sloping unconsolidated glacial deposits that are very susceptible to gravity sliding.

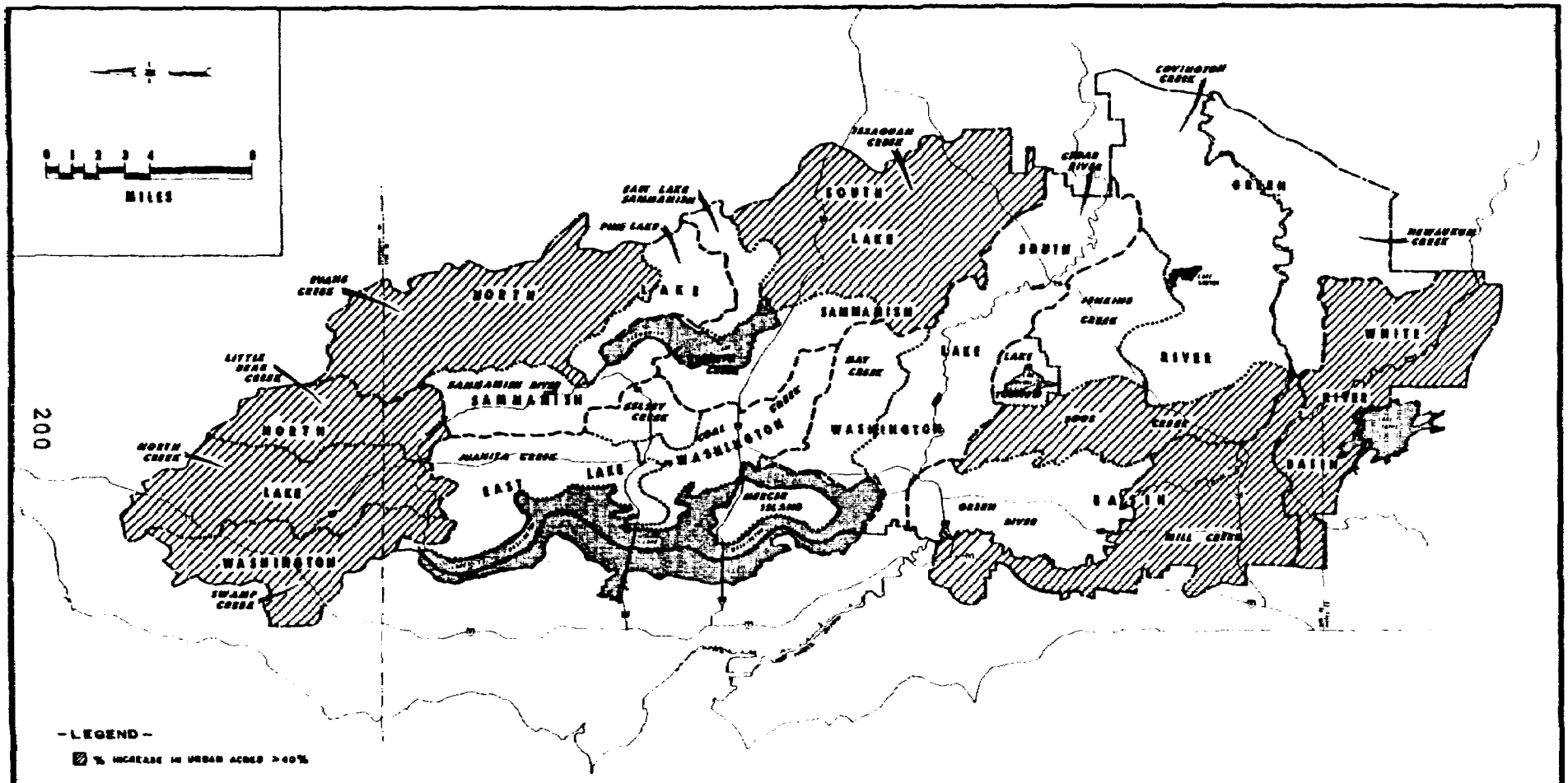



FIGURE 6-5. LOCATION OF HIGH GROWTH SUBDRAINAGE BASINS

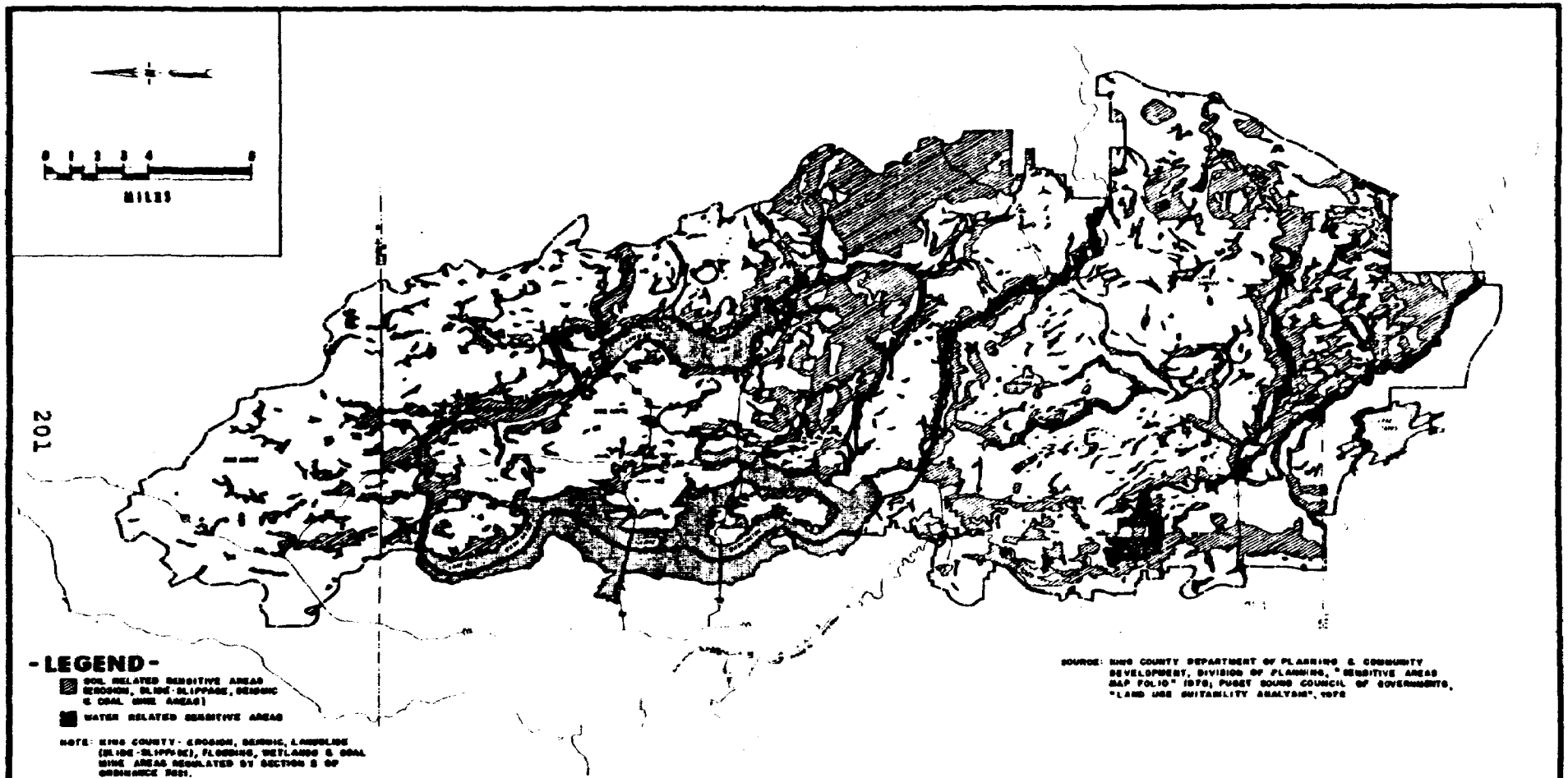



FIGURE 6-6. COMPOSITE MAP OF SENSITIVE AREAS WITHIN STUDY AREA

The entire Lake Washington/Green River Basins region is seismically active (King County, 1980). In most river basins, the extensive deposits of alluvial material and unconsolidated glacial materials contribute to an especially high susceptibility to earthquake damage.

