# Comprehensive Sediment Quality Summary Report for CSO Discharge Locations

**November 2018**

King County

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# EXECUTIVE SUMMARY

This *2018 Comprehensive Sediment Quality Summary Report* represents an update to the *2009 Comprehensive Sediment Quality Summary Report* for sediments near King County's 39 combined sewer overflow (CSO) outfalls. The 2018 report is required to be submitted to the Washington State Department of Ecology (Ecology) under Special Condition S13.C of the most recent National Pollutant Discharge Elimination System (NPDES) permit (WA0029181) renewal, effective February 1, 2015, for King County's West Point Treatment Plant.

The purpose of the 2018 report is to keep CSO sediment monitoring history information consolidated to help King County and Ecology assess the potential for sediment impacts from CSO discharges. As such, the report provides a summary of sediment quality, CSO discharge water quality, and receiving water quality monitoring data—including new site-specific information—around King County's CSO outfalls that have been collected through 2017. The report also provides information on sediment cleanup site status and monitoring plans.

The 2018 report is organized as follows:

- Section 1.0 describes the King County regional wastewater system and provides an overview of the history of the Seattle sewer system and improvements made to its infrastructure in creating the regional system.
- Sections 2.0, 3.0, 5.0, and 6.0 provide relevant CSO facility, sediment, and water quality data for the County's 39 CSOs that discharge to the Central Basin of Puget Sound, Elliott Bay, Duwamish Estuary, Lake Washington Ship Canal/Lake Union/Portage Bay, and Lake Washington, respectively.
- Section 7.0 presents a list of references cited in the report.

In addition to consolidating CSO sediment monitoring history information, the 2018 report provides new site-specific sediment quality and monitoring status information for the following outfalls:

- Brandon CSO
- Ballard CSO
- Chelan CSO
- Denny Way CSO
- Belvoir CSO
- Montlake CSO
- University Regulator CSO
- Barton Street CSO
- Murray Street CSO
- Magnolia CSO
- North Beach CSO
- 53rd Avenue Southwest CSO
- 3rd Avenue West CSO

The report also provides new site-specific discharge water quality information for the following outfalls:

- South Michigan CSO
- Dexter CSO
- Brandon CSO

# 1.0 INTRODUCTION

King County manages 39 combined sewer overflow (CSO) sites in the City of Seattle. These sites are regulated through the National Pollutant Discharge Elimination System (NPDES) permit (WA0029181) for the County's West Point Treatment Plant (West Point). In the most recent permit renewal, effective February 1, 2015, the Washington State Department of Ecology (Ecology) required submittal, by December 1, 2018, of an update to the 2009 Comprehensive Sediment Quality Summary Report (King County, 2009a) for sediments near the County's CSO outfalls. The requirement reads as follows:

> S13.C. Sediment quality summary at CSO outfalls.
> The Permittee must submit to Ecology an update to the *2009 Comprehensive Sediment Quality Summary Report* no later than December 1, 2018. The 2009 report summarizes sediment data collected at all CSO outfalls including CSO treatment plants. The purpose of this update is to keep CSO sediment monitoring history information consolidated to help King County and Ecology assess the potential for sediment impacts from CSO discharges. This update report must provide any new site-specific information including quantity and quality of the discharges, receiving water characteristics, and new knowledge about sediment quality near the CSO outfalls. The report must also include a status of sediment cleanup sites and monitoring plans.
>
> Data not previously submitted and not yet formatted and future data must be formatted in the EIM [Environmental Information Management] format.

This report provides a summary of sediment, CSO discharge water quality, and receiving water quality monitoring data around King County's CSO outfalls that have been collected through 2017 for a variety of purposes, including compliance with state sediment standards. For most CSOs, data are available to help determine whether impacts have occurred and if next steps are needed. For CSOs where sediment data have not been collected, information provided on site history, quantity and quality of discharges, and receiving water characteristics can help to determine the potential for sediment impacts.

Under state sediment standards, data that exceed the sediment criteria trigger structured administrative procedures for identifying, screening, ranking, prioritizing, and cleaning up sites with contaminated surface sediments. These more detailed assessments typically include collection of additional data and the initiation of source inventories. In complex urban areas like Seattle, where sediments reflect a variety of overlapping historical and contemporary pollution inputs, these efforts require the involvement of multiple stakeholder agencies and organizations. King County has participated in many such efforts.

Currently, plans and early remediation actions are close to completion for CSOs in the Duwamish River and its East and West Waterways. Planning for the west Lake Washington Ship Canal (ship canal) and Lake Union areas is on hold pending the availability of regulatory agency resources and funding. No planning efforts have been undertaken for the Lake Washington areas and Puget Sound shorelines. If data indicate the need for next steps, the County will proactively participate with other stakeholder entities in affected areas.

This chapter describes the King County regional wastewater system and provides an overview of the history of the Seattle sewer system and improvements made to its infrastructure by Metro (later King County) in creating the regional system. Maps of the system as it existed in 1958, just before Metro assumed responsibility, and updated versions of these maps that show current conditions are provided at the end of the chapter. The chapter also describes the stages of the County's CSO control efforts, including the monitoring of CSO overflow quality and sediments in response to changing regulations and program needs.

## 1.1 Description of the Regional Wastewater System

King County's wastewater system is the largest in the state. The system includes three large regional treatment plants (West Point in the City of Seattle, South Treatment Plant [South Plant] in the City of Renton, and Brightwater Treatment Plant [Brightwater] in unincorporated Snohomish County); one small treatment plant and one community septic system (Beulah Park and Cove) on Vashon Island; one small treatment plant in Carnation; four CSO wet weather treatment stations (Alki, Carkeek, Mercer/Elliott West, and Henderson/Martin Luther King [MLK] Jr. Way—all in the City of Seattle); over 391 miles of pipes; 25 regulator stations; 47 pump stations; and 39 CSO outfalls. The West Point, South, Brightwater, Vashon, and Carnation treatment plants provide secondary treatment; the CSO treatment facilities provide CSO treatment (equivalent to primary treatment). Four treatment plants and three of the wet weather treatment stations discharge treated and disinfected effluent to Puget Sound; the Carnation plant discharges to a wetland, but can optionally discharge to the Snoqualmie River. The Henderson/MLK facility discharges to the lower Duwamish Waterway.

There are two types of sewer systems in the King County wastewater service area: separated and combined. In separated systems, different pipes carry stormwater and wastewater. In combined systems, the same pipes carry both stormwater and wastewater. In the late 1890s and the early 1900s, when the first sewers were constructed in Seattle, combined sewers were common practice. Until the early 1940s, nearly all sewers constructed in the city were combined sewers. Approximately 41,000 acres of the 55,000 acres in Seattle are served by combined or partially separated sewers. Areas outside of Seattle are served by separated sewers.

King County's wastewater system is managed to send as much flow as possible to secondary treatment plants, to send additional flow to CSO treatment facilities, and to discharge untreated flow only as a last resort to avoid backups into residential basements and streets. During heavy rainstorms when sewers are full, untreated wastewater and stormwater in combined sewers discharge directly from CSO outfall pipes into marine waters, lakes, and rivers (Figure 1-1). These untreated discharges occur in three ways:

- Pump stations overflow to protect the stations from flood damage.
- Regulator stations control the volume of flow entering main interceptors from the local system; flows greater than the capacity of an interceptor will overflow.
- Weirs located in pipes allow for passive overflows when flow reaches the level of the weir; flows greater than the capacity of the pipe will overflow.


**Figure 1-1. King County CSO Locations**

## 1.2 History of the Seattle Sewer System

The aquatic sediments of the Seattle area tell the story of the history of the city, most notably its population growth and industrial development. A component of that story is the development of the urban wastewater system.

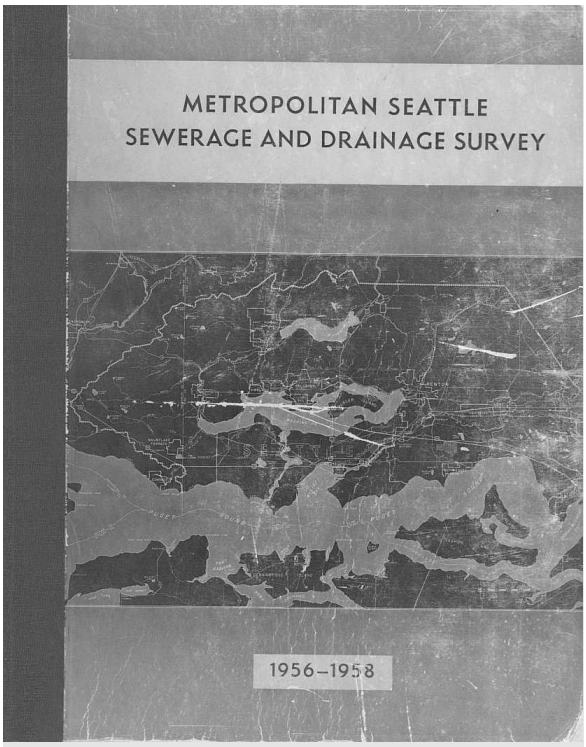
The community was incorporated by the territorial legislature in 1865 when its population was approximately 300. To manage the waste generated by this population, a board of public works undertook construction of the first sewers. These sewers were wooden troughs, or boxes, that carried wastes to the most convenient nearby water bodies—Elliott Bay and Lake Union. Organized planning and construction of sewers began in 1875, and the first permanent sewer, running from Fifth Avenue along Madison Street to Elliott Bay, was constructed in 1882. As time passed, water pollution rapidly increased to the extent that the design of a larger sewer system was warranted.

Conflicting plans called for separated sewers (1889, Waring Report) and combined sewers (1891, the Williams Report) (Brown and Caldwell, 1958). Both reports called for construction of a large tunnel (later called the Lake Union Tunnel) to carry wastes from the Lake Union area to Elliott Bay. The combined sewer approach was selected, and the first three systems were built to move wastewater from fresh waters to mixed salt waters. The three systems were the Lake Union Tunnel system that discharged to Elliott Bay, most of the North Trunk that discharged to Puget Sound off West Point, and the Beacon Hill Tunnel system that discharged to the Duwamish River. A sewer system for the Ballard area that discharged to Salmon Bay was built in 1904 and was connected to the North Trunk by the Ballard Siphon in 1935. Three combined sewage treatment plants were constructed in 1924 along the eastern edge of Seattle on Lake Washington at Perry Street, Alaska Street, and Massachusetts Avenue.

As concern for the protection of Lake Washington as a drinking water source increased, interceptors were built in the 1930s along the lake, which eliminated the need for the three plants and stopped all discharge of dry-weather flows. Approximately 30 outfalls continued to discharge storm-based flows to the lake. The Lake Washington interceptors were (1) a north section with pump stations to lift wastewater into the North Trunk system; (2) a central section with pumps to lift the flow into the Beacon Hill Tunnel system; and (3) a south section with pumps to lift flow to a new Henderson Street system. Concern for the protection of the Duwamish River also led to decisions to intercept sewers for transport to a new treatment facility where Diagonal Avenue ends on the east side of the river to manage both the Henderson and Duwamish flows. The Diagonal Way Treatment Plant, intended to treat only dry-weather flow, was completed in 1940. Overflows of storm-based flows continued in Lake Washington and the Duwamish River.

These efforts, however, did not keep up with growth and pollution. As the volume of raw sewage and the number of points of discharge increased, state and local health authorities, the Pollution Control Commission, and state and local agencies interested in water resources expressed increasing concern. More studies ensued, funding votes failed, and conflicting plans were developed. In 1956, the Pollution Control Commission established a policy to correct the discharge condition. The City of Seattle hired the engineering firm Brown and Caldwell to perform a comprehensive survey of metropolitan sewerage systems and needs. Financial participation by Washington State and King County was also negotiated.

The Metropolitan Seattle Sewerage and Drainage Survey (March 1958) became the foundation for a new regional municipal corporation called the Municipality of Metropolitan Seattle (Metro). Metro was empowered to plan, finance, and administer wastewater services. The survey provided a thorough baseline snapshot of conditions existing at the start of Metro's responsibilities, and its recommended plan became the approved Metro comprehensive sewerage plan.[1]




*The Metropolitan Seattle Sewerage and Drainage Survey became the foundation for a new regional metropolitan municipal corporation called Metro.*

Metro assumed ownership and responsibility for regional facilities in 1962. In Seattle, regional facilities, including CSOs, were defined as those beginning at the confluence of the drainage of 1,000 acres or more. Metro's responsibility was to provide wholesale conveyance and treatment to the local agencies, who retained responsibility for their local systems and the primary retail relationship with customers. The City of Seattle retained responsibility for CSOs in drainage areas less than 1,000 acres. Figures 1-2 through 1-21 (located in Section 1.6) show the 1958 baseline sewer system and updated versions of the same areas to show current conditions.

In subsequent years, Metro built conveyance facilities to new treatment plants and decommissioned old plants. To provide storm relief, CSOs remained at the intersections of the old raw sewage outfalls and the new interceptors and from pump stations; however, the dry-weather wastewater and the vast majority of storm-related flows were captured for treatment. Once the regional system was completed, work began to reduce CSOs. Metro also implemented an industrial pretreatment program and intercepted all industrial process water discharges that had previously gone to local waters.

Metro was designated the Clean Water Act Section 208 regional watershed planning agency in the late 1970s, and has since participated in collaborative water quality assessments and restorations. As the quality of the regional water column improved, attention shifted to sediment quality. In compliance with Chapter 173-245 of the Washington Administrative Code (WAC), Metro characterized the CSO discharges and sediments off the outfalls in the West Point system between 1988 and 1994.

Since 1994, when King County assumed Metro's responsibilities for regional wastewater management, sediment characterization has expanded to comply with the new Sediment Management Standards (SMS). King County published a sediment management plan in 1999 (King County, 1999); participates in collaborative sediment restoration efforts, including the Elliott Bay/Duwamish Restoration Program and the Lower Duwamish Waterway and Harbor

[1] The plan can be found at https://www.kingcounty.gov/depts/dnrp/wtd/about/history/1958-plan.aspx.

Island East Waterway Superfund initiatives; and is poised to participate in other efforts as they become regional priorities.

The sediments near CSOs reflect the legacy of the development of Seattle as a major urban and industrial area. Metro and King County's contributions since the 1960s have been to capture the majority of discharges to these sites, limit chemical components, steadily reduce the remaining CSO discharges, and implement several sediment remediations.

King County is committed to participating in any necessary sediment cleanups in partnership with the other entities that have contributed to the contamination of the sediments and/or have a stake in their restoration.

CSO-Related Studies, 1958–2000

1958 *Metropolitan Seattle Wastewater and Drainage Study* recommended sewer separation and storage, as needed, to control CSOs as part of a larger schedule of projects.

1978 Area wide Section 208 Water Quality Plan recommended sewer separation and storage, as needed, to control overflows.

1979–1984 *Toxicant Pretreatment Planning Study* recommended that CSO control be part of a coordinated Elliott Bay Action Plan and that source control, including enhancement of Metro's pretreatment program, should be a priority.

1983 *Water Quality Assessment of the Duwamish Estuary* identified CSOs as a minor contributor to the larger pollution problem and CSO control as one part of the solution.

1988 *Elliott Bay Action Plan* recommended elimination of direct industrial discharges into the bay and implementation of stormwater source control to improve CSO quality; set Denny Way and Michigan Street as priorities for CSO control.

1988–1996 Metro Receiving Water Monitoring Program affirmed that CSOs were not a major part of larger wet-weather problems and that CSO control would not yield the largest benefit to water quality.

1988–1997 Metro/King County CSO Discharge and Sediment Quality Characterization affirmed the Denny Way CSO as a priority for control based on pollutant concentrations.

1999 *CSO Water Quality Assessment of the Duwamish River and Elliott Bay* recommended continuation of CSO control to meet state regulations and helped set control priorities.

*1999 Sediment Management Plan* recommended that sediment remediation at CSO sites proceed ahead of CSO control because most contamination was from historical inputs.

*2017 Water Quality Assessment and Monitoring Study (WQA/MS)* is a comprehensive overview of water quality in Elliott Bay, Lake Union, the ship canal, and the Duwamish Estuary. A key finding is that some long-term water quality trends show improvements—even as the Puget Sound Region has grown. An important takeaway is that water quality investments in the region over the last 40 years have paid off.

*2018 Sediment Management Plan Update* describes all of the CSO discharge locations, summarizes ongoing and previously performed sediment cleanup work and the results of CSO discharge modeling, provides the status of existing sediment quality, and assigns an appropriate sediment management strategy for each CSO.

## 1.3 History of King County CSO Control Planning

Since the 1970s, Metro and its successor, King County, have been implementing CSO control projects to improve water quality in the Seattle area. King County does this under a CSO control plan that is amended or updated with each renewal of West Point's NPDES permit. Before each CSO control plan update, the County reviews the plan and progress made toward CSO control and compares its existing program against conditions that may have changed since the last update (e.g., flow patterns, scientific developments, changed regulations, new technologies, and public priorities). Significant changes may require adjustment of the CSO control plan and, potentially, the consent decree (CD).

Metro first formalized CSO control with the development of the 1979 CSO Control Program, which was initiated in cooperation with the U.S. Environmental Protection Association (EPA) and the City of Seattle. The 1979 program identified nine Metro projects to reduce the number of CSO events into fresh water (Lake Washington, Lake Union, and the ship canal). In 1985, the Washington State Water Pollution Control Act (Chapter 90.48 Revised Code of Washington [RCW]) introduced new regulations that required all municipalities with CSOs to develop plans for "the greatest reasonable reduction at the earliest possible date." Metro prepared the 1986 Final Supplemental Plan for Secondary Treatment Facilities and Combined Sewer Overflow Control (1986 Plan) to meet this requirement.

Before the 1986 Plan could be implemented, Ecology promulgated new regulations (WAC 173-245-020) that defined "greatest reasonable reduction" to mean "control of each CSO such that an average of one untreated discharge may occur per year." Metro worked with Ecology to develop an interim goal of 75 percent reduction of CSO volumes system-wide by the end of 2005. Metro's Final 1988 Combined Sewer Overflow Control Plan (1988 Plan) identified 11 CSO control projects designed to meet this interim goal.

King County took over responsibility for operating and maintaining the regional wastewater system from Metro in 1994. As part of the 1995 NPDES permit renewal for West Point, King County prepared an update and amendment to the 1988 Plan. The 1995 CSO Control Plan Update assessed the effectiveness of CSO reduction efforts to date, reevaluated priorities for control of CSO sites, and identified three control projects for completion between 1995 and 2000.

In the late 1990s, King County developed a major update to its comprehensive sewerage plan, including both the combined and separated systems, called the 1999 Regional Wastewater Services Plan (RWSP). During that period, Ecology agreed to discontinue the 75 percent volume reduction interim target for County CSO control to allow prioritization of control projects according to public health and environmental benefit rather than volume. The final RWSP adopted by the King County Council in 1999 included a revision to the 1995 Plan Update that consisted of 21 control projects to complete system control by 2030. The revision was included with the June 2000 submission of the West Point NPDES permit renewal application as the Year 2000 CSO Control Plan Update.

The 2000 Plan Update described King County's progress in CSO control, documented its compliance with CSO control requirements, and identified two large control projects—Denny Way/Lake Union and Henderson/MLK/Norfolk CSO control projects—for completion in the next five-year NPDES permit cycle. The resulting wet weather treatment stations—Elliott West WWTS/Mercer St. Treatment Tunnel and Henderson/MLK WWTS—came online in spring 2005.

In the RWSP, the King County Council called for review of the County's CSO Control Program ahead of the NPDES permit renewal application and an update to the 2000 Plan Update that was due in 2005. Issuance of the NPDES permit took longer than expected, pushing back the due date for the next application to 2008. King County completed the review in 2006 as the basis for the 2008 CSO Control Plan Update, which was then submitted as a part of the NPDES permit renewal application in 2008.

The 2008 Plan Update described the County's wastewater system, control status of its CSOs, and overall progress toward CSO control; how the County met EPA's Nine Minimum Controls; and summarized the scientific studies that have shaped the control program over time. The 2008 Plan Update also described planned, in-progress, and completed CSO control projects. No changes to the 1999 RWSP CSO Control Plan were recommended and King County committed to implementing the first four of the RWSP CSO projects: Barton Street, Murray Avenue, South Magnolia, and North Beach, collectively known as the "Puget Sound Beach Projects."

In 2012, the County completed a three-year review of the CSO Control Program. The 2012 Long-term Control Plan Amendment (2012 LTCP) was approved by the King County Council in September 2012. The 2012 LTCP was submitted to Ecology and EPA on November 20, 2012.

On July 3, 2013, a CD, Civil Action No. 2:13-cv-677, between the U.S. Department of Justice, EPA, Ecology, and King County was finalized. Section VIII of the CD requires submittal of an annual report detailing implementation of the CD. With agreement from EPA and Ecology, beginning with the 2014 annual report, the CSO and CD annual reports were consolidated into one report. This annual report meets the CD, WAC, and NPDES requirements.

The approved projects in the 2012 LTCP emerged from an evaluation of new conditions, opportunities, science, regulations, and community input since the last major CSO plan update in 1999. Project alternatives were developed for all uncontrolled CSOs to determine which were the most cost-effective.

The approved 2012 LTCP is the County's current plan to construct nine projects to control 14 CSOs by the end of 2030. King County will conduct green stormwater infrastructure (GSI) early, ahead of traditional CSO control projects, for four projects, to reduce the size of the gray infrastructure needed to control CSOs.

The King County Council also approved a plan to complete a water quality assessment and monitoring study (WQA/MS) ahead of the next update of the LTCP. The purpose of the study was to ensure that future CSO projects to control pollution are well planned and timed to improve water quality in Elliott Bay, the Duwamish River, and the ship canal. The study was intended to confirm or identify possible adjustments in the sequence and schedule of future CSO projects, look at other planned water quality projects, and consider findings as part of a potential Integrated Plan proposal. The recommendation for this study emerged through conversations with stakeholders and the public asking that CSO control be evaluated more fully, along with

other water quality improvement programs in the region. The WQA/MS is discussed further in Section 1.2.3, Water Quality Assessment/Monitoring Study.

In 2015, King County began a comprehensive update of the CSO Control Program and the 2012 LTCP approved in 2013. Approximately every five years, updates are required by WAC 173-245-090, West Point's NPDES permit, and King County Code 28.86.080. The resulting 2019 CSO Plan Update will be submitted to Ecology and EPA with the next West Point NPDES permit renewal application, due in January 2019.

In the 2019 CSO Plan Update, WTD conducted analyses of the remaining uncontrolled CSO locations where projects are not already being implemented, including an evaluation of the CSO control projects identified in the 2012 LTCP. New modeling and flow information have been obtained since the 2012 LTCP was completed. This information, along with additional options for collaboration with Seattle Public Utilities (SPU), will inform the 2019 CSO Plan Update.

At this time, King County is not recommending any significant changes to the 2012 LTCP. Any updated information on the alternatives identified in the 2012 LTCP will be in the 2019 CSO Plan Update that will be submitted to Ecology and EPA by January 31, 2019.

## 1.4 History of King County CSO Sediment Management Program—Monitoring and Data

The following chronology describes the evolution of King County's Sediment Management Program and its interaction with CSO control decisions.

In the early 1980s, Metro performed overflow and sediment sampling at selected CSO sites to characterize CSO impacts for CSO planning and control projects. Later, in response to new Chapter 173-245 WAC requirements, Metro expanded its monitoring to characterize the CSOs. Data were submitted in CSO control plan updates and project facility plans.

WAC 173-245-040(2) states:

> (2) CSO reduction plans shall include the following information together with any other relevant data as requested by the department.
>
> (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 CSOs. Monitoring and sampling at one or more CSO sites in a group that are in close proximity to one another is sufficient if the municipality can establish a consistent hydraulic and pollutant correlation between or among the group of CSO sites. Sampling may not be required for CSO sites that serve residential basins; and
>
> (ii) Developing a rainfall/stormwater runoff/CSO model to simulate each CSO site's activity; and

> (iii) Verifying the model's accuracy with data collected under (a)(i) of this subsection; and
>
> (iv) In circumstances where an historical impact may be discernible, observing and sampling the receiving water sediments adjacent to each CSO site or group of sites to establish the presence and extent of any bottom deposits; and
>
> (v) If the sewer service area upstream of a CSO site includes sanitary sewer sources other than domestic sewage, samples of the sediment deposits shall receive heavy metal analysis and organic pollutant screening. Pending review of results of these analyses, the department may require additional pollutant analyses. If two or more CSO sites serve the same industrial/commercial sources, sediment sampling adjacent to one representative CSO site may suffice.

Metro submitted a monitoring plan on December 8, 1988; the plan was verbally approved by Gary Anderson of Ecology on January 4, 1989. The monitoring plan laid out systematic sampling of overflow quality and sediments in front of the active West Point system outfalls. Ecology described the purpose of this monitoring as a one-time characterization to identify control priorities around which the CSO control plan would be developed. At that time, the sewer systems for the Carkeek and Alki treatment plants had not yet been connected to the West Point system. They were independent systems with their own NPDES permits that did not include requirements to characterize CSOs and develop control plans. Because the plants served residential areas with only light commercial development, sampling of CSOs from their outfalls was not done.

The CSO monitoring plan was implemented and completed in 1995. The results affirmed that the sediments around CSOs were of concern. The only location that stood out as needing early action was the Denny Way CSO. It was decided that the monitoring data would not determine the order and timing of the remaining control projects in the control plan and that other priorities would be considered.

In 1990, the SMS (Chapter 173-204 WAC) were established. The sediment standards provide "the basis for management and reduction of pollutant discharges" and a "management and decision process for the cleanup of contaminated sediments." They establish "administrative procedural requirements and criteria to identify, screen, rank and prioritize, and clean up contaminated surface sediment sites." In response to the standards, Metro proposed a comprehensive plan to structure the sampling according to the new protocols, perform any needed bioassays, model the discharge impact zones, and apply for sediment impact zones, as needed. Ecology determined that it was too early to implement such a plan. King County submitted a sediment sampling plan to Ecology on October 31, 1994, and updated it on January 31, 1995. The plan was also included in the NPDES permit renewal application for West Point in June 1995. Implementation of the plan was completed in 1997.

Also in 1990, Metro and the City of Seattle signed a CD to settle natural resource damage claims in Elliott Bay and the Duwamish River regarding releases from storm drains and CSOs. Metro was a member of the Elliott Bay/Duwamish Restoration Panel formed to implement the settlement. In 1994, a concept document was prepared that reviewed all available information and prioritized sediment remediation sites based on several factors. Three sites were initially selected for sediment cleanup. Two of these sites were near Metro CSOs at Diagonal/Duwamish and Norfolk; both of these sites also had considerable storm drain input.

In 1991, Metro implemented the Denny Way Capping Project. Ten years of post-remediation monitoring were completed to identify any migration of contaminants through the cap and any recontamination on the cap surface. No migration was found, and despite the continuing overflows from the Denny Way RS, limited recontamination was seen. Data were submitted when collected and interpreted in reports.

In 1999, King County implemented a comprehensive study, *CSO Water Quality Assessment of the Duwamish River and Elliott Bay* (1999, WQA), to better understand CSO impacts in relation to other sources and to establish science-based control priorities.[2] The study determined that contamination near CSOs was primarily from historical inputs from raw sewage outfalls and industrial discharges. Little ongoing sediment contamination appeared to be occurring from CSOs. Industrial pretreatment controls, water softening, and the high proportion of combined sewage capture were controlling most current CSO sources. The study identified risks to sediment-dwelling organisms from organic enrichment in the immediate vicinity of CSOs and possibly from 1,4-dichlorobenzene (commonly used in urinal cakes) and bis(2-ethylhexyl) phthalate (ubiquitous in the environment).

As the findings of the 1999 WQA were emerging and as a result of conversations with Ecology, King County developed and published its 1999 Sediment Management Plan (1999 SMP). The plan focused on marine areas for which SMS had been developed and on Ecology contaminated-site-listed areas in the Duwamish River and Elliott Bay. It reaffirmed the 1999 WQA findings that uncontrolled CSOs were not expected to recontaminate sediments, except at the Denny Way CSO (controlled later in 2005), the Brandon St. RS Overflow (above the lead cleanup screening level [CSL]), all sites above the CSL for bis(2-ethylhexyl) phthalate, and all sites above sediment quality standards (SQS) for chrysene (a polycyclic aromatic hydrocarbon [PAH]).[3]

The sediment management plan proposed a list of remediation projects, with schedules and budgets. It also recognized that the EFDC model used for the 1999 WQA and 1999 SMP was a "far-field model" with poor resolution near the outfall and that a near-field model needed to be developed.[4] Initial development of the near-field model was completed in 2011. The sediment management plan also recommended that a regional approach to solving the area-wide phthalate contamination problem be developed. Ecology coordinated a work group composed of agencies and stakeholders and, in 2007, published recommendations that acknowledged the recontamination problem caused by ubiquitous sources and identified regulatory changes to address.

The findings of the 1999 WQA and sediment management plan led King County to decide that remediation actions should move forward ahead of CSO control. Historical contamination was thought to present a greater risk than contamination from current CSOs and, therefore, it was determined that remediation should not be delayed while the slower CSO control projects were implemented. If any recontamination occurred between remediation and CSO control, the County understood it would have to be addressed.

[2] The 1999 WQA can be found at http://www.kingcounty.gov/environment/wastewater/CSO/Library/WaterQuality.aspx.
[3] The 1999 SMP can be found at https://www.kingcounty.gov/services/environment/wastewater/sediment-management/plan.aspx.
[4] EFDC = Environmental Fluids Dynamic Computer Code

King County sampled freshwater sediments in lakes Sammamish, Washington, and Union between 1999 and 2001 as part of the Sammamish Washington Assessment and Modeling Program (SWAMP). SWAMP was designed to provide water quality and quantity resource information to County decision-makers as they implemented the RWSP. Extensive sediment and water column data were collected and used, along with existing data, in hydrodynamic, fate, and transport modeling. The models simulated various water use and reuse options and compared predicted sediment and water quality under these options to baseline conditions. Model results were also used to conduct various ecological and human health risk assessments. As part of the SWAMP sediment sampling effort, surface sediments were collected and analyzed from areas near many of King County's freshwater CSOs in Lake Washington.

In the late 1990s, King County recognized that total maximum daily loads (TMDLs) would eventually be required for SMS violations and began discussing the need for a sediment-specific TMDL methodology with Ecology. Ecology proposed a joint project with the County, contributing a staff person whose salary was to be paid by both agencies. The staff person worked with both agencies and other interested parties. The Bellingham Bay cleanup was used as the vehicle to develop a model sediment TMDL. EPA subsequently approved this TMDL.

Abbreviations and Acronyms for CSO Infrastructure Names

| | |
|---|---|
| Ave. | Avenue |
| E | East |
| N | North |
| NE | Northeast |
| NW | Northwest |
| PS | Pump Station |
| RS | Regulator Station |
| S | South |
| SE | Southeast |
| St. | Street |
| SW | Southwest |
| W | West |
| WWTS | Wet Weather Treatment Station |

Discussions of a TMDL with the Port of Seattle, the City of Seattle, Boeing, and Ecology evolved into planning for the Lower Duwamish Waterway. EPA had proposed development of a non-Superfund approach to cleaning up the waterway. The approach focused on early actions at known "hot spots." Two of these spots were associated with County CSOs: Norfolk (already remediated at that time) and Diagonal/Duwamish. The County, City of Seattle, Port of Seattle, and Boeing, along with EPA and Ecology, signed an Administrative Order of Consent in December 2000 to carry out the remedial investigation and feasibility study of the Lower Duwamish Waterway. The area was listed as a Superfund site in 2001. The remedial investigation, summarizing recent data and characterizing the nature and extent of contamination was published in 2012 (AECOM, 2012); and the feasibility study laying out the cleanup alternatives was published in 2010 (Windward, 2010). EPA published its record of decision for the selected cleanup plan in 2014 (EPA, 2014).

Sediments near 10 active King County CSOs and one wet weather treatment facility are being addressed under the Lower Duwamish Waterway Superfund/Washington State Model Toxics Control Act:

- Norfolk St. Overflow (remediation completed in 1999)
- Henderson/MLK Outfall (remediation completed in 1999)
- Brandon St. RS Overflow
- 8th Ave. S RS Overflow

- S Michigan RS Overflow
- W Michigan RS Overflow
- E Marginal Way PS Overflow (has never overflowed)
- Terminal 115 Overflow
- Hanford #1 Overflow (Duwamish/Diagonal remediation completed in 2005)
- Duwamish PS Overflow (Duwamish/Diagonal remediation completed in 2005)
- W Duwamish Overflow

The County's Norfolk St. Overflow, along with several City of Seattle and Boeing storm drains and the Henderson/MLK WWTS outfall, were remediated under the Elliott Bay/Duwamish Restoration Program in 1999. A five-year post-remediation sampling plan was completed in 2007. Early monitoring results suggested that erosion of unremediated shoreline areas was recontaminating the site. Another area was remediated to address the recontamination. The Norfolk St. Overflow was controlled in 2005 and the Henderson/MLK WWTS was completed in 2005. Sediment data were submitted to Ecology in the various planning reports and were added to SEDQUAL/EIM.[5]

In 2005, King County completed a remediation of the Duwamish/Diagonal site, also under the Elliott Bay/Duwamish Restoration Program. A 10-year post-remediation sampling program was completed in 2013. Concentrations of polychlorinated biphenyls (PCBs) increased to near SQS levels, but only occasionally exceeded them. Phthalate concentrations near the outfall have exceeded the SQS. All data are submitted to Ecology as they are collected and are available on the County's website and in SEDQUAL/EIM.[6]

Following completion of the Denny Way CSO control project in 2005 (Denny RS Overflow and Elliott West Outfall), a Phase 2 remediation of nearshore areas around the old outfall was implemented. The remediation was completed in early 2008, followed by a six-year post-remediation monitoring program. The need for a third phase of remediation will be assessed based on that monitoring. All data are submitted as they are collected and are available on both the County's website and in SEDQUAL/EIM.[7]

Remediation of the area near the Hanford and Lander CSOs is currently occurring under the Harbor Island East and West Waterway Superfund effort. The Harbor and Chelan CSOs are also in this Superfund area.

Of the eight sites listed in the County's sediment management plan, three have been remediated (Norfolk [Norfolk RS/Henderson/MLK], Duwamish [Duwamish PS/East Siphon], and Denny Way [Denny RS/Elliott West]). Data suggest that remediation at one site may not be needed (Chelan Ave. RS), and remediation at one site was completed by the Port of Seattle (Lander St. RS). The area near the County's King Street CSO remains to be completed, pending decision by the Washington State Department of Transportation (WSDOT) to move forward in remediating

[5] Data are available at https://www.kingcounty.gov/services/environment/wastewater/sediment-management/projects/Norfolk.aspx.
[6] Data are available at https://www.kingcounty.gov/services/environment/wastewater/sediment-management/projects/DuDi.aspx.
[7] Data are available at https://www.kingcounty.gov/services/environment/wastewater/sediment-management/projects/DennyWay.aspx.

the area near their Coleman Dock terminal. The remaining two sites will be remediated through the Lower Duwamish and East Waterway Superfund cleanup process (Hanford #2 RS and Brandon St. RS). Long-term monitoring is being conducted at Denny RS/Elliott West to determine if any further action will be needed.

In 2018, the County has completed an update to its 1999 SMP that identifies appropriate sediment management strategies adjacent to each remaining King County CSO outfall location.[8] Additional sampling and modeling using the completed near-field model were used to characterize sediment quality at all County CSOs. The 2018 Sediment Management Plan Update identifies one additional site that will require remediation— University RS Overflow—and outlines the schedule for next actions.

Five CSOs located in highly developed areas in ship canal/Lake Union are also identified that require further scrutiny when a site-wide investigation is conducted:

- Ballard Siphon Overflow
- 11th Ave. NW Overflow
- 3rd Ave. W Overflow
- Canal St. Overflow
- Dexter Ave. RS Overflow

At these sites, sediment chemical concentrations are elevated throughout the area from multiple pathways and potential sources. A coordinated multi-agency planning group, called the Lake Union Action Team, was initiated in the mid-1990s to evaluate contaminated sediments in Lake Union and areas of the ship canal and to develop an action plan. This process was suspended in the mid-2000s until regulatory agency funding and resources become available. King County recommends that further investigation be done under pending coordinated multi-agency and potential liable party efforts under one site-wide investigation.

| King County CSOs, Wet Weather Treatment Stations, and Receiving Waters | |
|---|---|
| 11th Ave. NW Weir | Ship canal |
| 30th Ave. NE PS | Union Bay |
| 3rd Ave. W RS | Ship canal |
| 53rd Ave. SW PS Bypass | Puget Sound |
| 63rd Ave. PS Bypass | Puget Sound |
| 8th Ave. RS Bypass | Duwamish Waterway |
| SW Alaska St. Weir | Puget Sound |
| Alki Outfall | Puget Sound |
| Ballard RS | Ship canal |
| Barton St. PS Bypass | Puget Sound |
| Belvoir PS Bypass | Uniion Bay |
| Brandon St. RS | Duwamish Waterway |
| Canal St. Weir | Ship canal |
| Carkeek Outfall | Puget Sound |
| Chelan Ave. RS | Duwamish Waterway |
| Kingdome/Connecticut RS | Elliott Bay |
| Denny Way RS | Elliott Bay |
| Dexter Ave. RS | Lake Union |
| Duwamish Siphon W | Duwamish Waterway |
| Duwamish PS Bypass/Siphon E | Duwamish Waterway |
| Elliott West Oufall | Elliott Bay |
| Hanford #1 RS (Hanford at Rainier) | Lake Washington |
| Hanford #2 RS | Duwamish Waterway |
| Harbor Ave. RS | Elliott Bay |
| Henderson PS Bypass | Lake Washington |
| Henderson/MLK Outfall | Duwamish Waterway |
| King St. RS | Elliott Bay |
| Lander II St. RS | Duwamish Waterway |
| S Magnolia Weir | Puget Sound |
| E Marginal Way PS Bypass | Duwamish Waterway |
| Matthews Park PS Bypass | Lake Washington |
| S Michigan St. RS | Duwamish Waterway |
| W Michigan St. RS | Duwamish Waterway |
| MLK Jr. Way Weir | Lake Washington |
| Montlake RS | Ship canal |
| Murray PS Bypass | Puget Sound |
| Norfolk St. RS | Duwamish Waterway |
| North Beach PS Bypass | Puget Sound |
| North Beach PS Inlet | Puget Sound |
| E Pine St. PS Bypass | Lake Washington |
| Rainier Ave. PS Bypass | Lake Washington |
| Terminal 115 Weir | Duwamish Waterway |
| University RS | Ship canal |

[8] Information on King County's Sediment Management Program, including the 2018 Sediment Management Plan Update, can be found at http://www.kingcounty.gov/environment/wastewater/SedimentManagement.aspx.

Six CSOs are identified as needing additional monitoring to determine if these sites could generate SMS exceedances that would require a hazard assessment and cleanup site identification, if needed:

- North Beach PS Inlet Overflow
- Barton St. PS Overflow
- Kingdome RS Overflow
- Chelan Ave. RS Overflow
- MLK Jr. Way Overflow and Henderson St. PS Overflow (two co-located overflows)

At these sites, there is a lack of or conflicting data (e.g., between historic samples and modeling) that leave uncertainty in the current characterization. None of these sites appears to require immediate action.

Thirteen CSOs and two wet weather treatment facilities are identified for no further action because the sediments already comply with the SMS:

- Carkeek Outfall
- North Beach PS Wet Well Overflow
- S Magnolia Overflow
- 53rd Ave. SW PS Overflow
- Alki Outfall
- 63rd Ave. SW Overflow
- SW Alaska St. Overflow
- Murray Ave. PS Overflow
- Harbor RS Overflow
- Montlake RS Overflow
- Matthews Park PS Overflow
- Belvoir PS Overflow
- 30th Ave. NE Overflow
- E Pine St. PS Overflow
- Rainier Ave. PS Overflow

## 1.5 Organization of this Report

King County CSO outfalls are located in five distinct water bodies: the Central Basin of Puget Sound, Elliott Bay, the Duwamish River, the Ship Canal/Lake Union/Portage Bay system, and Lake Washington. To facilitate discussion of receiving water characteristics, this report is organized by these five water bodies. Although Elliott Bay is located in the Central Basin, Elliott Bay is discussed separately because of its unique characteristics.

King County is providing descriptions of each water body based on its understanding of the conditions under which it plans its CSO control and sediment management programs. The descriptions are not exhaustive or complete. Many other entities are studying these water bodies and developing various kinds of data to contribute to the greater understanding of the water body. The following entities also collect information on these water bodies:

- U.S. Geological Survey
- United States Navy
- National Oceanic and Atmospheric Administration
- Muckleshoot Indian Tribe
- Suquamish Tribe
- Tulalip Tribes
- Washington State Department of Ecology
- Washington State Department of Fish and Wildlife
- Washington State Department of Natural Resources
- Puget Sound Partnership
- University of Washington
- Washington State University
- King County Department of Natural Resources and Parks, Water and Land Resources Division

After describing the water body, each chapter provides the following information for each CSO that discharges to the water body: the 1958 baseline facilities, discharge location and outfall characteristics, the baseline overflow and frequency set in 1983 at the start of post-regional system CSO control planning, current overflow quantity and frequency, control project history, CSO effluent quality monitoring, post-construction monitoring, sediment sampling information, and sediment remediation activity. Two maps are provided for each CSO: one showing the location of the CSO outfall in relation to any known stormwater outfalls and one showing sediment sampling locations. Photographs of the CSO vicinity are also included.

Information on known outfalls not managed by King County is included to provide context for the County's approach to CSO control and sediment management. The information was taken from the City of Seattle's geographic information system (the completeness and accuracy of the data were not verified). The quantities or qualities of the discharges are not included. Ecology's databases of reported information under other regulatory programs, such as stormwater NPDES, contain the most complete and current information.

## 1.6 Sewer System Maps

Figures 1-2 through 1-21 show the 1958 baseline sewer system and updated versions of the same areas.

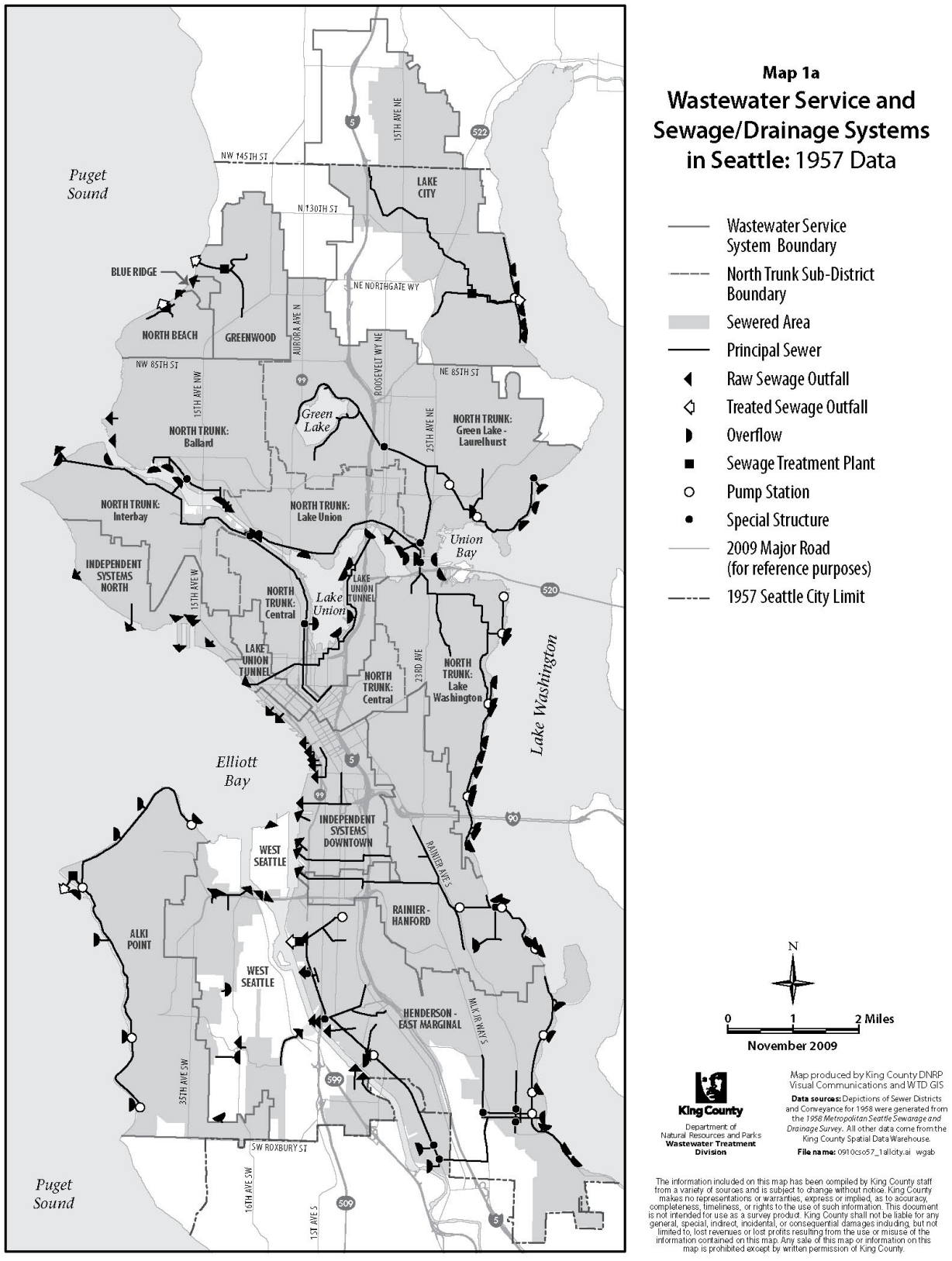



**Figure 1-2. Wastewater Service and Sewage/Drainage Systems in Seattle: 1957 Data**

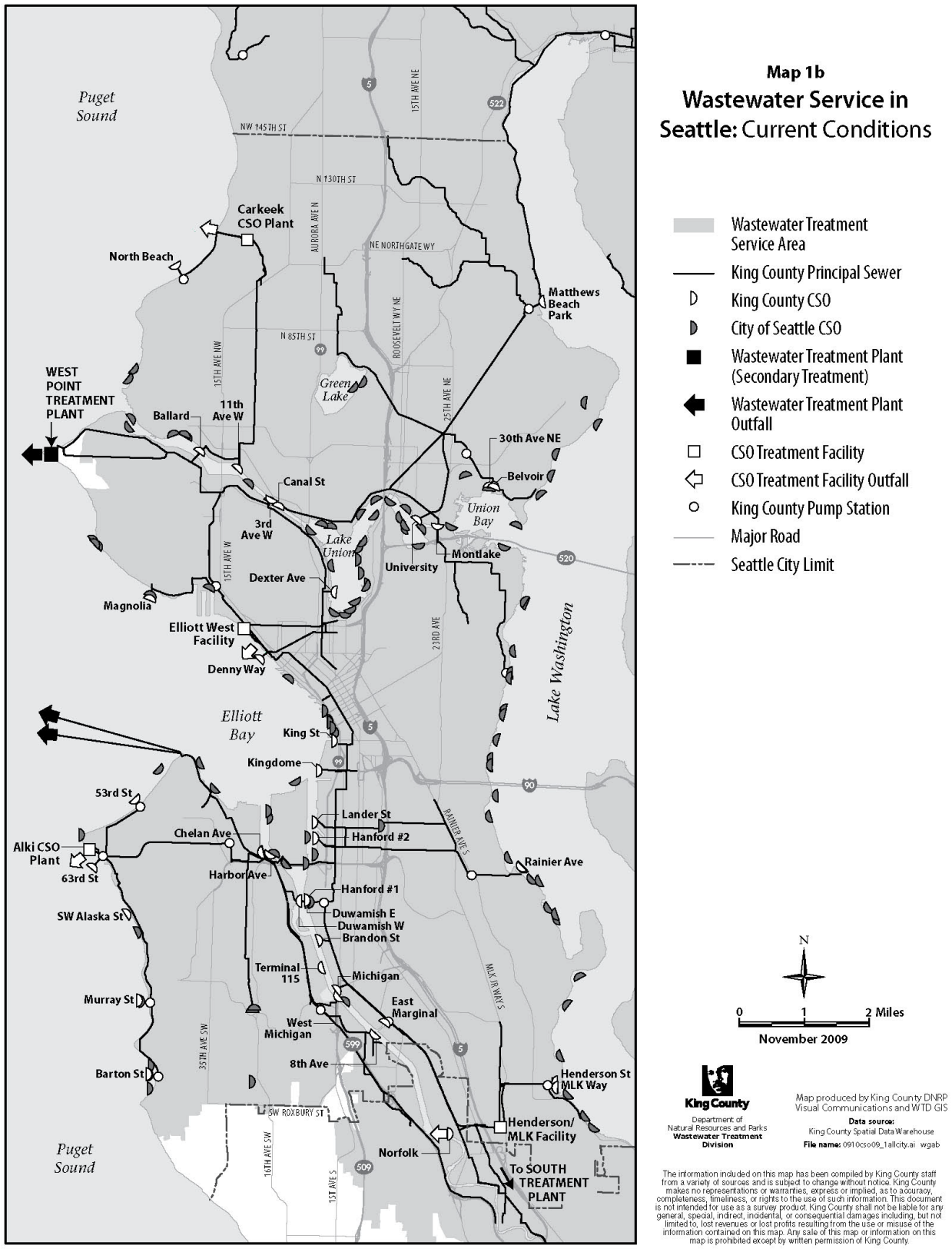
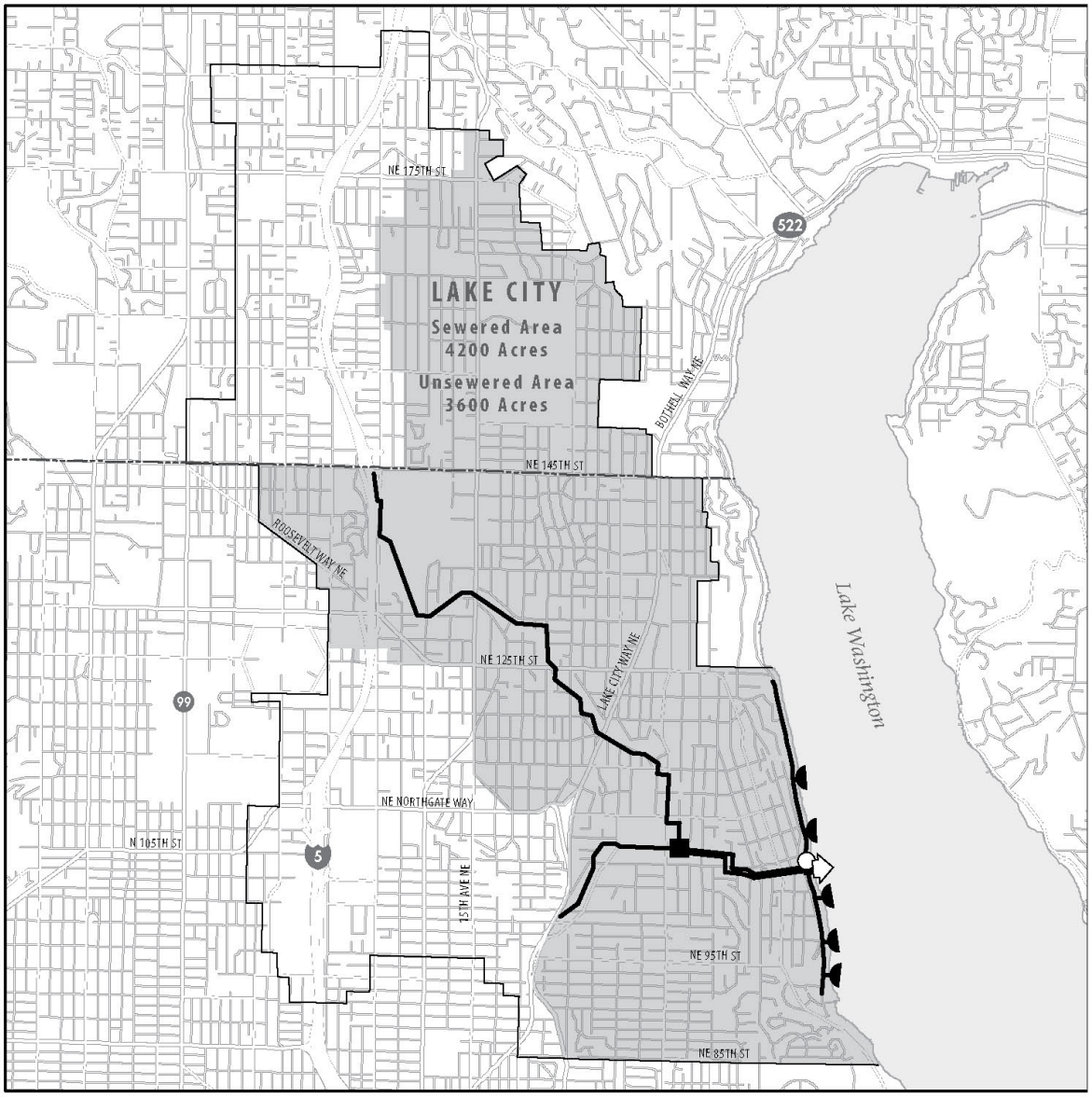



**Figure 1-3. Wastewater Service in Seattle: Current Conditions**




**Map 2a**

## Lake City System: 1957 Data

- Service Area Boundary
- Sewered Area
- Existing Trunk Sewer (1957)
- Treated Sewage Outfall
- Overflow
- Sewage Treatment Plant
- Pump Station
- 2009 Street Network (for reference purposes)
- 1957 Seattle City Limits

King County
Department of
Natural Resources and Parks
**Wastewater Treatment Division**

Map produced by King County DNRP
Visual Communications and WTD GIS

**Data sources:** Depictions of Sewer Districts and Conveyance for 1958 were generated from the *1958 Metropolitan Seattle Sewerage and Drainage Survey*. All other data come from the King County Spatial Data Warehouse.

