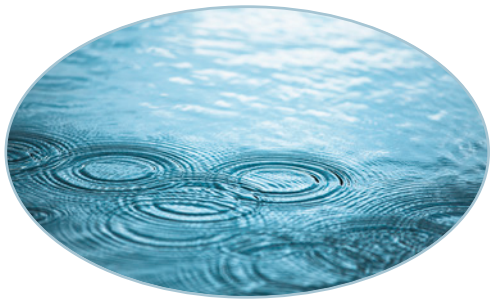
Combined Sewer Overflow Control Program

2018 CSO Control Program Update

October 2018



King County
Department of Natural Resources and Parks
Wastewater Treatment Division
Combined Sewer Overflow

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Natural Resources and Parks
Wastewater Treatment Division
Combined Sewer Overflow Program
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Acronyms and Abbreviations

CD	consent decree
County	King County
CSO	combined sewer overflow
CSOCP	combined sewer overflow control policy
CWA	Clean Water Act
DOJ	U.S. Department of Justice
ESJ	equity and social justice
EPA	U.S. Environmental Protection Agency
Ecology	Washington State Department of Ecology
GSI	green stormwater infrastructure
K.C.C.	King County Code
LTCP	long-term control plan
Metro	Municipality of Metropolitan Seattle
MG	million gallons
MGD	million gallons per day
MLK	Martin Luther King
NPDES	National Pollutant Discharge Elimination System
O&M	operations and maintenance
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PCMP	Post-construction Monitoring Plan
PLC	programmable logic controller
PS	pump station
ROW	right-of-way

RS	regulator station
RWSP	Regional Wastewater Services Plan
SCADA	supervisory control and data acquisition
SMP	Sediment Management Plan
SPU	Seattle Public Utilities
TP	treatment plant
UW CIG	University of Washington Climate Impact Group
WAC	Washington Administrative Code
WQA/MS	Water Quality Assessment and Monitoring Study
WTD	King County Wastewater Treatment Division
WWS	wet weather storage
WWTS	wet weather treatment station

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Executive Summary

This 2018 Combined Sewer Overflow (CSO) Control Program Update is submitted with King County's January 2019 National Pollutant Discharge Elimination System (NPDES) permit renewal application for the West Point treatment plant (TP). This Program Update documents the status of the County's implementation of the 2012 Long-term Control Plan (LTCP), including the County's CSO control strategies and accomplishments, progress on projects underway, planning-level control volume updates for future projects, and ongoing implementation of public involvement activities for the CSO program. This Program Update additionally reports on environmental studies completed since the 2012 LTCP that inform the CSO Control Program, including the Water Quality Assessment / Monitoring Study, a Climate Change study completed with the University of Washington Climate Impact Group, and the County's ongoing water and sediment monitoring programs.

Over the last two decades, there has been a downward trend for total annual CSO volume discharged while average annual rainfall has increased. This successful trend is a direct result of implementation of the CSO Control Program by King County.

On February 9, 2017, West Point TP experienced a major equipment failure, resulting in serious flooding at the plant and bypasses of untreated stormwater and wastewater into Puget Sound. The King County Wastewater Treatment Division (WTD) has been addressing recommendations from several investigative studies from the incident. Some of the recommendations address the ability of West Point TP to continue to reliably accommodate combined stormwater and wastewater flows, including stored CSO flows, in the future.

In preparation for this Program Update, alternatives developed as part of the approved 2012 LTCP for University, Montlake, and Hanford-Lander-Kingdome-King were reevaluated with updated information. The analysis considered recent monitoring of control techniques (such as green stormwater infrastructure), updated modeling information, and opportunities for collaboration with other agencies. The purpose of re-evaluating the approved 2012 LTCP alternatives was to identify any changes in conditions that could impact the type, size, and location of the alternatives since 2012. The results of this risk-based value analysis were similar to the triple bottom line results in the approved 2012 LTCP. Based on this review of the CSO program, the WTD does not recommend any changes or amendment to the LTCP at this time.