Erosion hazard areas are a concern mainly due to sedimentation, a process which occurs as eroded matter accumulates in receiving waters (streams, channels, lakes). Eventually, sedimentation can result in costly expenditures to dredge or otherwise remove the unwanted material. In addition, the threat to the proper functioning of delicate ecological systems is an important concern since both erosion and sedimentation are frequently accelerated by land use modification.

The abandoned subsurface mine workings associated with coal activates present potential danger of surface collapse and leakage of noxious gases. Many abandoned mines have been filled or partially filled by natural caving processes, which poses a potential danger of subsidence. Although coal mine areas are generally quite remote, occasional problems do arise (King County Department of Planning and Community Development, 1978).

*Subdrainage Basins with Greatest Potential for Adverse Impacts on Soil-Related Sensitive Areas.* Based on the comparative locations of high growth subdrainage basins and soil-related sensitive areas (Figures 6-5 and 6-6), the following subdrainage basins appear to have the greatest potential for adverse impacts: Issaquah Creek, Mill Creek, Soos Creek, and the White River basin. In addition, the following subdrainage basins, although not defined as high growth, also have a high potential for a significant adverse impact: Sammamish River, Coal Creek, May Creek, Tibbetts Creek, Green River, and Newaukum Creek.

It should be recognized that this identification serves only to "red flag" subdrainage basins with the greatest potential for adverse impacts. To evaluate the direct impact of development on soil-related sensitive areas, site-specific analyses must be conducted.

*Mitigation Measures.* In recent years, King County has adopted a series of policies and ordinances which provide guidelines for development of soil-related sensitive areas. In addition, many cities in King County have developed policy guidelines to direct development away from soil-related sensitive areas. To the extent that these policies and ordinances are implemented, adverse impacts of urban development on soil-related sensitive areas will be reduced. The following section reviews and evaluates existing King County policies.

Historically, policy concerning soil-related sensitive areas in King County has been included within open space policy. The open space element of the county comprehensive plan, together with subsequent amendments (Ordinance 1096 and Ordinance 1683), provides the existing basis for policy protection of soil-related sensitive areas. In recent years, the need for new and more specific policies has been recognized. King County's proposed General Development Guide (first draft) contains policies which, if adopted, would replace the existing policies relating to soil-related sensitive areas. These policies discourage development on slopes greater than 40 percent, and in landslide and coal mine hazard areas, and recommend reduced development intensity as slopes increase.

Implementation of policies relating to soil-related sensitive areas has been provided for with the adoption of King County Ordinance 4365 in July 1979. This ordinance defines and incorporates maps of soil-related sensitive areas, and establishes a review process on a case-by-case basis for development proposals in these areas. Before the ordinance can become effective, however, administrative guidelines to implement its provisions must be developed. These include uniform standards for development approvals, provisions to expedite the case-by-case review process, and incentives for dedications of lands for open space.

*Wetlands.*

*Characteristics and Potential Impacts of Urbanization.* In general, wetlands are lands where saturation with water is the dominant factor determining the nature of soil development and the types of plant and animal communities inhabiting the area. The wetlands shown on Figure 6-6 include marshes, bogs and swamps. Classification of wetlands by subtype is often difficult due to gradational physical, chemical, and biological characteristics. In the larger marshes, shallow water is usually retained throughout the drier season. In contrast to bogs, marsh substrate is generally mud or muck with minor areas of peat. Swamps are similar to marshes except they are characterized by trees and larger shrub vegetation.

Wetlands are significant with respect to the wildlife they support and their role in maintaining water quality. Wetlands support a variety of wildlife, including small mammals, waterfowl, and other birds. Wetlands can also act as natural water purifiers, filtering out sediments and stripping nutrients, and thus helping mitigate the effects of upstream urbanization on downstream areas.

The main impact of urbanization on wetlands is the outright loss of the wetlands through conversion to urban uses. This may happen by filling, diking, draining, or otherwise removing the water from the land. When this happens, the wildlife, water quality, and aesthetic benefits of the wetlands are lost.

*Subdrainage Basins with the Greatest Potential for Adverse Impacts on Wetlands.* Based on the existence of a relatively large amount of wetlands, the following subdrainage basins appear to have the greatest potential for adverse impacts on wetlands: Evans Creek (a high-growth subdrainage basin), Coal Creek, and Covington Creek. These are general red flag areas, based on a very general level of analysis. Impacts of individual projects on wetlands should be evaluated on a case-by-case basis.

*Mitigation Measures.* The King County Sewerage General Plan prohibits sewering of designated King County wetlands. Metro adopted the provisions of the plan for existing unincorporated areas in its Resolution 3380. Policies on sewering of development on wetlands in incorporated areas of King County, and in Snohomish and Pierce Counties, are more fragmented and varied. Study area cities could adopt stronger policies to prohibit or discourage sewering of wetlands within existing municipal boundaries.

King County's proposed General Development Guide (first draft) contains proposed policies for additional protection of wetlands in the county. These policies encourage retention of wetlands in their natural state and discourage development adjacent to wetlands where wetlands would be adversely affected.

*Floodplains.*

*Characteristics and Potential Impacts of Urbanization.* The floodplain designations on Figure 6-6 are 100-year floodplains. These areas are lands expected to be covered by floodwaters at least once over a 100-year period. Partial flooding may occur more frequently. Excessive storm runoff and snowmelt are generally the sources of floodwaters.

Floodplains are significant areas with respect to their value as occasional watercourses and their value as wildlife and fishery habitat features. Natural floodplains in an overbank flow situation carry floodwaters at greatly reduced velocities, as compared to a diked or modified river channel designed to carry floodwaters within the confines of the channel. Thus, natural floodplains minimize erosion and detain the flow somewhat to lessen flooding in downstream areas. Floodplains also contain riparian habitat areas which support a great variety of animal life and provide shade and sustenance to stream fish.

The impacts of urbanization on floodplains occur through urban development on the floodplain area, and also through urban development of the floodplain's watershed. Development of the floodplain area can eliminate riparian vegetation and its benefits to wildlife and the stream community.

Streams are often channelized and diked to protect investments on floodplains, thus further destroying riparian vegetation. Sometimes streams overcome these structural control measures, causing economic loss and physical danger to people occupying the floodplain.

Development of a floodplain's watershed increases the areal extent of a flood of a given frequency (e.g., 10-year flood, 100-year flood). This is caused by higher runoff water due to impervious surfaces, and less infiltration of water into the ground. Thus, the 100-year floodplain area actually grows larger as urbanization of a watershed progresses.

*Subdrainage Basins with the Greatest Potential for Adverse Floodplain Impacts.* Based on the existence of relatively extensive floodplains, the following subdrainage basins appear to have the greatest potential for adverse floodplain impacts: Evans Creek, Coal Creek, Cedar River, Issaquah Creek, Mill Creek and White River basin. Four of these subdrainages are high growth, whereas two (Coal Creek and Cedar River) are not. These are general red flag areas identified by a very general level of analysis. Impacts of individual developments on floodplains should be analyzed on a case-by-case basis.

*Mitigation Measures.* The King County Sewerage General Plan prohibits sewering of designated floodplain areas in King County. Metro adopted the provisions of the plan for existing unincorporated areas in its Resolution 3380.

Implementation of floodplain protection programs in incorporated areas of King County, and in Snohomish and Pierce Counties, is more fragmented and varies with local government policies. Some floodplain areas (adjacent to water bodies larger than 20 acres in size or streams with mean annual flow greater than 20 cubic feet per second) may be partially protected from development by local shoreline management plans prepared pursuant to the State Shoreline Management Act of 1971. Study area cities could adopt stronger policies prohibiting or discouraging the sewering of floodplains within existing municipal boundaries.