**File name:** 0910cso57_2lakecity.ai wgab

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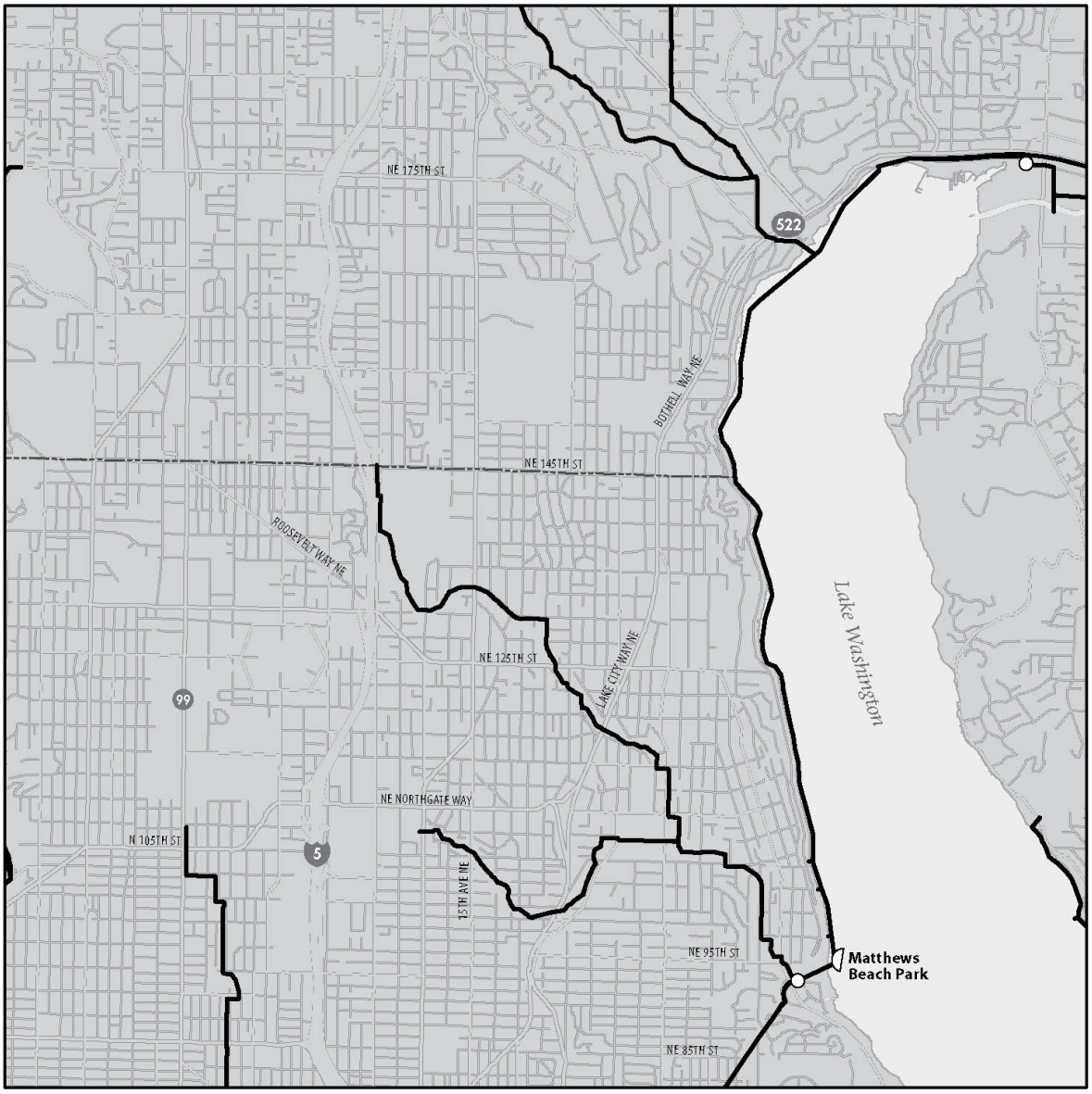
0 2000 4000 Feet

November 2009



**Figure 1-4. Lake City System: 1957 Data**




**Map 2b**

## Lake City Area: Current Conditions

Wastewater Treatment Service Area
King County Principal Sewer
King County CSO
King County Pump Station
Road
Seattle City Limit

King County
Department of
Natural Resources and Parks
**Wastewater Treatment Division**

Map produced by King County DNRP
Visual Communications and WTD GIS
**Data source:** King County Spatial Data Warehouse
**File name:** 0910cso09_2lakecity.ai wgab

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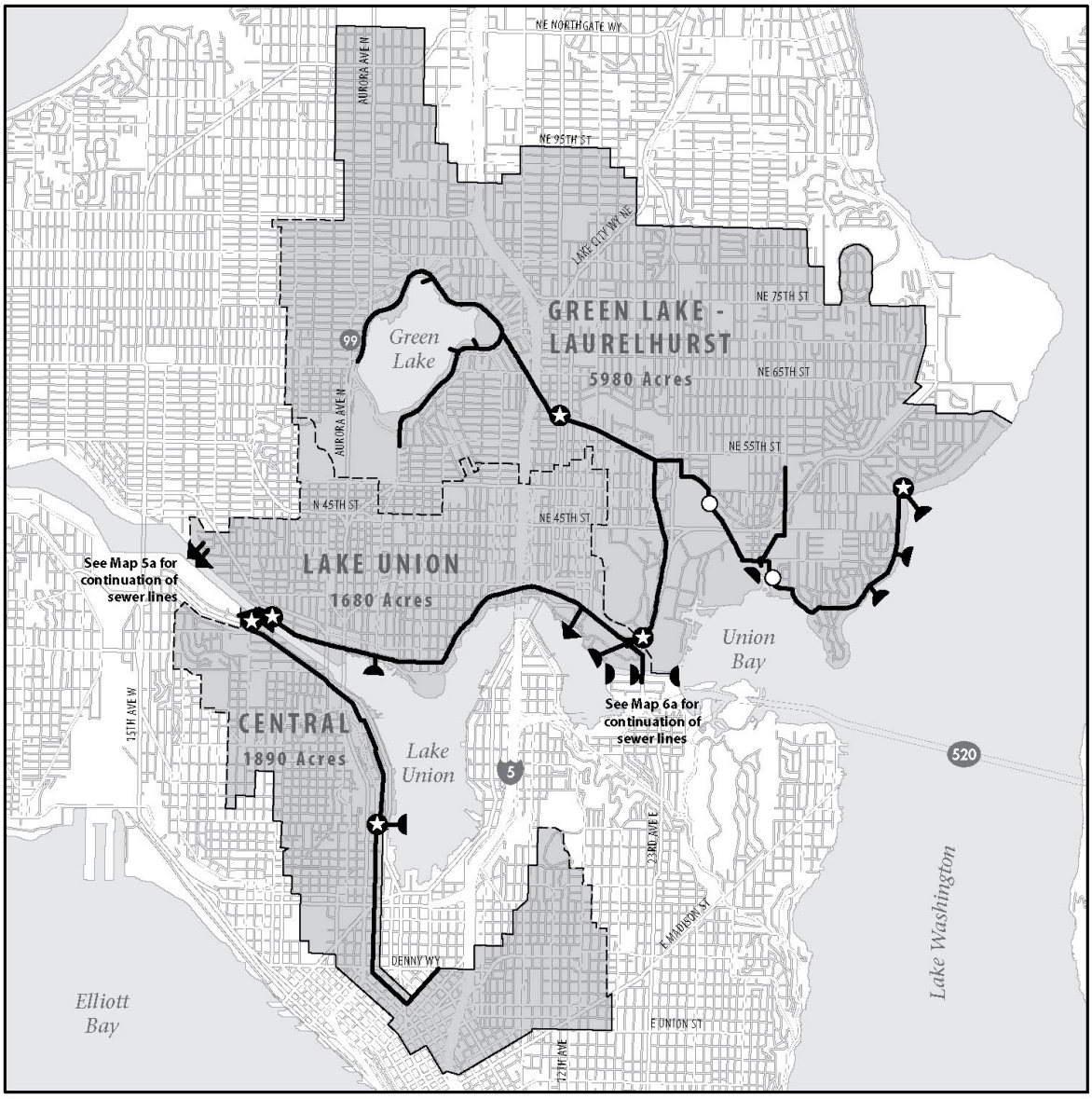
0 2000 4000 Feet
November 2009



**Figure 1-5. Lake City Area: Current Conditions**




**Map 3a**

## North Trunk System – Central, Lake Union, and Green Lake/Laurelhurst Sub-Districts: 1957 Data

- Service Area Boundary
- North Trunk Sub-District Boundary
- Sewered Area
- Existing Trunk Sewer (1957)
- Raw Sewage Outfall
- Overflow
- Pump Station
- Special Structure
- 2009 Street Network (for reference purposes)
- 1957 Seattle City Limits

King County
Department of
Natural Resources and Parks
**Wastewater Treatment Division**

Map produced by King County DNRP
Visual Communications and WTD GIS

**Data sources:** Depictions of Sewer Districts and Conveyance for 1958 were generated from the *1958 Metropolitan Seattle Sewarage and Drainage Survey*. All other data come from the King County Spatial Data Warehouse.

**File name:** 0910cso57_3greenlake.ai wgab

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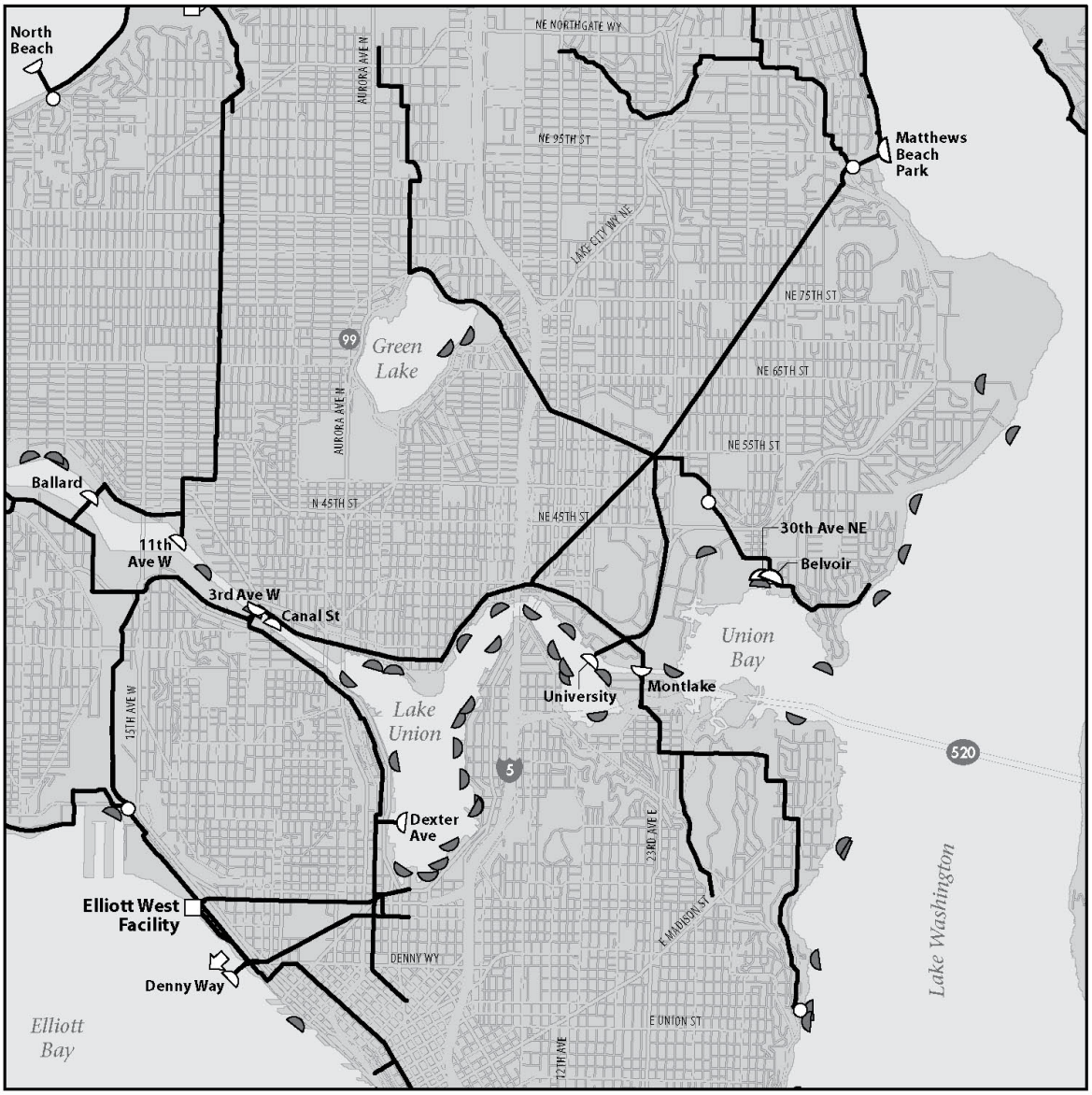
0 2000 4000 Feet

November 2009



**Figure 1-6. North Trunk System – Central, Lake Union, and Green Lake/Laurelhurst Sub-Districts: 1957 Data**




**Map 3b**

## Central, Lake Union, and Green Lake/Laurelhurst Area: Current Conditions

- Wastewater Treatment Service Area
- King County Principal Sewer
- King County CSO
- City of Seattle CSO
- CSO Treatment Facility
- CSO Treatment Facility Outfall
- King County Pump Station
- Road

King County
Department of Natural Resources and Parks
**Wastewater Treatment Division**

Map produced by King County DNRP Visual Communications and WTD GIS
**Data source:** King County Spatial Data Warehouse
**File name:** 0910cso09_3greenlake.ai wgab

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0 2000 4000 Feet
November 2009



**Figure 1-7. Central, Lake Union, and Green Lake/Laurelhurst Area: Current Conditions**


**Map 4a**

## Greenwood, North Beach, and Blue Ridge Systems: 1957 Data

Service Area Boundary
Sewered Area
Existing Trunk Sewer (1957)
Raw Sewage Outfall
Treated Sewage Outfall
Sewage Treatment Plant
2009 Street Network (for reference purposes)

King County
Department of Natural Resources and Parks
**Wastewater Treatment Division**

Map produced by King County DNRP Visual Communications and WTD GIS

**Data sources:** Depictions of Sewer Districts and Conveyance for 1958 were generated from the *1958 Metropolitan Seattle Sewarage and Drainage Survey*. All other data come from the King County Spatial Data Warehouse.

**File name:** 0910cso57_4greenwood.ai wgab

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November 2009



**Figure 1-8. Greenwood, North Beach, and Blue Ridge Systems: 1957 Data**


**Map 4b**

## **Greenwood, North Beach, and Blue Ridge Area:** Current Conditions

Wastewater Treatment Service Area
King County Principal Sewer
King County CSO
CSO Treatment Facility
CSO Treatment Facility Outfall
King County Pump Station
Road

King County
Department of
Natural Resources and Parks
**Wastewater Treatment Division**

Map produced by King County DNRP
Visual Communications and WTD GIS
**Data source:** King County Spatial Data Warehouse
**File name:** 0910cso09_4greenwood.ai wgab

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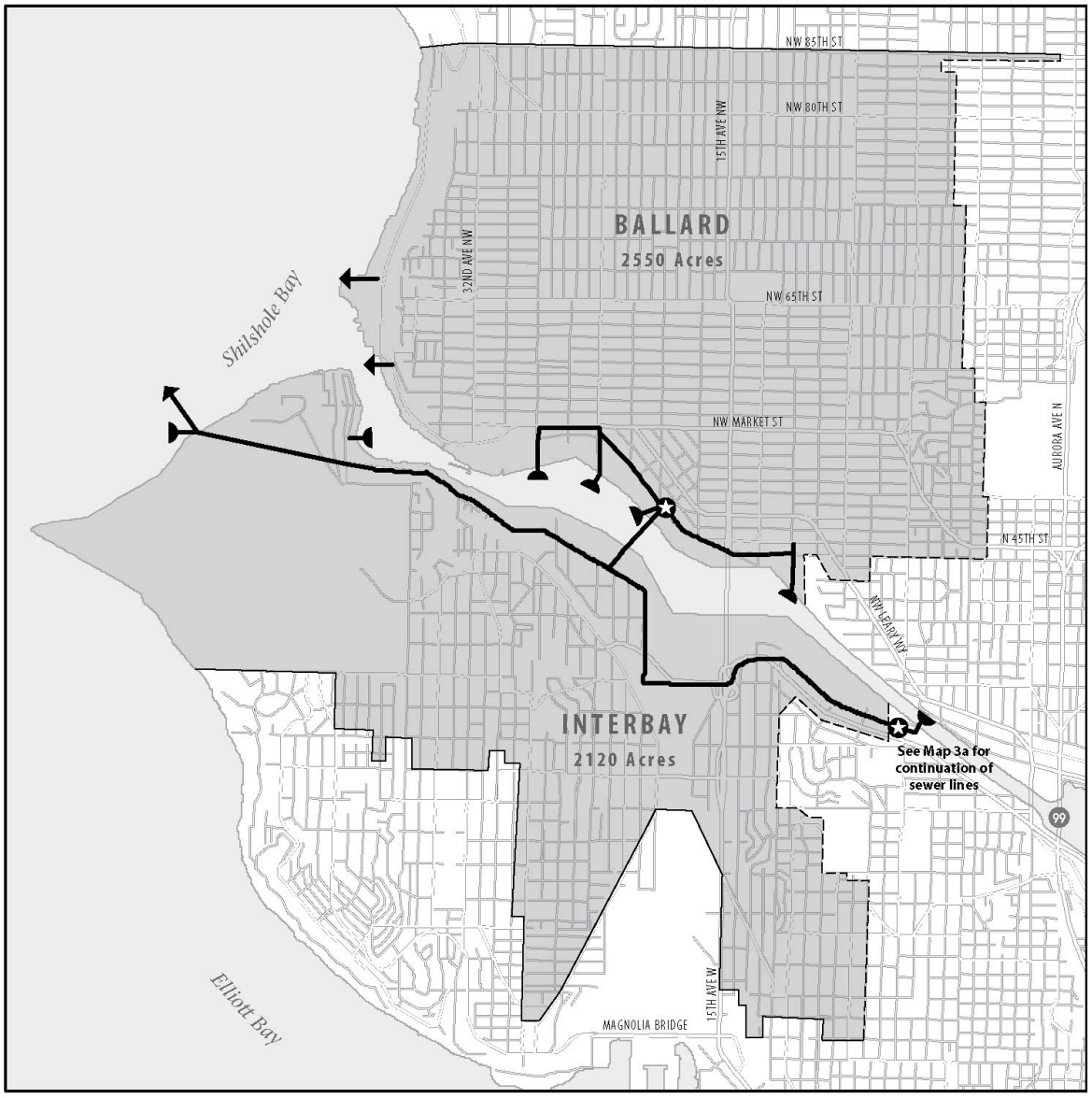
0 2000 4000 Feet
November 2009



**Figure 1-9. Greenwood, North Beach, and Blue Ridge Area: Current Conditions**




**Map 5a**

## North Trunk System – Interbay and Ballard Districts: 1957 Data

- Service Area Boundary
- North Trunk Sub-District Boundary
- Sewered Area
- Existing Trunk Sewer (1957)
- Raw Sewage Outfall
- Overflow
- Special Structure
- 2009 Street Network (for reference purposes)

King County
Department of Natural Resources and Parks
**Wastewater Treatment Division**

Map produced by King County DNRP Visual Communications and WTD GIS

**Data sources:** Depictions of Sewer Districts and Conveyance for 1958 were generated from the *1958 Metropolitan Seattle Sewarage and Drainage Survey*. All other data come from the King County Spatial Data Warehouse.

**File name:** 091ocso57_5ballard.ai wgab

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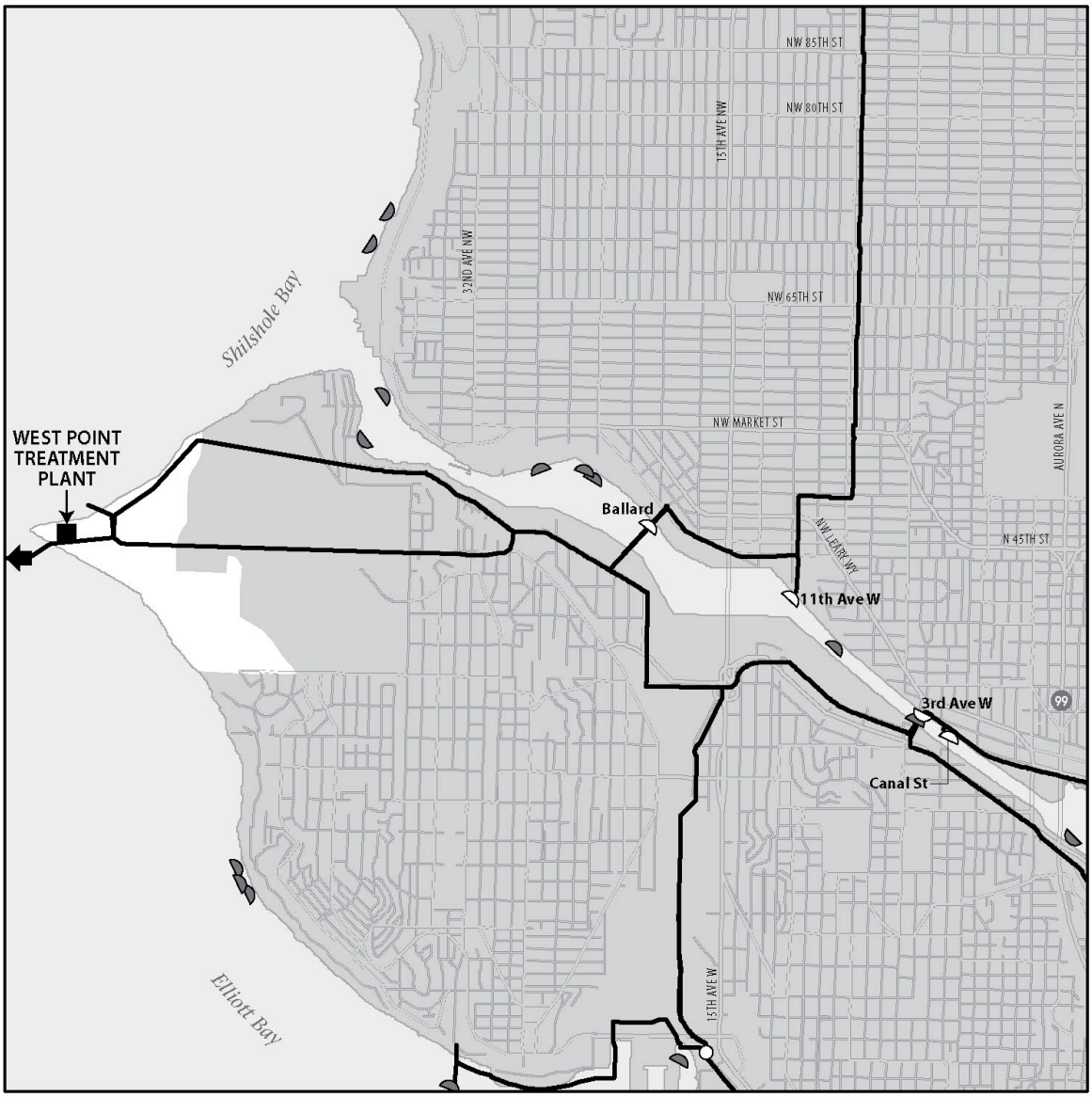
0 2000 4000 Feet

November 2009



**Figure 1-10. North Trunk System – Interbay and Ballard Districts: 1957 Data**




**Map 5b**

## Interbay and Ballard Area: Current Conditions

- Wastewater Treatment Service Area
- King County Principal Sewer
- King County CSO
- City of Seattle CSO
- Wastewater Treatment Plant (Secondary Treatment)
- Wastewater Treatment Plant Outfall
- King County Pump Station
- Road

King County
Department of Natural Resources and Parks
**Wastewater Treatment Division**

Map produced by King County DNRP Visual Communications and WTD GIS
**Data source:** King County Spatial Data Warehouse
**File name:** 0910cso09_5ballard.ai wgab

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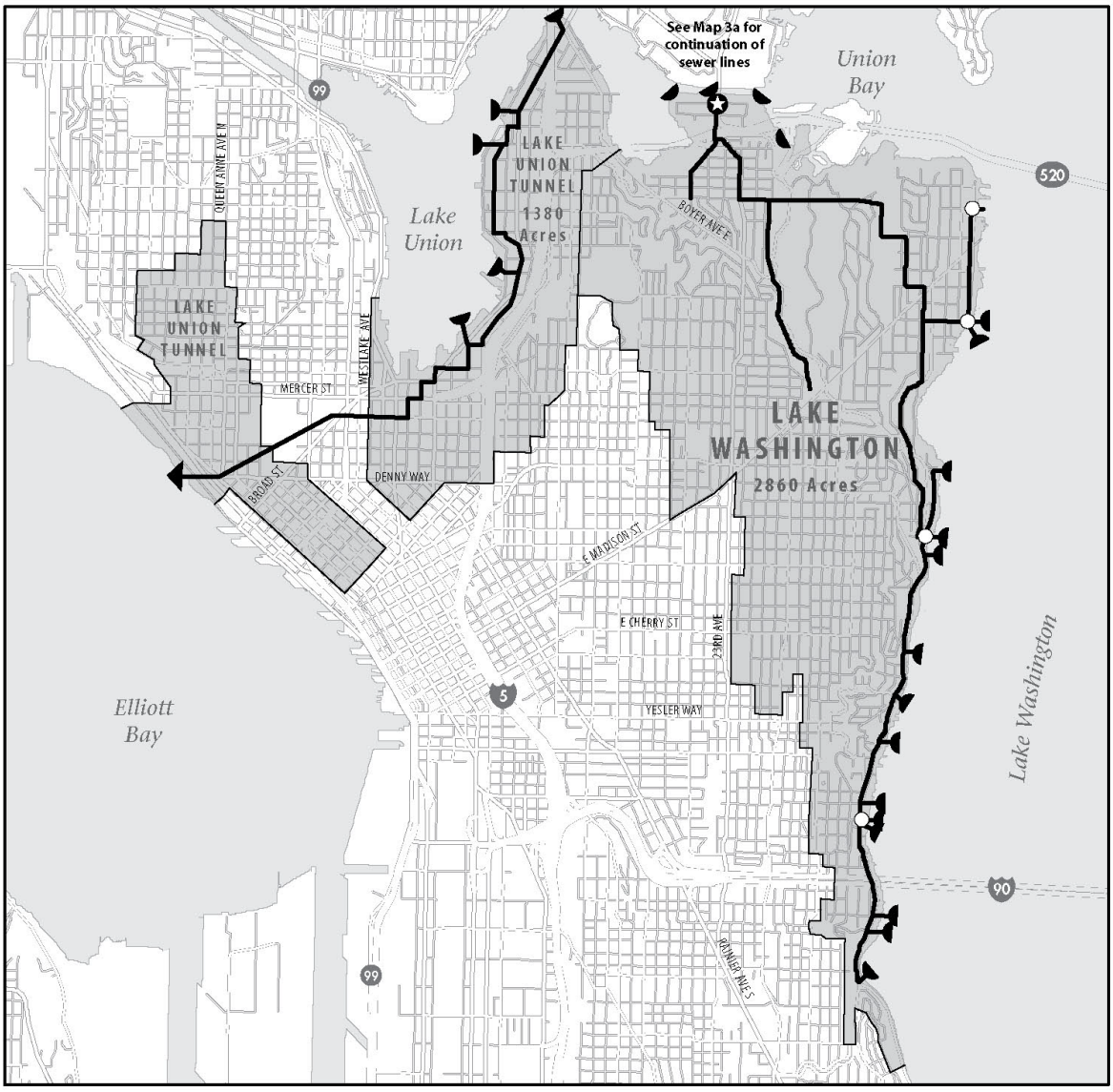
November 2009



**Figure 1-11. Interbay and Ballard Area: Current Conditions**




**Map 6a**

## North Trunk System – Lake Washington Sub-District, and Lake Union Tunnel System: 1957 Data

- Service Area Boundary
- Existing Trunk Sewer (1957)
- Pump Station
- Special Structure
- Raw Sewage Outfall
- Overflow
- Sewered Area
- 2009 Street Network (for reference purposes)

King County
Department of Natural Resources and Parks
**Wastewater Treatment Division**

Map produced by King County DNRP Visual Communications and WTD GIS

**Data sources:** Depictions of Sewer Districts and Conveyance for 1958 were generated from the *1958 Metropolitan Seattle Sewerage and Drainage Survey*. All other data come from the King County Spatial Data Warehouse.

**File name:** 0910cso57_6lkwash.ai wgab

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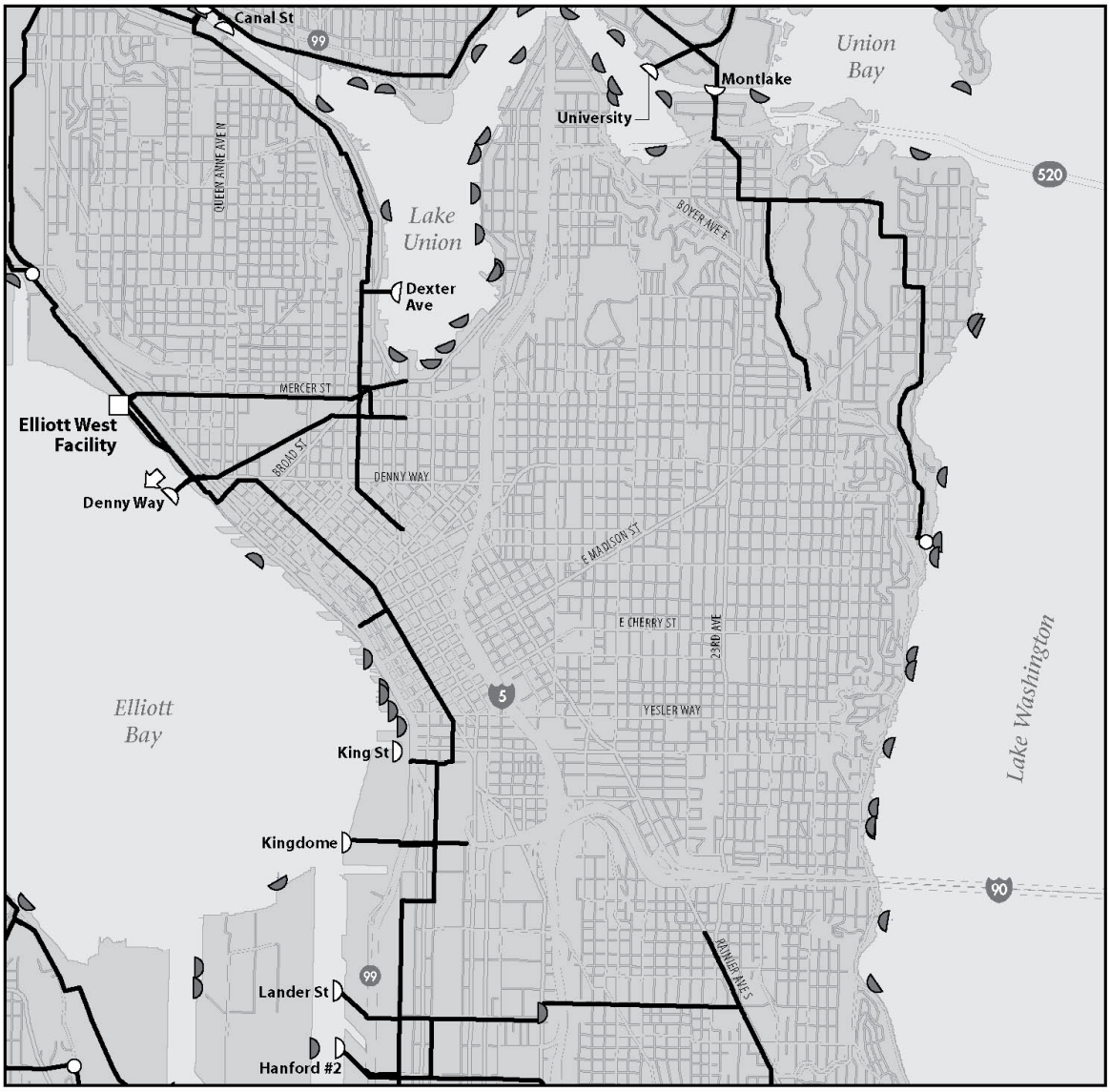
0 2000 4000 Feet

November 2009



**Figure 1-12. North Trunk System – Lake Washington Sub-District, and Lake Union Tunnel System: 1957 Data**




**Map 6b**

## Lake Washington and Lake Union Tunnel Area: Current Conditions

- Wastewater Treatment Service Area
- King County Principal Sewer
- King County CSO
- City of Seattle CSO
- CSO Treatment Facility
- CSO Treatment Facility Outfall
- King County Pump Station
- Road

King County
Department of Natural Resources and Parks
**Wastewater Treatment Division**

Map produced by King County DNRP Visual Communications and WTD GIS

**Data source:** King County Spatial Data Warehouse

**File name:** 091 0cso09_6lkwash.ai wgab

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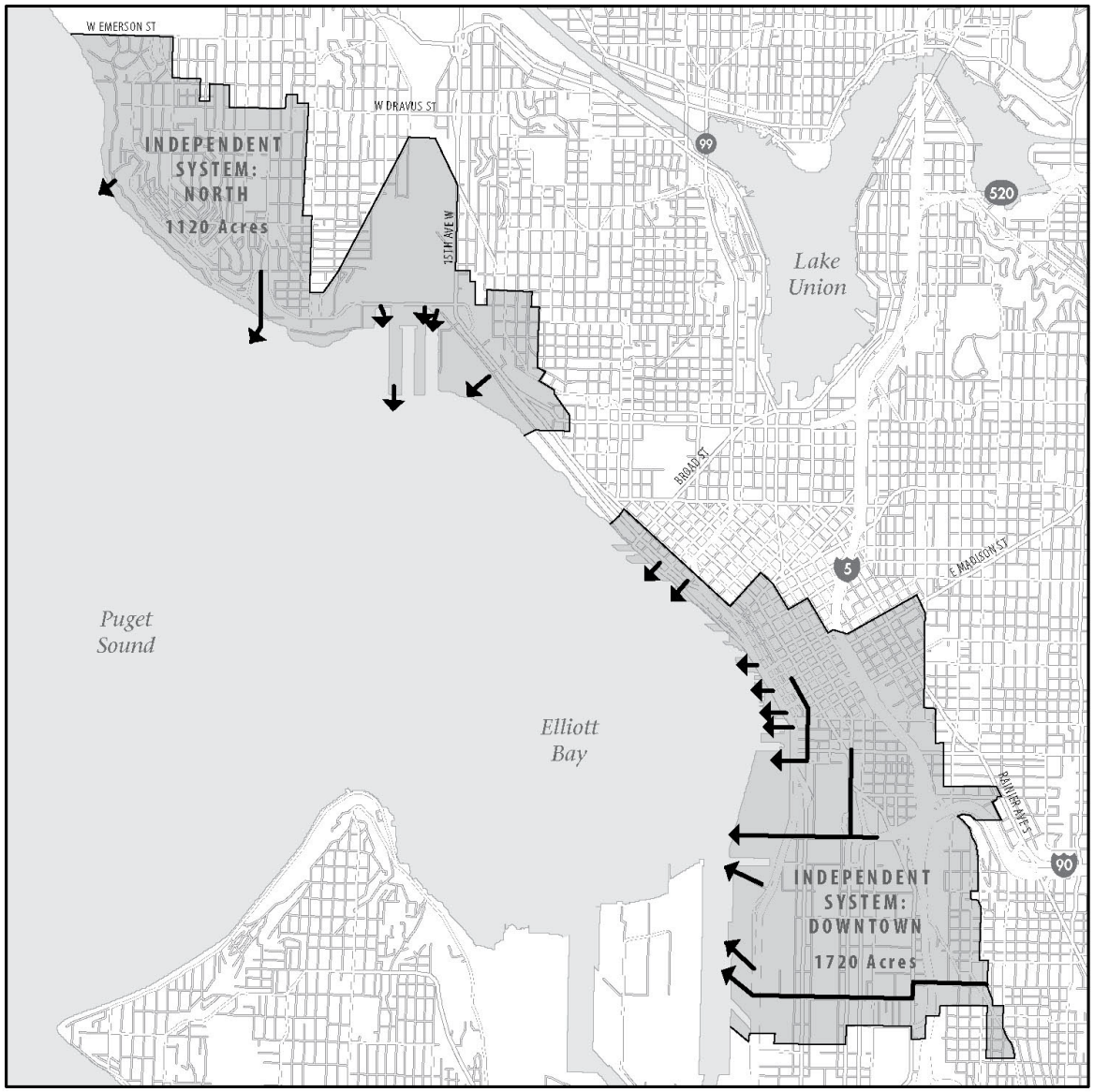
0 2000 4000 Feet

November 2009



**Figure 1-13. Lake Washington and Lake Union Tunnel Area: Current Conditions**




**Map 7a**

## Elliott Bay Independent Systems: 1957 Data

- Service Area Boundary
- Sewered Area
- Existing Trunk Sewer (1957)
- Raw Sewage Outfall
- Overflow
- Pump Station
- Special Structure
- 2009 Street Network (for reference purposes)

King County
Department of Natural Resources and Parks
**Wastewater Treatment Division**

Map produced by King County DNRP Visual Communications and WTD GIS

**Data sources:** Depictions of Sewer Districts and Conveyance for 1958 were generated from the *1958 Metropolitan Seattle Sewarage and Drainage Survey*. All other data come from the King County Spatial Data Warehouse.

**File name:** 0910cso57_7elliottbay.ai wgab

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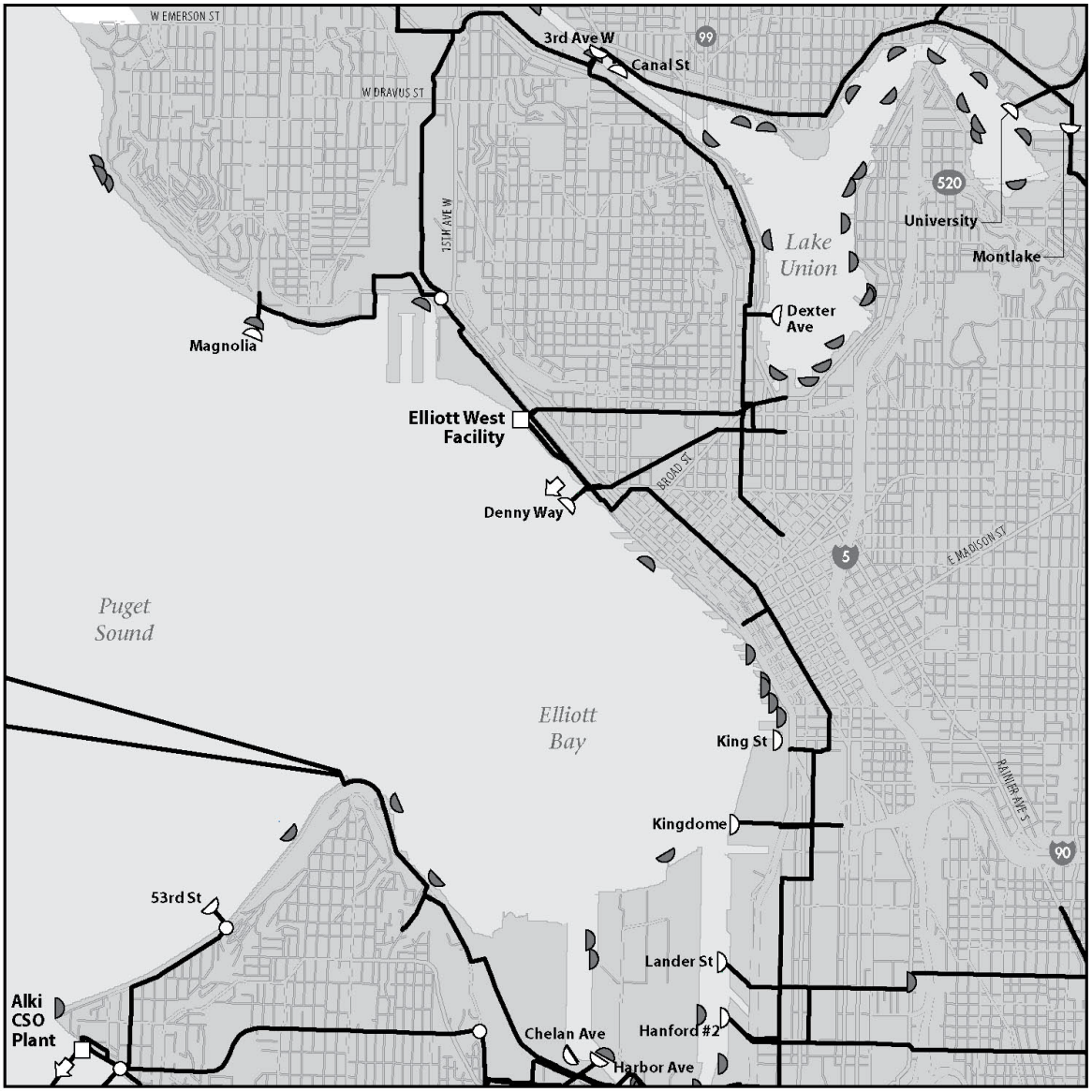
0 2000 4000 Feet

**November 2009**



**Figure 1-14. Elliott Bay Independent Systems: 1957 Data**




**Map 7b**

## Elliott Bay Area: Current Conditions

- Wastewater Treatment Service Area
- King County Principal Sewer
- King County CSO
- City of Seattle CSO
- CSO Treatment Facility
- CSO Treatment Facility Outfall
- King County Pump Station
- Road

King County
Department of Natural Resources and Parks
**Wastewater Treatment Division**

Map produced by King County DNRP Visual Communications and WTD GIS
**Data source:** King County Spatial Data Warehouse
**File name:** 0910cso57_7elliottbay.ai wgab

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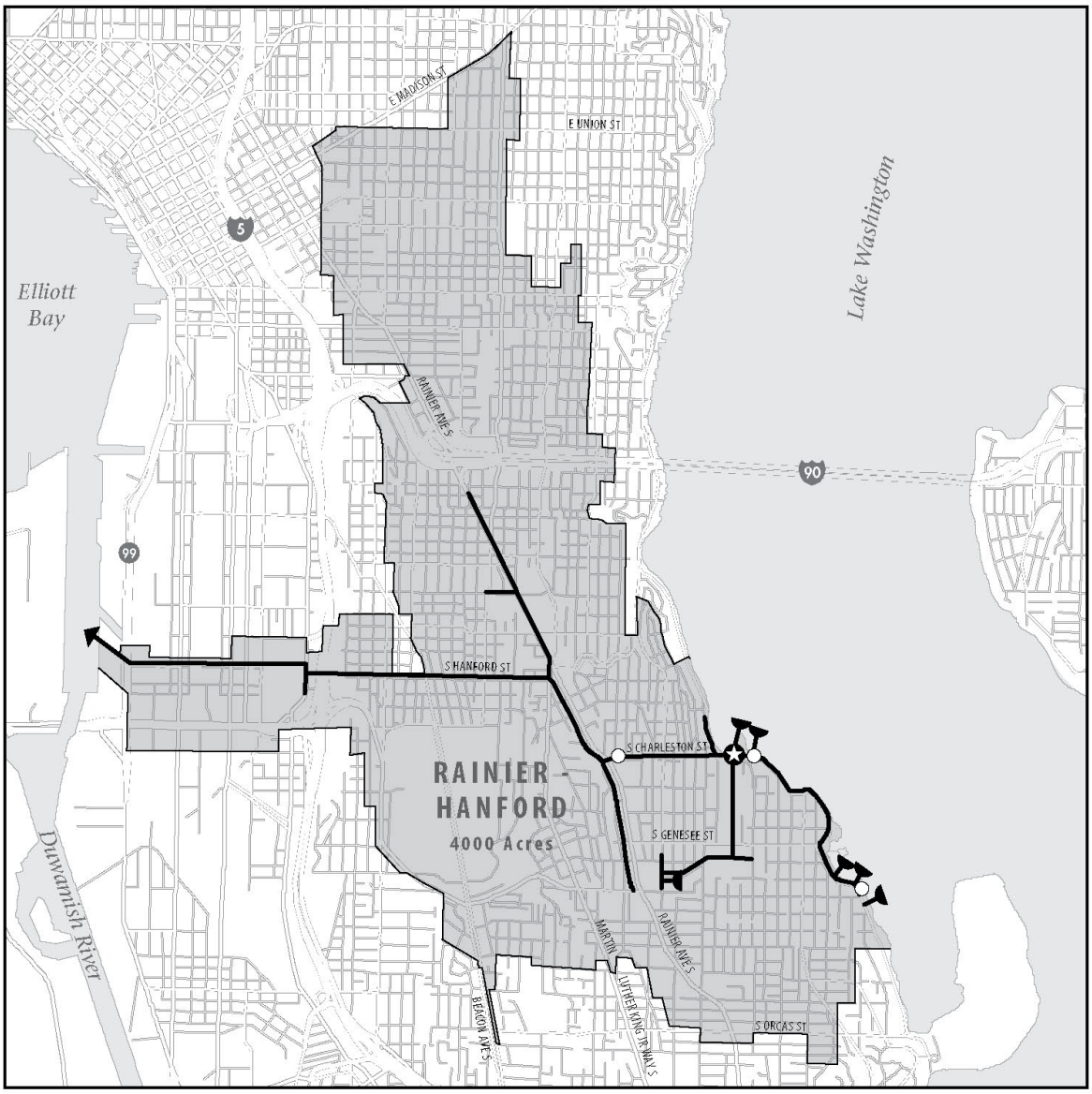
0 2000 4000 Feet
November 2009



**Figure 1-15. Elliott Bay Area: Current Conditions**




**Map 8a**

## Rainier – Hanford System: 1957 Data

- Service Area Boundary
- Sewered Area
- Existing Trunk Sewer (1957)
- Raw Sewage Outfall
- Overflow
- Pump Station
- Special Structure
- 2009 Street Network (for reference purposes)

King County
Department of
Natural Resources and Parks
**Wastewater Treatment Division**

Map produced by King County DNRP
Visual Communications and WTD GIS

**Data sources:** Depictions of Sewer Districts and Conveyance for 1958 were generated from the *1958 Metropolitan Seattle Sewarage and Drainage Survey*. All other data come from the King County Spatial Data Warehouse.