In the approved 2012 LTCP, the programmatic cost to implement the recommended alternatives was estimated at $711M. Escalated to 2017 dollars, this programmatic cost estimate is $849M. Further refinement of alternatives over the next ten years (when the last project is in design) could significantly increase the programmatic costs. CSO programmatic costs and alternatives that also protect or improve water quality will be evaluated in the WTD Systemwide Comprehensive Plan. As WTD continues implementation of the approved 2012 LTCP alternatives, it will incorporate updated modeling information and cost estimating into project planning and development. In doing so, the CSO Control Program will continue to evaluate CSO control alternatives and opportunities for projects that further benefit water quality in relation to its work.

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Chapter 1

Introduction

This 2018 CSO Control Program Update (Program Update) provides information on the current implementation status of King County's Combined Sewer Overflow (CSO) Long-term Control Plan (LTCP). The Washington State Department of Ecology (Ecology) CSO regulation (Washington Administrative Code [WAC] 173-245) requires that King County submit CSO LTCP updates to coincide with each National Pollutant Discharge Elimination System (NPDES) permit renewal for its West Point Treatment Plant (West Point TP). The updates are intended to document progress made toward implementation of the County's CSO Control Program and identify program priorities for the next five years and beyond. The last update submitted to Ecology was the 2012 CSO Long-term Control Plan (2012 LTCP), which recommended future capital projects for CSO control that are underway today. This Program Update is being submitted to Ecology with the West Point TP Application for NPDES Permit Renewal due January 31, 2019.

The U.S. Environmental Protection Agency (EPA) and Ecology approved the County's 2012 LTCP as meeting federal requirements on March 7, 2013. This approved version became the basis for settlement of ongoing negotiations with EPA, Ecology, and the U.S. Department of Justice (DOJ) to finalize a negotiated consent decree (CD) between King County, EPA, and Ecology. The CD (Case 2:13-cv-00677-JCC) was filed in U.S. District Court on July 3, 2013. The CD commits King County to implement capital projects cited in the 2012 LTCP within the timelines specified in the CD and 2012 LTCP. In addition to providing updated information on 2012 LTCP capital projects, the 2018 Program Update confirms King County is in line with approved LTCP and CD milestones.

This chapter describes what CSOs are, the reasons for controlling CSOs, and the County's CSO control strategies and accomplishments.

1.1 What Are CSOs?

Combined sewers, which carry both wastewater and stormwater in the same pipes, exist in many U.S. and international cities with infrastructure established before 1950, including older portions of the King County sewer system. CSOs are relief points designed into combined sewers that discharge excess stormwater and wastewater into water bodies when the combined sewer system is at capacity (Figures 1-1, 1-2, 1-3). These overflows protect wastewater treatment plants from being overwhelmed with too much flow, which can reduce a plant's treatment capacity or cause damage at the plant. The overflows also reduce sewer backups into homes, businesses, and streets during periods of heavy rain.

CSO discharges are made up of approximately 10 percent wastewater and 90 percent stormwater. CSOs are a recognized source of water pollution and, as such, are regulated by EPA and Ecology. King County is proactively working to reduce the frequency of CSOs at each of its CSO locations to no more than one overflow per year on a 20-year moving average.

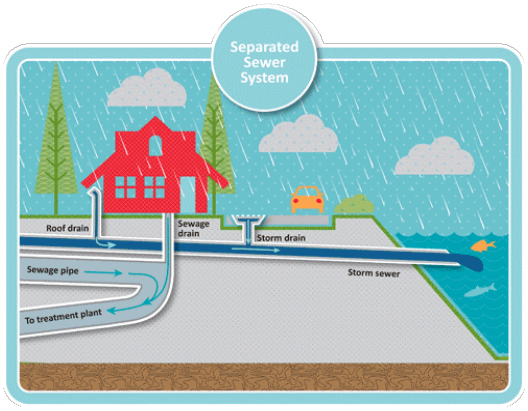

Figure 1-1 Separate Sewer System

A separate sewer system is designed to collect sewage from homes and carry it to a treatment plant. A separate storm system carries rainwater from roofs and streets to local water bodies without treatment.

