Combined Sewer Overflow Control Plan 1995 Update

An Amendment to Metro's Comprehensive Water Pollution Control Abatement Plan

February 1995

METRO
King County Department of Metropolitan Services

Clean Water – A Sound Investment

COMBINED SEWER OVERFLOW PLAN
1995 UPDATE

King County Department Of Metropolitan Services
Water Pollution Control Department
Capital Facilities Planning and Program Management
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Brown and Caldwell/KCM and Associated Firms

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EXECUTIVE SUMMARY

Metro was first formed as a metropolitan municipal corporation ("The Municipality of Metropolitan Seattle") in 1958 to clean up the waters of Lake Washington and the City of Seattle (City) waterfront. Today, as the King County Department of Metropolitan Services, Metro provides sewage treatment services to 33 cities and districts within and adjacent to King County. Seattle is the largest local agency served by Metro. The City and Metro have cooperated to jointly plan improvements to their respective wastewater systems because they both recognize the impact of each system on the other.

Combined sewer overflows, or CSOs, are discharges of untreated sewage mixed with stormwater released directly into lakes and rivers during periods of heavy rainfall. In a combined sewer system such as exists in parts of Seattle, sanitary sewage from businesses and households are combined with runoff from precipitation during storms. During long or intense storms, the additional stormwater exceeds the capacity of the sewers, causing overflows at designated points within the collection system. City and Metro overflows occur along the shorelines of Lake Washington, Lake Union, the Ship Canal, the lower Duwamish River, Elliott Bay, and along the West Seattle shoreline.

Planning for control of CSOs was first required by Section 201 of the Federal Water Pollution Control Act of 1972, commonly known as the Clean Water Act. Metro's first major CSO control effort was its *1979 CSO Control Planning Report*, prepared in conjunction with the City of Seattle's CSO planning. The Metro plan recommended a combination of storage and treatment facilities to reduce CSO discharges.

The 1985 Washington State Water Pollution Control Act (R.C.W. 90.48), required all cities with CSOs to provide "...the greatest reasonable reduction at the earliest possible date" (R.C.W. 90.48.480). In January of 1987, the Washington Department of Ecology defined "greatest reasonable reduction" to mean "control of each CSO such that an average of one untreated discharge may occur per year" and set this as a long-term goal to be achieved without defining a specific target date (WAC 173-245-020 (22)). At the same time, the department recognized that such a limit could not be achieved overnight and agreed that reducing CSO volumes by 75 percent system-wide by the end of 2005 was a reasonable interim goal. Metro's *Final 1988 Combined Sewer Overflow Control Plan (1988 Plan)* was developed to achieve that interim goal.

As part of the renewal process (currently underway) for its West Point National Pollution Discharge Elimination System (NPDES) permit, Metro must prepare an update/ amendment to its CSO reduction plan. That amendment must include an assessment of the effectiveness of CSO reduction efforts to date, a re-evaluation of priority for CSO sites, and a list of projects for the next five years (WAC 173-245-090(2)). This report is intended to serve as the required 1995 update of the *1988 Plan* in compliance with regulatory requirements.

In addition to CSO control obligations imposed on Metro by statute and regulation, Metro has also agreed with the National Oceanic and Atmospheric Administration

(NOAA) to improve sediment quality in Puget Sound and to clean up sediments contaminated in the past by CSO discharges and stormwater discharges. That agreement is contained in a 1990 settlement agreement following a lawsuit initiated by NOAA. NOAA has the right to bring suit in the future if sediment contamination is not reduced. Planning for CSO control must take this agreement into account, and adherence to all regulatory requirements will not guarantee compliance with the NOAA agreement.

The *1995 CSO Update* is organized into six chapters. The first chapter defines CSOs and summarizes the CSO problem. Chapter 2 provides the legal context for the *1988 Plan.* It includes a brief history of Metro, and it describes the regulatory environment as it pertains to CSO control. Metro planning efforts to comply with that evolving regulatory framework are summarized. The third chapter describes the Metro wastewater system. Chapter 4 evaluates Metro's progress in CSO Control since the *1988 Plan.* The chapter also includes an evaluation of the cost-effectiveness of past control efforts. Chapter 5 describes specific CSO-control studies and projects planned for the next five years. Chapter 6 describes the environmental documentation for CSO projects and this *1995 CSO Update.*

In Table ES-1, the column labeled "Stations" includes a list of all permitted CSO locations in the Metro system. The column labeled "1988 Baseline (MG)" displays the average yearly volume in million gallons as included in the *1988 Plan.* These were the estimated overflow volumes from the system as it existed in the 1981-83 period. The baseline data from the 1981-83 period constitutes the starting point from which progress toward CSO-reduction is measured. Since the *1988 Plan* was prepared, Metro has developed a new, more sophisticated computer model for simulating the behavior of its conveyance system during storms and has acquired additional data with which to calibrate its model. One result of the new model has been the development of a revised set of baseline data defining existing CSO volumes. This revised data, shown in the middle column of Table ES-1 and labeled, "Revised Baseline," represents a better estimate of baseline conditions resulting from the newer, more sophisticated model.

Table ES-1. Baseline Metro Overflow Volumes

Station	1988 Plan Baseline (MG)	Revised Baseline (MG)[d]	Difference in Volume (MG)
Southern Service Area			
8th Avenue South	15	15	0
W. Michigan Street	2	2	0
Terminal 115	N/A	5	5
Harbor Avenue	55	55	0
East Marginal Way	N/A	0	0
Chelan Avenue	25	73	48
Norfolk Street	4	60	56
Michigan Street	250	190	(60)
Brandon Street	35	60	25
Hanford #1	N/A		
Hanford #2	N/A		
Total Hanford	680[c]	605[c]	(75)
Lander #1	215	190	(25)
Connecticut Street	90	90	0
King Street	70	55	(25)
Denny Local	N/A		
Denny Lake Union	N/A		
Interbay	N/A		
Total Denny	370[c]	405[c]	35
Duwamish	130	1	(129)
Martin Luther King Way[a]	N/A	88	88
Rainier Avenue	N/A	0	0
Henderson Street[a]	N/A	10	10
S. Magnolia[a]	N/A	15	15
Northern Service Area	N/A		
Dexter Avenue	12	15	3
Canal Street	10	1	(9)
East Pine Street	N/A	0	0.
30th Avenue NE	N/A	0	0
Belvoir	N/A	0	0
Matthews Beach	N/A	0	0
University	211	110	(111)
Montlake	40	10	(30)
Ballard Regulator	N/A		
11th Avenue NW	N/A		
Total Ballard	90[c]	90[c]	0
3rd Avenue West	105	125	20
North Beach[a]	N/A	2	2
Alki			
Murray[b]	N/A	5	5
Barton[b]	N/A	7	7
53rd Avenue SW	N/A	<1	<1
SW Alaska Street[b]	N/A	12	12
63rd Avenue[b]	N/A	95	95
Total (MG)	**2409**	**2391**	**(18)**

[a]Stations not connected to CATAD and for which data was limited or non existent in 1988.
[b]Stations thought to be controlled in 1988, but not. Error resulted from problem with CATAD sensors.
[c]Methodology used to make these estimates necessitated the reporting of totals for closely associated overflows.
[d]Revised 1981-83 baseline estimate based on new model.

The *1988 Plan* described specific Metro projects and proposed completing them over a 20-year period in four phases. The projects and their phased completion dates were:

Phase 1: Completion of Ongoing CSO Control Projects (1987-1991)

- Hanford Separation/Bayview Storage
- CATAD Modifications

Phase 2: Completion by 1997

- Alki CSO Treatment Plant Project
- Carkeek Park CSO Treatment Plant Project
- Parallel Fort Lawton Tunnel
- University Regulator (Green Lake/Portage Bay Improvement Project)
- Lander Separation

Phase 3: Completion by 2001

- Denny Partial Separation

Phase 4: Completion by 2006

- Michigan Street Separation
- Kingdome/Industrial Separation

Nearly all Phase 1 and Phase 2 projects have been completed or will be completed by late 1997. Figure ES-1 shows the Metro CSO locations and an indication of whether they will have been controlled to one event per year by the time those Phase 1 and Phase 2 projects have been completed at the end of 1997. The Phase 3 Denny Partial Separation has been modified and delayed as discussed below. No Phase 3 or Phase 4 projects will have been completed prior to 1998.

The Phase 3 Denny Partial Separation Project has been modified by substitution of a new Denny Way/Lake Union storage and conveyance project developed jointly by Metro and the City of Seattle. The project includes an 18-foot diameter storage tunnel under Mercer Street from Westlake Avenue to Elliott Avenue, a storage tank at the former site of the Blackstock Lumber Company on Elliott Avenue, a new outfall to Puget Sound, two pump stations, and the necessary auxiliary pipelines and regulators. The project will achieve approximately 50 percent reduction of Denny overflows. The City of Seattle conveyance project associated with the Denny facilities is designed to control City overflows to Lake Union to a frequency of one event per year. The Denny project is planned to coordinate with wastewater system improvements proposed by the RWSP.

In addition to the Denny Way/Lake Union CSO Control Project, Metro has proposed two new CSO reduction projects in this Update. The Harbor CSO Pipeline Project is an addition to the Alki Transfer/CSO Facilities Project. Metro has proposed adding a 54-inch diameter gravity sewer to carry overflows from the Harbor Regulator to the planned

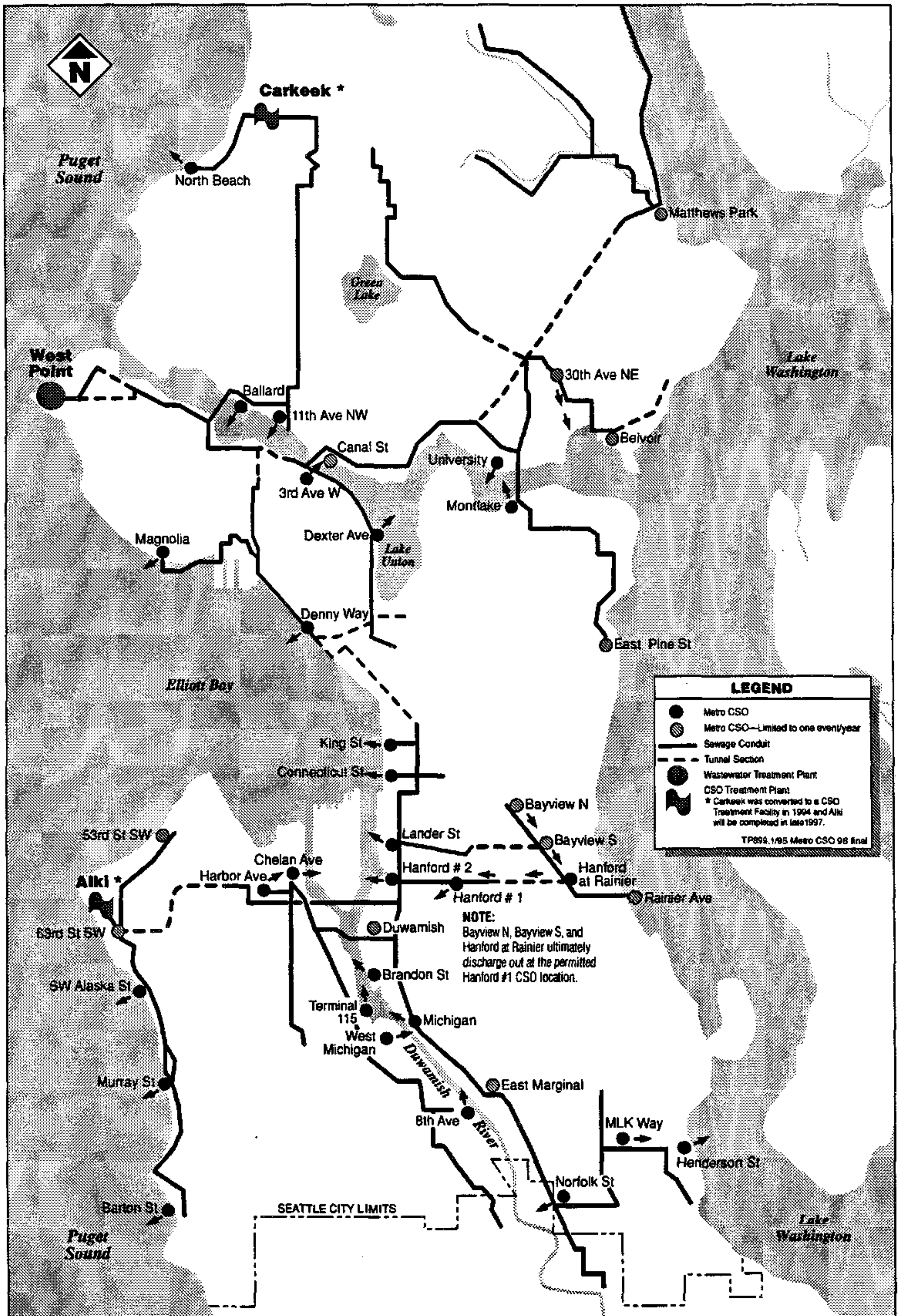


Figure ES-1. Combined Sewer Overflow Locations

10-foot diameter West Seattle Tunnel. Those overflows would be stored there until after a storm is over and flows in the Elliott Bay Interceptor have subsided. Then the stored Harbor Avenue flows would be pumped into the interceptor and be conveyed to West Point for treatment. The Harbor pipeline would control overflows at the regulator (presently estimated at 58 MG per year) in all but the largest storms. A Harbor project had originally been scheduled after the Phase 4 projects in the *1988 Plan*. Metro has accelerated a Harbor project ahead of the Phase 3 and Phase 4 projects because the Alki plant conversion requires a new forcemain from the West Seattle Pump Station at the end of the tunnel to pass by the Harbor Regulator. By laying both the forcemain and the CSO pipeline into the same trench at the same time, Metro could reduce construction costs and community impacts dramatically.

The other project Metro has added to its CSO control program is an engineering evaluation of overflows at the South Henderson Street Pump Station (presently estimated at 10 MG per year) and the Martin Luther King Way overflow weir (approximately 88 MG per year). In 1988, Metro believed these two overflows to Lake Washington had been controlled to one event per year, but recent monitoring data indicate otherwise. The overflow problem is believed to result from stormwater-related inflow from roof tops and infiltration remaining in these areas after partial separation, but a detailed study must be done and the causes of the problems better understood before solutions can be proposed. This evaluation will not directly result in CSO volume reduction. A final decision on how to control overflows at these sites and a schedule for their control will be made as part of the recommendations within the RWSP.

Table ES-2 shows the CSOs which have been controlled to one event per year, as well as the remaining annual volume and frequencies of CSOs needing to be controlled as of 1998, after all the projects presently underway have been completed in late 1997. The remaining volume to be controlled depends on the different assumptions about how much flow will be allowed to reach the West Point Treatment Plant. While engineering design data exists which indicate that 440 million gallons per day (mgd) can be routed through the plant, some concerns remain about plant operability during high flows. These concerns may require restricting these flows to 400 mgd. Reductions in flow to West Point will result in higher overflow volumes at some overflow points and lower overflows at others. The major increase occurs at the Denny overflow due to restrictions on the pumping rate at the Interbay Pump Station. Decreases in overflow occur at sites along the Lake Washington Ship Canal. The total impact of reduced West Point flow is an increase in total overflow volumes of less than six percent. Metro is examining what changes, if any, are necessary to routinely allow maximum flows of 440 mgd to reach West Point. This examination will be completed in late 1995.

Table ES-2 shows that by 1998, upon completion of all of the projects presently underway, Metro will have controlled approximately 796 to 886 million gallons of overflow. That amounts to approximately 33 to 37 percent of its revised 1988 baseline CSO volumes, depending on the maximum flow allowed to West Point. Either figure is below the 50 percent reduction anticipated by the end of Phase 2 in the *1988 Plan*.

Table ES-2. Annualized 1998 Baseline CSO Volumes and Frequencies

Overflow Location	Interbay Pump Station Unrestricted WP 440 mgd (MG)	Interbay Pump Station Restricted WP 400 mgd (MG)	Difference (MG)	Annual Overflow Frequency
Southern Service Area				
8th Avenue South	12	12	0	12
W. Michigan Street	2	2	0	9
Terminal 115	5	5	0	8
Harbor Avenue	58	58	0	56
East Marginal Way	0	0	0	<1
Chelan Avenue	66	66	0	25
Norfolk Street	6	6	0	4
Michigan Street	173	173	0	40
Brandon Street	57	57	0	40
Hanford #1 [a]	7	7	0	3
Hanford #2	202	207	5	23
Lander #2 [b]	161	164	3	23
Connecticut Street	91	93	2	25
King Street	23	33	10	31
Denny Local	79	82	3	51
Denny Lake Union	265	270	5	51
Interbay at Denny [c]	8	103	94	4 or 21
Total of Denny	*352*	*455*	*103*	
Martin Luther King Way	88	88	0	23
Rainier Avenue	0	0	0	<1
Henderson Street	10	10	0	16
Duwamish.	1	1	0	<1
S. Magnolia	15	15	0	21
Northern Service Area				
Dexter Avenue	15	15	0	4
Canal Street	<1	<1	0	<1
East Pine Street	0	0	0	<1
30th Avenue NE	0	0	0	<1
Belvoir	0	0	0	<1
Matthews Beach	0	0	0	<1
University	58	48	-10	8
Montlake	4	4	0	4
Ballard Regulator	4	1	-3	5
11th Avenue NW	18	16	-2	15
3rd Avenue West	51	33	-18	12
North Beach.	2	2	0	18
Alki				
Murray [d]	5	5	0	8
Barton [d]	7	7	0	23
53rd Avenue SW	<1	<1	0	<1
63rd Avenue SW	0	0	0	<1
SW Alaska Street [d]	12	12	0	23
Total (MG)	**1505**	**1595**	**90**	

[a] Includes overflows at Bayview North, Bayview South and S. Hanford St. at Rainier Ave. that overflow to the storm drain which leaves the system at the site of the former Hanford #1 Regulator.
[b] The Lander Separation included construction of a new regulator station.
[c] Frequency depends on West Point set point.
[d] The Alki basin calibration has not been completed for these overflow locations.

Based on Metro's current modeling and after completion of the new Denny/Lake Union CSO Control Project and the Harbor CSO Pipeline Project, annual overflow volumes will have been reduced by approximately 1,019 to 1,211 MG, or 43 to 51 percent of baseline CSO volumes, depending on West Point peak flows. The *1988 Plan* predicted that upon completion of all Phase 3 projects, Metro would have achieved about 60 percent CSO volume reduction. Assuming completion of the Phase 4 projects identified in the *1988 Plan* and the Denny and Harbor projects discussed above, Metro expects to have controlled from 57 to 65 percent of baseline volumes, still short of the 76 percent reduction projected in the *1988 Plan.* The RWSP will identify further control projects necessary to achieve the required reduction.

It now appears that the 1988 projections were overly optimistic. Reasons why control projects have achieved less than expected levels of control include:

1. The model used for estimating the CSO volumes for the *1988 Plan* over-estimated the overflows at the Duwamish Pump Station by 129 MG/year. It was also anticipated that this overflow would be controlled. Since the overflow did not in fact occur, no reduction is shown in the 1998 conditions.

2. The model used for estimating the CSO volumes for the *1988 Plan* overestimated the University overflows by nearly 50 percent (111 MG/year). As a result, the reduction assumed by the control projects for this regulator was overstated, and actual volume reduction resulting from those projects is lower than expected.

3. Stations not connected to CATAD in 1988 and for which data was limited or non-existent were not considered in the *1988 Plan.* These overflows amount to about ten percent of the baseline estimate. Since the *1988 Plan* did not make provision for CSO control at these locations, inclusion of these volumes now offsets real control gains made elsewhere within the system.

4. The degree of partial separation assumed for the Hanford and Lander separation projects was greater than was actually accomplished.

The actual capital costs for Phase 1 and 2 projects from the *1988 Plan* total $61 million (1994 dollars). Together those projects have (or will have, by 1998) controlled 33 to 37 percent of baseline volumes, or approximately 796 to 886 MG per year. Because volume controlled has amounted only two-thirds of what was anticipated, costs per million gallons controlled have averaged about 50 percent greater than anticipated by the *1988 Plan*, or about $73,000 per million gallons controlled. The *1988* Plan goal was to reach 75 percent volume reduction, which amounts to nearly an 1,800 MG reduction from the 1981-83 baseline volume of 2,391 MG. Metro still must reduce an additional 900 to 1,000 MG of annual CSO volume by the end of 2005 to reach that 1,800 MG goal. Estimates indicate that reaching 75 percent reduction of system-wide CSO volumes is likely to cost as much as $300 million over and above what has been spent to date, bringing the average cost of control to as much as $200,000 per million gallons.

CHAPTER 1
INTRODUCTION

In this chapter, the scope and organization of this *1995 CSO Update* are described. CSOs are defined, and the CSO problem is summarized. The chapter concludes by delineating the reasons for this *1995 CSO Update*.

Scope and Organization of Report

This report is organized into an Executive Summary and six chapters, plus appendices. Each chapter covers the following information:

Executive Summary

The Executive Summary reviews the highlights of the *1995 CSO Update*. It provides an overview of CSOs, what has been done to reduce them, and what more needs to be done.

Chapter 1. Introduction

The introduction describes the scope and organization of the *1995 CSO Update*. In addition, CSOs are defined and the CSO problem is summarized. The chapter also includes the reasons that the *1995 CSO Update* was prepared.

Chapter 2. Metro CSO History

This chapter provides a short history of Metro, along with an overview of CSO planning history. The overview describes the CSO regulatory framework governing Metro operations and the manner in which that framework evolved. The chapter also describes past planning efforts by Metro to comply with regulatory mandates.

Chapter 3. Overview of the Wastewater Conveyance System

This chapter provides a brief overview of existing Metro CSO facilities and the relationship between the City of Seattle and the Metro systems.

Chapter 4. Review of the Existing CSO Program

This chapter describes the conditions of the 1981-83 wastewater system with respect to CSO discharges, describes the status of CSO control projects proposed in earlier plans, and evaluates the impact of CSO-control facilities already constructed or presently under construction. This chapter also examines water and sediment quality issues and evaluates the cost-effectiveness of CSO reduction efforts.

Chapter 5. CSO-Control Projects for the Next Five Years

This chapter describes specific CSO-control studies and projects planned over the next five years in order to meet the Department of Ecology's goal of "...greatest reasonable reduction" and the interim goal of 75 percent volume reduction by the end of 2005. This chapter also provides information as to the costs, benefits, and scheduling of projects.

Chapter 6. Environmental Review

This chapter describes existing environmental documentation for CSO projects and the SEPA documentation required for the 1995 CSO Update.

Appendices

Appendix material includes:

A. A CSO Glossary

B. A CSO Bibliography

C. CSO Rate Analysis and Capital Improvement Program Schedule, Funding and Costs

D. SEPA Adoption Notice and Addendum

E. Results of CSO Monitoring Program

F. Basis of Capital Cost Estimates

CSOs: A Working Definition

Combined sewer overflows, or CSOs, are discharges of untreated sewage and stormwater released directly into marine waters, lakes, and rivers during periods of heavy rainfall. The upper illustration in Figure 1-1 provides a graphic representation of a CSO.

Combined sewers, those which carry sanitary sewage and storm runoff in a single pipe, are found in much of the Seattle sewer system today. Early engineers designed combined sewers to remove horse manure, runoff and garbage from city streets, as well as to convey household sewage. Because combining systems was the standard engineering practice, all of Seattle's sewers built from 1892 until the early 1940s were

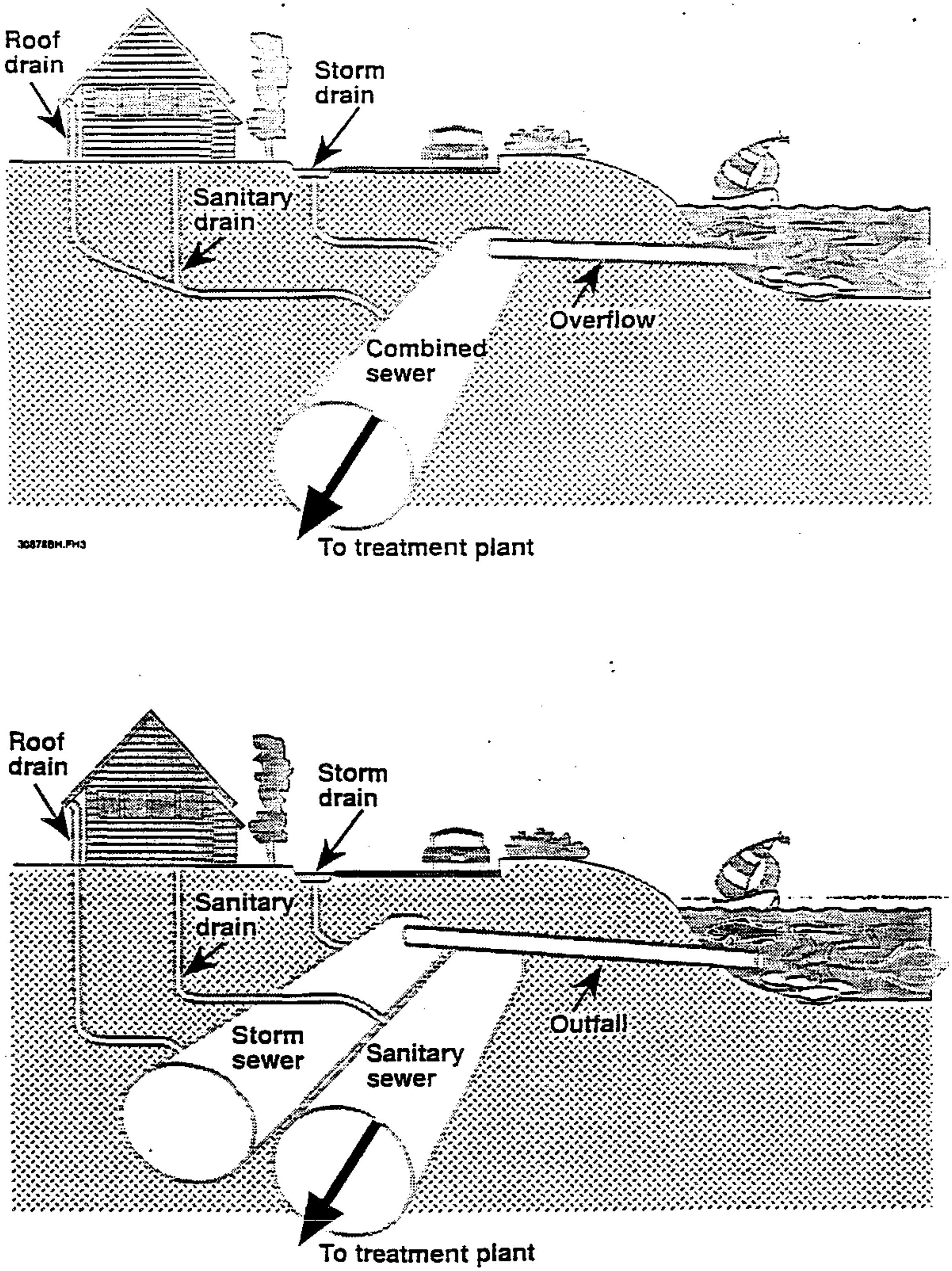


Figure 1-1. Combined and Separated Sewer Systems

combined sewers. When new sewer systems are installed in Seattle today, stormwater is separated from household, commercial, and industrial wastewater. This dual network of pipes, known as a separate sewer system or separated sewers, is illustrated in the lower part of Figure 1-1. Separated sewers have been mandatory within the City of Seattle since 1950.

Combined sewer overflows serve as safety valves for the sewer system. In combined sewer systems, the trunk sewers and interceptors have fixed capacities while the wastewater flows vary with precipitation. During periods of heavy or prolonged precipitation, wastewater volumes may exceed the capacity of the sewer pipes to convey that wastewater to a treatment plant. To prevent damage to wastewater treatment plants and to prevent sewers from backing up into homes and offices, combined sewers are designed to overflow at certain points. Typically, those overflow points are designed so that the overflowing wastewater can be discharged to marine waters and rivers, where the flushing action of tides and currents can disperse pollutants.

The CSO Problem and Regional Water Quality

Combined sewer overflows spill a mixture of untreated sanitary sewage and stormwater runoff at or near the shoreline. City of Seattle and Metro overflows occur along the shorelines of Lake Washington, Lake Union, the Ship Canal, the lower Duwamish River, Elliott Bay, and along the West Seattle shoreline. During the 1981-83 baseline period, nearly 2.4 billion gallons of untreated sewage were discharged from the Metro system per year. As a result of control efforts over the years, that number has been significantly reduced. As of 1994, even with the reductions achieved, about 1.8 billion gallons per year of combined sewage still overflows the Metro system.

Combined sewer overflow is a recognized source of water pollution. Overflows can result in aesthetic degradation of shorelines during CSO events and impact sediment quality at discharge sites. In addition, CSOs may raise public health concerns in areas where there is potential for public contact.

Why a 1995 CSO Update

Planning for control of CSOs was first required by Section 201 of the Federal Water Pollution Control Act of 1972, commonly known as the Clean Water Act. Metro's first major CSO control effort was its *1979 CSO Control Planning Report*, done in conjunction with the City of Seattle's CSO planning. The Metro plan recommended a combination of storage and treatment facilities to reduce CSO discharges.

The 1985 Washington State Water Pollution Control Act (R.C.W. 90.48), required all cities with CSOs to provide "...the greatest reasonable reduction at the earliest possible date" (R.C.W. 90.48.480). In January of 1987, the Washington Department of Ecology defined "greatest reasonable reduction" to mean, "control of each CSO such than an average of one untreated discharge may occur per year" and set this as a long-term goal to be achieved without defining a specific target date (WAC 173-245-020 (22)). At the same time, the department recognized that such a limit could not be achieved overnight and agreed that reducing CSO volumes by 75 percent system-wide by the end of 2005 was a reasonable interim goal. Metro's *Final 1988 Combined Sewer Overflow Control Plan (1988 Plan)* was designed to achieve that interim goal.

As part of the renewal process (currently underway) for its West Point National Pollution Discharge Elimination System (NPDES) permit, Metro must prepare an update/ amendment to its CSO reduction plan. That amendment must include an assessment of the effectiveness of CSO reduction efforts to date, a re-evaluation of priority for CSO sites, and a list of projects for the next five years (WAC 173-245-090(2)). This report is intended to serve as the required 1995 update of the *1988 Plan* in compliance with regulatory requirements.

In addition to CSO control obligations imposed on Metro by statute and regulation, Metro has also agreed with the National Oceanic and Atmospheric Administration (NOAA) to improve sediment quality in Puget Sound and to clean up sediments contaminated in the past by wastewater and CSO discharges. That agreement is contained in a 1990 settlement agreement following a lawsuit initiated by NOAA. NOAA has the right to bring suit in the future if sediment contamination is not reduced. Planning for CSO control must take this agreement into account, and adherence to all regulatory requirements will not guarantee compliance with the NOAA agreement.

Besides meeting legal requirements, this *1995 CSO Update* is intended to inform the King County Metropolitan Council and the public about the technical aspects of CSO control and about improvements needed to provide that control.

CHAPTER 2
METRO CSO HISTORY

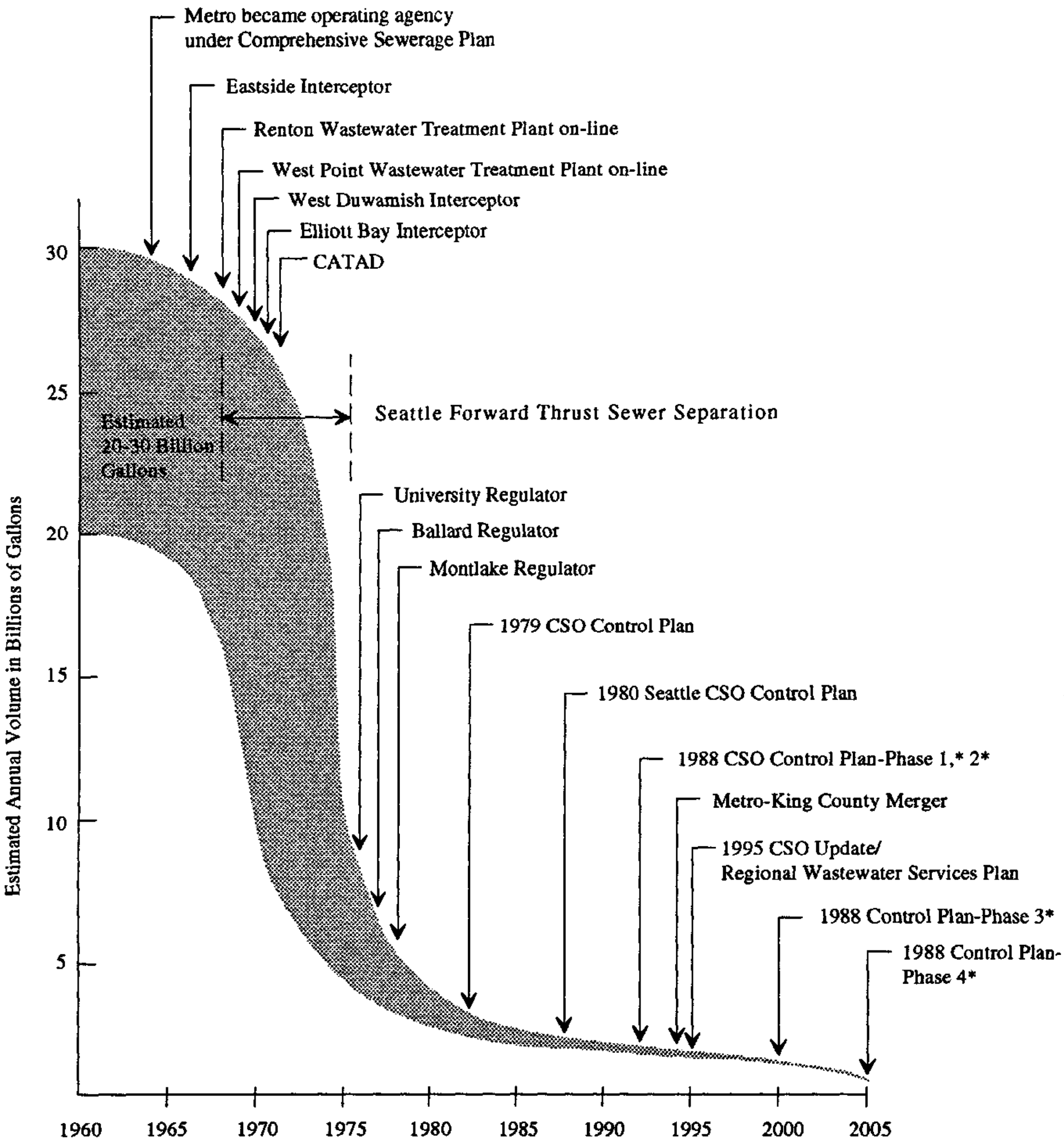
Metro was first formed as a metropolitan municipal corporation ("The Municipality of Metropolitan Seattle") in 1958 to clean up the waters of Lake Washington and the Seattle waterfront. In 1962, the City of Seattle transferred ownership of its treatment plants and portions of its sewer system to Metro, and Metro's monthly service charge went into effect. Today, Metro provides sewage treatment services to 33 cities and districts within and adjacent to King County. Metro operates wastewater treatment plants at West Point and Renton, a CSO treatment plant at Carkeek Park, and a primary treatment plant which is presently being converted to a CSO treatment plant at Alki. Metro also operates a series of large interceptor sewers to convey wastewater from local collection systems to a Metro plant for treatment. Metro thus operates a "wholesale" business, providing sewage conveyance and treatment services to "retailers" such as Seattle, who in turn sell sewer services to area residents and businesses. Seattle and the other local agencies are responsible for maintaining their own sewer collection systems. Seattle is the largest of the 33 local agencies served by Metro and the only one with a combined sewer system. In order to reduce CSOs in a more efficient manner, the City of Seattle and Metro have worked together on some wastewater system improvements.

In 1993, voters in King County voted to merge Metro with King County. That merger took effect on January 1, 1994. Metro ceased to exist as a separate entity as of that date and became the King County Department of Metropolitan Services. Likewise, the Metro Council was dissolved, and the King County Executive and Metropolitan King County Council assumed responsibility for sewers and water quality, including CSO reduction.

Clean Water Act

Since the 1960s, Metro has been conducting projects to improve water quality in the Seattle-King County area. Figure 2-1 graphically represents the progress Metro and the City of Seattle have made in reducing the volume of untreated wastewater released to local waters since then. The largest reductions in wastewater discharge occurred between 1965 and 1980, when the major Metro treatment plants and interceptors were built and a number of City separation projects were completed. The formal CSO control program was begun in 1979 with the development of the *1979 Combined Sewer Overflow Control Program (1979 Program).*

The impetus for the *1979 Program* was the passage of the Federal Water Pollution Control Act Amendments of 1972 (Public Law 92-500), also known as the Clean Water Act. The objective of the act was to "restore and maintain the chemical, physical, and biological integrity of the nation's waters." This goal was to be achieved through a large federal grant program to help communities build secondary wastewater treatment plants,



*Projects associated with1988 Plan phases are listed in Table 5-1 on page 5-3.

Source: Metro Staff Estimates

Figure 2-1
Reduction in Untreated Sanitary and
Combined Sewer Overflows in Seattle Area Since 1960

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and through implementation of the National Pollutant Discharge Elimination System (NPDES) permit program. NPDES permits set limitations on the volume and concentrations of pollutants that can be legally discharged into the environment by both municipalities and industries. In 1973, the Department of Ecology was authorized by the federal Environmental Protection Agency (EPA) to administer the NPDES program in Washington State.

By mid-1976, joint planning was underway by the EPA, Department of Ecology, and Metro to develop, evaluate, and fund alternatives which would provide secondary treatment and CSO controls. In 1977, amendments to the Clean Water Act increased the amount of funding available through EPA for combined sewer overflow control projects. These amendments also provided for waivers from secondary treatment if receiving water quality could be adequately protected. It became apparent that the progress on planning for treatment facilities was going to be delayed significantly by requests for waivers. These developments eventually led to the segregation, in 1978, of the combined sewer overflow control elements from treatment-related decisions.

The *1979 Program* identified a total of 30 projects to control CSO discharges to fresh water and marine waters. EPA had stipulated that grant money would be available only to those projects which could demonstrate a benefit justifying the cost of the project. The 30 projects were evaluated according to their benefit-to-cost ratio. That cost-to-benefit analysis was an important method of evaluating project proposals prior to 1986. Subsequent regulatory changes adopted performance standards, using one event per year as a goal. As a result, later CSO control studies would place greater emphasis on whether a project could control CSO volumes to the levels specified in those regulations and less emphasis on costs versus marginal benefits.