**File name:** 091 0cso57_8rainier.ai wgab

N

0 2000 4000 Feet

November 2009



**Figure 1-16. Rainier – Hanford System: 1957 Data**


**Map 8b**

## Rainier – Hanford Area: Current Conditions

Wastewater Treatment Service Area
King County Principal Sewer
King County CSO
City of Seattle CSO
CSO Treatment Facility
King County Pump Station
Road

King County
Department of
Natural Resources and Parks
**Wastewater Treatment Division**

Map produced by King County DNRP
Visual Communications and WTD GIS
**Data source:** King County Spatial Data Warehouse
**File name:** 091 0cso09_8rainier.ai wgab

N
0 2000 4000 Feet
November 2009



**Figure 1-17. Rainier – Hanford Area: Current Conditions**


**Map 9a**

## Henderson – East Marginal Way System: 1957 Data

- Service Area Boundary
- Sewered Area
- Existing Trunk Sewer (1957)
- Raw Sewage Outfall
- Treated Sewage Outfall
- Overflow
- Sewage Treatment Plant
- Pump Station
- Special Structure
- 2009 Street Network (for reference purposes)
- 1957 Seattle City Limits

King County
Department of
Natural Resources and Parks
**Wastewater Treatment Division**

N

0 2000 4000 Feet

November 2009

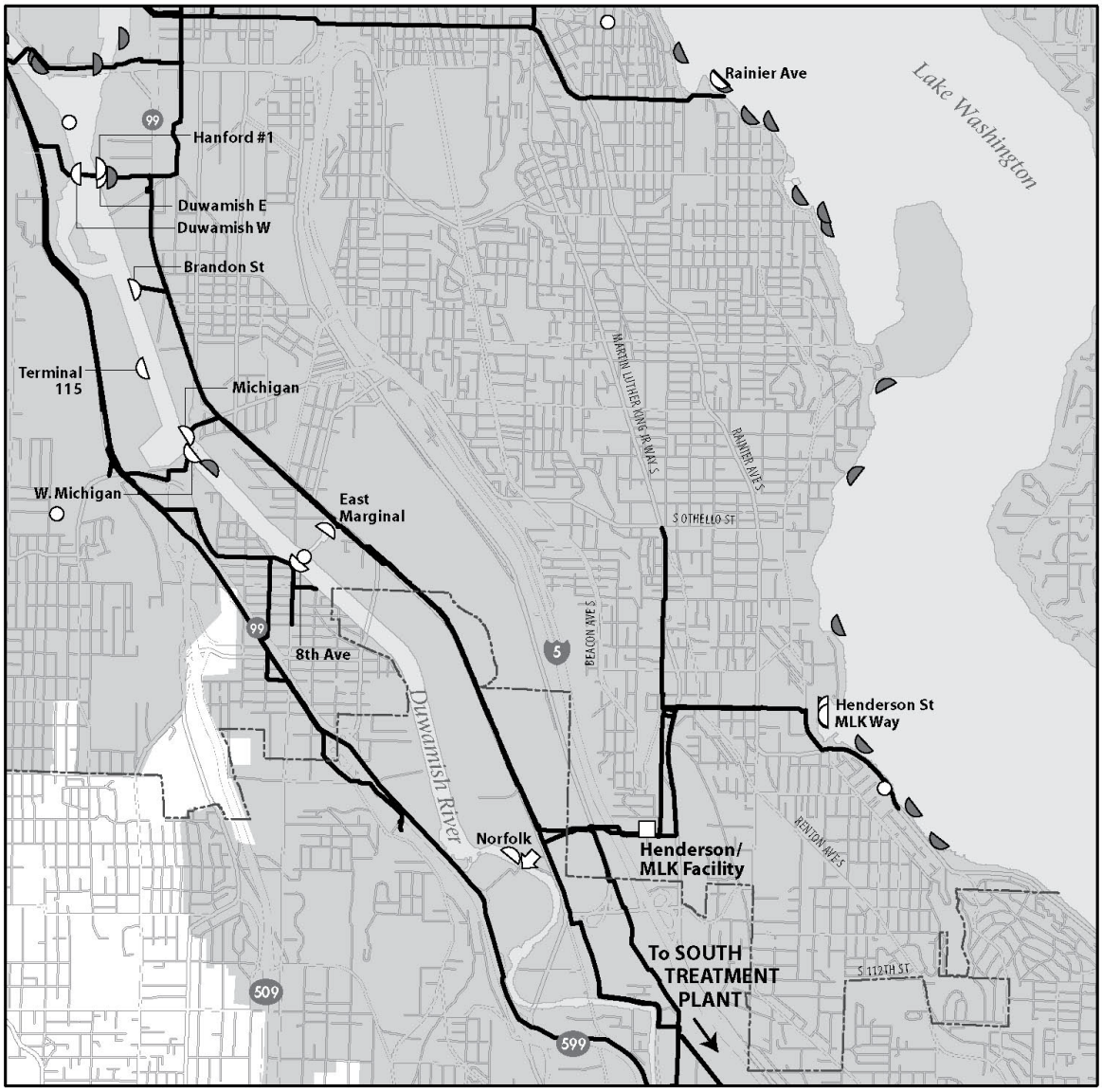
Map produced by King County DNRP
Visual Communications and WTD GIS

**Data sources:** Depictions of Sewer Districts and Conveyance for 1958 were generated from the *1958 Metropolitan Seattle Sewerage and Drainage Survey*. All other data come from the King County Spatial Data Warehouse.

**File name:** 0910cso57_9henderson.ai wgab



**Figure 1-18. Henderson – East Marginal Way System: 1957 Data**




**Map 9b**

## Henderson – East Marginal Way Area: Current Conditions

- Wastewater Treatment Service Area
- King County Principal Sewer
- King County CSO
- City of Seattle CSO
- CSO Treatment Facility
- CSO Treatment Facility Outfall
- King County Pump Station
- Road
- Seattle City Limit

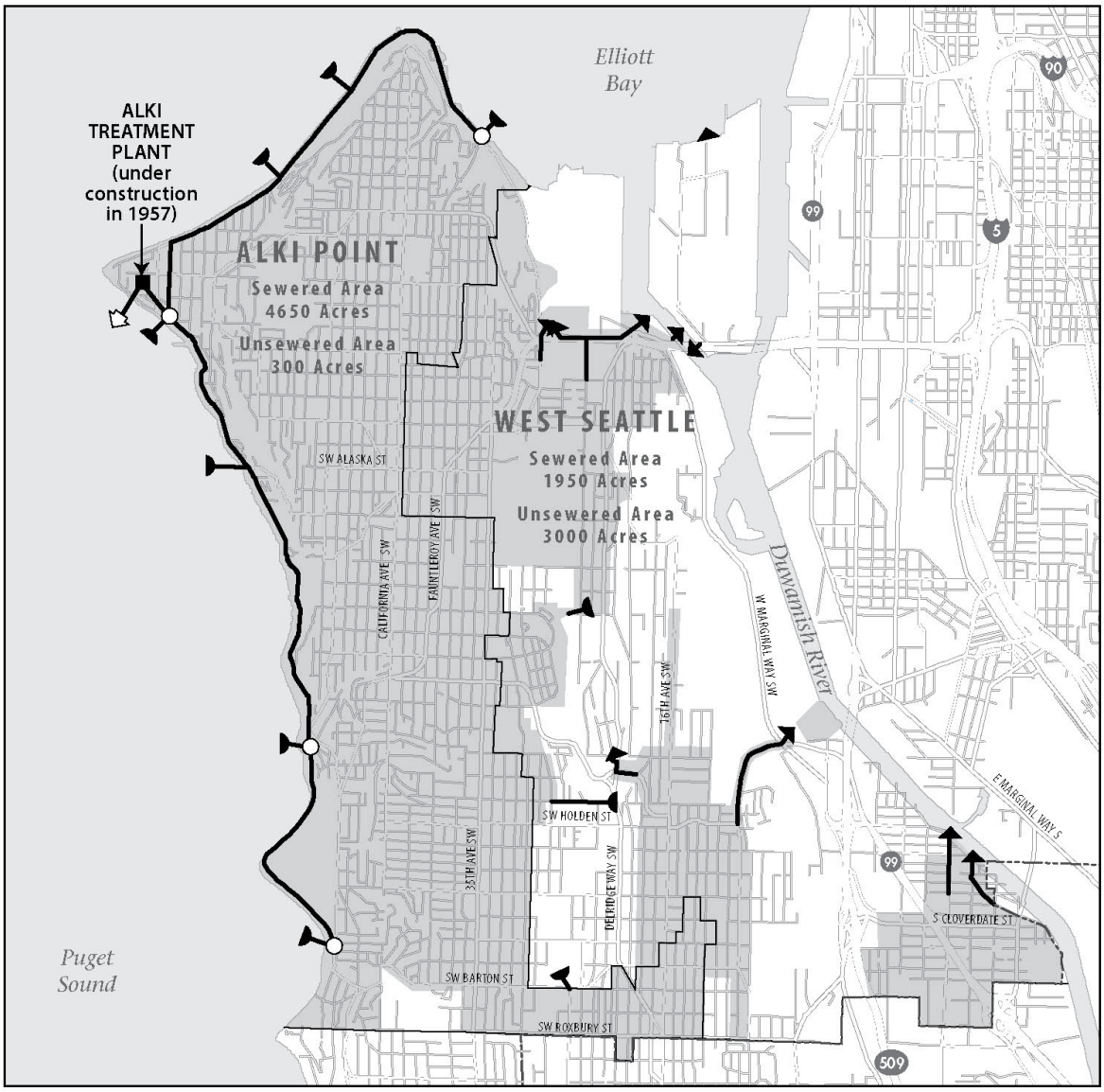
King County
Department of
Natural Resources and Parks
**Wastewater Treatment Division**

Map produced by King County DNRP
Visual Communications and WTD GIS
**Data source:** King County Spatial Data Warehouse
**File name:** 091 0cso09_9henderson.ai wgab

N
0 2000 4000 Feet
November 2009



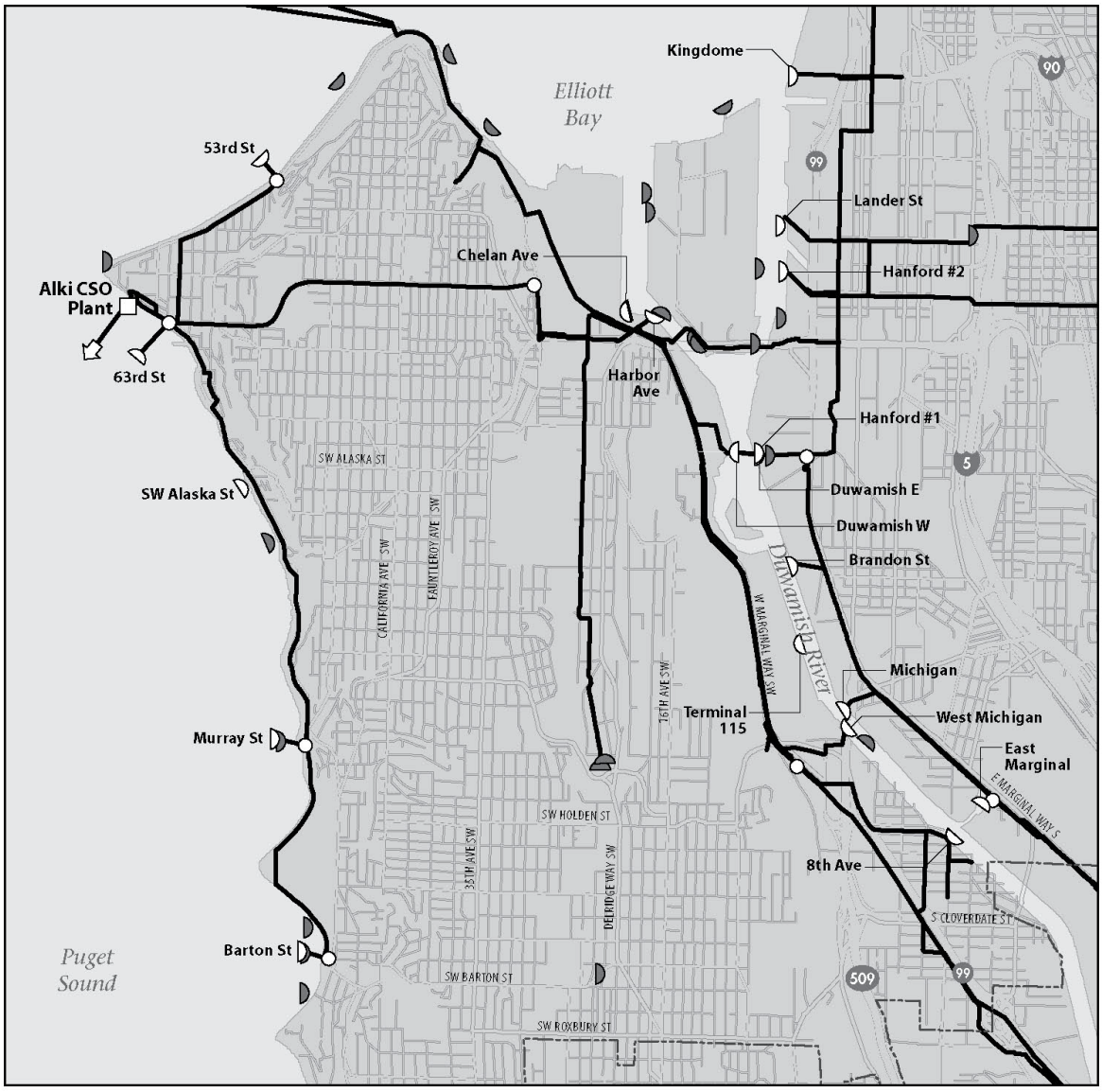
**Figure 1-19. Henderson – East Marginal Way Area: Current Conditions**




**Map 10a**

**West Seattle and Alki Point Systems:** 1957 Data

**Figure 1-20. West Seattle and Alki Point Systems: 1957 Data**




**Map 10b**

## West Seattle and Alki Point Area: Current Conditions

- Wastewater Treatment Service Area
- King County Principal Sewer
- King County CSO
- City of Seattle CSO
- CSO Treatment Facility
- CSO Treatment Facility Outfall
- King County Pump Station
- Road
- Seattle City Limit

King County
Department of Natural Resources and Parks
**Wastewater Treatment Division**

Map produced by King County DNRP Visual Communications and WTD GIS

**Data sources:** King County Spatial Data Warehouse

**File name:** 0910cso09_10wseattle.ai wgab

N

0 2000 4000 Feet

November 2009



**Figure 1-21. West Seattle and Alki Point Areas: Current Conditions**

# 2.0 CSO Outfalls in the Central Basin of Puget Sound

King County manages eight CSOs and two wet weather treatment stations that discharge to the Central Basin of Puget Sound. Projects have been completed or are about to be completed to control all of the eight CSOs in this area. The facilities include: two wet weather treatment stations (Carkeek and Alki), two pump station CSO bypasses (53rd Ave. and 63rd Ave.), one overflow (SW Alaska St.), and five CSOs (North Beach PS Wet Well, North Beach PS Inlet, South Magnolia, Murray Ave. PS, and Barton St. PS).

## 2.1 Receiving Water

### 2.1.1 Overview

Puget Sound is a fjord-like estuary that consists of a series of underwater valleys and ridges (called *basins*) and submerged hills (called *sills*). Sills impede the flow of water in and out of the sound and also induce vertical mixing as water moves over the sill. Puget Sound consists of four major interconnected basins: the Main (Admiralty Inlet and the Central Basin), Whidbey, Southern, and Hood Canal basins. All of King County's marine CSOs discharge to the Central Basin. The Central Basin has near-oceanic salinity throughout the year and is supplemented with cold, nutrient-rich, low-oxygenated deep oceanic water upwelled off the Washington coast during the late summer months. The Central Basin contains water depths up to 284 meters.

Freshwater flows influence water circulation in the Central Basin because the amount of freshwater input varies seasonally and affects water temperature, salinity, and density, which, in turn, determines stratification of the water column. Water column stratification can affect biological populations by trapping nutrients and/or affecting vertical migration through the water column. Freshwater input into rivers is mainly through rainfall; however, snowmelt input also contributes a large amount in late spring and early summer.

The two main freshwater inputs to the Central Basin from King County are the Green/Duwamish River, which enters Elliott Bay, and the Cedar River (Lake Washington drainage basin), which flows into the sound through the ship canal. Because flows in the Lake Washington drainage basin and the Green River are regulated, snowmelt does not increase the flows in these river systems to the extent that it does in other systems, and has diminished effect on salinity and stratification near the river mouths.

Water circulation in the Central Basin is dominated by tidal currents and generally consists of a two-layered flow, with incoming, saltier oceanic water flowing along the bottom and a fresher, less dense water layer flowing out at the surface. Salty, cold, dense waters enter Puget Sound at depth in the bottom layer through Admiralty Inlet. A portion flows south in the Central Basin while the other portion flows northeast through Possession Sound to the Whidbey Basin. Figure 2-1 shows the net circulation pattern in Puget Sound, with the deep incoming water flowing beneath the outflowing upper layer. Water tends to flow faster on the eastern side of the Central Basin near Alki Point and Point Wells and along the western side near Point Monroe and north of Kingston, where major topographic features affect the currents (King County, 2001). The

residence time of water in the Central Basin is about 48 days, depending on the time of year (Babson, 2004).

Amplitudes of tidal currents in the Central Basin are about 50 centimeters per second (cm/s). Estuarine circulation, which is important for transporting water masses, is typically up to about 10 cm/s, but can be higher during storms and bottom-water saltwater intrusion from Admiralty Inlet (King County, 2002).

### 2.1.2 Receiving Water Characteristics

Unless otherwise noted, the following description applies to receiving waters in the vicinity of all the Central Basin marine CSOs (excluding those in inner Elliott Bay and the Duwamish River, which are discussed separately). The discussion of receiving water characteristics is based on sampling results from the County's long-term marine ambient and point-source monitoring program.[9]

Surface water temperatures vary seasonally because of differences in air temperatures, wind speed, and solar radiation. The highest temperatures occur during the summer months and the lowest temperatures occur in January and February. Salinities in the upper 10 meters of the water column generally are lowest in the spring, and have been lower than normal in the early part of the year in recent years (PSEMP, 2017). In waters deeper than 10 meters, such as where the Carkeek and Alki wet weather treatment station outfalls discharge, the highest salinities occur in the fall and are associated with coastal upwelling and input of oceanic water. Salinities are at near-oceanic levels (up to 31 on the Practical Salinity Scale) throughout much of the year.

Other than seasonally influenced surface waters, a well-mixed water column occurs throughout most of the year. Density is a function of both salinity and temperature and can affect mixing and circulation, as large differences in water column density cause stratification. In general, the periods of the most intense water column stratification occur in the summer and winter, and most areas in the Central Basin exhibit a pattern of moderate and infrequent stratification. Fauntleroy Cove, in the vicinity of the Barton Street CSO outfall, exhibits a pattern of weak and infrequent stratification, which is less than in other areas. The water column in Fauntleroy Cove is well-mixed throughout most of the year.

Dissolved oxygen (DO) levels are above 7.0 milligrams per liter (mg/L) (the Washington State water quality standard for extraordinary use of marine surface waters) throughout most of the year. DO levels in Central Basin waters occasionally fall between 4.5 and 5.0 mg/L during the fall months (August through October) because of the input of upwelled oceanic waters that have naturally low DO levels. The exception to this is in Quartermaster Harbor, where low DO levels (< 3.0 mg/L) have been documented in the late summer and fall; however, no CSOs are located in this area.

Fecal coliform bacteria levels in Central Basin subtidal waters have always met the state water quality geometric mean and peak standards for primary contact recreation. Most values in subtidal waters were either 1 colony forming unit (CFU)/100 milliliter or not detected.

[9] Program data and reports are accessible at http://green.kingcounty.gov/marine/.

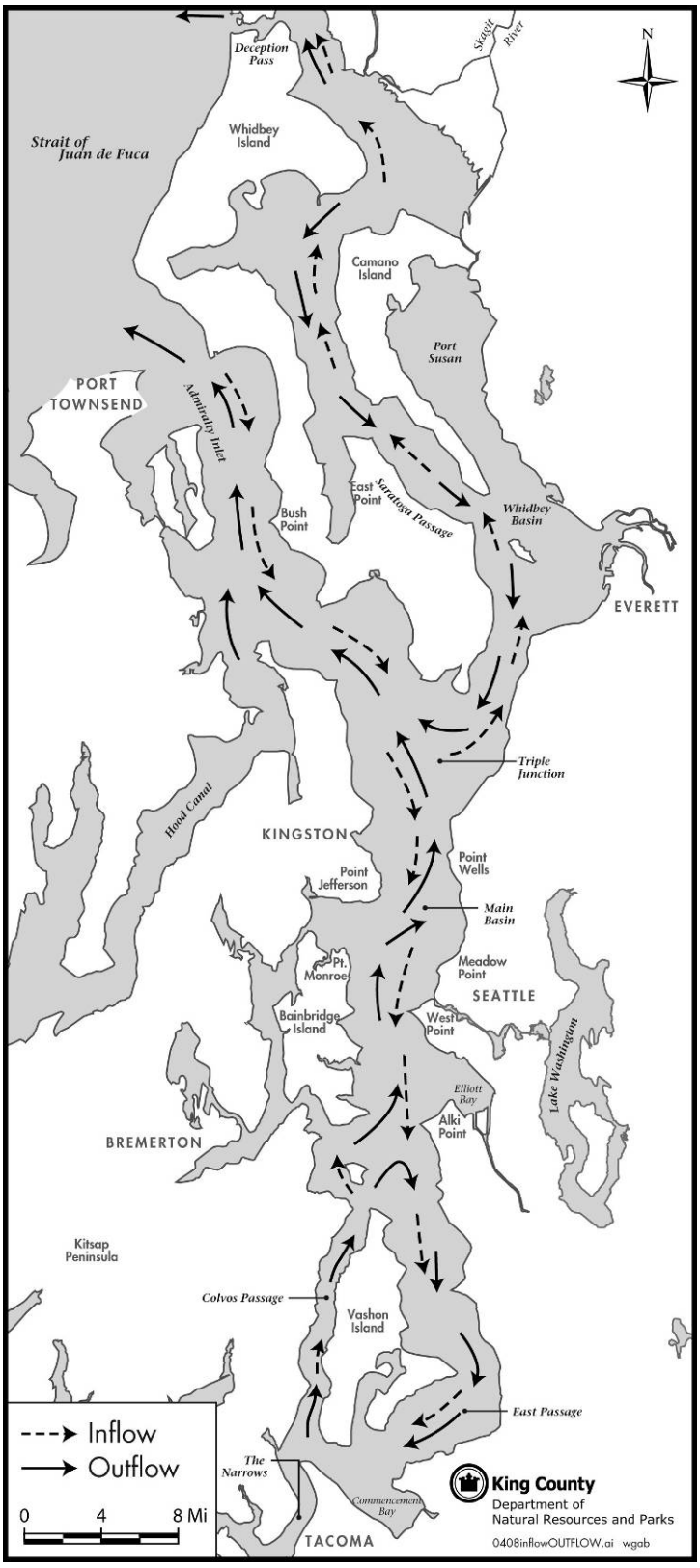



**Figure 2-1. Generalized Puget Sound Circulation (from King County, 2002)**

## 2.2 Information on Specific CSO Outfalls

This section presents outfall and discharge information and sediment chemistry results for the nine CSO outfalls in the Central Basin of Puget Sound. More information on the volume of CSO discharged yearly from each location can be found in the annual reports on King County's CSO Program available on King County's website.[10]

Table 2-1 presents a summary of sediment and discharge monitoring information for these CSOs. It also indicates whether there is a stormwater outfall associated with a CSO site.

**Table 2-1. Summary of Sediment and Discharge Information for CSOs in the Central Basin of Puget Sound**

| DSN | Facility Name | Control Status | Associated Stormwater Outfall | Discharge Quality Data | Last date of Sediment Sample | Number of Stations | Sediment Analysis Performed | Data submitted to EIM | SQS Exceedance |
|---|---|---|---|---|---|---|---|---|---|
| 046 | Carkeek WWTS Outfall | Treated | Yes | Yes | 2000 | 6 | Chemistry | Yes | None |
| 048b | North Beach PS (inlet structure) | Controlled | Yes | Not sampled—no NPDES requirement | 2018 | 6 | Chemistry | Data not back | Data not back |
| 048a | North Beach PS (wet well) | Controlled | Yes | Not sampled—no NPDES requirement | 2013 | 11 | Chemistry | Yes | None |
| 006 | Magnolia Overflow | Uncontrolled | Yes | Not sampled—no NPDES requirement | 2013 | 7 | Chemistry | Yes | None |
| 052 | 53rd Ave. SW PS | Controlled | Yes | Not sampled—controlled CSO | 2011 | 6 | Chemistry | Yes | Yes |
| 051 | Alki WWTS Outfall | Treated | Yes | Yes | 2001 | 6 | Chemistry | Yes | None |
| 054 | 63rd Ave. SW PS | Uncontrolled | Yes | Yes | 1997 | 6 | Chemistry | Yes | None |
| 055 | SW Alaska St. Overflow | Controlled | No | Not sampled—no NPDES requirement | 1997 | 6 | Chemistry | Yes | None |
| 056 | Murray Ave. PS | Controlled | Yes | Not sampled—no NPDES requirement | 2013 | 13 | Chemistry | Yes | Yes |
| 057 | Barton St. PS | Uncontrolled | Yes | Not sampled—no NPDES requirement | 2016 | 12 | Chemistry | Yes | Yes |

[10] Links to the annual reports are available at http://www.kingcounty.gov/environment/wastewater/CSO/Library/AnnualReports.aspx.

### 2.2.1 Carkeek WWTS

NPDES Discharge Serial Number 046

The Carkeek WWTS receives flows from the North Beach PS. Under normal conditions, sewage is conveyed to West Point. Flows in excess of the Carkeek pump station's capacity will enter the Carkeek WWTS, which provides some buffer capacity against the discharge of sewage to Puget Sound. If the storm flow volume is greater than the station's storage capacity, the sewage is given primary treatment, disinfection and dechlorination before discharging into Puget Sound.

**1958 Baseline Facility:** Built as a private treatment facility to provide floatables removal and chlorination; operated by the City of Seattle after 1954. In 1964, the original private Greenwood plant was upgraded to a 24/7 primary treatment plant; Metro (now King County) assumed responsibility in 1962 and converted the plant to CSO storage and wet weather treatment in 1994, when base and stored flows were transferred to West Point for secondary treatment.

**Discharge Location:** The Carkeek WWTS discharges to Puget Sound through a multi-port diffuser structure at latitude 47° 42' 45.5" N and longitude -122° 23' 16.4" W. The diffuser consists of 13 diffuser ports, varying from 5.5 to 10 inches in diameter. There are four 5.5-inch ports, four 6-inch ports, four 7-inch ports, and one 10-inch end port; all ports are spaced 4 feet apart. The ports discharge horizontally, alternating in direction with the final end port aligned with the outfall pipe. The diffuser terminates at a depth of 200 feet (61 meters) offshore of the Carkeek neighborhood of Seattle, in the Central Basin of Puget Sound (Figure 2-2). The outfall provides 93:1 dilution at the zone of acute criteria exceedance boundary and 146:1 at the chronic mixing zone boundary.

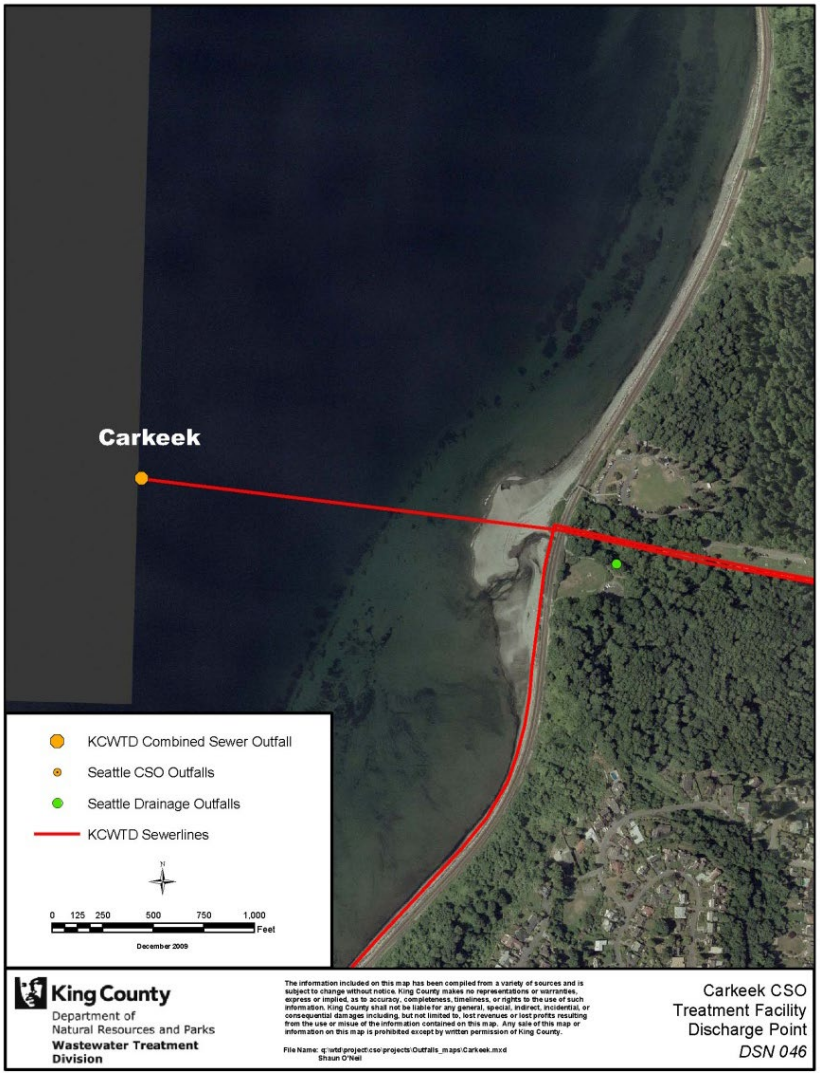



**Figure 2-2. Carkeek Wet Weather Treatment Station Discharge Point**

**1983 Overflow Baseline:** The plant is permitted to discharge up to 46 million gallons (MG) over up to 10 events per year.

**Overflow Quantity:** No untreated events occur from this facility; controlled to the state standard.

**Control Project History:** Facility was never an untreated CSO; converted to a wet weather treatment station, with disinfection and dechlorination, from a 24/7 primary treatment plant in 1994, when base flows were routed to West Point; no further projects are needed to meet state standards.

**CSO Effluent Quality Monitoring Data:** Monitoring is done per event for conventional parameters, and priority pollutants are monitored once per permit cycle under the NPDES permit. Data are available from the Ecology water quality permit program.

**Construction-Related Monitoring:** Post-construction monitoring was done for after the conversion to CSO treatment.

*Carkeek Wet Weather Treatment Station Vicinity; Beach Looking Southwest*

*Carkeek Wet Weather Treatment Station Sedimentation Tanks*

**Sediment Sampling:** Sediments in the vicinity of the Carkeek WWTS have been sampled multiple times, most recently in 2000. Sediment samples were collected from six locations proximal to the Carkeek outfall in October 2000. Five of the stations formed a transect perpendicular to the end of the outfall and the sixth station was located approximately 1,500 feet from the outfall in the direction of the prevailing current. Figure 2-3 shows station locations and the outfall discharge point. Sediment concentration results indicated that all detected chemical concentrations were less than the SMS. Data from this sampling event were included in the 2009 CD data submittal.

**Sediment Remediation Activity:** No action required.

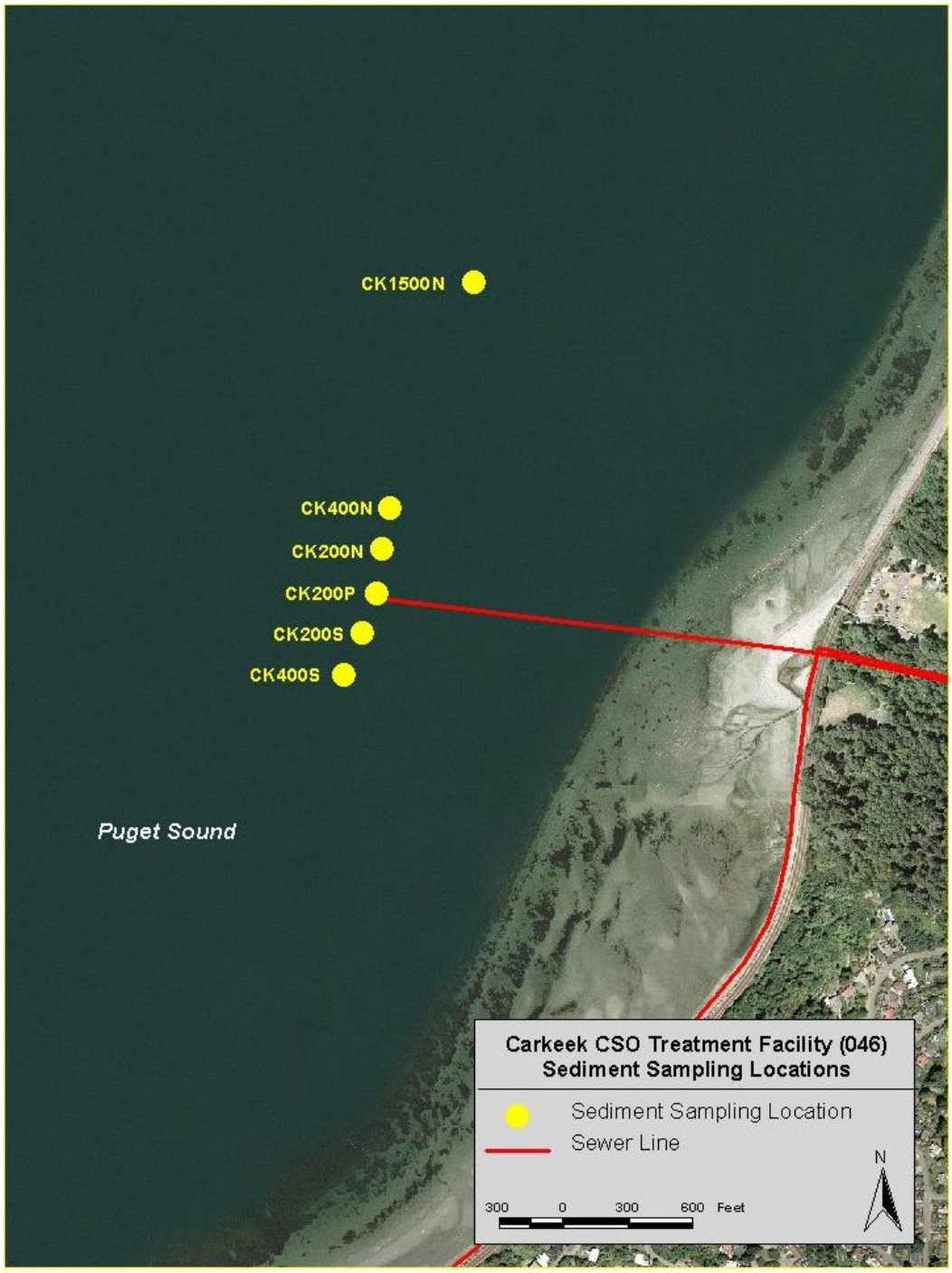



**Figure 2-3. Carkeek Wet Weather Treatment Station (046) Sediment Sampling Locations**

### 2.2.2 North Beach Pump Station

NPDES Discharge Serial Numbers 048a (wet well overflow to old plant outfall) and 048b (inlet overflow to storm drain and beach)

The North Beach PS receives flows from the Loyal Heights, Crown Hill, and Greenwood areas of Seattle. Flow from the North Beach PS travels to the Carkeek CSO treatment facility where it is either treated or pumped to West Point.

**1958 Baseline Facility:** Was a 24/7 primary treatment plant operated by the City of Seattle after being acquired from the private North Beach Sewer District in 1954. Converted to a pump station to transfer flows to the Greenwood/Carkeek primary plant by Metro (now King County) in 1962.

**Discharge Location:** Inlet overflow to storm drain and beach at latitude 47° 42’ 7.710” N and longitude -122° 23’ 26.735” W; wet well overflow via old plant outfall 1,000 feet offshore at latitude 47° 42’ 14.424” N and longitude 122° 23’ 33.229” W (Figure 2-4).


**Figure 2-4. North Beach Pump Station CSO Discharge Point**

**1983 Overflow Baseline:** 18 events and 6.0 MG per year.

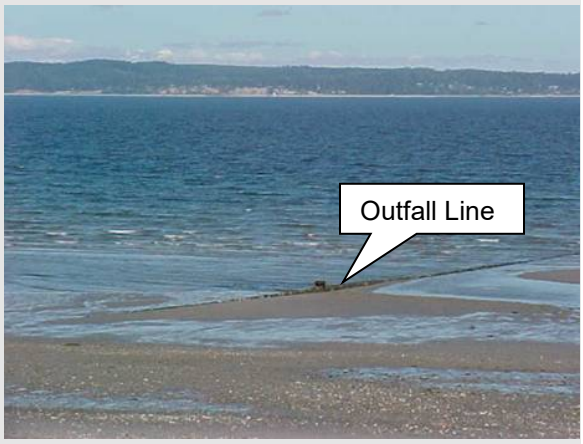
**Overflow Quantity:** Has overflowed 0 to 3 times per year since 1998. This CSO has been controlled and is expected to meet control standards going forward.

**Control Project History:** The North Beach CSO control project was completed in 2017.

**CSO Effluent Quality Monitoring Data:** Overflow quality monitoring to characterize the CSO was not required; estimated to be residential in quality.

**Construction-Related Monitoring:** King County's Post-Construction Monitoring Plan (PCMP) was approved by Ecology on September 28, 2012. Monitoring overflow volumes and frequency at the controlled untreated discharge locations is ongoing and reported monthly to Ecology. These data and sediment monitoring events are summarized in CSO annual reports.

*North Beach CSO Vicinity; Looking West from Community Park above Beach*




*North Beach CSO Wet Well Overflow Outfall; Looking West Across Puget Sound*

**Sediment Sampling:** Sediment samples were collected from 11 locations proximal to the North Beach PS wet well discharge point in August 2011 and March 2013. Sampling stations were sampled in 2011 per the PCMP. Additional stations were added in 2013 to correct the PCMP locations to an updated outfall location and to collect two additional samples inshore of the outfall to help validate the County's CSO discharge model. The stations farthest away were approximately 150 feet from the outfall discharge point (Figure 2-5). Results show all samples were below the SMS. Sediment proximal to the North Beach PS inlet discharge point have not been characterized and are being sampled in late 2018. The 2018 submittal includes data from the 2011 and 2013 sampling events.

**Sediment Remediation Activity:** No action required at 048a; additional evaluation needed at 048b.

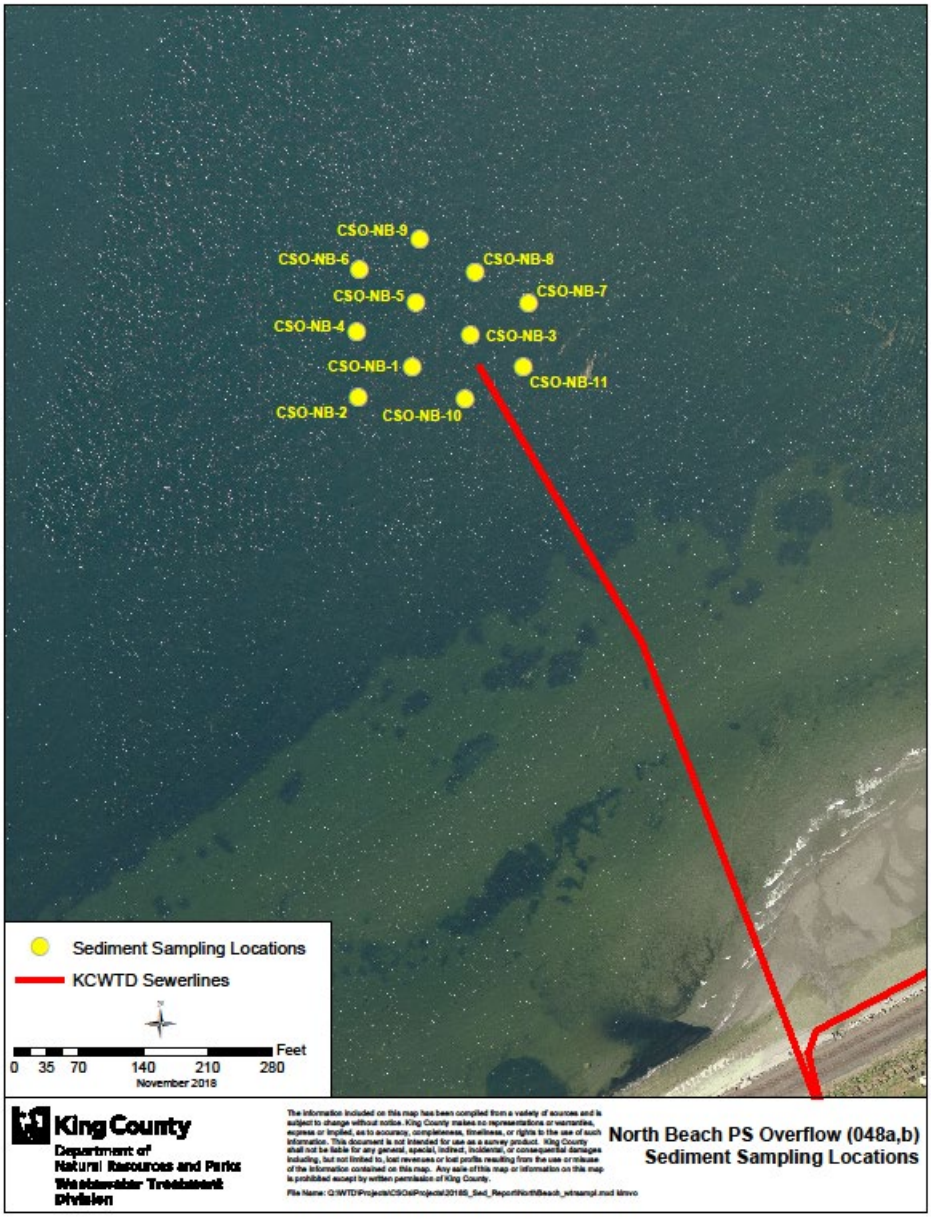



**Figure 2-5. North Beach Pump Station (048a,b) Sediment Sampling Locations**

### 2.2.3 South Magnolia

NPDES Discharge Serial Number 006

The South Magnolia wet weather storage facility receives flow from the Magnolia neighborhood of Seattle. Under normal conditions, flow bypasses the storage facility and travels to the Interbay Pump Station. Under high flow conditions, excess flow travels to the newly built diversion structure. If high flow conditions continue, flow travels to the new storage tanks. If a large enough storm occurs and the flow diversion structure and storage tank capacity are exceeded, excess flow is discharged into Elliott Bay.

**1958 Baseline Facility:** City of Seattle raw sewage discharge; intercepted by the City of Seattle in 1958 and then acquired by Metro (now King County) in 1962.

**Discharge Location:** Submerged offshore outfall discharges 780 feet offshore in Puget Sound at latitude 47° 37’ 48.663” N and longitude -122° 23’ 56.476” W; twin outfalls replaced by a single outfall in 1999 (Figure 2-6).


**Figure 2-6. South Magnolia CSO Discharge Point**

**1983 Overflow Baseline:** 25 events and 14 MG per year.

**Overflow Quantity:** Has overflowed between 0 and 38 times per year since 1998. Between 1998 and 2017, the 20-year average is 20.5 events per year.

*South Magnolia CSO Vicinity; Looking Southwest Across Elliott Bay.*

**Control Project History:** Construction of the Magnolia wet weather storage facility at Smith Cove was completed and became operational in December 2015. However, a failure and blockage of newly constructed pipe segment for the project was detected in late 2016. The pipe has been replaced and the project is expected to return to operational status by late 2018. This facility is currently under a supplemental compliance plan in accordance with the CD requirements. Control status will be reported in the 2018 CSO Annual Report. Construction of the facility will provide 1.5 MG of storage. Stored flows will be sent to West Point when capacity in the downstream conveyance system allows. If storage capacity is exceeded before flows can be sent to West Point, the excess flow will be discharged to Elliott Bay (King County, 2017c).

**CSO Effluent Quality Monitoring Data:** Overflow quality monitoring to characterize the CSO was not required. Estimated to be residential in quality.

**Construction-Related Monitoring:** King County's PCMP was approved by Ecology on September 28, 2012. Monitoring overflow volumes and frequency at the controlled untreated discharge locations is ongoing and reported monthly to Ecology. These and sediment monitoring events are summarized in CSO annual reports.

**Sediment Sampling:** Sediment samples were collected from seven locations proximal to the South Magnolia CSO discharge point in August 2011 and March 2013. The stations were collected per the PCMP in 2011, with one additional station added in 2013 just west of the outfall to help validate the County's CSO discharge model. The farthest stations are approximately 150 feet from the discharge point of the outfall. Figure 2-7 shows station locations and the outfall discharge point. All results were less than the SMS. The 2018 submittal includes data from this sampling event.

**Sediment Remediation Activity:** No action required.

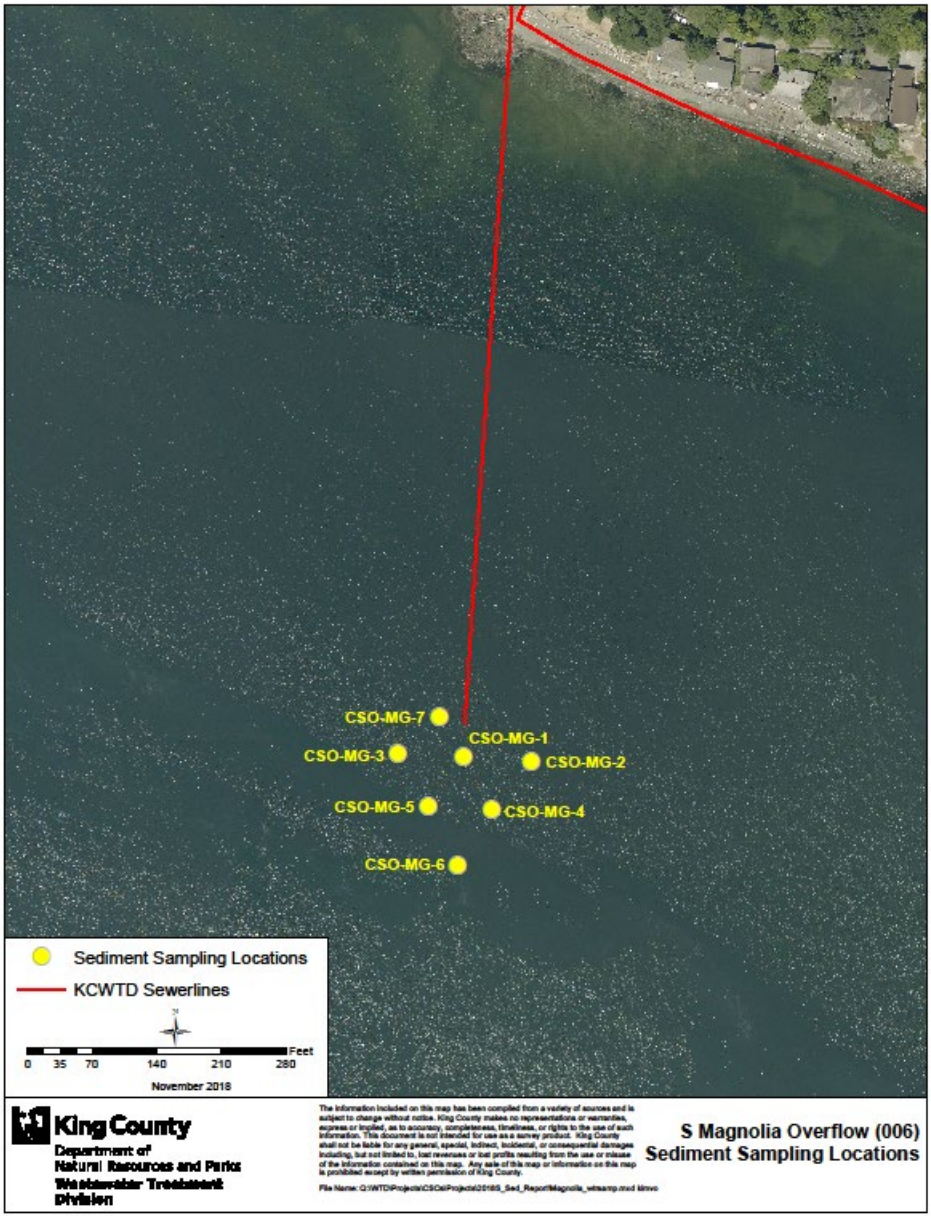



**Figure 2-7. South Magnolia Overflow (006) Sediment Sampling Locations**

### 2.2.4 53rd Avenue Pump Station

NPDES Discharge Serial Number 052

The 53rd Ave. PS receives flow from the Duwamish Head area of West Seattle. Flows are pumped to the South Plant via the 63rd Ave. PS.

**1958 Baseline Facility:** Seattle pump station built by the City of Seattle in 1953 and upgraded in 1962, 1985, and 2010. It was acquired by Metro (now King County) in 1962.

**Discharge Location:** Submerged 60-inch-diameter outfall, 560 feet offshore to Elliott Bay along North Alki Beach in West Seattle at latitude 47° 35’ 5.275” N and longitude -122° 24’ 9.186” W (Figure 2-8).


**Figure 2-8. 53rd Avenue Pump Station CSO Discharge Point**

**1983 Overflow Baseline:** 0 event and 0 MG per year.

**Overflow Quantity:** Has overflowed between 0 and 2 times per year since 2000 when monitoring began; the 18-year average is 0.3 events per year. This CSO has been controlled and is expected to meet control standards going forward.

**Control Project History:** The most recent 53rd Ave. PS upgrade was completed in 2010. This upgrade included an expanded vault, new pumps, a new odor control system, standby generator, and a new electrical and control system.

**CSO Effluent Quality Monitoring Data:** Overflow quality monitoring to characterize the CSO was not required. Estimated to be residential with some light commercial in quality.

**Construction-Related Monitoring:** Not applicable.

*53rd Avenue Pump Station CSO Vicinity; Looking West Across Elliott Bay*

*53rd Avenue Pump Station CSO Vicinity; Looking East Across Elliott Bay*

**Sediment Sampling:** Sediment samples were collected from six locations proximal to the 53rd Ave. PS discharge point in August 2011. Per the PCMP, the stations were positioned around the outfall, with the farthest station located approximately 150 feet from the discharge point of the outfall. Figure 2-9 shows station locations and the outfall discharge point. All results were less than the SMS criteria. The 2018 submittal includes data from this sampling event.