King County's proposed General Development Guide (first draft) contains proposed policies for additional protection of floodplains in the county. These policies discourage development within the 100-year floodplain and prohibit development within the floodway.

The federal Flood Insurance Program requires participating communities to participate in mandatory floodplain management and flood protection measures, and to apply common sense and good engineering practice in reviewing and approving building permit applications.

*Summary of Mitigation Measures for Sensitive Areas.* A number of laws, plans, and policies currently exist for the protection of sensitive areas within the study area. In addition to those already mentioned, an important mitigation measure is the SEPA's requirement for preparation of EISs when individual development projects could have a significant effect on the environment. To the extent that the existing laws, plans, and policies are implemented, impacts on sensitive areas will be mitigated.

An additional mitigation measure could be for Metro to conduct detailed assessments of sensitive areas impacts in future SEPA EISs for interceptor sewers connecting to the Renton plant. These EISs would focus on location-specific impacts and mitigation measures.

## Public Service Systems

Most local governments within the Lake Washington/Green River Basins have policies encouraging the coordination of growth and the provision of public services. This section of the EIS discusses the effects of growth projected for the study area on public service provision.

Appendix A to this EIS describes in detail the existing management system and plans and policies regarding service provision, wastewater management, water supply, drainage, solid waste management, recreation, social services, transportation, and electricity and gas. This section of the EIS, for each of the services, summarizes the existing management system, identifies known existing capacity problems and describes the potential impacts of projected growth. Since comprehensive data on local system capacities are generally not available for all public service systems, emphasis is placed here on regional, macrolevel public service impacts. Mitigation measures for adverse impacts of growth on public services, consisting of local comprehensive and special-purpose plans and policies, are discussed at the end of this section.

### Wastewater Management

Existing Management System. Within the study area, sewerage service is provided by local cities, water districts, and sewer districts, and by Metro, acting as a sewerage "wholesaler". Metro component agencies and existing Metro wastewater facilities within the study area are described in Chapter 2 of this EIS.

Existing Capacity Problems. As part of the identification of near-term actions for its facilities plan, Metro facilities with capacity problems were identified. In addition to these capacity problems, scattered local collection systems managed by cities and water or sewer districts are also experiencing capacity problems, or will experience such problems in the near future. In general, little information is available on local collection system capacity within the study area.

Impacts of Growth. PSCOG projects the sewered population within the study area will double over the next 20 years, from 340,890 in 1980 to 681,170 in the year 2000. In addition to the facilities planned in Metro's Draft Wastewater Management Plan, additional non-Metro facilities (in particular, collection sewers) will also be required to serve this growth. Some appreciation for the additional local collector sewers needed to serve projected growth may be gained by examining PSCOG's projections of sewered urban land within the study area. PSCOG's policy projection, shown in Table 6-9, predicts that sewered urban land will increase by 39,349 acres between 1980 and 2000. This amounts to 61.5 square miles of land, one-tenth of the entire study area, that must be provided with local collector sewers by Metro's component agencies over the next 20 years.

Numerous local sewer system projects will therefore be required to serve projected growth. Many of the needed local sewer projects have been identified in the comprehensive sewer plans which must be prepared by every local sewer agency within King County. If sewer system projects are not implemented in a timely fashion, growth could continue to create local sewerage system capacity problems.

The unsewered population growth within the study area will also place service demands on local agencies, particularly if increased on-site system management activities are implemented. Overall, PSCOG projects the study area's unsewered population to decrease from 196,198 in 1980 to 124,078 in the year 2000. However, this net decrease is attributable to much of the currently unsewered population becoming sewered over the next 20 years, and does not show that new population in outlying areas will continue to rely on on-site systems.

## Water Supply

Existing Management System. Almost all of the study area is supplied with water by the City of Seattle Water Department, either directly or indirectly through approximately 36 retail water purveyors (cities and water districts). Seattle-supplied surface water from the Cedar River and Tolt River is the main source of water for most of the study area residents, with some outlying communities supplied by local wells.

Table 6-9. PSCOG Projections of Sewered Urban Acres by Subdrainage Basin, 1980-2000

| Major Basin/Subbasin | 1980 | 1990 | 2000 | Increase 1980-2000 | Percent Increase 1980-2000 |
|---|---|---|---|---|---|
| North Lake Washington | 7,264 | 13,206 | 19,416 | 12,152 | 167.3 |
| Swamp Creek | 2,799 | 5,809 | 8,347 | 5,548 | 198.2 |
| North Creek | 3,668 | 6,177 | 9,348 | 5,680 | 154.9 |
| Little Bear Creek | 797 | 1,220 | 1,721 | 924 | 115.9 |
| North Lake Sammamish | 3,953 | 6,266 | 8,171 | 4,218 | 106.7 |
| Sammamish River | 2,710 | 3,818 | 4,561 | 1,851 | 68.3 |
| Evans Creek | 931 | 1,497 | 2,420 | 1,489 | 160.0 |
| Pine Lake | 312 | 951 | 1,190 | 878 | 281.4 |
| East Lake Washington | 13,565 | 17,608 | 19,407 | 5,842 | 43.1 |
| Juanita Creek | 6,173 | 8,455 | 9,513 | 3,340 | 54.1 |
| Kelsey Creek | 2,656 | 3,031 | 3,382 | 726 | 27.3 |
| Coal Creek | 4,736 | 6,122 | 6,512 | 1,776 | 37.5 |
| South Lake Washington | 4,368 | 6,877 | 7,652 | 3,284 | 75.2 |
| May Creek | 947 | 1,540 | 2,047 | 1,100 | 116.2 |
| Cedar River | 3,421 | 5,337 | 5,605 | 2,184 | 63.8 |
| South Lake Sammamish | 3,499 | 4,029 | 4,305 | 806 | 23.0 |
| Tibbetts Creek | 2,665 | 2,955 | 2,990 | 325 | 12.2 |
| East Lake Sammamish | 138 | 201 | 260 | 122 | 88.4 |
| Issaquah Creek | 696 | 873 | 1,055 | 359 | 51.6 |
| Green River Basin | 10,142 | 15,159 | 20,800 | 10,658 | 105.1 |
| Mill Creek | 4,903 | 7,241 | 9,889 | 4,986 | 101.7 |
| Green River | 2,905 | 4,122 | 5,306 | 2,401 | 82.7 |
| Soos Creek | 1,551 | 2,558 | 3,822 | 2,271 | 146.4 |
| Lake Young | 44 | 77 | 111 | 67 | 152.2 |
| Jenkins Creek | 415 | 661 | 872 | 451 | 110.1 |
| Covington Creek | 288 | 419 | 669 | 381 | 132.3 |
| Newaukum Creek | 36 | 81 | 131 | 95 | 263.9 |
| White River Basin | 643 | 1,480 | 2,965 | 2,322 | 361.1 |
| Mercer Island | 2,534 | 2,761 | 2,601* | 67 | 2.6 |
| Study Area Total | 45,968 | 67,386 | 85,317 | 39,349 | 85.6 |

*Decrease represents probable error in PSCOG projection.

SOURCE: PSCOG.

Existing Capacity Problems. Water supply capacity problems are of two types: regional and local. Regional water supply issues have been most recently addressed by the Comprehensive Regional Water Plan (Complan) prepared by the water department of Seattle (1980). The Complan projects that Seattle service area water demand will increase from a current demand of 155 MGD to 253 MGD in the year 2025. Since the existing system's capacity is 210 MGD (excluding groundwater), the Complan concludes that an additional supply of 50 MGD is needed by the year 1995. The Complan tentatively recommends that the North Fork Tolt River, with a firm yield of 70 MGD, be developed to provide the additional supply; development of the North Fork Snoqualmie River could become the preferred water source if its costs were equivalent to the North Fork Tolt River and if it were feasible.

Locally, scattered water supply problems related to insufficient capacity have been noted in areas such as the City of Kent and King County Water Districts 94, 105, and 111 (King County Department of Building and Land Development, pers. comm.); these capacity deficiencies have not been comprehensively documented. Lack of adequate water systems has been an important concern in developing the Tahoma/Raven Heights Community Plan (Monohan, 1980). Also, in some rural areas, water systems are not sufficient to meet county fire flow requirements.