During the early 1980s, considerable public attention focused on Puget Sound water quality and pollution issues, particularly contamination in urban bays. In May of 1984, Metro issued the *Toxicant Pretreatment Planning Study Summary Report*, which described toxicant problems in Elliott Bay and other bays and raised concerns about CSO impacts on sediment quality at discharge sites. That same year, the Department of Ecology introduced legislation requiring all municipalities with CSOs to develop plans for "the greatest reasonable reduction (of CSOs) at the earliest possible date."

Greatest Reasonable Reduction of CSO

In order to comply with the Department of Ecology legislation, Metro produced two documents: the *1985 Final Plan for Combined Sewer Overflow Control (1985 Plan)* and the *1986 Final Supplemental Plan for Combined Sewer Overflow Control (1986 Final Supplement)*. Each of these documents were part of a five volume *Plan for Secondary Treatment Facilities and Combined Sewer Overflow Control,* which explored four alternative plans for secondary treatment and associated plans for varying reductions in CSO volumes.

The *1986 Final Supplement* was prepared in response to the agreement between Metro and the City of Seattle to evaluate a fifth secondary treatment configuration: the relocation of the West Point plant to a non-shoreline location. The supplement presented additional CSO controls which would accompany this fifth alternative. In addition, Metro evaluated CSO projects which would achieve 75 and 90 percent volume reductions for all five secondary treatment configurations and included the results of upgraded computer modeling of the system.

Before the *1985 Plan* could be implemented, the Department of Ecology published a new regulation on CSO control, in January 1987. The regulation (WAC 173-245) defined the "greatest reasonable reduction" in CSO volumes as "control of each CSO such that an average of one untreated discharge may occur per year." The regulation further required that each community submit, by 1988, a CSO plan specifying the means of complying with the new CSO control level. The regulation also required that updates on the progress of the plan are to be produced with NPDES renewals which occur at least every five years. Metro worked with the Department of Ecology to develop an interim goal of achieving a 75 percent CSO volume reduction system-wide by the end of the year 2005 and agreed to continue to work towards achieving the ultimate goal of one event per year.

The revised plan, the *Final 1988 Combined Sewer Overflow Control Plan*, was submitted in April 1988. The plan describes CSO control projects that would be implemented to achieve the interim goal of 75 percent CSO volume reduction by the end of 2005. The plan also describes additional projects that could achieve the ultimate goal of one CSO event per year.

A *1988 Plan* update was required in 1991, but Metro and the Department of Ecology agreed that the 1991 update would include only monitoring data and status reports on all scheduled projects because only one project had been completed since the *1988 Plan*. However, as agreed with the Department of Ecology, Metro has prepared annual reports on the status of CSO projects and submitted them to the Department of Ecology yearly since 1988. Nevertheless, the *1995 CSO Update* is the first major report on the status of the CSO projects which have been completed or are underway since the *1988 Plan*.

The 1995 Regional Wastewater Services Plan

Metro's CSO planning is only one component of Metro's current long-range wastewater planning effort, the *1995 Regional Wastewater Services Plan (RWSP)*.

The *Metropolitan Seattle Sewerage and Drainage Survey* was prepared in 1958 to guide a long-range program of sewerage and drainage services for the Seattle area. That first comprehensive planning document was intended to provide a concise, up-to-date, central source of information concerning Metro's long-range plans. Since that time, numerous changes have been made to the original comprehensive plan. The RWSP will be an amendment to the *Metropolitan Seattle Sewerage and Drainage Survey* that will integrate long range planning in all areas of wastewater services, including treatment and conveyance, biosolids reuse, CSO control, and water reuse. The RWSP planning process will establish the priorities for all wastewater programs, including those that affect CSO controls. The RWSP is scheduled for completion in late 1995.

National Oceanic and Atmospheric Administration (NOAA) Agreement

In addition to EPA and the Department of Ecology, governmental requirements for support of CSO control have come from the National Oceanic and Atmospheric Administration (NOAA).

In 1990, Metro and the City of Seattle entered into a consent decree with NOAA as a result of a suit NOAA (as "trustee" of federal shorelines under the federal Comprehensive Environmental Response, Compensation, and Liability Act) filed over resource damages to marine sediments associated with CSOs and stormwater discharges. Under this agreement, Metro and the City of Seattle agreed to establish a fund for habitat enhancement and clean-up of contaminated sediments. NOAA has reserved the right to bring suit in the future if progress toward improving sediment quality is not maintained. Future CSO control planning by Metro must take into account the standards which NOAA will use to gauge continued progress. Compliance with federal and state regulations does not guarantee compliance with the provisions of the NOAA agreement.

CHAPTER 3
WASTEWATER CONVEYANCE SYSTEM OVERVIEW

Metro's wastewater system is the largest in the Puget Sound region. The system is composed of an extensive configuration of conveyance facilities, regulator stations, combined sewer overflow structures, and wastewater treatment plants. The conveyance facilities consist of pump stations, force mains, and gravity sewers that transport wastewater to the treatment plants. After treatment and disinfection, treated effluent is conveyed through outfall pipes to Puget Sound.

The locations of the wastewater system components are shown in Figure 3-1. Figure 3-1 also shows the locations of facilities which are under design or construction and which are scheduled to be on-line by January 1998. As illustrated, the Metro system consists of over 255 miles of pipeline, 38 pump stations, 22 regulator stations, four treatment plants, and 34 CSO structures. Each of these components is described briefly in the following sections.

Service Area

The Metro service area is composed of an East and a West Division, roughly split by Lake Washington. The wastewater facilities in each of the divisions consist of both conveyance and treatment components. Combined sewers and associated CSO-control structures lie mainly within the West Division.

The East Division receives wastewater flows from 97,300 acres east and south of Lake Washington. Most of the development within this division was originally constructed with separated conveyance systems for sanitary sewage and stormwater. As part of the Alki CSO Treatment Plant Project, the East Division Reclamation Plant at Renton will begin in 1995 to receive flows from the Norfolk Regulator Station tributary area, an area containing combined sewers. Most of the street drainage has been removed by partial separation projects in the Norfolk area, so the remaining stormwater component consists of flows from rooftops. Flows will be transferred out of the West Point system to the East Division Plant at the York Pump Station.

The West Division receives a mixture of separated flows from north of Lake Washington and combined sewage from the City of Seattle. The total service area is comprised of 66,800 acres, of which about 30,400 are served by combined sewers. The separated flows and the combined flows are joined prior to being routed through the treatment facilities.

Existing Treatment Plants

The two Metro wastewater treatment plants and two CSO treatment plants serve approximately 1.2 million residents in King and southwestern Snohomish counties. They are the West Point, East Division Reclamation Plant, Alki CSO Treatment Plant and Carkeek Park CSO Treatment Plant.

Table 3-1 summarizes information on each treatment plant, including the year the plant was initially placed into service, when it was upgraded or expanded, its capacity, and the type of treatment it provides. Each plant is described in the paragraphs which follow Table 3-1.

Table 3-1. Metro Wastewater Treatment Plant Data

Plant	Year Placed into Service	Year(s) Upgraded	Capacity (mgd)	Type of Treatment
West Point	1965	1996	133/440[a]	Secondary[a]
East Division Reclamation Plant	1965	1974, 1985, 1993	103/240[b]	Secondary
Alki	1958	1987, 1997[d]	65[c]	CSO[d]
Carkeek Park	1962	1994	20	CSO

Notes:

[a]The West Point plant will be converted from primary to secondary treatment by 1996. When the conversion is complete, the average wet weather flow capacity will be 133 mgd, and the peak hydraulic capacity will be 440 mgd. Up to 300 mgd will receive secondary treatment.

[b]The East Division Reclamation Plant has an average wet weather flow capacity of 103 mgd and a peak capacity of 240 mgd. Plans to expand to 115 mgd and 325 mgd peak are being considered.

[c]Because of outfall hydraulic restrictions, the Alki plant's existing capacity is between 45 and 67 mgd, depending on the tide. Outfall capacity will be increased to at least 65 mgd.

[d]The conversion of Alki to a CSO plant is expected to occur in late 1997. The plant will provide screening, grit removal, and disinfection of CSO flows.

West Point Treatment Plant

The West Point Treatment Plant serves Metro's West Division. Placed into service in 1965, the West Point plant was constructed as a primary treatment facility. The collection system for West Point contains both separated and combined sewers. When stormwater is being conveyed, flow coming into the plant increases considerably. The

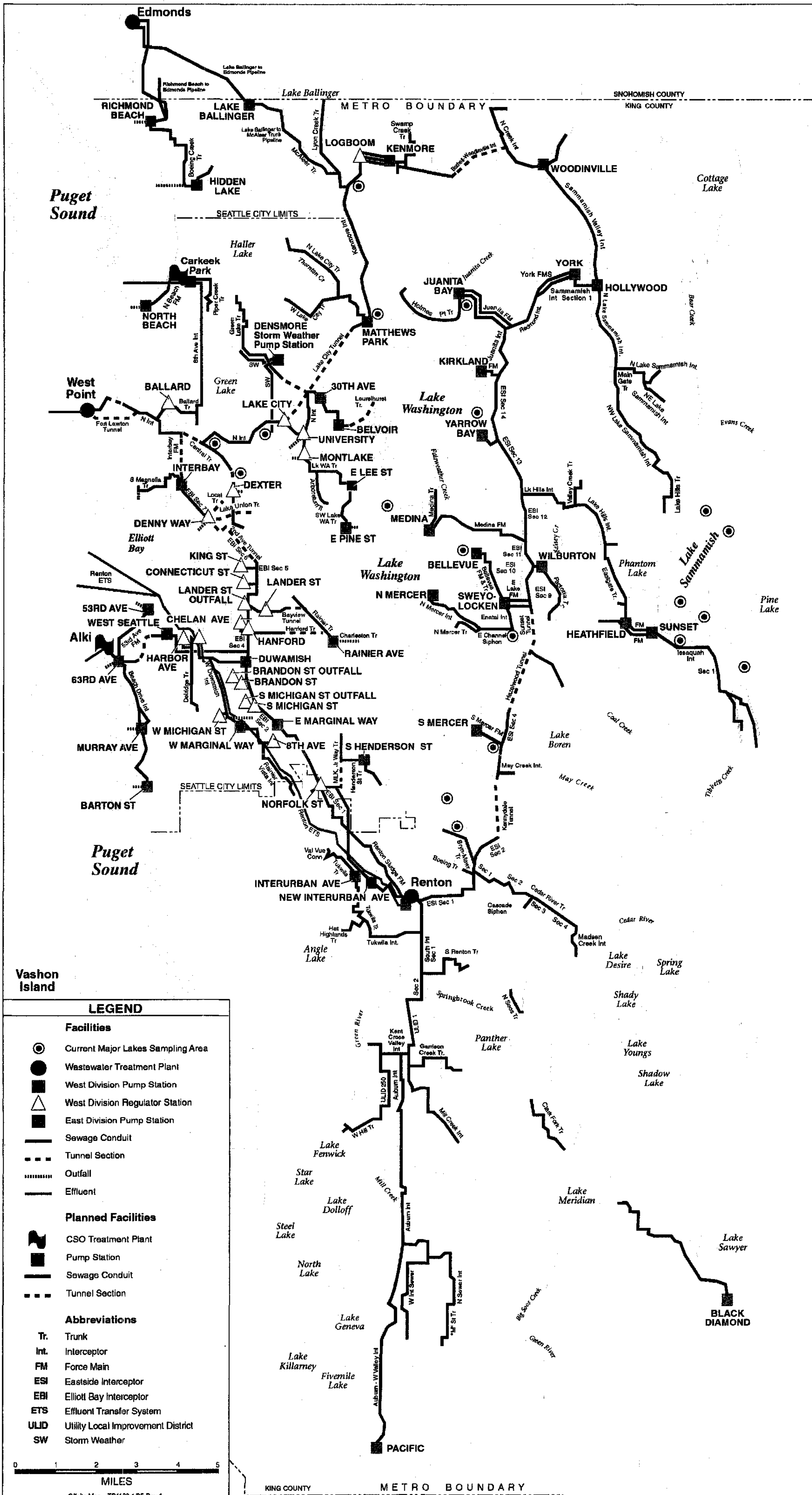
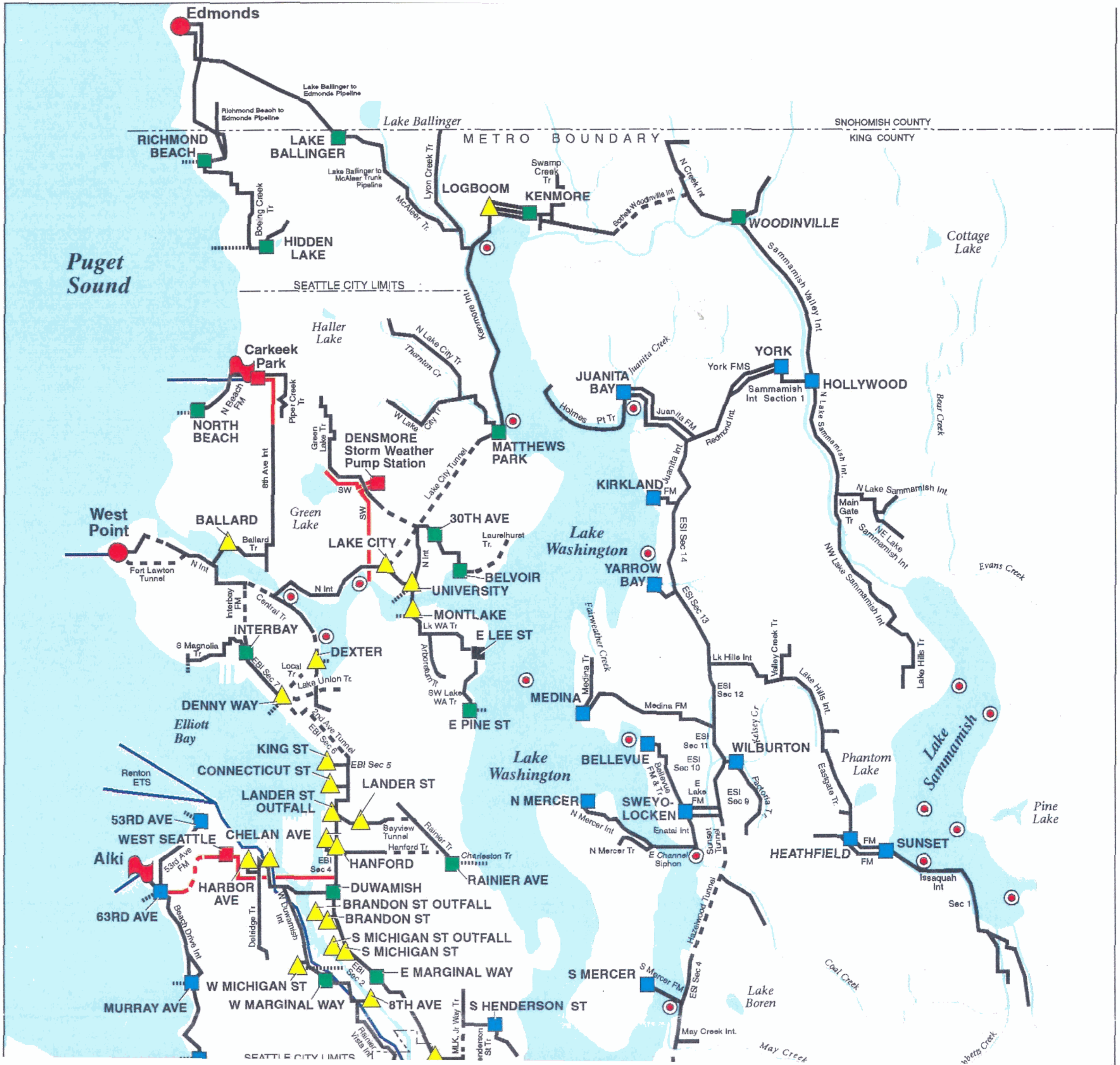


Figure 3-1. Metro Wastewater System Components

Color version of Figure 3-1
is located on the following pages



Edmonds
Lake Ballinger to Edmonds Pipeline
Richmond Beach to Edmonds Pipeline
Lake Ballinger
METRO BOUNDARY
SNOHOMISH COUNTY
KING COUNTY
RICHMOND BEACH
LAKE BALLINGER
Lake Ballinger to McAleer Trunk Pipeline
McAleer Tr.
Lyon Creek Tr
LOGBOOM
Swamp Creek Tr
KENMORE
N Creek Int
WOODINVILLE
Boeing Creek Tr
HIDDEN LAKE
Puget Sound
SEATTLE CITY LIMITS
Cottage Lake
Sammamish Valley Int
Kenmore Int
Haller Lake
N Lake City Tr
Thornton Cr
Carkeek Park
Juanita Creek
YORK
York FMS
HOLLYWOOD
JUANITA BAY
Sammamish Int Section 1
N Beach FM
Piper Creek Tr
Holmes Pt Tr
Juanita FM
NORTH BEACH
W Lake City Tr
Redmond Int
N Lake Sammamish Int
Bear Creek
8th Ave Int
Green Lake Tr
DENSMORE Storm Weather Pump Station
MATTHEWS PARK
Juanita Int
Lake City Tunnel
KIRKLAND
FM
N Lake Sammamish Int
Main Gate Tr
SW
Green Lake
West Point
BALLARD
Ballard Tr
30TH AVE
Laurelhurst Tr.
Lake Washington
ESI Sec 14
NE Lake Sammamish Int
NW Lake Sammamish Int
LAKE CITY
N Int
YARROW BAY
Evans Creek
Fort Lawton Tunnel
N Int
BELVOIR
UNIVERSITY
N Int
Interbay FM
Central Tr
MONTLAKE
Lk WA Tr
ESI Sec 13
INTERBAY
E LEE ST
Fairweather Creek
S Magnolia Tr
DEXTER
Valley Creek Tr
Lk Hills Int
Local Tr
Lake Union Tr
Arboretum Tr
Medina Tr
Lake Hills Tr
ESI Sec 12
Lake Hills Int
DENNY WAY
EBI Sec 7
SW Lake WA Tr
MEDINA
Elliott Bay
2nd Ave Tunnel
E PINE ST
Medina FM
KING ST
EBI Sec 6
ESI Sec 11
Kelsey Cr
WILBURTON
CONNECTICUT ST
EBI Sec 5
Lake Washington
BELLEVUE
ESI Sec 10
Bellevue FM & Tr
Phantom Lake
Lake Sammamish
Renton ETS
LANDER ST
LANDER ST OUTFALL
Factoria Tr
Eastgate Tr
E Lake FM
N MERCER
SWEYO-LOCKEN
ESI Sec 9
53RD AVE
Bayview Tunnel
Rainier Tr
N Mercer Int
Enatai Int
Pine Lake
WEST SEATTLE
CHELAN AVE
Hanford Tr
Charleston Tr
N Mercer Tr
E Channel Siphon
Sunset Tunnel
FM
SUNSET
Alki
53rd Ave FM
EBI Sec 4
HANFORD
HEATHFIELD
FM
RAINIER AVE
Issaquah Int
HARBOR AVE
DUWAMISH
Sec 1
63RD AVE
Beach Drive Int
Delridge Tr
W Duwamish Int
BRANDON ST OUTFALL
BRANDON ST
Hazelwood Tunnel
S MICHIGAN ST OUTFALL
S MICHIGAN ST
Coal Creek
EBI Sec 2
E MARGINAL WAY
S MERCER
S Mercer FM
ESI Sec 4
Lake Boren
W MICHIGAN ST
MURRAY AVE
W MARGINAL WAY
8TH AVE
MLK, Jr Way Tr
S HENDERSON ST
Rainier Vista Int
Henderson St Tr
May Creek Int.
May Creek
SEATTLE CITY LIMITS

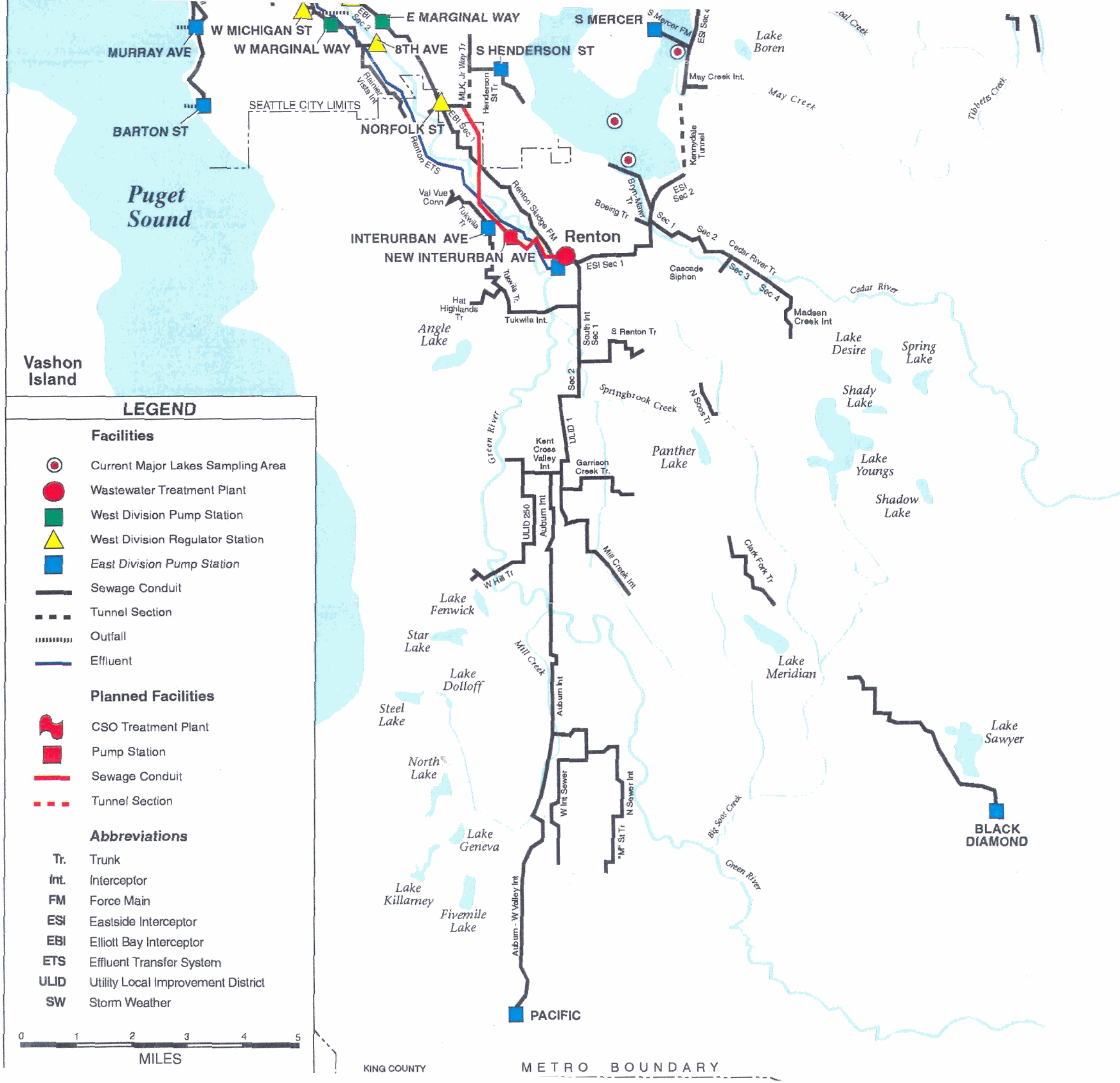


Figure 3-1. Metro Wastewater System Components

original treatment plant design capacity was 125 million gallons per day (mgd) average dry weather flow (ADWF) and 320 mgd peak flow. As indicated in Table 3-1, West Point is currently being upgraded. Secondary treatment components are being added, and the existing primary treatment facilities are being expanded for the purpose of providing CSO treatment. The peak primary treatment capacity (440 million gallons per day (mgd)) will be significantly greater than the peak secondary treatment capacity (300 mgd) to ensure peak storm-related flows receive at least primary treatment. Operability concerns have arisen with respect to the 440 mgd peak capacity. Metro is now examining modifications necessary to routinely accept peaks of 440 mgd. Until that examination process is completed sometime after startup of the new secondary facilities, it may be necessary to restrict peak flows to 400 mgd.

East Division Reclamation Plant

Metro's East Division Reclamation Plant in Renton began operation in 1965. The collection system for the plant is separated; the plant does not currently receive combined sewer flows, but will begin receiving combined flows from the Norfolk area in 1995. The original treatment plant had a secondary treatment capacity of 24 mgd ADWF, with effluent discharged into the Duwamish River. The plant is currently being expanded to 103 mgd average wet weather flow (AWWF). Plans to expand to 115 mgd AWWF and 325 mgd peak flow are being considered.

The East Division Reclamation Plant provides secondary treatment and serves Metro's East Division. Effluent from the plant is now discharged to Puget Sound through the Effluent Transfer System (ETS), which has a current capacity of approximately 240 mgd.

The ETS consists of an effluent pumping station, an 11 mile-long force main along the Duwamish River to Elliott Bay, and a 9,500 foot-long submarine outfall into Puget Sound. Discharge from the outfall is at a depth of 610 feet. The ETS, which was completed in 1987, eliminated the daily discharge to the Duwamish River.

Carkeek Park CSO Treatment Plant

The Carkeek Park plant came on-line in 1962 as a primary treatment plant. The service area is approximately 4,352 acres adjacent to Puget Sound in the northwest corner of the City of Seattle, between N.W. 145th Street and N.W. 85th Street. Because it was determined to be less expensive to transfer flows to West Point than to convert the Carkeek Park plant to a secondary facility, the Carkeek Park plant was converted to a CSO plant in 1994, and its sanitary sewage base flows (up to 8.4 mgd) were transferred to the West Point plant.

Alki CSO Treatment Plant

The Alki plant is a primary treatment plant that began operation in 1958. The area served by the plant includes approximately 4,100 acres adjacent to Puget Sound between Duwamish Head and S.W. Barton Street. Metro purchased the Alki plant from the City of Seattle in 1962. The plant was overhauled in 1987 to upgrade treatment equipment, add odor control equipment, and improve the architectural and landscaping features. The configuration of the existing outfall to Puget Sound restricts the plant's capacity to 45 to 67 mgd, depending on tidal conditions. A conveyance system is planned (the Alki Transfer/CSO Facilities Project) which, when constructed, will transfer the Alki plant's base flows (above 19 mgd) to the West Point Treatment Plant. In conjunction with this transfer, the Alki plant will be converted to a CSO treatment plant which, like the Carkeek Park plant, will provide primary treatment for combined sewer flows from the Alki area exceeding the base flow transfer capacity. At the same time, the outfall capacity will be increased.

Existing Conveyance Facilities

Metro oversees an extensive configuration of conveyance pipelines, regulator stations, and other wastewater facilities. These conveyance facilities consist of pumping stations, gravity sewers, and force mains that transport wastewater to treatment plants. After treatment, treated effluent is conveyed through outfall pipes to Puget Sound.

Pipelines

Metro operates a network of pipelines throughout its service area (Figure 3-1). Customer municipalities and sewer districts construct and maintain smaller pipelines from individual homes and businesses that connect to Metro's pipelines. Metro's pipelines consist of force mains (pressurized sewers), trunk sewers and interceptors. Metro trunk sewers pick up flows from the small collection pipelines and convey them to large diameter interceptors that serve as the conduits for transferring flow to the treatment facilities. Whenever possible, pipes move the flow by gravity. When necessary, the wastewater is pumped up and over hills in forcemains by a system of pumping stations. Of more than 255 miles of pipelines, approximately 17 miles are forcemains. The remainder convey wastewater by gravity flow.

Combined sewage travels to the West Point Treatment Plant primarily by way of the North Interceptor, the West Duwamish Interceptor, and the Elliott Bay Interceptor.

Pumping Stations

Metro's 38 pumping stations are located throughout its service area (Figure 3-1). Pumping stations are used to lift flow to a higher elevation from which it can flow by gravity to the treatment plant. Installed capacities range from one to about 325 mgd.

Regulator Stations

Regulator stations maximize the storage potential available in the large diameter trunk sewers by shutting off flow to the interceptors during conditions of high storm flows. As a result wastewater is forced to back up in the trunks. During low flow periods, when the interceptor flows are below a specified setpoint, the flow from the trunk sewer passes through the regulator and into the interceptor. As flows in the interceptor increase, the regulator gate closes, and the wastewater begins backing up in the trunk. When the trunk reaches its specified storage capacity, an overflow gate is opened and the trunk flows are released as combined sewer overflow. A typical regulator station is illustrated in Figure 3-2.

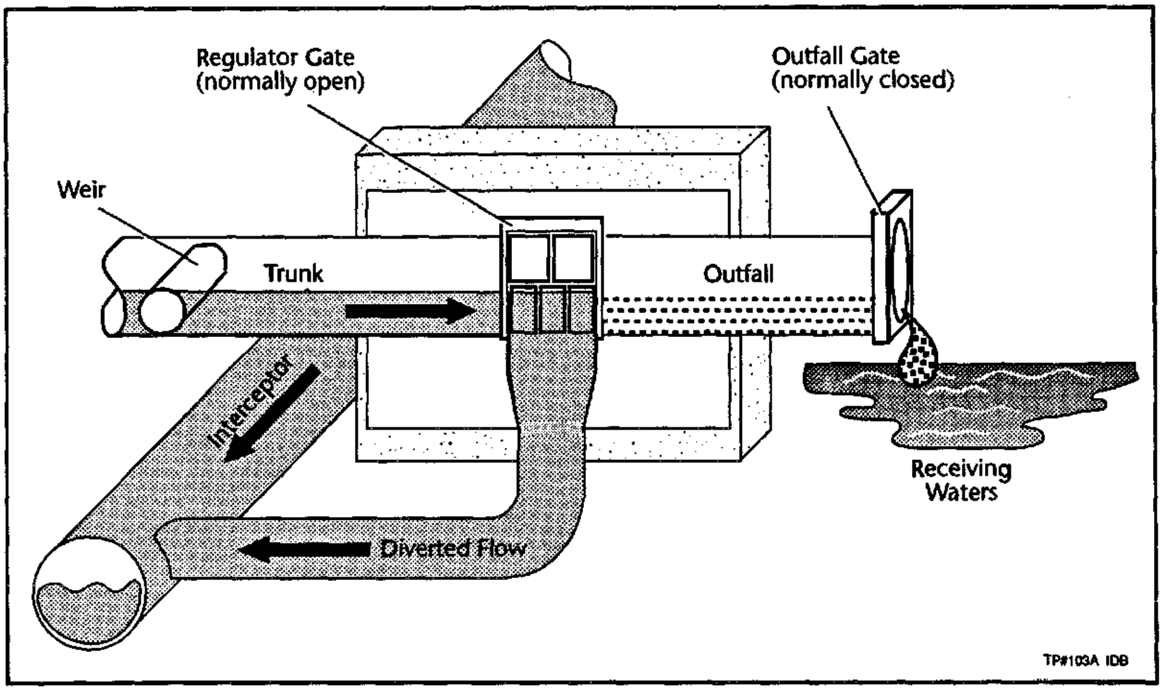


Figure 3-2. Typical Regulator Station

Flow Transfers

Metro flow transfer projects allow wastewater to be treated at existing plants that have excess capacity. By transferring flows, Metro can consolidate its secondary treatment facilities. Flow transfer projects are part of Metro's endeavor to provide secondary treatment for all base flows.

The flow transfer projects involving the Carkeek and Alki CSO treatment plants have been discussed previously. A third project was initiated in 1988 when the Richmond Beach Treatment Plant was abandoned and replaced with a pump station to transfer flows to the Edmonds secondary plant.

Effluent Disposal Systems

The treated effluent from each of Metro's treatment plants is discharged through outfalls into Puget Sound. Outfalls in the Metro system range in size from 30- to 96-inch diameters. The diameter, length, and depth of each outfall are listed in Table 3-2.

Table 3-2. Metro's Effluent Disposal Systems

Plant	Diameter (inch)	Length (feet)	Depth (feet)
West Point	96	3,650	240
East Division Reclamation	96 to Twin 64[a]	60,000 to 9,500	610
Alki	42	2,000	160
Carkeek Park	33	2,100	200

[a]The East Division ETS consists of approximately 60,000 feet of 96-inch pipe, which empties into a 9,500-foot section comprised of two 64-inch pipes.

CATAD Control

The Computer Augmented Treatment and Disposal (CATAD) system is another important component of the wastewater conveyance system. The CATAD system serves to regulate flow and maximize storage capacity in existing sewers throughout the West Division.

CATAD monitors and controls Metro's various pumps and regulator gates. From flow monitoring locations throughout the system, flow data is transmitted to the main control center at West Point. The computer is programmed to use incoming information to make decisions regarding how to best manage the volume of wastewater flow.

The basic objective of CATAD is to minimize CSOs from the system. CATAD continuously estimates flows to the pump and regulator stations. If these flows exceed the allowable flow rates at designated points within the system, key regulator gates are closed and pump station flows are curtailed in a sequence designed to store flows where capacity is available.

Relationship between Metro and City of Seattle Systems

When Metro was formed in 1958, it negotiated an agreement with the City of Seattle whereby ownership of certain system components would be transferred to Metro and other components would be retained by the City. Pipelines, trunks, and interceptor sewers were generally assigned to Metro if those facilities drained a natural drainage basin of more than 1000 acres or if the facilities served as major conduits to the outfall off Magnolia where sewage from Seattle was discharged. Metro also assumed ownership of treatment plants, some pump stations, regulators, and overflow points which had previously been operated by the City.

The City of Seattle operates a sewer collection system which includes separated, partially separated, and combined areas. Metro operates a conveyance and treatment system which moves large amounts of wastewater from large drainage basins to Metro plants for treatment. Because of this difference in purpose of the two systems, Metro's conveyance pipelines are much larger than the City's conveyance facilities.

When storms occur, both City of Seattle and Metro pipes can overflow. The overflows from the City system are usually smaller in volume and shorter in duration than the overflows from Metro's system. That is because the City's overflows respond more to peaks in the stormwater runoff, while the larger Metro pipes, which carry wastewater from larger areas, are more sensitive to total volume of runoff. Metro pipes tend to overflow for a longer period during and after storms

Two means have been used in the past to control CSOs in Seattle: partial separation and storage. Partial separation of combined areas (removing street drainage) reduces CSO volumes for both the City of Seattle and Metro. However, the subsequent discharge of stormwater may lead to degradation of the environment as evidenced by the NOAA settlement with Metro and the City discussed in the previous chapter. Both the City and Metro are placing less emphasis on partial separation as a CSO control method. Storage projects, on the other hand, hold back combined sewage for a brief period while the peak flow passes. Storage projects, either the City's or Metro's, may reduce or increase Metro's CSOs elsewhere, depending on the specific circumstances. If, for example, stored flows are released while Metro pipes downstream are still overflowing, the storage projects will have simply shifted the overflow to a new location without diminishing the total volume of wastewater discharged. It is possible that Metro operations of its system could increase or decrease City overflows in certain areas. Analysis of CSO projects to date indicates that City storage and separation projects undertaken since the baseline years of 1981-1983 are expected to have reduced Metro's overflows by about 3 percent (75 MG/year).

CHAPTER 4
REVIEW OF THE EXISTING CSO PROGRAM

Metro is required by WAC 173-245-090 to periodically review its plan for controlling CSO volumes and frequencies. This review is required to evaluate the progress towards meeting the interim goal of 75 percent overall volume reduction. If additional control appears necessary, Metro is required to propose additional control measures necessary to meet that goal. This chapter describes the CSO conditions which existed at the time of the *1988 Plan* and shows how changes and improvements to Metro's model have altered that description since 1988. The chapter will examine the status of projects included within the *1988 Plan* and the status of other control projects which were not part of the original *1988 Plan*. The impact of these projects on the 1988 existing conditions is evaluated to determine how far Metro has actually progressed towards meeting its goal. This chapter will also describe the impact of the *1988 Plan* on sediment and water quality and the extent to which implementation of the *1988 Plan* has improved water quality. Finally, the chapter will conclude with an analysis of the cost-effectiveness of Metro's CSO control projects.

Existing Conditions from the *1988 Plan*

The *1988 Plan* described the condition of the West Point system with respect to frequency, location, and volume of CSO discharge. In order to assess effectiveness of the *1988 Plan* and the progress Metro has made, it is necessary to begin with the existing conditions included in the *1988 Plan*.

Baseline Conditions

For any selected time period, the actual volume and frequency of CSOs depend on the pattern of rainfall. At the same time, the existence and extent of overflows are also functions of the physical characteristics of the system itself. Because the Metro system is not constant but evolves and changes over time, it was necessary to select a point in time and determine how the system which existed at that time would handle differing rainfall volumes and patterns.

In preparing its *1985 Final Plan for Combined Sewer Overflow Control,* Metro and the Department of Ecology determined that Metro CSO control system as it existed during the period 1981 to 1983 would be an appropriate baseline from which to measure CSO-control progress. Thus the term "baseline" refers to the physical characteristics of the collection and control system during 1981-83, as well as the volumes or frequencies of overflows which occurred from that system. The baseline condition was also initially characterized by selecting seven storms during the 1981 through 1983 period as design storms for calibration in the modeling work. The storms were selected because they cover a range of rainfall intensities and durations. These storms were also selected because adequate sewage flow and overflow data from the control monitoring points exist for those storms. One storm, Design Storm No. 6, which occurred November 16-18, 1982, is particularly significant. A facility which will control overflows during Design Storm No. 6 is expected to meet the goal of not more than one overflow event per year, on average.

1988 Computer Modeling

CSOs are modeled with computers to determine how they would change in the future and to predict the effects of alternative control strategies. Computer models are especially useful because of their ability to provide answers to a large number of "what if" questions quickly and relatively inexpensively.

Annual overflow volumes in the *Final 1988 Combined Sewer Overflow Control Plan (1988 Plan)* were obtained using the Seattle Area Combined Sewer Routing Organizer, or SACRO, a simplified model which simulates the routing of flows through Metro's conveyance system. It uses flowrates as its only means of control and does not compute water surface elevations in pipes. SACRO computes overflow volumes by adding all inflows to a given location (regulator or pump station, etc.) and subtracting the estimated capacity of the pipes or pump station leaving that location. Because it cannot explicitly account for the depth of flow upstream or downstream or for momentum or pressure effects, SACRO cannot provide highly accurate overflow estimates. SACRO estimates may be high or low, depending on the situation at each location. For example, SACRO predicted overflows at the Duwamish Pump Station that do not, in fact, occur.

The column in Table 4-1 entitled, "1988 CSO Plan Baseline" shows the estimated annual overflow volume in millions of gallons for Metro permitted CSO locations included in the *1988 Plan*. The *1988 Plan* included overflow locations that were thought to overflow regularly. Recorded CATAD data provided the bulk of the information on overflow locations. Stations which were not monitored by the CATAD system were not included in the *1988 Plan,* either because they were thought to be controlled to the one-event-per-year level or because there was not enough information available to ascertain whether they were controlled or not.