**Sediment Remediation Activity:** No action required.

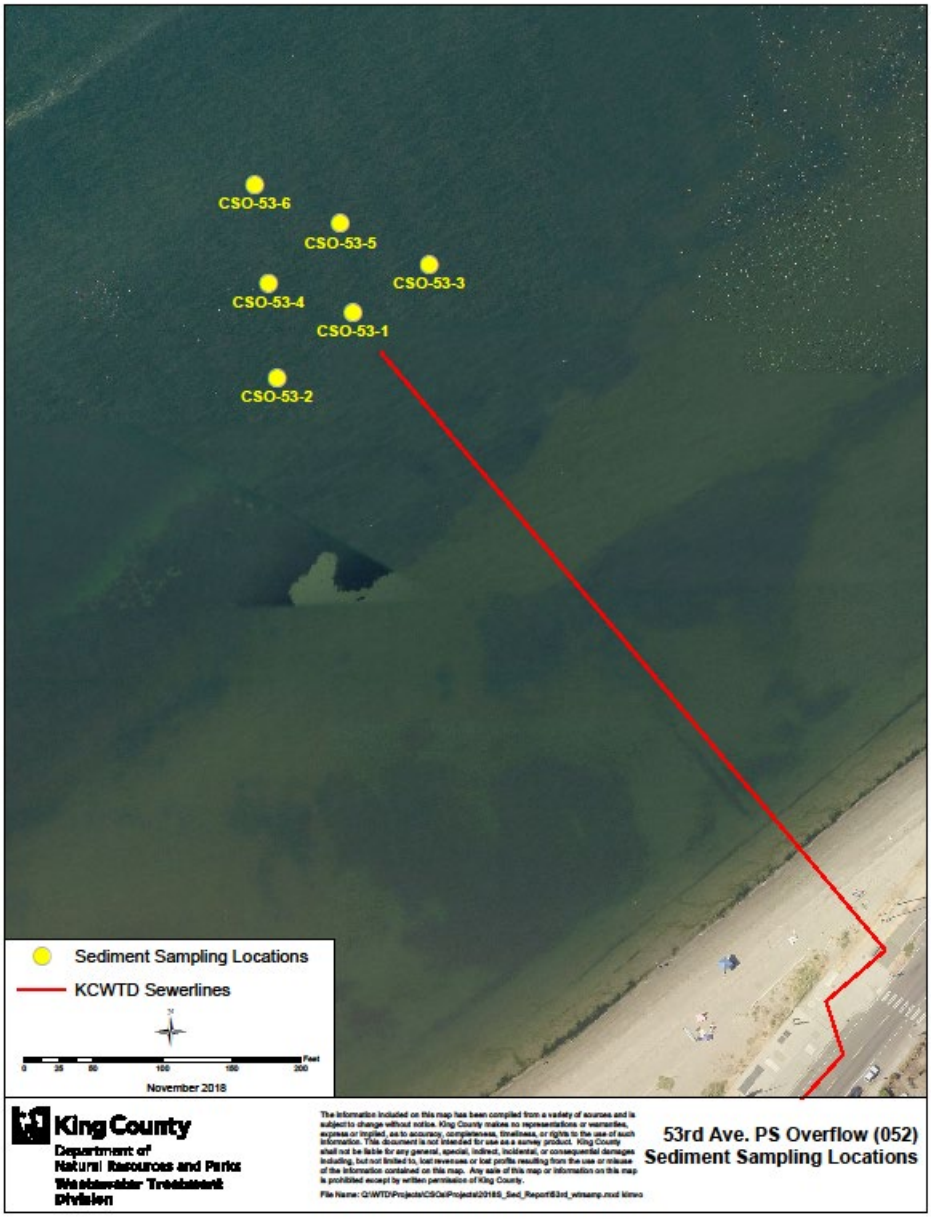



**Figure 2-9. 53rd Avenue Pump Station (052) Sediment Sampling Locations**

### 2.2.5 Alki Wet Weather Treatment Station

NPDES Discharge Serial Number 050

The Alki WWTS receives flows from the Barton and Murray pump stations and the Alki neighborhood in West Seattle. Under normal flow conditions, wastewater is sent to the West Seattle Tunnel. When the capacity of the West Seattle Tunnel is reached, flow is diverted to the Alki WWTS for primary treatment and discharge out the WWTS outfall. When flows recede, wastewater remaining in the station is pumped to the West Seattle Tunnel for treatment at West Point.

**1958 Baseline Facility:** Originally constructed by the City of Seattle as a primary treatment plant; acquired in 1962 by Metro (now King County); converted to a wet weather treatment station in 1998 when the base flows were transferred to West Point for secondary treatment.

**Discharge Location:** Discharges to Puget Sound south of Duwamish Head in West Seattle/Alki through a multi-port diffuser structure at latitude 47° 34’ 12.9” N and longitude -122° 25’ 21.0” W. The diffuser consists of eight 12-inch diffuser ports, terminating at a depth of 142.73 feet (43.5 meters) offshore (Figure 2-10). The diffuser provides 17.5:1 dilution at the edge of the zone of acute criteria exceedance and 61:1 dilution at the edge of the chronic mixing zone.

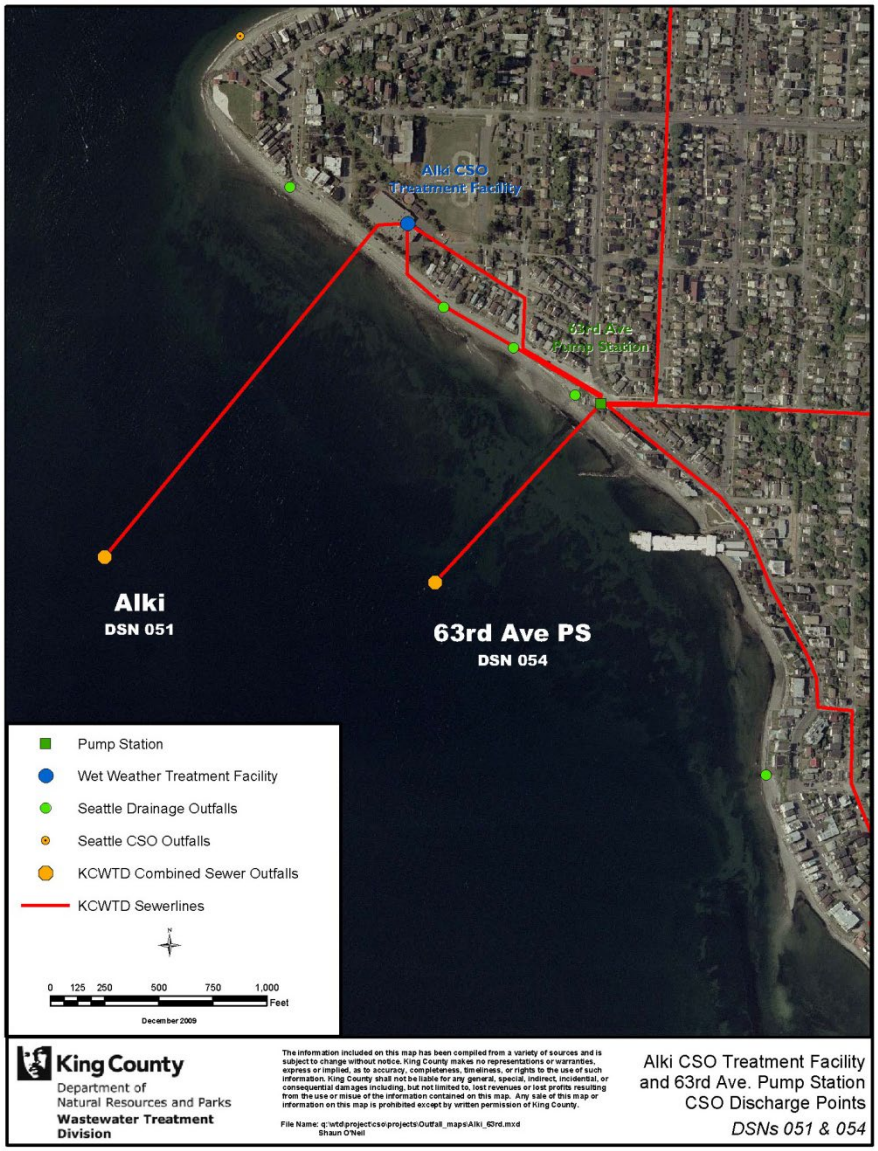



**Figure 2-10. Alki Wet Weather Treatment Station Discharge Point**

**1983 Overflow Baseline:** Not applicable; the plant is permitted to discharge up to 108 MG in 29 events per year.

**Overflow Quantity:** No untreated events occur from this facility; controlled to the state standard.

**Control Project History:** Facility never was an untreated CSO; converted to a wet weather treatment station, with disinfection and dechlorination from a 24/7 primary treatment plant in 1998; no further projects are needed.

*Alki CSO Treatment Plant Vicinity; Aerial, Looking West into Puget Sound*

**CSO Effluent Quality Monitoring Data:** Monitoring is done per event for conventional parameters, and priority pollutants are monitored once per permit cycle, under the NPDES permit. Data are available from the Ecology water quality permit program.

**Construction-Related Monitoring:** Post-construction monitoring was not done after the conversion to CSO treatment.

**Sediment Sampling:** Sediments in the vicinity of the Alki CSO Treatment Plant have been sampled multiple times, most recently in 2001. Sediment samples were collected from six locations proximal to the Alki outfall in October 2001. Five of the stations formed a transect perpendicular to the end of the outfall and the sixth station was located approximately 1,500 feet from the outfall. Figure 2-11 shows the station locations and the outfall discharge point. All detected chemical concentrations were less than the SMS. Data from this sampling event were included in the 2009 CD data submittal.

**Sediment Remediation Activity:** No action required.


**Figure 2-11. Alki CSO Treatment Plant (051) Sediment Sampling Locations**

## 2.2.6 63rd Avenue Pump Station

NPDES Discharge Serial Number 054

The 63rd Ave. PS receives flows from its tributary area in the Alki neighborhood. The facility pumps flow to the Alki WWTS.

**1958 Baseline Facility:** Pump station built by the City of Seattle; Seattle CSO after completion of Alki Sewage Treatment Plant; acquired by Metro (now King County) in 1962.

**Discharge Location:** Submerged, offshore to Puget Sound; 1,100 feet of 60-inch-diameter outfall at latitude 47° 34' 12.059" N and longitude -122° 24' 58.682" W (Figure 2-12).

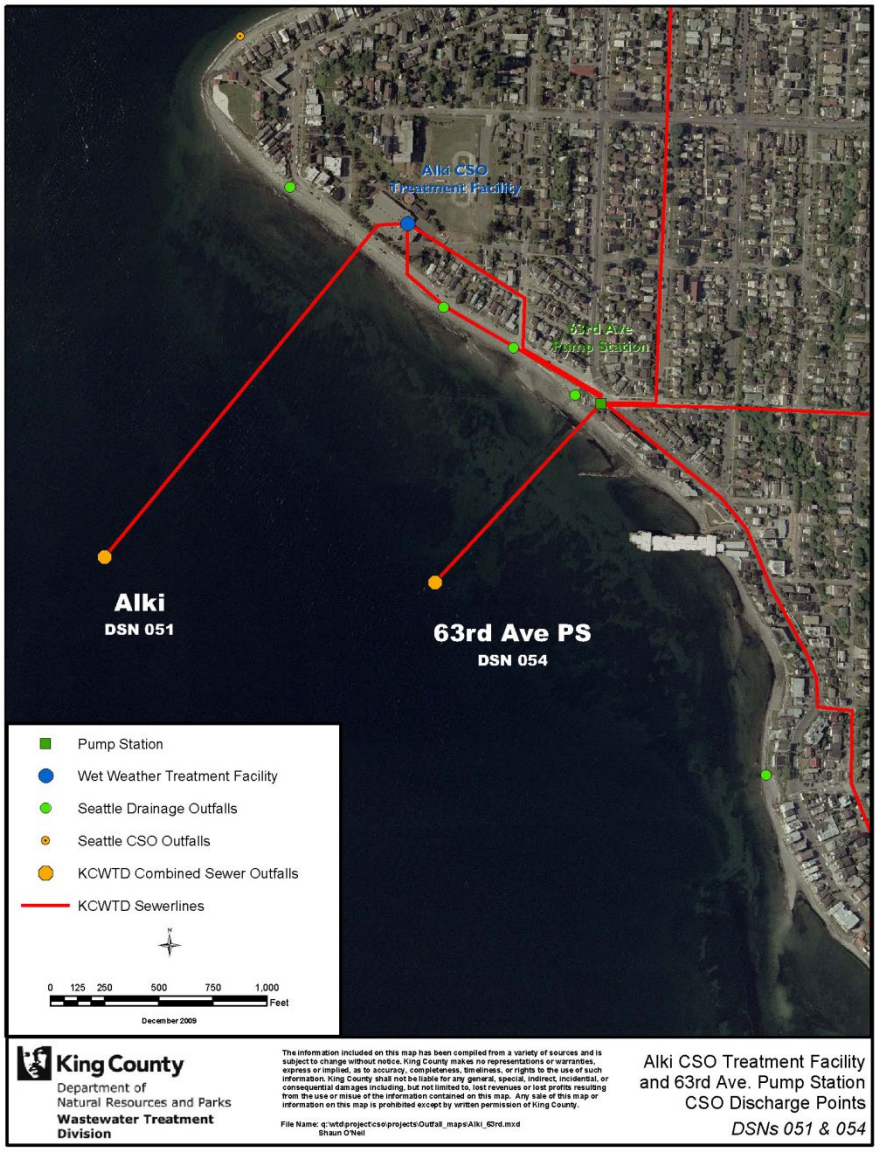



**Figure 2-12. 63rd Avenue Pump Station CSO's Discharge Point**

**1983 Overflow Baseline:** 2 events and 10 MG per year.

**Overflow Quantity:** Has overflowed between 0 and 5 times per year since 2000, when monitoring began; the 18-year average is 1.4 events per year.

*63rd Avenue Pump Station CSO Vicinity; Looking Northwest Across Puget Sound.*

**Control Project History:** Controlled in 1998 when converted to be used only when the West Seattle Tunnel is full; now functions to pump excess flow to the Alki WWTS. As of 2017, the number of overflows was determined to have increased because of hydraulic changes. In 2017, the pumps were fitted with new variable speed drives and associated controls that will provide greater operational flexibility and improve performance. A new operations computer model for the West Seattle system will be completed by late 2018 that will be used to optimize operations by 2020. Updates on control status will be reported in CSO annual reports.

**CSO Effluent Quality Monitoring Data:** No overflow quality monitoring to characterize the CSO was performed; quality will be the same as the influent to the Alki WWTS, whose data are available from the Ecology water quality permit program.

**Construction-Related Monitoring:** No post-construction monitoring was done.

**Sediment Sampling:** Sediment samples were collected from six locations proximal to the 63rd Ave. PS CSO discharge point in October 1997. Five of the stations formed a transect perpendicular to the end of the outfall and the sixth station was located approximately 1,000 feet from the outfall. Station locations and the outfall discharge point are shown in Figure 2-13. All detected chemical concentrations were less than the SMS. Data from this sampling event were included in the 2009 CD data submittal.

**Sediment Remediation Activity:** No action required.

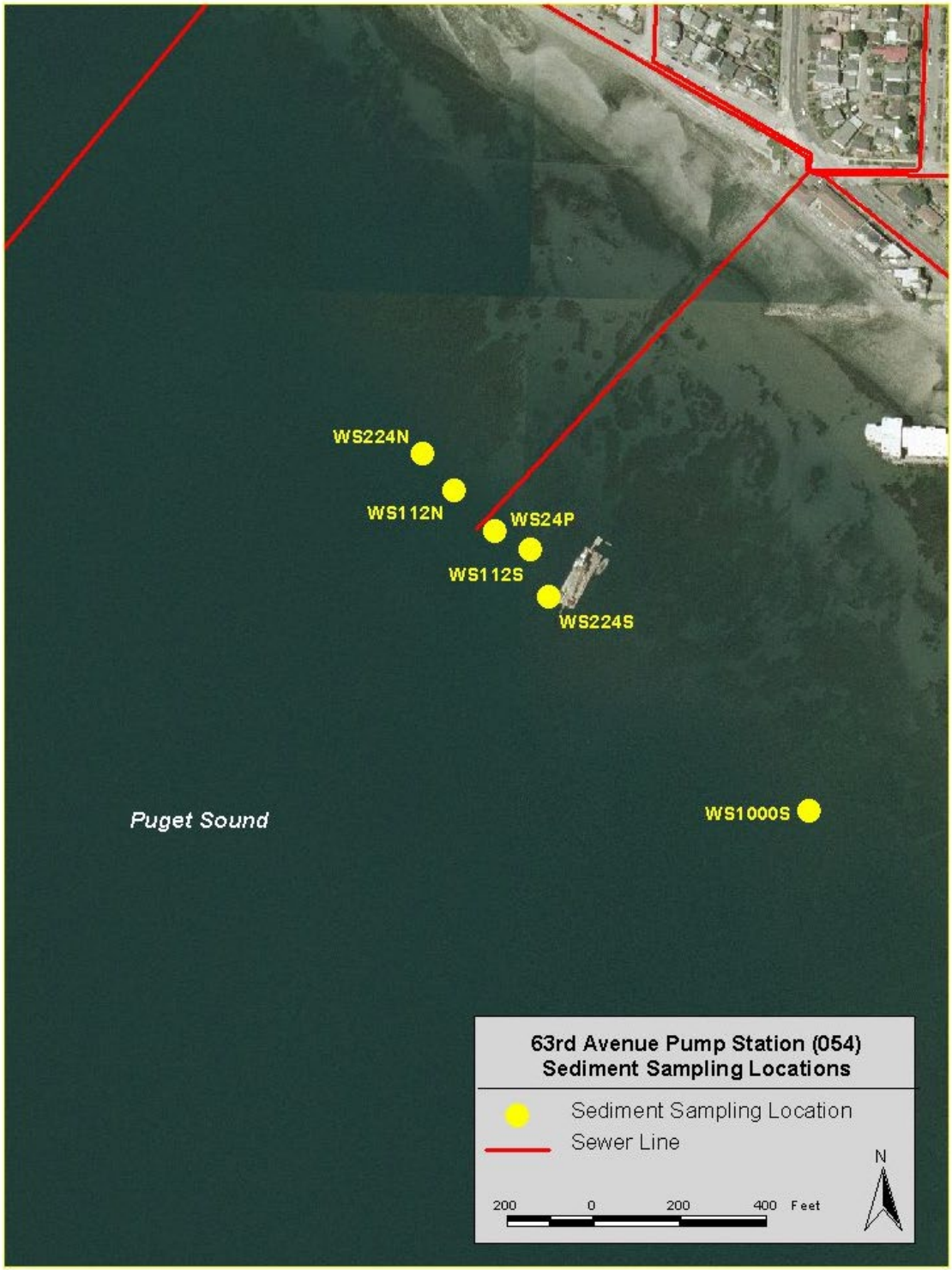



**Figure 2-13. 63rd Avenue Pump Station (054) Sediment Sampling Locations**

## 2.2.7 Southwest Alaska Street

NPDES Discharge Serial Number 055

Flows to this CSO originate in the Alki neighborhood of West Seattle. Flows from this location continue to the Alki WWTS.

**1958 Baseline Facility:** Seattle CSO after completion of Alki Sewage Treatment Plant; acquired by Metro (now King County) in 1962.

**Discharge Location:** A 54-inch-diameter outfall approximately 300 feet offshore at a depth of 20 feet into Puget Sound at latitude 47° 33' 33.992" N and longitude -122° 24' 25.010" W (Figure 2-14).


**Figure 2-14. Southwest Alaska Street CSO Discharge Point**

**1983 Overflow Baseline:** 1 event and less than 0.1 MG per year.

**Overflow Quantity:** Has overflowed between 0 and 1 time per year since 1998; between 1998 and 2017, the 20-year average was 0.3 events per year. This CSO has been controlled and is expected to meet control standards going forward.

**Control Project History:** A project was specified in the RWSP, but is not needed because the site is controlled.

*Alaska Street CSO Vicinity; Looking Northwest Across Puget Sound.*

**CSO Effluent Quality Monitoring Data:** Overflow quality monitoring to characterize the CSO was not required. Estimated to be residential in quality.

**Construction-Related Monitoring:** Not applicable.

**Sediment Sampling:** Sediment samples were collected from six locations proximal to the SW Alaska St. CSO discharge point in October 1997. Five of the stations formed a transect perpendicular to the end of the outfall and the sixth station was located approximately 1,000 feet from the outfall. Figure 2-15 shows the station locations and the outfall discharge point. All detected chemical concentrations were less than the SMS. Data from this sampling event were included in the 2009 CD data submittal.

**Sediment Remediation Activity:** No action required.


**Figure 2-15. Southwest Alaska Street Overflow (055) Sediment Sampling Locations**

### 2.2.8 Murray Avenue Pump Station

NPDES Discharge Serial Number 056

Flows to the Murray Ave. PS come from its tributary area in West Seattle and from the Barton St. PS. Flows are pumped to the 63rd Ave. PS.

**1958 Baseline Facility:** Pump station built by the City of Seattle; Seattle CSO after completion of Alki Sewage Treatment Plant; acquired by Metro (now King County) in 1962.

**Discharge Location:** 72-inch-diameter submerged outfall, 800 feet offshore of Lowman Beach Park in West Seattle into Puget Sound at latitude 47° 32’ 24.991” N and longitude -122° 24’ 0.009” W (Figure 2-16).


**Figure 2-16. Murray Avenue Pump Station CSO Discharge Point**

**1983 Overflow Baseline:** 1 event and 0 MG per year.

**Overflow Quantity:** Has overflowed between 0 and 1 time per year since 1998. The 20-year average is 0.3 events per year. This CSO has been controlled and is expected to meet control standards going forward.

**Control Project History:** The Murray wet weather facility upgrade was completed in spring of 2017.

**CSO Effluent Quality Monitoring Data:** Overflow quality monitoring to characterize the CSO was not required. Estimated to be residential in quality.

*Murray Avenue Pump Station CSO Vicinity; Looking West Across Puget Sound.*

**Construction-Related Monitoring:** King County's PCMP was approved by Ecology on September 28, 2012. Monitoring overflow volumes and frequency at the controlled untreated discharge locations is ongoing and reported monthly to Ecology. These and sediment monitoring events are summarized in CSO annual reports.

**Sediment Sampling:** Sediment samples were collected from 13 locations proximal to the Murray Ave. PS CSO discharge point in August 2011 and March 2013. The stations were collected per the PCMP in 2011, with additional stations added in 2013 to correct PCMP locations based on a revised discharge volume and velocity estimate and two additional stations inshore of the outfall to help validate the County's CSO discharge model. The farthest was approximately 450 feet from the discharge point of the CSO. Figure 2-17 shows the station locations and the outfall discharge point. Results indicate that four chemicals (phenanthrene, fluoranthene, benzo(a)anthracene, and pyrene) exceeded the CSL at one station. There is no combination of three stations where the average exceeds the CSL for either chemical and, therefore, there is no cluster of concern at the site (173-204 WAC). The 2018 submittal includes data from this sampling event.

**Sediment Remediation Activity:** No action required.

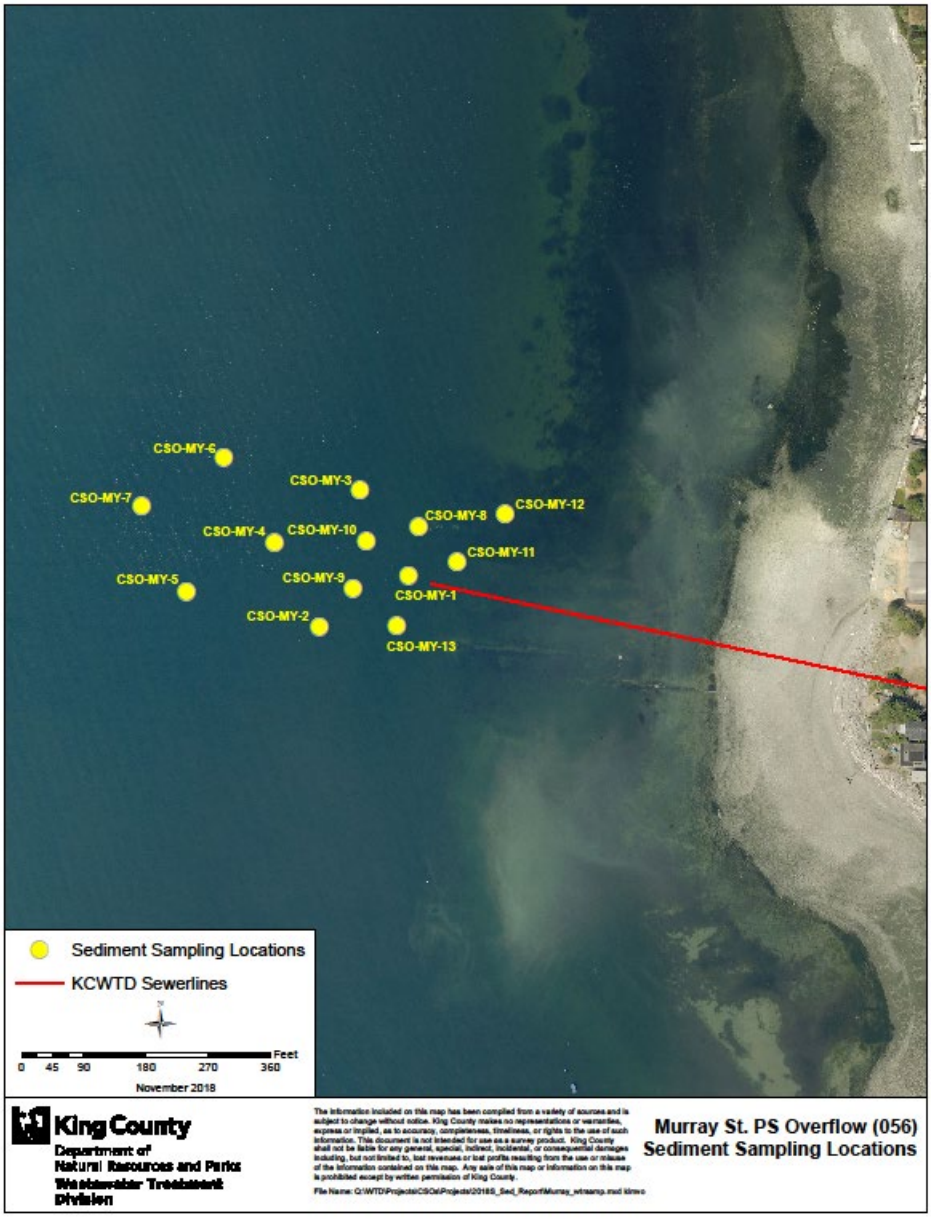



**Figure 2-17. Murray Avenue Pump Station (056) Sediment Sampling Locations**

### 2.2.9 Barton Street Pump Station

NPDES Discharge Serial Number 057

Flows to the Barton St. PS come from its local tributary area. Flows are pumped to the Murray St. PS.

**1958 Baseline Facility:** Pump station built by the City of Seattle; Seattle CSO after completion of Alki Sewage Treatment Plant; acquired by Metro (now King County) in 1962.

**Discharge Location:** 60-inch-diameter submerged outfall, 620 feet offshore of the Fauntleroy Ferry Terminal in West Seattle into Puget Sound at latitude 47° 31’ 25.991” N and longitude -122° 23’ 47.014” W (Figure 2-18).


**Figure 2-18. Barton Street Pump Station CSO Discharge Point**

**1983 Overflow Baseline:** 9 events and 8 MG per year.

**Overflow Quantity:** Has overflowed between 0 and 3 times per year since 1998. The 20-year average is 1.6 events per year.

*Barton Street Pump Station CSO Vicinity; Looking West Across Puget Sound.*

**Control Project History:** The Barton CSO control project was completed in 2015. The control project involved installation of GSI (i.e., rain gardens) and increasing pump station capacity from 22 to 33 million gallons per day (MGD). As of 2017, it has been determined that pumping operational controls were not programmed to fully use the increased pumping capacity, which resulted in the number of overflows slightly exceeding the control standard. The controls have been modified, and system operations will be modeled and monitored through 2020 to verify that the CSO is in control. The CSO is currently under a supplemental compliance plan.

**CSO Effluent Quality Monitoring Data:** Overflow quality monitoring to characterize the CSO was not required. Estimated to be residential in quality with some light commercial.

**Construction-Related Monitoring:** King County's PCMP was approved by Ecology on September 28, 2012. Monitoring overflow volumes and frequency at the controlled untreated discharge locations is ongoing and reported monthly to Ecology. These and sediment monitoring events are summarized in CSO annual reports.

**Sediment Sampling:** Sediment samples were collected from 13 locations proximal to the Barton St. PS discharge point in August 2016. Samples from these stations were collected per the PCMP, with additional stations added to bound some PAH exceedances seen in 2011 and additional stations inshore of the outfall to help validate the County's CSO discharge model. The farthest stations were located approximately 150 feet away from the discharge point of the CSO. Figure 2-19 shows station locations and the outfall discharge point. Results indicate bis(2-ethylhexyl)phthalate exceeded SQS at station CSO-BT-4 and butyl benzyl phthalate exceeded SQS at station CSO-BT-1. Stations reoccupying the PAH exceedances in 2011 did not exceed SQS. All other parameters were below the SMS. The 2018 submittal includes data from these sampling events.

**Sediment Remediation Activity:** No action required.

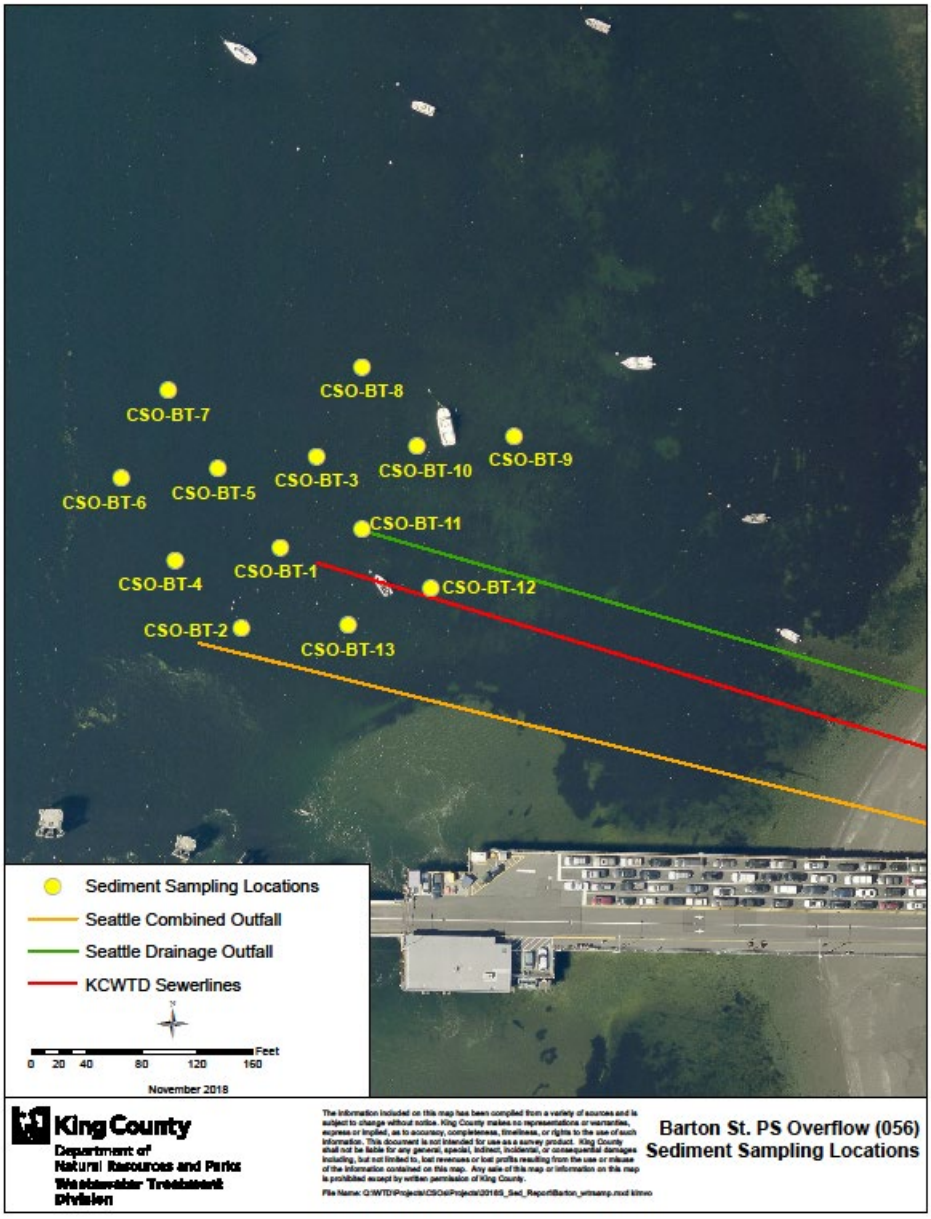



**Figure 2-19. Barton Street Pump Station (057) Sediment Sampling Locations**

# 3.0 CSO Outfalls in Elliott Bay

King County manages three CSOs and one wet weather treatment station that discharge to Elliott Bay. The Denny Way CSO will be controlled after post-control project fine-tuning is completed. The King St. and Kingdome (AKA Connecticut St.) CSOs are not yet controlled.

## 3.1 Receiving Water

### 3.1.1 Overview

Elliott Bay is an estuarine system dominated by the marine water of Puget Sound and influenced by the fresh water of the Duwamish Estuary, which discharges into the southeastern corner of the bay. Much of present-day Elliott Bay used to be a complex tidal marsh habitat that frequently flooded. Beginning in the late 1800s, the estuary tidelands were filled, drained, and dredged to support increased industrial and port activities, both in Elliott Bay and upstream in the Duwamish Estuary.

Elliott Bay is bordered on the east, north, and south by Seattle neighborhoods, including the downtown area to the east and industrialized Harbor Island in the southeast corner, and on the west by the waters of the Central Basin of Puget Sound.

In addition to industrial and shipping activities, the study area hosts fishing, boating, scuba diving, and beach activities. As an estuary, it supports a high diversity of fish, invertebrate, bird, and mammal species and acts as a transitory pathway for salmon migrating through the Duwamish Estuary and into the Green River. In addition to salmon, several other federally threatened and endangered species use Elliott Bay either as a permanent habitat or as a migratory route. Humans, threatened/endangered species, and other organisims that use the waters of Elliott Bay are potentially at risk from historical and ongoing sources of contamination (King County, 2017c).

### 3.1.2 Receiving Water Characteristics

The following discussion is based on the *Water Quality Assessment and Monitoring Study: Analysis of Existing Data on Elliott Bay* (King County, 2017c). From a regulatory and human health standpoint, elevated bacteria concentrations (as measured by fecal coliforms) are a persistent water quality issue in Elliott Bay. Concentrations of fecal coliform are highest nearshore, particularly near the downtown Seattle waterfront. Nearshore bacteria concentrations have declined in the last several decades despite frequent Washington State water quality criteria (WQC) exceedances. This decline is likely due, in part, to increased CSO control. Nonetheless, bacteria concentrations are still elevated above WQC, especially near the shoreline.

Water temperature exceeds WQC in much of Elliott Bay and may be too high for some aquatic organisms including salmonids, particularly in surface waters during the summer. Temperature

in the bay is greatly influenced by large-scale climate patterns, and no definitive trend for the overall bay could be discerned from the data.

WQC for dissolved oxygen (DO) are commonly exceeded in Elliott Bay, especially at depth and during fall. DO concentrations commonly fall below the state WQC at several locations in the bay and adjacent Puget Sound. Low DO environments can be detrimental to aquatic life. Concentrations are lowest in the deep waters of the bay and in the late summer/early fall when low-DO deep waters from the Pacific Ocean upwell into Puget Sound with subsequent de-stratification in Elliott Bay. In contrast, surface waters are typically saturated with DO from May to August when phytoplankton are at their peak abundances. DO concentrations in Elliott Bay have not significantly changed in the last 15–20 years.

Nitrogen, phosphorus, and silica concentrations in Elliott Bay are largely influenced by inputs from oceanic and freshwater sources and the growth and decay of phytoplankton. Elevated ammonia concentrations observed from routine monitoring at depth near the South Treatment Plant outfalls, located near the boundary of Elliott Bay and Puget Sound, are the only evidence of the presence of treated effluent. Throughout Elliott Bay, including waters surrounding other outfalls, nutrients are well below WQC. No definitive trends were identified in nutrient concentrations over the past two decades, suggesting no substantial changes in nutrient loads.

Recent water column data on metals concentrations are insufficient for assessing current water quality conditions in Elliott Bay. Metals have been analyzed at only one site in Elliott Bay in the last decade, and no data exist for the Seattle waterfront. The available data indicate that metals are well below Washington State WQC and U.S Environmental Protection Agency (EPA) Human Health Criteria. Spatial and temporal patterns of metals in the bay could not be assessed because of data limitations.

Over the past decade, organic compounds were sampled at only two sites in Elliott Bay. Data indicate that chemical concentrations do not exceed Washington State WQC; however, concentrations of bis(2-ethylhexyl)phthalate and three high molecular weight PAHs (HPAHs) (benzo(a)anthracene, benzo(b)fluoranthene, and benzo(k)fluoranthene) occasionally exceed EPA Human Health Criteria. The mean concentration at any one site never exceeded the criteria.

## 3.2 Information on Specific CSO Outfalls

This section presents outfall and discharge information and sediment chemistry results for the three CSO outfalls in Elliott Bay.

More information on the volume of CSO discharged yearly from each location can be found in the annual reports on King County's CSO program on King County's website.[11]

[11] Links to the annual reports are available at http://www.kingcounty.gov/environment/wastewater/CSO/Library/AnnualReports.aspx.

Table 3-1 presents a summary of sediment and discharge monitoring information for these CSOs. It also indicates whether there is a stormwater outfall associated with a CSO site.

**Table 3-1. Summary of Sediment and Discharge Information for CSOs in Elliott Bay**

| DSN | Facility Name | Control Status | Associated Stormwater Outfall | Discharge Quality Data* | Last Date of KC Sediment Sample | Number of Stations | Sediment Analysis Performed | Data submitted to EIM | SQS Exceedance |
|---|---|---|---|---|---|---|---|---|---|
| 027b | Elliot West WWTS | Treated | No | Yes | 2015 | 16 | Chemistry/ Benthic | Yes | Yes |
| 027a | Denny Way RS | Uncontrolled | No | Yes | 2015 | 16 | Chemistry/ Benthic | Yes | Yes |
| 028 | King St. RS | Uncontrolled | Yes | Yes | 1989 | 5 | Chemistry | Yes | Yes |
| 029 | Kingdome RS (Connecticut St.) | Uncontrolled | Yes | Yes | 1996 | 7 | Chemistry/ Bioassay | Yes | Yes |

### 3.2.1 Denny Way Regulator Station and Elliott West Wet Weather Treatment Station

**Denny Way CSO:** NPDES Discharge Serial Number 027a
**Elliott West CSO Treatment Facility:** NPDES Discharge Serial Number 027b

Control of the Denny Way RS in Myrtle Edwards Park was part of a larger CSO control project done in conjunction with the City of Seattle. Excess flows are stored in a tunnel and then sent to West Point after a storm. Flows in excess of tunnel capacity are sent to the Elliott West WWTS for treatment and discharge to an outfall into Elliott Bay near the Denny Way RS. Flows beyond the capacity of the treatment plant discharge untreated through a new outfall from the regulator station. The project was completed in 2005. The new system has substantially decreased annual discharges from Denny Way (King County, 2012). Adjustments continue to be made to achieve full control of the site (King County, 2017c).

**1958 Baseline Facility:** Seattle raw sewage outfall; acquired by Metro (now King County) in 1962 and intercepted for treatment at West Point in 1967.

**Discharge Location:** Untreated overflow on surface at northeast side of Elliott Bay until replaced in 2005 as part of the Denny Way/Lake Union CSO control project with a new submerged outfall 100 feet offshore at a 10-foot depth; also as part of the project, the new Elliott West WWTS started discharging treated CSO at latitude 47° 37’ 3.18” N and longitude -122° 21’ 42.68” W through a 90-inch-diameter submerged outfall 490 feet offshore at a 60-foot depth (Figure 3-1). The treated discharge outfall provides 7.8:1 dilution at the zone of acute criteria exceedance and 11:1 dilution at the chronic mixing zone boundary.


**Figure 3-1. Denny Way Regulator Station and Elliott West Wet Weather Treatment Station CSO Discharge Point**

**1983 Overflow Baseline:** 32 events and 502 MG per year.

**Denny Way Regulator Station:** The Denny Way RS was anticipated to be controlled as part of the Denny Way/Lake Union CSO Control Project completed in 2005. As part of this project, the Elliott West WWTS was constructed to control the Denny Way CSOs and multiple CSOs around Lake Union. Investigation suggested that two of the inputs to the regulator station were overflowing more than intended. The investigation recommended removal of the lower Denny Way local weir and modification of the Elliott West WWTS pump ramp-up strategy to drop the lead pump start set point by 2.25 feet and improve flow into the Elliott West WWTS. The weir modifications were completed in July 2011 and pumping strategy modifications were completed on November 17, 2011. Additional work on the pumping strategy was completed in the fall of 2015. Monitoring in 2016 still showed control issues with Denny Way and additional adjustments to pumping strategy were made in December 2016. The Denny Way RS is being monitored for two wet seasons, 2016 to 2017 and 2017 to 2018, and compliance will be assessed in 2019.

*Denny Way Original Outfall*

*Denny Way CSO and Elliott West CSO Treatment Facility Vicinity after New Outfalls; April 2008*

**Control Project History:** The Elliott West WWTS was completed in 2005 to control the Seattle east Lake Union CSOs and the County's west Lake Union Dexter CSO and Denny RS into Elliott Bay. The facility provides CSO (equivalent to primary) treatment, screening, disinfection, and dechlorination of captured CSOs. Additional adjustments are underway to complete control to the state standard.

**CSO Effluent Quality Monitoring Data:** Substantial overflow quality monitoring has been conducted through a variety of studies between 1982 and 1997 to characterize the CSO. More current data are available from the Ecology water quality permit program.

**Construction-Related Monitoring:** Pre-construction effluent and sediment monitoring was finished before the new outfalls were completed. Post-construction monitoring is currently underway.

**Sediment Sampling:** Sediments in the vicinity of the Denny Way CSO and, later, the Elliott West WWTS discharge points have been sampled extensively in the past. The current sediment monitoring program has been in effect since 2001 as part of the Denny Way/Lake Union CSO Control Project long-term sediment monitoring program. Samples were collected from 16 locations proximal to the two outfalls in 2001, 2003, 2004, 2006, 2007, 2008, 2009, 2010, 2011, 2012, and 2015. Figure 3-2 shows the station locations and the outfall discharge points.

The chemicals of concern at the Denny Way site include mercury, total PCBs, bis(2-ethylhexyl)phthalate, butyl benzyl phthalate, total high molecular weight polycyclic aromatic hydrocarbons, and some individual PAH compounds. Concentrations of these chemicals were above the SQS at various sampling stations and times over the monitoring period (in both 0- to 2-centimeter and 0- to 10-centimeter samples). Chemical concentrations above the SQS were most frequently detected at three monitoring stations: DWMP-01, -08, and -14. Monitoring station DWMP-10 represents sediments in an area of the site cleaned up in 2008. All chemical concentrations above the SQS at station DWMP-10 occurred before remedial actions and the area has not re-contaminated since that time. Sediment data collected for this monitoring program are interpreted in King County, 2018.

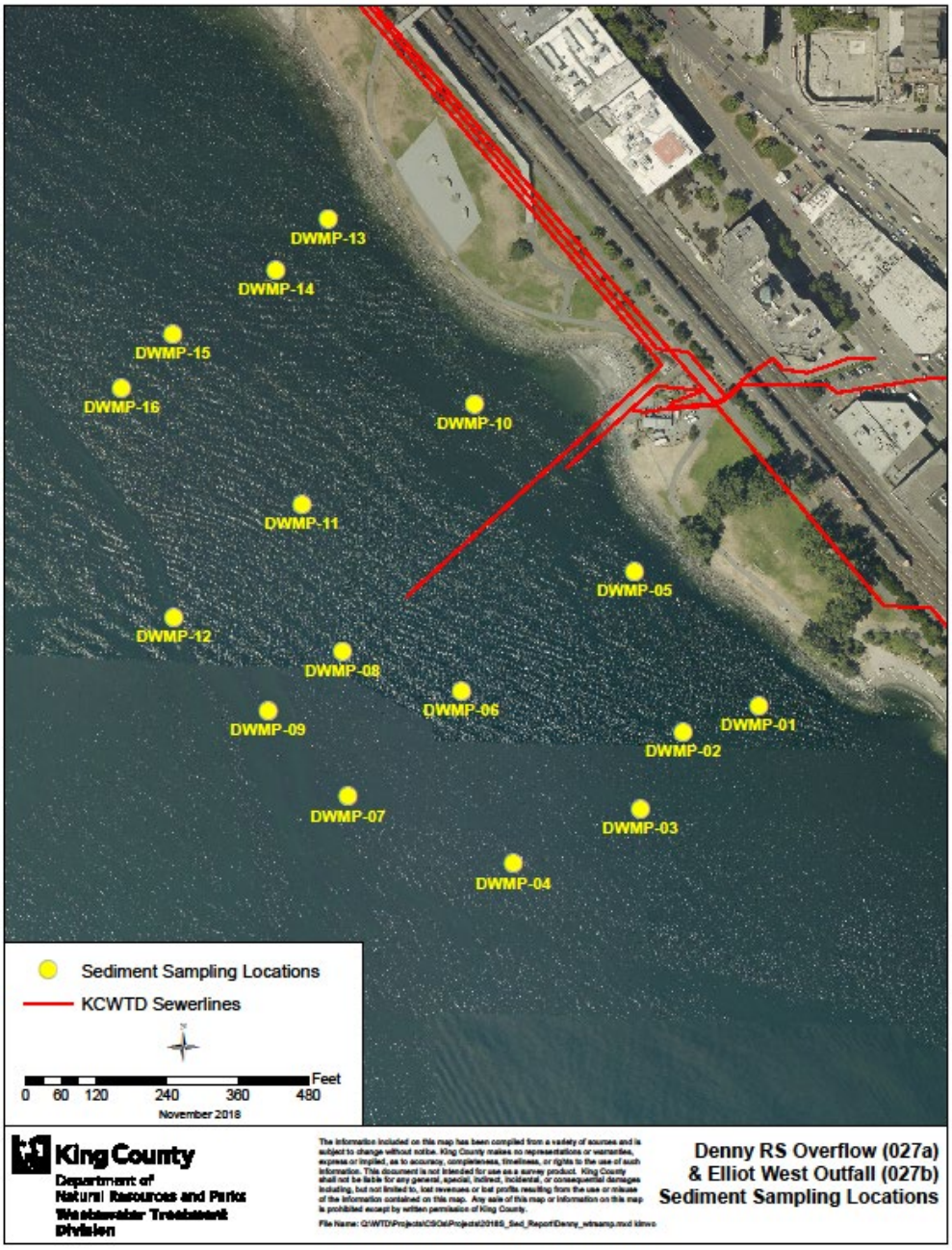



**Figure 3-2. Denny Way Regulator Station (027a) and Elliott West WWTS (027b) Sediment Sampling Locations**

**Sediment Remediation Activity:** In 1986, Metro (now King County) began a trial program to identify and reduce toxicant inputs to the sewer system discharging through the Denny Way CSO. In 1990, King County and the U.S. Army Corps of Engineers sponsored the Denny Way CSO capping project to test the feasibility of capping contaminated sediments in Elliott Bay with clean, dredged material from the Duwamish Waterway. A 3-foot layer of clean sand, dredged from the upper Duwamish Waterway during routine maintenance, was placed over a 3-acre area in water depths ranging from approximately -25 to -60 feet mean lower low water (MLLW).

King County has monitored the effectiveness of the cap at containing contaminated sediment for the past 17 years. Results show that the cap is stable and not eroding, and has successfully isolated the underlying contaminated sediments (King County, 2005). However, chemical concentrations on the cap surface layer (offshore of the Denny Way CSO) increased after cap construction, suggesting possible recontamination from the continued CSO discharges from Denny Way or potential redistribution of remaining contaminated sediments from the intertidal area and the inshore edge of the cap.

In 1997, King County characterized the nature and extent of surface and subsurface sediment contamination in the outfall area and in areas inshore and offshore of the existing sediment cap (SEA, 1997). Follow-up sediment sampling conducted by King County in 2005 demonstrated that chemical concentrations in the offshore areas declined over time because of a combination of natural processes, including biodegradation of chemicals, accumulation and mixing of clean sediment, and reduction of contaminant sources (King County, 2005). Thus, monitored natural recovery is a prospective cleanup remedy for the offshore areas. These areas continued to be evaluated by Ecology and King County to determine if a more active cleanup remedy is required.

In 1997, sediments sampled within inshore areas of the site contained concentrations of cadmium, copper, lead, mercury, silver, PAHs, PCBs, bis(2-ethylhexyl)phthalate, and butyl benzyl phthalate that exceeded the SQS. Contaminant concentrations above SQS chemical criteria were present to a depth of approximately 10 feet below the existing mudline. Unlike offshore areas of the site, natural recovery rates in the inshore sediment areas appeared to be progressing relatively slowly. To accelerate cleanup of the site and minimize the risk of future recontamination to other site areas, including the offshore cap, an interim sediment cleanup action plan for the site was developed by King County and Ecology in 2007 that included dredging, to the maximum extent practicable, to remove contaminated sediments and backfilling to restore the grade to close to pre-project conditions.

The Denny Way CSO interim action remediated contaminated sediment present in two nearshore areas in the immediate vicinity of the former Denny Way CSO outfall (Areas A and B in Figure 3-3). A combination of dredging, backfilling, and armoring was used to remediate the nearshore areas.