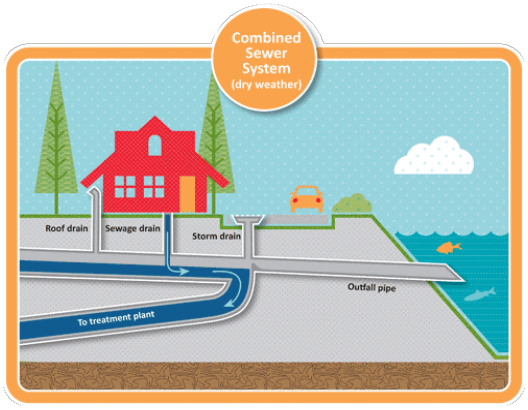

Figure 1-2 Combined Sewer System (Dry Weather)

A combined sewer system is designed to carry sewage and stormwater in the same pipes. During dry weather, all sewage is collected and treated.

Figure 1-3 Combined Sewer System (Wet Weather)

During rainy, wet weather, sewage and stormwater are largely collected and treated. However, heavy rains can overwhelm the sewer system, causing CSOs.

1.2 Why Reduce CSOs?

Regulations, agreements, policies, and public expectations require, either directly or indirectly, the reduction of CSOs to protect public health, water quality, sediment quality, and aquatic species in water bodies.

1.2.1 CSO Control Regulations

The Clean Water Act (CWA) of 1972 is the main driver for the reduction of CSOs. The goals of the CWA are to eliminate the discharge of pollutants into the nation's waterways and to achieve and maintain fishable and swimmable waters. These goals are achieved through the NPDES permit program and through federal, state, and local pollution control programs to meet specific water quality standards. Effluent limits are established to protect human health and the environment. King County holds NPDES permits for its West Point, South, Vashon, Carnation, and Brightwater treatment plants. The West Point TP NPDES permit includes operation and management of four CSO wet weather treatment stations and 39 CSOs for which King County is responsible. (There are additional CSOs within the King County service area that are managed by the City of Seattle under their own CD and LTCP.)

State and federal laws focus on reducing the number of CSO events that occur each year. Because the threat to public health from exposure to bacteria is temporary, reducing CSO events reduces that threat. These laws focus on water quality, sediment quality, and species protection in response to public concern over observed environmental impacts to rivers and lakes in their communities. The number of allowable CSO events is set by Ecology and reinforced by the County's own policies. As defined by Ecology's CSO regulation (WAC 173-245), a "controlled" CSO can overflow no more than one time each year. When the average frequency of overflows from a CSO exceeds the CSO event limit, or performance standard, the CSO is considered "uncontrolled".

1.2.2 King County Policies

In the 1970s, the Municipality of Metropolitan Seattle (Metro) and its successor, King County, began implementing CSO control projects to improve water quality in the Seattle area. Metro first developed and implemented a specific CSO control program in 1979. Since then, WTD has expanded its approach to CSO control, incorporating changes and updates based on water quality and climate research, community input, regional priorities, and evolving regulations and policy guidance.

As set forth in King County Code (K.C.C. 28.86), CSO control policies (CSOCPs) and decisions on CSO control must balance several factors, including public health and the environment, regulatory requirements, financial goals, scientific information, and public opinion, as follows:

- *CSOCP-1: King County shall plan to control its CSO discharges by the end of 2030 to meet:*

    1. *The state's CSO control standard of an average of one untreated discharge per CSO outfall per year based on a twenty-year moving average, and*

2. Conditions of National Pollutant Discharge Elimination System permit requirements;

3. Conditions of the Environmental Protection Agency/Washington State Department of Ecology Consent Decree.

- *CSOCP-2: King County shall continue to work with state and federal agencies to develop cost-effective regulations that protect water quality. King County shall meet the requirements of state and federal regulations and agreements.*

- *CSOCP-3: Consistent with the Environmental Protection Agency/Washington State Department of Ecology Consent Decree and the county's long-term CSO control plan as approved through Ordinance 17413, King County shall give the highest priority for control of CSO discharges that have the highest potential to impact:*

  1. Human health through contact with CSO flows or fish consumption; or

  2. Environmental health, such as in areas where sediment remediation is underway or anticipated or where there is potential to impact species listed under ESA.