Table 4-1. Baseline Metro Overflow Volumes

Station	1988 Plan Baseline (MG)	Revised Baseline (MG)[d]	Difference in Volume (MG)
Southern Service Area			
8th Avenue South	15	15	0
W. Michigan Street	2	2	0
Terminal 115	N/A	5	5
Harbor Avenue	55	55	0
East Marginal Way	N/A	0	0
Chelan Avenue	25	73	48
Norfolk Street	4	60	56
Michigan Street	250	190	(60)
Brandon Street	35	60	25
Hanford #1	N/A		
Hanford #2	N/A		
Total Hanford	680[c]	605[c]	(75)
Lander #1	215	190	(25)
Connecticut Street	90	90	0
King Street	70	55	(25)
Denny Local	N/A		
Denny Lake Union	N/A		
Interbay	N/A		
Total Denny	370[c]	405[c]	35
Duwamish	130	1	(129)
Martin Luther King Way[a]	N/A	88	88
Rainier Avenue	N/A	0	0
Henderson Street[a]	N/A	10	10
S. Magnolia[a]	N/A	15	15
Northern Service Area	N/A		
Dexter Avenue	12	15	3
Canal Street	10	1	(9)
East Pine Street	N/A	0	0.
30th Avenue NE	N/A	0	0
Belvoir	N/A	0	0
Matthews Beach	N/A	0	0
University	211	110	(111)
Montlake	40	10	(30)
Ballard Regulator	N/A		
11th Avenue NW	N/A		
Total Ballard	90[c]	90[c]	0
3rd Avenue West	105	125	20
North Beach[a]	N/A	2	2
Alki			
Murray[b]	N/A	5	5
Barton[b]	N/A	7	7
53rd Avenue SW	N/A	<1	<1
SW Alaska Street[b]	N/A	12	12
63rd Avenue[b]	N/A	95	95
Total (MG)	**2409**	**2391**	**(18)**

[a]Stations not connected to CATAD and for which data was limited or non existent in 1988.
[b]Stations thought to be controlled in 1988, but not. Error resulted from problem with CATAD sensors.
[c]Methodology used to make these estimates necessitated the reporting of totals for closely associated overflows.
[d]Revised 1981-83 baseline estimate based on new model.

The *1988 Plan* computed annual overflow volumes either from CATAD data where available, or from the computer models then in use if CATAD data were not available. Because simulations of the entire Metro sewer system require extended periods of computer time to accomplish, it was decided to use the results from several actual storms as representative of the operation over an extended period. These 'design' storms were selected from the record to cover a range of actual system overflows from small to large. From the CATAD overflow records, factors were determined to apply to the overflows from the design storms so that they could be used to represent overflows from other storms of similar magnitude. When the overflows computed from the design storms are multiplied by these factors and the results for all design storms summed, an estimate of the total system annual overflow volume is the result. This method of computing annual overflow volumes is also being used currently to arrive at annual reduction estimates due to alternative projects.

Metro's New Model

One element of the *1985 Plan* was an update of CATAD for the West Point Service Area. The CATAD improvement was intended to improve the efficiency of the system by making better use of the available storage capacity in the existing sewers. As part of that CATAD-modification process, Metro obtained and developed a new, more complete hydraulic routing model known as "UNSTDY." The SACRO model only compared flow rates. UNSTDY computes flow velocities and water surface levels throughout the system, allowing the computer to simulate backwater, flow reversal, surcharged and open channel flow, as well as correct regulator and pump station operation. The new model provides a degree of detail and accuracy which were not available with older models.

Development of the new model required an investigation of the collection system and the previous CATAD control software. During this analysis, Metro discovered and corrected errors in the computer code used for the old control program, errors in pipe characteristics in the system, and inaccuracies in the level sensors at certain control points. The new model was then recalibrated. This error-location, error-correction process is now on-going.

Using the new model with the same rainfall data and the same existing system used to model CSOs in the *1988 Plan* has produced revised baseline overflow volumes. Those revised CSO baseline volumes are shown in the middle column of data in Table 4-1.

Revised Existing Conditions

An updated set of overflow volumes based on the new Metro model gives a better, more accurate picture of the location and volumes of overflows under the 1981-83 baseline conditions. These new volumes reflect the increase in knowledge gained since the *1988 Plan*. A number of locations which were thought to be controlled to the one event per year level in 1988 appear to require additional control measures. The right-hand column of Table 4-1 compares the annual overflow volumes from the 1981-83 system as determined in the *1988 Plan* with the results obtained from the new Metro model. It is important to recognize that these new existing conditions take into account only data developed by use of the new model. Rainfall data used to calculate overflows did not change, and changes or improvements to the system itself since 1983 were not included. As in the *1988 Plan*, the starting point is still the 1981-83 system. Now, however, Metro has better data with which to describe that existing system.

As Table 4-1 illustrates, there is little difference in total overflow volume between the *1988 Plan* total of 2.409 billion gallons and the revised total volume of 2.391 billion gallons. However, while the totals may not have changed much, the variation at specific CSO sites is sometimes significant. The new volumes for the University and Montlake Regulators and Duwamish Pump Station are notably lower. At the same time, the estimated Chelan Regulator CSO volume increased almost three-fold, and the total Denny overflow volume rose by almost ten percent. Some overflows which were thought controlled to one event per year are not. These locations are discussed more fully in subsequent sections.

Control Projects from the *1988 Plan*

The *1988 Plan* described a number of CSO control projects which Metro would undertake through late 2005 to reduce CSO volume by 75 percent system-wide from the baseline volumes described in that plan. Some of those projects had been part of the 1985 CSO control planning effort and were included within the *1988 Plan* as current projects. Other projects were first proposed in the *1988 Plan*. Table 4-2 summarizes *1988 Plan* projects, the year the project was to commence, and the year of anticipated completion. The *1988 Plan* estimated that once the projects were constructed and brought on-line, overflow volumes would be reduced from 2,409 MG a year to 568 MG a year, a 76 percent reduction.

Table 4-2. Projects from the 1988 Plan

Project	Year to Start	Year to be Completed
Hanford Separation	1986	1987
Lander Separation/Bayview Storage	1986	1992
CATAD Modifications	1987	On-going
Alki CSO Transfer Facilities	1989	Late 1997[a]
Carkeek CSO Treatment Plant	1988	1994
Parallel Fort Lawton Tunnel	1987	1991
University Regulator (Green Lake/Portage Bay Improvement Project)	1986	1994
Denny Partial Separation	1993	Delayed[b]
Diagonal Separation	1995	1999
Michigan Street Separation	1997	2003
Kingdome/Industrial Separation	2000	2006

[a] Delayed as a result of a bid protest regarding the tunnel component.

[b] Delayed and modified as discussed in text. See page 5-4.

Specific CSO control projects from the *1988 Plan* and the status of each are as follows:

South Hanford Street Tunnel Separation Project

The Metro component of the Hanford project involved installation of a new 36-inch sanitary sewer line inside the existing 108-inch South Hanford Street Tunnel. The work was done in conjunction with a City of Seattle partial separation project covering about 1,132 acres upstream from the tunnel. The new 36-inch line carries the remaining combined sewage flows to the Elliott Bay Interceptor, while the tunnel itself is used to carry separated stormwater flows to the Diagonal Way storm drain and then to the Duwamish River. The project was originally thought to have eliminated CSOs discharged at the Hanford No. 1 Regulator Station. However, new evidence indicates that probable overflows totaling 7 MG per year occur from the Metro system upstream from the Hanford Street Tunnel, eventually reaching the Diagonal Way Storm Drain. The newly estimated overflows occur at three weirs in the Rainier Valley (designated as "Bayview North," "Bayview South," and South Hanford Street at Rainier Avenue on Figure 4-1. Overflows may occur at these weirs due to hydraulic restrictions in the 36-inch line inside the Hanford Street Tunnel, causing flow to be spilled to the stormwater line that leaves the system at the Hanford No. 1 Regulator site. Further study is required to confirm current overflow values. The Hanford project was completed in October 1987.

Lander Separation/Bayview Storage Project

The Lander Separation took place in two phases. In Phase I, a new 96-inch sanitary trunk, with the necessary connection structures, was constructed in South Lander Street, providing 1.4 million gallons of storage. Also, the Bayview Tunnel was reconditioned and reactivated in 1986 to divert sanitary flows from the Hanford Basin to the new 96-inch trunk. Phase II consisted of installation of a new stormwater collection system for the Lander basin. Construction of the Bayview/Lander project was completed in January 1992. An interlocal agreement between the City and Metro clarifies NPDES stormwater permit responsibilities within the Lander and Densmore (University Regulator Separation) drainage basins. A new regulator station was constructed as part of this work (designated "Lander No. 2").

CATAD Modifications

The Metro wastewater control system was designed to allow operators to change the system's operating strategy in response to changing conditions. The CATAD controls for the West Division collection system were modified to improve system efficiency through increased use of storage capacity in the existing sewers. Previously, the computer control system utilized 17 to 28 MG of the system's 60 MG capacity, or approximately 28 to 47 percent. Metro expected that improvements to the system would reduce annual CSO volumes by 150 MG per year. The project is mostly complete, although work on the level sensors is continuing. Computer simulations indicate that overflow reduction achieved by these improvements may total 200 MG.

Fort Lawton Parallel Tunnel Project

The Fort Lawton project involved construction of a new 12-foot diameter tunnel to provide a reliable influent line to the West Point Treatment Plant. The new tunnel, when used in conjunction with the existing 144-inch brick tunnel, increased the influent capacity of the plant from 325 mgd to 440 mgd. Tunnel construction was completed in the summer of 1991, and the new tunnel went into operation during November of that year. Flows to West Point will initially be restricted to 400 mgd during the startup at the West Point Secondary Plant to address operational concerns. Metro anticipates that flows can be increased to 440 mgd as operators become more familiar with the facility and facility modifications are made. Metro is now examining what modifications are necessary.

University Regulator Separation

This project included construction of a gravity pipeline, pump station, force main, and outfall pipeline to divert stormwater runoff from the Densmore drain, Interstate 5, and the outflow from Green Lake from the North Interceptor to the new outfall in the Lake Washington Ship Canal. The reduction in stormwater through the University Regulator will significantly reduce CSO discharges to Portage Bay. Construction of the major components was completed in 1994, and the facility has begun operation.

Carkeek Park Transfer and CSO Treatment Facility

In 1989, the wastewater treatment plant at Carkeek Park was taken off line and converted into a CSO treatment facility. Combined flows of up to 8.4 mgd from the Carkeek basin are transferred to West Point for secondary treatment. Flows into Carkeek in excess of 8.4 mgd (to a maximum of 20 mgd) receive primary treatment and disinfection at the Carkeek Park plant, then are discharged through the existing outfall. Combined flows in excess of 20 mgd are stored until flows subside and treatment capacity is once again available. If storage capacity is not available, excess flows are discharged. Construction of all elements of the project is now complete, and the plant began operation in the fall of 1994.

Alki Transfer/CSO Facilities Project

The Alki project is designed to transfer flows of up to 19 mgd from the Alki drainage basin to West Point for secondary treatment. Combined sewer flows above 19 mgd, up to a maximum of 65 mgd, will receive treatment and disinfection at the existing Alki treatment plant before being discharged through the existing outfall. Flows in excess of 65 mgd (expected to occur less frequently than once per year) will be discharged via the 63rd Avenue Pump Station outfall, which is permitted as a CSO location. The existing Alki Treatment Plant will be modified to permit intermittent operation.

To avoid capacity problems in the West Point system which might result from the addition of Alki flows, pipelines are under construction to transfer a corresponding amount of flow from the Norfolk Regulator to the East Division Reclamation Plant at Renton via the Allentown Trunk and Interurban Pump Station. A new West Seattle Tunnel will provide conveyance of Alki flows out of the Alki basin. A pipeline for control of Harbor Regulator overflows is being added to this project as discussed later in this report.

The Alki project design began in 1992 and construction of some components has begun. Final completion and start-up for the project have been delayed as a result of a bid protest on the tunnel component of the project. The transfer/conversion of Alki to a CSO treatment plant is expected to occur by late 1997. Specific conditions for the permit to operate Alki are being negotiated with the Department of Ecology.

Kingdome/Industrial Area Storage and Separation Project

The *1988 Plan* called for total separation of the Kingdome parking lot and the industrial area south of the Lander project. The project was one of the last *1988 Plan* projects, with design to begin in 2000 and completion by the end of 2005. The predesign report for the Kingdome project was accelerated to 1992 in conjunction with work undertaken to improve Royal Brougham Way for car ferry access.

During predesign, total separation was rejected as not cost-effective due to the cost of disconnecting building drains on private property and the limited capacity of the existing combined sewer lines to convey stormwater. As a result, the project was modified to include partial separation by removing street and Kingdome parking lot drainage from the combined system. The revised Kingdome project involves construction of a new 96-inch sanitary trunk in Royal Brougham Way, 11.3 MG of off-line storage, and a new regulator station and connection to the Elliott Bay Interceptor. Recent results from Metro's modeling indicate that storage must be increased to at least 13.6 MG. Because of Metro's desire to cooperate with the City of Seattle's Royal Brougham street-widening project, construction of a portion of the 96-inch line was moved forward to 1994. Until the rest of the project is designed and constructed, the new line will be used for CSO storage. Whether the partial separation and off-line storage portions of the project will be rescheduled is under review as part of the RWSP.

Denny Way CSO Control

The *1986 CSO Control Plan* called for a storage and treatment approach for controlling Denny overflows. The *1988 Plan,* however, recommended a partial separation project comprised of 584 acres in the Denny/Lake Union and Denny Local basins, to be complemented by an assumed City of Seattle partial separation of over 600 acres upstream of the Lake Union Tunnel. The *1988 Plan* scheduled this partial separation predesign to begin in 1993 with construction to be completed by 1999.

Metro subsequently reassessed the Denny project in light of changes in the regulatory environment and progress made in its CSO control program. Then, in 1991, the City of Seattle Drainage and Wastewater Utility requested that Metro participate in a joint CSO-control alternative analysis to find ways to control discharges into Lake Union from Seattle's system and into Elliott Bay at the Denny Regulator Station from Metro's system. In 1992, a joint Denny/Lake Union project was submitted as a candidate for Coastal Cities Grant funds, and the Denny project was accelerated in order to take advantage of the potential $35 million in grant funding (which is expected to become available in 1995 for the project). During 1994, a specific joint City of Seattle/Metro Denny/Lake Union CSO Control Project was identified as part of Metro's CSO control program for the next five years. That Denny/Lake Union CSO Control Project is described in Chapter 5.

Michigan Separation Project

The *1985 CSO Control Plan* called for a total separation project in the Michigan basin. This project would involve removing both street drainage and roof top drainage by providing new sanitary sewers. The *1988 Plan* scheduled such a project for the latter part of its 20-year program, calling for completion by the end of 2005. The predesign report for Michigan was accelerated to 1992 in conjunction with work being undertaken by the Washington Department of Transportation to upgrade of the First Avenue South Bridge. The predesign report rejected total separation as too costly and disruptive to private property and recommended installation of approximately 3,430 feet of sanitary trunk sewer in South Michigan Street/Corson Avenue South, separation of industrial areas identified in the basin, and construction of a new regulator station and a new 4.2 MG storage tank. Metro modeling indicates that the storage tank will need to be increased to at least 5.3 MG. Through construction of the above facilities, approximately 70 percent of the stormwater would be removed from 238 acres in the Michigan basin.

Because part of the sewer line crosses the Duwamish River in the vicinity of First Avenue South, the schedule for design activities for Michigan has been accelerated to coordinate with the Department of Transportation's construction of bridge improvements at the First Avenue South Bridge. Final design of the project will depend on action recommended by the RWSP. Other alternatives are under study.

Diagonal Separation Project

The *1988 Plan* considered a separation project to totally separate sanitary and storm drainage in approximately 720 acres of combined and partially-separated industrial area. The project would have complimented the City of Seattle's separation project near Metro's Duwamish Pump Station. The final *1988 Plan* included a Diagonal storage/separation project as a City of Seattle project and not as a Metro project.

Other CSO Projects

Since adoption of the *1988 Plan* (largely because of more accurate modeling information than was available at the time the *1988 Plan* was adopted), four new projects for CSO control have emerged. New projects which were not identified in the *1988 Plan* and the anticipated starting and ending dates for each are shown in the following Table 4-3 and are briefly described as follows:

Table 4-3. Projects Not Identified in the 1988 Plan

Project	Year to Start	Year to be Completed
Henderson/Martin Luther King Way CSO Control Engineering Evaluation	1995	Project to be determined in RWSP
North Beach Storage Pump Station Upgrade	1993	To be determined in RWSP
Harbor CSO Pipeline	1995	1997
Brandon Separation	1992	To be determined in RWSP

Henderson /Martin Luther King Way CSO Control Engineering Evaluation

At the time of adoption of the *1988 Plan*, Metro believed all CSOs into Lake Washington, including the discharge from the Henderson Street Pump Station and the Martin Luther King Way overflow weirs, had been controlled to one overflow event per year. Monitoring data were not available for the Martin Luther King Way or Henderson Street Pump Stations overflows during preparation of the *1988 Plan*. Recent monitoring data, however, indicate that overflows at these locations in fact occur more frequently than one event per year. As a result, Metro has begun a study to characterize the sources and causes of overflows at these locations and identify interim and permanent corrective measures to control overflows. Findings from that study, to be completed by mid 1995, will be incorporated into the Regional Wastewater Services Plan.

As part of the Alki Transfer/CSO Facilities Project, most wastewater flows from the Norfolk area are being transferred to the East Division Reclamation Plant at Renton.. Approximately 6 MG of annual overflow volume at the Norfolk Regulator remains. Metro will make sure that any project to control overflows in the Henderson and Martin Luther King Way areas will not cause additional overflows at Norfolk.

Harbor CSO Pipeline Project

As noted previously, part of the Alki project was the construction of a new tunnel (West Seattle Tunnel) to move combined flows out of the Alki basin. During the development of the *1995 CSO Update*, it was noted that the tunnel could provide storage of up to 5.5 MG of combined wastewater to relieve overflows at the Harbor Regulator (which overflows 56 times per year, resulting in average overflows of 58 MG per year). Metro is currently negotiating with the Department of Ecology to amend the National Environmental Policy Act (NEPA) Environmental Assessment to include the Harbor CSO Pipeline Project, described in Chapter 5, as part of the Alki project. The Harbor CSO Pipeline Project would reduce CSOs at this location to one event per year.

North Beach Storage/Pump Station Upgrade

Metro believed in 1988 that overflows from the North Beach Pump Station did not occur more than once per year. However, during predesign for the Carkeek Park CSO Treatment Plant, overflows were identified. Metro therefore initiated a predesign process to control those overflows, and a predesign report was completed in July 1993. That report called for constructing a new storage basin at the pump station site, increasing the pump station capacity, and constructing a new pipeline in Carkeek Park to reroute flows from two City of Seattle gravity sewer lines that discharge directly to Metro's force main. The schedule for implementing the predesign report recommendations will be determined in the RWSP.

Brandon Separation Project

During the predesign work on the Michigan Separation project, the predesign team recommended a Brandon partial separation and storage project as an addition to the Michigan project. Brandon basin separation will require 1,640 feet of new sanitary trunk, partial separation of approximately 52 acres, construction of a new regulator station, and a new 4.7 MG off-line storage facility. Recent Metro modeling suggests that the storage could be reduced to 3 MG. Preliminary design of Brandon was completed in 1992 in conjunction with the Michigan separation project, and a portion of the Brandon design was accelerated to allow coordination with the First Avenue South bridge improvements. Final design will begin in 1998, depending on an RWSP decision. Brandon Separation is one of a number of alternatives under consideration in the RWSP process.

1998 Existing Conditions

Since the *1988 Plan*, several projects have been completed by Metro to reduce CSOs. The projects which have been completed are as follows:

- Hanford Separation Project.
- Lander Separation Project.
- Bayview Storage Project.
- University Regulator project, including removal of Densmore Drain and Green Lake flows.
- Carkeek Park CSO Treatment Plant.
- Parallel Fort Lawton Tunnel.
- CATAD modifications, including:

    Predictive Control Computer Program.
    CSO mode at Interbay Pump Station.
    Some bubbler corrections.
    Flow calculation corrections.

- Initial portion of 96-inch trunk in Royal Brougham Way.

The following projects are scheduled to be completed by late 1997:

- Completion of bubbler repair.
- Alki Transfer/CSO Facilities Project (including transfer of Norfolk flows to Renton).
- West Point Upgrade to secondary treatment and 440 mgd capacity (to include CSO treatment).
- Interbay Pump Station Upgrade to 133 mgd.
- Completion of the 96-inch diameter trunk line in Royal Brougham Way.

Metro recently conducted new computer simulations in order to assess the effectiveness of the system, now that some CSO control projects have been completed. For purposes of these simulations, all which will be completed by 1998 were assumed completed. Because the simulation is of the wastewater system as it will exist in 1998, the results of that simulation are referred to as the 1998 conditions.

Between 1981 and the end of 1993, the City of Seattle constructed 29 storage projects, four storage and separation projects, and six stormwater separation projects. All of these projects were also included in the model simulations for 1998 conditions.

The seven design storms were simulated to estimate the annual overflow volumes remaining in the year 1998 and to estimate the volume associated with Design Storm No. 6, the one-year CSO event. Two different assumptions were made for these simulations:

- Alternative Assumption 1: Interbay would be allowed to pump up to 133 mgd without being restricted, and the West Division Treatment Facility at West Point would operate at 440 mgd as much as possible to minimize CSOs overall.

- Alternative Assumption 2: Interbay would be restricted such that flow to the West Division plant would seldom exceed 400 mgd. This assumption reflects operability concerns of allowing 440 mgd to flow into an untested new plant.

The annual overflow volumes expected in 1998 resulting from each assumption are presented in Table 4-4. That table shows that upon completion of all of projects now underway, Metro will have controlled approximately 796 to 886 million gallons of overflow. That amounts to approximately 33 to 37 percent of its revised 1988 baseline CSO volumes, depending on whether West Point peak flows are restricted to 400 mgd or allowed to reach 440 mgd. As of 1988, Metro still needs to control an additional 1,027 mgd. Included in these annual estimates are the overflows which were thought to have been controlled to the one event per year level in the *1988 Plan* but have been shown by flow monitors to occur more frequently. Table 4-4 also shows the number of overflows expected in an average year after all improvements completed by 1998 have come on line. Figure 4-1 shows the status of Metro permitted CSO locations with respect to the one event per year goal after completion of all projects described above.

Limiting Interbay Pump Station flow when flows are high in the North Interceptor will decrease annual overflows into the Ship Canal. At the same time, reducing the Interbay setpoint will increase annual overflow volumes into Elliott Bay, with most of the increase occurring at Denny Way.

Additional Study Requirements

In performing the newest modeling studies, certain locations still do not have sufficient data to estimate an accurate baseline. These locations will require further study. That future study includes possible flow monitoring during storm events in order to obtain reliable data to calibrate the model. Specific locations for which additional study is ongoing include:

South Magnolia. The uncertainty about South Magnolia overflow volume results from uncertainty about restrictions in the conveyance system in that vicinity. Current modeling indicates 15 MG per year for South Magnolia overflows. However, an investigation of downstream pipe systems may reveal that value to be excessive.

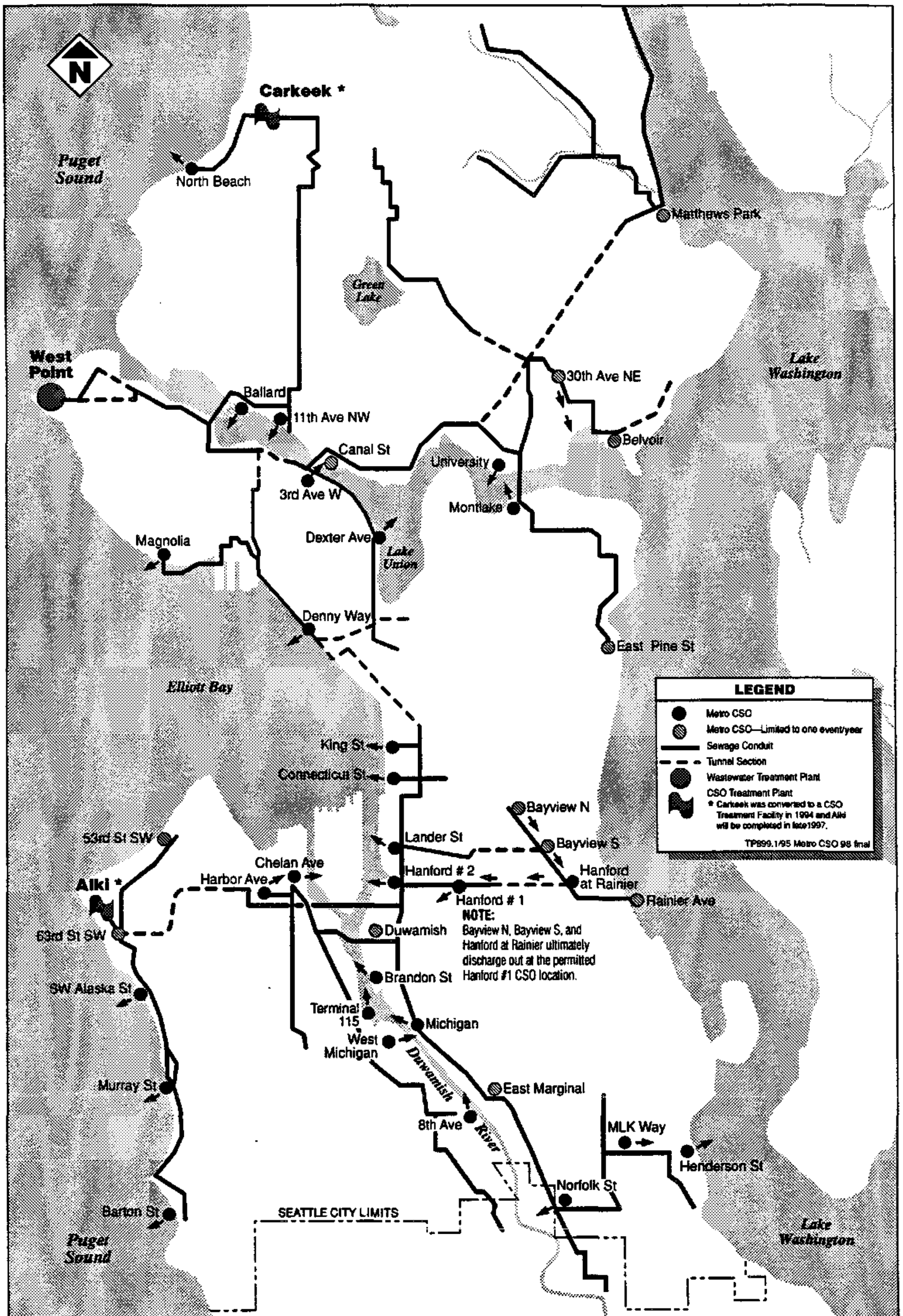


Figure 4-1. Combined Sewer Overflow Locations

Table 4-4. Annualized 1998 Baseline CSO Volumes and Frequencies

Overflow Location	Interbay Pump Station Unrestricted WP 440 mgd (MG)	 Restricted WP 400 mgd (MG)	Difference (MG)	Annual Overflow Frequency
Southern Service Area				
8th Avenue South	12	12	0	12
W. Michigan Street	2	2	0	9
Terminal 115	5	5	0	8
Harbor Avenue	58	58	0	56
East Marginal Way	0	0	0	<1
Chelan Avenue	66	66	0	25
Norfolk Street	6	6	0	4
Michigan Street	173	173	0	40
Brandon Street	57	57	0	40
Hanford #1 [a]	7	7	0	3
Hanford #2	202	207	5	23
Lander #2 [b]	161	164	3	23
Connecticut Street	91	93	2	25
King Street	23	33	10	31
Denny Local	79	82	3	51
Denny Lake Union	265	270	5	51
Interbay at Denny [c]	8	103	94	4 or 21
Total of Denny	*352*	*455*	*103*	
Martin Luther King Way	88	88	0	23
Rainier Avenue	0	0	0	<1
Henderson Street	10	10	0	16
Duwamish.	1	1	0	<1
S. Magnolia	15	15	0	21
Northern Service Area				
Dexter Avenue	15	15	0	4
Canal Street	<1	<1	0	<1
East Pine Street	0	0	0	<1
30th Avenue NE	0	0	0	<1
Belvoir	0	0	0	<1
Matthews Beach	0	0	0	<1
University	58	48	-10	8
Montlake	4	4	0	4
Ballard Regulator	4	1	-3	5
11th Avenue NW	18	16	-2	15
3rd Avenue West	51	33	-18	12
North Beach.	2	2	0	18
Alki				
Murray [d]	5	5	0	8
Barton [d]	7	7	0	23
53rd Avenue SW [d]	<1	<1	0	<1
63rd Avenue SW	0	0	0	<1
SW Alaska Street [d]	12	12	0	23
Total (MG)	**1505**	**1595**	**90**	

[a] Includes overflows at Bayview North, Bayview South and Rainier Ave. at Hanford St. that overflow to the storm drain which leaves the system at the site of the former Hanford #1 Regulator.
[b] The Lander Separation included construction of a new regulator station.
[c] Frequency depends on West Point set point.
[d] The Alki basin calibration has not been completed for these overflow locations.

Hanford No.1. The Hanford No. 1 overflows are the product of overflows from three weirs in the Rainier Valley (Bayview North, Bayview South, and South Hanford Street at Rainier Avenue). Overflows from the area were thought to be controlled by the 1987 Hanford separation project. However, modeling suggests that the desired degree of control was not achieved in the Hanford project. All three weirs spill into the storm drain leading to Hanford Tunnel which discharges to a stormwater pipe in the Diagonal area at the former site of the Hanford No. 1 Regulator. Recent modeling suggests a combined discharge flow from the three weirs amounts to approximately 7 MG per year. That volume is an estimate only based on uncalibrated model results. This will be refined by calibration after collection of monitoring data.

Connecticut Street. Initial computer simulations of the Connecticut Street basin produced overflow estimates substantially higher than actual monitoring has ever revealed. Additional investigation of the basin is required to determine the reason for the variance. The annual overflows shown in Tables 4-1 and 4-4 are consistent with measured values using adjusted computer simulations.

Chelan. A discrepancy between the computer model and actual operation of the City of Seattle's storage tanks in the Delridge area along Longfellow Creek was recently noted. This may impact estimates for Chelan overflows in the future. The values shown in Table 4-1 are correct for the 1981-83 baseline period which preceded construction of the City's tanks, however.

Alki. The calibration of the Metro model has not been completed at the Barton, Murray and SW Alaska Street CSOs. Data is now being collected to confirm the current estimates.

Water and Sediment Quality

In order to comply with WAC 173-245-040(2), a CSO-reduction plan must include the following information:

> (a) Documentation of CSO activity. Municipalities shall complete a field assessment and mathematical modeling study to establish each CSO's location, baseline annual frequency, and baseline annual volume; to characterize each discharge; and to estimate historical impact by:
>
> > (i) Flow monitoring and sampling of CSOs. Monitoring and sampling at one or more CSO sites in a group which are in close proximity to one another shall be sufficient if the municipality can establish a consistent hydraulic and pollutant correlation between/among the group of CSO sites. Sampling may not be required for sites which serve residential basins.

These WAC requirements were translated into a monitoring plan through the NPDES permit for the West Point Treatment Plant. Metro agreed to conduct discharge and sediment sampling at five CSO sites each year through 1992.

CSO Monitoring Program

As described in the *1988 Plan,* Metro's sampling program was to collect data for five CSO sites per year. Discharge samples were to be taken four times per year under overflow conditions at each site, and the sampling data was to be used to characterize the CSO effluent at each site. Table 4-5 shows the number of discharge samples taken at each site and summarizes the status of discharge sampling for each site. The monitoring program is nearly complete. As the table indicates, three sites (Dexter, Eighth Avenue, and Chelan) still require sampling, and one of the sites (Montlake) has had only three of the required four samples taken. Because the 1993-1994 season proved to be considerably drier than normal, and also because of equipment malfunctions, Metro sampling for those four sites could not be completed. All four are due to be sampled during the 1994-95 wet season, assuming sufficient storm events.

The results of the CSO Monitoring Program are presented in the series of tables found in Appendix E.

Sediment Monitoring Program

As noted above, sediment sampling is part of NPDES requirements. Sediment quality is an especially important issue for Metro. In 1991, the United States, on behalf of the National Oceanic and Atmospheric Administration (NOAA) filed suit against Metro and the City of Seattle, claiming, among other things, that CSO discharges had unduly damaged benthic sediment quality. Subsequently Metro, the City of Seattle, NOAA, and others settled the litigation, with Metro and the City each agreeing to pay up to $12 million in sediment protection and restoration work. However, NOAA expressly reserved the right to sue again to bring claims for recovery of natural resource damages in the area covered by the consent decree resulting from the release of hazardous substances from CSO and/or stormwater outfall systems after the effective day of the consent decree.

The *1988 Plan* provided for sediment samples to be taken at nine CSO sites. Plan requirements were completed in 1990. However, Metro is in the process of developing a comprehensive, site-specific baseline study plan for biological and chemical analysis of the sediment to meet additional NPDES requirements. A *Sediment Baseline Monitoring Plan,* which provides for additional monitoring of marine sediments in the vicinity of wastewater treatment plant outfalls and CSOs, was submitted to the Department of

Table 4-5. CSO Monitoring Program Status

CSO	Serial	Date	Sample #	Status of Program
Discharge Monitoring				
Michigan	W039	03/26/88	8800300	Permit Requirements Met
Lander	W030	03/26/88	8800301	Permit Requirements Met
Denny	W027	03/25/88	8800302	Permit Requirements Met
11th Ave. NW	W004	02/22/89	8801743	Permit Requirements Met
		04/06/88	8800352	
		01/14/88	8800052	
		11/02/88	8802026	
3rd Avenue West	W008	02/22/89	8801742	Permit Requirements Met
		01/14/88	8800053	
		03/26/88	8800303	
		11/02/89	8802027	
Ballard	W003	12/02/89	8909776	Permit Requirements Met
		03/09/90	9000286	
		10/04/90	9000880	
		01/06/90	9000002	
Connecticut	W029	08/22/89	8900832	Permit Requirements Met
		10/22/89	8909689	
		04/23/90	9000394	
		02/07/90	9000215	
Brandon Street	W041	03/14/90	9000289	Permit Requirements Met
		06/03/90	9000510	
		10/04/90	9000881	
		12/04/90	9010003	
Norfolk Street	W044	10/14/90	9000887	Permit Requirements Met
		06/06/90	9000524	
		04/03/91	9100612	
		12/04/90	9010006	
W. Michigan	W042	01/12/91	9100012	Permit Requirements Met
		04/03/91	9100613	
		01/28/92	9200134	
		10/06/93	L2224-1	
Eighth Avenue	W040			Sampling in 1994/1995
Chelan Avenue	W036			Sampling in 1994/1995
Dexter Avenue	W009			Sampling in 1994/1995
Montlake	W014	12/04/90	9100009	Additional Sampling 1994/1995
		04/03/91	9010609	
		02/21/92	9010006	
Sediment Monitoring				
Ballard	W003	05/30/89	8900560	Permit Requirements Met
11th Avenue NW	W004	05/30/89	8900561	Permit Requirements Met
3rd Avenue West	W008	05/30/89	8900563	Permit Requirements Met
Dexter Avenue	W009	05/30/89	8900565	Permit Requirements Met
Montlake	W014	05/30/89	8900564	Permit Requirements Met
Eight Avenue	W040	05/23/90	9006690	Permit Requirements Met
Brandon Street	W041	05/23/90	9006687	Permit Requirements Met
Michigan	W042	05/23/90	9006691	Permit Requirements Met
Norfolk Street	W044	05/23/90	9006688	Permit Requirements Met

Ecology for approval in the fall of 1994. That plan characterizes each CSO site according to the status of clean-up activities as follows:

- For five sites, a cleanup study is already underway or contemplated in the near future, and therefore no new baseline sampling is being proposed under the plan.
- For five sites, baseline sampling is complete, and no additional sampling is planned unless requested by the Department of Ecology.
- For three sites, cleanup activities are anticipated, and sampling is required to facilitate those activities.
- For seven sites, new baseline sampling is proposed. For these sites, the monitoring plan specifies the manner in which sampling will be carried out.

Cost-Effectiveness of CSO Control Projects

In accordance with Environmental Protection Agency policy, the *1979 Combined Sewer Overflow Control Program* evaluated CSO control projects on the basis of the cost-effectiveness of those projects. A graph plotting cost versus reduction of overflow volume was made. In all cases analyzed for that plan, a pronounced "knee," representing a dramatic increase in marginal control costs, could be identified. That was considered the cost-effectiveness point, beyond which the incremental benefits were not considered worth the additional costs. This "knee-of-the-curve" approach to cost-benefit analysis was generally similar to the analysis used on most Metro project proposals at that time. In the 1985-86 planning effort, the knee of the cost/benefit curve approach was also used to select an appropriate control level of 60 percent reduction in annual CSO volume.

The regulatory environment has changed since 1979 which makes the "knee-of-the-curve" approach no longer valid. Specific overflow frequency and volume reduction targets for CSO control were established. In addition, regulations requiring that Metro inventory and monitor the wastewater/CSO system were established. These regulations led to an on-going effort to develop the new Metro model to better understand the system and the acquisition of additional data to calibrate that model. As previously noted, Metro must meet the long-term CSO control goal of no more than one overflow event per year, and in the short-term, CSO control must provide 75 percent volume reduction by the end of 2005. Metro is free to select specific program elements which will be used to meet those goals, but the regulations do not provide for an exemption from control requirements because the marginal costs exceed the marginal benefits as was the case in 1979.

Re-examination of costs and effectiveness of the *1988 Plan* projects during the development of this *1995 CSO Update* indicates that the estimated construction costs of those projects have increased due to inflation as well as other factors noted later in this section, and that the effectiveness in terms of CSO volume control is less than anticipated. Figure 4-2 presents estimated accumulated capital costs to achieve specified levels of CSO volume control based on the *1988 Plan*. Capital costs from the *1988 Plan* have been inflated 21 percent according to the difference in the Engineering News Record Construction Cost Index in 1988 and 1994 to facilitate comparison. The points on the line labeled "*1988 Plan* Inflated to 1994 dollars" correspond to the phases of implementation included in that plan through the program to achieve one-event-per-year controls.