In the initial design, approximately 17,000 cubic yards of contaminated sediments and associated side slopes were to be dredged from approximately +10 feet MLLW to approximately -35 feet MLLW within the 1.2-acre interim action area. A change order during dredging decreased the overall dredge footprint by over-steepening the side slopes to minimize the disturbance and removal of the riprap seawall. After the change order, approximately 13,700 cubic yards of contaminated sediments and associated side slopes were dredged. The dredged area was backfilled and armored with an average thickness of more than 8 feet of material. Approximately 11,886 cubic yards of well-graded clean sand was armored with approximately 4,821 cubic yards of sandy-gravel habitat mix and with large cobbles and boulders. An additional 1,540 cubic yards of well-graded clean sand was placed in an approximately 6-inch-thick layer around the perimeter of the dredge prism to address any residuals that may have resulted from the dredging.

Post-construction sediment monitoring is documented in the Denny Way CSO Interim Sediment Cleanup Project Closure Report.[12]

[12] The report is available at https://your.kingcounty.gov/dnrp/library/wastewater/sedman/Denny/Denny_200810.pdf.

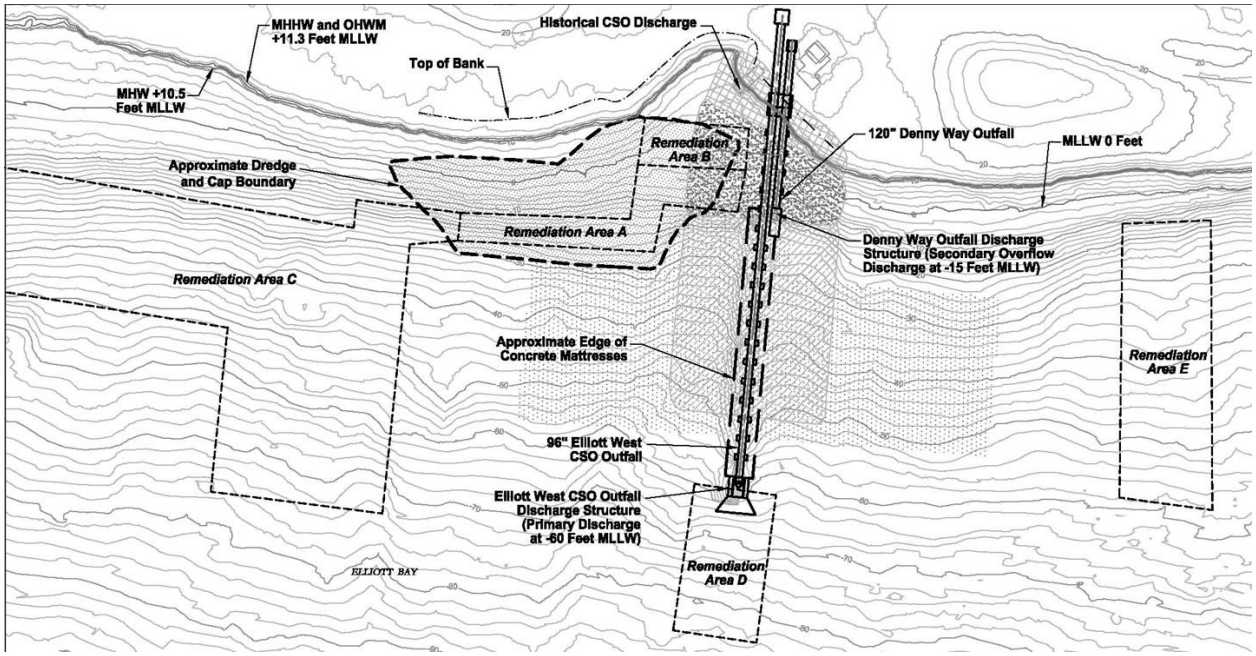



**Figure 3-3. Remediation Areas Associated with Denny Way CSO**

### 3.2.2 King Street Regulator Station

NPDES Discharge Serial Number 028

The King St. RS sends flows to the Elliott Bay Interceptor (EBI) on their way to West Point or, during heavy storms, to the King St. CSO outfall into Elliott Bay.

**1958 Baseline Facility:** Seattle raw sewage outfall; acquired by Metro (now King County) in 1962 and intercepted for conveyance to West Point in 1971.

**Discharge Location:** Located next to Terminal 30 at the southeast end of Elliott Bay; Seattle-owned 48-inch-diameter outfall 150 feet offshore at a depth of 20 feet at latitude 47° 37’ 56.411” N and longitude -122° 20’ 14.730” W (Figure 3-4).

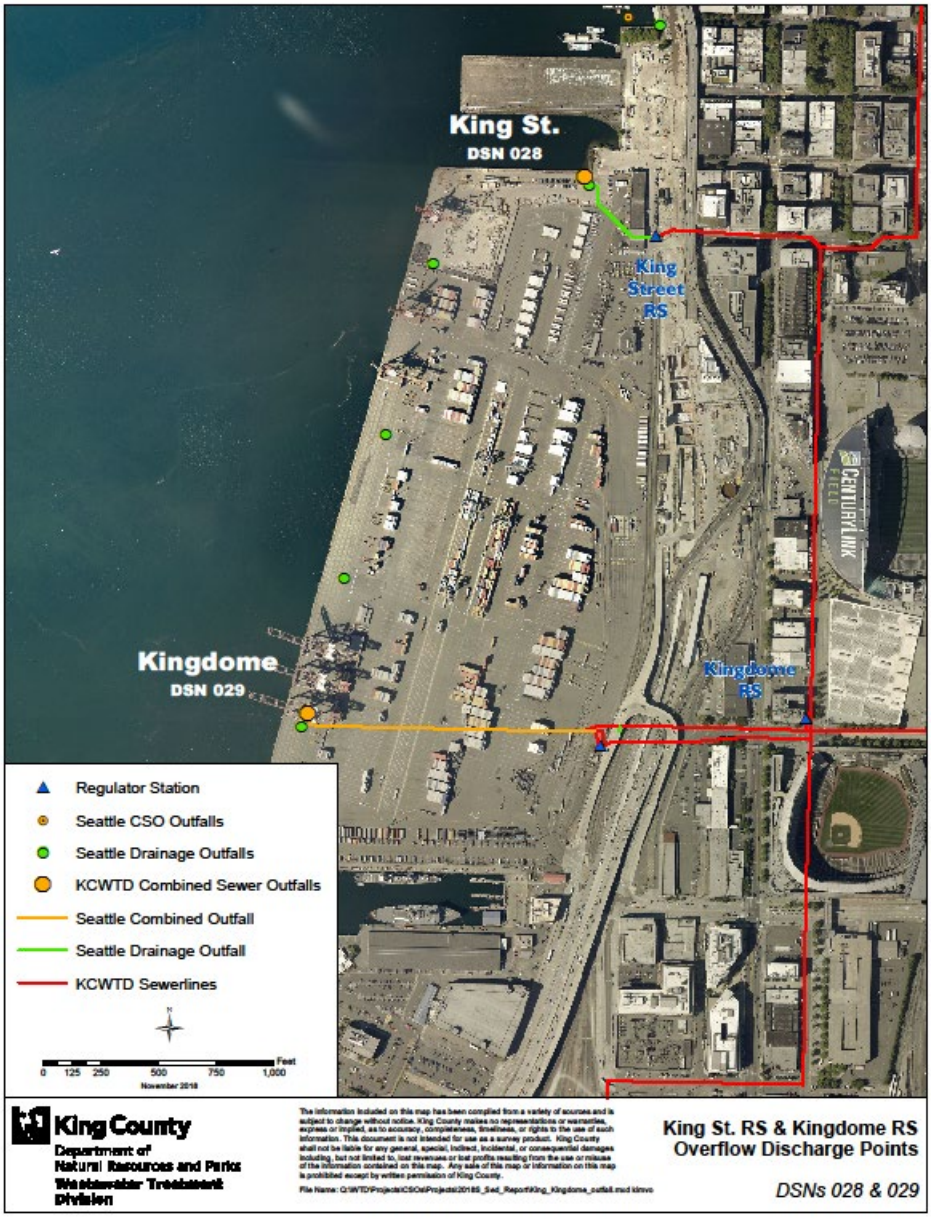


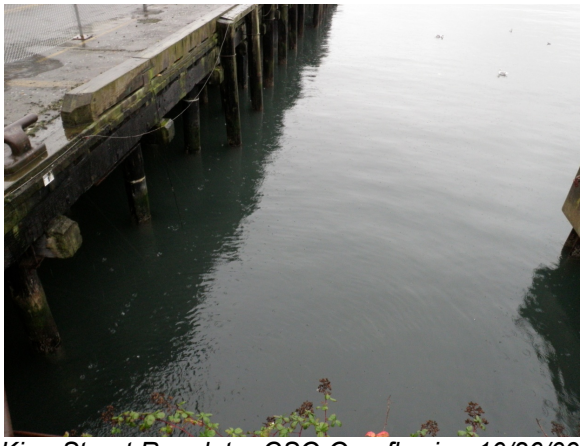

**Figure 3-4. King Street Regulator Station CSO Discharge Point**

**1983 Overflow Baseline:** 16 events and 55 MG per year.

**Overflow Quantity:** Has overflowed between 2 and 27 times per year since 1998; between 1987 and 2017, the 20-year average was 13.6 events per year.

**Control Project History:** Improved system efficiencies have reduced annual discharge volumes from the site. King County plans to build a new 151-MGD wet weather treatment station to control the King St. and Kingdome CSOs into Elliott Bay along with the Lander and Hanford CSOs into the East Waterway. The facility's outfall will likely be located in either Elliott Bay or the waterway. The project is expected to be completed by 2030 (King County, 2017c).

*King Street Regulator CSO Outfall at Extreme Low Tide*



*King Street Regulator CSO Overflowing 10/26/09*

**CSO Effluent Quality Monitoring Data:** Overflow quality monitoring to characterize the CSO was performed in 1996 and 1997.

**Construction-Related Monitoring:** King County's PCMP was approved by Ecology on September 28, 2012. Monitoring volume and frequency of overflows at the controlled untreated discharge locations is ongoing, reported monthly to Ecology. These data and sediment monitoring events are summarized in CSO annual reports.

**Sediment Sampling:** Sediment samples were collected from four locations proximal to the King St. RS discharge point in May 1988. A fifth location was sampled in June 1989. Figure 3-5 shows the station locations and the outfall discharge point. Several chemicals exceeded LAET and/or 2LAET values (total organic carbon was not analyzed) included several polycyclic aromatic hydrocarbons, bis (2-ethylhexyl) phthalate, total PCBs, arsenic, mercury, silver, and zinc. These sediment data were included in the 2009 CD.

**Sediment Remediation Activity:** Remediation was defined in King County's sediment management plan (King County, 1999). The remediation will need to be completed as a coordinated multi-agency project that includes WSDOT (Coleman Dock and Pier 48 projects) and the City of Seattle (Washington St. CSO/storm drain).


**Figure 3-5. King Street Regulator Station (028) Sediment Sampling Locations**

### 3.2.3 Kingdome (Connecticut Street) Regulator Station

Discharge Serial Number 029

The Kingdome and Connecticut regulator stations regulate flows from the Kingdome Trunk and Connecticut St. storm drain, respectively. Both stations send flows to EBI during normal conditions and to the Connecticut St. storm drain, owned by the City of Seattle, for discharge into Elliott Bay during storm conditions.

**1958 Baseline Facility:** A Seattle raw sewage discharge; acquired by Metro (now King County) in 1962. Flows were intercepted in 1971 to be conveyed to West Point for treatment.

**Discharge Location:** Seattle-owned outfall discharging 150 feet offshore at a depth of 20 feet into the East Waterway of the Duwamish River, near the mouth of the river at latitude 47° 35’ 33.114” N and longitude -122° 20’ 31.581” W; shared with Connecticut storm drain (Figure 3-6).

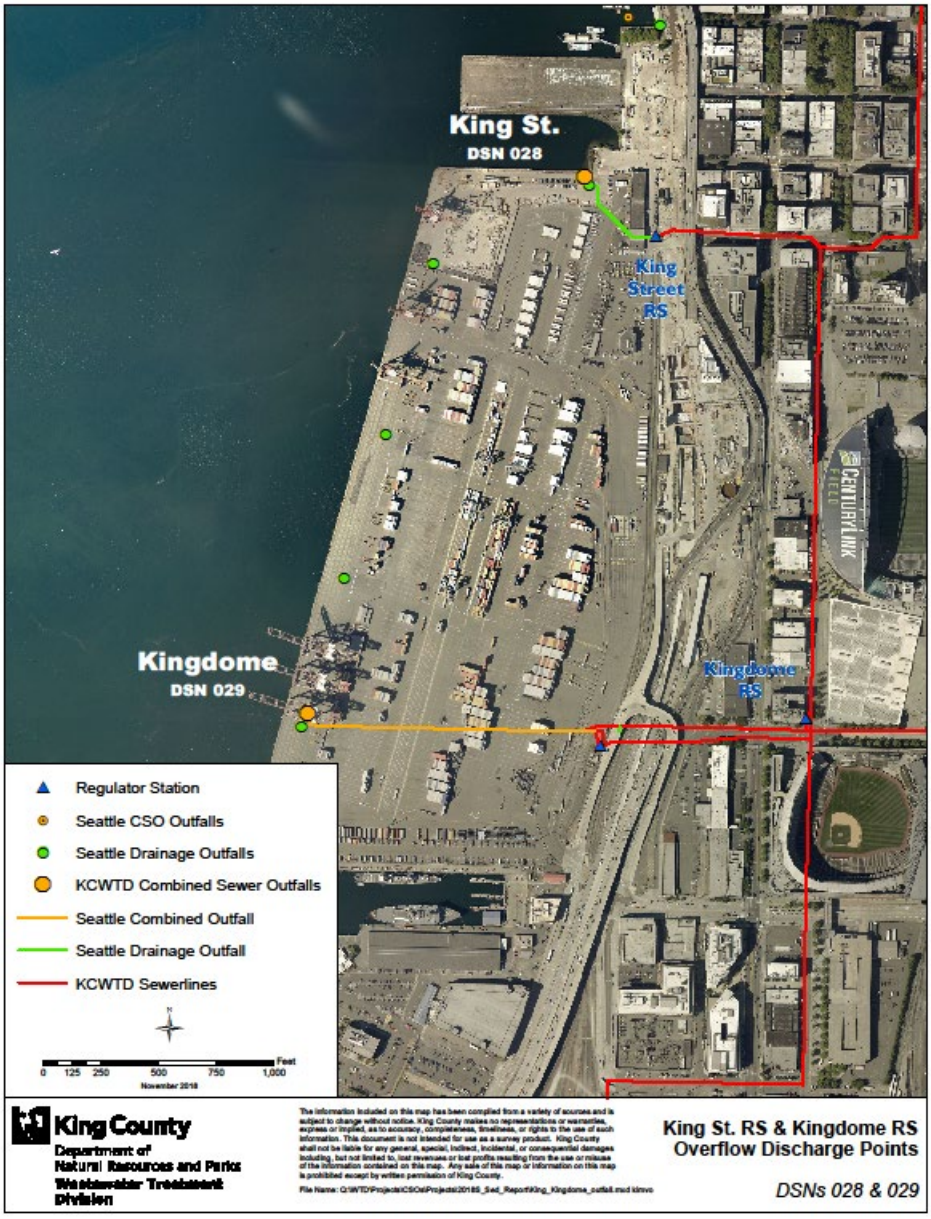



**Figure 3-6. Kingdome (Connecticut Street) Regulator Station CSO Discharge Point**

**1983 Overflow Baseline:** 29 events and 90 MG per year.

**Overflow Quantity:** This CSO has overflowed between 0 and 22 times per year since 1998; between 1998 and 2017, the 20-year average was 6.1 events per year.

**Control Project History:** The Kingdome (Connecticut St.) RS was built in 1996 to replace the Connecticut RS in anticipation of a sewer separation when Royal Brougham Avenue was widened. In 1998, the Washington State Stadium Authority completed the separation, converting the Connecticut sewer and regulator to a storm-only system. In 1994, the County, City of Seattle, and WSDOT installed a pipeline that increased storage capacities near the Kingdome CSO, which helped reduce annual discharges (King County, 2012). This CSO location will be controlled by 2030 through construction of a new CSO wet weather treatment station to control the King St. and Kingdome CSOs into Elliott Bay along with the Lander and Hanford CSOs into the East Waterway. The facility's outfall will likely be located in either Elliott Bay or the waterway (King County, 2017c).

**CSO Effluent Quality Monitoring Data:** Overflow quality monitoring to characterize the CSO was performed from 1989 to 1990 and 1996 to 1997, before the separation project occurred.

**Construction-Related Monitoring:** King County's PCMP was approved by Ecology on September 28, 2012. Monitoring overflow volumes and frequency at the controlled untreated discharge locations is ongoing, reported monthly to Ecology. These and sediment monitoring events are summarized in CSO annual reports.

**Sediment Sampling:** Sediment samples were collected from seven locations proximal to the Kingdome (Connecticut St.) RS discharge point in June 1995. Several chemicals exceeded the SQS or CSL including several polycyclic aromatic hydrocarbons, benzyl butyl phthalate, bis (2-ethylhexyl) phthalate, total PCBs, and copper. Data from these samples were included in the 2009 CD. Since that time, the area has been dredged and new conditions may exist at this location.

**Sediment Remediation Activity:** Berth area maintenance along Pier 48 removed several feet of surface sediments in front of the outfall. The area was evaluated under the East Waterway Superfund Remedial Investigation to determine if it needed to be within the cleanup site boundaries (Windward and Anchor, 2014). Based on the sediment data collected in the vicinity, the area was not included in the site, suggesting no further action is needed.


**Figure 3-7. Kingdome (Connecticut Street) Regulator Station (029) Sediment Sampling Locations**

# 4.0 CSO Outfalls in the Duwamish Estuary

King County manages 14 CSOs and one wet weather treatment station that discharge to the Duwamish Estuary. Five of these CSOs are controlled: West Duwamish, East Duwamish, 8th Ave. S RS, E Marginal Way PS, and Norfolk RS. Nine CSOs are not controlled: Harbor Ave. RS, Lander St. RS, Hanford #1, Hanford #2 RS, Chelan Ave. RS, Brandon St. RS, Terminal 115 CSO, W Michigan RS, and S Michigan RS.

## 4.1 Receiving Water

### 4.1.1 Overview

The Duwamish Estuary encompasses the lowest 6.4 miles of the Green-Duwamish River watershed. The area is located in the City of Seattle, City of Tukwila, and a small area of unincorporated King County. It includes all of Harbor Island (an approximately 0.62-square-mile manmade industrial area) that fronts Elliott Bay, the East and West waterways of the Duwamish Estuary that bound Harbor Island, and the Lower Duwamish Waterway that includes 5 miles of cut channel upstream of the southern tip of Harbor Island. The Duwamish River begins at the upstream end of the estuary at the turning basin and extends upstream to the confluence of the Black and Green rivers. The estuary serves as a major shipping route for bulk and containerized cargo, and the majority of the shoreline has been developed for industrial and commercial operations. The estuary is maintained as a federal navigation channel by U.S. Army Corps of Engineers (Windward, 2008). Navigation elevations maintained within the estuary generally range from -30 feet MLLW from Harbor Island to the First Avenue South Bridge to -20 feet MLLW from the First Avenue South Bridge to Slip 4 and -15 feet MLLW from Slip 4 to the turning basin (Windward, 2008).

The Green River, which is the main freshwater source for the Duwamish Estuary, originates in the Cascade Mountains near Stampede Pass and flows by the Howard Hanson Dam and the Tacoma Headworks Dam. The Howard Hanson Dam was installed in 1961 in the upper part of the Green River, primarily for flood control and low-flow augmentation to preserve fish life when river flows are low. The dam effectively decreased peak flows, which now rarely exceed 12,000 cubic feet per second (cfs), but increased moderate flows from 3,920 to 6,460 cfs because of the periodic metered release of water stored behind the dam (Windward, 2008). Between 2000 and 2006, the annual average flow rate measured at the Auburn gauging station was 1,190 cfs (ranging between 851 and 1,549 cfs). Approximately 80 percent of the water in the Duwamish River eventually flows through the West Waterway because of a sill at the south end of the East Waterway. Flow rates are greatest during the winter months because of seasonal precipitation and lowest throughout the late summer dry season (Windward, 2008). Water circulation within the lower Duwamish is driven by tidal actions and river flow; the relative influence of each is highly dependent on seasonal river discharge volumes.

### 4.1.2 Receiving Water Characteristics

Fresh water moving downstream overlies the tidally influenced salt water entering the system. Typical of tidally influenced estuaries, the lower Duwamish has a relatively sharp interface between the freshwater outflow at the surface and saltwater inflow (wedge) at depth (Windward, 2008). When freshwater inflow is greater than 1,000 cfs, the saltwater wedge does not extend upstream beyond the East Marginal Way South Bridge (river mile 6.3), regardless of the tide height (Windward, 2008). During high tide stages and periods of low freshwater inflow, the saltwater wedge has been documented as extending as far upstream as the Foster Bridge (RM 8.7). At the river's mouth at the northern end of Harbor Island, a salinity of 25 PSS (Practical Salinity Scale) is typical for the entire water column; salinity decreases toward the upriver portion of the estuary. The thickness of the freshwater layer increases as the river flow rate increases (Windward, 2008). The upstream area of the Duwamish is primarily a freshwater river with tidal influence, whereas the mouth of the river is primarily marine with a variable freshwater layer. The cross-channel salinity distribution is typically uniform for a given location and depth, and the salt wedge up the river is controlled by tides and freshwater flow. The upstream extent of the salt wedge is dependent on freshwater inflow and tidal elevation, except that flows greater than 1,000 cfs will prevent intrusion of the wedge farther than 12.6 kilometers upstream, regardless of tide height (King County, 1999).

Elevated bacteria concentrations (as measured by fecal coliform bacteria) are a persistent water quality concern in the Green-Duwamish area. Concentrations were typically highest in the Lower Duwamish Waterway and decreased moving upstream. Frequent exceedances of water quality criteria upstream and downstream of CSOs have occurred. Despite exceedances, it appears that bacteria concentrations have declined in the last 20 to 30 years. CSO control and improved stormwater management may have contributed to this decline. Additional mitigation of bacteria sources and pathways is needed to further enhance water quality and protect human health (King County, 2017b).

The analysis indicates that the lower and middle sections of the Green River are more likely to exceed temperature standards for salmonids than downstream and upstream locations. The Duwamish Estuary remains relatively cool because of the influence of Puget Sound, and reaches of the Green River farther upstream are cooler because land cover is predominantly forest. Analysis showed significant increasing long-term temperature trends in the West Waterway (King County, 2017b).

Generally, DO concentrations have increased in the Duwamish Estuary and the lower Green River in the last 40 years, yet these reaches are more likely to violate DO standards for salmonids than upstream reaches of the Green River. No significant trends were observed for upstream sites in the Green River (King County, 2017b).

Nutrient concentrations in the Duwamish Estuary are affected by inputs from CSOs, stormwater, upstream locations, and internal cycling (nutrients becoming attached to sediments and then being released from sediments during annual seasonal cycles). Trend analysis found that phosphorus, nitrogen, and ammonia concentrations have generally decreased or remained stable in the last 20 to 30 years, indicating that loading has decreased or stayed the same. For ammonia, orthophosphate, and total phosphorus, greater rates of decrease in the Duwamish Estuary suggest less importance of internal cycling (King County, 2017b).

Overall, ambient water in the Green-Duwamish area did not exceed the Washington State water quality criteria for aquatic life or EPA's recommended Human Health Criteria for metals. Total metals concentrations varied. The metals with the highest detection frequencies were aluminum, arsenic, barium, calcium, copper, magnesium, manganese, nickel, sodium, vanadium, and zinc. Dissolved metals were detected at a lower frequency than total metals. Metal concentrations in the Duwamish Estuary are affected by inputs from stormwater, upstream locations, leaching from antifouling vessel paint, and, to a lesser extent, from CSO discharges (King County, 2017b).

No organophosphorus pesticides were detected in the water column. One chlorinated herbicide (triclopyr) was detected in a single sample. PAHs were detected frequently. Various other organic compounds were detected infrequently. PCB congeners were detected from all samples taken. Total PCB concentrations measured by congener analysis exceeded the Human Health Criteria in 66 of 72 samples. Two samples exceeded the Human Health Criteria for bis(2-ethylhexyl)phthalate: one collected in the East Waterway and one collected at the downstream end of the Lower Duwamish Waterway. Most of the older samples typically had detection limits above many of the chronic water quality criteria for the protection of aquatic life or the recommended Human Health Criteria and had higher frequencies of blank contamination. Organic chemicals in the Duwamish Estuary water column are primarily affected by stormwater, upstream locations, internal cycling from sediments, leaching from creosote-treated pilings, and, to a lesser extent, from CSO discharges (King County, 2017b).

## 4.2 Information on Specific CSO Outfalls

This section presents outfall and discharge information and sediment chemistry results for the 15 CSO and wet weather treatment station outfalls in the Duwamish Estuary. (One outfall is shared by two King County CSOs.) More information on the volume of CSO discharged yearly from each location can be found in the annual reports on King County's CSO program on King County's website.[13]

Table 4-1 presents a summary of sediment and discharge monitoring information for these CSOs. It also indicates whether there is a stormwater outfall associated with a CSO site.

[13] Links to the annual reports are available at http://www.kingcounty.gov/environment/wastewater/CSO/Library/AnnualReports.aspx.

**Table 4-1. Summary of Sediment and Discharge Information for CSOs in the Duwamish River**

| DSN | Facility Name | Control Status | Associated Stormwater Outfall | Discharge Quality Data | Last date of Sediment Sample | Number of Stations | Sediment Analysis Performed | Data submitted to EIM | SQS Exceedance |
|---|---|---|---|---|---|---|---|---|---|
| 030 | Lander St. RS | Uncontrolled | Yes | Yes | Ongoing[a] | — | — | — | — |
| 031 | Hanford #1 Overflow | Uncontrolled | Yes | No | Ongoing[a] | — | — | — | — |
| 032 | Hanford #2 RS | Uncontrolled | Yes | Yes | Ongoing[b] | — | — | — | — |
| 034 | E Duwamish PS | Controlled | Yes | No | Ongoing[b] | — | — | — | — |
| 035 | W Duwamish PS | Controlled | Yes | Yes | Ongoing[b] | — | — | — | — |
| 043 | E Marginal Way PS | Controlled | Yes | No | Ongoing[b] | — | — | — | — |
| 039 | Michigan RS (S Michigan RS) | Uncontrolled | Yes | Yes | Ongoing[b] | — | — | — | — |
| 041 | Brandon St. RS | Uncontrolled | Yes | Yes | 2011 | 6 | Metals, Organics | Yes | Yes |
| 044a | Norfolk | Controlled | | | | | | | |
| 044 | Henderson MLK WWTS | Controlled | Yes | Yes | Ongoing[a] | — | — | — | — |
| 037 | Harbor Ave. RS | Uncontrolled | Yes | No | Ongoing[a] | — | — | — | — |
| 036 | Chelan Ave. RS | Uncontrolled | Yes | Yes | 2011, 2013 | 8 | Metals, Organics | Yes | Yes |
| 038 | Terminal 115 Overflow | Uncontrolled | Yes | No | Ongoing[b] | — | — | — | — |
| 042 | W Michigan Regulator (SW Michigan St. RS) | Uncontrolled | Yes | Yes | Ongoing[b] | — | — | — | — |
| 040 | 8th Ave. S RS (W Marginal Way PS) | Controlled | Yes | Yes | Ongoing[b] | — | — | — | — |

[a] CSO in the Harbor Island Superfund project.

[b] CSO in the Lower Duwamish Waterway Superfund project.

### 4.2.1 Lander Street Regulator Station

NPDES Discharge Serial Number 030

The Lander St. RS sends wastewater flows from the Lander St. Trunk to EBI and on to West Point. The area is served by separated sewers. Stormwater from the Lander St. storm drain is sent to West Point during periods of low stormwater flow. During high flows, stormwater discharges directly to the East Waterway and wastewater is stored in upstream pipes. When wastewater flow exceeds storage capacity, the regulator station diverts excess flow to the Lander Street storm drain for discharge to the waterway.

**1958 Baseline Facility:** Seattle raw sewage discharge; acquired by Metro (now King County) in 1962. Regulator #1 built in 1971 to intercept flows for conveyance to West Point for treatment.

**Discharge Location:** Discharges via Seattle-owned 96-inch-diameter outfall; 150 feet offshore at a depth of 20 feet into the East Waterway of the Duwamish River, under Port of Seattle piers at latitude 47° 34’ 53.316” N and longitude -122° 20’ 33.320” W; shared with Lander Street storm drain that resulted from 1992 separation project. Discharge also controlled by an outfall gate (Figure 4-1).

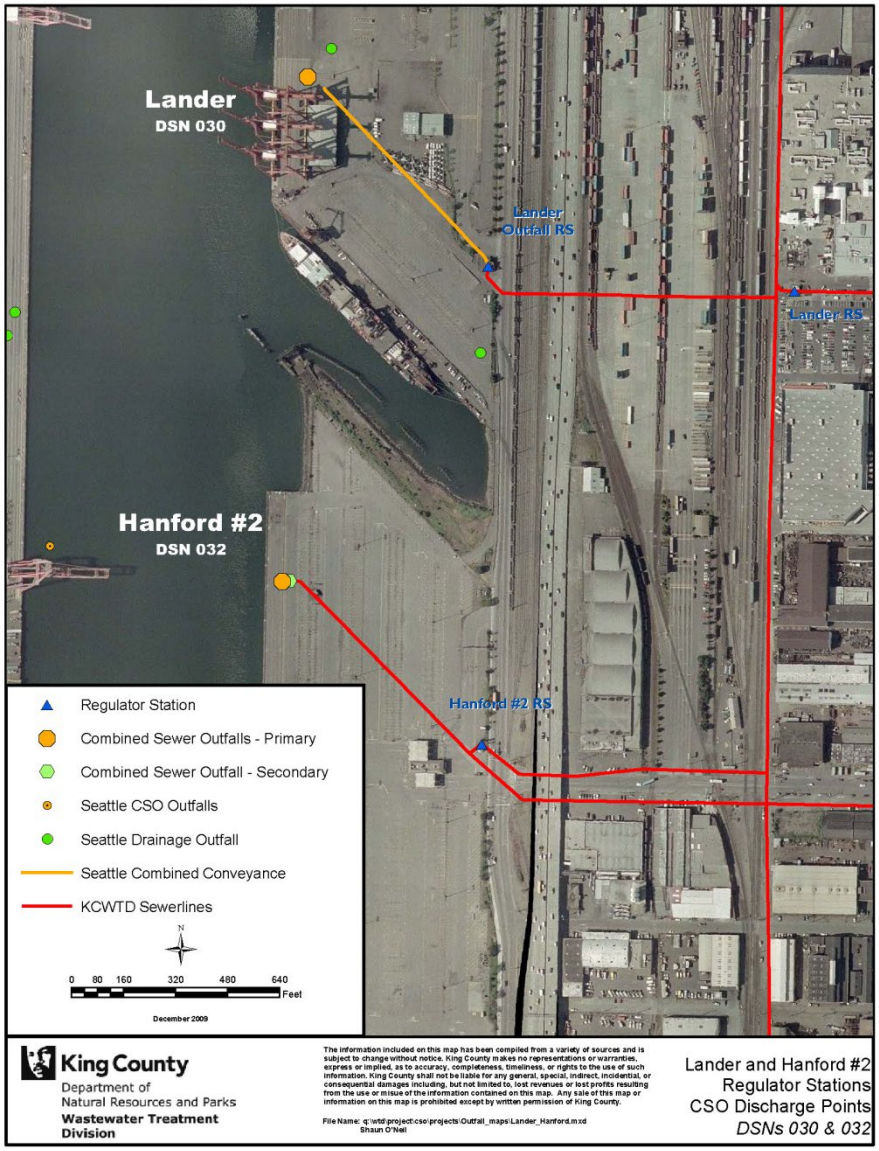



**Figure 4-1. Lander Street Regulator Station CSO Discharge Point**

**1983 Overflow Baseline:** 26 events and 143 MG per year.

**Overflow Quantity:** Has overflowed between 6 and 29 times per year since 1998; between 1998 and 2017, the 20-year average was 15.2 events per year.

**Control Project History:** Regulator #2 built in 1992 for Bayview/Hanford/Lander separation project; resulted in annual reduction of 43 MG. Regulator #1 provides a low-flow diversion to capture the stormwater first flush for treatment at West Point. This CSO location will be controlled by 2030 through construction of a new 151-MG CSO wet weather treatment facility to control the King St. and Kingdome CSOs into Elliott Bay along with the Lander St. and Hanford #2 CSOs into the East Waterway. The facility's outfall will likely be located in either Elliott Bay or the waterway.

**CSO Effluent Quality Monitoring Data:** Overflow quality monitoring to characterize the CSO was performed between 1982 and 1988, before the first separation project occurred, and more recently in 2008 and 2009. These data are in the 2009 CD.

**Construction-Related Monitoring:** King County's PCMP was approved by Ecology on September 28, 2012. Monitoring overflow volumes and frequency at the controlled untreated discharge locations is ongoing, reported monthly to Ecology. These and sediment monitoring events are summarized in CSO annual reports.

**Sediment Sampling**: The sediments, waters, and tissues of fish and shellfish inhabiting the East Waterway operable unit (OU) have been the subject of multiple investigations and cleanup actions. Contaminants of concern include PCBs, arsenic, PAHs, tributyltin (TBT), and dioxins/furans (Windward and Anchor QEA, 2014). The supplemental remedial investigation documenting the nature and extent of contamination and human health and ecological risks was completed in 2014 (Windward and Anchor QEA, 2014).

**Sediment Remediation Activity:** Berth deepening along Terminal 30 was completed in 2008, removing sediment down to -50 MLLW in front of the Lander St. RS. A feasibility study for alternatives to clean up contaminated sediments was completed in late 2018 (Anchor QEA and Windward, 2018). Following the feasibility study, EPA will issue a record of decision for any needed further cleanup of the sediments under the Harbor Island/East Waterway Superfund action.

### 4.2.2 Hanford #2 Regulator Station

NPDES Discharge Serial Number 032

The Hanford St. RS sends combined sewage flow from the Hanford Trunk to EBI for conveyance to West Point. The station directs excess flows to the Hanford #2 outfall for discharge to the East Waterway.

**1958 Baseline Facility:** Seattle raw sewage outfall, acquired by Metro (now King County) in 1962. Regulator built in 1971 to intercept flows for conveyance to West Point for treatment.

**Discharge Location:** A 48-inch-diamter, 150-foot-long outfall under Port of Seattle piers at latitude 47° 34' 38.004" N and longitude -122° 20' 34.009" W. Discharge also controlled by an outfall gate (Figure 4-2).

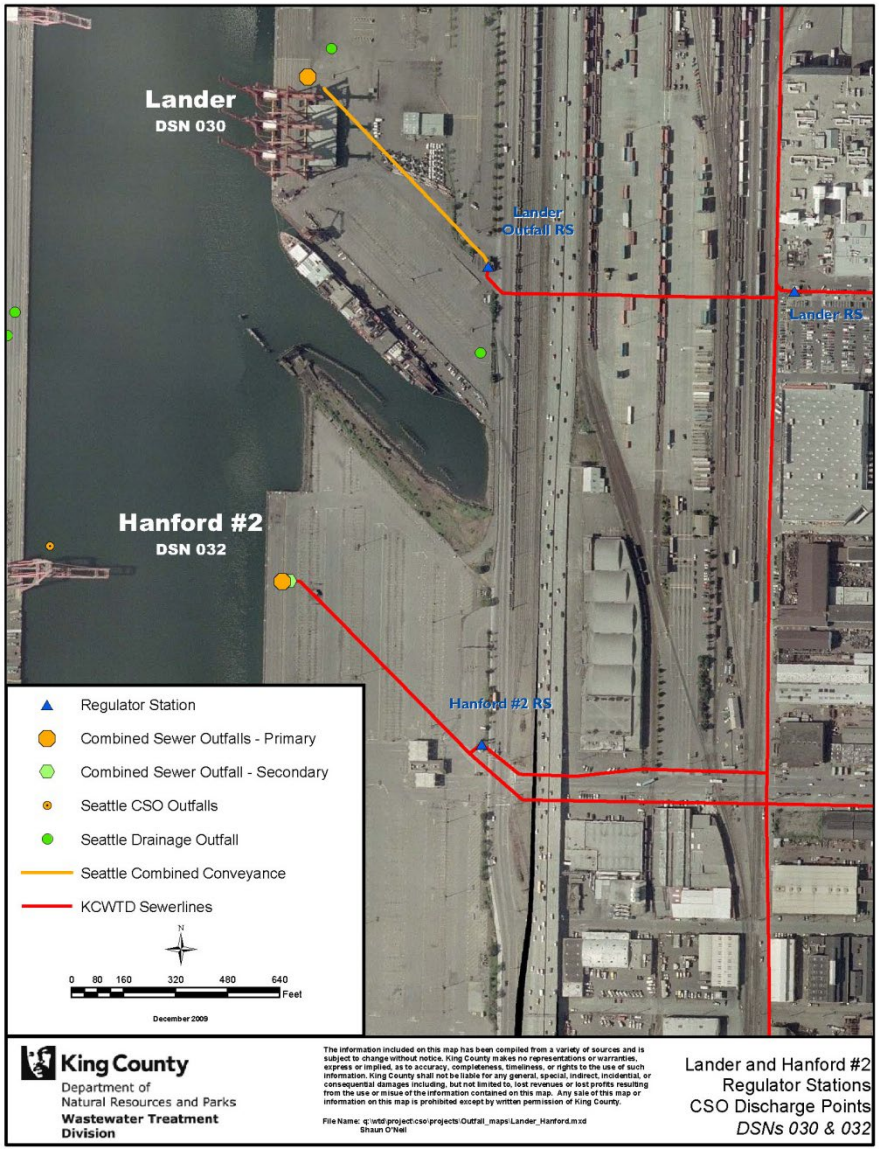



**Figure 4-2. Hanford #2 Regulator Station CSO Discharge Point**

**1983 Overflow Baseline:** 28 events and 266 MG per year.

**Overflow Quantity:** Hanford #2 has overflowed between 8 and 27 times per year since 1998; between 1998 and 2017, the 20-year average was 16.5 events per year.

**Control Project History:** 1992 Phase I project—Hanford/Lander/Bayview separation—reduced the overflow volume by 56 MG. This CSO location will be controlled through the project described for the Lander St. CSO.

**CSO Effluent Quality Monitoring Data:** Overflow quality monitoring to characterize the CSO has been performed starting in 1996. Data for these samples are on the 2009 CD.


*Hanford #2 Regulator Station CSO Vicinity; Discharge Is Under this Pier; Looking West Across East Waterway*

**Construction-Related Monitoring:** King County's PCMP was approved by Ecology on September 28, 2012. Monitoring overflow volumes and frequency at the controlled untreated discharge locations is ongoing, reported monthly to Ecology. These and sediment monitoring events are summarized in CSO annual reports.

**Sediment Sampling**: The sediments, waters, and tissues of fish and shellfish inhabiting the East Waterway OU have been the subject of multiple investigations and cleanup actions. Contaminants of concern include PCBs, arsenic, PAHs, TBT, and dioxins/furans (Windward and Anchor QEA, 2014). The supplemental remedial investigation documenting the nature and extent of contamination and human health and ecological risks was completed in 2014 (Windward and Anchor QEA, 2014).

**Sediment Remediation Activity:** A feasibility study for alternatives to clean up contaminated sediments was completed in late 2018 (Anchor QEA and Windward, 2018). Following the feasibility study, EPA will issue a record of decision for cleanup of the sediments under the Harbor Island/East Waterway Superfund action.

### 4.2.3 Hanford #1 Regulator Station

NPDES Discharge Serial Number 031

The Hanford #1 RS receives flows from three regulated CSOs in the Rainier Valley and one regulated CSO in the SODO area of Seattle. The Hanford #1 discharge is through a City of Seattle storm drain to the east side of the Lower Duwamish Waterway near the E Duwamish CSO outfall.

**1958 Baseline Facility:** Seattle raw sewage discharge, acquired by Metro (now King County) in 1962. Regulator #1 built in 1971 to intercept flows for conveyance to West Point for treatment.

**Discharge Location:** Discharges into the Seattle Diagonal storm drain, which is a 144-inch-diameter culvert that discharges at the shoreline just north of the Duwamish E Siphon Overflow and the Duwamish PS emergency overflow at latitude 47° 33’ 47.187” N and longitude -122° 20’ 43.135” W (Figure 4-3).

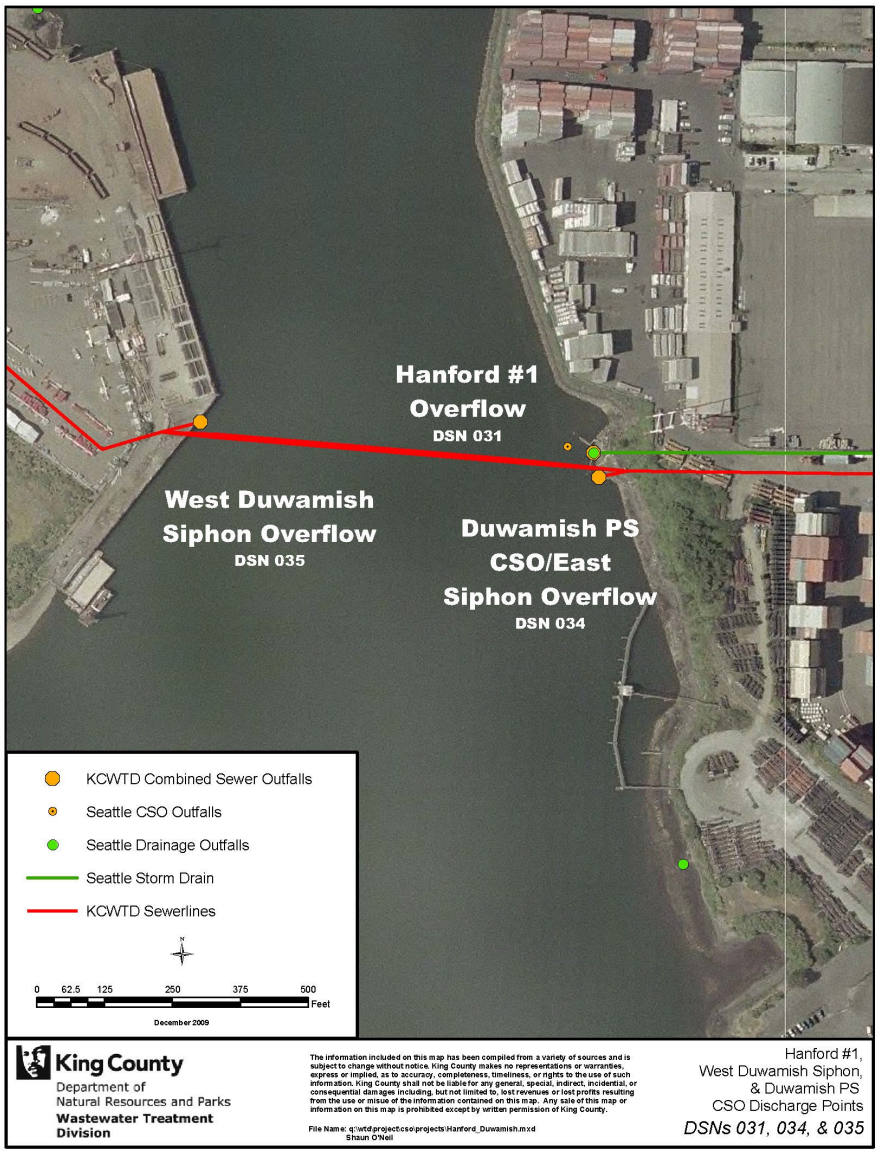



**Figure 4-3. Hanford #1 Regulator Station CSO Discharge Point**

**1983 Overflow Baseline:** 30 events and 378 MG per year.

**Overflow Quantity:** Hanford #1 has overflowed between 0 and 26 times per year since 1998; between 1998 and 2017, the 20-year average was 11.1 events per year.

*Diagonal Storm Drain (Hanford #1) Outfall at Low Tide; Grate Is Now Gone.*

**Control Project History:** 1992 Hanford/Lander/Bayview separation project was believed to have controlled the overflow. In 1995, three small overflows (Hanford at Rainier, Bayview N, and Bayview S) far upstream into the Diagonal storm drain were discovered. A project to control the Rainier Valley CSO locations is underway. The project, scheduled for completion in 2017, will include new storage and conveyance facilities. All of these overflows (Bayview N, Bayview S, Hanford at Rainier, and Hanford #1) are intra-system overflows that all may contribute to discharge from Diagonal storm drain (also known as Hanford #1), which is the regulated outfall.

**CSO Effluent Quality Monitoring Data:** Overflow quality monitoring to characterize the CSO was not performed because it was determined that the CSO was controlled.

**Construction-Related Monitoring:** King County's PCMP was approved by Ecology on September 28, 2012. Monitoring overflow volumes and frequency at the controlled untreated discharge locations is ongoing, reported monthly to Ecology. These and sediment monitoring events are summarized in CSO annual reports.

**Sediment Sampling:** Extensive surface and subsurface sampling was conducted for the design of the remedial action at the Diagonal storm drain (Hanford #1)/Duwamish PS CSO site in 2005. PCBs, phthalates, and mercury were the main cleanup drivers, although several other metals and organics also exceeded the SMS (King County et al., 2005). Eight years of post-construction monitoring was completed in 2010 (King County, 2015). Additional sampling in the area and contaminant characterization was conducted as part of the Lower Duwamish Superfund site. Contaminants of concern identified in the remedial investigation include PCBs, arsenic, PAHs, and dioxins/furans (Windward, 2010).

**Sediment Remediation Activity:** Seven acres in front of the Diagonal storm drain were remediated in 2004 by King County for the Elliott Bay Duwamish Restoration Program (EBDRP) and as an early action project for the Lower Duwamish Superfund site. Dredging and backfill replaced contaminated sediments with clean sand and fish habitat substrate. Four acres around the south potion of the remedy also received a thin layer of sand to address residuals. Further detail is presented in Section 4.2.4, East Duwamish Pump Station, Siphon. A feasibility study for alternatives to clean up contaminated sediments was completed in late 2012 (AECOM, 2012). Following the feasibility study, EPA issued a record of decision in 2014 (EPA, 2014). Any further remedial action in this area will be done under the Superfund site process.

### 4.2.4 East Duwamish Pump Station, Siphon

NPDES Discharge Serial Number 034

The E Duwamish PS CSO location is at the aftbay to the Duwamish Siphon on the east side of the Lower Duwamish Waterway. A gate opens to allow for overflows above the capacity of the Duwamish PS.

**1958 Baseline Facility:** Associated with Seattle Diagonal Way Treatment Plant overflow; pump station built by Metro (now King County) in 1969 to convey flows to West Point for treatment from the E Marginal Trunk that went to the Diagonal Way Treatment Plant or overflowed raw. The Diagonal Way Treatment Plant was then decommissioned. Siphon built in 1976 and, when connected to the Duwamish PS, overflow point became the aftbay of the siphon.

**Discharge Location:** Discharges from a 36-inch-diameter, 50-foot-long line from siphon aftbay at latitude 47° 33’ 47.605” N and longitude -122° 20’ 53.720” W (Figure 4-4).

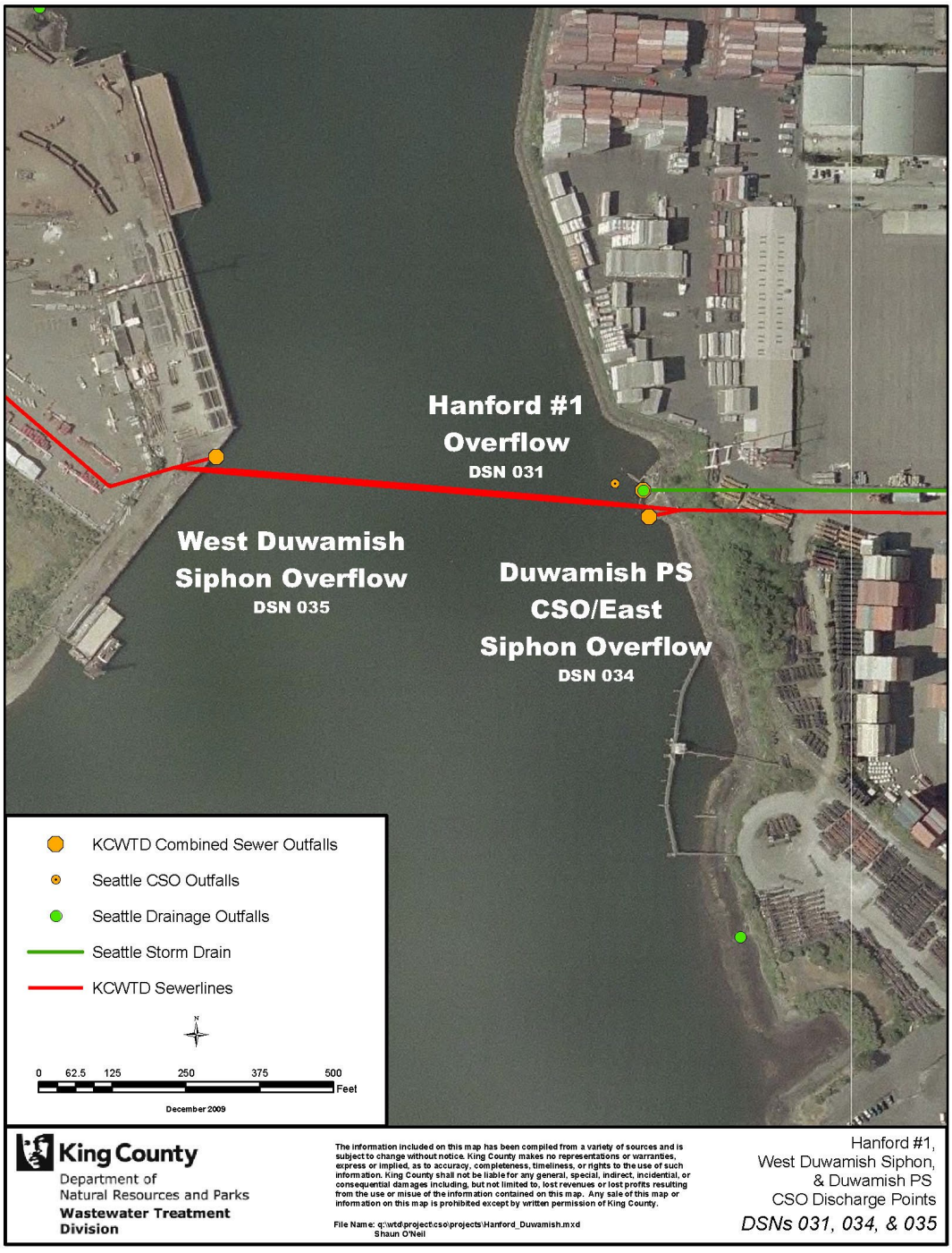



**Figure 4-4. E Duwamish Pump Station, CSO Discharge Point**

**1983 Overflow Baseline:** 1 event per year.

**Overflow Quantity:** The E Duwamish PS has overflowed between 0 and 1 time per year since 1998; between 1998 and 2017, the 20-year average was 0.2 events per year.