Impacts of Growth. Growth projected for the study area will generate additional needs for regional water supplies and local water system improvements. Study area growth is primarily responsible for the need for Seattle to develop an additional surface water supply, since 90 percent of the population growth projected by Seattle's Complan is projected to occur in "suburban purveyor areas", incorporating most of the study area. The Complan project's total costs, through the year 2025, will be $221 million.

At the local level, numerous local water system improvement projects will be required to serve projected growth. Many of the needed local water improvement projects have been identified in the comprehensive water plans prepared by water purveyors within King County. If planned water system improvement projects are not implemented in a timely fashion, growth could create local water system capacity problems.

## Drainage and Flood Control

Existing Management System. Local drainage facilities planning and implementation are the responsibility of cities and counties within the study area. The Army Corps of Engineers is responsible for several major flood control drainage projects. The Corps has also widened and deepened the Sammamish River Channel to prevent flooding, and periodically dredges the Duwamish River and Lake Washington Ship Canal to maintain navigation.

Existing Capacity Problems. The urbanization process, through development in flood-prone areas and through paving of previously permeable surfaces, increasing runoff volumes and flow rates, creates the need for drainage and flood control measures. At the local level, drainage improvement projects to manage increased storm flows can be found in the capital improvements program of virtually every local government within the study area. Many local drainage problems were identified as part of the RIBCO urban drainage study in 1975.

At the regional level, the major existing drainage problem within the study area is flooding along tributaries to the Green River caused by insufficient capacity of the river to handle peak storm flows. To minimize flood damage and also ensure continued multiple use of the Green River, the Green River Basin Program was initiated by several local agencies in 1978.

Impacts of Growth. Projected population growth will generate the demand for additional drainage and flood control facilities, as well as for nonstructural control measures. These drainage facilities include both the types of trunk drainage facilities described in the RIBCO urban drainage study (e.g., holding ponds, drainage channels, streambank protection with riprap, erosion control weirs, pumping stations, levee improvements) and local collector facilities. If drainage programs are not implemented in a timely fashion, growth could continue to create both local and regional drainage and flooding problems.

The financing of drainage system maintenance in King County is an important service issue for the future. Currently, the county requires developers to maintain residential storm-water control facilities for only 1 year following construction, after which the county "may" take over responsibility. A countywide surface water utility district has been discussed as a method for financing drainage system maintenance, the costs of which have been estimated at $42.5 million over the next 30 years (Penhole, 1980b).

## Solid Waste Management

Existing Management System. The local solid waste management system involves the basic steps of collection, transfer, and disposal. The King Subregional Council is the Solid Waste Management Board for King County. Most of the solid waste in the study area is collected by private companies. King County and the City of Seattle operate the main transfer stations and landfills which serve the study area. The Cedar Hills landfill is the major landfill serving the study area, and will play an even greater role in solid waste disposal as rural landfills within King County are phased out. The Cedar Hills landfill has enough capacity to last for approximately another 20 years (King County Department of Building and Land Development, pers. comm.). The feasibility of establishing waste-to-energy conversion plants as an alternative to continued landfilling is currently being studied by King County.

Existing Capacity Problems. No near-term capacity problems appear to exist with the solid waste management system.

Impacts of Growth. Growth projected for the study area will generate additional needs for solid waste transfer and disposal facilities. A rough estimate of the additional solid waste generated by population growth can be made using the RIBCO solid waste plan per capita figures of 19.77 pounds per capita per day for solid waste generation and 5.74 pounds per capita per day for solid waste remaining for ultimate disposal; these figures include residential, commercial/industrial, and special wastes. Using these figures and the PSCOG policy projection for the year 2000, solid waste generation within the study area can be projected to increase from 1.94 to 2.91 million tons per year between 1980 and 2000, and solid waste remaining for disposal can be projected to increase from 0.56 to 0.84 million tons per year.

## Recreation

Existing Management System. A number of federal, state, and local agencies provide recreation services to study area residents. Within the study area and its vicinity, residents enjoy a wide range of recreation opportunities. In particular, rivers, lakes, marine shorelands, and the inland waters of Puget Sound offer many opportunities for water-oriented recreation.

Existing Capacity Problems. King County's draft General Development Guide distinguishes among four types of parks: neighborhood (5-10 ac), community (20-40 ac), resources-based (1-100 ac) and major urban (at least 100 ac). No comprehensive data on park capacity problems exist. Through the communities planning process, deficiencies in one or more of these types of parks have been noted within different communities

planning areas. In addition, a Bureau of Outdoor Recreation (1977) study of the recreational needs of the study area and its vicinity identified boating facilities, swimming beaches, and shoreline access as high priority recreational needs common to all local jurisdictions.

Impacts of Growth. Growth projected for the study area will generate additional demands for parks and recreation facilities. The King County draft General Development Guide recommends 5 acres per thousand persons as the standard for major urban parks (the draft General Development Guide also contains standards for neighborhood and community parks, but within built-up areas only). Using this standard, the projected increase in population for the study area of 321,000 between the years 1980 and 2000 would require 1,600 acres of additional major urban parks.

## Social Services

Existing Management System. Schools and police and fire protection typically fall within the category of social services. Schools within the study area are run by 15 independent school districts. Centralized administrative support is provided by Educational Service District (ESD) 121 in King County and ESD 189 in Snohomish County. Police and fire services within the study area are provided by cities within their boundaries and by counties in unincorporated areas.

Existing Capacity Problems. No comprehensive data exist regarding existing capacity problems of schools, police, or fire services. Through the communities planning process, deficiencies in one or more of these services have been noted within individual communities planning areas. As a general rule, schools are seldom provided for in advance of development, and school capacity is often the major social service concern in rapidly growing areas.

Impacts of Growth. Projected population growth will generate demand for additional social services. If these services are not provided in a timely fashion, the quality of social services within the study area could deteriorate.

It is possible to estimate the number of additional students who will require classrooms by using ESP 121's planning rule of thumb estimate of 20 students per 100 persons added within King County. Using this figure, the projected increase in population for the study area of 321,000 between the years 1980 and 2000 would generate an additional 64,200 students. Of course, schoolroom capacity would not be needed for all 64,200 at one time, since students generated early in the planning period would be leaving the public school system prior to the year 2000.

## Transportation

Existing Management System. Management of roads and highways within the study area is the responsibility of the federal and state Departments of Transportation, PSCOG, and cities and counties. (This section is limited to examining the impacts of projected growth on roads and highways, and does not consider airports, railroads, or ferry services.) Metro is responsible for operating the regional mass transportation system.

Existing Capacity Problems. Capacity problems exist for both local roads and regional highways. Some of these have been identified in communities plans. PSCOG is in the process of identifying regional and subregional highway problems as part of its current updating program for the 1990 Transportation System Plan.

Impacts of Growth. Projected population growth will generate additional person-trips and vehicle-miles travelled. Many highway and transit improvements have been programmed by PSCOG, local governments and Metro to meet projected demands. Metro's 10-year capital expenditure needs for transit improvements alone were recently estimated at $1.9 million (Penhole, 1980a). If transportation facilities and services are not provided in a timely fashion to meet increased demands, or if strategies to reduce vehicle-miles-travelled are unsuccessful, additional congestion and increased travel times could result. This could have localized air quality impacts.

A good indicator of the increase in transportation demand is the number of home-to-work trips. Table 6-10 shows PSCOG's projection of home-to-work/college trips by place of residence and place of work for 10 planning districts in Pierce, King, and Snohomish Counties. The trip projections are based on PSCOG's policy population projection, identical to that used for Metro's wastewater facilities planning. The data in Table 6-10 indicate that the five transportation planning districts located within the study area are all expected to show significant increases in trips from home and trips to work.