The projects in the first four phases of the *1988 plan* are noted in Table 4-6. Additional partial separation projects were developed in the *1988 Plan* which, when added to the first four phases, were to result in one event per year control at each of Metro's CSO locations. On Figure 4-2, the one event per year point lies at 85 percent CSO volume reduction. This is because the system will still be overflowing at an average frequency of once per year even after implementation of these control projects. The projects and costs are listed in Appendix F.

The line labeled "1995 Estimate" on Figure 4-2 includes actual total project capital cost estimates for projects through Phase 2 of the *1988 Plan,* and estimated costs for projects in modified phases 3 and 4 as well as possible one event per year controls developed in this *1995 CSO Update*. Projects in the modified phase 3 are as included in this *1995 CSO Update* described in Chapter 5. Projects for modified phase 4 and one event per year are a potential selection, but are not recommended in this *1995 CSO* Update. The projects are also noted in Table 4-6 and are described in early sections of this chapter and in Chapter 5. Estimates of the effectiveness of those projects developed with Metro's new model are included. The 1995 Estimate line starts from the 1998 Baseline condition as shown in Table 4-4 after completion of phase 1 and 2 projects from the *1988 Plan*. As noted earlier, these projects are anticipated to provide a 33 to 37 percent reduction in annual CSO volume rather than the 50 percent estimated in the *1988 Plan*. Also as noted earlier, the original phase 3 and 4 projects are not expected to achieve 75 percent volume reduction as assumed in the *1988 Plan*. Thus, the 1995 Estimate includes additional projects to reach the 75 percent CSO control objective. These additional projects include CSO storage projects at the Martin Luther King Way and Henderson CSO locations, the addition of components to the Denny Way project defined in Chapter 5 to enhance treatment capabilities, and the Brandon separation/storage project defined earlier in this chapter. To reach the one event per year control level, the 1995 Estimate includes CSO treatment facilities at the Hanford and Lander CSO locations and storage facilities at all other CSO locations not included in other phases (see Appendix F). These projects represent only one potential approach to achieving the CSO Control objectives. Later analysis in the RWSP process will make final project recommendations and prepare schedules.

Total project costs to Metro through Phase 2 of the *1988 Plan* were lower than anticipated due to grant funding. However, examination of Figure 4-2 indicates that the currently-estimated total project capital costs to achieve the CSO control objectives of 75

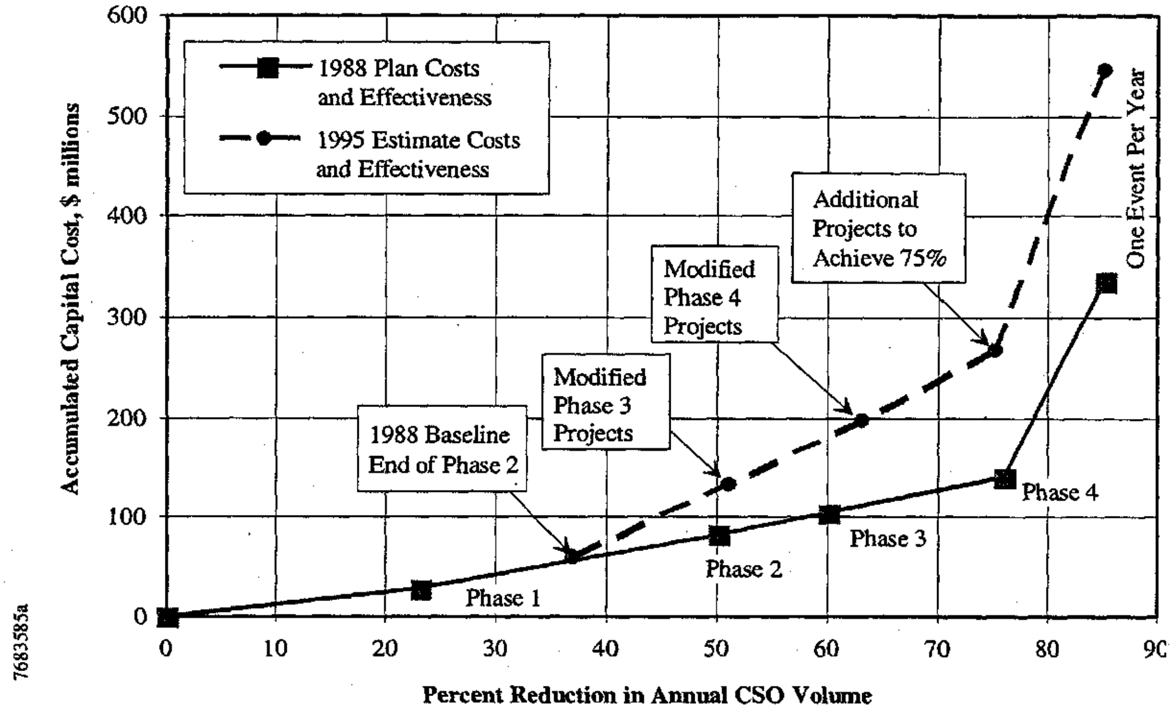


Figure 4-2. Capital Costs Necessary to Achieve Control of CSO Volumes

Table 4-6. Actual and Representative Projects Included in Cost-Effectiveness Analysis

1988 Plan Projects		1995 Estimate Projects	
Project and Phase	Cumulative reduction	Project and Phase	Cumulative reduction
Phase 1 Hanford/Bayview CATAD Modifications	23	**Phase 1** Hanford/Bayview CATAD Modifications	NA
Phase 2 Alki CSO Treatment Carkeek Park CSO Treatment Fort Lawton Tunnel University Regulator Separation Lander Separation	50	**Phase 2** Alki CSO Treatment Carkeek Park CSO Treatment Fort Lawton Tunnel University Regulator Separation Lander Separation	37
Phase 3 Denny Partial Separation	60	**Modified Phase 3** Denny Way/Lake Union CSO Control Harbor CSO Pipeline Henderson/Martin Luther King Way Engineering Evaluation	51
Phase 4 Michigan Separation Kingdome/Industrial Area Separation	76	**Modified Phase 4 (a)** Michigan Separation and Storage Kingdome/Industrial Area Separation and Storage	62
		Additional Projects to Achieve 75% Volume Reduction (a) Martin Luther King Way and Henderson Storage Denny Way CSO Treatment Brandon Separation and Storage	75

(a) Representative projects only. RWSP will make final project selection and prepare schedules.

percent volume reduction and one event per year have increased significantly since preparation of the *1988 Plan*. The current estimate of total costs to achieve 75 percent CSO volume reduction and one event per year control are approximately double what was estimated in 1988. Reasons for this increase in cost include the following:

- Additional markups on construction cost as a result of recent experience. Current cost estimates use higher contingencies and allied costs than were used in 1988.
- Changes in cost estimating methodology. Cost estimates are now made using more detailed accounting of all components of any project. As a result, they are more accurate.
- Changes in basic project assumptions. For example, the costs of partial separation have risen dramatically due to changes in City of Seattle requirements. These include the requirement to provide drainage facilities for the 10 year storm instead of the 5 year storm, and the requirement to replace one full panel of the street surface where concrete paving is used. Also, the Denny Way partial separation project described in the *1988 Plan* understated the project area requiring separation by approximately 200 acres. It was assumed by Metro in 1988 those 200 acres would be included in the City's East Lake Union separation. In fact, however, the City elected not to separate this area since it was not needed for control of its CSOs. Thus Metro would have been forced to increase the separation project area to maintain the desired volume control or settle for a smaller amount of volume controlled for the original project budget.
- Decreased project effectiveness. As noted before, the new Metro model has indicated that the *1988 Plan* estimates of annual CSO volume at the Duwamish pump station and University Regulator were significantly higher than actually occurred. Since the *1988 Plan* assumed these CSOs would be significantly reduced, the estimates for effectiveness for the projects in that plan were overstated. As a result, it will be necessary to do additional projects at increased cost to provide the required 75 percent reduction in annual CSO volume.
- Wastewater/CSO System Complexity. The complex hydraulics of the Metro system require an on-going effort to refine understanding of the system's behavior. As this process proceeds, changes in both scope and effectiveness will occur as Metro moves into design and construction.

Figure 4-2 shows that the 'knee of the curve' remains at approximately the 75 percent volume reduction point as was the case in 1988. Costs to reach that level of control and the ultimate one event per year controls are now estimated to be significantly higher than anticipated in the *1988 Plan*. Work in this Update indicates that the projects included in Phase 4 of that plan (Michigan and Kingdome/Industrial Area storage and separation projects as described on pages 4-9 and 4-10) appear to remain cost-effective on the basis of dollars per gallon of CSO controlled compared to alternative projects. The RWSP is examining these projects in light of concerns over stormwater discharge to the Duwamish estuary arising from the NOAA settlement described on page 1-5. The RWSP process will be complete in late 1995 or early 1996. It will define projects, priorities and schedules for control of CSOs beyond the three specific projects (Denny Way/Lake Union CSO Control, Harbor CSO Pipeline and Henderson/Martin Luther King Way Engineering Evaluation) identified in Chapter 5 of this *1995 CSO Update.*

CHAPTER 5
CSO CONTROL PROJECTS FOR THE NEXT FIVE YEARS

The previous chapter evaluated the progress Metro has made towards meeting its goals of one overflow event per year and 75 percent volume reduction. This chapter will begin with a brief review of projects originally proposed in Phases 3 and 4 of the *Final 1988 Combined Sewer Overflow Control Plan (1988 Plan).* Then it will describe the specific *1995 CSO Update* projects which Metro will undertake during the next five years. Those 1995 projects are the Denny Way/Lake Union CSO Control Project, the Harbor CSO Pipeline Project, and the Henderson/Martin Luther King Way CSO Control Engineering Evaluation. The locations of each are shown on Figure 5-1. The 1995 projects and their implementation schedules will be evaluated in terms of *1988 Plan* goals. The chapter will conclude by examining the benefits those new projects will produce and the project costs Metro will incur.

Projects from the *1988 Plan*

As discussed in Chapter 4, the 1988 Plan described 11 specific Metro projects and proposed phasing them over a 20 year period in four phases. Table 5-1 provides a summary of the *1988 Plan* projects and compares their status with the projects set forth in the *1995 CSO Update* which are to be completed in the next five years.

Denny Partial Separation Project

The Denny project described in the *1988 Plan* called for partial separation of Denny Local, a portion of Denny Way/Lake Union, and Vine Street Basin flows. This project, which would have intercepted street drainage only, was expected to reduce the annual overflow volumes at the Denny Regulator by 50 percent. In the plan development, it was assumed that the City of Seattle would separate most of the remaining combined area tributary to the Lake Union Tunnel. Metro's Denny project was to begin in 1993, and construction was to be completed by 1999. Metro, however, delayed the project in 1990 out of concerns about compatibility of the project with City plans.

At the same time Metro was developing its *1988 Plan,* the City of Seattle was preparing a CSO control plan of its own. The City's *1988 CSO Control Plan* included partial separation of part of the East Lake Union basin and construction of a large storage tank near the south end of Lake Union. The tank would have drained to Metro's Lake Union Tunnel, which conveys sewage from the south Lake Union area to the Denny Way

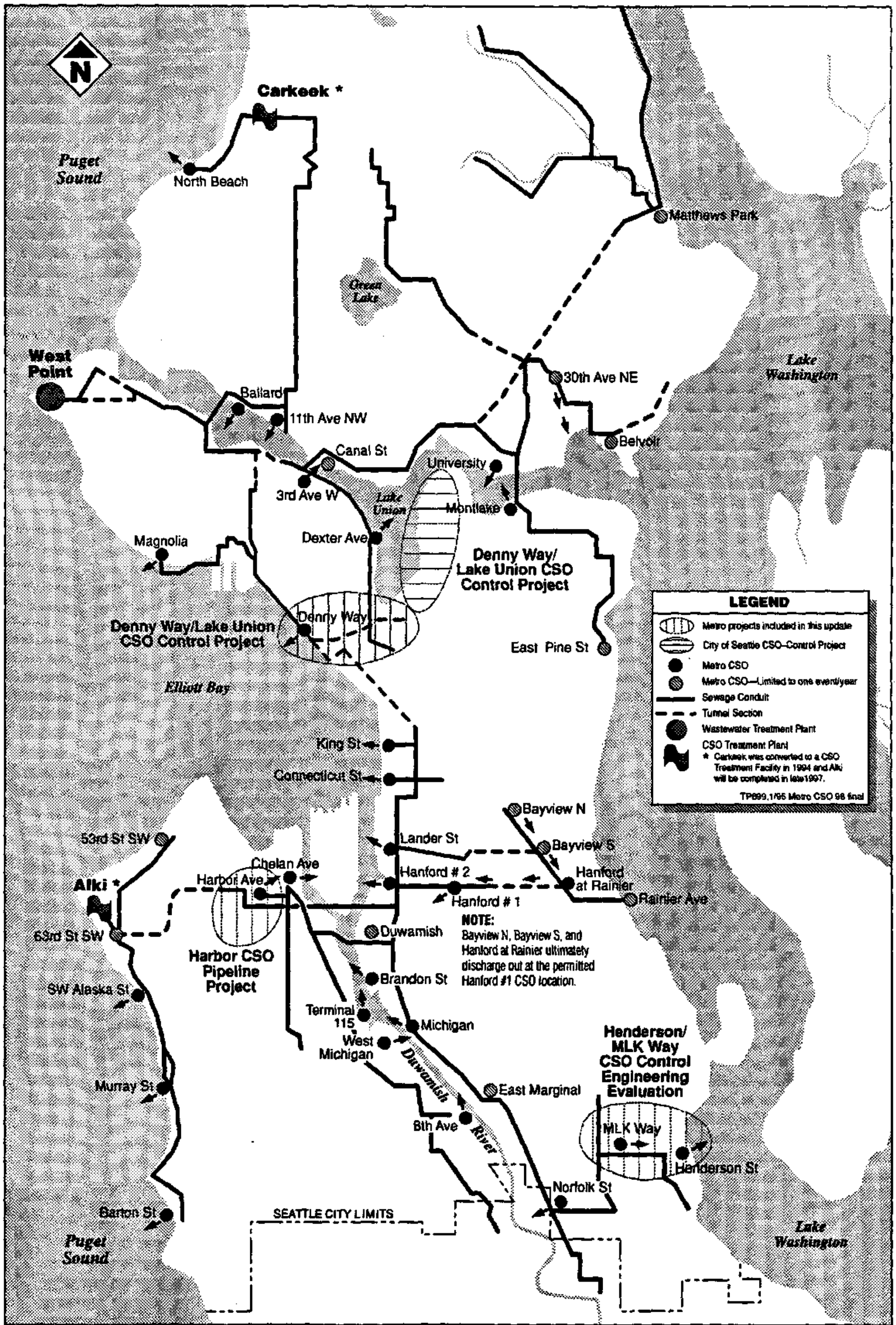


Figure 5-1. Locations of CSO Control Projects for the Next Five Years

Table 5-1. Comparison of CSO Control Projects in *1988 Plan* and *1995 CSO Update*.

1988 Plan Projects	Date to Be Completed	1995 Update Projects	Date to Be Completed
Phase 1 (1987-91)			
Hanford Separation	Completed		
Bayview Storage	Completed		
CATAD Modifications	On-Going	CATAD Modifications	On-Going
Phase 2 (1992-97)			
Alki Transfer/CSO Facilities	1995	Alki Transfer/CSO Facilities	Late 1997 [a]
Carkeek Park CSO Treatment Plant	Completed		
Parallel Fort Lawton Tunnel	Completed		
University Regulator	Completed		
Lander Separation	Completed		
Phase 3 (1995-99)			
Denny Partial Separation	1999	Denny Way/Lake Union CSO Project[c]	2000
		Henderson/Martin Luther King Way CSO Engineering Evaluation	Mid 1995
Diagonal Separation[b]	2000	Harbor CSO Pipeline	1998
Phase 4 (2000-2005)			
Michigan Street Separation	2003	Michigan Street Separation	To be Determined in RWSP
Kingdome/Industrial Separation[d]	2005	Kingdome/Industrial Separation	To be Determined in RWSP

[a] Delayed as a result of a bid protest regarding the tunnel component.
[b] The *1988 Plan* designated Diagonal as a City project.
[c] Original project modified and delayed. The project is now called the Denny Way/Lake Union CSO Control Project and is scheduled to be completed in 2000. Some components may be re-scheduled as part of RWSP.
[d] Partially completed in 1994.

Regulator Station. In later predesign studies, the City developed a plan for the area east and south of Lake Union that conveyed flows to the south end of the lake instead of separating the area. The later plan called for CSO flows to be stored in an even larger tank there. There was concern of whether capacity existed in Metro's Elliott Bay Interceptor to convey these stored flows to West Point for treatment and whether release of the large volume of stored sewage would increase Metro's overflow at the Denny Regulator.

In 1991, the City of Seattle began working with Metro to find better ways of controlling CSO and stormwater discharges into Lake Union and into Elliott Bay. A joint City/Metro project offered both parties the opportunity to view its own CSO problem in the larger context of total system volume reduction. A joint project would also allow the parties to pool their resources to design and construct the best system-wide solution. A joint project would control City flows and other flows draining to the Lake Union Tunnel and overflows from the Dexter Regulator to the one-event-per-year level. The May 1992 *Feasibility Study-CSO Control for Lake Union and Denny Regulator* recommended construction of an eight-foot diameter tunnel from south Lake Union to Elliott Avenue. The report also recommended construction of a CSO treatment plant in the vicinity of the Denny Regulator. The *Feasibility Study* did not consider separation options.

Recently, Metro has re-examined the overflow problem at the Denny Regulator Station in light of changes to Metro's model since the *Feasibility Study.* Metro also wanted to evaluate partial separation and other options for the Denny basin. After carefully evaluating partial separation and other alternatives, Metro modified the Denny project described in the *1988 Plan*. The modified Denny project is described beginning on Page 5-5.

Michigan Street Separation Project

The *1988 Plan* included a total separation project for Michigan Street as one of its final project elements. As noted in Chapter 4, the predesign report for Michigan was completed in 1992. The predesign rejected total separation as too costly and disruptive to private property. Pipeline design has been accelerated to coordinate with a Department of Transportation project to improve the First Avenue South Bridge over the Duwamish River. Design for the balance of the project will depend on action recommended by the RWSP.

Kingdome/Industrial Separation Project

The final Phase 4 project under the *1988 Plan* involved separation of the Kingdome parking lot and the industrial area to the south and construction of a new sanitary trunk for remaining flows as described in Chapter 4. During 1994, Metro installed a portion of the new 96-inch trunk in order to coordinate the installation with a City of Seattle street widening project south of the Kingdome on Royal Brougham Way. The new line can be used for CSO storage until the rest of the project is constructed. Metro is re-examining the project schedule for the Kingdome project as part of its RWSP.

CSO Control Program Changes for the Next Five Years

In place of partial separation for Denny Way, Metro has put forth a modified Denny project, the Denny Way/Lake Union CSO Control Project described below. The Kingdome and Michigan projects described above, the modified Denny project, a Harbor CSO Pipeline Project, and a Henderson /Martin Luther King Way CSO Control Engineering Evaluation, make up Metro's CSO program for the next five years.

Denny Way/Lake Union CSO Control Project

The Denny Regulator Station overflows approximately 494 MG per year (Metro and Seattle combined), making it the single largest overflow in the West Point System. Using new Metro model data, the consultant team developed approximately 32 different alternatives to control Denny CSOs to the degree required by the Department of Ecology. Those alternatives include separation, storage, conveyance, and treatment options and are described in the CSO Update *Task 4.0 Report, Development of Alternatives*. Metro also looked at treatment of CSO flows at a new plant in the Duwamish area, south of downtown Seattle, as a substitute for treatment at Denny. Existing land uses in the Duwamish area are more consistent with a treatment plant than those in the waterfront area near the Denny Regulator Station.

On April 8, 1994, Metro conducted a Denny-specific workshop to review and evaluate the CSO-control options which were developed by the CSO Update project team. Workshop participants also brainstormed additional alternatives. The workshop participants added a new alternative to the list, one involving CSO storage and treatment in the Interbay area. That alternative was eventually rejected because of land use concerns. Of the control alternatives presented at the workshop, storage and conveyance with treatment received about equally favorable responses. Workshop participants found the partial separation approach to be the least attractive option for Denny CSO control, primarily because of the high unit cost of separation.

One factor which particularly influenced selection of the final Denny Way/Lake Union project was Metro's desire that the project be able to integrate with any program which the RWSP might recommend. Controlling Denny overflows is important because of the large volume of wastewater discharged there. That large volume will require a large investment in a control project. Metro wants to make sure that a solution for Denny will still perform well following completion of any project which the RWSP might recommend to achieve long-term treatment and conveyance system needs, including CSO control.

The recommended Denny Way/Lake Union project which came out of this process consists of a new, 18-foot diameter, 6800-foot long tunnel under Mercer Street. The tunnel would run from Dexter Avenue to Elliott Avenue. The plan also includes a 2.5 MG concrete storage tank near the Denny Regulator Station, on the site once used by the Blackstock Lumber Company. Also included in the Denny Way/Lake Union project are two pump stations, a new outfall in Elliott Bay, and necessary piping and regulators. A drawing depicting the layout of the new Denny facilities is included as Figure 5-2.

The project would work by storing Denny flows in the 18-foot storage tunnel when the Elliott Bay Interceptor is full. When the tunnel is full, flows would be diverted to the Blackstock storage tank. During most storms, that storage capacity (15.44 MG of new storage) would be adequate to contain Denny sewage until flows in the Elliott Bay

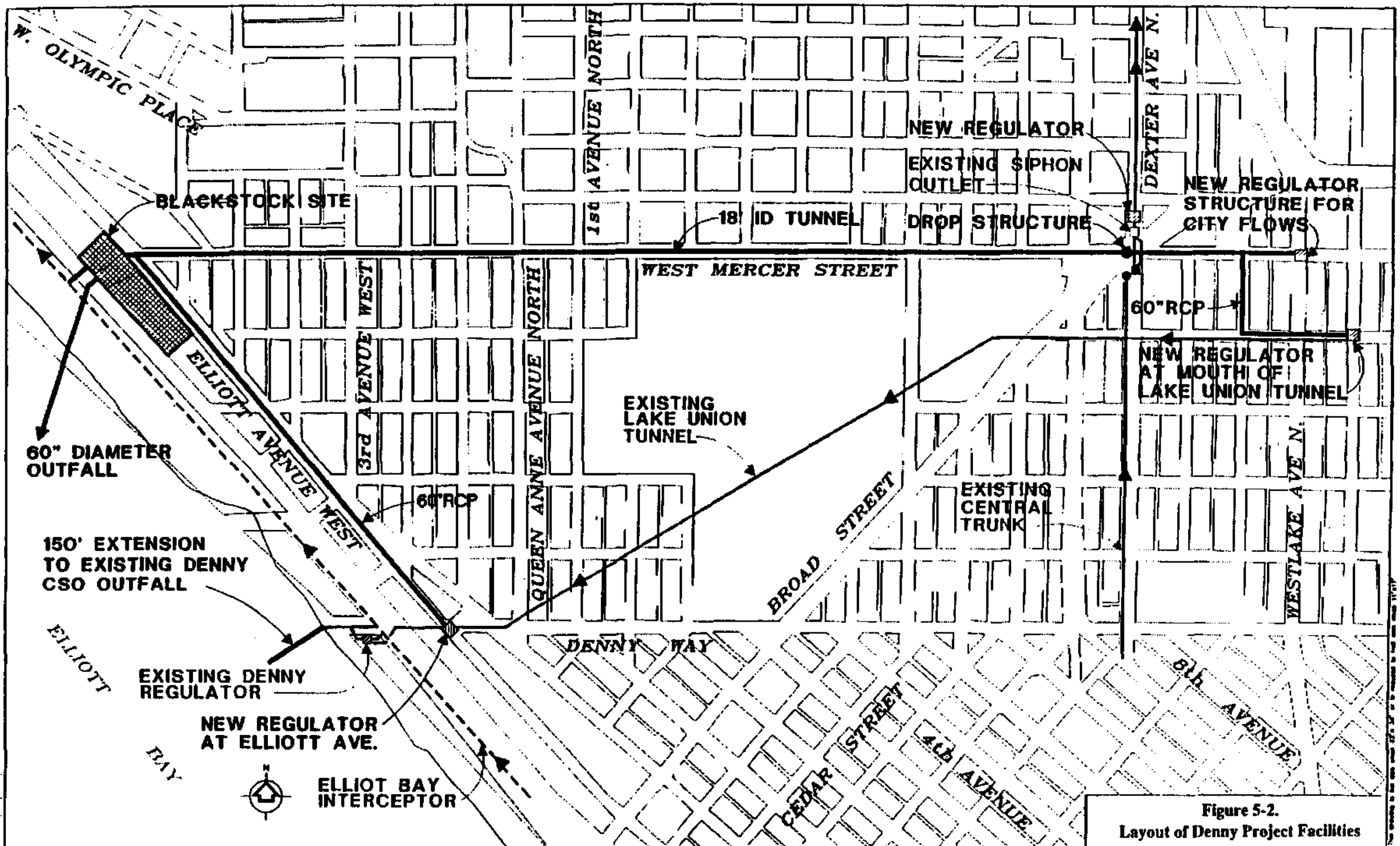


Figure 5-2.
Layout of Denny Project Facilities

Interceptor subside and interceptor capacity becomes available. Then the stored wastewater would drain into the interceptor and be transported to West Point for treatment. If a storm produces more combined flows than the system can handle, the excess would pass through the storage tank, where floatables would be removed, then be discharged out the new outfall into the Elliott Bay.

Initially, Metro expects that the proposed Denny Way/Lake Union project would reduce combined City and Metro annual overflow volumes by approximately 50 percent. It would also reduce overflow frequency from over 50 times per year to approximately eight times. The Denny project, however, will not be the final step in solving the Denny overflow problem. The Regional Wastewater Services Plan is reviewing a number of wastewater treatment and CSO-control options as part of its planning effort. For example, one RWSP idea would provide for a secondary treatment plant in the Duwamish area. Routing flow in the Elliott Bay Interceptor to a new Duwamish plant could control Denny to the one-event-per-year requirement. A CSO treatment plant in the Duwamish instead of the secondary plant would do the same. It may also be possible to transfer more flows from West Point to the East Division Reclamation Plant at Renton, thereby freeing up additional capacity in the Elliott Bay Interceptor for Denny flows. If any of those options were adopted as part of the RWSP, the Denny Way/Lake Union project would still be required to provide storage until capacity in the interceptor becomes available to move those Denny flows to West Point. Meanwhile, the proposed Denny storage facility would provide substantial frequency and volume reduction. Metro's estimated cost for the Denny Way/Lake Union project is $120 million, less any grant received and less the City's contribution.

The Denny Way/Lake Union project has been phased to both coincide with the RWSP process while still qualifying for the Coastal Cities Grant funding. The project is divided into the following four phases:

Phase 1: City's project to upsize pipes along Eastlake to control several of the City's Lake Union CSOs.

Phase 2: Continuation of the City's projects that will connect the City's Eastlake project to Metro's Phase 3.

Phase 3: Metro's design and construction of those facilities that will accommodate the increased flows from the City's Lake Union system, that will reduce the Dexter CSO discharge to one event per year, and that will reduce the Denny Way discharges to 50 percent of the baseline annual CSO volume. The preferred alternative includes a parallel Lake Union tunnel, a 2.5 MG storage facility on Elliott Avenue, a new submarine outfall, and extension of the existing Denny outfall.

Phase 4: Metro's project to reduce CSOs at Denny to one event per year (e.g. design and construction of a CSO treatment facility at Denny or Duwamish). This phase will be coordinated with the RWSP.

Design for Phase 1, a portion of a new combined sewer conveyance line along the east side of Lake Union, has been initiated by the City of Seattle. An environmental impact statement and facilities plan for Phases 2 and 3 are underway, with completion scheduled in 1996. Design for the Phase 3 facilities is scheduled to begin in 1996, and construction is scheduled to be completed by 2000. RWSP decisions may alter completion dates or final configuration of these facilities.

Harbor CSO Pipeline Project

The Harbor Regulator overflows on average 56 times per year. Overflows are diverted to a City storm drain and are eventually discharged to Longfellow Creek. Average annual overflow volume is approximately 58 MG, indicating that CSOs are frequent but generally small. During Design Storm No. 6, the volume of overflow is estimated to be 3.4 MG.

The proposed pipeline would carry overflows from the Harbor Regulator to the new West Seattle Pump Station for storage in the new West Seattle Tunnel. The tunnel will have an empty volume of 5.9 MG. The volume available for storage of combined wastewater after allowance for transporting 19 mgd of base flows will be about 5.5 MG. The proposed 54-inch diameter gravity pipeline could carry all overflows from the Harbor Regulator during all but the largest storms. With the proposed pipeline, Harbor Regulator overflows would drop from 56 times per year to one event per year or less. Even in large storms, most of the overflow volume will be contained. The project would bring the Harbor CSO to the one-event-per-year level.

The *1988 Plan* assumed that control of Harbor overflows would be accomplished by partial separation. Such a separation was scheduled to occur sometime after 2005. Recent modeling indicates that there would still be overflows at Harbor, even after partial separation, thus necessitating the addition of storage to reach the one event per year objective. The current Harbor CSO Pipeline Project takes advantage of the opportunity to utilize storage for wastewater in the West Seattle Tunnel.

The Harbor CSO Pipeline Project has been reprioritized to be done sooner than scheduled in the *1988 Plan* because of the cost and environmental benefits from constructing the pipeline concurrently with the West Seattle Forcemain. A portion of the forcemain would be laid in Harbor Avenue between the Harbor Regulator and the new West Seattle Pump Station. The West Seattle Tunnel will be 10 feet in diameter for constructability and safety purposes. The tunnel volume provides for storage of combined wastewater for secondary treatment. The Harbor pipeline portion of the project enlarges the trench for the forcemain and lays a new 54-inch pipe underneath. The Harbor CSO pipeline adds less than $1 million to the construction cost of the Alki project. On the basis of cost per million gallons of CSO controlled annually, this project would cost about $14,000 per MG. The cost of excavating a new pipeline trench and laying the new pipe later on would be much higher and could affect the integrity of the forcemain.

Henderson/Martin Luther King Way CSO Control Engineering Evaluation

As discussed in Chapter 2, Metro's original mission was to clean up Lake Washington and the Seattle waterfront. In 1979, this mission continued to be supported as Metro and the City of Seattle agreed that Lake Washington CSO projects would receive top priority. As a result of that policy and previous City separation and storage projects, CSOs to Lake Washington were considered controlled by the time of the *1988 Plan*. Recently, however, Metro discovered new evidence of overflows to the lake. Those overflows have been identified as coming from the South Henderson Street Pump Station and the Martin Luther King Way overflow weir. Annual overflows total 10 MG at the Henderson location and 88 MG at the Martin Luther King Way location.

The overflows are believed to be the result of heavy inflow and infiltration to the system in those two areas. Metro believes that controlling inflow and infiltration may be a cost-effective way to prevent overflows. As a result, Metro has undertaken an engineering evaluation of the area to locate major sources of inflow and to make recommendations for controlling it. The evaluation will also consider the impact of these overflows on the Norfolk Regulator. The study is scheduled to be complete by mid-1995.

Impact of 1995 Program Changes on Control Goals

According to the *1988 Plan*, 1981-83 Metro overflows amounted to 2,409 million gallons per year. The plan called for eventual reduction to 568 MG per year by the end of 2005. Breaking the planned projects into phases, progress milestones from the plan and the actual results achieved are as shown in Table 5-2.

Table 5-2. ***1988 Plan*** **and Actual CSO Reduction, by Plan Phase**

Plan Phase	CSO Volume Remaining (MG)		Volume Reduced (Percent)	
	1988 Plan	Current Estimate	1988 Plan	Current Estimate
1988 Existing Conditions	2409	2391	0	0
Phase 1 (1987-1991)	1844	NA	23	NA
Phase 2 (1992-1996)	1209	1505-1595[a]	50	33-37[a]
Phase 3 (1997-2001)	966	1180-1372[a]	60	43-51[a]
Phase 4 (2002-2006)	568	840-1032[a]	76	57-65[a]

[a]Range depends on West Point peak flow set point.

As discussed in Chapter 4 of this report (which provided the review of the projects included in the *1988* Plan), the total existing conditions figure of 2,409 million gallons used in the *1988 Plan* was not completely accurate. Metro's new model revises the annual overflow volume in the 1981-83 control system to 2,391 million gallons. Data derived from the new model indicates that annual CSO volumes remaining after Phase 2, but before the Denny Way/Lake Union CSO Control Project and Harbor CSO Pipeline Project, and before implementation of any Henderson/Martin Luther King Way CSO control project which might be recommended by the evaluation team, are approximately 1,505 to 1,595 million gallons (depending on West Point peak flow set point), representing a 33 to 37 percent reduction. Assuming the Denny and Harbor CSO projects described above are implemented as Phase 3, remaining annual volumes will still total nearly 1,200 to 1,400 million gallons. That represents a 43 to 51 percent reduction, still short of the *1988 Plan* goal of 60 percent. Assuming complete implementation of Phase 4 projects, Metro will have controlled only about 57 to 65 percent of baseline volumes, falling short of its interim reduction goal of 75 percent reduction by the end of 2005.

Reasons why control projects have achieved less than expected levels of control include:

1. The model used for estimating the CSO volumes for the *1988 Plan* over-estimated the overflows at the Duwamish Pump Station by 129 MG/year. It was also anticipated that this overflow would be controlled. Since the overflow did not in fact occur, no reduction is shown in the 1998 conditions.

2. The model used for estimating the CSO volumes for the *1988 Plan* overestimated the University overflows by nearly 50 percent (111 MG/year). As a result, the reduction assumed by the control projects for this regulator was overstated, and actual volume reduction resulting from those projects is lower than expected.

3. Stations not connected to CATAD in 1988 and for which data was limited or non-existent were not considered in the *1988 Plan*. These overflows amount to about ten percent of the baseline estimate. Since the *1988 Plan* did not make provision for CSO control at these locations, inclusion of these volumes now offsets real control gains made elsewhere within the system.

4. The degree of partial separation assumed for the Hanford separation, Bayview storage, and Lander separation projects was greater than was actually accomplished.

Cost-Effectiveness of 1995 Program Changes

The CSO-related capital cost for the projects from the *1988 Plan* which have been completed or are under construction total $61 million (1994 dollars). Together those projects have (or will have, by 1998) controlled approximately one-third of baseline volumes (796 to 886 MG, depending on whether West Point flows are restricted to 400 mgd or are allowed to reach 440 mgd). Control costs have thus averaged about $73,000 per million gallons controlled, a figure which is about 50 percent greater than anticipated by the *1988 Plan*. Estimates indicate that to reach 75 percent reduction of system-wide CSO volumes is likely to cost as much as $200 million over and above what has been spent to date, bringing the average cost per MG controlled to as much as $150,000.

The Denny Way/Lake Union project described in this report will be the most expensive Metro CSO control project to date. The total cost estimate for the project is $120 million. The cost to Metro will be less than this by the City of Seattle's contribution ($24 million) and any grant received ($26 million to Metro is anticipated). This cost will exceed the combined cost of all CSO control projects which preceded the Denny project. All control projects before Denny will have resulted in control of approximately 796 to 886 MG of overflow. The specific Denny project proposed will control about 250 to 350 MG more, including the City's East Lake Union overflows controlled. It is important to keep in mind, however, that Denny is not a complete project. Rather, the Denny proposal is a part of a strategy to be developed in the RWSP for controlling all of Denny flows. Should, for example, the RWSP recommend construction of a secondary treatment plant in the Duwamish area, the routing CSO flows there would significantly increase the effectiveness of the Denny project. The final Denny unit control costs will fall in the $300,000/MG range, which is about the average unit cost of other projects being examined system-wide.

The Harbor CSO Pipeline Project, on the other hand, is among the most cost-effective of Metro's projects. Costs are estimated at $750,000, making the cost per million gallons controlled about $14,000. That is less than the cost of any other CSO project considered to date.

The cost-effectiveness of a Henderson/Martin Luther King Way CSO control project is difficult to estimate at present, as no project has been proposed or planned. Metro has begun an engineering study to obtain a better understanding of the problem at the South Henderson Street Pump Station and at Martin Luther King Way. Once the engineering study has been completed, a specific project or projects can be selected and costs estimated.

Rate Impacts of 1995 CSO Update Projects

The Metro service charge in 1994 was $15.90 per month per residential customer equivalent. Of that amount, approximately $0.62 was attributable to CSO control projects. Current projects including *all* on-going costs for *all* of Metro's programs suggest that the total monthly charge will rise to $24.94 in 2000. This charge would cover all projects from Phase 1 and 2 of the *1988 Plan* (as shown in Table 5-1), as well as the projects identified in this *1995 CSO Update* (Denny Way/Lake Union CSO Control Project, Harbor CSO Pipeline Project, and Henderson/Martin Luther King Way Engineering Evaluation). This rate analysis has assumed that the Henderson/Martin Luther King Way Engineering Evaluation will recommend a project and that it will be scheduled in the RWSP process. Thus, funds were included in the rate analysis to cover construction by 2000. However, construction costs for projects at Martin Luther King Way and Henderson have not yet been appropriated. These unappropriated costs are included in Metro's CIP only to provide an estimate of potential rate impacts. Actual selection and scheduling of projects at these locations will ocurr in the RWSP process, and this *1995 CSO* Update is not recommending either actual projects or a schedule for their implementation. Using assumed or known grant funding and other contributions, approximately $1.84 of the projected total monthly charge in 2000 is attributable to CSO control projects. Without grants and assuming higher interest charges on bonds yields, an upper range estimate for the CSO portion of the monthly rate of approximately $2.82. The rate analysis is included in Appendix C. These values are consistent with the information on rates presented to the King County Council in October, 1994.

An analysis of the rate impact of only the projects included in this *1995 CSO Update* (Denny Way/Lake Union CSO Control Project, Harbor CSO Pipeline Project, and Henderson/Martin Luther King Way CSO Control Engineering Evaluation) was also prepared. For only these projects with the same assumptions on grants and contributions used in Metro's CIP, the rate impact varies from $0.01 in 1994 to $1.11 in 2000. A sensitivity analysis on the rates assuming low and high range cost estimates for these projects, as well as higher interest rates and a shorter bond life, indicates a potential range of $0.81 to $1.99 in the year 2000 for the *1995 CSO Update* projects. This sensitivity analysis is discussed further in Appendix C.