**Control Project History:** Controlled to the state standard.

**CSO Effluent Quality Monitoring Data:** Overflow quality and sediment monitoring to characterize the CSO were not done because the CSO is controlled.

**Sediment Sampling:** Extensive surface and subsurface sampling was conducted for the design of the remedial action at the Diagonal storm drain/E Duwamish PS CSO site in 2005. PCBs, phthalates, and mercury were the main cleanup drivers, although several other metals and organics also exceeded the SMS (King County et al., 2005). Eight years of post-construction monitoring was completed in 2010 (King County, 2015). Additional sampling in the area and contaminant characterization was conducted as part of the Lower Duwamish Superfund site. Contaminants of concern identified in the remedial investigation include PCBs, arsenic, PAHs, and dioxins/furans (Windward, 2010).

*Diagonal Way Storm Drain Looking East; Includes Discharge from Hanford #1 and East Duwamish Pump Station*

*Vicinity of East Duwamish Pump Station CSO; Looking West Across Duwamish River*

**Sediment Remediation Activity:** To implement the requirements of a 1991 CD (United States District Court, 1991) defining the terms of a natural resources damage agreement, the Elliott Bay/Duwamish Restoration Program (EBDRP) was established. Program oversight is provided by the EBDRP Panel, which is composed of federal, state, and tribal natural resource trustees, the Municipality of Metropolitan Seattle (which subsequently became part of King County, and the City of Seattle (City). The goals of the EBDRP include remediation of contaminated sediments associated with King County City CSOs and storm drains, restoration of habitat in Elliott Bay and the Duwamish River, and control of potential sources of contaminants from the outfalls.

The EBDRP identified 24 potential sediment remediation sites associated with King County and City CSOs and storm drains. These sites were evaluated against several criteria, which included extent of contamination, degree of source control near sites, and public input, as reported in the Final Concept Document. Ultimately, the EBDRP selected three sites (the E Duwamish PS CSO and Diagonal Way CSO/storm drain, the Norfolk CSO, and the Seattle Waterfront) for further

investigation. The Duwamish PS CSO and the Diagonal Way CSO/storm drain outfalls were combined into one site because of their proximity (the Duwamish/Diagonal outfalls).

King County implemented field collection activities between August 1994 and September 1996. The primary goal was to determine the extent of sediment contamination around the Duwamish/Diagonal outfalls based on a comparison to SMS. Sediment chemistry data collected by EPA in 1998 for a National Priority List evaluation were also used to define areas exceeding SMS for four specific chemicals: PCBs, mercury, and two phthalate compounds.

The site was remediated from 2003 to 2004. The plan called for installation of an engineered sediment cap to isolate contaminated sediment while maintaining existing bottom elevations for navigation and fisheries in a 7-acre area in front of the outfalls. The remedial action included mechanical dredging of 68,250 cubic yards of contaminated sediment. All dredged material was placed on barges, and the contaminated sediments were transported to an offloading facility in the East Waterway for transport and disposal at a permitted Subtitle D landfill. Capping the site with clean material to produce final bottom elevations that were approximately equal to pre-dredge bottom elevations required different layers of capping material for isolation, armoring to prevent erosion from tugboats using an adjacent mooring pier, and a surface of fish habitat material.

A follow-up action was conducted in February 2005. A thin layer of sand was placed around a portion of the dredged area to reduce the level of contaminants from the previous dredging activity.[14]

A feasibility study for alternatives to clean up contaminated sediments was completed in late 2012 (AECOM, 2012). Following the feasibility study, EPA issued a record of decision in 2014 (EPA, 2014). Any further remedial action in this area will be done under the Superfund site process.

[14] Information on the Duwamish/Diagonal sediment remediation project can be found at https://www.kingcounty.gov/services/environment/wastewater/sediment-management/projects/DuDi.aspx.

### 4.2.5 West Duwamish Siphon Overflow

NPDES Discharge Serial Number 035

**1958 Baseline Facility:** Did not exist in 1958. Siphon and forebay built by Metro (King County) in 1976 with West Marginal Interceptor.

**Discharge Location:** Discharges through a 36-inch-diameter line from siphon forebay to west side of Duwamish River at latitude 47° 33' 46.748" N and longitude -122° 20' 42.979" W (Figure 4-5).

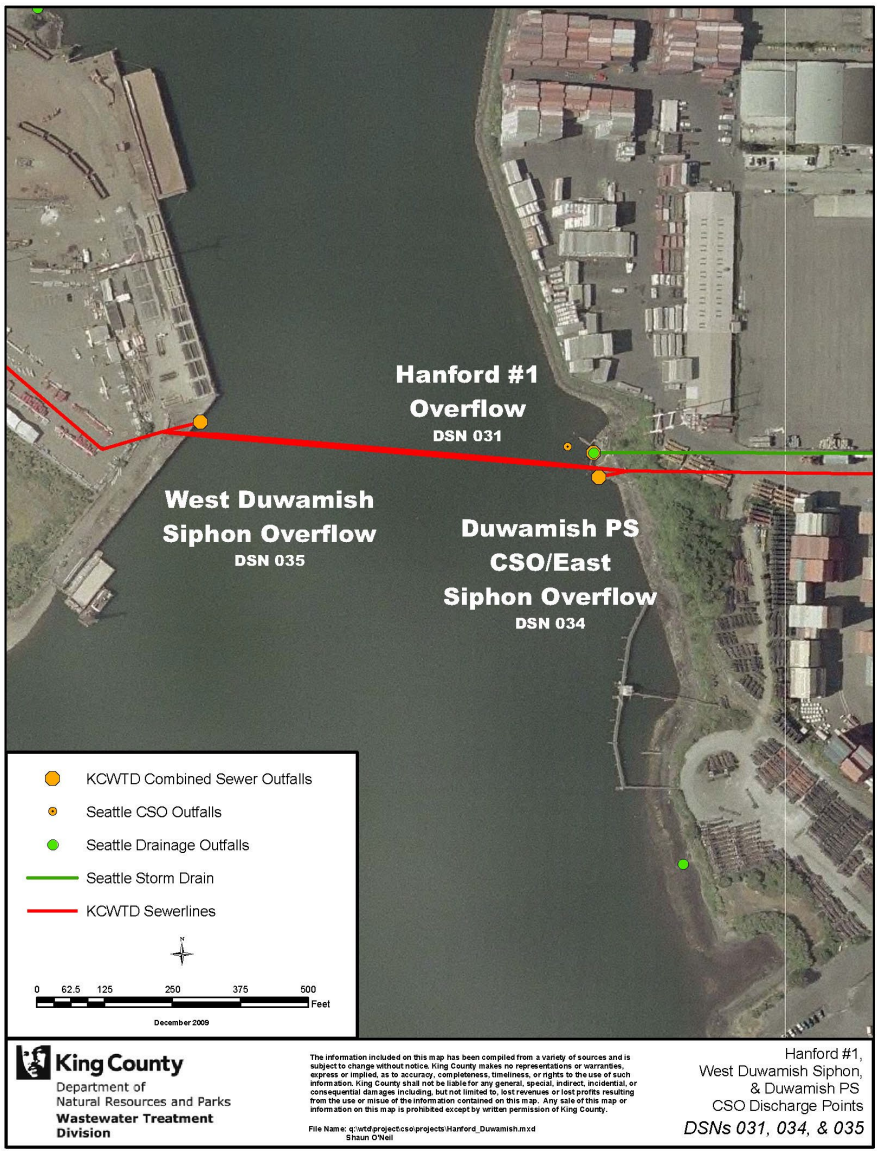



**Figure 4-5. West Duwamish Siphon CSO Discharge Point**

**1983 Overflow Baseline:** The modeled baseline is 1 event.

**Overflow Quantity:** Has overflowed between 0 and 1 time per year since 2005 when monitoring began; 13-year average is 0.4 events per year.

**CSO Effluent Quality Monitoring Data:** Samples were collected in 2007 and 2009 from the forebay at high flows to be representative of any overflow that might occur (data are in 2009 CD).

*Vicinity of West Duwamish Siphon CSO; Looking West Across Duwamish River to Site*

**Construction-Related Monitoring:** King County's PCMP was approved by Ecology on September 28, 2012. Monitoring overflow volumes and frequency at the controlled untreated discharge locations is ongoing, reported monthly to Ecology. These and sediment monitoring events are summarized in CSO annual reports.

**Sediment Sampling:** Sediment sampling in the area and contaminant characterization was conducted as part of the Lower Duwamish Superfund site. Contaminants of concern identified in the remedial investigation include PCBs, arsenic, PAHs, and dioxins/furans (Windward, 2010).

**Sediment Remediation Activity:** A feasibility study for alternatives to clean up contaminated sediments was completed in late 2012 (AECOM, 2012). Following the feasibility study, EPA issued a record of decision in 2014 (EPA, 2014). Any remedial action needed in this area will be done under the Superfund site process.

### 4.2.6 East Marginal Way Pump Station

NPDES Discharge Serial Number 043

The E Marginal Way PS pumps combine flows along EBI, including flows from the Norfolk RS to the south. The station serves an area that includes the Boeing industrial complex. Excess flows discharge through the E Marginal Way PS CSO outfall on the east side of the Lower Duwamish Waterway.

**1958 Baseline Facility:** Seattle raw sewage discharge; part of Diagonal Way Treatment Plant collection system; acquired by Metro in 1962; pump station built by Metro (now King County) in 1964 to convey flows to West Point for treatment from the E Marginal Trunk that went to the Diagonal Way Treatment Plant or overflowed raw.

**Discharge Location:** Discharges through a 36-inch-diameter overflow line at the end of Slip 4 at latitude 47° 32’ 13.372” N and longitude -122° 19’ 6.563” W (Figure 4-6).

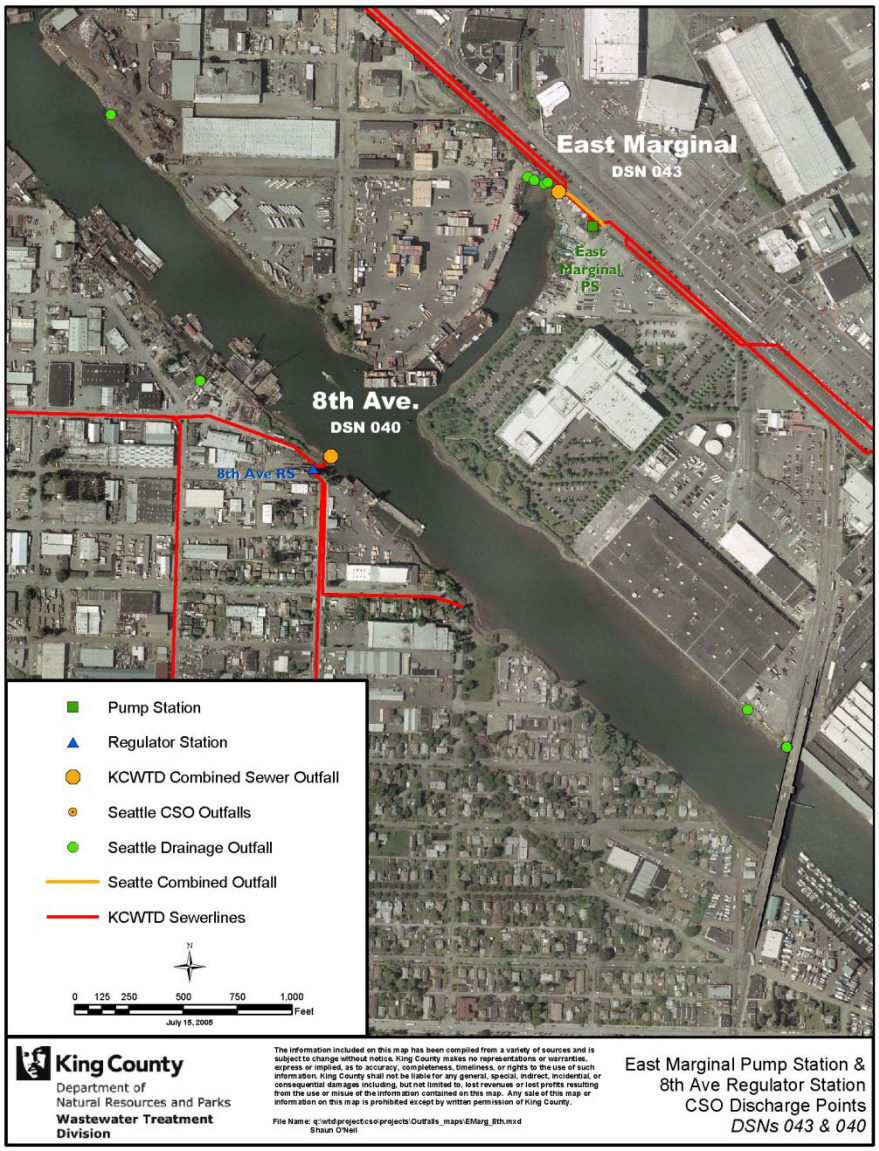



**Figure 4-6. East Marginal Way Pump Station CSO Discharge Point**

**1983 Overflow Baseline:** 0 event and 0 MG per year.

**Overflow Quantity:** Has not overflowed since 1991 when monitoring began.

**Control Project History:** Controlled to the state standard.

**CSO Effluent Quality Monitoring Data:** Overflow quality monitoring has not been done because the CSO is controlled to the state standard.

**Construction-Related Monitoring:** Not applicable because the CSO is controlled to the state standard.

*Vicinity of East Marginal Way Pump Station CSO; Looking North Across Slip 4*

*Vicinity of East Marginal Way Pump Station CSO; Looking South Across Slip 4*

**Sediment Sampling:** Sediment sampling in the area and contaminant characterization were conducted as part of the Lower Duwamish Superfund site. Contaminants of concern identified in the remedial investigation include PCBs, arsenic, PAHs, and dioxins/furans (Windward, 2010). Sediment sampling in Slip 4 was conducted in 2004 as part of an early action in the Lower Duwamish Waterway Superfund site. Both surface and subsurface sampling was conducted extensively in several hundred feet of the outfall to determine the remediation boundaries. Results are presented in Integral (2006). SMS exceedances included several metals, total PCBs, several PAHs, and bis(2-ethylhexyl)phthalate. Post-construction is occurring for the Slip 4 early action to characterize the existing conditions (Windward, 2010).

**Sediment Remediation Activity:** 3.5 acres at the head of Slip 4 adjacent to the E Marginal PS overflow were remediated in 2012 by the City of Seattle as an early action project for the Lower Duwamish Superfund site. The following actions took place as part of the project: dredging, installation of an engineered cap, replacement of contaminated sediments, and creation of a fish and upland wildlife habitat.[15]

A feasibility study for alternatives to clean up contaminated sediments was completed in late 2012 (AECOM, 2012). Following the feasibility study, EPA issued a record of decision in 2014 (EPA 2014). Any additional remedial action in this area will be done under the Superfund site process.

[15] Information on the Slip 4 early action sediment remediation project can be found at https://cumulis.epa.gov/supercpad/SiteProfiles/index.cfm?fuseaction=second.scs&id=1002020&doc=Y&colid=30683&region=10&type=SC.

### 4.2.7 South Michigan Street Regulator Station

NPDES Discharge Serial Number 039

The S Michigan Street RS in south Seattle directs combined flow from the Michigan St. Trunk to EBI. Excess flow is diverted to the S Michigan St. RS CSO location on the east side of the Lower Duwamish Waterway.

**1958 Baseline Facility:** Seattle raw sewage discharge; part of Diagonal Way Treatment Plant collection system; acquired by Metro in 1962; regulator built by Metro (now King County) in 1964 to convey flows to West Point for treatment that went to the Diagonal plant or overflowed raw.

**Discharge Location:** Outfall station discharges at east bank of Duwamish River at latitude 47° 32’ 36.709” N and longitude -122° 20’ 5.880” W (Figure 4-7).

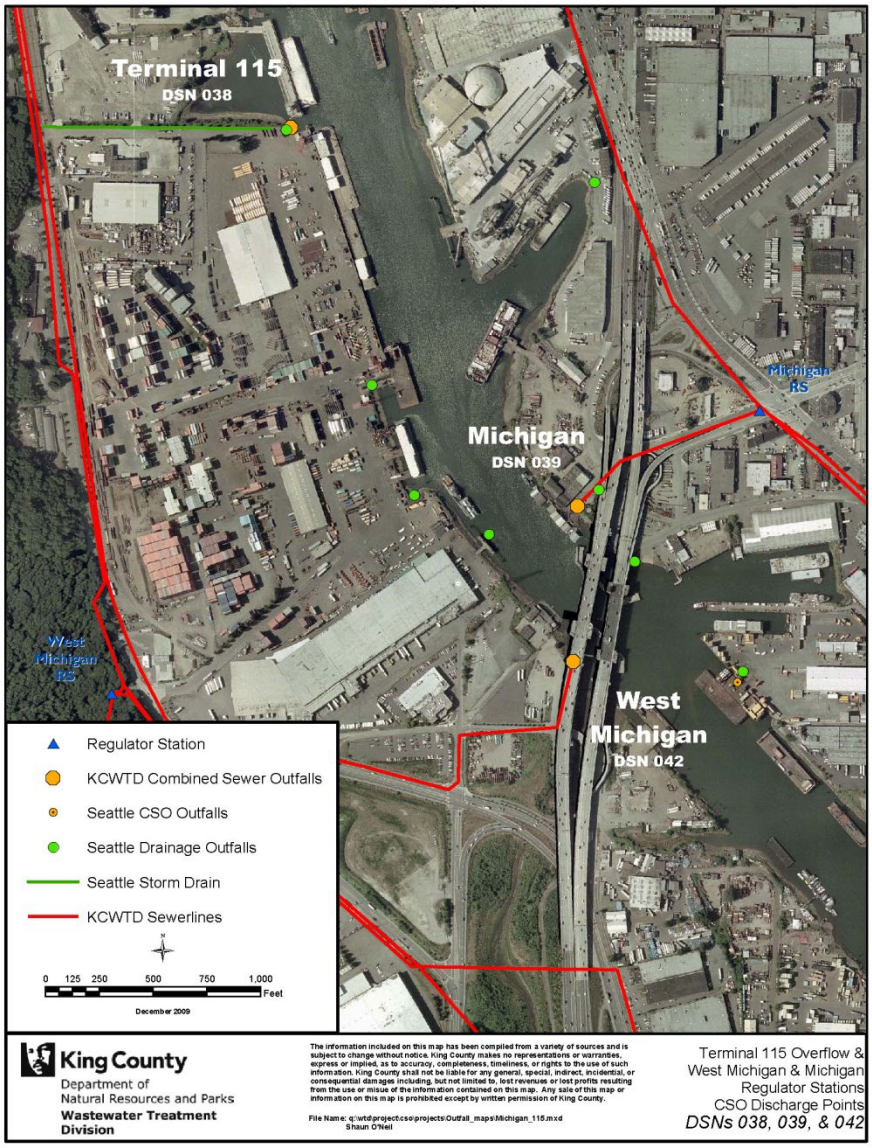



**Figure 4-7. South Michigan Street Regulator Station CSO Discharge Point**

**1983 Overflow Baseline:** 34 events and 190 MG per year.

**Overflow Quantity:** Has overflowed between 0 and 26 times per year since 1998; between 1998 and 2017, the 20-year average was 10.6 events per year.

**Control Project History:** The S Michigan St. RS and Brandon St. RS CSO locations will be controlled through construction of a 70-MGD wet weather treatment station (Georgetown WWTS) scheduled for completion in December 2022. The new outfall for the facility will be located at the S Michigan St. RS CSO in the Lower Duwamish Waterway.

**CSO Effluent Quality Monitoring Data:** Overflow quality monitoring to characterize this CSO has been performed several times throughout the years. The 2018 data submission includes these data.

**Construction-Related Monitoring:** King County's PCMP was approved by Ecology on September 28, 2012. Monitoring overflow volumes and frequency at the controlled untreated discharge locations is ongoing, reported monthly to Ecology. These and sediment monitoring events are summarized in CSO annual reports.

**Sediment Sampling:** Sediment sampling in the area and contaminant characterization were conducted as part of the Lower Duwamish Superfund site. Contaminants of concern identified in the remedial investigation include PCBs, arsenic, PAHs, and dioxins/furans (Windward, 2010). Sediment was previously collected from four stations in front of the Michigan outfall in 1992. The 2009 CD includes data from this sampling event.

*South Michigan Street Regulator Station CSO at Extreme Low Tide*


*South Michigan Street Regulator Station CSO Overflowing 10/26/09*


*South Michigan Street Regulator Station CSO Overflowing 10/26/09*

**Sediment Remediation Activity:** A feasibility study for alternatives to clean up contaminated sediments was completed in late 2012 (AECOM, 2012). Following the feasibility study, EPA issued a record of decision in 2014 (EPA, 2014). Any remedial action needed in this area will be done under the Superfund site process.

### 4.2.8 Brandon Street Regulator Station

NPDES Discharge Serial Number 041

The Brandon St. RS sends flows from the Brandon St. Trunk to EBI. Excess flows discharge to the east side of the Lower Duwamish Waterway.

**1958 Baseline Facility:** Seattle raw sewage discharge; part of Diagonal Way Treatment Plant collection system; acquired by Metro in 1962; regulator built by Metro (now King County) in 1964 to convey flows to West Point for treatment that went to the Diagonal Way Treatment Plant or overflowed raw.

**Discharge Location:** Outfall station discharges at east bank of Duwamish at latitude 47° 33' 16.781" N and longitude -122° 20' 26.996" W (Figure 4-8).

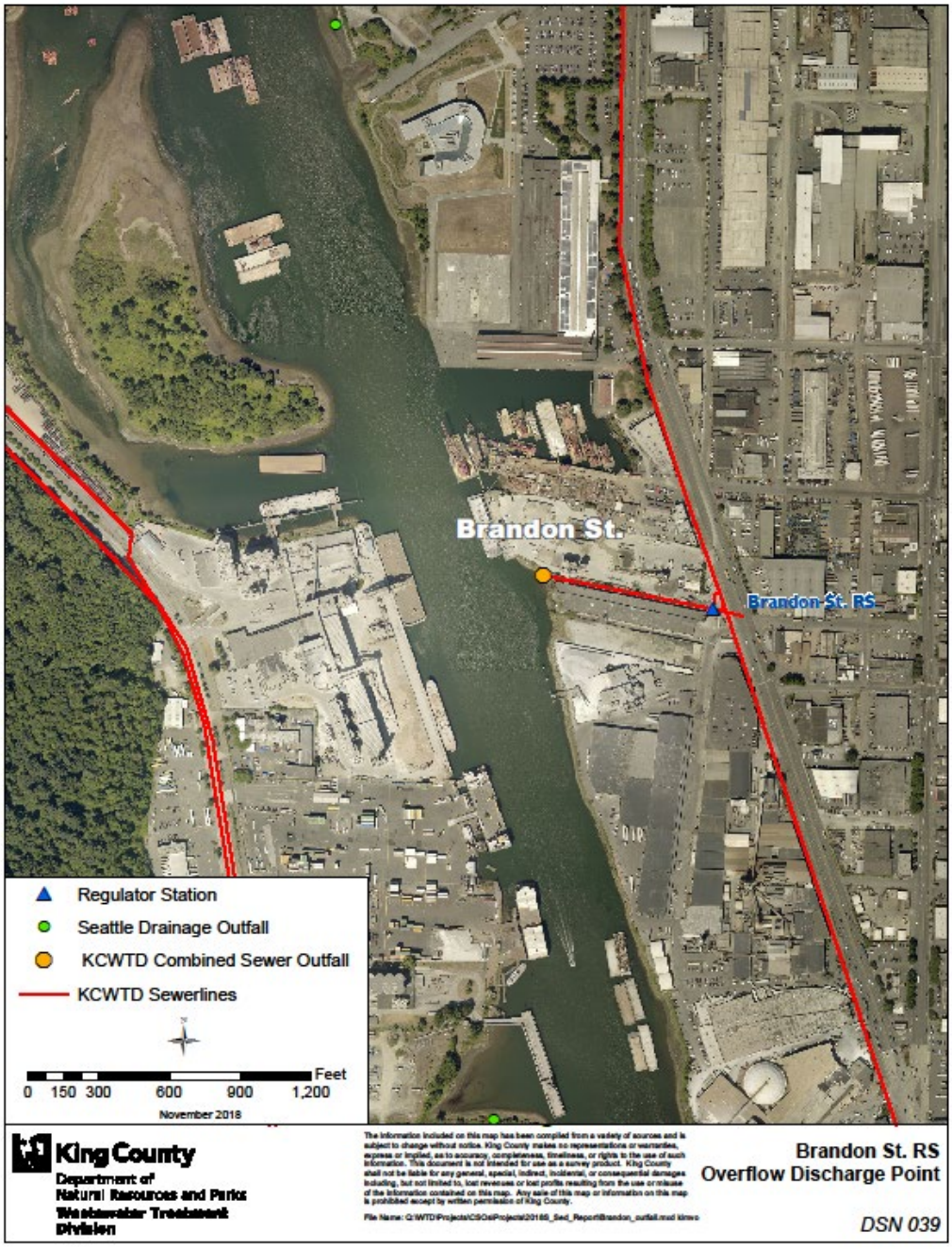



**Figure 4-8. Brandon Street Regulator Station CSO Discharge Point**

**1983 Overflow Baseline:** 36 events and 64 MG per year.

**Overflow Quantity:** Has overflowed between 3 and 32 times per year since 1998; between 1998 and 2017, the 20-year average was 17.6 events per year.

**Control Project History:** A project to increase the size of the pipe from the regulator station to EBI and, therefore, decrease the small and frequent overflows, was completed in 2006. The Brandon St. RS and S Michigan St. CSO locations will be controlled through construction of a 70-MGD wet weather treatment station (Georgetown WWTS) scheduled for completion in 2022. The new outfall for the facility will be located at the S Michigan St. RS CSO in the Lower Duwamish Waterway.

**CSO Effluent Quality Monitoring Data:** Extensive overflow quality monitoring to characterize the CSO was performed beginning in 1990 and continued through 2016. The 2018 data submittal includes data collected since 2009.

**Construction-Related Monitoring:** King County's PCMP was approved by Ecology on September 28, 2012. Monitoring overflow volumes and frequency at the controlled untreated discharge locations is ongoing, reported monthly to Ecology. These and sediment monitoring events are summarized in CSO annual reports.

*Brandon Street Regulator Station CSO Overflow at Extreme Low Tide*


*Brandon Street Regulator Station CSO Vicinity; Looking West Across Duwamish River*

*Brandon Street Regulator Station CSO Overflowing 10/17/09*

**Sediment Sampling:** Sediment sampling in the area and contaminant characterization were conducted as part of the Lower Duwamish Superfund site. Contaminants of concern identified in the remedial investigation include PCBs, arsenic, PAHs, and dioxins/furans (Windward, 2010). Sediment samples were collected per the PCMP in 2011. Six samples were collected proximal to the Brandon CSO outfall. The stations were positioned around the outfall, with the farthest stations located approximately 150 feet away from the CSO discharge point (see Figure 4-9). Several organic chemicals exceeded the CSL at one station, CSO-BR-03. No other chemicals exceeded the CSL at any other station. 2011 data are included in the 2018 data submittal.

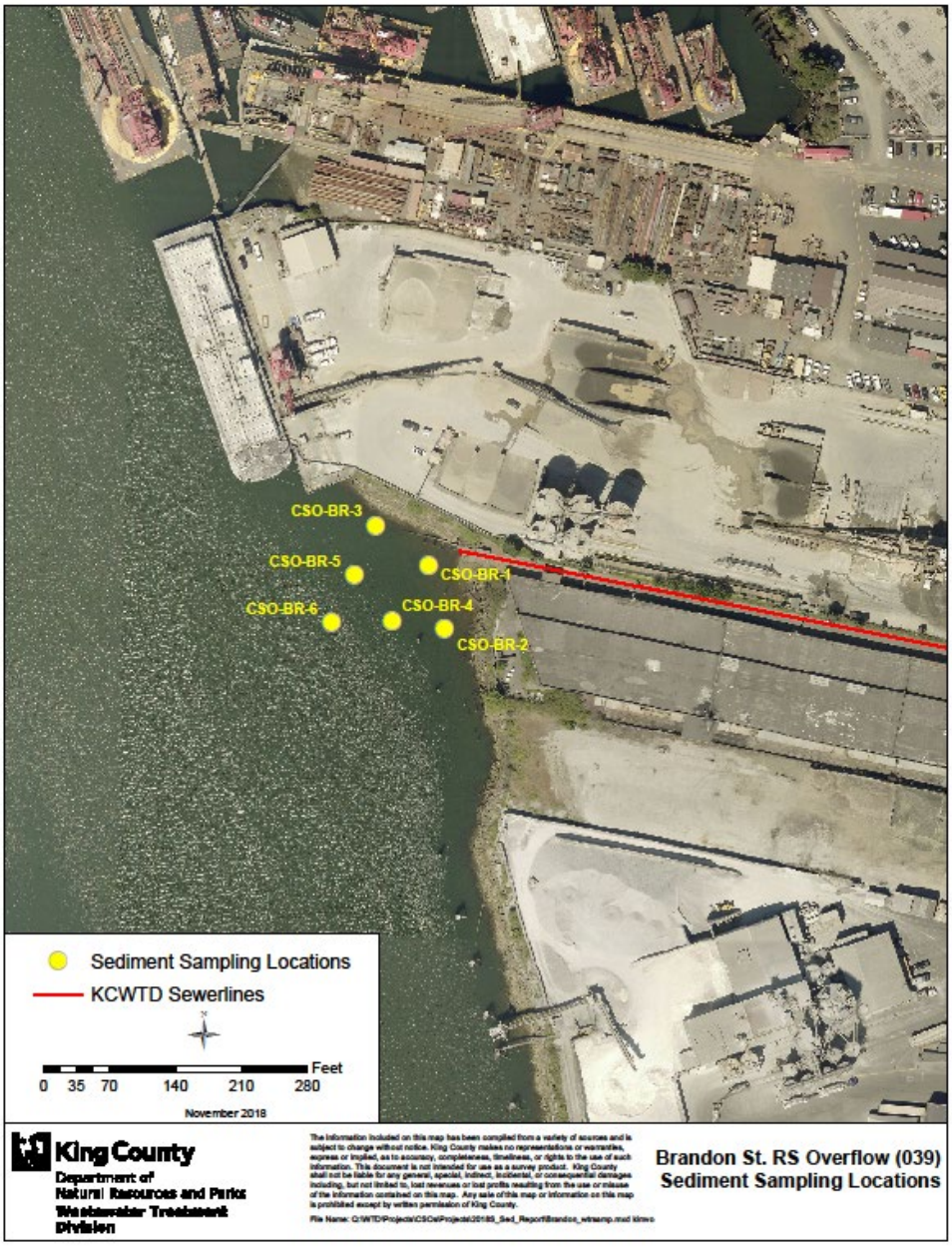



**Figure 4-9. Brandon Street Regulator Station CSO Sediment Sampling Location**

**Sediment Remediation Activity:** A feasibility study for alternatives to clean up contaminated sediments was completed in late 2012 (AECOM, 2012). Following the feasibility study, EPA issued a record of decision in 2014 (EPA, 2014). Any remedial action needed in this area will be done under the Superfund site process.

### 4.2.9 Norfolk Street Regulator Station and Henderson/MLK Wet Weather Treatment Station

**Norfolk St. RS:** NPDES Discharge Serial Number 044a

The Norfolk St. RS regulates flow from the Henderson St. Trunk into EBI and on to the E Marginal Way PS. The station directs excess flow to the Norfolk St. RS CSO outfall on the east side of the Lower Duwamish Waterway, just upstream of the Upper Turning Basin.

**Henderson/MLK WWTS**: NPDES Discharge Serial Number 044

**1958 Baseline Facility:** Seattle CSO; part of Diagonal Way Treatment Plant collection system.

**Discharge Location:** East side of Duwamish River by turning basin at latitude 47° 30’ 42.98” N and longitude -122° 17’ 50.48” W (Figure 4-10). The untreated Norfolk St. RS CSO discharge and the treated Henderson/MLK WWTS discharge share the Norfolk outfall, but each is monitored independently. The outfall does not have a diffuser. It provides 1.9:1 dilution at the edge of the zone of acute criteria exceedance and 10.3:1 dilution at the edge of the chronic mixing zone.

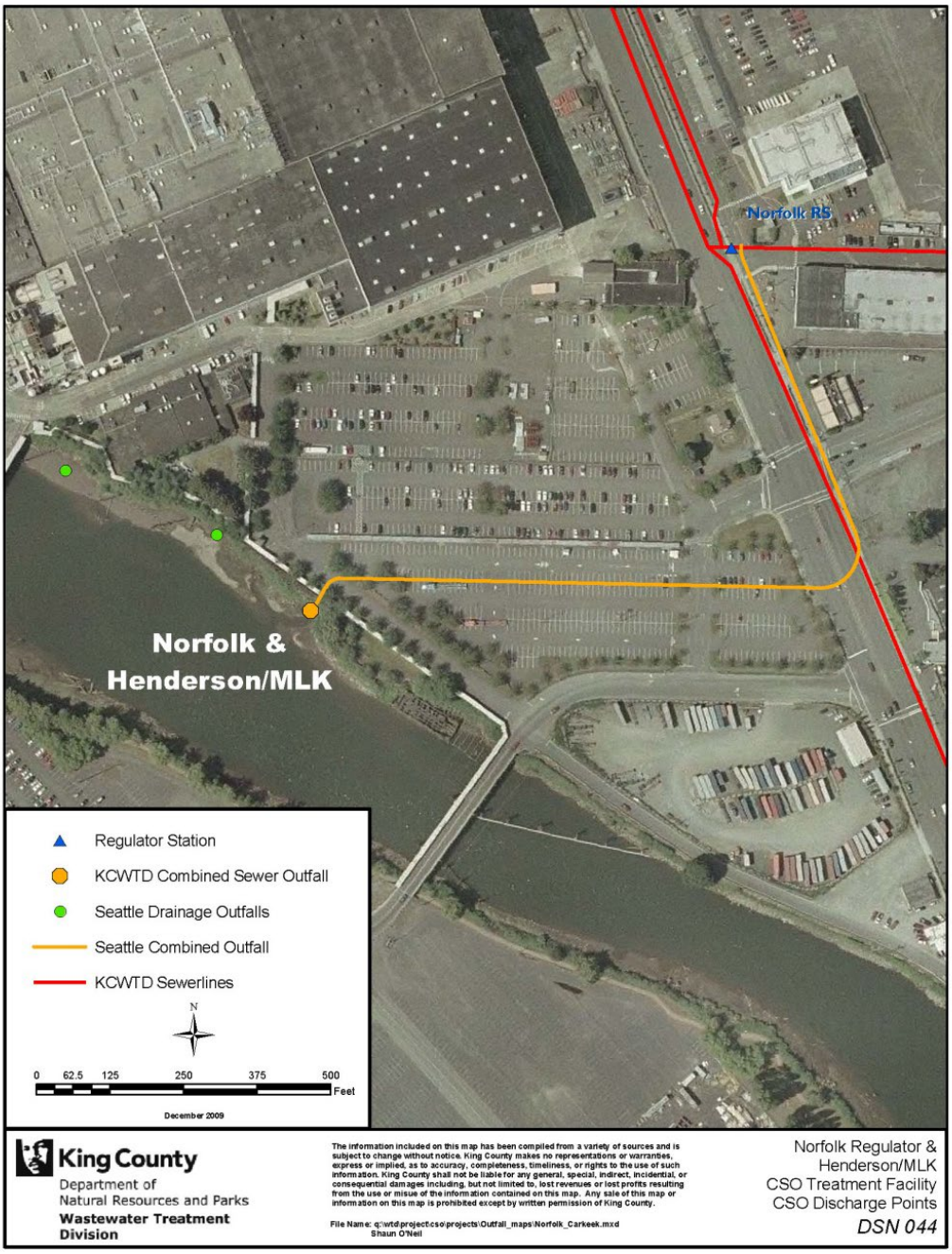



**Figure 4-10. Norfolk Street Regulator Station CSO Discharge Point**

**1983 Overflow Baseline:** 20 events and 39 MG per year.

**Overflow Quantity:** Has overflowed between 0 and 1 times per year since 1998; between 1998 and 2017, the 20-year average was 0.1 events per year.


*Vicinity of Norfolk Street Regulator Station CSO; Looking East Across River Toward Outfall Site*

**Control Project History:** The Allentown Diversion, completed in 1995, removed Henderson/MLK area flows from EBI, creating capacity for the Norfolk CSO flows (reducing them by about 34 MG per year) and introducing Alki area flows to EBI further downstream. Control was completed in 2005 with the construction of the Henderson/MLK WWTS and storage facilities. This project also controlled the MLK and Henderson overflows into Lake Washington. The treatment station provides CSO treatment (equivalent to primary treatment), screening, disinfection, and dechlorination.

**CSO Effluent Quality Monitoring Data:** Overflow quality monitoring to characterize the CSO has been performed; the 2009 CD includes these data.

**Construction-Related Monitoring:** Post-construction monitoring was completed in conjunction with the post-remediation monitoring done under the EBDRP Panel.

**Sediment Sampling:** Sediment sampling off the Norfolk CSO/storm drain was conducted over three rounds from 1994 through 1995 under the EBDRP (King County, 1996). Both surface and subsurface sampling were extensively conducted in several hundred feet of the outfall to determine the remediation boundaries. Results are presented in the *Norfolk CSO Cleanup Study Report* (King County, 1996). SMS exceedances included mercury, total PCBs, 1, 4 dichlorobenzene, and bis(2-ethylhexyl)phthalate. The SQS was used to set the remediation boundaries. Data from this study may be found in EIM under User Study ID NRFK9495. Five years of post-construction monitoring was completed in 2005 (King County, 2005). Sediment sampling in the area and contaminant characterization were conducted as part of the Lower Duwamish Superfund site. Contaminants of concern identified in the remedial investigation include PCBs, arsenic, PAHs, and dioxins/furans (Windward, 2010).

**Sediment Remediation Activity:** In 1994, a plan to investigate the extent of contamination at the Norfolk CSO was prepared by King County (then Metro) on behalf of the EBDRP Panel. King County implemented field data collection activities to determine the extent of sediment contamination around the Norfolk CSO outfall, based on comparison to SMS criteria and to determine a preferred remedial alternative for the site.

Site remediation was completed in 1999. Activities consisted of dredging contaminated sediment and backfilling the dredged area to original grade with clean sediment. Contaminated sediments were removed from the site by mechanical dredging and dewatered onshore in a containment area. Sediments with a PCB concentration greater than 45 parts per million (ppm) were transported to a Subtitle C landfill for disposal. Sediments with a PCB concentration less than 45 ppm were transported to a Subtitle D landfill for disposal. A total of 5,190 cubic yards of

sediment was removed during the dredging; approximately 1,900 cubic yards were transported to a Subtitle D landfill as hazardous waste. Sediment was generally removed to a depth of 3 feet.

The post-project monitoring was completed in 2005. The site is now under evaluation as part of the early action sites in the Superfund area.

Monitoring to evaluate possible recontamination of the backfill sediment identified some PCBs had recontaminated part of the cap. Following identification and control of the source, Boeing conducted a mall cleanup of sediment near the Norfolk CSO site in 2003 (approximately 100 cubic yards). Further monitoring demonstrated this action resolved the problem.

A feasibility study for alternatives to clean up contaminated sediments was completed in late 2012 (AECOM, 2012). Following the feasibility study, EPA issued a record of decision in 2014 (EPA, 2014). Any further remedial action needed in this area will be done under the Superfund site process.

### 4.2.10 Harbor Avenue Regulator Station

NPDES Discharge Serial Number 037

The Harbor Ave. RS sends combined flows from the north and northeast areas of West Seattle to the Delridge Trunk. The station diverts excess flow to a City of Seattle storm drain that discharges to the West Duwamish Waterway.

**1958 Baseline Facility:** Seattle raw sewage outfall; acquired by Metro (now King County) in 1962; Metro built the regulator in 1967.

**Discharge Location:** Duwamish West Waterway via a 96-inch-diameter Seattle storm drain that also carries Seattle CSOs and Longfellow Creek at latitude 47° 34’ 25.341” N and longitude -122° 21’ 40.174” W (Figure 4-11).

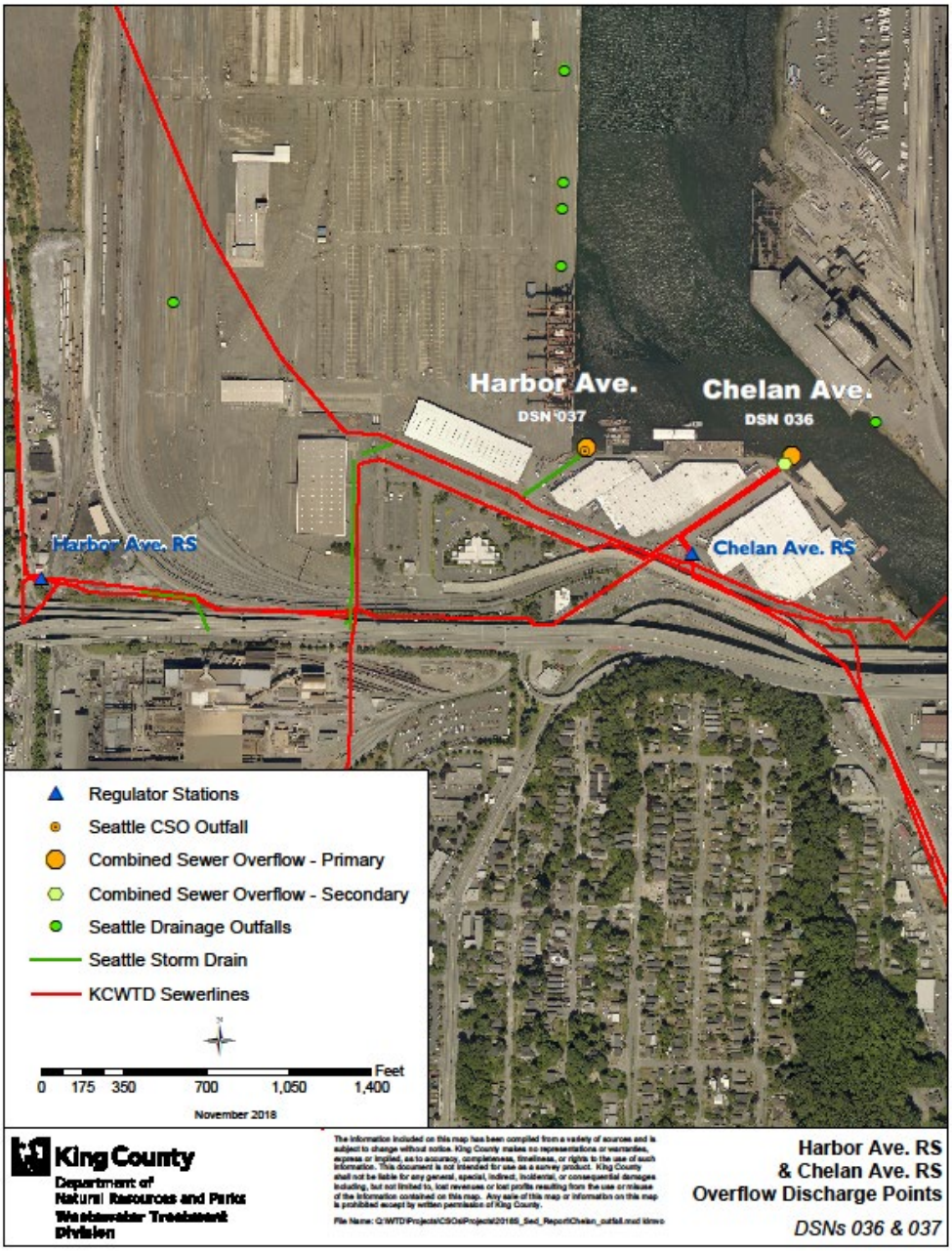



**Figure 4-11. Harbor Avenue Regulator Station CSO Discharge Point**

**1983 Overflow Baseline:** 30 events and 36 MG per year.

**Overflow Quantity:** Has overflowed between 0 and 5 times per year since 1998; between 1998 and 2017, the 20-year average was 1.6 events per year.

**Control Project History:** A 2000 project diverted flows to the West Seattle Tunnel to achieve control. Additional control adjustments have been required to ensure the control level is maintained. The Harbor Ave. RS is currently under a supplemental compliance plan to achieve control. A project is being implemented to install a new actuator on the CSO gate in order to improve the ability to divert flows from the Harbor Ave. RS to the West Seattle Tunnel for storage. Following installation of the actuator in the Harbor Ave. RS, the station will be monitored for two wet seasons, and control status will be assessed in 2021. This CSO is under supplemental compliance.

*Harbor Avenue Regulator Station CSO/Seattle Storm Drain Outfall at Extreme Low Tide*

*Vicinity of Harbor Avenue Regulator Station CSO; Looking Northeast Across West Waterway*

**CSO Effluent Quality Monitoring Data:** Overflow quality monitoring to characterize the CSO was provided to Ecology before the 1986 sampling plan. The Ecology-approved 1988 NPDES CSO monitoring plan referenced data that had been previously submitted in reports to Ecology. Those older data are not available from the current Laboratory Information Management System.

**Construction-Related Monitoring:** The Harbor Island Superfund action will determine if any further monitoring is needed.

**Sediment Sampling:** Sediment sampling in this part of the Duwamish River has been characterized by EPA (2003) as part of the ongoing Harbor Island Superfund action.

**Sediment Remediation Activity:** The Harbor Ave. RS and Chelan Ave. outfalls are located within the Harbor Island Superfund West Waterway OU. The Harbor Island site was listed on the National Priorities List in 1983. The Harbor Island Superfund site is composed of upland portions and marine portions, with seven OUs. The West Waterway OU was addressed by a record of decision in 2003, which stated that no remedial action is necessary in the West Waterway OU, in accordance with the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA).

Ecology concurred that the no-action decision for the West Waterway is consistent with CERCLA requirements. Ecology also recognizes that the no-action decision is based on Superfund risk assessment that is similar to the requirements of the Model Toxics Control Act, but not entirely consistent with the state cleanup regulation. The determination was made in accordance with an interagency agreement between EPA and Ecology dated February 23, 2000.

For the West Waterway OU, EPA has determined that no further action is necessary under CERCLA because environmental investigations and site-specific risk assessments found that concentrations in marine sediments in the operable unit do not pose unacceptable risks to human health and the environment. The last five-year review (September 2015) concluded that no additional evaluations are required at this time.

### 4.2.11 Chelan Avenue Regulator Station

NPDES Discharge Serial Number 036

The Chelan Ave. RS receives combined flows from the Delridge Trunk in West Seattle and sends them via the West Duwamish Interceptor east of the waterway to the Duwamish PS, EBI, and West Point. The station diverts excess flows through a City of Seattle storm drain to the Chelan Ave. CSO location in the West Waterway.

**1958 Baseline Facility:** Seattle raw sewage outfall; acquired by Metro (now King County) in 1962; Metro built the regulator in 1967.

**Discharge Location:** West side of Duwamish West Waterway below Port of Seattle facilities via parallel submerged 30- and 48-inch outfalls at latitude 47° 34’ 25.201” N and longitude -122° 21’ 28.004” W (Figure 4-12).

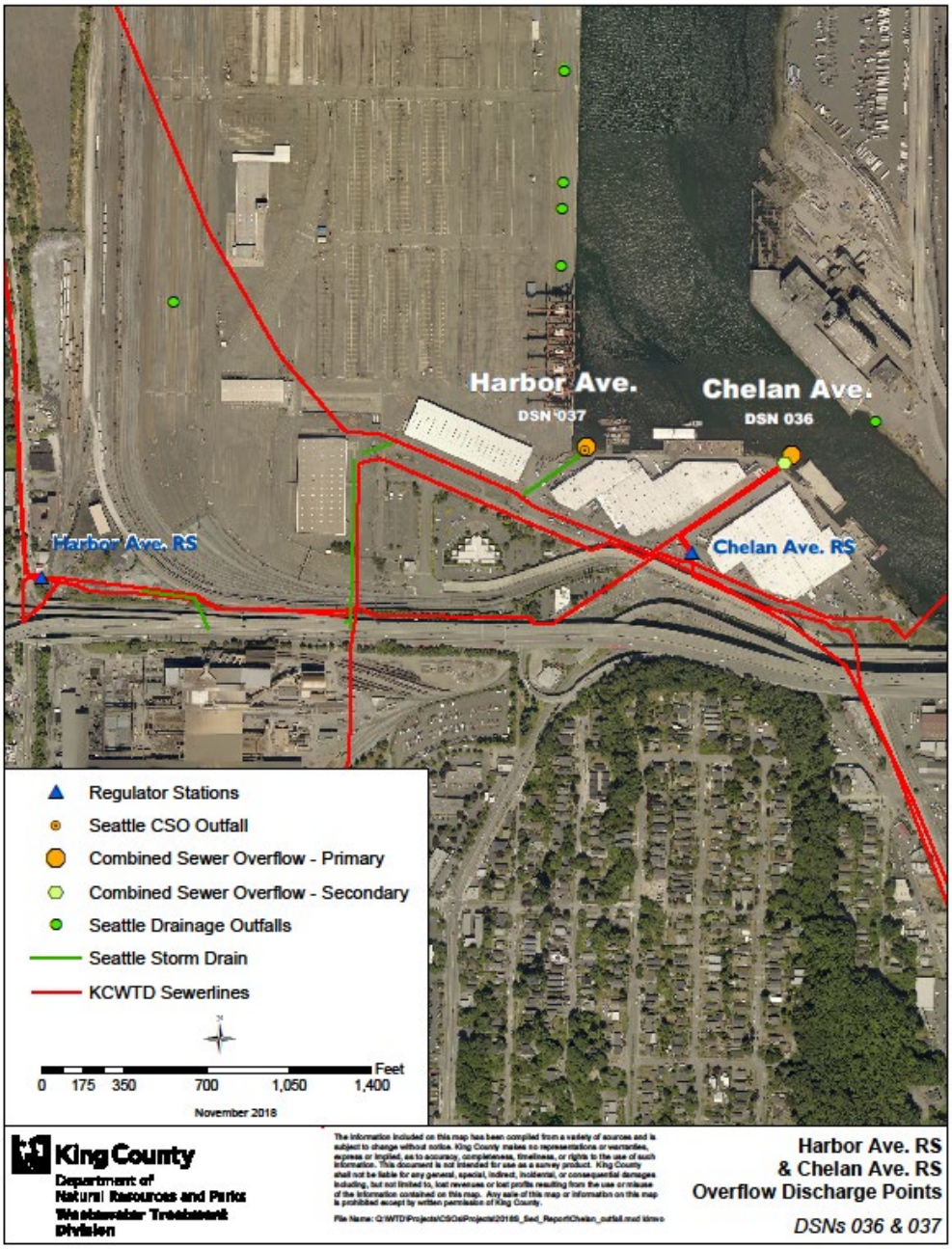



**Figure 4-12. Chelan Avenue Regulator Station CSO Discharge Point**

**1983 Overflow Baseline:** 7 events and 61 MG per year.

**Overflow Quantity:** Has overflowed between 0 and 13 times per year since 1998; between 1998 and 2017, the 20-year average was 5.2 events per year.