## Electricity and Gas

Existing Management System. Electricity is supplied to most of the study area by Puget Sound Power and Light (PSP&L); in Snohomish County, electricity is supplied by Snohomish Public Utility District. In 1979, 78 percent of the electricity supply by PSP&L came from hydroelectric plants, with thermal sources accounting for the remaining 22 percent.

Natural gas is supplied in the study area by Washington Natural Gas. Supplies are purchased from the Northwest Pipeline Corporation.

Table 6-10. Projected Home-Work/College Trips by Place of Residence and Place of Work

| District | Trips from Home in this District | | | Trips to Work in this District | | |
|---|---|---|---|---|---|---|
| | 1977 | 2000 | Percent Change | 1977 | 2000 | Percent Change |
| 1. Tacoma/Lakewood | 157.2 | 216.9 | + 38.0 | 179.1 | 255.4 | + 42.6 |
| 2. Puyallup, Spanway, S. E. Pierce County | 88.2 | 192.7 | +118.5 | 41.1 | 103.9 | +152.8 |
| 3. Federal Way, Auburn, Kent, Maple Valley* | 119.8 | 234.6 | + 95.8 | 83.5 | 175.7 | +110.4 |
| 4. Renton, Tukwila, Barien, Sea-Tac* | 137.0 | 168.1 | + 22.7 | 113.3 | 182.7 | + 61.3 |
| 5. Seattle, South of Ship Canal | 201.5 | 227.4 | + 12.9 | 412.6 | 505.9 | + 22.6 |
| 6. East Lake Washington* | 184.3 | 286.9 | + 55.7 | 104.4 | 186.1 | + 78.3 |
| 7. North Seattle's Shoreline | 203.6 | 212.7 | + 4.5 | 199.7 | 239.5 | + 19.9 |
| 8. Montlake Terrace, North Creek, Alderwood Manor* | 37.0 | 103.7 | +180.3 | 9.2 | 33.1 | +259.8 |
| 9. Edmunds, Lynnwood* | 69.6 | 114.0 | + 63.8 | 39.9 | 88.4 | +121.6 |
| 10. Everett and Suburban Areas | 63.0 | 129.0 | +104.8 | 82.3 | 144.2 | + 75.2 |
| County Totals | | | | | | |
| Pierce | 245.4 | 409.6 | + 66.9 | 220.2 | 359.3 | + 63.2 |
| King | 846.2 | 1,129.7 | + 33.5 | 913.5 | 1,289.9 | + 41.2 |
| Snohomish | 169.6 | 346.7 | +104.4 | 131.4 | 265.7 | +102.2 |

*Denotes districts within Lake Washington/Green River Basins.

SOURCE: PSCOG, 1979a.

Existing Capacity Problems. The near-term outlook for electricity supplies in the study area is uncertain. That electricity supplies could be a problem is best demonstrated by a pending petition filed in late 1979 by PSP&L with the Washington Utility and Transportation Commission. This petition requests a 4-year restriction on new electricity hook-ups where other fuel types would be more efficient or where supplies are more available; the main effect of this petition would be to limit new hook-ups for residential space heating or water heating. In contrast to the electricity outlook, the near-term outlook for natural gas within the study area is considered good.

Impacts of Growth. Population growth projected for the study area will generate additional energy demands. Current uncertainties in factors such as the future of nuclear power, energy pricing policy, and the role of conservation, among others, make projections of 20-year energy demand and supply quite difficult, and such projections are not attempted here.

## Mitigation Measures for Public Services Impacts

In an effort to assure the coordination of growth and provision of public services, local agencies within the study area have developed numerous comprehensive and special purpose (functional) plans and policies. The status of plans and policies is described in detail in Appendix A of this EIS. Some of the more important plans and policies affecting public services provisions are listed below.

Comprehensive Plans. King County General Development Guide (first draft), community plans in King and Snohomish Counties, comprehensive plans prepared by cities.

Wastewater Management Plans. Sewer district comprehensive plans, King County Sewerage General Plan, Metro Resolution 2933, nonsewer policies of Seattle-King Counties and Snohomish County Health Departments.

Water Supply. Water district comprehensive plans, Seattle Complan.

Drainage and Flood Control. Metro 208 plan, local government drainage policies, Green River Basin Program.

Solid Waste Management. King County Solid Waste Management Plan.

Transportation. PSCOG 1990 Transportation System Plan update, PSCOG subregional transportation plans.

To the extent that these and other local plans and policies regarding public services provision are implemented, the potential adverse impacts of growth on public services will be mitigated; if public services plans and policies are not successfully implemented, localized service deficiencies could create changes in growth patterns, but these are unlikely to be of sufficient magnitude to affect the study area's projected growth rate or the phasing of Metro's wastewater facilities. At this time, development of additional mitigation measures as part of this EIS does not appear warranted.

## Secondary Impacts on Public Finance

### Background

Growth accommodated by the Metro Wastewater Management Plan will affect the balance between public costs and revenues. Public costs are incurred with the provision of services such as police, fire protection, streets and roads, water, sewers, libraries and public health. Revenues are obtained from property taxes, sales taxes, utility taxes, charges for services, fines and transfers from other (such as state and federal) governments.

The municipal budgeting process and collection of revenue to pay for public services are governed by a well-defined set of regulations. According to Washington state law, local government budgets must be balanced; that is, revenues must equal costs.

The amount of revenue collected is not specifically limited, but there are some constraints. Revenue from property taxes in any year may not exceed 106 percent of the largest property tax collection in the previous 3 years, with three exceptions: (1) voters may suspend this limitation one time only, for a period of 1 year; (2) voters may authorize the sale of general obligation bonds to be repaid by an extra property tax levy; and (3) new development may be added to the collection base subject to certain rules. Sales tax receipts are derived from a distribution of state sales tax revenues. Municipal bonds, issued by local governments to cover capital costs, are limited by the total assessed valuation in the jurisdiction (for general obligation and local improvement district bonds) or the revenue of the enterprise (for revenue bonds).

### Responsibility for Provision of Services

Public services in the study area are provided by a combination of local government entities. Within cities, King County is responsible for county streets and roads; health; law, safety, and justice (excluding police); solid

waste collection; and some parks. The city provides general government, police and fire protection, parks and recreation, water and sewer services. Some cities also provide libraries. In unincorporated areas of the county, King County provides general government; streets and roads; law, safety and justice (including sheriff); solid waste collection; and parks and recreation. Fire protection, water and sewers are provided by special districts.

Further details regarding the existing management system for study area public services may be found in the previous section assessing secondary public services impacts.

## Fiscal Outlook of the Study Area

Interviews were held with finance officers and city treasurers in the seven largest cities in the King County portion of the study area and with staff of the King County budget division to assess the fiscal outlook. Officials in six of the seven cities - Auburn, Bellevue, Kirkland, Kent, Redmond, and Renton - indicated that the fiscal conditions and outlooks of those cities are similar. In all six, diversified tax bases provide substantial property and sales tax revenues. Continuing development, especially of commercial and industrial uses, allows property tax collections to increase at a greater rate than 6 percent per year and helps in covering the cost of services to residential areas. Sales tax receipts, which rise not only with new commercial development but also with inflation and real income gains (the amount by which increases in income exceed inflation), contribute additional funds.

Several of the cities place major importance on user fees to generate revenue not only for water and sewer service but also for development processing and recreation programs. A notable example is the City of Kent, which serves a large population in the unincorporated area around the city, and charges for services in an effort to assign the costs of those services to the people who actually use them. Several of the cities have additional sources of revenue - such as business and occupation tax and gross receipts tax - available to them when the constraints imposed by the 106 percent limit become too severe. All of the cities have major portions of their bonding capacity uncommitted, and none has had trouble passing bond issues when they have been submitted to the voters. In general, these cities have adopted a conservative approach to budgeting, overestimating expenses and underestimating revenues, in an attempt to maintain solvency and respond adequately to the service needs and demands of their residents.

There are, nonetheless, some differences among these six cities. Some have substantial cash reserves available to cover emergency funding requirements, while others have virtually none. Some of the cities anticipate significant population growth in the future, in some cases involving annexations as well as new development within current city boundaries, while others expect only minor infill development.