CHAPTER 6
ENVIRONMENTAL REVIEW

This chapter and Appendix D provide the SEPA review and documentation for the *1995 CSO Update.*

Environmental Documentation for Previous CSO Plans

In the mid-1980's, Metro amended its Comprehensive Water Pollution Abatement Plan for the Seattle-King County metropolitan area by adopting a facilities plan (i.e., the *Final Plan for Secondary Treatment Facilities: Plan for Secondary Facilities and Combined Sewer Overflow Control,* November 1985) calling for the upgrade Metro's sewage treatment plants to secondary treatment and to further control CSOs. The facilities plan was to be implemented in phases to serve projected growth in the Seattle-King County region to the year 2030. That 1985 facilities plan was appealed and a *Final Supplemental Plan for Secondary Treatment Facilities* was completed in July 1986. Then in January 1987, the Department of Ecology modified the state CSO control regulations, so Metro modified its 1985 and 1986 plans with its *Final 1988 Combined Sewer Overflow Control Plan.*

The following sections discuss the environmental documentation for these plans.

1985 Final Environmental Impact Statement

In November 1985, the *Final Environmental Impact Statement (1985 FEIS)* for the *1985 Plan* was issued by Metro. The *1985 FEIS* addressed environmental impacts related to secondary treatment, CSOs, and other wastewater facilities. The "Affected Environment" section (page 4-21), included the following:

> "CSOs have been recognized for a number of years as a serious source of local water pollution. Early perception of CSO-problems -- and the priority for past CSO control efforts focused on the direct human health concerns associated with water contact (e.g., swimming) in an area contaminated with untreated sewage. CSOs release bacteria and potential human pathogens into receiving waters."

The *1985 FEIS* also concluded (page 4-25), "All of the proposed CSO control projects would affect water quality at existing discharge points." However, as CSOs are detained and treated, impacts to water quality are reduced.

Environmental impacts resulting from overall system-wide components are evaluated in the *1985 FEIS*. Chapter 3 of the *1985 FEIS* provides a detailed description of the recommended alternative. The second column of Table 6-1 in this document displays those CSO project elements included in the *1985 FEIS*. Five CSO control options included the following project elements: CATAD system improvements, CSO treatment facilities, CSO storage facilities (such as underground tanks and tunnels), partial and complete separation of stormwater and wastewater in certain basins, and associated conveyance improvements. The environmental impacts and mitigation measures for each of those CSO project elements were addressed in Chapters 5 through 8 of the *1985 FEIS*.

1986 Final Supplemental Environmental Impact Statement

After issuing the *1985 FEIS*, Metro identified an additional system alternative for the Comprehensive Plan. The additional alternative included three options which would provide secondary facilities at a new Duwamish or Interbay site or smaller plants at both locations. The alternative also included CSO control projects to be implemented with the alternative. The environmental document issued by Metro for the additional alternative was the *1986 Final Supplemental Environmental Impact Statement, Plan for Secondary Treatment Facilities and Combined Sewer Overflow Control (1986 FSEIS)*. The environmental impacts and mitigation measures for the additional system alternative, including CSO control projects, were addressed in Chapters 5 through 7 of the *1986 FSEIS*.

1988 CSO Control Plan

In September 1986, the Department of Ecology advised Metro that changes in the *1986 Plan* would be required because of changes to the state CSO control regulation that were subsequently adopted by Ecology in January 1987. In response, Metro issued its *1988 Plan*. The *1988 Plan* described modifications to previously-identified CSO projects following the *1986 Plan* and additional Metro CSO projects to achieve a 75-percent CSO volume reduction system-wide by the end of the 2005. The *1988 Plan* also identified CSO projects that could be added to the 20-year plan to achieve the ultimate goal of one untreated CSO event per site per year. The fourth and fifth columns of Table 6-1 shows those CSO projects included for 75-percent control and for one event per year. Many identified projects had been addressed in previous plans, but some projects were added to achieve the higher level of control required. Each element of the *1988 Plan* consisted of CATAD improvements, CSO treatment, CSO storage, sewer separation, or conveyance. Therefore, project impacts had been addressed programmatically in the *1985 FEIS* and *1986 FSEIS*.

Table 6-1. Comprehensive List Of CSO Project Elements Addressed In Historical And Current Planning Projects

	NOV. 1985 FEIS	JULY 1986 FSEIS	1988 - 75% Control CSO PLAN	1988 - One event/year CSO PLAN	1995 CSO UPDATE
CATAD IMPROVEMENTS					
CATAD Improvements North	X		X		X
CATAD Improvements South	X		X		X
TREATMENT					
Denny Way CSO Treatment	X				
Stormweather Treatment at Alki	X		X		
Stormweather Treatment at Carkeek	X		X		
Duwamish CSO Treatment	X			X	
Kingdome CSO Treatment	X				
STORAGE					
Fort Lawton Tunnel	X		X		
University Regulator Storage	X		X	X	
Washington Park Storage	X				
Dexter Regulator Storage	X			X	
Harrison Street Tunnel	X				
Denny Way Storage	X				X
Harbor Regulator Storage	X				X
Henderson Street Storage	X				
Storage in Abandoned EBI		X			
Third Avenue West Storage				X	
Ballard Regulator Storage				X	
Ballard No. 1 Weir Storage				X	
SEPARATION					
Hanford Tunnel Separation	X		X		
University Regulator Separation	X		X		
Michigan Street Separation/Storage	X		X		
Diagonal Separation	X		X		
Kingdome/Industrial Area Separation	X		X		
NSA Separation		X		X	
Duwamish Separation		X			
Hanford Separation/Bayview Storage			X		
Lander Separation			X		
Denny Way Tunnel Partial Separation			X		X
Denny Local Partial Separation			X		X
Ballard Basins 1-4 Separation				X	
University Basins 5-11 Separation				X	
Duwamish Basins 1-9 Separation				X	
OTHER PROJECTS					
Belvoir/30th NE Pumping	X				
Increase New Regional interceptor and		X			
Central Interceptor Expansion				X	
SW Lake Washington Interceptor Expansion				X	
W. Marginal Way Sewers				X	
Henderson/Martin Luther King CSO Engineering Eval.					X

1995 CSO Update Environmental Documentation

Chapter 4 of this *1995 CSO Update* describes the status of the *1988 Plan* projects, and Chapter 5 describes Metro's CSO program for the next five years. The sixth column of Table 6-1 shows those CSO project elements that are described in Chapter 5 of this document. Metro has modified some of these projects since 1988 and also added new projects for the CSO Control Program for the next five years. The following new projects are planned to be completed in the next five years:

- Denny Way CSO Control Project (modification of Denny partial separation project).
- Harbor CSO Pipeline.
- Henderson/Martin Luther King Way CSO Control Engineering Evaluation.

Again, all projects for the next five years consist of one or more of the five CSO control options (i.e., CATAD improvements, CSO treatment, CSO storage in tanks and tunnels, separation, and conveyance facilities) addressed in the 1985, 1986 and 1988 plans and Environmental Impact Statements. Therefore, as SEPA Lead Agency, Metro has decided to Adopt and Addend the *1985 FEIS* and *1986 FSEIS* consistent with WAC 197-11-600(4)(c). The Addendum does not substantially change the analysis of significant impacts and alternatives in the previous environmental documents but does add new information. The Adoption form and Addendum are located in Appendix D.

Project-Level Environmental Documentation

Both the *1985 FEIS* and the *1986 FSEIS* were written at the programmatic level of environmental review and included statements that Metro will conduct project-level environmental review prior to the construction of CSO facilities. Following is a summary of project-level environmental review planned for the CSO program over the next five years.

Denny Way/Lake Union CSO Control Project - The project-level SEPA environmental documentation for this project will be an Environmental Impact Statement. Metro began the EIS process in late 1994. The draft is expected in mid-1995 with the final environmental impact statement issued by the end of the year.

Harbor CSO Pipeline Project - The project-level SEPA environmental documentation for this proposal is an adoption of a NEPA Addendum to the Alki Transfer/CSO Facilities Project. The NEPA Addendum is dated January 11, 1995. The SEPA Adoption form is scheduled for submission after completion of the NEPA process in the first quarter of 1995.

Henderson/Martin Luther King Way CSO Control Engineering Evaluation - The current proposal is for an engineering evaluation. Appropriate SEPA environmental documentation will be completed by Metro before commencement of construction activities.

Appendix A

A CSO Glossary

CSO GLOSSARY

Average dry weather flow	The average non-storm flow over 24 hours during the dry months of the year (May through September). It is composed of the average sewage flow and the average dry weather inflow/infiltration.
Average wet weather flow	The average flow over 24 hours during the wet months of the year (October through April) on days when no rainfall occurred on that or the preceding day.
Base flow	Wastewater flow (including a reasonable amount of inflow and infiltration) originating from residential, commercial and industrial sources.
Baseline study	A study that documents the existing state of an environment to serve as a reference point against which future changes to that environment can be measured.
Best Management Practice (BMP)	A method, activity, or procedure for reducing the amount of pollution entering a water body
Calibration	The determination, checking, or rectifying of the graduation of any instrument giving quantitative measurements. With respect to a computer model, calibration is a process whereby data recorded during an actual event is compared with data derived from a computer simulation of that event in order to determine the accuracy of the simulation.
CATAD system	Computer Augmented Treatment and Disposal System, which monitors flows in the wastewater conveyance system and operates regulator and pump stations to gain maximum use of pipe capacities.
Clean Water Act (CWA)	Also known as the Federal Water Pollution Control Act (33 U.S.C. 1251 et seq.).
Combined sewer overflows (CSOs)	Overflows, during wet weather, of combined wastewater and stormwater. CSOs occur when flows in the wastewater collection system exceed the capacity of that system. The term "CSO" is also sometimes used to denote a pipe that discharges those overflows.

Combined sewer system	A wastewater collection and treatment system where domestic and industrial wastewater is combined with storm runoff.
Combined sewers	A sewer that carries both sewage and stormwater runoff.
Cost-effective alternative	An alternative control or corrective method identified after analysis as being the best available in terms of reliability, performance, and costs.
CSO event	A period of rainfall during which an overflow was recorded and that was preceded by three hours with no overflow and followed by three hours without overflow after the overflows from the system have ceased.
Design event	A computer-simulated combined sewer overflow event, usually based on a design storm, which is used to determine the probable response of the sewer system to proposed modifications.
Design storm	A rainstorm used in the design of wastewater systems, primarily for system which controls combined sewer overflows. A particular storm may be selected as a design storm because adequate data exist to allow a calibration of a computer model being used to simulate the behavior of the sewer system during that storm.
Detention	The process of collecting and holding back stormwater or combined sewage for delayed release to receiving waters.
Discharge, direct or indirect	The release of wastewater or contaminants to the environment. A direct discharge of wastewater flows from a land surface directly into surface waters, while an indirect discharge of wastewater flows into surface waters by way of a sewer system.
Disenfection	A chemical or physical process that kills organisms which cause infectious disease. Chlorine is often used to disinfect treated sewage.
Domestic wastewater	Human-generated sewage that flows from homes and businesses.
Effluent	Treated water, wastewater or other liquid flowing out of a treatment facility.

Environmental assessment — A written environmental analysis which is prepared pursuant to the National Environmental Policy Act to determine whether a proposed action would significantly affect the environment and thus require preparation of a more detailed environmental impact statement.

Environmental Impact Statement (EIS) — A document that discusses the likely significant impacts of a development project or a planning proposal, ways to lessen the impacts, and alternatives to the project or proposal. EISs may be required by national and state environmental policy acts

Environmental Protection Agency (EPA) — A federal agency established in 1979 by Presidential executive order to control pollution of the environment.

Fecal coliform bacteria — A group of organisms common to the intestinal tracts of humans and animals. The presence of fecal coliform bacteria in water, wastewater, or biosolids is an indicator of pollution and possible contamination by pathogens.

Final Design — The final phase of a project's design process. During final design, contract plans and specifications necessary for bidding are prepared. These contract documents provide all the necessary information needed by suppliers and contractors to construct the facility.

Force main — A pipeline leading from a pumping station that transports wastewater under pressure.

Groundwater infiltration — Infiltration that enters the sewerage system through pipe defects located below the normal groundwater table.

Hydraulic — Pertaining to the energy, momentum, and continuity effects of liquid in motion. The term usually refers to the flow of liquids in natural environments (e.g., rivers) or man-made structures (e.g., pipes).

Hydrograph — The variation of the flow of liquids over time.

Hydrology — The science dealing with the properties, distribution and circulation of water. The term usually refers to the flow of water on or below the land surface before reaching a stream or man-made structure.

Infiltration	The penetration of water from the land surface into the soil, or the penetration of water from the soil into a sewer system by such means as defective pipes, pipe joints or connections, or manhole walls.
Inflow	Flows of extraneous water into a wastewater conveyance system from sources other than a sanitary sewer connections, such as roof leaders, basement drains, manhole covers, cross-connections from storm sewers, and street washing.
Influent	Water, wastewater or other liquid flowing into a reservoir, basin or treatment plant.
Influent pump station	A pump station that pumps flow from an interceptor sewer into a treatment plant.
Infrastructure	Streets, water, sewer lines, and other public facilities basic and necessary to the functioning of an urban area.
Interceptor sewers	The portion of a collection system that connects main and trunk sewers with the wastewater treatment plant, thereby controlling the flow into the plant.
Lateral sewers	Pipes that receive sewage from homes and businesses and transport that sewage to trunks and mains.
MG	Million gallons, a measure of liquid volume.
mgd	Million gallons per day, a rate of liquid flow.
Metro's Hydraulic Routing Model	A computer model used to simulate the flow of water in Metro's pipes.
Model	A formal set of relationships that attempt to represent some processes of the real world. Some models are intended to explain causes and effects of processes, others are tools to estimate or project the results of those processes, even if the processes themselves are not fully understood.
Monitor	To systematically and repeatedly measure conditions in order to track changes. For example, dissolved oxygen in a bay might be monitored over a period of several years in order to identify trends in concentration.

National Pollutant Discharge Elimination System (NPDES)
Section 402 of the federal Clean Water Act, which prohibits discharge of pollutants into navigable waters of the United States unless a special permit is issued by EPA, a state, or (where delegated) a tribal government on an Indian reservation.

Nonpoint source pollution
Pollution that enters water from dispersed and uncontrolled sources (such as surface runoff) rather than through pipes. Nonpoint sources (e.g., stormwater runoff from agricultural or forest operations, on-site sewage disposal systems, and discharge from boats) may contribute pathogens, suspended solids, and toxicants. The cumulative effects of nonpoint source pollution can be significant.

NPDES Permit
Permit issued under the National Pollution Discharge Elimination System, which establishes reporting requirements and other conditions for discharge of pollutants to receiving waters.

Outfall
The exit point, usually a pipe or pipes where effluent is discharged from the wastewater collection system into receiving water and which is engineered to ensure dispersion and dilution of the effluent in the receiving waters.

Pathogens
Microorganisms that can cause disease in other organisms or humans, animals, and plants. Pathogens include bacteria, viruses, fungi, or parasites found in sewage, in runoff from farms or city streets, and in water used for swimming. Pathogens can be present in municipal, industrial, and nonpoint source discharges.

Peak flow
The maximum flow expected to enter a facility.

Pre-design
The initial phase of a project's design process. The results of this initial phase are generally limited to determination of the alignment, layout and technology for the project.

Primary treatment
The first stage of wastewater treatment involving removal of floating debris and solids by screening and/or settling.

Pump Station
A structure used to move wastewater uphill, against gravity.

Raw sewage
Untreated wastewater.

Regulator

A structure that controls the flow of wastewater from two or more input pipes to a single output. Regulators can be used to restrict or halt flow, thus causing wastewater to be stored in the conveyance system until it can be handled by the treatment plant.

Runoff

That part of precipitation, snow melt, or irrigation water that runs off of the land surface into streams or other surface water instead of infiltrating the land surface.

Secondary treatment

Biochemical treatment of wastewater after the primary stage, using bacteria to consume the organic wastes. The secondary treatment step includes settling, disinfection and discharge through an outfall. Secondary treatment in conjunction with primary treatment removes about 85 to 90 percent of suspended solids in wastewater.

Sediment

Once-suspended material which has settled to the bottom of a liquid, such as the sand and mud that make up much of the shorelines and bottom of Puget Sound.

Sediment quality standards

Standards which identify chemical concentration and biological toxicity limits allowed in sediments which correspond to no observable acute or chronic adverse effects on biological resources and which do not pose a significant health threat to humans.

Sedimentation tanks

Tanks for holding wastewater where floating wastes are skimmed off and solids settle by gravity. Settled solid, called "sludge," are pumped out for treatment. Sedimentation tanks are also referred to as clarifiers.

Separation, total or partial

A method for controlling combined sewer overflow whereby the combined sewer is separated into both a sanitary sewer and a storm drain, as is the practice in new development. Separation may be total, in which case no stormwater is diverted to the sanitary sewer, or it may be partial, involving only the removal of runoff from streets and parking lots from the sanitary system.

Setpoint

A defined indicator point in an electronic or mechanical control system where an action takes place. In a sewage conveyance system, a setpoint is generally the liquid level or flow rate which causes a valve to be opened or closed or a pump to be activated.

Sewer	A channel or conduit that carries wastewater or stormwater runoff from the source to a treatment plant or receiving stream. Sanitary sewers carry household, industrial, and commercial wastewater. Storm sewers carry runoff from rain or snow. Combined sewers carry both kinds of water.
State Environmental Policy Act (SEPA)	A state law (Chapter 43.21C RCW) which requires that state agencies and local governments consider environmental impacts when making decisions regarding certain activities, such as development proposals over a certain size, and comprehensive plans. As part of this process, environmental impacts are documented and opportunities for public comment are provided.
Storage	A method for controlling combined sewer overflows by storing the combined sewage until the rain storm subsides, then releasing it back into the conveyance system to be treated at the normal treatment plant.
Storm drain	A system of gutters, pipes, or ditches used to collect and carry stormwater from buildings or land surfaces to streams, lakes, or other receiving waters. In practice storm drains carry a variety of substances such as sediments, metals, bacteria, oil, and antifreeze which enter the system through runoff, deliberate dumping, or spills. This term also refers to the end of the pipe where the stormwater is discharged.
Storm sewer	A system of pipes (separate from sanitary sewers) that carry only water runoff from building and land surfaces.
Stormwater	Water that is generated by rainfall and is often routed into drain systems in order to prevent flooding
Stormweather plant	A plant designed to provide primary treatment of combined sanitary sewage and storm water for peak flows above the 2.25 times the average wet weather flow. Such plants operate only intermittently, unlike most wastewater treatment plants which operate continuously.
Suspended solids	Small particles of organic or inorganic materials that float on the surface of, or are suspended in, sewage or other liquids and which cloud the water. The term may include sand, mud, and clay particles as well as waste materials.
Telemeter	To transmit to a distant receiving station by radio or other electronic means.

Toxic	Causing death, disease, behavioral abnormalities, cancer, genetic mutations, physiological malfunctions (including malfunctions in reproduction), or physical deformations in any organism or its offspring upon exposure, ingestion, inhalation, or assimilation.
Treatment	Chemical, biological, or mechanical procedures applied to industrial or municipal wastewater or to other sources of contamination to remove, reduce, or neutralize contaminants.
Washington Administrative Code (WAC).	The codified regulations adopted by various Washington state agencies through the rulemaking process.
Wastewater	Total flow within a sewerage system. In separated systems, it includes sewage and infiltration/inflow. In combined systems, it includes sewage and stormwater.
Water quality criteria	The levels of pollutants that affect use of water for drinking, swimming, raising fish, farming or industrial use.
Water pollution	The addition of harmful or objectionable material to water in concentrations or sufficient quantities to adversely affect is usefulness or quality.
Weir	An overflow section of a pipe.

APPENDIX B

A CSO BIBLIOGRAPHY

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APPENDIX C

CSO RATE ANALYSIS AND CAPITAL IMPROVEMENT PROGRAM SCHEDULE, FUNDING AND COSTS

APPENDIX C

RATE ANALYSIS AND CAPITAL IMPROVEMENT PROGRAM SCHEDULE, FUNDING AND COSTS

The following identifies the Metro sewer system capital improvement program costs, schedule, and funding sources available for secondary treatment, biosolids management, and CSO abatement. Capital improvement cost estimates have been escalated to the point of construction. A summary has been provided that describes the rate impacts of the *1995 CSO Update*. Cumulative monthly residential customer equivalent (RCE) rates for the *1995 CSO Update* range from $0.01 in 1994 to $1.11 in the year 2000.

Table C-1 identifies the system capital improvement projects and estimated grant funding for the CSO program and other projects. Table C-2 shows the total source and use of funds to finance the capital improvement program. Funding sources include a transfer from the operating fund, general obligation bond financing, short term borrowing, and grant funding. Approximately 76% of the funds are from bonds and short term borrowing, 11% from grant funding and the remaining 13% is from other sources.

The projected rate impacts of the overall capital program and sewer system operations are shown in Table C-3. Monthly wholesale rates per RCE are estimated to increase from $17.95 per RCE in 1995 to $24.94 per RCE in 2000. General inflation is assumed to be 2.8% between 1995 and 2000, and inflation for capital expenditures is 3.8%. The interest rate for general obligation bond financing is assumed to be 6.5% with a 40 year term, and short term borrowing assumes an interest rate of 5%. Interest income is calculated at 4%. The assumed rate increases will be sufficient to maintain the required 1.25 debt service coverage ratio.

Table C-4 projects the monthly wholesale rate impacts of the CSO program per RCE. This scenario assumes that all CSO projects, or portions thereof, that are not funded from grants or other revenues will be funded from general obligation bond proceeds. The annual debt service assumes 40 year general obligation bonds with a 6.5% interest rate will be issued in each year to fund capital projects. The cumulative rate impact of the CSO program will range from $0.42 per RCE through 1992 to $1.84 per RCE in the year 2000. Annual increases in monthly rates per RCE range from $0.03 to $0.34. The rate impact of the CSO program may change if the actual financing program differs from the current projections. Table C-5 identifies rate impact of the CSO program if annual debt service after 1994 is based on a 20 year general obligation bond with an 8% interest rate and no grant funding is available. The cumulative rate for the CSO program would increase to $2.82 per RCE in by the year 2000. The graph on Figure C-1 shows a sensitivity analysis of alternative funding assumptions.

SUMMARY

1995 CSO Update Capital Improvement Program, Grant Funding and Rate Impacts

Description	-----------Actual---------- thru 1992	1993	----------Estimated---------- 1994	1995	1996	1997	1998	1999	2000	Total Cost
1995 Update CSO Projects										
Harbor						750				750
Denny Way	110	14	376	1,500	9,000	28,000	40,000	28,000	13,000	120,000
Henderson Street(a)				415	1,200	4,200	8,500	12,500	5,200	32,015
Total 1995 Update CSO Projects	110	14	376	1,915	10,200	32,950	48,500	40,500	18,200	152,765
Less CSO Project Grant Funding						5,000	10,000	11,000		26,000
Less City of Seattle Contributed Funds						4,000	8,000	8,000	4,000	24,000
Total Funding Required from Other Sources	110	14	376	1,915	10,200	23,950	30,500	21,500	14,200	102,765
Annual Debt Service(b)	8	9	35	171	892	2,585	4,741	6,261	7,265	
Debt Service Coverage(c)	2	2	9	43	223	646	1,185	1,565	1,816	
Residential Customer Equivalents(RCE)	659	659	659	653	653	663	673	683	683	
1995 CSO Update Cumulative Monthly Rates per RCE through 1992-2000	$0.00	$0.00	$0.01	$0.03	$0.14	$0.41	$0.73	$0.95	$1.11	
Annual Increase in Monthly Rates/RCE 1993-2000		$0.00	$0.00	$0.02	$0.11	$0.27	$0.33	$0.23	$0.15	

Note: Rates are included as part of the current rate projections identified in the 1995 budget.

(a)Costs after 1995 have not been formally appropriated.

(b)Assumes annual general obligation bond issues with an interest rate of 6.5% and a 40 year term.

(c)Includes funds required to maintain an annual debt service coverage ratio of 125 percent of annual debt service.

Table C-1. Projected Capital Improvement Program Cost Schedule and Grant Funding.

Description	----------Actual---------- thru 1992	1993	----------Estimated---------- 1994	1995	1996	1997	1998	1999	2000
Capital Projects (in thousands)									
CSO Projects									
1995 Update CSO Projects									
Harbor Island						750			
Denny Way	110	14	376	1,500	9,000	28,000	40,000	28,000	13,000
Henderson Street(a)				415	1,200	4,200	8,500	12,500	5,200
Subtotal 1995 Update CSO Projects	110	14	376	1,915	10,200	32,950	48,500	40,500	18,200
1988 CSO Projects	37,590	12,336	5,276	836	1,630	8,504	0	0	0
Other Capital Projects / Improvements	392,214	170,048	181,695	206,400	124,192	80,193	161,551	143,555	111,340
Subtotal Capital Projects	429,914	182,398	187,347	209,151	136,022	121,647	210,051	184,055	129,540
Grant Funding Budget									
CSO Projects									
1995 Update CSO Projects						5,000	10,000	11,000	
1988 CSO Projects(b)						2,173			
Other Capital Projects / Improvements	130,633	75,155	24,846	41,990	29,685	17,763	12,500	12,500	12,500
Subtotal Grant Funding	130,633	75,155	24,846	41,990	29,685	24,936	22,500	23,500	12,500
Funding Required From Other Sources									
CSO Projects	37,700	12,350	5,652	2,751	11,830	34,281	38,500	29,500	18,200
Other Capital Projects / Improvements	261,581	94,893	156,849	164,410	94,507	62,430	149,051	131,055	98,840
Total Funding Required From Other Sources	299,281	107,243	162,501	167,161	106,337	96,711	187,551	160,555	117,040

Source: King County Department of Metropolitan Services 1995 sewer rate model and CSO cost by project worksheet.

(a)Costs after 1995 have not been formally appropriated.

(b)Assumes 60% of the total grant funds for the Alki Stormweather Project in 1997 are apportioned to CSO based on the percentage of project cost related to CSO.

Table C-2. Projected Capital Improvement Funding Sources and Debt Requirements.

Description	---Actual--- 1993	1994	1995	1996	---Estimated--- 1997	1998	1999	2000
Beginning Fund Balance(in thousands)	48,085	42,493	64,945	4,943	5,109	4,998	5,005	5,009
Additional Source of Funds								
Bond Proceeds	90,000	170,000	75,000	95,000	77,687	159,513	134,925	92,651
Short Term Borrowing	50,000		65,000	65,000	65,000	70,000	70,000	70,000
Grants(a)	29,611	31,312	41,990	29,685	24,936	22,500	23,500	12,500
Other(b)	110	969	1,395	1,301	5,342	9,377	9,413	5,450
Operating Fund Transfer(c)	16,572	18,145	18,789	19,890	22,913	24,696	26,998	28,864
Total Additional Source of Funds	186,293	220,426	202,174	210,876	195,878	286,086	264,836	209,465
Use of Funds								
Debt Retirement	438	7,225	50,875	72,138	72,138	72,138	77,388	77,388
Capital Expenditures	182,287	187,349	209,151	136,022	121,647	210,051	184,055	129,539
Debt Issuance Expense	2,500	3,400	2,150	2,550	2,204	3,890	3,389	2,553
Adjustments	3,105							
Bond Reserve Contributions	3,556							
Total Use of Funds	191,886	197,974	262,176	210,710	195,989	286,079	264,832	209,480
Ending Fund Balance	42,492	64,945	4,943	5,109	4,998	5,005	5,009	4,994

Source: King County Department of Metropolitan Services 1995 sewer rate model.
(a)From Table C-1.
(b)Includes a $24 million contribution between 1997 and 2000 from the City of Seattle for the Denny Way project.
(c)Operating fund balance from Table C-3.

Table C-3. Projected Operating Cash Flow and Rate Impacts.

Description	---Actual--- 1993	---Estimated--- 1994	1995	1996	1997	1998	1999	2000
Operating Revenue(in thousands)								
Rates	107,109	125,256	140,721	159,144	169,432	182,250	196,418	207,540
Interest Income	9,101	8,941	7,887	6,940	6,254	7,908	7,539	6,779
Capacity Charges	3,108	2,500	3,000	3,500	4,000	4,500	5,000	5,500
City of Seattle CC Benefit			787	625	750	875	1,000	1,125
Other Revenues	7,179	7,994	8,541	8,734	8,979	9,230	9,489	9,755
Total Operating Revenues	126,497	144,691	160,936	178,943	189,415	204,763	219,446	230,699
Operating Expenditures								
Operating Expenses	51,113	57,208	66,177	75,594	77,554	80,246	83,036	85,928
Annual Debt Service	56,545	69,177	75,665	83,011	88,477	99,723	109,277	115,768
Operating Reserves	287	161	305	448	471	98	135	139
Total Operating Expenditures	107,945	126,546	142,147	159,053	166,502	180,067	192,448	201,835
Operating Fund Balance	18,552	18,145	18,789	19,890	22,913	24,696	26,998	28,864
Net Operating Income	75,384	87,483	94,759	103,349	111,861	124,517	136,410	144,771
Debt Service Coverage Ratio(a)	1.33	1.26	1.25	1.25	1.26	1.25	1.25	1.25
Customer Equivalents	659	659	653	653	663	673	683	683
Projected Monthly Rates	$13.62	$15.90	$17.95	$20.30	$21.29	$22.57	$23.96	$24.94

Source: King County Department of Metropolitan Services 1995 sewer rate model.

(a)Equal to operating revenues less operating expenses divided by annual debt service.

Table C-4. Projected CSO Program Rate Impacts.

	Actual		Estimated						
Description	thru 1992	1993	1994	1995	1996	1997	1998	1999	2000
CSO Projects(in thousands)(a)									
1995 Update CSO Projects									
Harbor Island						750			
Denny Way	110	14	376	1,500	9,000	28,000	40,000	28,000	13,000
Henderson Street				415	1,200	4,200	8,500	12,500	5,200
Subtotal 1995 Update CSO Projects	110	14	376	1,915	10,200	32,950	48,500	40,500	18,200
1988 CSO Projects	37,590	12,336	5,276	836	1,630	8,504	0	0	0
Subtotal CSO Projects	37,700	12,350	5,652	2,751	11,830	41,454	48,500	40,500	18,200
CSO Project Grant Funding and Other Contributed Funds									
1995 Update CSO Projects						5,000	10,000	11,000	
City of Seattle Contribution(b)						4,000	8,000	8,000	4,000
1988 CSO Projects						2,173			
Subtotal Grant Funding and Other Contributed Funds						11,173	18,000	19,000	4,000
Total Funding Required From Other Sources	37,700	12,350	5,652	2,751	11,830	30,281	30,500	21,500	14,200
Bond Proceeds	37,700	12,350	5,652	2,751	11,830	30,281	30,500	21,500	14,200
Short Term Borrowing									
Other									
Operating Fund Transfer									
Subtotal Funding Required from Other Sources	37,700	12,350	5,652	2,751	11,830	30,281	30,500	21,500	14,200
Annual Debt Service(c)	2,665	3,538	3,938	4,132	4,968	7,109	9,265	10,765	11,789
Debt Service Coverage(d)	666	885	984	1,033	1,242	1,777	2,316	2,696	2,947
Residential Customer Equivalents(RCE)(e)	659	659	659	653	653	663	673	683	683
Cumulative Monthly Rates/RCE Through 1992-2000	$0.42	$0.56	$0.62	$0.65	$0.79	$1.12	$1.46	$1.69	$1.84
Annual Increase in Monthly Rates/RCE 1993-2000		$0.14	$0.06	$0.03	$0.13	$0.34	$0.33	$0.23	$0.15

(a)From Table C-1.

(b)Includes $24 million in contributed funds for the Denny Way project from the City of Seattle between 1997 and 2000.

(c)Assumes annual general obligation bond issues with an interest rate of 6.5% and a 40 year term.

(d)Includes funds required to maintain an annual debt service coverage ratio of 125 percent of annual debt service.

(e)From Table C-3.

Table C-5. Alternative Projected CSO Program Rate Impacts.

	Actual		Estimated						
Description	thru 1992	1993	1994	1995	1996	1997	1998	1999	2000
CSO Projects(in thousands)(a)									
1995 Update CSO Projects									
Harbor Island						750			
Denny Way	110	14	376	1,500	9,000	28,000	40,000	28,000	13,000
Henderson Street				415	1,200	4,200	8,500	12,500	5,200
Subtotal 1995 Update CSO Projects	110	14	376	1,915	10,200	32,950	48,500	40,500	18,200
1988 CSO Projects	37,590	12,336	5,276	836	1,630	8,504	0	0	0
Subtotal CSO Projects	37,700	12,350	5,652	2,751	11,830	41,454	48,500	40,500	18,200
CSO Project Grant Funding and Other Contributed Funds									
1995 Update CSO Projects									
City of Seattle Contribution(b)						4,000	8,000	8,000	4,000
1988 CSO projects									
Subtotal Grant Funding and Other Contributed Funds						4,000	8,000	8,000	4,000
Total Funding Required From Other Sources	37,700	12,350	5,652	2,751	11,830	37,454	40,500	32,500	14,200
Bond Proceeds	37,700	12,350	5,652	2,751	11,830	37,454	40,500	32,500	14,200
Short Term Borrowing									
Other									
Operating Fund Transfer									
Subtotal Funding Required from Other Sources	37,700	12,350	5,652	2,751	11,830	37,454	40,500	32,500	14,200
Annual Debt Service(c)	2,665	3,538	3,938	4,218	5,423	9,238	13,363	16,673	18,119
Debt Service Coverage(d)	666	885	984	1,054	1,356	2,309	3,341	4,168	4,530
Residential Customer Equivalents(RCE)(e)	659	659	659	653	653	663	673	683	683
Cumulative Monthly Rates/RCE Through 1992-2000	$0.42	$0.56	$0.62	$0.67	$0.86	$1.46	$2.10	$2.60	$2.82
Annual Increase in Monthly Rates/RCE 1993-2000		$0.14	$0.06	$0.04	$0.19	$0.60	$0.64	$0.50	$0.22

(a)From Table C-1.

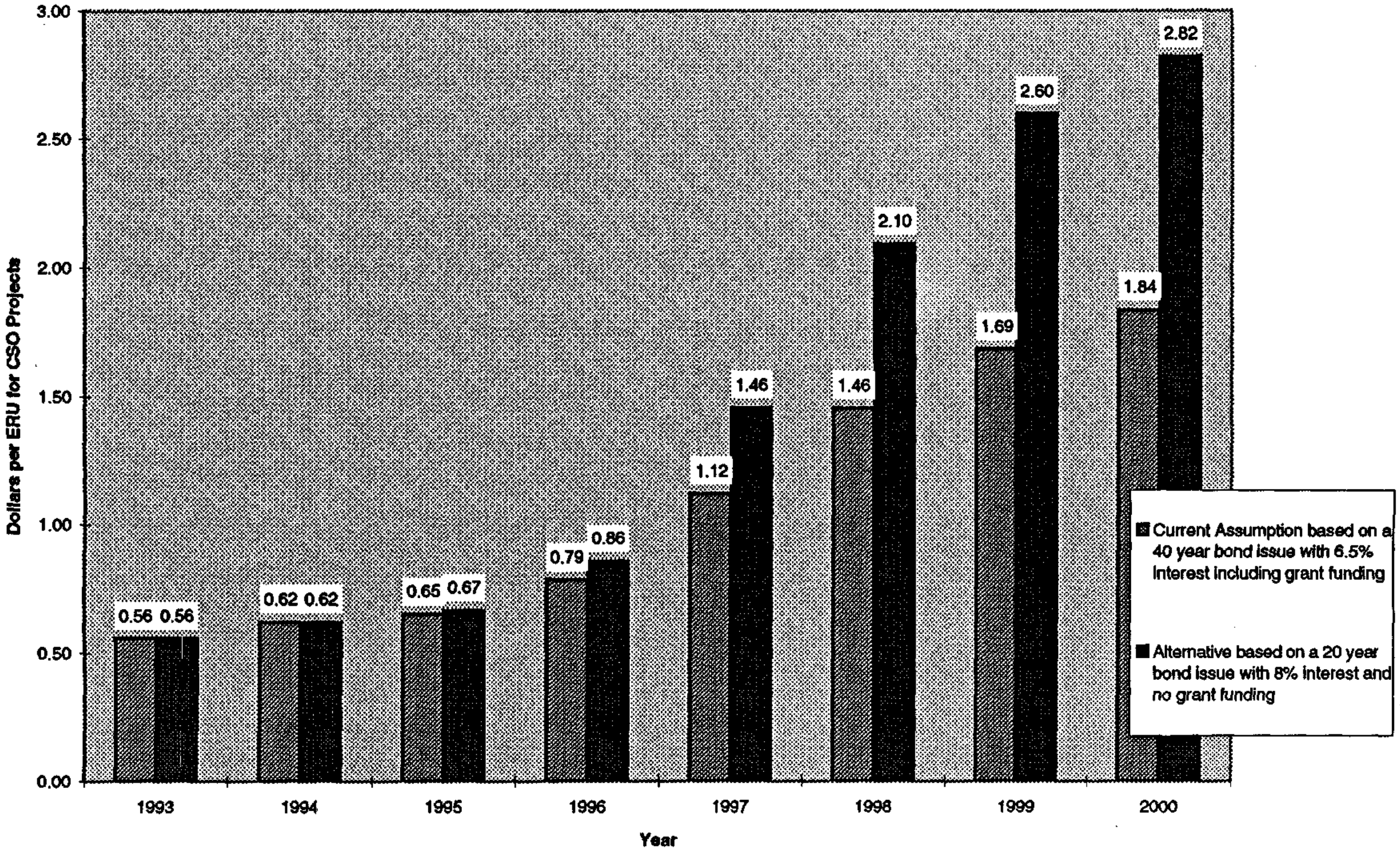
(b)Includes $24 million in contributed funds for the Denny Way project from the City of Seattle between 1997 and 2000.

(c)Assumes annual general obligation bond issues after 1994 with an interest rate of 8% and a 20 year term.

(d)Includes funds required to maintain an annual debt service coverage ratio of 125 percent of annual debt service.

(e)From Table C-3.

Figure C-1. Alternative Funding Analysis and Rate Impacts for CSO Projects



SENSITIVITY ANALYSIS OF IMPACTS OF *1995 CSO UPDATE* PROJECTS ON RATES

The following tables present an analysis of the sensitivity of the impact on Metro rates through the year 2000 of the three *1995 CSO Update* projects, Harbor CSO Pipeline Project, Denny Way/Lake Union CSO Control Project, and Henderson/Martin Luther King Way CSO Control Engineering Evaluation and storage projects. The tables are based on assumptions about individual project costs, financing terms, and interest rates. These assumptions are as follows:

Low Range Estimates

The table entitled "Low Cost Alternative" assumes a Denny project cost of $104 million, which assumes that RWSP decisions result in deletion of the outfall and effluent pumping station from the project. The table also assumes that cost will be further reduced to Metro by City of Seattle contributions of $24 million and grant funding of $26 million. For Henderson/Martin Luther King CSO control, the table assumes that the initial project storage cost estimate of $32 million (from the Task 4.0 Report) can be reduced by half as the result of a $4 million volunteer rooftop disconnection program, producing a total project cost estimate of $20 million.