**CSO Effluent Quality Monitoring Data:** Overflow quality monitoring to characterize the CSO has been performed since 1989. Data from this CSO have been provided in the 2009 CD data submittal.

**Construction-Related Monitoring:** King County's PCMP was approved by Ecology on September 28, 2012. Monitoring overflow volumes and frequency at the controlled untreated discharge locations is ongoing, reported monthly to Ecology. These and sediment monitoring events are summarized in CSO annual reports.

**Sediment Sampling:** Sediment samples were collected most recently near the Chelan Ave. RS outfall in 2011 and 2013. Stations were collected per the PCMP in 2011, with additional stations added in 2013 to help validate the County's CSO discharge model. Eight samples were collected proximal to the Chelan Ave. RS CSO outfall, with the farthest stations located approximately 150 feet away. Figure 4-13 shows station locations and the outfall discharge point. Results indicate that bis(2ethylhexyl)phthalate exceeded the CSL at three stations, although these stations are farthest away from the outfall and other nearby potential sources exist. The 2018 submittal includes these results.

**Sediment Remediation Activity:** In 2003, a "no action" record of decision for the West Waterway OU was issued based on the determination that public health and the welfare of the environment were not at risk from contaminants identified in the waterway (EPA, 2003). The Chelan Ave. outfall is located near the OU boundary. The last five-year review (September 2015) concluded that no additional evaluations are required at this time. However, post-construction monitoring will occur once the CSO is controlled to revisit sediment quality and the potential need for further action.

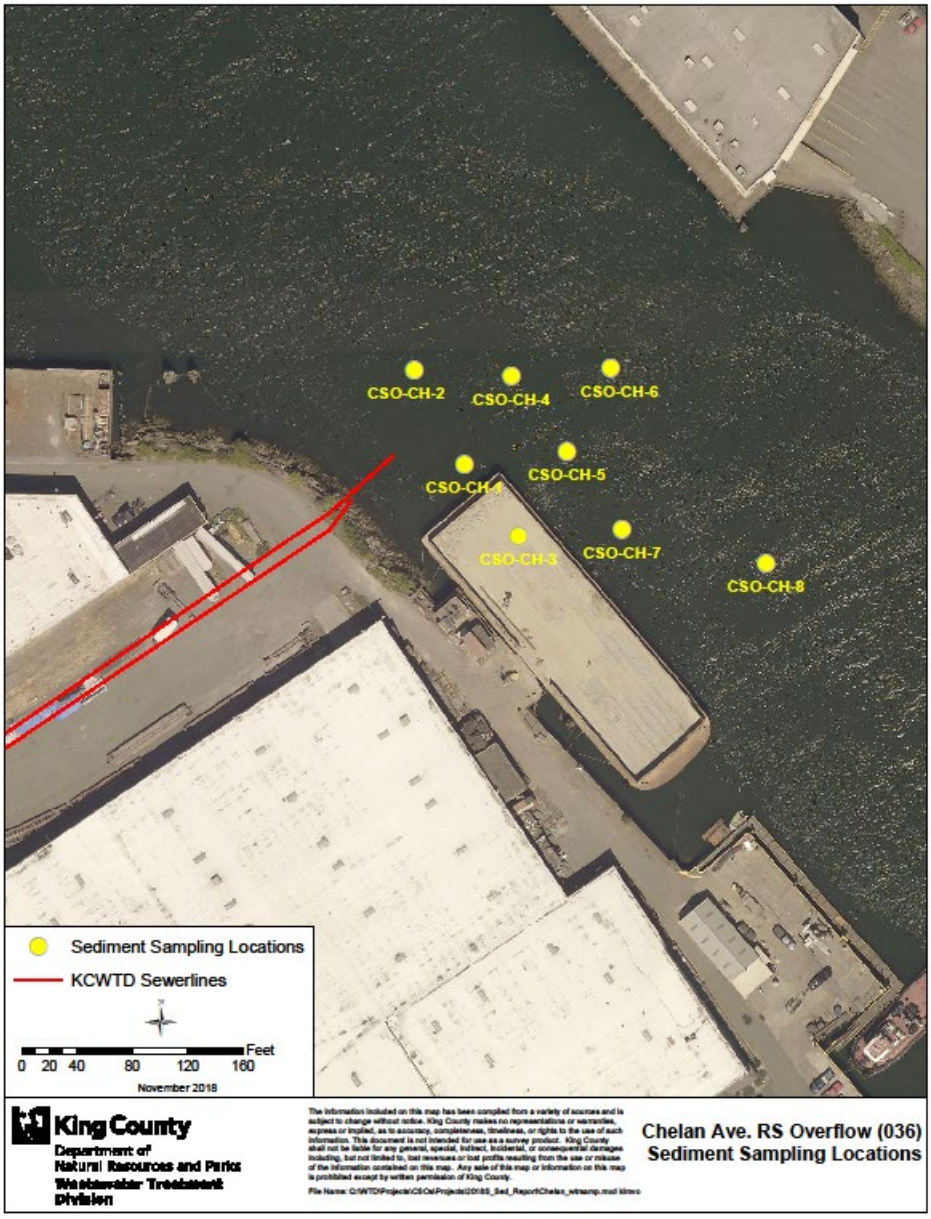



**Figure 4-13. Chelan Avenue Regulator Station CSO Sediment Sampling Locations**

### 4.2.12 Terminal 115 CSO

NPDES Discharge Serial Number 038

A flap gate in the West Duwamish Interceptor, which travels north along the west side of the Lower Duwamish Waterway, allows excess flows to empty into a local storm drain that discharges to the Terminal 115 CSO location on the waterway.

**1958 Baseline Facility:** Seattle raw sewage outfall built in 1958; acquired by Metro (now King County) in 1962. Intercepted for treatment in 1976 when the West Marginal Interceptor and Duwamish Siphon were built.

**Discharge Location:** Overflows into a 48-inch-diameter Seattle storm drain that discharges into the west side of the Duwamish River at latitude 47° 32’53.737” N and longitude -122° 20’ 25.810” W (Figure 4-14).

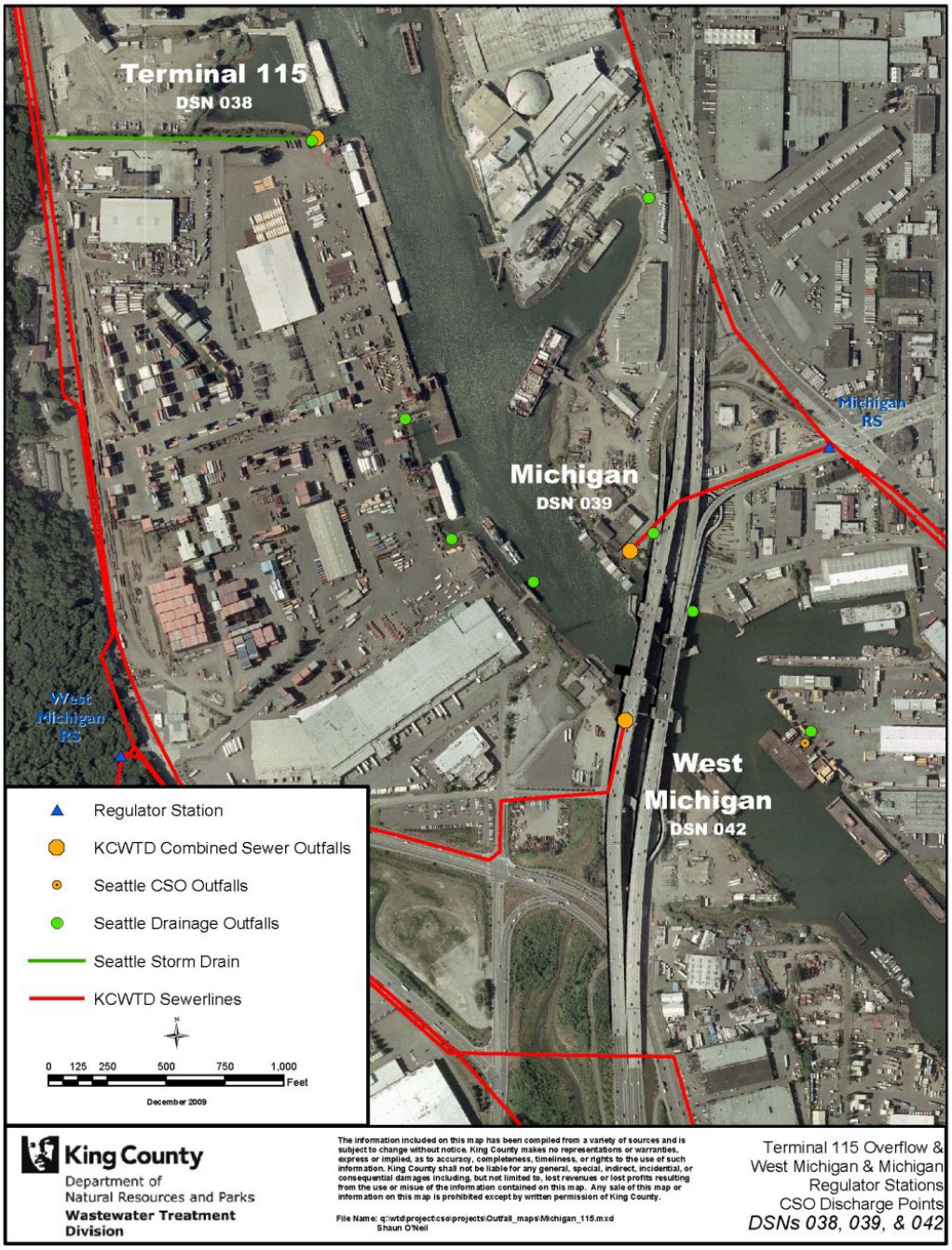



**Figure 4-14. Terminal 115 CSO Discharge Point**

**1983 Overflow Baseline:** 4 events and 2.0 MG per year.

**Overflow Quantity:** Has overflowed between 0 and 7 times per year since 2003, when monitors were installed (improved monitoring techniques allowed for safe installation); 15-year average is 1.8 events per year.

**Control Project History:** The CSO control plan includes new conveyance and a 0.32-MG storage pipe to control this location and the W Michigan St. CSO location by 2025. The project will include GSI to help reduce the required capacities of the new facilities.

**CSO Effluent Quality Monitoring Data:** No overflow quality monitoring to characterize the CSO has been performed. The quality is expected to be similar to that of the W Michigan CSO because of similar land use and industries.

**Construction-Related Monitoring:** King County's PCMP was approved by Ecology on September 28, 2012. Monitoring overflow volumes and frequency at the controlled untreated discharge locations is ongoing, reported monthly to Ecology. These and sediment monitoring events are summarized in CSO annual reports.

**Sediment Sampling:** Sediment sampling in the area and contaminant characterization were conducted as part of the Lower Duwamish Superfund site. Contaminants of concern identified in the remedial investigation include PCBs, arsenic, PAHs, and dioxins/furans (Windward, 2010).

**Sediment Remediation Activity:** A feasibility study for alternatives to clean up contaminated sediments was completed in late 2012 (AECOM, 2012). Following the feasibility study, EPA issued a record of decision in 2014 (EPA, 2014). Any remedial action needed in this area will be done under the Superfund site process.

### 4.2.13 West Michigan St. Regulator Station

NPDES Discharge Serial Number 042

The W Michigan St. RS directs combined flow from the Highland Park area of Seattle to the West Duwamish Interceptor during normal flows and directs excess flow to the W Michigan St. CSO outfall on the west side of the Lower Duwamish Waterway below the First Avenue South Bridge.

**1958 Baseline Facility:** Seattle raw sewage outfall; acquired by Metro (now King County) in 1962. Regulator built in 1967, and flows intercepted for treatment in 1976 when the West Marginal Interceptor and Duwamish Siphon were built.

**Discharge Location:** Overflows through a submerged 36-inch-diameter outfall to the west side of the Duwamish River under the First Avenue South bridge at latitude 47° 32’ 29.621” N and longitude -122° 20’ 5.978” W (Figure 4-15).

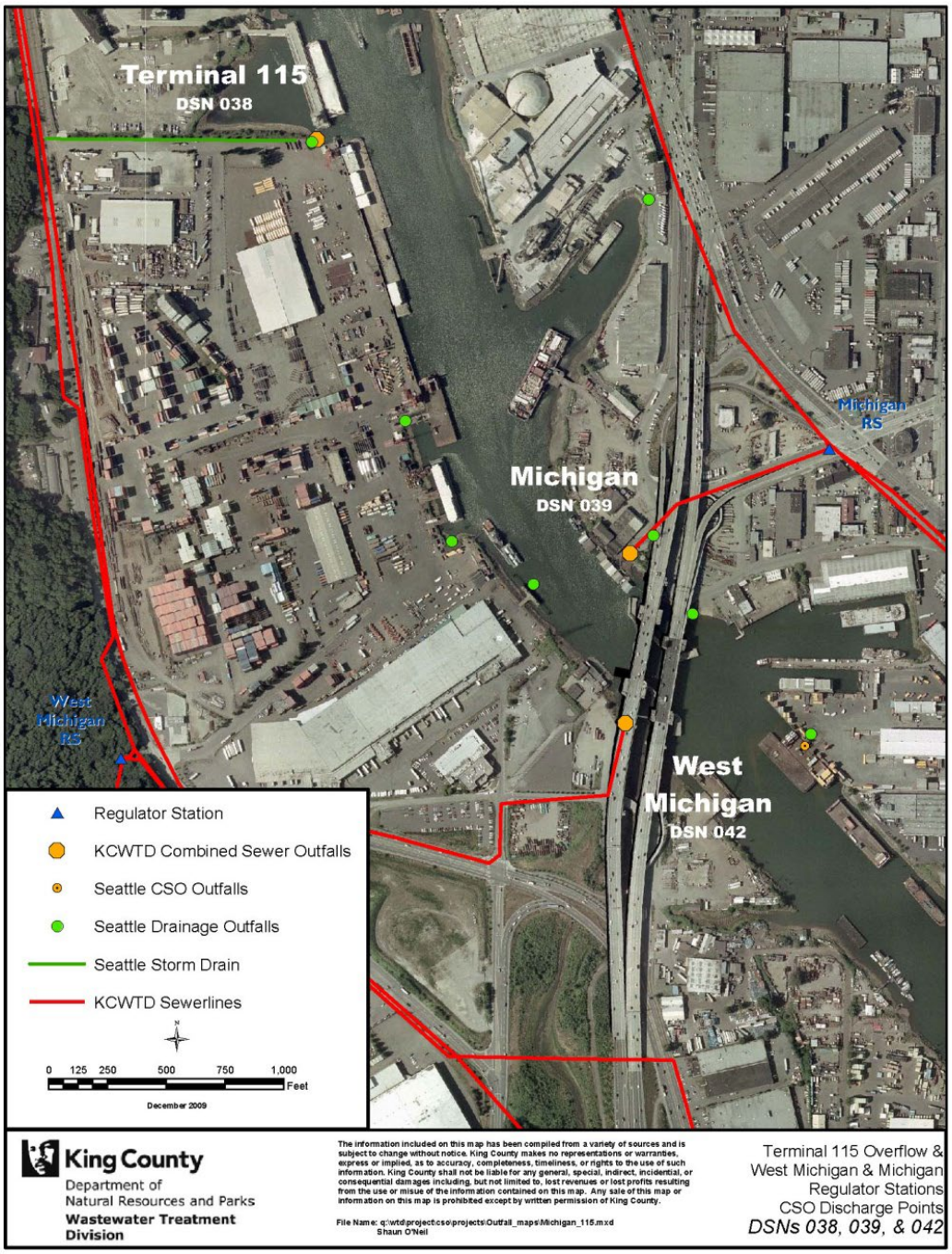



**Figure 4-15. West Michigan Regulator Station CSO Discharge Point**

**1983 Overflow Baseline:** 5 events and 2.0 MG per year.

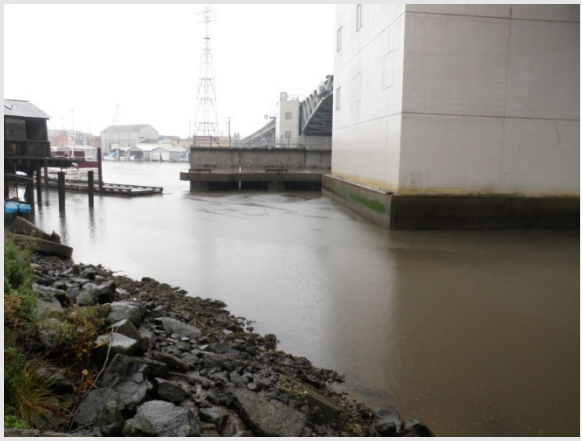
**Overflow Quantity:** Has overflowed between 0 and 9 times per year since 1998; between 1998 and 2017, the 20-year average was 4.6 events per year.

**Control Project History:** No specific control project has been done; some improvement may have resulted from installation of supervisory control and data acquisition system. This location will be controlled as part of the Terminal 115 CSO control project.

**CSO Effluent Quality Monitoring Data:** Overflow quality monitoring to characterize the CSO has been performed during various years. The 2009 CD includes these data.

**Construction-Related Monitoring:** King County's PCMP was approved by Ecology on September 28, 2012. Monitoring overflow volumes and frequency at the controlled untreated discharge locations is ongoing, reported monthly to Ecology. These and sediment monitoring events are summarized in CSO annual reports.

*West Michigan Regulator Station CSO Vicinity; Looking North at the First Avenue South Bridge Footing*



*West Michigan Regulator Station CSO Overflowing 10/17/2009*

**Sediment Sampling:** Sediment sampling in the area and contaminant characterization were conducted as part of the Lower Duwamish Superfund site. Contaminants of concern identified in the remedial investigation include PCBs, arsenic, PAHs, and dioxins/furans (Windward, 2010).

**Sediment Remediation Activity:** A feasibility study for alternatives to clean up contaminated sediments was completed in late 2012 (AECOM, 2012). Following the feasibility study, EPA issued a record of decision in 2014 (EPA, 2014). Any remedial action needed in this area will be done under the Superfund site process.

### 4.2.14 8th Avenue South Regulator Station

NPDES Discharge Serial Number 040

The 8th Ave. S RS sends flows from the Highland Park area of Seattle (Rainier Vista Interceptor) to the West Duwamish Interceptor. The station diverts excess flows to the 8th Ave S CSO outfall on the west side of the Lower Duwamish Waterway.

**1958 Baseline Facility:** Seattle raw sewage outfall; acquired by Metro (now King County) in 1962. Regulator built in 1967, and flows intercepted for treatment in 1976 when West Marginal Interceptor and Duwamish Siphon were built.

**Discharge Location:** Submerged discharge to west side of Duwamish River via a 36-inch-diameter outfall line at latitude 47° 32’ 1.131” N and longitude -122° 19’ 21.501” W (Figure 4-16).

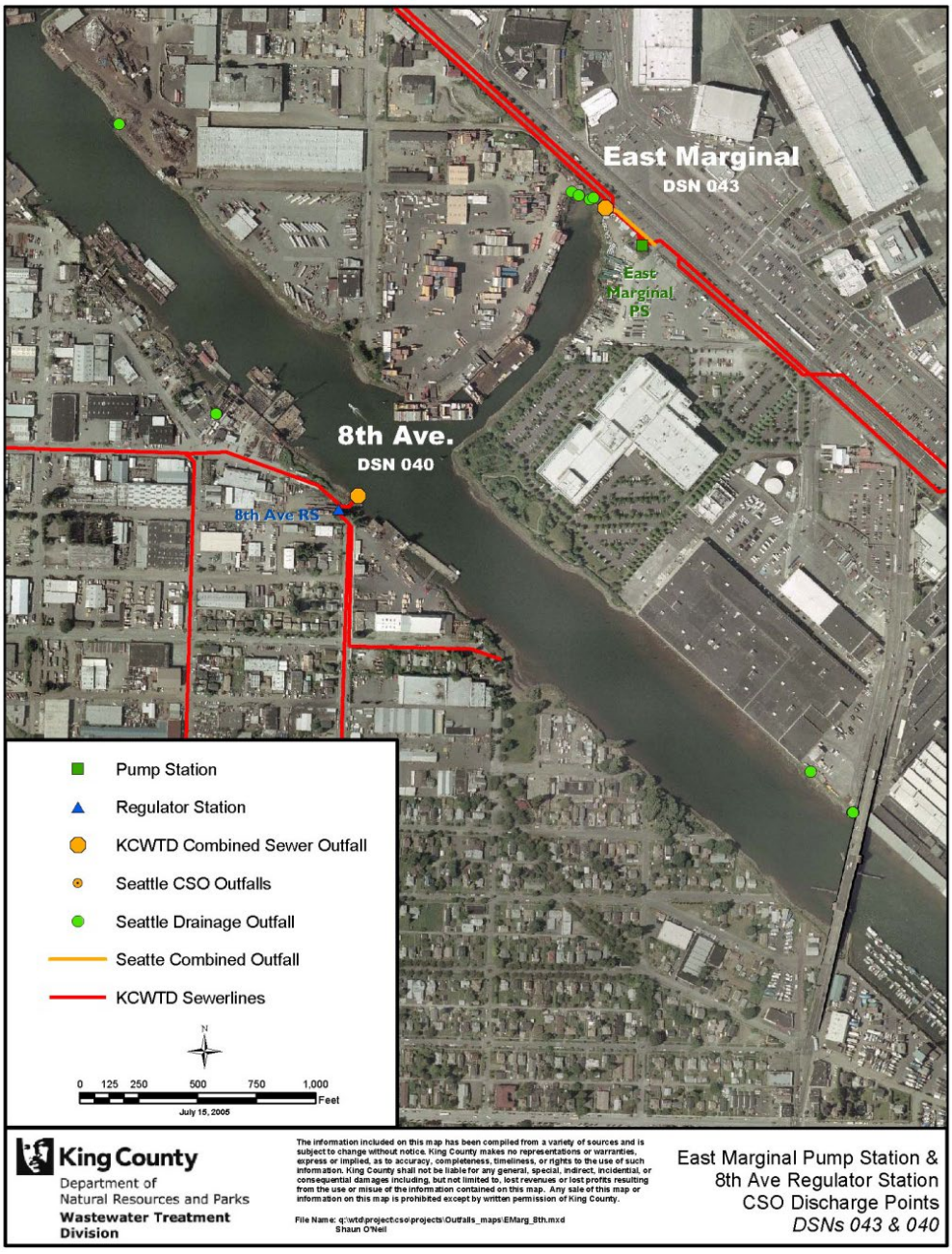



**Figure 4-16. 8th Avenue South Regulator CSO Discharge Point**

**1983 Overflow Baseline:** 6 events and 8.0 MG per year.

**Overflow Quantity:** Has overflowed between 0 and 1 times per year since 1998; between 1998 and 2017, the 20-year average was 0.1 events per year.

**Control Project History:** No specific control project has been done; some improvement may have resulted from installation of a supervisory control and data acquisition system. This CSO location is controlled.

**CSO Effluent Quality Monitoring Data:** Overflow quality monitoring to characterize the CSO was performed in 1994. Only one sample could be collected because of the infrequency of overflow. The 2009 CD includes these data.

**Construction-Related Monitoring:** King County's PCMP was approved by Ecology on September 28, 2012. Monitoring overflow volumes and frequency at the controlled untreated discharge locations is ongoing, reported monthly to Ecology. These and sediment monitoring events are summarized in CSO annual reports.

*8th Avenue South Regulator Station CSO Vicinity; Looking Northwest Across Duwamish River*

*8th Avenue South Regulator Station CSO Vicinity; Looking East Along Duwamish River*

**Sediment Sampling:** Sediment sampling in the area and contaminant characterization were conducted as part of the Lower Duwamish Superfund site. Contaminants of concern identified in the remedial investigation include PCBs, arsenic, PAHs, and dioxins/furans (Windward, 2010).

**Sediment Remediation Activity:** A feasibility study for alternatives to clean up contaminated sediments was completed in late 2012 (AECOM, 2012). Following the feasibility study, EPA issued a record of decision in 2014 (EPA, 2014). Any remedial action needed in this area will be done under the Superfund site process.

# 5.0 CSO Outfalls in Lake Washington Ship Canal/Lake Union/Portage Bay

King County manages seven CSOs in ship canal/Lake Union/Portage Bay. The Canal St. CSO, Dexter Ave. RS, and Ballard CSO are controlled. Four CSOs are not controlled: 11th Ave. NW, 3rd Ave. W, University RS, and Montlake RS.

## 5.1 Receiving Water

### 5.1.1 Overview

Lake Union is a freshwater lake with depths ranging from 35 to 52 feet. The lake receives most of its inflow from Lake Washington via the Montlake Cut and Portage Bay. Lake Union discharges to the Puget Sound Central Basin via the Hiram Chittenden Locks. At certain times of the year, the lake has a significant amount of salt water near the bottom because of saltwater intrusion entering from the locks.

Water circulation patterns in Lake Union are complex and affected by several factors, such as saltwater intrusion, freshwater flows from Lake Washington, wind, and temperature and density stratification. Lake Union exhibits a general pattern of summer stratification and winter flushing. During the dry summer months, water movement from Lake Washington into Lake Union decreases by over 90 percent compared to peak winter flows (Herrera, 1993). As the flow from Lake Washington decreases, the water temperature in Lake Union rises and salt water moves into the lake from the locks. This results in a stratified water column with colder, saltier water on the bottom and warmer, fresh water at the surface.

The saltwater intrusion begins around May and continues through the summer until around November, when rainfall increases freshwater flow into the lake and flushes out salt water. The northern portion of Lake Union has more flushing than the southern portion because of the proximity to the Lake Washington flow, which directs flow toward the locks and Puget Sound (Herrera, 1993).

Density stratification during the summer and fall creates two distinct sections of Lake Union. Circulation during the winter and spring is mainly dominated by water inflow from Lake Washington, which creates a high flushing rate. Weather factors, such as wind speed and direction, can have a significant effect on water circulation.

### 5.1.2 Receiving Water Characteristics

The following description applies to receiving waters in the vicinity of the ship canal CSOs. The discussion of receiving water characteristics is based on data collected beginning in the early 1970s and analysis completed as part of the CSO Water Quality Assessment and Monitoring Study Analysis of Existing Data on Lake Union/Ship Canal (King County, 2017a).

- **Bacteria.** From a regulatory and human-health standpoint, elevated bacteria concentrations (as measured by fecal coliform bacteria) are a persistent water quality issue in Lake Union/ship canal. Bacteria concentrations are typically greatest near the locks and decrease moving upstream, likely because the dominant circulation pattern in the system pushes the bacteria westward toward

the locks. Despite ongoing frequent water quality criteria failures, bacteria concentrations have declined in the last several decades. CSO control and improved stormwater management may have contributed to this decline. Other sources of bacteria need to be identified and mitigated to further enhance water quality and protect human health.

- **Temperature and DO.** The high temperatures and low DO content in Lake Union/ship canal threaten salmonids and other aquatic life at certain times of the year. During the summer salmonid migration, temperatures of the 10 meters of surface waters exceed thermal stress and direct mortality thresholds. By late summer, temperatures can exceed the thermal stress threshold even in the hypolimnetic waters below 10 meters. The stress is further intensified by low DO conditions, in which hypolimnetic hypoxia/anoxia prevent adequate refuge from high water temperatures by making the cooler waters inhospitable. Over the past three decades, surface temperatures in Lake Union/ship canal have increased, temperatures of the summer hypolimnion have decreased, and thermal stratification has strengthened.
- **Salinity.** The conditions in Lake Union/ship canal are substantially influenced by the intrusion of salt water via the locks during the summer; the amount varies greatly year to year. Over the course of the summer, salinity along the bottom increases. A saltwater layer in some years may reach as far upstream as Portage Bay and Lake Washington. After use of the locks has decreased in the fall and winter, saltwater pockets may remain in the deep holes of the Lake Union basin, preventing mixing and prolonging anoxic and acidic conditions. Increased concentrations of metals, organic compounds, and nutrients were observed near the lake bottom during an extended period of saltwater intrusion in 2002 to 2003. The influence of the saltwater layer on sediment chemistry and resuspension is the most likely cause of these increases.
- **Nutrient concentrations.** Nutrient concentrations in Lake Union/ship canal are affected by inputs from Lake Washington and Union Bay via the Montlake Cut, from CSO and stormwater outfalls, and from internal loading from the lake's sediments. Nutrient concentrations in the system have decreased over the years. The decreasing trends suggest that loading both from Lake Washington and the immediate Lake Union/ship canal watershed has decreased.

## 5.2 Information on Specific CSO Outfalls

This section presents outfall and discharge information and sediment chemistry results for the seven CSO outfalls in ship canal/Lake Union/Portage Bay. More information on the volume of CSO discharged yearly from each location can be found in the annual reports on King County's CSO Program on the County's website.[16]

Table 5-1 presents a summary of sediment and discharge monitoring information for these CSOs. It also indicates whether there is a stormwater outfall associated with a CSO site.

[16] The annual reports are available at http://www.kingcounty.gov/environment/wastewater/CSO/Library/AnnualReports.aspx.

**Table 5-1. Summary of Sediment and Discharge Information for CSOs in Lake Washington Ship Canal/Lake Union/Portage Bay**

| DSN | Facility Name | Control Status | Associated Stormwater Outfall | Discharge Quality Data* | Last Date of Sediment Sample | Number of Stations | Sediment Analysis Performed | Data Submitted to EIM | SQS Exceedance |
|---|---|---|---|---|---|---|---|---|---|
| 003 | Ballard Siphon Regulator via Seattle Storm Drain | Controlled | Yes | Yes | 2015 | 7 | Chemistry | Yes | Yes |
| 004 | 11th Ave. NW (aka East Ballard) | Uncontrolled | Yes | Yes | 1989 | 1 | Chemistry | No | |
| 008 | 3rd Ave. W and Ewing St. | Uncontrolled | Yes | Yes | 2011 | 7 | Chemistry | Yes | Yes |
| 007 | Canal St. Overflow | Controlled | Yes | No | Not sampled—controlled CSO | — | — | — | |
| 009 | Dexter Ave. RS | Controlled | Yes | Yes | 2001 | 1 | Chemistry | Yes | |
| 015 | University RS | Uncontrolled | Yes | Yes | 2011 | 7 | Chemistry | Yes | Yes |
| 014 | Montlake RS | Uncontrolled | Yes | Yes | 2011 | 7 | Chemistry | Yes | No |

### 5.2.1 Ballard Siphon CSO

NPDES Discharge Serial Number 003

The Ballard Siphon CSO discharges from outfalls on the north side of Salmon Bay in Ballard. As of 2014, the Ballard Siphon CSO is considered controlled through construction of a new 7-foot-wide sewer pipe under Salmon Bay between the Ballard and Interbay areas of Seattle. The new pipe partners with two 3-foot-wide wooden pipes (Ballard Siphons) built in the 1930s to serve north Seattle. On most days, combined sewage flows through the older pipes to West Point. The new pipe stores extra flow during storms when the older pipes are full (King County, 2017a).

**1958 Baseline Facility:** City of Seattle CSO on the North Trunk; acquired by Metro (now King County) in 1962.

**Discharge Location:** North side of ship canal at Salmon Bay through a Seattle storm drain at latitude 47° 39’ 50.096” N and longitude -122° 22’ 56.400” W (Figure 5-1).


**Figure 5-1. Ballard Siphon CSO Discharge Point**

**1983 Overflow Baseline:** 13 events and 90 MG per year.

**Overflow Quantity:** Has overflowed between 0 and 2 times per year since 1998; between 1998 and 2017, the 20-year average was 0.2 events per year.

**Control Project History:** Significant control was achieved through building of the Parallel Ft. Lawton tunnel in 1992 to transfer captured CSO to West Point for treatment.

**CSO Effluent Quality Monitoring Data:** Overflow quality monitoring to characterize the CSO was performed from 1989 to 1990.

*Ballard Siphon Regulator CSO Vicinity; Looking South Across Ship Canal*

**Construction-Related Monitoring:** King County's PCMP was approved by Ecology on September 28, 2012. Monitoring volume and frequency of overflows at the controlled untreated discharge locations is ongoing, reported monthly to Ecology. These updates and sediment monitoring are summarized in each CSO annual report.

**Sediment Sampling:** King County collected seven sediment samples proximal to the Ballard Siphon Regulator CSO discharge point per the PCMP in 2015. The stations were positioned around the outfall, with the farthest stations located approximately 150 feet away from the CSO discharge (see Figure 5-2). All seven locations exceeded the Sediment Cleanup Objectives (SCO), with one or more exceedances for metals (arsenic, cadmium, copper, mercury, nickel, and silver), total PCBs, total PAHs, BEHP, and di-n-octyl phthalate. One location exceeded the CSL (for mercury and BEHP). The 2018 submittal includes these data.

**Sediment Remediation Activity:** This CSO is located in a highly developed area in Lake Washington ship canal/Lake Union with sediments affected from multiple pathways and potential sources. Further investigation is needed as part of a site-wide investigation in a coordinated multi-agency approach.


**Figure 5-2. Ballard Siphon Regulator (003) Sediment Sampling Location**

### 5.2.2 11th Avenue Northwest CSO

NPDES Discharge Serial Number 004

The 11th Ave. NW CSO site, located on the north side of the Fremont Cut at the east end of Salmon Bay, receives flows from the Ballard neighborhood.

**1958 Baseline Facility:** City of Seattle CSO on the North Trunk; acquired by Metro (now King County) in 1962.

**Discharge Location:** From a side weir to a submerged 72-inch-diameter outfall that discharges at a depth of approximately 20 feet to the north side of ship canal at latitude 47° 39’ 34.169” N and longitude -122° 22’ 56.400” W (Figure 5-3).


**Figure 5-3. 11th Avenue Northwest CSO Discharge Point**

**1983 Overflow Baseline:** 16 events and 5 MG per year.

**Overflow Quantity:** Has overflowed between 6 and 25 times per year since 1998; between 1998 and 2017, the 20-year average was 14.5 events per year.

**CSO Effluent Quality Monitoring Data:** Overflow quality monitoring to characterize the CSO was performed from 1988 to 1989.

**Construction History:** The 11th Ave. CSO is scheduled to be controlled through the joint Ship Canal Water Quality Project (SCWQP) with the City of Seattle that would construct a storage tunnel on the north side of the Fremont Cut by 2025. The SCWQP will control two County (11th Ave. NW and 3rd Ave. W) and four city CSO sites.

**Construction-Related Monitoring:** King County's PCMP was approved by Ecology on September 28, 2012. Monitoring volume and frequency of overflows at the controlled untreated discharge locations is ongoing, reported monthly to Ecology, and summarized in CSO annual reports.

*11th Avenue Northwest CSO Vicinity; Looking South across Ship Canal*

*11th Avenue Northwest CSO Overflowing 10/26/09*

**Sediment Sampling:** King County collected a sediment sample from one location proximal to the 11th Ave. NW CSO discharge point in May 1989. Figure 5-4 shows the station location and the overflow discharge point. One sample was collected from Station KTTB01. Results indicate that several organic and metals contaminants exceeded the CSL, including bis(2-ethylhexyl)phthalate, PCBs, 1,1-Dichloro-2,2-bis(p-chlorophenyl) ethylene (DDE), and mercury, among others. In 2005, two surface sediment samples were collected adjacent to the 11th Ave. NW Overflow discharge area as part of the Lower Duwamish Waterway Phase 2 investigation and tested for PCBs, pentachlorophenol, and dioxin/furans. The SCO was exceeded for total PCBs only.

**Sediment Remediation:** Historically, concentrations of many chemicals are elevated throughout the area, and other nearby sources of contamination exist. This CSO is located in a highly developed area in Lake Washington ship canal/Lake Union, with sediments affected from multiple pathways and potential sources. Further investigation is needed as part of a site-wide investigation in a coordinated multi-agency approach.

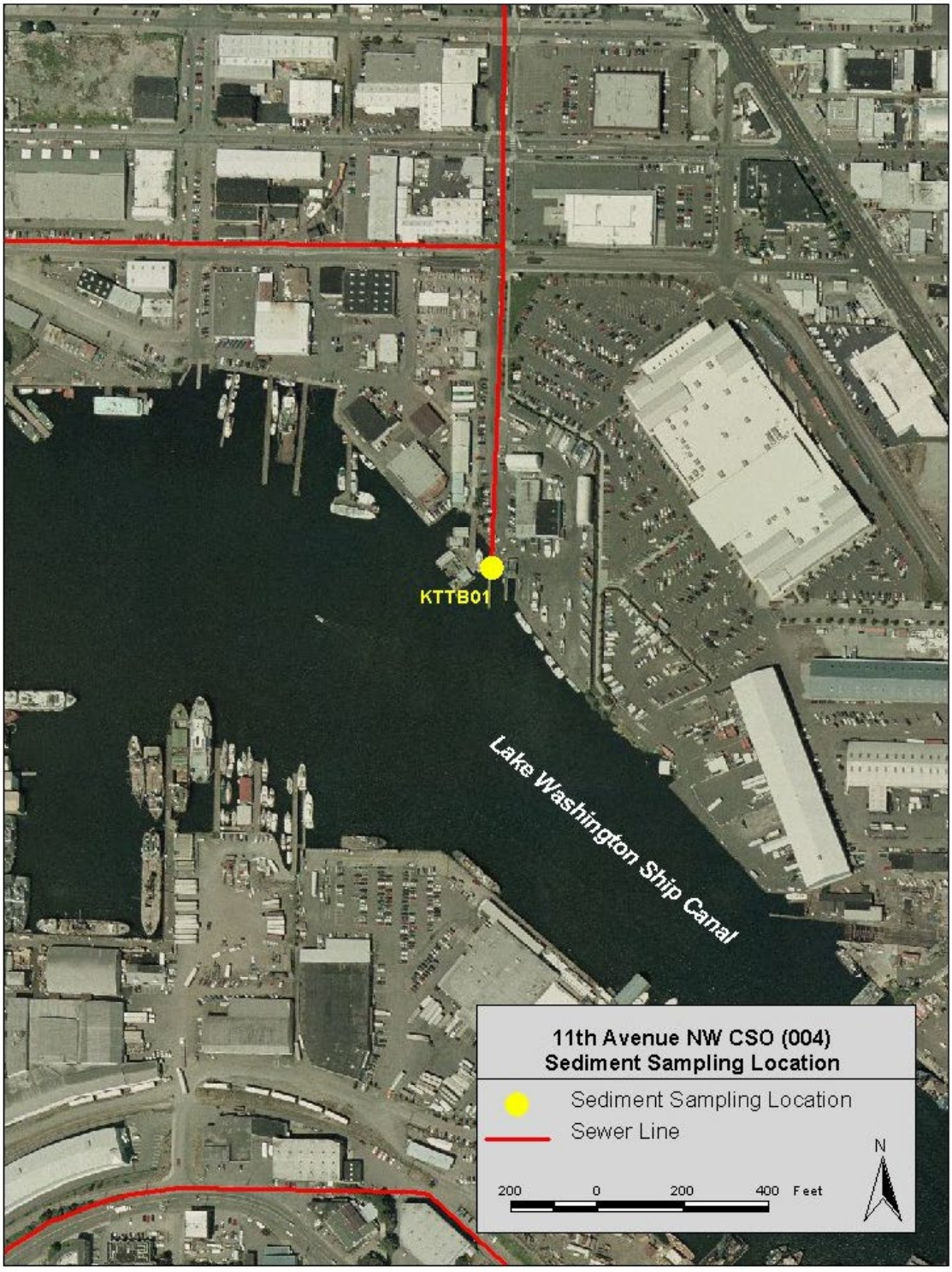



**Figure 5-4. 11th Avenue Northwest CSO (004) Sediment Sampling Location**

### 5.2.3 3rd Avenue West CSO

NPDES Discharge Serial Number 008

The 3rd Ave. W CSO site, located on the south side of the Fremont Cut, is the aftbay to the Fremont Siphon.

**1958 Baseline Facility:** Seattle CSO, sand-catcher and 30-foot-long side overflow weir built in 1958; acquired by Metro (now King County) in 1962.

**Discharge Location:** To south ship canal seawall via a 5-foot-square opening in the quay wall at a depth of 3 feet at latitude 47° 39’ 34.169” N and longitude -122° 22’ 56.400” W (Figure 5-5).


**Figure 5-5. 3rd Avenue West CSO Discharge Point**

**1983 Overflow Baseline:** 17 events and 106 MG per year.

**Overflow Quantity:** Has overflowed between 1 and 13 times per year since 1998; between 1998 and 2017, the 20-year average was 6.9 events per year.

**Control Project History:** 64-MG reduction was achieved through building of the Parallel Ft. Lawton Tunnel in 1992 to transfer captured CSO to West Point for treatment. The site will be controlled, along with the 11th Ave NW CSO, through the joint SCWQP.

**CSO Effluent Quality Monitoring Data:** Overflow quality monitoring to characterize the CSO was performed from 1988 to 1989.

**Construction-Related Monitoring:** King County's PCMP was approved by Ecology on September 28, 2012. Monitoring volume and frequency of overflows at the controlled untreated discharge locations is ongoing, reported monthly to Ecology. These updates and sediment monitoring are summarized in CSO annual reports.

*3rd Avenue West CSO Vicinity; Looking Northwest across Ship Canal*

*3rd Avenue West Overflowing 10/26/09*

**Sediment Sampling:** King County collected seven sediment samples proximal to the 3rd Ave. W CSO discharge point in 2011. Figure 5-6 shows the sample locations and the overflow discharge point. Several organic contaminants exceeded the CSL at some of the locations. Data are included in the 2018 submittal.

**Sediment Remediation Activity:** This CSO is located in a highly developed area in Lake Washington ship canal/Lake Union, with sediments affected from multiple pathways and potential sources. Further investigation is needed as part of a site-wide investigation in a coordinated multi-agency approach.

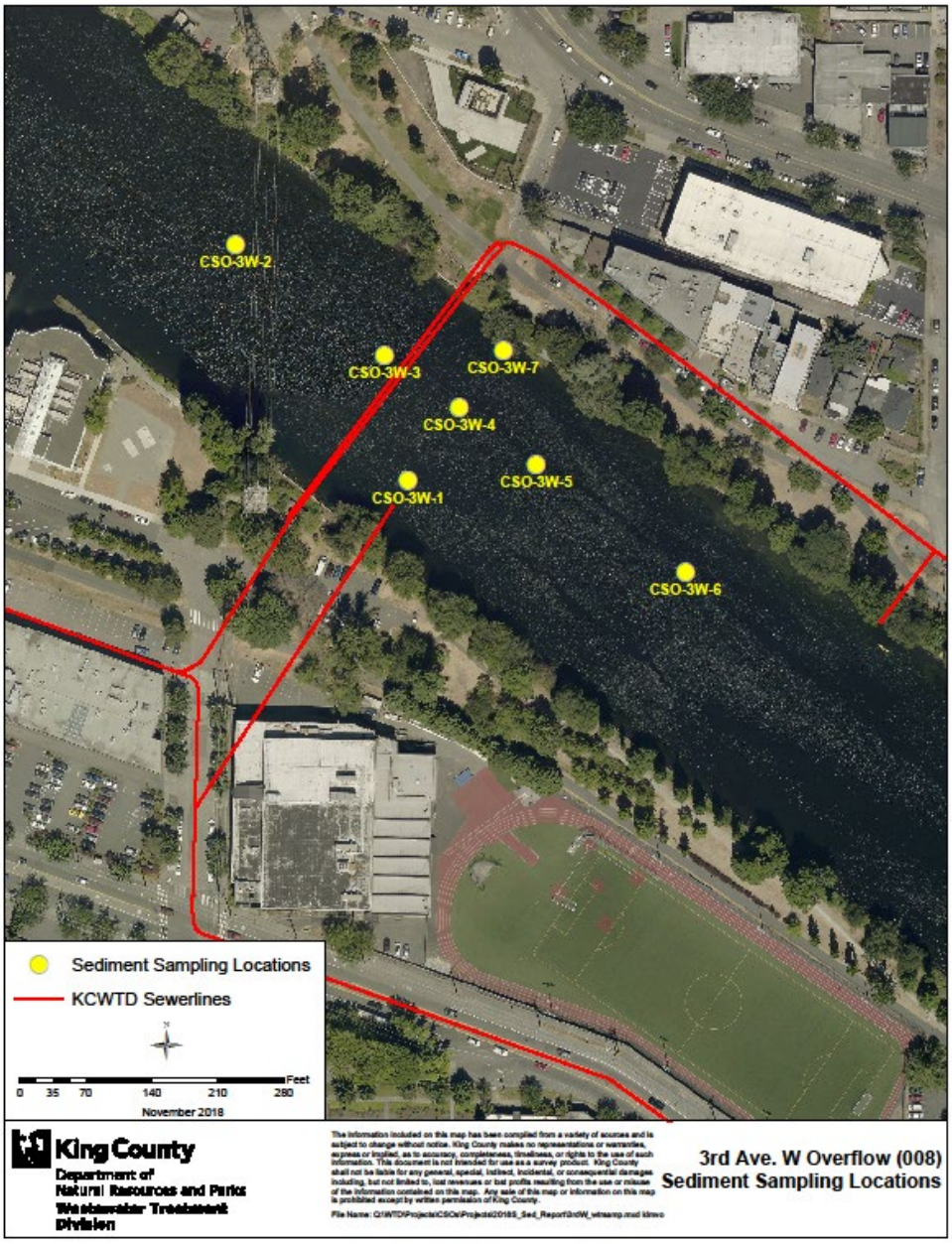



**Figure 5-6. 3rd Avenue West CSO (008) Sediment Sampling Location**

### 5.2.4 Canal Street CSO

NPDES Discharge Serial Number 007

The Canal St. CSO site, located on the north side of the Fremont Cut, is the forebay to the Fremont Siphon.

**1958 Baseline Facility:** Seattle built the relief and sand-catcher in 1958 to control flows across the Fremont Siphon; Metro (now King County) acquired it in 1962.

**Discharge Location:** From the sand-catcher to the ship canal seawall through north quay wall at a depth of 3 feet at latitude 47° 39' 6.683" N and longitude -122° 21' 29.208" W (Figure 5-7).

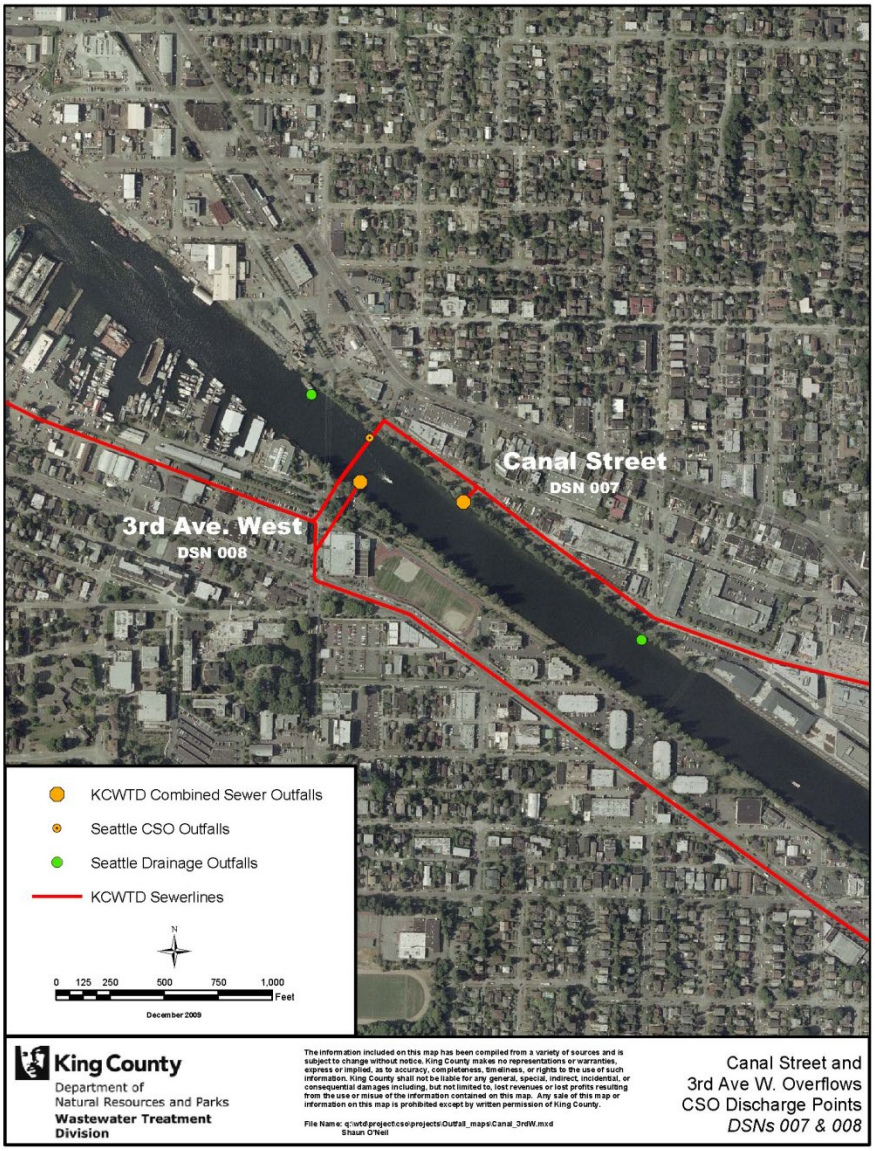



**Figure 5-7. Canal Street CSO Discharge Point**

**1983 Overflow Baseline:** 0 events and 1 MG per year.

**Overflow Quantity:** Has overflowed between 0 and 2 times per year since 1998; between 1998 and 2017, the 20-year average was 0.5 events per year; controlled to the state standard.