Officials in the six cities expressed confidence in their fiscal soundness and their abilities to handle future growth. They based this optimism on increasing sales tax revenues, future possibilities of additional revenues from other sources (user charges, business and occupations tax), the future possibility of suspending the 106 percent property tax limit and careful management practices.

The seventh city, Mercer Island, differs from the other six in several ways. It is completely contained by the island, almost fully developed and almost completely residential. The residential character of development means that the city must rely heavily on property taxes for locally-generated revenues, knowing that most costs will rise at a greater rate than 6 percent per year and thus that the city's finances face continual strain in the future. Voters suspended the 106 percent limit this year, leaving that option unavailable in the future. Even the very limited potential for future population growth and the knowledge that whatever growth does occur will probably not significantly increase city costs (because it will occur within the existing framework for service provision) does not bolster the city's fiscal outlook. Smaller cities in the study area with development characteristics similar to Mercer Island are likely to find themselves in the same fiscal condition.

The King County government, which provides some services countywide and some to the unincorporated area, shares the fiscal outlook of the City of Mercer Island, although for different reasons. The services provided by the county - primarily law, safety and justice, streets and roads, and public health - are difficult or impossible to finance with user charges (parks and recreation in the unincorporated area may be an exception). Therefore, the county must rely on property and sales taxes for revenue. Its property tax levies and sales tax receipts differ, however, between the incorporated and unincorporated areas; property tax levies in the incorporated areas (city territory) are lower because the county provides fewer services there, and sales tax receipts are lower because the cities share in the revenue. The county policy which encourages new development in existing urban concentrations makes it likely that the county will receive a smaller share of the fiscal benefits from that development than it would if construction in unincorporated areas were more acceptable.

The county also has more difficulty than the cities in mounting and passing bond issues, because a county issue must be approved by residents of both the incorporated and unincorporated areas. The greater diversity of population and interests in the countywide electorate dilutes the appeal of any county proposal and requires a major political effort to adopt a bonding program.

It should be noted that neither county special districts nor Snohomish nor Pierce Counties budget officials were interviewed for this study, and consequently the foregoing description of county finances presents only a partial picture.

## Mitigation Measures for Fiscal Impacts

Local jurisdictions within the study area are implementing a variety of measures to finance the public costs of growth. For example, as part of its General Development Guide program, King County is examining the fiscal impacts of four alternative development patterns, and fiscal considerations will play an important role in determining which alternative is selected. At this time, development of additional mitigation measures as part of this EIS does not appear warranted.

Chapter 7

# ALTERNATIVES AVAILABLE TO EPA

## Overview

EPA's objective for the 201 construction grant program is to assist public agencies to meet their responsibility for work toward the goals of the Clean Water Act. The primary methods EPA and the State of Washington use to meet water quality goals are to establish water quality standards necessary to protect the beneficial uses of streams, and to administer the National Pollution Discharge Elimination System (NPDES) whereby effluent discharge permits contain terms intended to maintain water quality standards. EPA will consider a wastewater treatment construction grant application to assist Metro in meeting the terms of its NPDES permit, and to protect water quality.

EPA's implementation procedures for the National Environmental Policy Act (NEPA) require, in addition to considering the grant applicant's alternatives, that EISs explicitly consider alternatives available to EPA. These alternatives may include structural or locational alternatives not investigated by the grant applicant, or can be administrative only. The administrative options may include such choices as funding or not funding the proposed action; funding portions of the project; funding the project in stages; or providing a reduced or increased level of funding. Administrative options can also relate to grant conditions, including impact mitigation measures that EPA may wish to make part of any subsequent grant offer to the applicant.

## Structural Alternatives

EPA, at its discretion may propose, within its EIS, facility alternatives in addition to those proposed by an applicant. In the case of Metro's Draft Wastewater Management Plan for the Lake Washington/Green River Basins, EPA believes that Metro has examined a full range of long-term facility alternatives. These include both centralized and decentralized approaches, as well as several discharge options. Broad new facilities approaches do not appear warranted at this time as part of this EIS. The option of exploring additional alternatives for implementing specific components within Metro's

preferred plan will be retained. For example, EPA could include alternative sizing of nonmodular facilities or alternative mitigation measures to alleviate environmental impacts.

## Administrative Alternatives: Funding

### Fund or Not Fund Project

EPA funding is based on a determination that the applicant's preferred alternative is approvable. An approvable alternative must be the cost-effective and environmentally acceptable means of accomplishing the project objectives. If these requirements were not met and federal funds were not provided, the applicant's preferred alternative would need to be funded entirely from state and local sources: otherwise, it might not be built. In the former case, increases in costs to local ratepayers might be expected. In the latter case, impacts such as those discussed in this EIS under the no-project alternative could be expected, including serious water quality and fisheries impacts.

If the preferred alternative is found to be cost-effective and environmentally acceptable, federal funding could be provided, but funding would be dependent on availability of funds and funding priorities. Under the Clean Water Act, EPA may provide grants of up to 75 percent of eligible project costs. It is possible that the EPA would be able to provide 75 percent funding for only a portion of the $310 - 410 million capital costs of Metro's preferred program. Recent EPA construction grant annual funding for Washington State has ranged from close to $80 million in 1978 to near $60 million in 1980. Annual funds may be expected to continue in the $60 - 80 million range in the near future. Administration or Congressional actions or national economic trends may affect this estimate. Full EPA funding of this project could therefore be expected to require the commitment of all Washington State's share of federal construction grant funds for several years. This in turn would require denying funding for other projects within Washington State.

Actual distribution of federal funds to projects in Washington State is determined by the State Department of Ecology. The most recent state priority list shows that design funds for this Metro project will not be available until FY 1983. The state estimates that after FY 1984 the maximum annual amount of federal funds made available for this project is likely to be approximately $20 million per year.

Washington State voters recently passed a bond measure providing $315 million over 10 years for wastewater treatment projects. This program will be administered by the Department of Ecology. It is anticipated that this money will be used to fund projects at between 50-75 percent of eligible costs. Due to the wastewater treatment needs of small communities, Metro has in the past received only about 12 percent of the funds from past state bonding authorities. The State of Washington expects that Metro's fair share of the new bonding authority will be higher, based on the realization that a majority of the state's population and a significant portion of the state's remaining wastewater treatment needs are in the Seattle metropolitan area. Therefore, state funds may be available to supplement federal funds for this Metro project.

EPA approval of the preferred program would be approval of the entire program. Since the entire program is necessary to prevent water quality problems, EPA funding would be dependent on Metro's commitment to implement the entire program. If only a portion of the program were to be completed, EPA would not have achieved its intent in approving the preferred program, and water quality standards violations could occur.

Recognizing the need to commit to implementing the entire preferred program, and recognizing the limits and uncertainties of federal and state funding, Metro will need to prepare a realistic financial plan. Such a plan should show the sources of funds needed for Metro to implement the entire preferred program, including realistic estimates of federal, state and local funds. This plan should include a critical path schedule showing target dates for various portions of the preferred program to come on-line, starting times for design and construction phases of the various portions necessary to meet those target dates, and amounts and sources of funds needed to accomplish each phase. A financial plan of this nature is needed to assure EPA and the Department of Ecology that federal and state funds will be spent as part of an agreed-upon total program to meet wastewater treatment objectives in an environmentally-acceptable manner.

Planning of project phasing should recognize that some portions of the preferred program are essential to achieve water quality objectives. For example, under the preferred program, project phasing should guarantee that the tunnel and outfall will come on-line in time to transfer to Puget Sound the increased discharge from treatment plant expansion. If increased discharge from plant expansion preceded completion of the tunnel and outfall, unacceptable water quality impacts in the Duwamish River might occur.

## Funding of Project Phases

Metro has proposed to stage the design and construction of its preferred long-term program in two phases. Phase 1, consisting of expansion of treatment plant and solids-handling facilities to 72 MGD, the effluent tunnel/outfall, and Phase 1 of the Redmond connection, would start in 1981 and be complete by 1985. Phase 2, consisting of expansion of treatment and solids handling capacity to 99 MGD, Phase 2 of the Redmond Connection, and the North Creek/Hollywood connection, would start in 1986 and be complete in either 1991 or 1993, depending on the facility.