The low range table further assumes construction will be financed by means of a 40 year general obligation bond issue at 6.5 percent.

High Range Estimates

To arrive at the high range of cost estimates, the table entitled "High Cost Alternative" assumes the basic Denny project cost of $120 million, less City of Seattle contributions ($24 million) and grant funding ($26 million), but adds an additional $21 million for upgrades to enhance treatment capabilities of the 2.5 MG storage tank included in the project.

The table further assumes the Henderson/Martin Luther King Way control project will need to control Norfolk Regulator overflows as well. As a result, an estimate of $4 million is added to the base $32 million Henderson estimate for storage at Norfolk.

The high range table also assumes construction will be financed by means of a 40 year general obligation bond issue at 6.5 percent.

High Range Estimates--Alternative 2

To arrive at the highest range of cost estimates, the table entitled "High Cost Alternative 2" assumes the same construction costs as used in the table entitled "High Cost Alternative," but the higher range estimates further assume that the bond interest rate will climb from 6.5 percent to 8 percent and that the bond will be amortized over 20 years instead of 40 years.

SUMMARY - Low Cost Alternative

1995 CSO Update Capital Improvement Program, Grant Funding and Rate Impacts

	------------Actual----------		---------------------			Estimated	-------------------			
Description	thru 1992	1993	1994	1995	1996	1997	1998	1999	2000	Total Cost
1995 Update CSO Projects										
Harbor Island						750				750
Denny Way	110	14	376	1,500	7,780	24,203	34,576	24,203	11,237	104,000
Henderson Street(a)				415	759	2,658	5,380	7,911	3,291	20,415
Total 1995 Update CSO Projects	110	14	376	1,915	8,539	27,612	39,956	32,115	14,528	125,165
Less CSO Project Grant Funding						5,000	10,000	11,000		26,000
Less City of Seattle Contributed Funds						4,000	8,000	8,000	4,000	24,000
Total Funding Required from Other Sources	110	14	376	1,915	8,539	18,612	21,956	13,115	10,528	75,165
Annual Debt Service(b)	8	9	35	171	774	2,090	3,642	4,569	5,314	
Debt Service Coverage(c)	2	2	9	43	194	523	911	1,142	1,328	
Residential Customer Equivalents(RCE)	659	659	659	653	653	663	673	683	683	
1995 CSO Update Cumulative Monthly Rates per RCE through 1992-2000	$0.00	$0.00	$0.01	$0.03	$0.12	$0.33	$0.56	$0.70	$0.81	
Annual Increase in Monthly Rates/RCE 1993-2000		$0.00	$0.00	$0.02	$0.10	$0.21	$0.24	$0.14	$0.11	

Note: Rates are included as part of the current rate projections identified in the 1995 budget.

(a)Costs after 1995 have not been formally appropriated.

(b)Assumes annual general obligation bond issues with an interest rate of 6.5% and a 40 year term.

(c)Includes funds required to maintain an annual debt service coverage ratio of 125 percent of annual debt service.

SUMMARY - High Cost Alternative

1995 CSO Update Capital Improvement Program, Grant Funding and Rate Impacts

	Actual		Estimated							
Description	thru 1992	1993	1994	1995	1996	1997	1998	1999	2000	Total Cost
1995 Update CSO Projects										
Harbor Island						750				750
Denny Way	110	14	376	1,500	10,602	32,983	47,119	32,983	15,314	141,000
Henderson Street(a)				415	1,367	4,785	9,684	14,241	5,924	36,415
Total 1995 Update CSO Projects	110	14	376	1,915	11,969	38,518	56,802	47,224	21,238	178,165
Less CSO Project Grant Funding						5,000	10,000	11,000		26,000
Less City of Seattle Contributed Funds						4,000	8,000	8,000	4,000	24,000
Total Funding Required from Other Sources	110	14	376	1,915	11,969	29,518	38,802	28,224	17,238	128,165
Annual Debt Service(b)	8	9	35	171	1,017	3,104	5,847	7,842	9,060	
Debt Service Coverage(c)	2	2	9	43	254	776	1,462	1,960	2,265	
Residential Customer Equivalents(RCE)	659	659	659	653	653	663	673	683	683	
1995 CSO Update Cumulative Monthly Rates per RCE through 1992-2000	$0.00	$0.00	$0.01	$0.03	$0.16	$0.49	$0.90	$1.20	$1.38	
Annual Increase in Monthly Rates/RCE 1993-2000		$0.00	$0.00	$0.02	$0.13	$0.33	$0.42	$0.30	$0.19	

Note: Rates are included as part of the current rate projections identified in the 1995 budget.

(a)Costs after 1995 have not been formally appropriated.

(b)Assumes annual general obligation bond issues with an interest rate of 6.5% and a 40 year term.

(c)Includes funds required to maintain an annual debt service coverage ratio of 125 percent of annual debt service.

SUMMARY - High Cost Alternative 2

1995 CSO Update Capital Improvement Program, Grant Funding and Rate Impacts

	-----------Actual----------		------------------------			Estimated	------------------------			
Description	thru 1992	1993	1994	1995	1996	1997	1998	1999	2000	Total Cost
1995 Update CSO Projects										
Harbor Island						750				750
Denny Way	110	14	376	1,500	10,602	32,983	47,119	32,983	15,314	141,000
Henderson Street(a)				415	1,367	4,785	9,684	14,241	5,924	36,415
Total 1995 Update CSO Projects	110	14	376	1,915	11,969	38,518	56,802	47,224	21,238	178,165
Less CSO Project Grant Funding						5,000	10,000	11,000		26,000
Less City of Seattle Contributed Funds						4,000	8,000	8,000	4,000	24,000
Total Funding Required from Other Sources	110	14	376	1,915	11,969	29,518	38,802	28,224	17,238	128,165
Annual Debt Service(b)	11	13	51	246	1,465	4,471	8,424	11,298	13,054	
Debt Service Coverage(c)	3	3	13	61	366	1,118	2,106	2,825	3,263	
Residential Customer Equivalents(RCE)	659	659	659	653	653	663	673	683	683	
1995 CSO Update Cumulative Monthly Rates per RCE through 1992-2000	$0.00	$0.00	$0.01	$0.04	$0.23	$0.70	$1.30	$1.72	$1.99	
Annual Increase in Monthly Rates/RCE 1993-2000		$0.00	$0.01	$0.03	$0.19	$0.47	$0.61	$0.44	$0.27	

Note: Rates are included as part of the current rate projections identified in the 1995 budget.

(a)Costs after 1995 have not been formally appropriated.

(b)Assumes annual general obligation bond issues with an interest rate of 8% and a 20 year term.

(c)Includes funds required to maintain an annual debt service coverage ratio of 125 percent of annual debt service.

APPENDIX D

SEPA ADOPTION NOTICE AND ADDENDUM

WAC 197-11-965 Adoption notice.

DETERMINATION OF SIGNIFICANCE/
ADDENDUM AND ADOPTION OF EXISTING ENVIRONMENTAL DOCUMENTS

Adoption for (check appropriate box) ☐ **DNS** XX **EIS** ☐ **other** _

Description of current proposal The current proposal is Metro's 5-year update to its CSO Control Program for the period 1995-2000. The Washington State Water Pollution Control regulations require Metro's CSO Control Program to be updated every five years. The 1995-2000 capital program will include three projects: the Denny Way/Lake Union CSO Control Project (18-foot diameter, 6,800-foot long tunnel under Mercer Street; a 2.5 million gallon concrete storage tank near the Denny Regulator Station; two pump stations; a new outfall into Elliott Bay; necessary piping and regulators); the Harbor CSO Pipeline (54-inch diameter gravity pipeline between the Harbor Regulator and the new West Seattle Pump Station); and the Henderson/Martin Luther King Way CSO Engineering Evaluation. The program also includes mechanical and electrical alterations to improve CSO storage within existing facilities. Metro has determined that this proposal will have a significant adverse impact on the environment.

Proponent King County Department of Metropolitan Services (Metro)

Location of current proposal All three capital projects are located in the City of Seattle, Washington.

Title of documents being adopted 1) Final Environmental Impact Statement, Plan for Secondary Treatment Facilities and Combined Sewer Overflow Control, An Amendment to Metro's Comprehensive Water Pollution Abatement Plan (1985 FEIS); and 2) Final Supplemental Environmental Impact Statement, Plan for Secondary Treatment Facilities and Combined Sewer Overflow Control, An Amendment to Metro's Comprehensive Water Pollution Abatement Plan (1986 FSEIS). In addition, Metro has prepared an Addendum to these environmental documents.

Agency that prepared document being adopted Municipality of Metropolitan Seattle (Metro), now called King County Department of Metropolitan Services (Metro)

Date adopted documents were prepared 1) November 1985 and 2) July 1986

Description of document (or portion) being adopted Metro is adopting the entire Final EIS and Final Supplemental EIS. The current proposal is described above.

If the documents being adopted have been challenged (197-11-630), please describe:
The 1985 FEIS was appealed by the City of Seattle. The appeal was addressed by the issuance of the 1986 FSEIS. No appeals were received on the 1986 FSEIS.

The document is available to be read at (place/time)
Seattle Public Library
Downtown Branch, 1000 4th Avenue; Queen Anne Branch, 400 West Garfield Street;
Rainier Beach Branch, 9125 Rainier Avenue South; West Seattle Branch, 2036 42nd Avenue South
King County Department of Metropolitan Services Library, 8am-5pm M-F
9th floor, Exchange Building, 821 Second Avenue.

We have identified and adopted these documents as being appropriate for this proposal after independent review. The documents meet our environmental review needs for the current proposal and will accompany the proposal to the decisionmaker.

Name of agency adopting document King County Department of Metropolitan Services

Contact person, if other than responsible official Karen E. Watkins, Environmental Planner **Phone** 206-684-1171

Responsible official Gregory M. Bush

Position/title Manager/Environmental Planning & Real Estate Division
Phone 206-684-1164

Address 821 Second Avenue, M.S. 120, Seattle, Washington, 98104

Date 2-9-95 **Signature** Shirley Marroquin for Gregory M. Bush

SEPA ADDENDUM TO THE

FINAL ENVIRONMENTAL IMPACT STATEMENT
AND
FINAL SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT

FOR THE
PLAN FOR SECONDARY TREATMENT FACILITIES AND COMBINED SEWER OVERFLOW CONTROL

Prepared by
King County Department of Metropolitan Services

FEBRUARY 9, 1995

TABLE OF CONTENTS

I. INTRODUCTION

Since Washington State Water Pollution Control regulations require Metro's CSO Control Program to be updated every five years, Metro may periodically issue to the public and interested agencies addenda providing additional information or analysis about a proposal to previous SEPA documents. Insofar as the current update is intended to provide the Washington State Department of Ecology (Ecology) with a status report on those projects named in a previously adopted plan, with attendant SEPA process, an addendum is the proper environmental process for the current update.

This document is an addendum to the *SEPA Final Environmental Impact Statement* issued in November 1985 (1985 FEIS) and the *SEPA Final Supplemental Environmental Impact Statement* issued in July 1986 (1986 FSEIS) by the Municipality of Metropolitan Seattle (Metro) for *the Plan for Secondary Treatment Facilities and Combined Sewer Overflow Control*. The Addendum provides additional information and analysis regarding Metro's CSO Control Program for the next five years (1995-2000) including facilities presented in the 1985 FEIS and/or 1986 FSEIS. The Metro Council adopted Resolution 4780 on July 17, 1986, which included Metro's decision to proceed with the preferred CSO control alternative, and included projects and/or control strategies planned for the period 1995-2000.

The CSO Control Program (Program) for 1995-2000 includes the Denny Way CSO Control Project, Harbor CSO Pipeline, and Henderson/Martin Luther King Way CSO Engineering Evaluation. Since the 1985 FEIS and 1986 FSEIS were issued, Ecology has modified the State CSO control regulations and Metro has modified its computer model for simulating the behavior of its conveyance system during storms. Therefore, Metro's CSO Control Program has shifted to meet the new regulations and incorporate better baseline data presented by their computer model, Computer Augmented Treatment and Disposal system (CATAD). Therefore, plans for specific projects from the 1985 FEIS and 1986 FSEIS have been modified and the impacts and mitigation measures for these modified facilities and projects presented in the previous 1985/86 SEPA documents are discussed in this addendum.

Metro has determined that the new information described in this Addendum does not involve any probable significant adverse impacts that are beyond the range of alternatives and impacts discussed in the existing SEPA EISs. A supplemental EIS on this information, therefore, is not required under SEPA (WAC 197-11-600(4)(c)). Metro will conduct appropriate project-level environmental review for CSO control projects before construction.

This Addendum has been prepared in accordance with WAC 197-11-625. As per WAC 197-11-630, no action on the proposal will be taken for seven days following issuance of this Notice of Adoption/Addendum. Readers should call Karen Watkins of Metro at 206-684-1171 if they have any questions or suggestions. This Addendum adds to the existing 1985 SEPA Final Environmental Impact Statement and 1986 SEPA Final Supplemental Environmental Impact Statement for the Plan for Secondary Treatment Facilities and Combined Sewer Overflow Control.

CSO Legislation

Planning for control of CSOs was first required by Section 201 of the Federal Water Pollution Control Act of 1972, commonly known as the Clean Water Act. Metro's first major CSO control effort was its 1979 CSO Control Planning Report, done at the same time as the City of Seattle's CSO Planning. The Metro Plan recommended a combination of storage and treatment facilities to reduce CSO discharges.

New legislation in 1985, the Washington State Water Pollution Control Act (R.C.W. 90.48), required all cities with CSOs to provide "...the greatest reasonable reduction at the earliest possible date" (R.C.W. 90.48.480). Metro responded with its *Final Plan and FSEIS for Combined Sewer Overflow Control and FEIS* in November 1985. Its Approved Plan for Secondary Treatment Facilities and Combined Sewer Overflow Control followed in July of 1986. In January of 1987, state regulators defined "greatest reasonable reduction" to mean one overflow per outfall per year (WAC 173-245-020(22)). However, Ecology recognized that such a limit could not be achieved overnight. Ecology and Metro agreed that reducing CSO volumes by 75 percent system-wide by the end of 2005 was a reasonable interim goal. Metro issued its Final 1988 Combined Sewer Overflow Plan (1988 Plan), a program designed to achieve that interim goal, which identified projects that had been addressed previously in the 1985 FEIS and 1986 FSEIS or similar projects added to achieve the higher level of control required. Since all 1988 Plan projects fell within the five CSO control options analyzed programmaticly in the 1985/86 SEPA documents (i.e., CATAD improvements, CSO treatment, CSO storage, sewer separation, and conveyance), no further SEPA documentation was required for the 1988 Plan. That plan was approved by Ecology on August 8, 1988.

Regulations (WAC 173-245-040) require Metro's CSO Control Plan to be updated every five years. The 1988 plan was the five year update for 1990, however, due to State regulation changes regarding CSOs, Metro updated the 1990 plan two years early in 1988. The 1995 CSO Update is intended to serve as the required 1995 update of the 1988 Plan.

Project Elements in This Addendum

This Addendum addresses plan-level analysis of two projects and one engineering evaluation which comprise Metro's 1995 CSO Control Program for the years 1995 through 2000. The 1985 FEIS included CSO projects at Denny Way, Harbor and Henderson in the analysis of environmental impacts of treatment, storage, and separation projects including the necessary conveyance improvements. Mechanical and electrical improvements to the CATAD system were included in the plan as well. The 1986 FSEIS analyzed the impacts of additional storage and separation alternatives. Specific plan-level analysis on the Denny Way CSO Control Project, Harbor CSO Pipeline, and Henderson/Martin Luther King Way CSO Engineering Evaluation is described in the 1995 CSO Update.

Relationship to Coincident CSO Projects

In 1988, Metro and Ecology agreed on the 75 percent system-wide reduction by the end of 2005, but Ecology also requested a specific 50 percent reduction of the Denny Way CSO in the same time period. In light of this, Metro planned the Denny Way CSO Control Project as a partial separation project and scheduled predesign to begin in 1993 with construction to be completed by 1999. In 1991, however, the City of Seattle Drainage and Wastewater Utility (DWU) requested that Metro participate in a joint CSO control alternative analysis to find ways to control discharges into Lake Union from Seattle's and Metro's systems and into Elliott Bay at the Denny Regulator Station from Metro's system. In 1992, a joint Denny/Lake Union CSO Control Project was identified as an ideal candidate for Coastal Cities Grant funds, and the Denny project was accelerated in order to take advantage of the potential $35 million in grant funding. The joint City/Metro project is currently in design with construction to be completed by the year 2000. The joint project is subject to project-level environmental review under SEPA which is currently being conducted by DWU and Metro.

Metro's 1986 adopted comprehensive plan included upgrading the Metro system so that all sewage in the region would receive secondary treatment. Metro evaluated alternatives for the Alki service area and selected the alternative which involved the transfer of sewage from the Alki primary treatment plant to another plant for secondary treatment and the modification of the Alki plant to treat high flows that occur during storms. This project became the Alki Transfer/CSO Facilities Project. This project has been in design since 1992 and construction on a portion of the project beginning in 1993. The project includes a new West Seattle Tunnel to store flows from the Alki service area before conveyance to the West Point Treatment Plant. The 10-foot tunnel would allow for excess storage capacity. Metro's 1985/86 comprehensive planning process included control of Harbor CSOs with storage at the regulator, however, because the Harbor Regulator is located less than 1,500 feet from the new West Seattle Tunnel the excess capacity in the tunnel is available for storage of Harbor flows. To convey excess flows to the tunnel, the project expanded to include the Harbor CSO Pipeline, a 54-inch gravity sewer from the Harbor Regulator to the new West Seattle Pump Station which would pump flows into the new tunnel for storage. The Harbor CSO Pipeline was added to the Alki Transfer/CSO Facilities Project in 1994 to reduce community and environmental impacts and to maintain the integrity of the forcemain. Metro is currently conducting a project-level SEPA review of the Harbor CSO Pipeline.

II. 1985 FEIS AND 1986 FSEIS ENVIRONMENTAL ANALYSES

The 1985 FEIS addressed the environmental impacts and mitigation measures associated with CATAD improvements, treatment facilities, storage facilities, and sewer separation including necessary conveyance improvements. It also addressed more specific impacts for various CSO options including a Denny Way CSO treatment facility, Denny Way storage, Harbor Regulator storage, and Henderson Street storage with associated appurtenances such as pump stations, regulators, and connecting pipes to facilities. The 1986 FSEIS addressed the environmental impacts and mitigation measures associated with storage facilities and sewer separation.

Table 1 provides a summary of the environmental impacts and mitigation measures for CSO-control facilities and specific CSO control projects analyzed in the 1985 FEIS and 1986 FSEIS.

III. DENNY WAY/LAKE UNION CSO CONTROL PROJECT

The Denny Regulator Station overflows approximately 494 million gallons (MG) per year, making it the single largest overflow in the Metro System. The 1985 FEIS analyzed a storage and treatment approach for controlling Denny overflows. The 1988 CSO Control Plan, however, recommended a partial separation project comprised of 584 acres in the Denny/Lake Union and Denny Local basins, to be complemented by City of Seattle partial separation of over 600 acres upstream of the Lake Union Tunnel.

Metro subsequently reassessed the Denny project in light of changes in the regulatory environment and progress made in its CSO control program. In 1991, DWU requested that Metro participate in a joint CSO-control alternative analysis to find ways to control discharges into Lake Union from Seattle's system and into Elliott Bay at the Denny Regulator Station from Metro's system. In 1992, a joint Denny Way/Lake Union CSO Control Project was submitted as a candidate for Coastal Cities Grant funds, and the Denny project was accelerated in order to take advantage of the potential $35 million in grant funding which is to become available for the project in 1995.

The Denny Way/Lake Union CSO Control Project which Metro has identified as part of this update would meet the City's goal of controlling Lake Union discharges to one event per year, would control Metro's Dexter Regulator overflows to one event per year, and would meet Metro's interim goal of reducing CSO discharges at the Denny Regulator to approximately 50 percent of the baseline overflow. Metro has identified various control alternatives including separation, storage, conveyance, and treatment options. Through workshop review and consultant evaluation of the CSO-control options, Metro selected a preferred alternative.

Description of Proposed Action

Metro's preferred alternative for the Denny Way/Lake Union CSO Control Project is a new 18-foot diameter, 6,800-foot long tunnel under Mercer Street. The tunnel would run from Dexter Avenue to Elliott Avenue. The alternative also includes a 2.5 MG concrete storage tank near the Denny Regulator Station, two pump stations, a new outfall in Elliott Bay, and necessary piping and regulators.

Environmental Consequences of Proposed Action

The 1985 FEIS included environmental analysis of a Denny CSO treatment facility, Denny Way storage, Denny Way tunnel/partial separation, and Denny local partial separation. The current proposal is not significantly different from these CSO-control options analyzed in the

TABLE 1
SUMMARY OF POTENTIAL
ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES
FOR CSO FACILITIES IN GENERAL
IDENTIFIED IN THE 1985 FEIS AND 1986 FSEIS

	ENVIRONMENTAL IMPACTS	MITIGATION MEASURES
Natural Environment		
Earth Resources		• Minimize erosion and sedimentation. • Dispose of excavated material at approved landfill.
Air Resources	• CATAD improvements - increased storage could increase or prolong odor escaping from manholes or vents. • Sewer separation - dust from construction, diesel fumes and emissions from heavy equipment, odors from stored wastewater during construction. • Treatment facilities - odors.	• Air filters could be installed to minimize odors. • Disinfection of CSOs prior to storage. • Ozonation or carbon treatment of pump station or headworks ventilation.
Water Resources	• CSO control benefits water quality by reducing pollutants entering water bodies through CSOs.	
Biological Resources	• CSO control benefits aquatic plants and animals as water quality improves.	
Energy	• Consumption of energy to run vehicles and equipment during construction and by operation of new facilities.	
Built Environment		
Environmental Health	• Construction - noise levels could increase temporarily.	• Maintain construction equipment and vehicles in good condition. • Use mufflers in order to minimize noise.
Land and Shoreline Use	• Construction - temporary dust, noise and traffic disruption. • Most CSO projects in shoreline zone.	
Aesthetics	• CSO projects located underground except for manhole lids, vent pipes or electrical boxes at or above ground, but views not significantly changed.	
Recreation	• CSO reduction benefits recreational water use and aesthetic appreciation by improving water quality.	
Historic/ Archaeological Resources	• Construction - may disturb previously undocumented cultural remains.	• Survey conducted during design to assess potential for finding archaeological or historic resources. • Program developed to protect resources during construction.
Transportation	• Operation - generate little vehicular traffic except occasional disinfectant deliveries by truck or rail.	

previous SEPA document. Therefore, the environmental impacts would be the same as those described in the 1985 FEIS.

Metro and the City of Seattle are currently conducting on project-level NEPA and SEPA environmental evaluation of the joint Denny Way/Lake Union CSO Control Project which are scheduled for completion by the end of 1996.

Mitigation Measures

The 1985 FEIS included general mitigation measures for various types of CSO-control facilities and specific measures for the Denny project. Table 1 provides a summary of the mitigation measures for general CSO-control facilities and Table 2 provides a summary of the specific measures for the Denny Project. Additional specific mitigation measures will be identified as part of the project-specific evaluation.

IV. HARBOR CSO PIPELINE

Metro's CSO Program is responsible for reducing the number of CSO events and volume of CSO discharges within Metro's system. A 1987 agreement Ecology requires Metro to reduce system-wide CSOs by 75 percent by the year 2006. The 1985 FEIS included Harbor Regulator station storage as an alternative CSO control project. The 1995 CSO Update proposes to utilize excess capacity in the new West Seattle Tunnel for storage rather than constructing a separate storage facility.

If a conveyance pipeline is constructed between the regulator and the pump station, Metro could optimize the tunnel operation to reduce CSOs at the Harbor Regulator. However, Harbor Regulator flows can only be stored when Alki average wet weather non-storm flows entering the west end of the tunnel are less than 19 million gallons per day (MGD), which would occur approximately 55 times per year. The flows stored in the tunnel would be slowly released to the Elliott Bay Interceptor (EBI) for transport to West Point Treatment Plant for secondary treatment.

Description of Proposed Action

The Harbor CSO Pipeline would be a 54-inch gravity sewer from the Harbor Regulator to the splitter structure at the new West Seattle Pump Station, constructed concurrently with the West Seattle Forcemain. The Harbor CSO Pipeline would be approximately 1,350 feet long and placed in the same trench excavated for the West Seattle Forcemain in Harbor Avenue. The 54-inch pipeline would be placed a minimum of three feet below the 30-inch forcemain.

Environmental Consequences of Proposed Action

Cumulative impacts are reduced by placing two pipelines in the same trench rather than constructing the pipelines in separate trenches and at separate times. The environmental impacts

TABLE 2
SUMMARY OF POTENTIAL ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES SPECIFICALLY IDENTIFIED IN THE 1985 FEIS AND 1986 FSEIS FOR A DENNY TREATMENT OR STORAGE FACILITY

RESOURCE	ENVIRONMENTAL IMPACTS	MITIGATION MEASURES
Natural Environment		
Earth Resources	• Excavation and fill for vault underground and connecting pipelines and outfall.	
Air Resources	• Construction - temporary increase in dust and other airborne emissions from construction vehicles; equipment and diesel fumes. • Operation - potential for odor.	
Water Resources	• CSO discharges to Duwamish River and Elliott Bay. • Extension of outfall would increase dilution rate and improve water quality near shore. • Increase volume discharge of effluent, but effluent would be treated, disinfected, discharged further offshore, and greater diffusion due to greater depth.	
Biological Resources	• Improvement of water quality and near shore waters by reducing CSO discharges would benefit fish and wildlife from the reduction in the toxicant levels and otherwise improved habitat. • Discharge of treated effluent would reduce water quality within the zone of initial dilution that could lead to a change in habitat and thereby in the fish and benthic communities.	
Built Environment		
Environmental Health	• Temporary increase in noise from trucks and equipment.	
Land and Shoreline Use	• Dust, noise and traffic disruption; located in the shoreline zone.	
Aesthetics	• Located underground in Myrtle Edwards Park with access, vent pipes and electrical box visible at the surface. • Would not obstruct current views from adjacent properties, streets, or the park.	• Park restored/landscaped. • Architectural treatment or planting to screen the access or above-ground vent and electrical box.
Recreation	• Park would be closed to recreation use in the immediate area of construction. • Improvements to near shore water quality could enhance aesthetic experience of the park.	• Affected area restored and reopened after construction. • Schedule construction to avoid high-use.
Historic/ Archaeological Resources	• Park located on fill which would reduce likelihood of discovering archaeological or historic resources.	
Transportation	• Temporarily increase truck and vehicular traffic on adjacent streets. • No streets would likely be obstructed during construction, but a portion of the parking lot at park might be temporarily unavailable.	

associated with the Harbor CSO Pipeline are similar to those described and analyzed in the 1985 FEIS for the Harbor Regulator storage and in both the 1985 FEIS and 1986 FSEIS for construction and operation impacts of pipelines. Table 1 presents a summary of potential environmental impacts for CSO facilities, in general. Metro is currently conducting a project-level SEPA and NEPA review of the Harbor CSO Pipeline. Impacts and mitigation measures for building pipelines were addressed in the 1985 FEIS and 1986 FSEIS.

Mitigation Measures

Table 1 presents a summary of mitigation measures for CSO facilities, in general. A project-level environmental analysis is currently in process. Additional specific mitigation measures will be identified as part of the project-specific evaluation.

V. HENDERSON/MARTIN LUTHER KING WAY CSO ENGINEERING EVALUATION

Elimination of CSOs to Lake Washington has been a continuing priority in Metro's CSO control planning, and until recently it was believed that all Lake Washington CSOs had been controlled. However, Metro recently discovered new evidence of overflows to the lake from the South Henderson Street Pump Station and the Martin Luther King Way overflow weir in 1994. Annual estimated overflows total 10 MG at the Henderson location and 88 MG at the Martin Luther King location.

Description of Proposed Action

The overflows at the Henderson Street Pump Station and the Martin Luther King Way overflow weir are believed to be the result of heavy inflow and infiltration to the system in those two areas. Metro believes that controlling inflow and infiltration may be a cost effective way to preventing overflows. As a result, Metro has undertaken an engineering evaluation of the area to locate major sources of inflow to obtain a better understanding of the problem at these locations, and to make recommendations for controlling it. The evaluation is scheduled to be completed by the summer of 1995. Once the engineering evaluation has been completed, a specific control project or projects will be selected.

Environmental Consequences of Proposed Action

The potential solutions for the Henderson/Martin Luther King Way overflows (e.g., separation, storage and conveyance) were all addressed at a plan level in the 1985 FEIS and 1986 FSEIS. Comprehensive data of the overflow problems at the Henderson Street Pump Station and Martin Luther King Way overflow weir are needed by Metro in order to determine the best resolution of the overflow problem. Once these studies are completed, Metro will conduct a project-level environmental review to identify specific impacts and mitigation measures.

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Date 2-9-95 **Signature** Shirley Marroquin for Gregory M. Bush

APPENDIX E

RESULTS OF CSO MONITORING PROGRAM

CSO Monitoring Results (1986-1991)

CSO OVERFLOW MONITORING PROGRAM

Introduction

Metro's NPDES sampling program calls for discharge sampling of five CSO sites annually through 1992 to meet requirements of WAC 173-245-040 (2) (a) (i) and condition S11.C1 of the West Point Treatment Plant's National Pollutant Discharge Elimination System (NPDES) permit. Appendix A lists stations, sample numbers, dates when samples were taken, and the status of each site in the monitoring program. Nine stations were selected for sediment quality sampling and four discharge samples for each CSO under overflow conditions were to be collected to supplement previous monitoring efforts. Sediment sampling requirements were completed in 1990.

1988-1991 CSO Discharge Organics Analyses Results

Organics analyses results are presented in Table 7 (Pages 24-35) and Appendix B describes Metro's trace organics analyses procedures. Summaries of organics analyses results are available for Ballard Siphon, Brandon, Connecticut, East Ballard #1, Norfolk St., and Third Ave. West.

Ballard Siphon CSO

No pesticides or PCBs were detected in the Ballard CSO sample. BNA and VOA results were typical of wastewater. Chlorinated solvents, acetone, and xylene were detected in the VOA analysis while phenols, polycyclic aromatic hydrocarbons (PAHs), and phthalates were present in the BNA analysis. Acetone, a common solvent frequently detected in wastewater, was present at 31 ppb, methylene chloride at 13 ppb, and tetrachloroethylene at 16 ppb. All remaining organics which were detected had concentrations less than 5 ppb.

Brandon CSO

No pesticides or PCBS were detected in the Brandon CSO sample. Volatile organics included low levels of chloroform and 1,1,1-trichloroethane. BNAs included low levels of polycyclic aromatic hydrocarbons (PAHs), phthalates, methylphenol, and benzoic acid. The highest concentration noted was 15 ppb of 1,1,1-trichloroethane and BNAs did not exceed 10 ppb.

TABLE 7A

CSO DISCHARGE ORGANICS DATA

(in ppb or ug/L)			
Sample #	8800302	8800301	8800300
Station	Denny Way	Lander St.	Michigan St.
NPDES Serial Number	WO27	WO30	WO39
PRIORITY POLLUTANT ORGANICS			
ACIDS			
PHENOL	4.00	3.20	
2-CHLOROPHENOL			
4-CHLORO-3-METHYL PHENOL		0.71	
2,4-DICHLOROPHENOL			
2,4,5-TRICHLOROPHENOL			
2,4,6-TRICHLOROPHENOL			
2,3,4,6-TETRACHLOROPHENOL			
PENTACHLOROPHENOL			
2-NITROPHENOL			
4-NITROPHENOL			
2,4-DINITROPHENOL			
2,4-DIMETHYLPHENOL			0.64
4,6-DINITRO-2-METHYLPHENOL			
2-METHYLPHENOL (O-CRESOL)			
3-METHYLPHENOL (M-CRESOL)			
4-METHYLPHENOL (P-CRESOL)			
BENZOIC ACID	37.00		
BASES			
N-NITROSODIMETHYLAMINE			
N-NITROSODI-N-PROPYLAMINE			
N-NITROSODIPHENYLAMINE			
BENZIDINE			
3,3-DICHLOROBENZIDINE			
PYRIDINE			
ANALINE			
4-CHLOROANILINE			
2-NITROANILINE			
3-NITROANILINE			
4-NITROANILINE			
NEUTRALS			
1,2-DICHLOROBENZENE	6.60		
1,3-DICHLOROBENZENE			
1,4-DICHLOROBENZENE			
1,2,4-TRICHLOROBENZENE			
HEXACHLOROBENZENE			
NITROBENZENE			
HEXACHLOROETHANE			
HEXACHLOROCYCLOPENTADIENE			
HEXACHLOROBUTADIENE			
TRICHLOROBUTADIENE			
TETRACHLOROBUTADIENE			

TABLE 7B

CSO DISCHARGE ORGANICS DATA

(in ppb or ug/L)

Sample #	8800302	8800301	8800300
Station	Denny Way	Lander St.	Michigan St.
NPDES Serial Number	WO27	WO30	WO39
NEUTRALS			
PENTACHLOROBUTADIENE			
BIS (2-CHLOROETHYL) ETHER			
BIS (2-CHLOROISOPROPYL) ETHER			
4-CHLOROPHENYL PHENYL ETHER			
4-BROMOPHENYL PHENYL ETHER			
BIS (2-CHLOROETHOXY) METHANE			
2,4-DINITROTOLUENE			
2,6-DINITROTOLUENE			
NAPHTHALENE	2.10	1.20	0.71
2-METHYLNAPTHALENE	1.20	3.60	1.70
FLUORENE		0.58	0.48
ACENAPHTHENE		0.22	
ACENAPHYTHYLENE			
ANTHRACENE			
PHENANTHRENE	0.32	1.40	1.90
FLUROANTHENE		1.20	2.30
PYRENE		1.00	1.90
CHRYSENE		0.61	1.40
BENZO (A) ANTHRACENE			0.77
BENZO (A) PYRENE			
BENZO (B) FLUORANTHENE			
BENZO (K) FLUORANTHENE			
INDENO (1,2,3-C,D)PYRENE			
DIBENZO (A-H) ANTHRACENE			
BENZO (G,H,I) PERYLENE			
2-CHLORONAPHTHALENE			
DIMETHYL PHTHALATE			
DIETHYL PHTHALATE	2.80	0.42	0.42
DI-N-BUTYL PHTHALATE			
BENZYL BUTYL PHTHALATE	1.30	1.10	1.40
DI-N-OCTYL PHTHALATE			2.20
BIS (2-ETHYLHEXYL) PHTHALATE	15.00	6.30	18.00
BENZYL ALCOHOL	7.60		
DIBENZOFURAN		0.37	
1-2, DIPHENYLHYDRAZINE			
ISOPHORONE			
PCBS AND PESTICIDES			
TOTAL PCBs			
AROCLOR 1016			
AROCLOR 1221			
AROCLOR 1232			
AROCLOR 1242			
AROCLOR 1248			

TABLE 7C

CSO DISCHARGE ORGANICS DATA

(in ppb or ug/L)			
Sample #	8800302	8800301	8800300
Station	Denny Way	Lander St.	Michigan St.
NPDES Serial Number	WO27	WO30	WO39
PCBS AND PESTICIDES			
AROCLOR 1254			
AROCLOR 1260			
ALPHA-BHC			
BETA-BHC			
DELTA-BHC			
GAMMA-BHC (LINDANE)			
4,4-DDE			
4,4-DDD			
4,4-DDT			
ALDRIN			
DIELDRIN			
ENDRIN			
ENDRIN ALDEHYDE			
CHLORDANE			
HEPTACHLOR			
HEPTACHLOR EPOXIDE			
METHOXYCHLOR			
ENDOSULFAN I			
ENDOSULFAN II			
ENDOSULFAN SULFATE			
TOXAPHENE			
2,3,7,8-TCDD			
DEMETON			
GUTHION			
MALATHION			
MIREX			
PARATHION			
VOLATILES			
METHYL CHLORIDE			
METHYLENE CHLORIDE	2.50	3.00	
CHLOROFORM	2.00		
CHLOROMETHANE			
CHLOROETHANE			
1,1-DICHLOROETHANE			
1,2-DICHLOROETHANE			
1,1,1-TRICHLOROETHANE	1.50		
1,1,2-TRICHLOROETHANE			
1,1,1,2-TETRACHLOROETHANE			
1,1,2,2-TETRACHLOROETHANE			
VINYL CHLORIDE			
1,1-DICHLOROETHYLENE			
TRANS-1,2-DICHLOROETHYLENE			
CIS-1,2-DICHLOROETHYLENE			

TABLE 7D

CSO DISCHARGE ORGANICS DATA

(in ppb or ug/L)

Sample #	8800302	8800301	8800300
Station	Denny Way	Lander St.	Michigan St.
NPDES Serial Number	WO27	WO30	WO39
VOLATILES			
TRICHLOROETHYLENE	2.00		
TETRACHLOROETHYLENE	4.50		
1,1,2-TRICHLOROETHYLENE			
1,2-DICHLOROPROPANE			
CIS-1,3-DICHLOROPROPENE			
TRANS-1,3-DICHLOROPROPENE			
METHYL BROMIDE			
DICHLOROBROMOMETHANE			
CHLORODIBROMOMETHANE			
BROMOFROM			
DICHLORODIFLUOROMETHANE			
TRICHLOROFLUOROMETHANE			
ACROLEIN			
ACRYLONITRILE			
CARBON TETRACHLORIDE			
BENZENE			
TOLUENE	7.00	2.00	
ETHYLBENZENE	2.00		
BIS (CHLOROMETHYL) ETHER			
2-CHLOROETHYL VINYL ETHER			
CARBON DISULFIDE			
ISOBUTANOL			
ACETONE	43.00	4.00	10.00
VINYL ACETATE			
2-BUTANONE (MEK)			
4-METHYL-2-PENTANONE (MIBK)			
2-HEXANONE			
TOTAL XYLENE	5.50		
STRYENE			