**Control Project History:** No project has been needed and none is planned because the CSO is controlled.

**CSO Effluent Quality Monitoring Data:** Overflow quality and sediment monitoring to characterize the CSO was not done because the CSO is controlled.

*Canal Street CSO Vicinity; Looking South Across Ship Canal*

**Construction-Related Monitoring:** Not applicable; the CSO is controlled.

**Sediment Sampling:** King County has not sampled ship canal sediments in the vicinity of the Canal St. CSO discharge point. Data would be similar to that from 3rd Ave. W.

**Sediment Remediation Activity:** Concentrations of those chemicals elevated at 3rd Ave. W are elevated throughout the area, and other nearby sources of contamination exist. This CSO is located in a highly developed area in Lake Washington ship canal/Lake Union, with sediments affected from multiple pathways and potential sources. Further investigation is needed as part of a site-wide investigation in a coordinated multi-agency approach.

### 5.2.5 Dexter Avenue Regulator Station

NPDES Discharge Serial Number 009

Since its completion in 2005, the Mercer Tunnel stores combined flows that would otherwise discharge through the Dexter Ave. RS CSO. If tunnel capacity is exceeded before flows can be sent to West Point, the stored flows are treated at the Elliott West WWTS, which discharges to Elliott Bay (King County, 2017a).

**1958 Baseline Facility:** Seattle CSO; 30-foot-long side weir overflow; acquired by Metro (now King County) in 1962; regulator station built by Metro in 1972.

**Discharge Location:** Lake Union via a 48-inch-diameter and 414-foot-long submarine outfall at latitude 47° 37' 56.298" N and longitude -122° 20' 19.506" W (Figure 5-8).

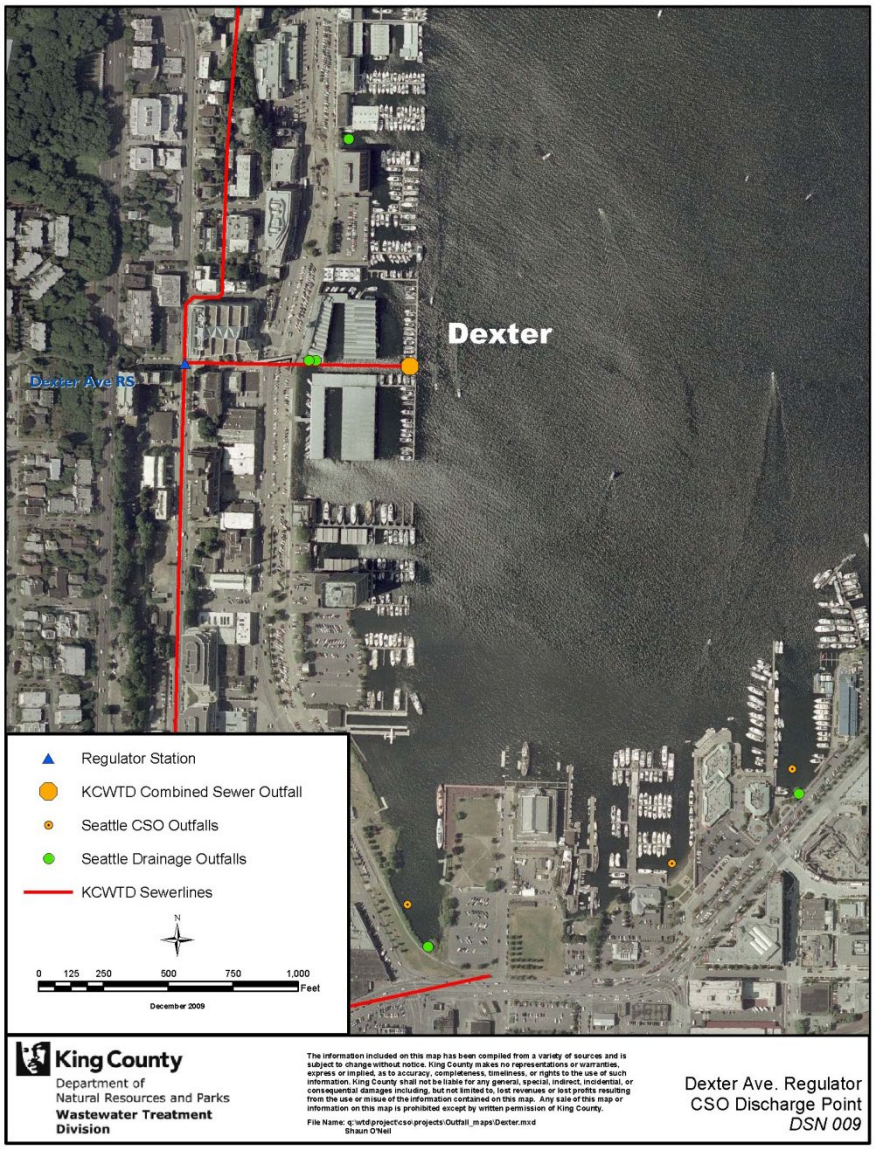



**Figure 5-8. Dexter Avenue Regulator Station CSO Discharge Point**

**1983 Overflow Baseline:** 15 events and 24 MG per year.

**Overflow Quantity:** Has overflowed between 0 and 1 times per year since 1998; between 1998 and 2017, the 20-year average was 0.3 events per year.

**Control Project History:** Substantial control achieved from Denny Lake Union project, online May 2005; additional control modifications are underway to complete control.

**CSO Effluent Quality Monitoring Data:** Overflow quality monitoring to characterize the CSO was performed most recently in 2011 and 2012.

*Dexter Avenue Regulator Station CSO Vicinity, Looking South, Parallel to Westlake Avenue*

**Construction-Related Monitoring:** King County's PCMP was approved by Ecology on September 28, 2012. Monitoring volume and frequency of overflows at the controlled untreated discharge locations is ongoing, reported monthly to Ecology, and summarized in CSO annual reports.

**Sediment Sampling:** King County collected a sediment sample from one location proximal to the Dexter Ave. RS CSO discharge point in May 1989. The station location and the overflow discharge point are shown in Figure 5-9. One sample was collected from Station KTHY01. Sediments in the vicinity of this discharge point were sampled again in August 2001. One sample was collected from Station 0569. Results from the 2001 sampling event adjacent to the Dexter Ave. RS overflow discharge area had exceedances of both the SCO and CSL criteria. SCO exceedances from 2001 included arsenic, nickel, and BEHP; CSL exceedances included metals (cadmium, chromium, copper, lead, mercury, and silver), tributyltin (TBT), total PCBs, total PAHs and other organics. Data from this event was included in the 2009 CD.

**Sediment Remediation Activity:** Concentrations of those chemicals elevated at the site are elevated throughout the area and other nearby sources exist. This CSOs is located in a highly developed area in Lake Washington Ship Canal/Lake Union with sediments affected from multiple pathways and potential sources. Further investigation is needed as part of a site-wide investigation as a coordinated multi-agency approach.


**Figure 5-9. Dexter Avenue Regulator Station (009) Sediment Sampling Locations**

### 5.2.6 University Regulator Station

NPDES Discharge Serial Number 015

The University RS CSO discharges from the east side of Portage Bay.

**1958 Baseline Facility:** Originally a City of Seattle CSO; acquired by Metro (now King County) in 1962; regulator built by Metro in 1976.

**Discharge Location:** Discharges at surface through seawall at latitude 47° 38’ 56.299” N and longitude -122° 18’ 40.281” W (Figure 5-10).


**Figure 5-10. University Regulator Station CSO Discharge Point**

**1983 Overflow Baseline:** 13 events and 126 MG per year.

**Overflow Quantity:** Has overflowed between 3 and 14 times per year since 1998; between 1998 and 2017, the 20-year average was 6.9 events per year.

**Control Project History:** A Phase I partial separation project was completed in 1994, creating a new stormwater outfall under the I-5/University Bridge, called the Densmore Drain. Project volume reduction was approximately 36 MG per year. Control will be achieved by 2030 either through a joint county-city 5.23-MG storage tank that would also control three city CSO sites or through a County project that would construct a 2.94-MG storage tank. In addition, GSI will be implemented in the basin to enhance CSO control.

**CSO Effluent Quality Monitoring Data:** Overflow quality monitoring to characterize the CSO was performed most recently from 2011 to 2012.

**Construction-Related monitoring:** King County's PCMP was approved by Ecology on September 28, 2012. Monitoring volume and frequency of overflows at the controlled untreated discharge locations is ongoing, reported monthly to Ecology, and summarized in CSO annual reports.

*University RS CSO Vicinity; Looking South across Ship Canal*

*University Regulator Station Overflowing 10/26/09*

**Sediment Sampling:** Most recently, sediment samples were collected near the outfall in 2011 and 2013. Stations were collected per the PCMP in 2011, with additional stations added in 2013 to help validate the County's CSO discharge model. Figure 5-11 shows the station locations and the overflow discharge point. The stations were positioned around the outfall, with the farthest stations located approximately 150 feet away from the CSO discharge. Many samples exceeded the SCO, with exceedances recorded for total PCBs, mercury, silver, nickel, lead, and phenol. Three samples exceeded the CSL, with exceedances recorded for total PCBs, mercury, and silver. The 2011 and 2013 data are included in the 2018 submittal.

**Sediment Remediation Activity:** University RS Overflow was likely to be identified as a cleanup site and underwent a preliminary evaluation of cleanup alternatives in the SMP (King County, 2018) to develop cost estimates for long-range planning. At this time, sediment cleanup is assumed to commence following CSO control because of modeled recontamination potential.

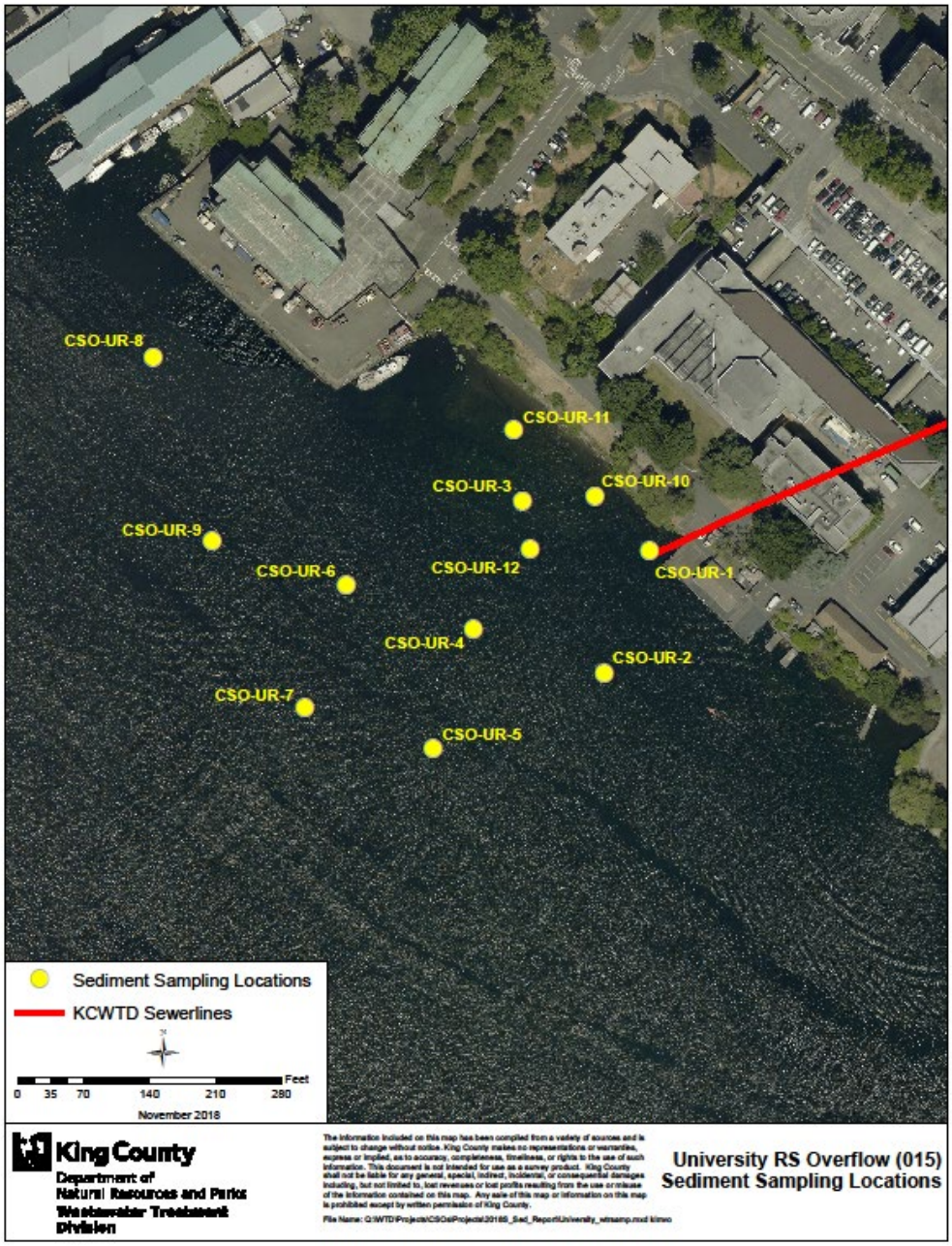



**Figure 5-11. University Regulator Station (015) Sediment Sampling Location**

### 5.2.7 Montlake CSO

NPDES Discharge Serial Number 014

The Montlake CSO discharges from the south side of the Montlake Cut.

**1958 Baseline Facility:** Originally a City of Seattle CSO; acquired by Metro (now King County) in 1962; regulator built by Metro in 1978,

**Discharge Location:** Discharges at the surface on the south seawall at latitude 47° 38’ 49.597” N and longitude -122° 18’ 17.498” W **(**Figure 5-12**).**


**Figure 5-12. University and Montlake CSOs Discharge Points**

**1983 Overflow Baseline:** 6 events and 32 MG per year.

**Overflow Quantity:** Has overflowed between 0 and 20 times per year since 1998; between 1998 and 2017, the 20-year average was 7.7 events per year.

**Control Project History:** Built in 1978. Control will be achieved by 2028, either through a joint County–City 7.87-MG storage tank that would also control three City North Union Bay CSO sites or through a County project that would construct a 6.6-MG storage tank. GSI will be implemented in the basin to enhance CSO control.

**CSO Effluent Quality Monitoring Data:** Overflow quality monitoring to characterize the CSO was performed between 1990 and 1995.

**Construction-Related Sediment Monitoring:** King County's PCMP was approved by Ecology on September 28, 2012. Monitoring volume and frequency of overflows at the controlled untreated discharge locations is ongoing, reported monthly to Ecology, and summarized in CSO annual reports.

**Sediment Sampling:** King County collected seven sediment samples per the PCMP proximal to the Montlake CSO discharge point in 2011. Figure 5-13 shows the sample locations and the overflow discharge point. Results show no SQS exceedances. These data are included in the 2018 submittal.

**Sediment Remediation Activity:** No action required.


*Montlake Regulator Station CSO Vicinity Looking East*

*Montlake Regulator Station CSO Vicinity Looking West*

*Montlake Regulator Station CSO Overflowing 10/26/09*

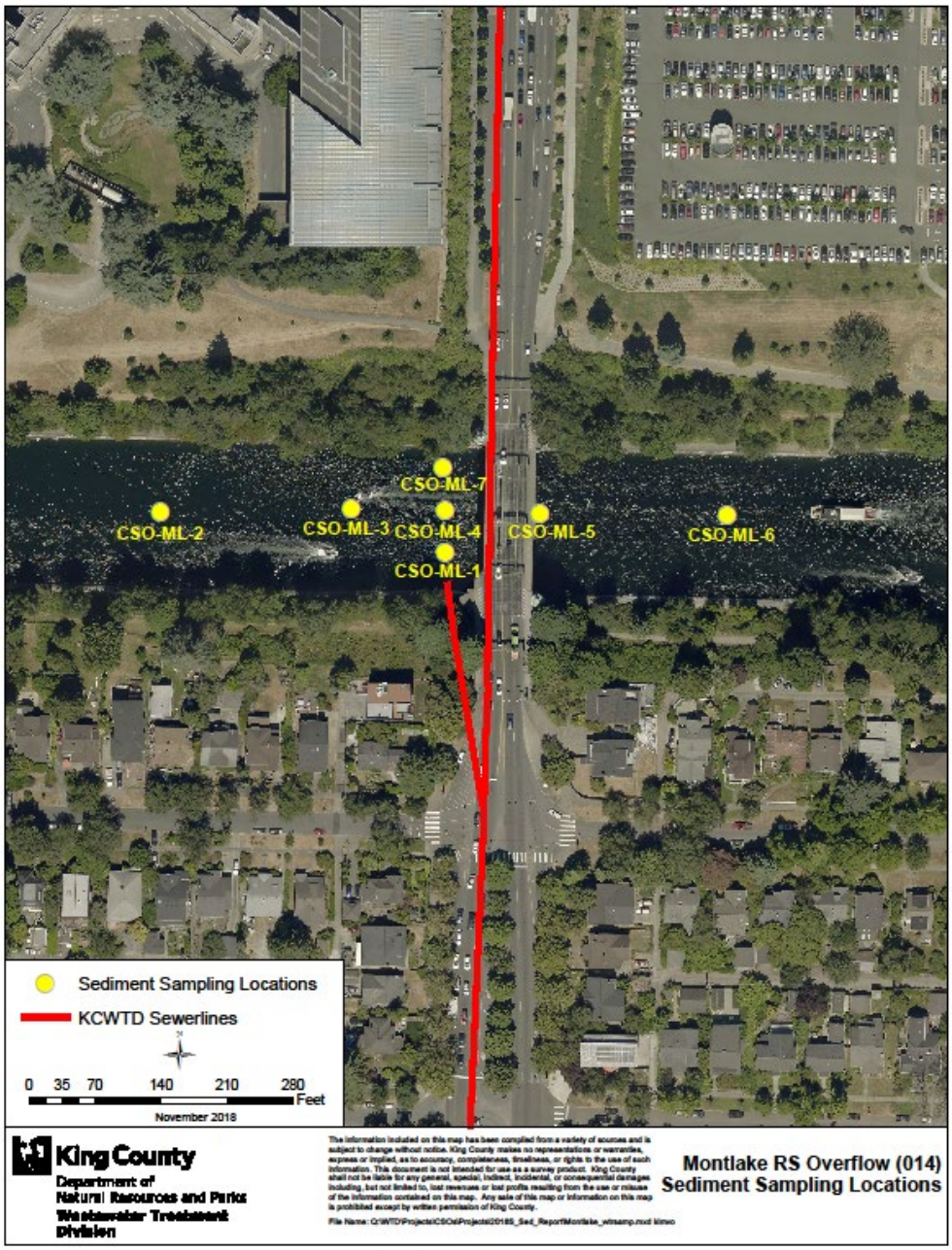



**Figure 5-13. Montlake Regulator Station CSO (014) Sediment Sampling Location**

# 6.0 CSO Outfalls in Lake Washington

King County manages six CSOs in Lake Washington: Matthews Park PS, 30th Ave. NE, Belvoir PS, E Pine St., Rainier Ave. PS, and Henderson St. PS (including the MLK Jr. Way CSO). All CSOs except Belvoir PS are controlled.

## 6.1 Receiving Water

### 6.1.1 Overview

Lake Washington is the largest of the three major lakes in King County. Lake Washington's two major influent streams are the Cedar River at the southern end, which contributes about 57 percent of the annual hydraulic load and 25 percent of the phosphorus load, and Lake Sammamish via the Sammamish River from the north, which contributes 27 percent of the hydraulic load and 41 percent of the phosphorus load. Most of the lake shoreline is highly developed, with 63 percent fully developed (King County, 2009). Between 1941 and 1963, the lake received raw, primary, and secondary treated wastewater, which resulted in eutrophication and poor water quality. By 1968, wastewater was diverted from the lake, and discharge of untreated effluent, except for CSOs, was reduced to zero.

The Lake Washington basin is a deep, narrow, glacial trough with steeply sloping sides. The lake is 20.6 feet above MLLW and is connected to the Puget Sound Central Basin via Lake Union and the ship canal. Mercer Island lies in the southern half of the lake, separated from the east shore by a relatively shallow and narrow channel, and from the west shore by a much wider and deeper channel. The mean depth of the lake is 108 feet, with a maximum depth of 214 feet (King County, 2009).

### 6.1.2 Receiving Water Characteristics

The following description applies to receiving waters in the vicinity of all Lake Washington CSOs, unless otherwise noted. The discussion of receiving water characteristics is based on 1990 to 2001 sampling results from the County's freshwater monitoring program.[17]

Lake Washington has one mixing and one stratification event per year and undergoes complete mixing from the surface to the bottom from December through March. The water column is stratified the remainder of the year. The lake begins to stratify in April and experiences a strong stratification from June to October. Surface water starts to cool in October when the stratification weakens and the thermal stratification that separates the surface and deep waters breaks down.

Lake Washington temperatures generally ranged from 6 to 9 ºC between December and March, with maximum temperatures between 21.5 and 24.5 ºC observed during July and August. Temperatures in nearshore areas, such as those near the County CSOs, generally exceeded 17.8 ºC from mid-July through early October (King County, 2003).

[17] Data and reports are accessible at http://green.kingcounty.gov/lakes/LakeWashington.aspx.

DO concentrations in deep waters were typically over 9.0 mg/L during months when the water column was mixed, but dropped to a low of 2.5 mg/L in the hypolimnion during stratification (King County, 2003).

Mean summer transparencies in pelagic, or deep, areas of the lake ranged between 3.5 to 5.6 meters. Mean transparencies in nearshore areas were slightly less, by 0.1 to 0.5 meters, than those in pelagic areas. Transparencies in the fall were typically higher than other seasons (King County, 2003).

## 6.2 Information on Specific CSO Outfalls

This section presents outfall and discharge information as well as sediment chemistry results for the six CSO outfalls in Lake Washington. More information on the volume of CSOs discharged yearly from each location can be found in annual reports on King County's CSO Program on the County's website.[18]

Table 6-1 presents a summary of sediment and discharge monitoring information for the Lake Washington CSOs. It also indicates whether there is a stormwater outfall associated with a particular CSO site.

**Table 6-1. Summary of Sediment and Discharge Information for CSOs in Lake Washington**

| DSN | Facility Name | Control Status | Associated Stormwater Outfall | Discharge Quality Data* | Last Date of Sediment Sample | Number of Stations | Sediment Analysis Performed | Data Submitted to EIM | SQS Exceedance |
|---|---|---|---|---|---|---|---|---|---|
| 018 | Matthews Park PS | Controlled | Yes | No | Not sampled—controlled CSO | — | — | — | |
| 049 | 30th Ave. NE | Controlled | Yes | No | 2013 | 1 | Chemistry | Yes | Yes |
| 012 | Belvoir PS | Uncontrolled | Yes | No | 2013 | 1 | Chemistry | Yes | Yes |
| 011 | E Pine St. | Controlled | Yes | No | 2000 | 2 | Chemistry | Yes | |
| 033 | Rainier Ave. PS | Controlled | Yes | No | 2000 | 2 | Chemistry | Yes | |
| 045 | Henderson St. PS | Controlled | Yes | Yes | 2000 | 2 | Chemistry | Yes | |
| 013 | MLK Jr. Way | Controlled | Yes | Yes | 2000 | 2 | Chemistry | Yes | |

[18] The annual reports can be accessed at http://www.kingcounty.gov/environment/wastewater/CSO/Library/AnnualReports.aspx.

### 6.2.1 Matthews Park Pump Station

NPDES Discharge Serial Number 018; northeastern part of the King County combined system.

This station receives flow from the north via the Kenmore PS and interceptor and from the west via the North and West Lake City trunks and the Thornton Creek Trunk.

**1958 Baseline Facility:** Did not exist in 1958. Built by Metro (now King County) in 1967 to divert flow from the service area of the City of Seattle's 2.5-MGD Lake City secondary treatment plant (allowing it to be decommissioned) and from the north end of the system to the new West Point plant. Separated flows, highly affected by infiltration and inflow, arrive from upstream.

**Discharge Location:** Any overflow occurs from a series of seven flapgates along the Kenmore Lakeline, starting from the southernmost flapgate (Flapgate 01Aa) at latitude 47° 37' 3.108" N and longitude -122° 16' 21.54" W (Figure 6-1).


**Figure 6-1. Matthew's Park Pump Station CSO Discharge Point (Flapgate 01Aa)**

**1983 Overflow Baseline:** 0 events and 0 MG per year.

**Overflow Quantity:** Has rarely overflowed since 1991, when monitoring began; 20-year average is less than 1 event per year; 2001 to 2007 average volume was less than 1 MG per year; overflows only during 100-year-type storms.

**Control Project History:** No project has been needed or planned; controlled to the state standard.

**CSO Effluent Quality Monitoring Data:** Overflow quality and sediment monitoring to characterize the CSO was not done because the CSO is controlled.

**Construction-Related Monitoring:** Not applicable; no control project is needed.

**Sediment Sampling:** King County has not sampled Lake Washington sediments in the vicinity of the Matthews Park PS CSO discharge point.

**Sediment Remediation Activity:** No action required.

*Matthews Park Pump Station CSO Vicinity; Looking Northeast*

*Matthews Park Pump Station CSO Vicinity; Looking Southeast*

### 6.2.2 30th Avenue Northeast

NPDES Discharge Serial Number 049

30th Ave. NE receives flows from the Laurelhurst Trunk and the Belvoir Place PS.

**1958 Baseline Facility:** Seattle PS 1; replaced with new pump station by Metro (now King County) in 1971.

**Discharge Location:** Shares outfall with Belvoir PS; discharges to Union Bay Slough through a 36-inch-diameter outfall that discharges 40 feet offshore at a depth of 10 feet at latitude 47° 39' 24.111" N and longitude -122° 17' 15.321" W (Figure 6-2).

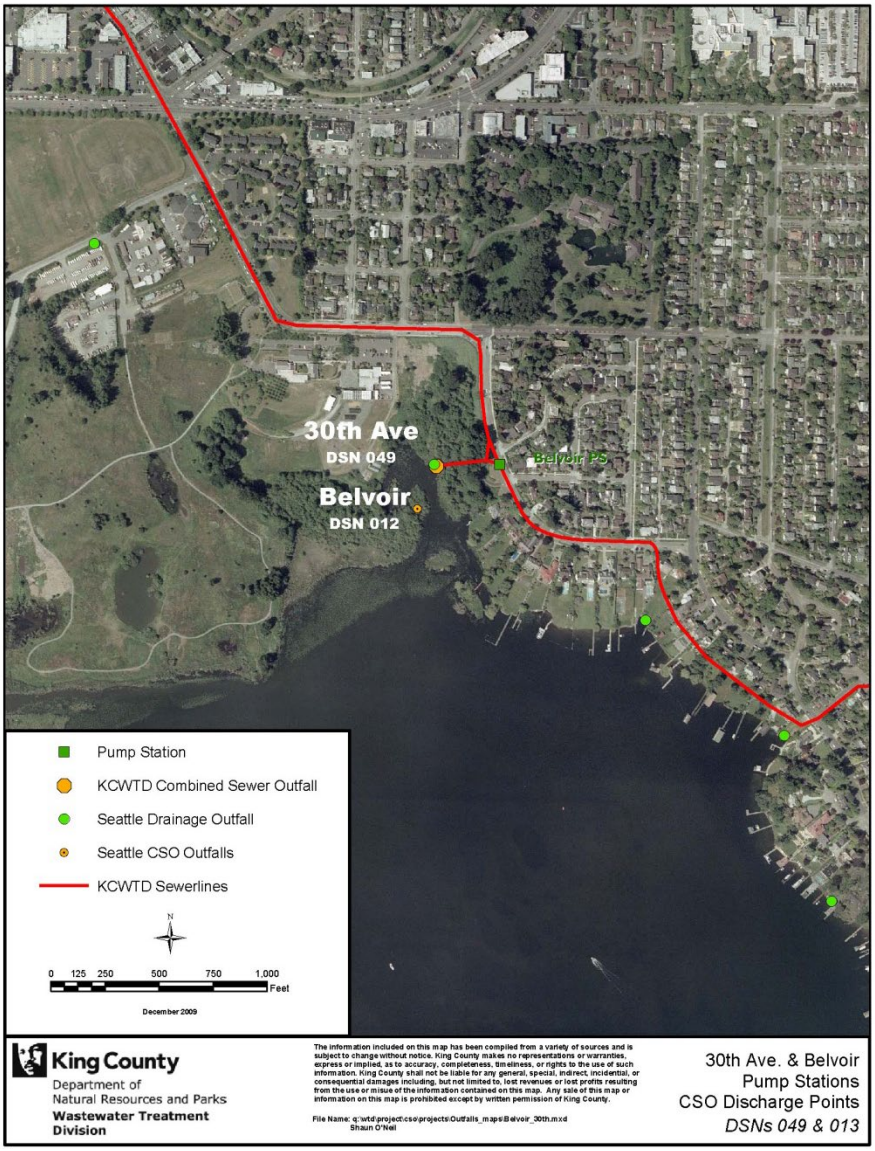



**Figure 6-2. 30th Avenue Northeast CSO Discharge Point**

**1983 Overflow Baseline:** 0 events and 0 MG per year.

**Overflow Quantity:** Has overflowed between 0 and 5 times since 1998; between 1998 and 2017, the 20-year average was 0.8 events per year.

**Control Project History:** No project has been planned.

**CSO Effluent Quality Monitoring Data:** Overflow quality and sediment monitoring to characterize the CSO was not done because the CSO is controlled.

**Construction-Related Monitoring:** None.

**Sediment Sampling:** One surface sediment sample adjacent to the 30th Ave. NE/Belvoir PS overflow in 2013 was collected as part of the nearfield model calibration effort because this was the largest Lake Washington discharge. Surface sediment chemistry results from the 2013 sediment sampling exceeded the SCO for BEHP and total DDE. There were no CSL exceedances. The 2018 submittal includes these data.

**Sediment Remediation Activity:** No action required.

*30th Avenue Northeast and Belvoir Place Pump Stations' CSO Vicinity; Looking Southwest, No Warning Signage Because No Public Access*

*30th Avenue Northeast and Belvoir Place Pump Stations' CSO from Shore Looking Southwest*

### 6.2.3 Belvoir Pump Station

NPDES Discharge Serial Number 012

The Belvoir PS receives flows from the Laurelhurst Trunk.

**1958 Baseline Facility:** Originally Seattle PS 2; replaced with a new pump station by Metro (now King County) in 1971.

**Discharge Location:** Shared outfall with 30th Ave. NE PS; discharges to Union Bay Slough through a 36-inch-diameter outfall that discharges 40 feet offshore at a depth of 10 feet at latitude 47° 39' 24.111" N and longitude -122° 17' 15.321" W (Figure 6-3).

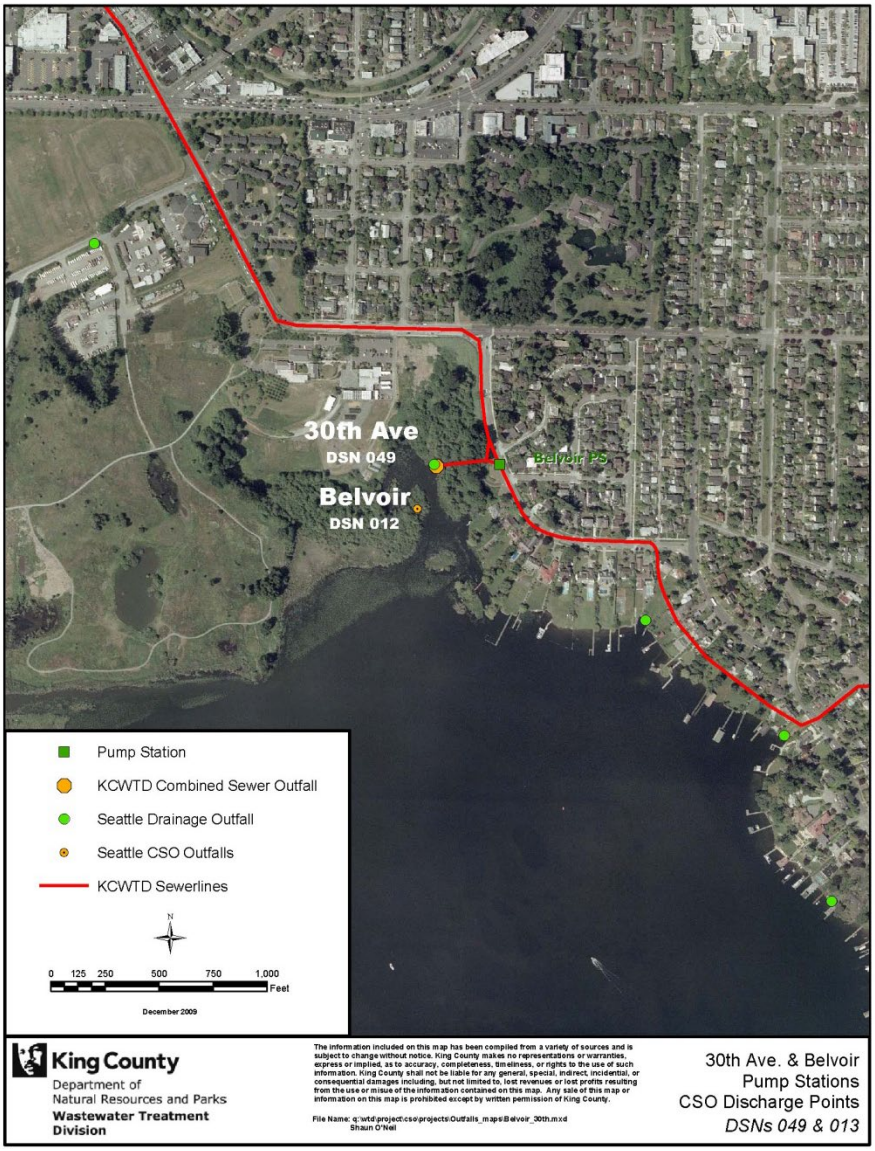



**Figure 6-3. Belvoir Pump Station CSO Discharge Point**

**1983 Overflow Baseline:** 0 events and 0 MG per year.

**Overflow Quantity:** Has overflowed between 0 and 5 times per year since 1998; between 1987 and 2017, the 20-year average was 1.5 events per year.

**Control Project History:** The Belvoir PS Overflow has historically been reported as controlled. However, updated modeling indicated that the CSO frequency had increased because of hydraulic and hydrologic changes. As of 2016, Belvoir does not meet the CSO control performance standard. WTD and SPU recognize that hydraulic and hydrologic changes have affected compliance at the Belvoir PS Overflow. WTD and SPU are committed to coordinating and developing mutually beneficial solutions. This includes working together to control WTD's Belvoir PS Overflow and SPU's Windermere Basins 13 and 15, which are combined sewer areas upstream of the Belvoir PS. As a first step, WTD is working with SPU to meet the approach and schedule included in SPU's approved Windermere Basin 13 and Basin 15 Supplemental Compliance Plans, dated December 7, 2016, and April 18, 2018, respectively.

**CSO Effluent Quality Monitoring Data:** Overflow quality and sediment monitoring to characterize the CSO has not been done.

**Construction-Related Monitoring:** None.

**Sediment Sampling:** One surface sediment sample adjacent to the 30th Ave. NE/Belvoir PS overflow was collected in 2013 as part of the nearfield model calibration effort because this was the largest Lake Washington discharge. Surface sediment chemistry results from the 2013 sediment sampling exceeded the SCO for BEHP and total DDE. The 2018 submittal includes these data.

**Sediment Remediation Activity:** No action required.

### 6.2.4 East Pine Street

NPDES Discharge Serial Number 011

This pump station receives flows from a local tributary area in east Mount Baker and south Madrona. Flows are pumped to the SW Lake Washington Interceptor.

**1958 Baseline Facility:** Originally Seattle PS 5; Metro (now King County) replaced the pump station in 1976.

**Discharge Location:** 24-inch diameter 300-foot-long outfall into Lake Washington at latitude 47° 36' 53.732" N and longitude -122° 16' 15.321" W (Figure 6-4).


**Figure 6-5. East Pine Street CSO Discharge Point**

**1983 Overflow Baseline:** 0 events and 0 MG per year.

**Overflow Quantity:** Has not overflowed since 1992, when monitoring began.

**Control Project History:** No project has been needed or planned; controlled to the state standard.

**CSO Effluent Quality Monitoring Data:** Overflow quality and sediment monitoring to characterize the CSO were not done because the CSO is controlled.

**Construction-Related Monitoring:** Not applicable; CSO is controlled.

*East Pine Street Vicinity; Looking Southeast Over Lake Washington*

**Sediment Sampling:** King County collected sediment samples from two locations proximal to the E Pine St. CSO discharge point in September 2000. Figure 6-6 shows station locations and the discharge point. Triplicate samples were collected from Station SD007A, and a single sample was collected from Station SD007B. Surface sediment chemistry results exceeded the SCO for nickel (both locations), BEHP (one of two locations), and sulfide (one of two locations) and did not exceed the CSL for any chemical. The 2009 CD contains data from this sampling event.

**Sediment Remediation Activity:** No action required.


**Figure 6-6. East Pine Street (011) Sediment Sampling Locations**

### 6.2.5 Rainier Avenue Pump Station

NPDES Discharge Serial Number 033

Flows to this pump station come from its local tributary area in the Rainier Valley and from the City's 46th Ave. PS. Flows from this pump station are pumped to the Rainier-Hanford Trunk.

**1958 Baseline Facility:** Emergency Relief Overflow for Seattle pump station that transferred flows from the Lake Washington shoreline into the Rainier/Hanford sewer system, where they were discharged raw into the East Waterway of the Duwamish River at today's Hanford CSO site; Metro (now King County) assumed control in 1962; the sewage was intercepted for treatment at West Point in 1967; pump station modified by Metro in 1973.

**Discharge Location:** Discharges into Lake Washington near an active boating and hydroplane racing area at Stan Sayers Pits via a 36-inch-diameter and 400-foot-long outfall at a depth of 30 feet at latitude 47° 34' 16.946" N and longitude -122° 16' 31.909" W (Figure 6-6).

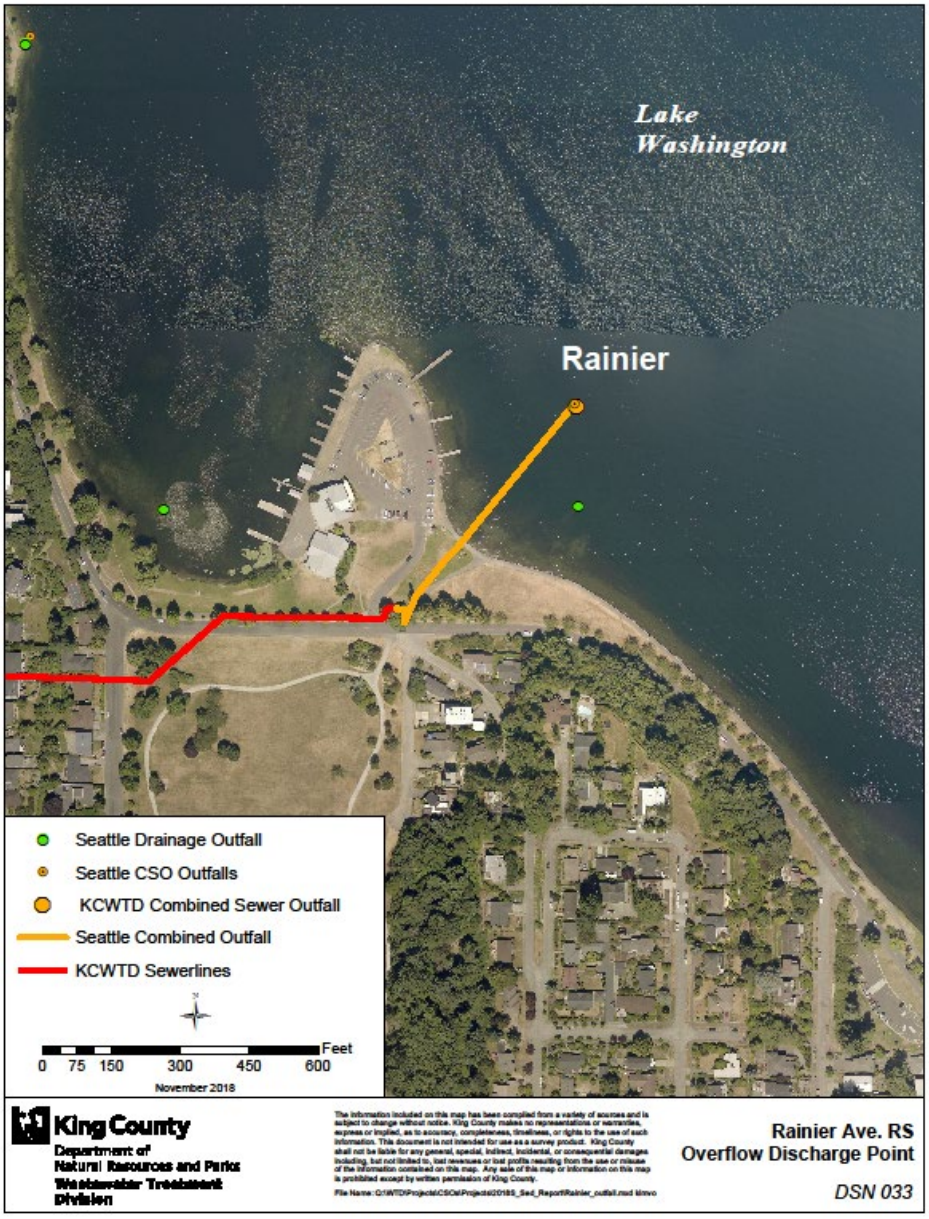



**Figure 6-7. Rainier Avenue Pump Station CSO Discharge Point**

**1983 Overflow Baseline:** 0 events and 0 MG per year.

**Overflow Quantity:** 20-year average is 0 events per year.

**Control Project History:** No project has been needed or planned; controlled to the state standard.

**CSO Effluent Quality Monitoring Data:** Overflow quality monitoring to characterize the CSO was not done because the CSO is controlled.

**Construction-Related Monitoring:** Not applicable; no control project needed.

*Rainier Avenue Pump Station CSO Vicinity, Looking North Along Lake Washington*

**Sediment Sampling:** King County collected sediment samples from two locations proximal to the Rainier Ave, PS CSO discharge point in September 2000. Figure 6-8 Station shows the locations and the overflow discharge point. A single sample was collected both from Station 0864A and Station 0864B. Surface sediment chemistry results exceeded the SCO for nickel, silver, TBT, total PCBs, BEHP, and sulfide at one or two locations depending on the chemical. The 2009 CD includes data from this sampling event.

**Sediment Remediation Activity:** No action required.

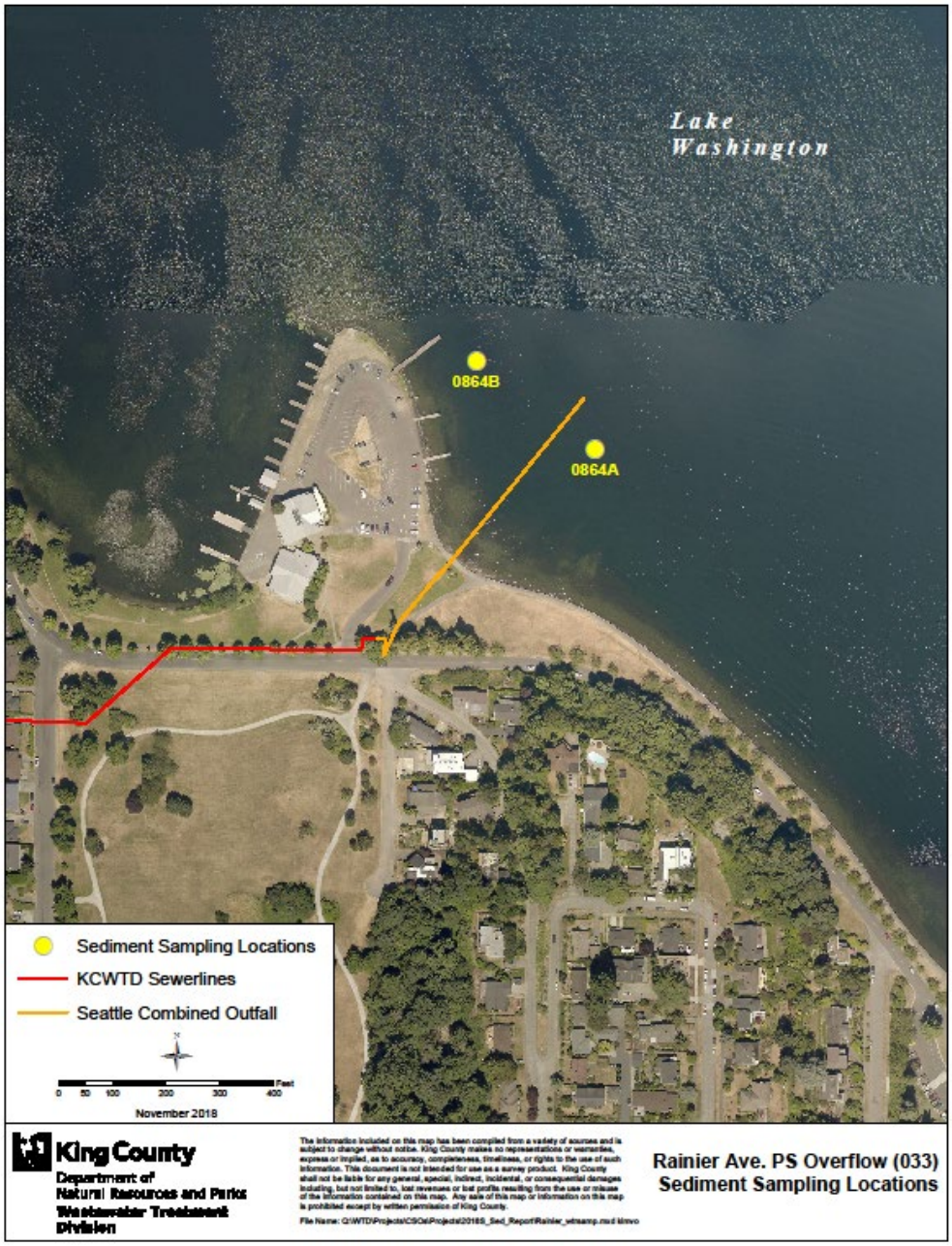



**Figure 6-8. Rainier Avenue Pump Station (033) Sediment Sampling Locations**

### 6.2.6 Henderson Street Pump Station and Martin Luther King Jr. Way CSO

Henderson St. PS CSO NPDES Discharge Serial Number 045

**1958 Baseline Facility:** Seattle pump station that transferred flows from the Lake Washington shoreline into the Henderson/E Marginal sewer system and on to the Diagonal primary treatment plant; Metro (now King County) assumed responsibility in 1962 and replaced the pump station in 1976 and again in 2005 as part of the CSO control project; flows were conveyed to West Point for secondary treatment beginning in 1969.

**Discharge Location:** Lake Washington via an 84-inch-diameter Seattle storm drain that discharges 50 feet offshore at a depth of 12 feet at latitude 47° 31’ 23.827” N and longitude -22° 15’ 46.619” W. Storm sewer also carries overflow from the MLK Jr. Way CSO (Figure 6-8).


**Figure 6-9. Henderson Street Pump Station/Martin Luther King Jr. Way CSOs' Discharge Point**

**1983 Overflow Baseline:** 12 events and 15 MG per year.

**Overflow Quantity:** Has not overflowed since 2005; a combination of modeling and monitoring indicates the 20-year average is 0 events per year.

**Control Project History:** The project to control this CSO, along with the MLK Jr. Way CSO and Norfolk CSO, was completed in 2005, and is controlled to the state CSO performance standard. Flows are now conveyed to South Plant for secondary treatment. Flows in excess of plant capacity are stored in the new Henderson/MLK storage tunnel. Flows exceeding the capacity of the storage tunnel are discharged in an outfall shared with the Norfolk CSO to the Duwamish River after receiving primary treatment, screening, disinfection, and dechlorination. After a storm passes, stored flows drain to South Plant.

*Henderson Street Pump Station CSO Vicinity, Looking South Along Lake Washington*

*Henderson Street Pump Station CSO Vicinity, Looking East Along Lake Washington*

**CSO Effluent Quality Monitoring Data:** Overflow quality monitoring to characterize the CSO was not done as part of the NPDES characterization because the CSO was believed to be controlled. Overflow monitoring was done concurrently with the MLK Jr. Way and Norfolk CSOs for pre-control project characterization.

**Construction-Related Monitoring:** Post-construction monitoring off the Henderson outfall has not been conducted because of the ongoing shared stormwater discharge.

**Sediment Sampling:** King County collected sediment samples in September 2000 from two locations proximal to the discharge point that serves both the MLK Jr. Way CSO and the Henderson St. PS CSO. Figure 6-10 shows station locations and the overflow discharge point. Triplicate samples were collected from Station 4903A, and a single sample was collected from Station 4903B. Both locations exceed the SCO with one or more chemicals for nickel, mercury, TBT, total PCBs, PAHs, dibenzofuran, dieldrin, sulfide, and BEHP. One sediment sample was collected from a third location, Station 4903, in July 1995. That sample had exceedances of the SCO for BEHP, dibenzofuran, and dieldrin, and exceeds the CSL for total PAHs. The 2009 CD includes data from both the 2000 and 1995 sampling events.

**Sediment Remediation Activity:** The historical PAH exceedances would require site hazard evaluation. No CSO events on record (since 1991), but other pathways and potential sources are nearby. Further evaluation may be warranted.


**Figure 6-10. Martin Luther King Jr. Way CSO (013) and Henderson Street Pump Station (045) Sediment Sampling Locations**

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