EPA intends to provide initial federal funding for only Phase 1 of the preferred program (if selected). An alternative would be to provide funds at this time for both phases; this alternative does not appear necessary given funding constraints, the relative independence of the two phases (i.e., Phase 2 is not a necessary part of Phase 1), and their separation in time.

## Funding Beyond 20-Year Capacity

EPA cost effectiveness guidelines require that cost-effectiveness analyses be based on a planning period of 20 years. As a general rule, EPA does not fund facilities beyond their 20-year capacities. If Metro's preferred program is selected, it is unlikely that EPA would fund the Redmond connection and the tunnel and outfall to Puget Sound beyond their 20-year capacities. The costs of additional incremental capacity would therefore need to be funded entirely from local sources, assuming the Department of Ecology would also not fund beyond the 20-year capacity.

## Administrative Alternatives: Grant Conditions

A number of potential adverse environmental impacts have been identified throughout this EIS. In many cases measures can be taken to mitigate these impacts. Mitigation measures have been discussed at various places in the body of this EIS and are summarized in the EIS Summary (Table S-1). Specific mitigation measures are the responsibility of various federal, state or local agencies. For example, several agencies have responsibilities to implement 208 plan recommendations necessary to mitigate nonpoint source impacts of urbanization on surface water in the study area. Certain mitigation measures can also be taken by Metro.

Where EPA determines that mitigation measures are necessary to prevent or minimize unacceptable adverse impacts of the selected project, and that such measures could be taken by Metro, EPA may place conditions on the award of subsequent grants to require that Metro take appropriate mitigative actions. Grant conditions can include specific monitoring requirements, requests for supporting ordinances, and a variety of other controls on the construction and operation of the wastewater treatment and disposal facilities.

EPA regulations require EPA to ensure that a grantee has the authority to fulfill grant conditions. Suggested mitigation measures not included as grant conditions, which are beyond Metro's authority, have been included in this EIS to give the public an idea of measures that could be implemented, and which agencies have responsibility for them. Although these additional measures are not part of the proposed action, and the proposed action is not dependent on them, EPA believes it is appropriate to present them in this EIS.

EPA is considering several potential grant conditions for the Metro facilities plan. Final decisions on grant conditions will be made following public review and comments on this EIS. The general types of grant conditions being considered are discussed here.

Construction and Site-Related Impacts

1. Completion of cultural resources surveys for the routes of the Redmond connection, the North Creek/Hollywood connection, and the tunnel and outfall to Puget Sound.

2. As proposed by Metro, completion of additional predesign engineering and geotechnical studies for the tunnel and outfall to Puget Sound.

Operational Impacts

1. As proposed by Metro, completion of additional predesign oceanographic and biological studies for the selected Puget Sound outfall.

2. To reduce short-term water quality and fisheries impacts in the Green/Duwamish River:

    a. Implementation of measures proposed to be implemented in Metro's Draft Plan.

b. Implementation of some combination of additional measures available mentioned in Metro's Draft Plan, such as diversion, increased treatment, reduced influent pollutant loads, or in-river actions, which can be reasonably expected to correct the short-term problem.

c. Reduction of residual chlorine levels in Renton effluent as soon as possible.

3. Further consultation with local planning agencies and PSCOG to determine 50-year population and peak flow projections derived to the greatest extent possible from current planning or projections.

Secondary Impacts

This Draft EIS has identified a number of potential impacts that could result from projected growth within the study area, for example, impacts on agricultural lands, floodplains and wetlands. EPA recognizes that questions of growth management and land use are primarily the responsibility of local land use agencies. In fact, the King County Sewerage General Plan and General Development Guide (first draft) contain measures designed to protect agricultural lands and sensitive areas. Metro's Resolution 3380 adopts those measures contained in the Sewerage General Plan. However, as shown in this EIS, not all agricultural and sensitive areas which may be important in the study area are protected by these measures.

EPA recognizes that land use and planning and regulation are the responsibilities of local governments. EPA must also be responsive to federal policies. These include Executive Orders 11988 and 11990 on floodplain and wetland protection, and EPA policies on floodplains, wetlands and agricultural lands. EPA regulations require that EPA shall avoid direct and indirect support of floodplain and wetland development wherever there is a practicable alternative. In addition, EPA policy states that EPA shall determine primary and secondary impacts on agricultural land as part of EPA EISs, and recommend mitigation measures. If EPA funds expansion of sewage treatment capacity, and if subsequently that capacity is used to treat wastewater from new development located in agricultural or sensitive lands, which might not otherwise have located in those areas, then the impacts on those lands can logically be considered a secondary or indirect impact of EPA's action, which EPA should attempt to mitigate to the greatest extent practicable.

Given these policies, grant conditions for secondary impacts being considered may provide that:

1. Prior to Metro's construction of any interceptor or trunk sewer projects which will discharge to the Renton treatment plant and which will serve agricultural, floodplain or wetland areas not included in local protective measures, Metro will conduct an analysis, with public involvement, of likely impacts on those areas. These analyses will include an exploration of practicable alternatives which may prevent impacts and measures which may be used to mitigate impacts. These analyses may be incorporated into environmental reports or impact statements prepared pursuant to the State Environmental Policy Act (SEPA).

2. Prior to hook-up of any locally-constructed interceptor to Metro's Renton collection system, Metro will ensure that the responsible local agency has completed an analysis of impacts to agricultural, floodplain or wetland areas as described above. Metro will be responsible for completion of such an analysis if it is not prepared by the responsible local agency.

3. As an alternative to 1 and 2 above, EPA could consider alternative grant conditions which require Metro to certify, before any future Metro collection facilities or local interceptors are allowed to discharge to the Renton system, that such facilities do not and will not service development in designated agricultural, floodplain or wetland areas which are not already protected by local policies.

4. For water quality impacts caused by on-site systems in the nonsewer area, a further grant condition which could be considered is to require assurance that institutional agreements are in place establishing responsibilities for septic tank management in nonsewer areas.

# Chapter 8

# COORDINATION

## Introduction

Section 6.203 of EPA's procedures for implementation of the National Environmental Policy Act requires that EISs discuss the extent and results of coordination activities conducted prior to publication of EISs. This chapter describes the involvement of government agencies, interest groups, and the public in general in determining the scope and content of this EIS.

## Public Participation

Public participation for this EIS has been coordinated, and, where possible, integrated with the full-scale public participation program undertaken by Metro in preparing its Draft Wastewater Management Plan. Key EIS public participation activities to date are summarized below.

### Information Brochure

In August 1979 EPA published a brochure entitled Decisions on Water Quality in the Renton Area. This widely-distributed brochure provided background information on the Wastewater Management Plan being prepared by Metro, listed and discussed key issues for the EIS, described EPA's role in decision making and in preparing the EIS, and identified future public involvement opportunities. The brochure also included a Notice of Intent inviting members of the public to attend the initial project "kickoff" and scoping meetings.

### Scoping Meeting

An initial kickoff/scoping meeting was scheduled for September 16, 1979. Because attendance was much larger than anticipated and exceeded the capacity of the meeting room, the kickoff/scoping meeting was rescheduled and held on October 17, 1979.

Because the kickoff/scoping meeting was jointly held by Metro and EPA, both wastewater planning and EIS issues were discussed. In addition to Metro's presentation, presentations were made by EPA staff and the EIS consultant regarding EPA's role in preparing the EIS and some of the important issues that would be addressed in the EIS.

Following the presentations, most public comments addressed the Wastewater Management Plan. However, one issue was raised by a citizen regarding the importance of air quality considerations in the EIS. This citizen felt that the EIS should consider the inadequacy of the existing monitoring station network for carbon monoxide within the study area; without more monitoring stations in certain "hot spots", the commenter felt, it would be difficult to predict and mitigate the air quality impacts of future growth in the study area. The EIS consultant responded at that time that the EIS would probably not undertake new efforts to predict and mitigate future air quality problems unless the population projections used for wastewater planning were inconsistent with those used for the Washington State Implementation Plan; these population projections have been determined to be consistent in this EIS (see Chapter 6).