TABLE 7E

CSO DISCHARGE ORGANICS DATA

(in ppb or ug/L)			
Sample #	8909776	9000289	9000887
Station	Ballard Siphon	Brandon St.	Norfolk St.
NPDES Serial Number	WOO3	WO41	WO44
PRIORITY POLLUTANT ORGANICS			
ACIDS			
PHENOL	1.60		
2-CHLOROPHENOL			
4-CHLORO-3-METHYL PHENOL			
2,4-DICHLOROPHENOL			
2,4,5-TRICHLOROPHENOL			
2,4,6-TRICHLOROPHENOL			
2,3,4,6-TETRACHLOROPHENOL			
PENTACHLOROPHENOL			
2-NITROPHENOL			
4-NITROPHENOL			
2,4-DINITROPHENOL			
2,4-DIMETHYLPHENOL			
4,6-DINITRO-2-METHYLPHENOL			
2-METHYLPHENOL (O-CRESOL)			
3-METHYLPHENOL (M-CRESOL)			
4-METHYLPHENOL (P-CRESOL)	2.30	1.60	
BENZOIC ACID		10.00	
BASES			
N-NITROSODIMETHYLAMINE			
N-NITROSODI-N-PROPYLAMINE			
N-NITROSODIPHENYLAMINE			
BENZIDINE			
3,3-DICHLOROBENZIDINE			
PYRIDINE			
ANALINE			
4-CHLOROANILINE			
2-NITROANILINE			
3-NITROANILINE			
4-NITROANILINE			
NEUTRALS			
1,2-DICHLOROBENZENE			
1,3-DICHLOROBENZENE			
1,4-DICHLOROBENZENE			
1,2,4-TRICHLOROBENZENE			
HEXACHLOROBENZENE			
NITROBENZENE			
HEXACHLOROETHANE			
HEXACHLOROCYCLOPENTADIENE			
HEXACHLOROBUTADIENE			
TRICHLOROBUTADIENE			
TETRACHLOROBUTADIENE			

TABLE 7F

CSO DISCHARGE ORGANICS DATA

(in ppb or ug/L)

Sample #	8909776	9000289	9000887
Station	Ballard Siphon	Brandon St.	Norfolk St.
NPDES Serial Number	WOO3	WO41	WO44
NEUTRALS			
PENTACHLOROBUTADIENE			
BIS (2-CHLOROETHYL) ETHER			
BIS (2-CHLOROISOPROPYL) ETHER			
4-CHLOROPHENYL PHENYL ETHER			
4-BROMOPHENYL PHENYL ETHER			
BIS (2-CHLOROETHOXY) METHANE			
2,4-DINITROTOLUENE			
2,6-DINITROTOLUENE			
NAPHTHALENE	0.62		
2-METHYLNAPTHALENE	0.58	0.85	
FLUORENE		0.68	
ACENAPHTHENE			
ACENAPHYTHYLENE			
ANTHRACENE			
PHENANTHRENE	0.46	3.50	
FLUROANTHENE	0.52	5.50	
PYRENE	0.53	2.90	
CHRYSENE	0.33	2.50	
BENZO (A) ANTHRACENE	0.21	1.20	
BENZO (A) PYRENE		1.20	
BENZO (B) FLUORANTHENE		1.60	
BENZO (K) FLUORANTHENE		1.30	
INDENO (1,2,3-C,D)PYRENE		1.10	
DIBENZO (A-H) ANTHRACENE			
BENZO (G,H,I) PERYLENE			
2-CHLORONAPHTHALENE			
DIMETHYL PHTHALATE			
DIETHYL PHTHALATE	0.60		1.30
DI-N-BUTYL PHTHALATE		9.50	
BENZYL BUTYL PHTHALATE	0.76	6.60	0.82
DI-N-OCTYL PHTHALATE			
BIS (2-ETHYLHEXYL) PHTHALATE	5.40	9.80	
BENZYL ALCOHOL	1.20		
DIBENZOFURAN			
1-2, DIPHENYLHYDRAZINE			
ISOPHORONE			
PCBS AND PESTICIDES			
TOTAL PCBs			
AROCLOR 1016			
AROCLOR 1221			
AROCLOR 1232			
AROCLOR 1242			
AROCLOR 1248			

TABLE 7G

CSO DISCHARGE ORGANICS DATA

(in ppb or ug/L)			
Sample #	8909776	9000289	9000887
Station	Ballard Siphon	Brandon St.	Norfolk St.
NPDES Serial Number	WOO3	WO41	WO44
PCBS AND PESTICIDES			
AROCLOR 1254			
AROCLOR 1260			
ALPHA-BHC			
BETA-BHC			
DELTA-BHC			
GAMMA-BHC (LINDANE)			
4,4-DDE			
4,4-DDD			
4,4-DDT			
ALDRIN			
DIELDRIN			
ENDRIN			
ENDRIN ALDEHYDE			
CHLORDANE			
HEPTACHLOR			
HEPTACHLOR EPOXIDE			
METHOXYCHLOR			
ENDOSULFAN I			
ENDOSULFAN II			
ENDOSULFAN SULFATE			
TOXAPHENE			
2,3,7,8-TCDD			
DEMETON			
GUTHION			
MALATHION			
MIREX			
PARATHION			
VOLATILES			
METHYL CHLORIDE			
METHYLENE CHLORIDE	13.00		
CHLOROFORM		1.40	
CHLOROMETHANE			
CHLOROETHANE			
1,1-DICHLOROETHANE			
1,2-DICHLOROETHANE			
1,1,1-TRICHLOROETHANE	1.90	15.00	
1,1,2-TRICHLOROETHANE			
1,1,1,2-TETRACHLOROETHANE			
1,1,2,2-TETRACHLOROETHANE			
VINYL CHLORIDE			
1,1-DICHLOROETHYLENE			
TRANS-1,2-DICHLOROETHYLENE			
CIS-1,2-DICHLOROETHYLENE			

TABLE 7H

CSO DISCHARGE ORGANICS DATA

(in ppb or ug/L)			
Sample #	8909776	9000289	9000887
Station	Ballard Siphon	Brandon St.	Norfolk St.
NPDES Serial Number	WOO3	WO41	WO44
VOLATILES			
TRICHLOROETHYLENE			
TETRACHLOROETHYLENE	16.00		6.20
1,1,2-TRICHLOROETHYLENE	1.10		
1,2-DICHLOROPROPANE			
CIS-1,3-DICHLOROPROPENE			
TRANS-1,3-DICHLOROPROPENE			
METHYL BROMIDE			
DICHLOROBROMOMETHANE			
CHLORODIBROMOMETHANE			
BROMOFROM			
DICHLORODIFLUOROMETHANE			
TRICHLOROFLUOROMETHANE			
ACROLEIN			
ACRYLONITRILE			
CARBON TETRACHLORIDE			
BENZENE			
TOLUENE			
ETHYLBENZENE			
BIS (CHLOROMETHYL) ETHER			
2-CHLOROETHYL VINYL ETHER			
CARBON DISULFIDE			
ISOBUTANOL			
ACETONE	31.00		20.00
VINYL ACETATE			
2-BUTANONE (MEK)			
4-METHYL-2-PENTANONE (MIBK)			
2-HEXANONE			
TOTAL XYLENE	2.40		
STRYENE			

TABLE 71

CSO DISCHARGE ORGANICS DATA

(in ppb or ug/L)

Sample #	8900177	8900174	8909689
Station	East Ballard #1	3rd Ave. West	Connecticut
NPDES Serial Number	WOO4	WOO8	WO29
PRIORITY POLLUTANT ORGANICS			
ACIDS			
PHENOL		3.20	
2-CHLOROPHENOL			
4-CHLORO-3-METHYL PHENOL			
2,4-DICHLOROPHENOL			
2,4,5-TRICHLOROPHENOL			
2,4,6-TRICHLOROPHENOL			
2,3,4,6-TETRACHLOROPHENOL			
PENTACHLOROPHENOL			
2-NITROPHENOL			
4-NITROPHENOL			
2,4-DINITROPHENOL			
2,4-DIMETHYLPHENOL			
4,6-DINITRO-2-METHYLPHENOL			
2-METHYLPHENOL (O-CRESOL)		1.40	
3-METHYLPHENOL (M-CRESOL)			
4-METHYLPHENOL (P-CRESOL)			2.80
BENZOIC ACID			12.00
BASES			
N-NITROSODIMETHYLAMINE			
N-NITROSODI-N-PROPYLAMINE			
N-NITROSODIPHENYLAMINE			
BENZIDINE			
3,3-DICHLOROBENZIDINE			
PYRIDINE			
ANALINE			
4-CHLOROANILINE			
2-NITROANILINE			
3-NITROANILINE			
4-NITROANILINE			
NEUTRALS			
1,2-DICHLOROBENZENE			
1,3-DICHLOROBENZENE			
1,4-DICHLOROBENZENE			
1,2,4-TRICHLOROBENZENE			
HEXACHLOROBENZENE			
NITROBENZENE			
HEXACHLOROETHANE			
HEXACHLOROCYCLOPENTADIENE			
HEXACHLOROBUTADIENE			
TRICHLOROBUTADIENE			
TETRACHLOROBUTADIENE			

TABLE 7J

CSO DISCHARGE ORGANICS DATA

(in ppb or ug/L)

Sample #	8900177	8900174	8909689
Station	East Ballard #1	3rd Ave. West	Connecticut
NPDES Serial Number	WOO4	WOO8	WO29
NEUTRALS			
PENTACHLOROBUTADIENE			
BIS (2-CHLOROETHYL) ETHER			
BIS (2-CHLOROISOPROPYL) ETHER			
4-CHLOROPHENYL PHENYL ETHER			
4-BROMOPHENYL PHENYL ETHER			
BIS (2-CHLOROETHOXY) METHANE			
2,4-DINITROTOLUENE			
2,6-DINITROTOLUENE			
NAPHTHALENE			
2-METHYLNAPTHALENE			
FLUORENE			0.70
ACENAPHTHENE			
ACENAPHYTHYLENE			
ANTHRACENE			
PHENANTHRENE	0.52	0.71	3.20
FLUROANTHENE	1.20	0.77	3.20
PYRENE	1.00	0.83	3.80
CHRYSENE	0.54	0.46	2.40
BENZO (A) ANTHRACENE	0.36	0.31	1.30
BENZO (A) PYRENE			
BENZO (B) FLUORANTHENE			
BENZO (K) FLUORANTHENE			
INDENO (1,2,3-C,D)PYRENE			
DIBENZO (A-H) ANTHRACENE			
BENZO (G,H,I) PERYLENE			
2-CHLORONAPHTHALENE			
DIMETHYL PHTHALATE			
DIETHYL PHTHALATE	1.30	1.80	1.80
DI-N-BUTYL PHTHALATE			
BENZYL BUTYL PHTHALATE	0.81	1.20	4.70
DI-N-OCTYL PHTHALATE			
BIS (2-ETHYLHEXYL) PHTHALATE			22.00
BENZYL ALCOHOL			
DIBENZOFURAN			
1-2, DIPHENYLHYDRAZINE			
ISOPHORONE			
PCBS AND PESTICIDES			
TOTAL PCBs			
AROCLOR 1016			
AROCLOR 1221			
AROCLOR 1232			
AROCLOR 1242			
AROCLOR 1248			

TABLE 7K

CSO DISCHARGE ORGANICS DATA

(in ppb or ug/L)

Sample #	8900177	8900174	8909689
Station	East Ballard #1	3rd Ave. West	Connecticut
NPDES Serial Number	WOO4	WOO8	WO29
PCBS AND PESTICIDES			
AROCLOR 1254			
AROCLOR 1260			
ALPHA-BHC			
BETA-BHC			
DELTA-BHC			
GAMMA-BHC (LINDANE)			
4,4-DDE			
4,4-DDD			
4,4-DDT			
ALDRIN			
DIELDRIN			
ENDRIN			
ENDRIN ALDEHYDE			
CHLORDANE			
HEPTACHLOR			
HEPTACHLOR EPOXIDE			
METHOXYCHLOR			
ENDOSULFAN I			
ENDOSULFAN II			
ENDOSULFAN SULFATE			
TOXAPHENE			
2,3,7,8-TCDD			
DEMETON			
GUTHION			
MALATHION			
MIREX			
PARATHION			
VOLATILES			
METHYL CHLORIDE			
METHYLENE CHLORIDE	5.60		
CHLOROFORM	1.20		
CHLOROMETHANE			
CHLOROETHANE			
1,1-DICHLOROETHANE			
1,2-DICHLOROETHANE			
1,1,1-TRICHLOROETHANE			
1,1,2-TRICHLOROETHANE			
1,1,1,2-TETRACHLOROETHANE			
1,1,2,2-TETRACHLOROETHANE			
VINYL CHLORIDE			
1,1-DICHLOROETHYLENE			
TRANS-1,2-DICHLOROETHYLENE			
CIS-1,2-DICHLOROETHYLENE			

TABLE 7L

CSO DISCHARGE ORGANICS DATA

(in ppb or ug/L)			
Sample #	8900177	8900174	8909689
Station	East Ballard #1	3rd Ave. West	Connecticut
NPDES Serial Number	WOO4	WOO8	WO29
VOLATILES			
TRICHLOROETHYLENE			
TETRACHLOROETHYLENE	6.50	2.80	
1,1,2-TRICHLOROETHYLENE			
1,2-DICHLOROPROPANE			
CIS-1,3-DICHLOROPROPENE			
TRANS-1,3-DICHLOROPROPENE			
METHYL BROMIDE			
DICHLOROBROMOMETHANE			
CHLORODIBROMOMETHANE			
BROMOFROM			
DICHLORODIFLUOROMETHANE			
TRICHLOROFLUOROMETHANE			
ACROLEIN			
ACRYLONITRILE			
CARBON TETRACHLORIDE			
BENZENE		1.50	1.70
TOLUENE		1.00	5.20
ETHYLBENZENE			
BIS (CHLOROMETHYL) ETHER			
2-CHLOROETHYL VINYL ETHER			
CARBON DISULFIDE			
ISOBUTANOL			
ACETONE			
VINYL ACETATE			
2-BUTANONE (MEK)			
4-METHYL-2-PENTANONE (MIBK)		9.80	
2-HEXANONE			
TOTAL XYLENE		11.00	
STRYENE			

Connecticut Regulator CSO

No pesticides or PCBs were detected. The only volatile organics detected were low levels of benzene, toluene, and xylene, and acetone (a common solvent). The primary contaminants in the BNA fraction were PAHs, 4-methylphenol, and benzoic acid. With the exception of 22 ppb of the ubiquitous plasticizer bis (2-ethylhexyl) phthalate, all of the BNA concentrations were less than 5 ppb. PAHs are fuel combustion products that are commonly detected in stormwater and wastewater samples. Methylphenol is a common disinfectant found in wastewater. Benzoic acid is a naturally occurring compound (most berries contain 0.05 percent).

East Ballard #1 CSO

Only low levels of organics were present. No PCBs or pesticides were detected. The volatile organics found were those found in fuels (benzene, toluene, and xylene), degreasers (tetrachloroethylene and methylene chloride) and drinking water (chloroform). Phthalates, PAHS, and phenol, semivolatile organics commonly found in storm and wastewater samples, were detected.

Norfolk St. CSO

Very few organics were detected in the Norfolk CSO sample. No pesticides or PCBs were present. Volatile organics detected in the Norfolk sample included low levels of tetrachloroethylene and acetone. Semivolatile organics for the Norfolk sample included traces of two phthalates.

Third Ave. West CSO

Only low levels of organics were present. No PCBs or pesticides were detected. The volatile organics found were those found in fuels (benzene, toluene, and xylene), degreasers (tetrachloroethylene and methylene chloride) and drinking water (chloroform). Phthalates, PAHs, and phenol (semivolatile organics commonly found in storm and wastewater samples) were detected.

1988-1991 CSO Discharge Metals and Conventionals Analyses Results

Metals and conventionals analyses results were compared to typical CSO pollutant levels (see Metro's Toxicant Pretreatment Planning Study Technical Report A2: Collection System Evaluation, 1984) in Table 8 (Pages 37-39). These "typical" pollutant levels were derived from an analysis of CSO discharges and West Point treatment plant influent during storm events. They represent a theoretical average Metro CSO. Some variation from these values on an

TABLE 8A

CSO DISCHARGE METALS/CONVENTIONALS DATA

NPDES#		WOO3 Ballard				WO41 Brandon St. Outfall				WO44 Norfolk Reg.			
METALS	N1/N2	MIN VALUE (MG/L)	MAX VALUE (MG/L)	MEAN VALUE (MG/L)	N1/N2	MIN VALUE (MG/L)	MAX VALUE (MG/L)	MEAN VALUE (MG/L)	N1/N2	MIN VALUE (MG/L)	MAX VALUE (MG/L)	MEAN VALUE (MG/L)	TYPICAL CSO VALUES (TPPS REPORT) (MG/L)
ALUMINUM	4/4	1.3000	1.5000	1.3500	4/4	1.5000	9.5000	4.9750	4/4	2.8000	3.7000	3.4250	4.600000
ARSENIC	1/3	0.0020	0.0020	0.0020	3/4	0.0040	0.0080	0.0060	1/4	0.0040	0.0040	0.0040	0.010000
BERYLLIUM	0/4				0/4				0/4				0.000067
CADMIUM	0/4				0/4				0/4				0.002800
CHROMIUM	4/4	0.0060	0.0100	0.0075	4/4	0.0100	0.0600	0.0275	4/4	0.0070	0.0100	0.0090	0.033000
COPPER	4/4	0.0270	0.0480	0.0365	4/4	0.0290	0.0860	0.0565	4/4	0.0200	0.0440	0.0333	0.072400
IRON	4/4	1.5000	1.9000	1.7000	4/4	2.2000	14.0000	7.0000	4/4	3.5000	5.1000	4.5250	3.700000
LEAD	4/4	0.0600	0.0700	0.6250	4/4	0.0400	0.1000	0.0750	3/4	0.0300	0.0400	0.0333	0.140000
MANGANESE	4/4	0.0410	0.0590	0.0478	4/4	0.0490	0.3200	0.1780	4/4	0.1000	0.1500	0.1375	0.100000
MERCURY	2/4	0.0003	0.0003	0.0003	2/4	0.0002	0.0004	0.0003	4/4	0.0002	0.0007	0.0004	0.000260
NICKEL	0/4				4/4	0.0200	0.0500	0.0350	2/4	0.0100	0.0100	0.0100	0.034000
SELENIUM	0/3				2/4	0.0070	0.0070	0.0070	1/4	0.0100	0.0100	0.0100	
SILVER	0/4				2/4	0.0060	0.0070	0.0060	0/4				0.005000
ZINC	4/4	0.1400	0.2200	0.1700	4/4	0.1300	0.3400	0.2350	4/4	0.0870	0.1500	0.1143	0.210000

NPDES#		WOO3 Ballard				WO41 Brandon St. Outfall				WO44 Norfolk Reg.			
CONVENTIONALS	N1/N2	MIN VALUE (MG/L)	MAX VALUE (MG/L)	MEAN VALUE (MG/L)	N1/N2	MIN VALUE (MG/L)	MAX VALUE (MG/L)	MEAN VALUE (MG/L)	N1/N2	MIN VALUE (MG/L)	MAX VALUE (MG/L)	MEAN VALUE (MG/L)	TYPICAL CSO VALUES (TPPS REPORT) (MG/L)
BOD	4/4	22.00	35.00	27.75	4/4	7.40	22.00	15.35	4/4	35.00	60.00	49.00	60.00
COD	4/4	64.00	115.00	89.75	4/4	66.00	176.00	105.50	4/4	73.00	190.00	133.25	140.00
TOTAL-SS	4/4	58.14	84.00	71.79	4/4	72.00	300.00	169.29	3/3	139.00	218.00	179.67	112.00
VOLATILE-SS	4/4	23.26	37.33	31.15	4/4	27.00	68.00	43.25	3/3	52.00	74.00	60.00	60.00
OIL-GREASE	3/4	5.70	8.00	6.93	2/4	12.00	12.00	12.00	3/4	6.10	12.00	8.97	8.60

NOTE: A BLANK CELL INDICATES THAT A CONSTITUENT WAS NOT DETECTED

TABLE 8B

CSO DISCHARGE METALS/CONVENTIONALS DATA

NPDES#	W029 Connecticut				W008 3rd Ave. West				W004 E. Ballard #1				
METALS	N1/N2	MIN VALUE (MG/L)	MAX VALUE (MG/L)	MEAN VALUE (MG/L)	N1/N2	MIN VALUE (MG/L)	MAX VALUE (MG/L)	MEAN VALUE (MG/L)	N1/N2	MIN VALUE (MG/L)	MAX VALUE (MG/L)	MEAN VALUE (MG/L)	TYPICAL CSO VALUES (TPPS REPORT) (MG/L)
ALUMINUM	4/4	2.7000	13.6000	7.3250	3/3	1.6600	2.3500	2.1100	3/3	1.1200	1.4200	1.2300	4.600000
ARSENIC	1/2	0.0040	0.0040	0.0040	1/3	0.0043	0.0043	0.0043	1/1	0.0012	0.0012	0.0012	0.010000
BERYLLIUM	0/3				1/3	0.0030	0.0030	0.0030	0/3				0.000067
CADMIUM	2/4	0.0020	0.0070	0.0045	0/3				0/3				0.002800
CHROMIUM	4/4	0.0100	0.0640	0.0310	3/3	0.0070	0.0110	0.0090	2/3	0.0070	0.0080	0.0075	0.033000
COPPER	4/4	0.0340	0.1750	0.0875	3/3	0.0320	0.0490	0.0380	3/3	0.0160	0.0280	0.0240	0.072400
IRON	4/4	3.4000	19.4000	9.9000	3/3	2.0400	2.9500	2.5933	3/3	1.2500	1.6700	1.4200	3.700000
LEAD	4/4	0.0500	0.3400	0.1350	3/3	0.0300	0.0700	0.0533	3/3	0.0300	0.0700	0.0633	0.140000
MANGANESE	3/3	0.0740	0.3840	0.2293	3/3	0.0660	0.0740	0.0697	3/3	0.0300	0.0690	0.0466	0.100000
MERCURY	4/4	0.0003	0.0013	0.0006	3/3	0.0003	0.0010	0.0006	1/3	0.0002	0.0002	0.0002	0.000260
NICKEL	3/4	0.0200	0.0500	0.0333	0/3				0/3				0.034000
SELENIUM	0/2				0/1				0/1				
SILVER	3/4	0.0040	0.0150	0.0077	1/3	0.0060	0.0060	0.0060	0/3				0.005000
ZINC	4/4	0.1500	0.7090	0.3272	3/3	0.1120	0.1610	0.1333	3/3	0.0720	0.1350	0.1020	0.210000

NPDES#	W029 Connecticut				W008 3rd Ave. West				W004 E. Ballard #1				
CONVENTIONALS	N1/N2	MIN VALUE (MG/L)	MAX VALUE (MG/L)	MEAN VALUE (MG/L)	N1/N2	MIN VALUE (MG/L)	MAX VALUE (MG/L)	MEAN VALUE (MG/L)	N1/N2	MIN VALUE (MG/L)	MAX VALUE (MG/L)	MEAN VALUE (MG/L)	TYPICAL CSO VALUES (TPPS REPORT) (MG/L)
BOD	4/4	25.00	270.00	97.50	3/3	30.90	46.30	38.40	3/3	8.60	17.60	13.07	60.00
COD	4/4	58.00	200.00	129.00	3/3	98.40	133.66	117.35	3/3	50.00	88.36	71.12	140.00
TOTAL-SS	4/4	104.00	428.00	252.50	3/3	86.00	130.00	110.18	3/3	58.00	78.00	66.66	112.00
VOLATILE-SS	4/4	34.00	112.00	70.42	1/1	53.33	53.33	53.33	1/3	30.00	30.00	30.00	60.00
OIL-GREASE	4/4	8.20	29.00	18.05	3/3	5.00	17.20	10.93	1/3	8.70	8.70	8.70	8.60

NOTE: A BLANK CELL INDICATES THAT A CONSTITUENT WAS NOT DETECTED

TABLE 8C

CSO DISCHARGE METALS/CONVENTIONALS DATA

NPDES#	WO39 Michigan	WO30 Lander	WO27 Denny	
METALS	MEAN VALUE (MG/L)	MEAN VALUE (MG/L)	MEAN VALUE (MG/L)	TYPICAL CSO VALUES (TPPS REPORT) (MG/L)
ALUMINUM	5.80000	5.10000	2.90000	4.600000
ARSENIC	0.00910	0.01000	0.01000	0.010000
BERYLLIUM	0.00100	0.00009	0.00003	0.000067
CADMIUM	0.00410	0.00510	0.00200	0.002800
CHROMIUM	0.04200	0.07100	0.02300	0.033000
COPPER	0.06000	0.15000	0.07300	0.072400
IRON	5.10000	4.90000	2.30000	3.700000
LEAD	0.22000	0.11000	0.15000	0.140000
MANGANESE	0.11000	0.19000	0.06000	0.100000
MERCURY	0.00027	0.00011	0.00039	0.000260
NICKEL	0.02900	0.07700	0.02700	0.034000
SELENIUM				
SILVER	0.00420	0.00170	0.01400	0.005000
ZINC	0.20000	0.28000	0.22000	0.210000

NPDES #	WO39 Michigan	WO30 Lander	WO27 Denny	
CONVENTIONALS	MEAN VALUE (MG/L)	MEAN VALUE (MG/L)	MEAN VALUE (MG/L)	TYPICAL CSO VALUES (TPPS REPORT) (MG/L)
BOD	49.00	55.00	72.00	60.00
COD	100.00	130.00	180.00	140.00
TOTAL-SS	98.00	130.00	100.00	112.00
VOLATILE-SS		64.00	60.00	60.00
OIL-GREASE		7.00	10.00	8.60

NOTE: A BLANK CELL INDICATES THAT A CONSTITUENT WAS NOT DETECTED

individual basis are to be expected and do not represent a violation of regulatory standards. Other studies have reported large variations in toxicant concentrations in CSOs, however for Metro's Toxicant Pretreatment Planning Study Technical Report A2 the variability was less significant.

A value of zero is assumed for constituents below the detection limit in computing arithmetic mean values in Table 8. The typical CSO pollutant level is not available for selenium. Typical CSO pollutant levels are geometric mean values.

Ballard CSO

The mercury mean constituent level was above the typical CSO pollutant level in the Ballard CSO sample. All other mean constituent concentrations were at or below typical CSO pollutant levels.

Brandon CSO

Aluminum, iron, manganese, nickel, silver, zinc, total suspended solids, and oil-grease mean constituent levels were above the typical CSO pollutant levels in the Brandon CSO sample. All other mean constituent concentrations were at or below typical CSO pollutant levels.

Connecticut CSO

Aluminum, cadmium, copper, iron, manganese, mercury, silver, zinc, BOD, total suspended solids, volatile suspended solids, and oil-grease mean constituent levels were above typical CSO pollutant levels in the Brandon CSO sample. All other mean constituent concentrations were at or below typical CSO pollutant levels.

Denny Way CSO

Copper, lead, mercury, zinc, BOD, COD, and oil-grease mean constituent levels were above typical CSO pollutant levels in the Denny Way CSO. All other mean constituents were at or below typical CSO pollutant levels.

East Ballard #1

The oil-grease mean constituent level was above the typical CSO pollutant level. All other mean constituent concentrations were at or below typical CSO pollutant levels.

Lander St. CSO

Aluminum, beryllium, cadmium, chromium, copper, iron, manganese, nickel, zinc, total suspended solids, and volatile suspended solids mean constituent levels were above typical CSO pollutant levels. All other mean constituent levels were at or below typical CSO pollutant levels.

Michigan CSO

Aluminum, beryllium, cadmium, chromium, iron, lead, manganese, and mercury mean constituent levels were above typical CSO pollutant levels. All other mean constituent concentrations were at or below typical CSO pollutant levels.

Norfolk CSO

Iron, total suspended solids, and oil-grease mean constituent levels were above the typical CSO pollutant levels in the Norfolk CSO sample. All other mean constituent concentrations were at or below typical CSO pollutant levels.

Third Ave. West CSO

Mercury, silver, and oil-grease mean constituent levels were above the typical CSO pollutant levels in the Third Ave. West CSO. All other mean constituent concentrations were at or below typical CSO pollutant levels.

<u>1988-1991 CSO Marine Sediments Organics Analyses Results</u>

Organics analyses results for CSO marine sediments are reported in Table 9 (Pages 42-53).

<u>1988-1991 CSO Marine Sediments Metals/Conventionals Analyses Results</u>

Metals/conventionals analyses results are presented in Table 10 (Page 54).

TABLE 9A

CSO MARINE SEDIMENT ORGANICS DATA

(in ppb dry or ug/L)

Sample #	8900560	8900561	8900563
Station	Ballard Siphon	East Ballard #1	3rd Ave. West
NPDES Serial Number	WOO3	WOO4	WOO8
PRIORITY POLLUTANT ORGANICS			
ACIDS			
PHENOL			
2-CHLOROPHENOL			
4-CHLORO-3-METHYL PHENOL			
2,4-DICHLOROPHENOL			
2,4,5-TRICHLOROPHENOL			
2,4,6-TRICHLOROPHENOL			
2,3,4,6-TETRACHLOROPHENOL			
PENTACHLOROPHENOL			
2-NITROPHENOL			
4-NITROPHENOL			
2,4-DINITROPHENOL			
2,4-DIMETHYLPHENOL			
4,6-DINITRO-2-METHYLPHENOL			
2-METHYLPHENOL (O-CRESOL)			
3-METHYLPHENOL (M-CRESOL)			
4-METHYLPHENOL (P-CRESOL)			
BENZOIC ACID			
BASES			
N-NITROSODIMETHYLAMINE			
N-NITROSODI-N-PROPYLAMINE			
N-NITROSODIPHENYLAMINE			
BENZIDINE			
3,3-DICHLOROBENZIDINE			
PYRIDINE			
ANALINE			
4-CHLOROANILINE			
2-NITROANILINE			
3-NITROANILINE			
4-NITROANILINE			
NEUTRALS			
1,2-DICHLOROBENZENE			
1,3-DICHLOROBENZENE			
1,4-DICHLOROBENZENE		482.759	
1,2,4-TRICHLOROBENZENE			
HEXACHLOROBENZENE			
NITROBENZENE			
HEXACHLOROETHANE			
HEXACHLOROCYCLOPENTADIENE			
HEXACHLOROBUTADIENE			
TRICHLOROBUTADIENE			
TETRACHLOROBUTADIENE			

TABLE 9B

CSO MARINE SEDIMENT ORGANICS DATA

(in ppb or ug/L)

Sample #	8900560	8900561	8900563
Station	Ballard Siphon	East Ballard #1	3rd Ave. West
NPDES Serial Number	WOO3	WOO4	WOO8
NEUTRALS			
PENTACHLOROBUTADIENE			
BIS (2-CHLOROETHYL) ETHER			
BIS (2-CHLOROISOPROPYL) ETHER			
4-CHLOROPHENYL PHENYL ETHER			
4-BROMOPHENYL PHENYL ETHER			
BIS (2-CHLOROETHOXY) METHANE			
2,4-DINITROTOLUENE			
2,6-DINITROTOLUENE			
NAPHTHALENE	264.000	127.586	577.778
2-METHYLNAPTHALENE	1200.000	465.517	288.889
FLUORENE	760.000	396.552	511.111
ACENAPHTHENE	520.000	362.069	1022.222
ACENAPHYTHYLENE	76.000	58.621	188.889
ANTHRACENE	960.000	448.276	1111.111
PHENANTHRENE	5600.000	2241.379	3777.778
FLUROANTHENE	10000.000	2413.793	4222.219
PYRENE	6800.000	1706.896	8666.664
CHRYSENE	4800.000	1051.724	4222.219
BENZO (A) ANTHRACENE	3200.001	913.793	3111.111
BENZO (A) PYRENE	4800.000	879.310	4666.664
BENZO (B) FLUORANTHENE	5200.000	1000.000	3555.555
BENZO (K) FLUORANTHENE	5600.000	965.517	4000.000
INDENO (1,2,3-C,D)PYRENE	1360.000	327.586	1933.333
DIBENZO (A-H) ANTHRACENE		139.655	955.555
BENZO (G,H,I) PERYLENE	1800.000	413.793	2111.111
2-CHLORONAPHTHALENE			
DIMETHYL PHTHALATE	304.000	41.379	113.333
DIETHYL PHTHALATE			
DI-N-BUTYL PHTHALATE			
BENZYL BUTYL PHTHALATE	8000.000	258.621	
DI-N-OCTYL PHTHALATE			
BIS (2-ETHYLHEXYL) PHTHALATE			
BENZYL ALCOHOL			
DIBENZOFURAN	308.000	162.069	177.778
1-2, DIPHENYLHYDRAZINE			
ISOPHORONE			
PCBS AND PESTICIDES			
TOTAL PCBs			
AROCLOR 1016			
AROCLOR 1221			
AROCLOR 1232			
AROCLOR 1242			
AROCLOR 1248			

TABLE 9C

CSO MARINE SEDIMENT ORGANICS DATA

(in ppb or ug/L)

Sample #	8900560	8900561	8900563
Station	Ballard Siphon	East Ballard #1	3rd Ave. West
NPDES Serial Number	WOO3	WOO4	WOO8
PCBS AND PESTICIDES			
AROCLOR 1254	248.000	1017.241	62.222
AROCLOR 1260	248.000	1017.241	80.000
ALPHA-BHC			
BETA-BHC			
DELTA-BHC			
GAMMA-BHC (LINDANE)			
4,4-DDE			
4,4-DDD			
4,4-DDT			
ALDRIN			
DIELDRIN			
ENDRIN			
ENDRIN ALDEHYDE			
CHLORDANE			
HEPTACHLOR			
HEPTACHLOR EPOXIDE			
METHOXYCHLOR			
ENDOSULFAN I			
ENDOSULFAN II			
ENDOSULFAN SULFATE			
TOXAPHENE			
2,3,7,8-TCDD			
DEMETON			
GUTHION			
MALATHION			
MIREX			
PARATHION			
VOLATILES			
METHYL CHLORIDE			
METHYLENE CHLORIDE	152.000		128.889
CHLOROFORM			
CHLOROMETHANE			
CHLOROETHANE			
1,1-DICHLOROETHANE			
1,2-DICHLOROETHANE			
1,1,1-TRICHLOROETHANE			
1,1,2-TRICHLOROETHANE			
1,1,1,2-TETRACHLOROETHANE			
1,1,2,2-TETRACHLOROETHANE			
VINYL CHLORIDE			
1,1-DICHLOROETHYLENE			
TRANS-1,2-DICHLOROETHYLENE			
CIS-1,2-DICHLOROETHYLENE			

TABLE 9D

CSO MARINE SEDIMENT ORGANICS DATA

(in ppb or ug/L)			
Sample #	8900560	8900561	8900563
Station	Ballard Siphon	East Ballard #1	3rd Ave. West
NPDES Serial Number	WOO3	WOO4	WOO8
VOLATILES			
TRICHLOROETHYLENE			
TETRACHLOROETHYLENE		14.828	
1,1,2-TRICHLOROETHYLENE			
1,2-DICHLOROPROPANE			
CIS-1,3-DICHLOROPROPENE			
TRANS-1,3-DICHLOROPROPENE			
METHYL BROMIDE			
DICHLOROBROMOMETHANE			
CHLORODIBROMOMETHANE			
BROMOFROM			
DICHLORODIFLUOROMETHANE			
TRICHLOROFLUOROMETHANE			
ACROLEIN			
ACRYLONITRILE			
CARBON TETRACHLORIDE			
BENZENE		29.310	
CHLOROBENZENE	1017.241		
TOLUENE	108.000		
ETHYLBENZENE	26.000		
BIS (CHLOROMETHYL) ETHER			
2-CHLOROETHYL VINYL ETHER			
CARBON DISULFIDE		12.241	
ISOBUTANOL			
ACETONE	560.000	344.827	222.222
VINYL ACETATE			
2-BUTANONE (MEK)			177.778
4-METHYL-2-PENTANONE (MIBK)			
2-HEXANONE			
TOTAL XYLENE	88.000	14.138	
STRYENE			

TABLE 9E

CSO MARINE SEDIMENT ORGANICS DATA

(in ppb dry or ug/L)

Sample #	8900564	8900565	9006687
Station	Montlake	Dexter Ave	Brandon St.
NPDES Serial Number	WO14	WOO9	WO41
PRIORITY POLLUTANT ORGANICS			
ACIDS			
PHENOL			
2-CHLOROPHENOL			
4-CHLORO-3-METHYL PHENOL			
2,4-DICHLOROPHENOL			
2,4,5-TRICHLOROPHENOL			
2,4,6-TRICHLOROPHENOL			
2,3,4,6-TETRACHLOROPHENOL			
PENTACHLOROPHENOL			
2-NITROPHENOL			
4-NITROPHENOL			
2,4-DINITROPHENOL			
2,4-DIMETHYLPHENOL			
4,6-DINITRO-2-METHYLPHENOL			
2-METHYLPHENOL (O-CRESOL)			
3-METHYLPHENOL (M-CRESOL)			
4-METHYLPHENOL (P-CRESOL)	94.805		
BENZOIC ACID	75.325		616.438
BASES			
N-NITROSODIMETHYLAMINE			
N-NITROSODI-N-PROPYLAMINE			
N-NITROSODIPHENYLAMINE			
BENZIDINE			
3,3-DICHLOROBENZIDINE			
PYRIDINE			
ANALINE			
4-CHLOROANILINE			
2-NITROANILINE			
3-NITROANILINE			
4-NITROANILINE			
NEUTRALS			
1,2-DICHLOROBENZENE			
1,3-DICHLOROBENZENE			
1,4-DICHLOROBENZENE	42.857		
1,2,4-TRICHLOROBENZENE			
HEXACHLOROBENZENE			
NITROBENZENE			
HEXACHLOROETHANE			
HEXACHLOROCYCLOPENTADIENE			
HEXACHLOROBUTADIENE			
TRICHLOROBUTADIENE			
TETRACHLOROBUTADIENE			

TABLE 9F.

CSO MARINE SEDIMENT ORGANICS DATA

(in ppb or ug/L)

Sample #	8900564	8900565	9006687
Station	Montlake	Dexter Ave	Brandon St.
NPDES Serial Number	WO14	WOO9	WO41
NEUTRALS			
PENTACHLOROBUTADIENE			
BIS (2-CHLOROETHYL) ETHER			
BIS (2-CHLOROISOPROPYL) ETHER			
4-CHLOROPHENYL PHENYL ETHER			
4-BROMOPHENYL PHENYL ETHER			
BIS (2-CHLOROETHOXY) METHANE			
2,4-DINITROTOLUENE			
2,6-DINITROTOLUENE			
NAPHTHALENE		160.000	
2-METHYLNAPTHALENE		733.333	
FLUORENE	36.364	2166.667	89.041
ACENAPHTHENE	12.987	1933.333	84.932
ACENAPHYTHYLENE		36.667	
ANTHRACENE	272.727	1333.333	106.849
PHENANTHRENE	311.688	7333.332	520.548
FLUROANTHENE	753.247	4666.664	808.219
PYRENE	870.130	5666.664	698.630
CHRYSENE	415.584	2333.333	520.548
BENZO (A) ANTHRACENE	363.636	1766.667	452.055
BENZO (A) PYRENE	207.792	1766.667	273.972
BENZO (B) FLUORANTHENE	259.740	2200.000	273.972
BENZO (K) FLUORANTHENE	337.662	2266.667	246.575
INDENO (1,2,3-C,D)PYRENE	106.493	800.000	150.685
DIBENZO (A-H) ANTHRACENE			
BENZO (G,H,I) PERYLENE	114.286	966.667	136.986
2-CHLORONAPHTHALENE			
DIMETHYL PHTHALATE			
DIETHYL PHTHALATE			
DI-N-BUTYL PHTHALATE		2333.333	
BENZYL BUTYL PHTHALATE		466.667	
DI-N-OCTYL PHTHALATE			
BIS (2-ETHYLHEXYL) PHTHALATE			
BENZYL ALCOHOL			
DIBENZOFURAN		1400.000	49.315
1-2, DIPHENYLHYDRAZINE			
ISOPHORONE			
PCBS AND PESTICIDES			
TOTAL PCBs			
AROCLOR 1016			
AROCLOR 1221			
AROCLOR 1232			
AROCLOR 1242			
AROCLOR 1248			

TABLE 9G

CSO MARINE SEDIMENT ORGANICS DATA

(in ppb or ug/L)

Sample #	8900564	8900565	9006687
Station	Montlake	Dexter Ave	Brandon St.
NPDES Serial Number	WO14	WOO9	WO41
PCBS AND PESTICIDES			
AROCLOR 1254			82.192
AROCLOR 1260	29.870		136.986
ALPHA-BHC			
BETA-BHC			
DELTA-BHC			
GAMMA-BHC (LINDANE)			
4,4-DDE			
4,4-DDD			
4,4-DDT			
ALDRIN			
DIELDRIN			
ENDRIN			
ENDRIN ALDEHYDE			
CHLORDANE			
HEPTACHLOR			
HEPTACHLOR EPOXIDE			
METHOXYCHLOR			
ENDOSULFAN I			
ENDOSULFAN II			
ENDOSULFAN SULFATE			
TOXAPHENE			
2,3,7,8-TCDD			
DEMETON			
GUTHION			
MALATHION			
MIREX			
PARATHION			
VOLATILES			
METHYL CHLORIDE			
METHYLENE CHLORIDE	79.221		
CHLOROFORM	16.883		
CHLOROMETHANE			
CHLOROETHANE			
1,1-DICHLOROETHANE			
1,2-DICHLOROETHANE			
1,1,1-TRICHLOROETHANE			
1,1,2-TRICHLOROETHANE			
1,1,1,2-TETRACHLOROETHANE			
1,1,2,2-TETRACHLOROETHANE			
VINYL CHLORIDE			
1,1-DICHLOROETHYLENE			
TRANS-1,2-DICHLOROETHYLENE			
CIS-1,2-DICHLOROETHYLENE			

TABLE 9H

CSO MARINE SEDIMENT ORGANICS DATA

(in ppb or ug/L)

Sample #	8900564	8900565	9006687
Station	Montlake	Dexter Ave	Brandon St.
NPDES Serial Number	WO14	WOO9	WO41
VOLATILES			
TRICHLOROETHYLENE			
TETRACHLOROETHYLENE		60.000	
1,1,2-TRICHLOROETHYLENE			
1,2-DICHLOROPROPANE			
CIS-1,3-DICHLOROPROPENE			
TRANS-1,3-DICHLOROPROPENE			
METHYL BROMIDE			
DICHLOROBROMOMETHANE			
CHLORODIBROMOMETHANE			
BROMOFROM			
DICHLORODIFLUOROMETHANE			
TRICHLOROFLUOROMETHANE			
ACROLEIN			
ACRYLONITRILE			
CARBON TETRACHLORIDE			
BENZENE			
	7.662	26.000	
TOLUENE		220.000	
ETHYLBENZENE		113.333	
BIS (CHLOROMETHYL) ETHER			
2-CHLOROETHYL VINYL ETHER			
CARBON DISULFIDE			
ISOBUTANOL			
ACETONE		276.667	
VINYL ACETATE			
2-BUTANONE (MEK)	106.493		
4-METHYL-2-PENTANONE (MIBK)			
2-HEXANONE			
TOTAL XYLENE		600.000	
STRYENE			

TABLE 9I

CSO MARINE SEDIMENT ORGANICS DATA

(in ppb dry or ug/L)

Sample #	9006691	9006690	9006688
Station	S.W. Michigan	Eighth Ave.	Norfolk St.
NPDES Serial Number	WO42	WO40	WO44
PRIORITY POLLUTANT ORGANICS			
ACIDS			
PHENOL			
2-CHLOROPHENOL			
4-CHLORO-3-METHYL PHENOL			
2,4-DICHLOROPHENOL			
2,4,5-TRICHLOROPHENOL			
2,4,6-TRICHLOROPHENOL			
2,3,4,6-TETRACHLOROPHENOL			
PENTACHLOROPHENOL			
2-NITROPHENOL			
4-NITROPHENOL			
2,4-DINITROPHENOL			
2,4-DIMETHYLPHENOL			
4,6-DINITRO-2-METHYLPHENOL			
2-METHYLPHENOL (O-CRESOL)			
3-METHYLPHENOL (M-CRESOL)			
4-METHYLPHENOL (P-CRESOL)			
BENZOIC ACID	233.766		725.806
BASES			
N-NITROSODIMETHYLAMINE			
N-NITROSODI-N-PROPYLAMINE			
N-NITROSODIPHENYLAMINE			
BENZIDINE			
3,3-DICHLOROBENZIDINE			
PYRIDINE			
ANALINE			
4-CHLOROANILINE			
2-NITROANILINE			
3-NITROANILINE			
4-NITROANILINE			
NEUTRALS			
1,2-DICHLOROBENZENE			
1,3-DICHLOROBENZENE			
1,4-DICHLOROBENZENE			596.774
1,2,4-TRICHLOROBENZENE			
HEXACHLOROBENZENE			
NITROBENZENE			
HEXACHLOROETHANE			
HEXACHLOROCYCLOPENTADIENE			
HEXACHLOROBUTADIENE			
TRICHLOROBUTADIENE			
TETRACHLOROBUTADIENE			

TABLE 9J

CSO MARINE SEDIMENT ORGANICS DATA

(in ppb or ug/L)

Sample #	9006691	9006690	9006688
Station	S.W. Michigan	Eighth Ave.	Norfolk St.
NPDES Serial Number	WO42	WO40	WO44
NEUTRALS			
PENTACHLOROBUTADIENE			
BIS (2-CHLOROETHYL) ETHER			
BIS (2-CHLOROISOPROPYL) ETHER			
4-CHLOROPHENYL PHENYL ETHER			
4-BROMOPHENYL PHENYL ETHER			
BIS (2-CHLOROETHOXY) METHANE			
2,4-DINITROTOLUENE			
2,6-DINITROTOLUENE			
NAPHTHALENE			
2-METHYLNAPTHALENE			
FLUORENE	27.273		59.677
ACENAPHTHENE	23.377		41.935
ACENAPHYTHYLENE	19.481		20.968
ANTHRACENE	83.117		106.452
PHENANTHRENE	259.740	59.459	661.290
FLUROANTHENE	1090.909	132.432	838.710
PYRENE	948.052	93.243	741.936
CHRYSENE	506.493	71.622	483.871
BENZO (A) ANTHRACENE	454.545	60.811	387.097
BENZO (A) PYRENE	402.597	39.189	354.839
BENZO (B) FLUORANTHENE	441.558	56.757	354.839
BENZO (K) FLUORANTHENE	298.701	43.243	370.968
INDENO (1,2,3-C,D)PYRENE	155.844		225.806
DIBENZO (A-H) ANTHRACENE			62.903
BENZO (G,H,I) PERYLENE	142.857		209.677
2-CHLORONAPHTHALENE			
DIMETHYL PHTHALATE			
DIETHYL PHTHALATE			
DI-N-BUTYL PHTHALATE			
BENZYL BUTYL PHTHALATE			
DI-N-OCTYL PHTHALATE			
BIS (2-ETHYLHEXYL) PHTHALATE			
BENZYL ALCOHOL			
DIBENZOFURAN			
1-2, DIPHENYLHYDRAZINE			
ISOPHORONE			
PCBS AND PESTICIDES			
TOTAL PCBs			
AROCLOR 1016			
AROCLOR 1221			
AROCLOR 1232			
AROCLOR 1242			
AROCLOR 1248			

TABLE 9K

CSO MARINE SEDIMENT ORGANICS DATA

(in ppb or ug/L)			
Sample #	9006691	9006690	9006688
Station	S.W. Michigan	Eighth Ave.	Norfolk St.
NPDES Serial Number	WO42	WO40	WO44
PCBS AND PESTICIDES			
AROCLOR 1254			96.774
AROCLOR 1260			48.387
ALPHA-BHC			
BETA-BHC			
DELTA-BHC			
GAMMA-BHC (LINDANE)			
4,4-DDE			
4,4-DDD	2.468		
4,4-DDT			
ALDRIN			
DIELDRIN			
ENDRIN			
ENDRIN ALDEHYDE			
CHLORDANE			
HEPTACHLOR			
HEPTACHLOR EPOXIDE			
METHOXYCHLOR			
ENDOSULFAN I			
ENDOSULFAN II			
ENDOSULFAN SULFATE			
TOXAPHENE			
2,3,7,8-TCDD			
DEMETON			
GUTHION			
MALATHION			
MIREX			
PARATHION			
VOLATILES			
METHYL CHLORIDE			
METHYLENE CHLORIDE			
CHLOROFORM			
CHLOROMETHANE			
CHLOROETHANE			
1,1-DICHLOROETHANE			
1,2-DICHLOROETHANE			
1,1,1-TRICHLOROETHANE			
1,1,2-TRICHLOROETHANE			
1,1,1,2-TETRACHLOROETHANE			
1,1,2,2-TETRACHLOROETHANE			
VINYL CHLORIDE			
1,1-DICHLOROETHYLENE			
TRANS-1,2-DICHLOROETHYLENE			
CIS-1,2-DICHLOROETHYLENE			

TABLE 9L

CSO MARINE SEDIMENT ORGANICS DATA

(in ppb or ug/L)

Sample #	9006691	9006690	9006688
Station	S.W. Michigan	Eighth Ave.	Norfolk St.
NPDES Serial Number	WO42	WO40	WO44
VOLATILES			
TRICHLOROETHYLENE			
TETRACHLOROETHYLENE			
1,1,2-TRICHLOROETHYLENE			
1,2-DICHLOROPROPANE			
CIS-1,3-DICHLOROPROPENE			
TRANS-1,3-DICHLOROPROPENE			
METHYL BROMIDE			
DICHLOROBROMOMETHANE			
CHLORODIBROMOMETHANE			
BROMOFROM			
DICHLORODIFLUOROMETHANE			
TRICHLOROFLUOROMETHANE			
ACROLEIN			
ACRYLONITRILE			
CARBON TETRACHLORIDE			
BENZENE			
TOLUENE			
ETHYLBENZENE			
BIS (CHLOROMETHYL) ETHER			
2-CHLOROETHYL VINYL ETHER			
CARBON DISULFIDE			
ISOBUTANOL			
ACETONE			
VINYL ACETATE			
2-BUTANONE (MEK)			
4-METHYL-2-PENTANONE (MIBK)			
2-HEXANONE			
TOTAL XYLENE			
STRYENE			

TABLE 10

CSO MARINE SEDIMENT METALS/CONVENTIONALS DATA

NPDES#	WOO3	WOO4	WOO8	WO14	WOO9	WO41	WO42	WO40	WO44
STATION	BALLARD SIPHON	EAST BALLARD #1	3RD AVE. WEST	MONTLAKE OVER.	DEXTER AVE.	BRANDON ST.	S.W. MICHIGAN	EIGHTH AVE.	NORFOLK ST.
% SOLIDS	25	58	45	77	30	73	77	74	62
METALS									
ALUMINUM	12400.0000	10793.1000	10177.7800	6246.7500	20266.6700	7123.2850	8571.4300	8918.9180	15967.7400
ARSENIC	31.6400	44.4830	13.9330	7.4550	27.8330	9.5890	12.9870	8.1080	14.5160
BERYLLIUM	0.1600	0.3450	0.2220	0.1300	0.6670			0.1080	0.3230
CADMIUM	3.6000	2.7590	0.4440		2.3330	0.2740	0.2600		0.3230
CHROMIUM	80.4000	68.1030	44.4440	17.4030	78.6670	60.2740	27.2730	13.5140	22.5810
COPPER	361.2000	182.7590	105.7780	20.7790	750.0000	39.7260	37.6620	17.5680	40.3230
IRON	37680.1000	33965.5200	19000.0000	9116.8830	28700.0000	1568.4920	14285.7100	14864.6800	20967.7400
LEAD	520.0000	470.6890	142.2220	81.8180	1173.3330	27.3970	168.8310	12.1620	38.7100
MANGANESE	356.8000	382.7590	218.6670	140.2600	393.3330	356.1640	181.8180	162.1620	241.3960
MERCURY	0.8400	0.6379	0.4667	0.0519	2.7000	0.1781	0.3896	0.0405	0.9032
NICKEL	56.0000	63.7930	37.7780	15.5840	66.6670	164.3840	20.7790	11.3510	17.7420
SELENIUM									
SILVER									0.4840
ZINC	856.0000	539.6550	222.2220	62.9870	540.0000	102.7400	111.6880	45.9460	111.2900

NPDES#	WOO3	WOO4	WOO8	WO14	WOO9	WO41	WO42	WO40	WO44
	BALLARD SIPHON	EAST BALLARD #1	3RD AVE. WEST	MONTLAKE OVER.	DEXTER AVE.	BRANDON ST.	S.W. MICHIGAN	EIGHTH AVE.	NORFOLK ST.
CONVENTIONALS									
SULFIDE	1212.00	270.90	190.00	4.03	1273.00	71.20	24.68	7.80	95.20
COD	640000.00	206896.00	266666.00	155844.00	533333.00	32876.70	11688.00	13513.00	48387.00
TOT VOL SOLIDS	256000.00	91379.00	55555.00	24675.00	106666.00	21917.80	15584.00	13513.00	46774.00
TOC	84000.00	36206.00	22000.00	11039.00	33333.00	6849.00	3766.00	6351.00	22580.00
OIL-GREASE	2600.00	4400.00	1800.00	410.00	20000.00	1780.70	441.60	148.60	1097.00

NOTE: A BLANK CELL INDICATES THAT A CONSTITUENT WAS NOT DETECTED

CSO Monitoring Results (1992-1993)

CSO MONITORING PROGRAM

Introduction

Metro's National Pollutant Discharge Elimination System (NPDES) CSO sampling program requires discharge and sediment sampling of five CSO sites annually through 1992 to meet requirements of WAC 173-245-040 (2) (a) (i) and condition S11.C1 of the West Point Treatment Plant's NPDES permit. Appendix A lists stations, sample numbers, dates when samples were taken, and the status of each site in the monitoring program. Nine stations were selected for sediment quality sampling and four discharge samples for each CSO under overflow conditions were to be collected to supplement previous monitoring efforts. Sediment sampling requirements were completed in 1990. Discharge sampling requirements remain for five discharge locations. Eighth Avenue (W040), Chelan Avenue (W036), and Dexter Avenue (W009) require all four samples be taken, while one sample remains for West Michigan (W042) and Montlake (W014).

1992/1993 Discharge Sampling Data

Successful sampling was inhibited during the 1992/93 reporting period due to inadequate storm events and equipment failures. Sampling attempts were not completed for West Michigan (W042), Eighth Avenue (W040), Chelan Avenue (W036), Montlake (W014), or Dexter Avenue (W009).

The CSO sampling program will be completed once samples are successfully collected for the five remaining CSO locations. Upon completion of Metro's sampling efforts, the data will be fully analyzed and consolidated as a complete report so that Metro can present a comprehensive overview of the results of the CSO sampling program.

CSO Monitoring Results (1993-1994)

CSO MONITORING PROGRAM

Introduction

Metro's National Pollutant Discharge Elimination System (NPDES) CSO sampling program requires discharge and sediment sampling of five CSO sites annually through 1992 to meet requirements of WAC 173-245-040 (2) (a) (i) and condition S11.C1 of the West Point Treatment Plant's NPDES permit. Appendix A lists stations, sample numbers, dates when samples were taken, and the status of each site in the monitoring program. Nine stations were selected for sediment quality sampling and four discharge samples for each CSO under overflow conditions were to be collected to supplement previous monitoring efforts. Sediment sampling requirements were completed in 1990. Discharge sampling requirements remain for four stations. Eighth Avenue (W040), Chelan Avenue (W036), and Dexter Avenue (W009) require all four samples be taken, while one sample remains for Montlake (W014).

Metro is in the process of developing a comprehensive site-specific baseline study plan for chemical and biological analysis of the sediment to meet additional NPDES requirements. Metro is required to collect sediment samples to check compliance with Washington State sediment standards. Implementation of the plan will supplement previous monitoring efforts.

1993/1994 Discharge Sampling Status

The fourth sampling round was collected at West Michigan on October 6, 1993. Table 7 provides available concentrations of metals and conventionals. Successful sampling was inhibited for remaining sampling locations during the 1993/1994 reporting period due to inadequate storm events and equipment failures. Sampling attempts were not completed for Eighth Avenue (W040), Chelan Avenue (W036), Montlake (W014), or Dexter Avenue (W009). Grab samples will be obtained in the 1994/1995 wet weather season to complete Metro's regulatory obligations if there are sufficient storm events.

The CSO sampling program will be completed once samples are successfully collected for the four remaining CSO locations. Upon completion of Metro's sampling efforts, the data will be fully analyzed and consolidated as a complete report so that Metro can present a comprehensive overview of the results of the CSO sampling program.

Organics Results

No pesticides or PCBs were detected in the West Michigan discharge sample. High levels of volatile organics typically used as industrial solvents were found including toluene (17 ppb), acetone (37 ppb), and 2-butanone (10 ppb). Semi-volatile organics for the West Michigan sample included traces of 1,4-dichlorobenzene and benzyl butyl phthalate.

Other organics that exceeded detection limits include benzyl alcohol (2.3 ppb), 4-methylphenol (26 ppb), benzoic acid (21 ppb), and coprosantol (69 ppb).

Metals and Conventionals Results

High levels of lead, copper, total suspended solids (TSS) and chemical oxygen demand (COD) were detected in the West Michigan discharge sample. The high level of TSS may have been due to the discharge of sediments that have built up at the outfall gate.

Other metals and conventionals that exceeded detection limits include aluminum (7.7 ppb), chromium (.02 ppb), iron (8.9 ppb), nickel (.02 ppb), and total oil and grease (32 ppb).

TABLE 7: CSO DISCHARGE DATA

Locator:	Sta. 070167		
Locator description:	W. Michigan CSO -- W042		
Collectdate:	6-Oct-93		
Lab sample number:	L2224-1		
FIELD INFO			
Time (hr.)	1719		
Delta time (hrs.)	1		
Discharge volume (gallons)	26,655		
CONVENTIONAL PARMS	mg/l	MDL	RDL
Biochemical Oxygen Demand	92	2	5
Chemical Oxygen Demand	450	3	5
Oil and Grease, Total	32	2	5
Total Suspended Solids	260	0.5	1
Volatile Suspended Solids	120	0.5	1
Cyanide	<MDL	0.005	0.01
MICROBIOLOGY PARMS	orgs/100mls		
Fecal Coliform	1,800,000		
Enterococcus	69000		
METALS PARMS	mg/l	MDL	RDL
Beryllium, Total, ICP	<MDL	0.001	0.005
Aluminum, Total, ICP	7.7	0.1	0.5
Cadmium, Total, ICP	<MDL	0.003	0.015
Antimony, Total, ICP	<MDL	0.03	0.15
Arsenic, Total, ICP	<MDL	0.05	0.25
Chromium, Total, ICP	<RDL	0.005	0.025
Copper, Total, ICP	0.082	0.004	0.02
Iron, Total, ICP	8.9	0.05	0.25
Lead, Total, ICP	0.18	0.03	0.15
Mercury, Total, CVAA	<RDL	0.0002	0.002
Nickel, Total, ICP	<RDL	0.02	0.1
Selenium, Total, ICP	<MDL	0.05	0.25
Silver, Total, ICP	<MDL	0.004	0.02
Thallium, Total, ICP	<MDL	0.2	1
Zinc, Total, ICP	0.42	0.005	0.025

TABLE 7: CSO DISCHARGE DATA

ORGANICS PARMS	ppb	MDL	RDL
N-Nitrosodimethylamine	<MDL	4	6
Phenol	6.1	4	6
Bis(2-Chloroethyl)Ether	<MDL	0.6	1
2-Chlorophenol	<MDL	2	4
ORGANICS PARMS	ppb	MDL	RDL
1,3-Dichlorobenzene	<MDL	0.6	1
1,4-Dichlorobenzene	7.9	0.6	1
1,2-Dichlorobenzene	<MDL	0.6	1
Bis(2-Chloroisopropyl)Ether	<MDL	2	4
N-Nitrosodi-N-Propylamine	<MDL	1	2
Hexachloroethane	<MDL	1	2
Nitrobenzene	<MDL	1	2
Isophorone	<MDL	1	2
2-Nitrophenol	<MDL	1	2
2,4-Dimethylphenol	<MDL	1	2
Bis(2-Chloroethoxy)Methane	<MDL	1	2
2,4-Dichlorophenol	<MDL	1	2
1,2,4-Trichlorobenzene	<MDL	0.6	1
Naphthalene	<MDL	2	3
Hexachlorobutadiene	<MDL	1	2
4-Chloro-3-Methylphenol	<MDL	2	4
Hexachlorocyclopentadiene	<MDL	1	2
2,4,6-Trichlorophenol	<MDL	4	8
2-Chloronaphthalene	<MDL	0.6	1
Acenaphthylene	<MDL	0.6	1
Dimethyl Phthalate	<MDL	0.4	0.6
2,6-Dinitrotoluene	<MDL	0.4	0.8
Acenaphthene	<MDL	0.4	0.8
2,4-Dinitrophenol	<MDL	2	4
4-Nitrophenol	<MDL	2	4
2,4-Dinitrotoluene	<MDL	0.4	0.8
Fluorene	<MDL	0.6	1
Diethyl Phthalate	<MDL	1	2
4-Chlorophenyl Phenyl Ether	<MDL	0.6	1
4,6-Dinitro-O-Cresol	<MDL	2	4
N-Nitrosodiphenylamine	<MDL	1	2
1,2-Diphenylhydrazine	<MDL	2	4
4-Bromophenyl Phenyl Ether	<MDL	0.4	0.6
Hexachlorobenzene	<MDL	0.6	1
Pentachlorophenol	<MDL	1	2
Phenanthrene	<MDL	0.6	1
Anthracene	<MDL	0.6	1
Di-N-Butyl Phthalate	<MDL	1	2
Fluoranthene	<MDL	0.6	1.2
Benzidine	<MDL	20	48
Pyrene	<MDL	0.6	1

TABLE 7: CSO DISCHARGE DATA

Benzyl Butyl Phthalate	1.1	0.6	1
Benzo(A)Anthracene	<MDL	0.6	1
Chrysene	<MDL	0.6	1
3,3'-Dichlorobenzidine	<MDL	1	2
Bis(2-Ethylhexyl)Phthalate	<MDL	0.6	1
Di-N-Octyl Phthalate	<MDL	0.6	1
ORGANICS PARMS	ppb	MDL	RDL
Benzo(B)Fluoranthene	<MDL	2	3
Benzo(K)Fluoranthene	<MDL	2	3
Benzo(A)Pyrene	<MDL	1	2
Indeno(1,2,3-Cd)Pyrene	<MDL	1	2
Dibenzo(A,H)Anthracene	<MDL	2	3
Benzo(G,H,I)Perylene	<MDL	1	2
Aniline	<MDL	2	4
Benzyl Alcohol	2.3	1	2
2-Methylphenol	<MDL	1	2
4-Methylphenol	26	1	2
Benzoic Acid	21	4	6
4-Chloroaniline	<MDL	2	4
2-Methylnaphthalene	<MDL	2	3
2,4,5-Trichlorophenol	<MDL	4	8
2-Nitroaniline	<MDL	4	6
3-Nitroaniline	<MDL	4	6
Dibenzofuran	<MDL	1	2
4-Nitroaniline	<MDL	4	6
Carbazole	<MDL	1	2
Coprostanol	69	4	6
4,4'-DDD	<MDL	0.05	0.1
4,4'-DDE	<MDL	0.05	0.1
4,4'-DDT	<MDL	0.05	0.1
Aldrin	<MDL	0.05	0.1
Alpha-BHC	<MDL	0.05	0.1
Aroclor 1016	<MDL	0.5	1
Aroclor 1221	<MDL	0.5	1
Aroclor 1232	<MDL	0.5	1
Aroclor 1242	<MDL	0.5	1
Aroclor 1248	<MDL	0.5	1
Aroclor 1254	<MDL	0.5	1
Aroclor 1260	<MDL	0.5	1
Beta-BHC	<MDL	0.05	0.1
Chlordane	<MDL	0.3	0.5
Delta-BHC	<MDL	0.05	0.1
Dieldrin	<MDL	0.05	0.1
Endosulfan I	<MDL	0.05	0.1
Endosulfan II	<MDL	0.05	0.1
Endosulfan Sulfate	<MDL	0.05	0.1
Endrin	<MDL	0.05	0.1
Endrin Aldehyde	<MDL	0.05	0.1

TABLE 7: CSO DISCHARGE DATA

Gamma-BHC (Lindane)	<MDL	0.05	0.1
Heptachlor	<MDL	0.05	0.1
Heptachlor Epoxide	<MDL	0.05	0.1
Methoxychlor	<MDL	0.3	0.5
Toxaphene	<MDL	0.5	1
CHLOROMETHANE	<MDL	1	2
ORGANICS PARMS	ppb	MDL	RDL
VINYL CHLORIDE	<MDL	1	2
BROMOMETHANE	<MDL	1	2
CHLOROETHANE	<MDL	1	2
TRICHLOROFLUOROMETHANE	1	1	2
ACROLEIN	<MDL	5	10
1,1-DICHLOROETHYLENE	<MDL	1	2
METHYLENE CHLORIDE	<MDL	5	10
ACRYLONITRILE	<MDL	5	10
TRANS-1,2-DICHLOROETHYLENE	<MDL	1	2
1,1-DICHLOROETHANE	<MDL	1	2
CHLOROFORM	<MDL	1	2
1,1,1-TRICHLOROETHANE	<MDL	1	2
CARBON TETRACHLORIDE	<MDL	1	2
BENZENE	<MDL	1	2
1,2-DICHLOROETHANE	<MDL	1	2
1,1,2-TRICHLOROETHYLENE	<MDL	1	2
1,2-DICHLOROPROPANE	<MDL	1	2
BROMODICHLOROMETHANE	<MDL	1	2
2-CHLOROETHYLVINYLETHER	<MDL	1	2
TRANS-1,3-DICHLOROPROPENE	<MDL	1	2
TOLUENE	17	1	2
CIS-1,3-DICHLOROPROPENE	<MDL	1	2
1,1,2-TRICHLOROETHANE	<MDL	1	2
TETRACHLOROETHYLENE	<MDL	1	2
CHLORODIBROMOMETHANE	<MDL	1	2
CHLOROBENZENE	<MDL	1	2
ETHYLBENZENE	<MDL	1	2
BROMOFORM	<MDL	1	2
1,1,2,2-TETRACHLOROETHANE	<MDL	1	2
ACETONE	37	5	10
CARBON DISULFIDE	<MDL	1	2
VINYL ACETATE	<MDL	5	10
2-BUTANONE (MEK)	<RDL	5	10
4-METHYL-2-PENTANONE (MIBK)	<MDL	5	10
2-HEXANONE	<MDL	1	10
TOTAL XYLENES	<MDL	1	2
STYRENE	<MDL	1	2

APPENDIX F

BASIS OF CAPITAL COST ESTIMATES

Basis for construction of Figure 4-2

Figure 4-2 presents accumulated capital costs and estimated CSO volume reduction effectiveness for the projects included in the *1988 Plan* and for additional projects identified as necessary in this *1995 CSO Update*. The projects, phasing, cost estimates, and estimated effectiveness are shown in Table F-1. The first column of Table F-1 includes the projects considered in construction of Figure 4-2. These include those projects identified in the *1988 Plan* or in this Update. The second column of Table F-1 includes the project capital cost estimates from the *1988 Plan*. The third column presents the 1988 costs inflated to 1994 for better comparison with estimates made in preparation of this *1995 CSO Update*. 1988 costs were inflated by the ratio of the Engineering News Record Construction Cost Index in 1994 (approximately 5500) to that in 1988 (approximately 4740).

The fourth column of Table F-1, entitled "Actual cost or 1995 estimate," includes the actual costs incurred for the Phase 1 and 2 projects of the *1988 Plan* that have been completed or will be completed by late 1997. These figures include the impact of grants received for the Alki and Fort Lawton projects. Also for these projects, the figures presented include only that portion of the total costs for the Alki and Fort Lawton projects that were assigned to the CSO program. The assignment and listing of actual costs is contained in the Memorandum from Rob Moritz of Metro dated 8/9/94 that is included in this appendix. For Phases 3 and 4, the fourth column of Table F-1 includes the 1995 Metro CIP estimates for the Denny Way/Lake Union CSO Control Project, the Henderson/Martin Luther King Way CSO Engineering Evaluation, and the Harbor CSO Pipeline projects that are the projects identified in this *1995 CSO Update* as the CSO control program for the next five years. The cost estimate for the Denny Way/Lake Union CSO Control Project is the total project budget of $120 million, less an assumed grant of $26 million and the City of Seattle contribution of $24 million.

For Phase 4, Table F-1 shows the Michigan and Kingdome/Industrial Area separation projects. The cost estimate shown in column 4 reflects the estimate for these projects, including the CSO storage elements recommended in the recent predesign studies discussed in Chapters 4 and 5. The cost estimates from the predesign studies have been increased to reflect the higher contingencies (30 percent) and allied costs (35 percent) currently used in estimating project costs for this Update. The recommended Brandon separation/storage project was not included in this phase.

The fifth column of Table F-1 includes the estimate of the effectiveness of each phase in CSO volume reduction based on the new Metro model results. The *1988 Plan* assumed that the projects through phase 4 would achieve 75 percent reduction. Results of the new model indicate that these will actually achieve only about 62 percent reduction. Thus, a list of additional projects was selected from the Draft Task 4 Development of Alternatives report for addition to reach the 75 percent objective. These projects represent one approach to achieving the 75 percent objective and may vary depending on RWSP priority and scheduling decisions. The projects selected to construct the "1995 Estimate" line on Figure 4-2 include CSO storage tanks at the Martin Luther King Way

Table F-1. Basis of Figure 4-2

Project	Project Cost in $thousands: 1988 Plan cost	1988 Plan inflated to 1994(f)	Actual cost or 1995 estimate	Estimated cumulative CSO controled (a)	Source of actual or 1995 cost estimate
Phase 1					
Hanford/Bayview	20,100	23,323	3,008		Rob Moritz memo dated 8/9/94
CATAD modifications	4,200	4,873	2,995		Rob Moritz memo dated 8/9/94
Diagonal			2		Rob Moritz memo dated 8/9/94
Subtotal	24,300	28,196	6,005	NA	
Phase 2					
Alki SW plant	10,800	12,532	8,450		Rob Moritz memo dated 8/9/94
Carkeek SW plant	1,800	2,089	2,913		Rob Moritz memo dated 8/9/94
Ft Lawton Tunnel	11,100	12,880	2,874		Rob Moritz memo dated 8/9/94
University	22,300	25,876	20,141		Rob Moritz memo dated 8/9/94
Lander separation	in Phase 1		20,336		Rob Moritz memo dated 8/9/94
Subtotal	46,000	53,376	54,714	37	
Phase 3					
Denny Way	20,000	23,207	70,000		Nigel Lewis, 1995 Metro CIP (b)
Henderson Engr. Evaluation			415		Nigel Lewis, 1995 Metro CIP
Harbor pipeline			750		Nigel Lewis, 1995 Metro CIP
Subtotal	20,000	23,207	71,165	51	
Phase 4					
Michigan Separation	24,300	28,196	30,000		Task 4-includes storage (c)
Kingdome/Ind Sep.	7,300	8,470	35,000		Task 4-includes storage (c)
Subtotal	31,600	36,667	65,000	62	
Additional Projects needed to reach 75% reduction					
MLK Way storage			27,000		Task 4-storage (c)
Henderson Storage			5,500		Task 4-storage (c)
Denny Treatment elements			21,000		Task 4 (c),(d)
Brandon Sep/storage			17,000		Task 4-includes storage (c)
Subtotal			70,500	75	
Additional Projects needed to reach one event/year					
Additional projects	168,000	194,937	277,200	85(e)	Task 4--storage/trtmt projects
Totals	289,900	336,382	544,584		

(a) Assumes West Point flow set point of 440 mgd.
(b) Cost shown for Denny Way is total project budget of $120 million less $24 million City contribution and $26 million anticipated grant funding.
(c) Brown and Caldwell, "Draft Task 4 Report, Development of Alternatives," June 1994.
(d) Expands Denny project to include treatment elements for disinfection and enhanced solids removal.
(e) Achieves 100 percent control of permited CSO locations by reducing frequency of untreated discharges to one event per year or less. Annual volume reduction is about 85 percent.
(f) Inflated by the ratio of ENR Index in 1988 and 1994 or about 5500/4740.

and Henderson overflows. In addition, it was assumed that the Denny Way/Lake Union CSO Control Project would be upgraded to add elements to the storage tank in that project to enhance suspended solids removal. This is intended to bring the project to a full one event per year level of control by providing required treatment. To complete the achievement of 75 percent volume reduction, the additional projects also include the Brandon separation/storage project recommended in the predesign for Michigan.

To achieve one event per year controls, the *1988 Plan* developed a list of partial separation projects that were representative of a potential approach and costs to achieve this objective. To generate the 1995 Estimate line on Figure 4-2, alternative projects were selected from the Draft Task 4 Development of Alternatives report. These include the following:

Projects Included in One Event per Year Controls in 1995 Estimate

CSO Location	Project Description	Estimated Project Cost, $million
8th Ave S	1.0 MG storage	5.8
W. Michigan	Conveyance upgrade	0.4
Chelan	4.0 MG storage	19.0
Norfolk	0.7 MG storage	4.0
Hanford	Vortex Treatment	44.0
Lander	Vortex Treatment	30.0
King	2.2 MG storage	16.0
S. Magnolia	1.3 MG storage	6.0
Rainier @ Hanford	0.6 MG storage	3.0
Terminal 115	0.5 MG storage	3.0
Univ/Montlake total	7.5 MG storage	85.0
3rd West	5.5 MG storage	27.0
Ballard	0.4 MG storage	2.0
11th Ave W	1.7 MG storage	11.0
Alki beaches total	1.6 MG storage	17.0
North Beach	storage/pump upgrade	4.0
Total		277.2

The fifth column of Table F-1 includes the estimates of the effectiveness of each project group or phase based on use of Metro's new model. These values are used together with the subtotal costs for each group as the plotting coordinates on Figure 4-2.

Once projects are implemented to achieve the one event per year control level, overflows are expected to only occur once per year on average at each overflow location. Since there will still be overflows about once per year, there will remain an annual overflow at each location, even though the frequency has been reduced. Estimates made with Metro's new model suggest that the annual volume reduction after these one event per year projects will be approximately 85 percent of the 1981-83 baseline volume. Thus, about 400 MG of overflow can be expected each year on average after all CSO locations are controlled to the one event per year level.

METRO
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Date: August 9, 1994

From: Rob Moritz

To: Teri Flaherty
Valerie Wittwer
Gunars Sreibers
Bob Hirsch

Subj: CSO costs

Ref (a) Amendment to Agreement for Sewage Disposal between the City of Seattle and the Municipality of Metropolitan Seattle, dated Oct. 2, 1992, Subsection (7)(d)
(b) Final 1988 Combined Sewer Overflow Control Plan
(c) 1994 Appropriated Budget
(d) 1995 Proposed Appropriation
(e) Memo from Teri Flaherty dated August 1, 1994
(f) Memo from Laura Wharton dated June 30, 1994
(g) Memo from Joy Keniston-Longrie dated July 28, 1994
(g) Memo from Kathryn White dated April 3, 1994
(i) Analysis by Steve Klusman tilted "CSO Program Costs"
(j) Alki Program Worksheet, ARMS based
(k) Carkeek Program Worksheet, ARMS based

Encl: (1) CSO Costs By Project

In accordance with reference (a), Veronica Baca of the City of Seattle Drainage and Wastewater Utility requested actual and projected expenditures for Metro's CSO program. Conversations between Bob Hirsch and Veronica Baca further clarified the request.

In response to ref. (a), enclosure (1) is forwarded. All projects are wholly dedicated to CSO costs with exception of Alki, Carkeek and the Fort Lawton tunnel. The CSO costs for Alki were determined by calculating the incremental costs to transfer the CSO's to West Point or Renton facility, as per ref (i, j and k). The CSO costs for Carkeek were derived by determining the costs associated with the pump station. (Account number A71668/9) calculating 25% as the estimated CSO portion, and increasing the amount by 58% to account for allied costs. These costs were primarily the result of the pump station and transmission lines to handle the CSO's. The CSO costs associated with the Fort Lawton Tunnel were determined by calculating the percentage increase in volume needed to handle the CSO's (from 358 mgd to 440 mgd or 22.9% of total costs per ref (b)) applied to the after grant cost of $12.5 million (total cost of $24.843 million, per ref (d), less grants received of $12.295 million) for an allocated CSO cost of $2.874 million.

Accordingly, total funding on CSO projects was $50.0 million through 1993 and is forecast to be $123.8 million from 1994 through 2000, for total CSO funding of $173.8 million.

Bob Hirsch will transmit this information to Veronica.

Questions and/or comments would be most appreciated.

CSO COSTS BY PROJECT
CSO Only Projects
(In Thousands)

Project	Actuals Through 1993	1994 - 2000	Total
Denny[1]	124	89,750	89,874
Diagonal Separation	2	0	2
Hanford Tunnel	3,008	0	3,008
Kingdome Separation	3,147	4,242	7,389
CATAD/CSO	2,995	0	2,995
Lander	20,336	0	20,336
Michigan Separation	202	15,568	15,770
University Regulator	15,121	5,020	20,141
Total CSO	44,935	114,580	159,515

CSO Portions of Secondary Treatment Projects[2]

Project	Actuals Through 1993	1994 - 2000	Total
Alki	0	8,450	8,450
Carkeek	2,240	673	2,913
Fort Lawton[3]	2,874	0	2,874
Total Combined	5,114	9,123	14,237
Total CSO Funding	50,049	123,763	173,752

1 City of Seattle participation in projected Denny costs are currently being negotiated.
2 Grant funding is included
3 Fort Lawton and Hanford Tunnel data are from the 1994 Adopted budget (pg. 244) while all other data is from the 1995 proposed budget (pg. 150-1).