## Notice of Intent

On October 2, 1979, EPA's formal Notice of Intent to prepare an EIS was published in the Federal Register.

## Presentation to Wastewater Plan Citizens Advisory Committee

On January 23, 1980, the EIS consultant presented a status report on the EIS to the Renton 201 Citizens Advisory Committee. The different emphases of the Wastewater Management Plan and EIS were discussed.

## Public Meeting on Alternatives

On February 6, 1980, Metro held a public meeting to obtain public input on the advantages and disadvantages of various wastewater management alternatives. EPA staff and the EIS consultant attended this meeting, gave a short presentation on the status of the EIS, and participated in the small group discussions which were the focus of the meeting.

## Public Meetings on Preliminary Plan

On May 13, 14, and 19, 1980, Metro held a series of public meetings on its preliminary plan; in these meetings the contents of the plan were discussed by Metro staff and consultants, followed by a question-and-answer session. EPA staff or the EIS consultant were in attendance at each of these meetings. Two questions arose specifically related to the EIS: 1) whether the EIS would focus on a preferred action or alternative actions, and 2) whether the EIS would address the land use impacts of a Kenmore treatment plant.

Answers given at the meetings to these questions were: 1) alternative courses of action will be assessed in the EIS, and 2) site-specific impacts of the Kenmore plant would be addressed in the EIS, the level of detail depending on the specificity of the Wastewater Management Plan regarding alternatives sites.

## Comments and Suggestions Received During Preparation of the Draft EIS

During the preparation of the Draft EIS numerous comments and suggestions on the EIS approach and content were made by both citizens and agencies. The citizen comments were received in conjunction with the public participation activities reviewed above. Agency input to the Draft EIS was of two types: formal written comments and informal suggestions.

Only two formal written comments were received regarding the scope of the Draft EIS while it was being prepared. Mr. Bob Ziegler, applied ecologist with the Washington Department of Game's Environmental Affairs Program, expressed the following concerns in a April 14, 1980 letter to the EIS consultant: loss of fish and wildlife habitat caused by sewering of unsewered areas and accompanying urban growth; cumulative impacts to the Green-Duwamish fishery resource from proposed widening and deepening of the Duwamish, as well as from stormwater runoff; loss of wildlife habitat from conversion of wetlands in the Green River drainage basin from watershed projects; loss of riparian habitats and wildlife corridors along streams; consistency of the Wastewater Management Plan with local land use planning; and alternatives to sewering. EPA believes that most of the Department of Game's concerns regarding the impacts of urban growth on fish and wildlife are addressed in the secondary impact analysis in Chapter 6 of this EIS; alternatives to sewering are addressed most fully in Metro's Draft Wastewater Management Plan and are presented in Chapter 3 of this EIS.

The second written comment was made by Mr. Bruce Laing, Chairman of King County Council's Growth Management Committee, in a June 6, 1980 letter to Metro. Mr. Laing requested the EIS to analyze the relative impacts of developing six new decentralized treatment plants (under example program C) along the urban fringe, in contrast to continuing interceptor sewer service to the sites. In response to this comment, a section analyzing the land use impacts of the decentralized plants was prepared and is included in Chapter 5 of this EIS.

In addition to these two written comments, numerous suggestions were made to EPA staff or the EIS consultant during meetings with affected agencies. In particular, valuable input was given by staffs of the following agencies during preparation of the Draft EIS: Washington Department

of Ecology, Washington Department of Fisheries, Washington Department of Game, Washington Department of Ecology, King County Planning Division, King County Office of Agriculture, King County Department of Building and Land Development, Puget Sound Council of Governments, and Metro.

## Upcoming Coordination Efforts

This Draft EIS has been forwarded to numerous federal, state and local agencies, special interest groups, and private citizens to act as both an informational document and as an avenue to comment on the proposed wastewater project. The distribution list is shown in Table 8-1. The document has been forwarded to public libraries in the study area so that other concerned residents can review the potential impact of the project.

Individuals of groups that wish to comment on the EIS may forward written comments to:

U. S. Environmental Protection Agency
Region X
1200 Sixth Avenue
Seattle, Washington 98101
Attention: Roger Mochnick M/S 443

Comments should be sent by February 2, 1981.

Joint public workshops have been scheduled on the Draft Wastewater Management Plan and Draft EIS by Metro and EPA during early January 1981. Citizens and agency representatives will have a chance to learn about the plan and EIS, and discuss their questions and concerns in an informal workshop atmosphere. Formal public hearings on the Draft Wastewater Management Plan and Draft EIS have been scheduled for late January 1981. During these public hearings, formal oral and written testimony will be received.

All oral and written comments received on the Draft EIS will be recorded and responded to in a Final EIS, which will be made available to interested individuals, groups and agencies approximately 3 months after the public hearing.

Table 8-1. Distribution List for Draft EIS

Office of the Secretary
U. S. Dept. of Agriculture
Coordinator of Environmental
Quality Activities
Washington, DC 20250

Mrs. Kathi Wilson
Office of Environmental Review
EIS Filing Section (A-104)
U. S. Environ. Prot. Agency
401 M Street, SW, Room 2119 WSM
Washington, DC 20460

Ernest E. Sligh, Director
Environ. Impact Div., FEA
New Post Office Bldg.
12th and Pennsylvania Avenue, NW
Washington, DC 20461

John D. McDermott, Director
Office of Review & Compliance
Adv. Council on Hist. Preserv.
P. O. Box 25085
Denver, CO 80225

Deputy Assistant Secretary for
Mgmt. Analysis and Systems
Dept. of Health, Educ. & Welfare
200 Independence Ave., SW, Room 514F
Washington, DC 20201

Environmental Officer for
Community Plan. & Mgmt.
Housing and Urban Development
1321 2nd Ave., Arcade Plaza
Seattle, WA 98101

Donald Samuelson, Reg. Rep.
Dept. of Transportation, Region X
Arcade Plaza Bldg.
1321 Second Avenue
Seattle, WA 98101

Oil & Special Materials Div.
Water Prog. Operations (WH-548)
Environ. Prot. Agency
Room 2106, Waterside Mall
Washington, DC 20460

Santo A. Furfari
Public Health Serv.-DHEW
Northeast Technical Center
CB Center Bldg., S-26
Davisville, RI 02854

Adv. Council on Hist. Preserv.
Office of Arch. & Environ. Pres.
Suite 430, 1522 K St., NW
Washington, DC 20005

Mr. Bruce Blanchard, Dir.
Office of Environ. Proj. Review
Interior Bldg., Room 4256
Washington, DC 20240

Office of Legislation (A-102)
Environ. Prot. Agency
Room 3105, WSM
Washington, DC 20460

Office of Public Affairs (A-107)
Environ. Prot. Agency
Room 3014, WSM
Washington, DC 20460

National Marine Fisheries
NOAA
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P. O. Box 4332
Portland, OR 97208

U. S. Dept. of Agriculture
Area Conservationist
Suite 214, Bldg. 4
300 120th Ave., NE
Bellevue, WA 98005

Seattle Dist. Corps of Engineers
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4735 E. Marginal Way, S
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Dr. R. D. Daugherty, Director
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Facility Requirements Division (WH-595)
Environ. Prot. Agency
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Washington, DC 20460
Attn: Sylvia Lowrance

Kaylor Martinson, Regional Director
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Lloyd 500 Bldg. - 1692
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Portland, OR 97232

Office of the Governor
State Planning Division and Community
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100 Insurance Bldg.
Olympia, WA 98504

Ecological Commission
c/o WA Dept. of Ecology
Olympia, WA 98504

Director, WA Dept. of Fisheries
Room 115, General Admin. Bldg.
Olympia, WA 98501

Director, Heritage Conservation
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Room 312, 915 Second Avenue
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Commissioner of Public Lands
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