- *CSOCP-4: Consistent with its legal authority, if King County constructs new projects that would separate stormwater from its combined system that result in separated stormwater discharges to waterways, the county shall coordinate with the city of Seattle in the city's municipal stormwater National Pollutant Discharge Elimination System permit (MS4) process as appropriate.*

- *CSOCP-5: King County's wastewater conveyance and treatment facilities shall not be designed to intercept, collect and treat new sources of stormwater. However, King County may evaluate benefits and impacts to the county system from accepting stormwater from the city of Seattle that is not currently in the combined system and shall consider factors including, but not limited to existing capacity, benefits and costs to ratepayers and the regional system, operational impacts, payment to county for value of the use of available capacity and for the costs of conveyance and treatment of new sources of stormwater and compliance with state and federal regulations and commitments.*

- *CSOCP-6: In accordance with King County's industrial waste rules and regulations, including K.C.C. 28.84.050.K.1 and 28.84.060, the county shall accept contaminated stormwater runoff from industrial sources and shall establish a fee to capture the cost of transporting and treating this stormwater. Specific authorization for such discharge is required.*

- *CSOCP-7: King County shall consider implementing green stormwater infrastructure projects to control CSOs when results of technical, engineering, and benefit/cost*

analyses and modeling demonstrate it is a viable and cost-effective CSO control method.

- *CSOCP-8: King County shall consider implementing joint CSO control projects with the city of Seattle when it is cost-effective, is within county legal authorities and can be accomplished within the schedule outlined in the Environmental Protection Agency/Washington State Department of Ecology Consent Decree and the county's approved long-term CSO control plan.*

- *CSOCP-9: King County shall implement its long-range sediment management strategy to address its portion of responsibility for contaminated sediment locations associated with county CSOs and other facilities and properties. Where applicable, the county shall implement and cost share sediment remediation activities in partnership with other public and private parties, including the county's current agreement with the Lower Duwamish Waterway Group, the Department of Ecology and the Environmental Protection Agency, under the federal Comprehensive Environmental Response, Compensation and Liability Act.*

- *CSOCP-10: Consistent with the Environmental Protection Agency/Washington state Department of Ecology Consent Decree, King County shall assess CSO control projects, priorities and opportunities using the most current studies and information available, for each CSO Control Plan Amendment as required by the Department of Ecology in the National Pollutant Discharge Elimination System permit renewal process.*

- *CSOCP-11: Before completion of a National Pollutant Discharge Elimination System required CSO Control Plan Amendment, the executive shall submit a CSO program review report to the council and RWQC. The purpose of the review is to evaluate, at a minimum, changes to regulations, new technologies, existing CSO control performance, and human and environmental health priorities that may affect implementation of the CSO Control Plan. Based on its consideration of the CSO program review, RWQC may make recommendations to the council for modifying or amending the CSO program, including changing the sequencing of CSO projects. Any future updates or amendments to the county's long-term CSO control plan are subject to Environmental Protection Agency and Washington state Department of Ecology approvals.*

- *CSCOP-12: King County shall implement its CSO control projects in accordance with the Environmental Protection Agency/Washington state Department of Ecology Consent Decree and the schedule outlined in the county's approved long-term CSO control plan.*

- *CSOCP-13: King County shall prepare a water quality assessment and monitoring study, consistent with the guidance provided in Ordinance 17413 and other applicable legal requirements, to inform the next combined sewer overflow control*

program review in 2018. (Ord. 17587 § 1, 2013: Ord. 15602 § 4, 2006: Ord. 13680 § 8, 1999)

Before each CSO LTCP update, the County reviews the plan, progress made toward CSO control, and priorities of its existing CSO Control Program against conditions that may have changed since the last update. Conditions include flow patterns, scientific developments, new or revised regulations, new technologies, and public priorities. Any significant changes in conditions may require adjustment of the LTCP and, potentially, the CD.

1.2.3 Public Perception and Preferences

The community has regularly provided input on CSO-related plans and projects since the regional wastewater system was formed in 1958. Community input is routinely sought through meetings, workshops, and interviews with environmental and community groups, tribes, agencies, and the general public. WTD public involvement activities during this Program Update have reaffirmed the following themes heard during development of previous CSO control plans, CSO Control Program reviews, and CSO control projects:

- Water quality is a priority for the residents of King County.
- WTD should continue to protect and enhance water quality.
- King County residents believe CSOs should be controlled.
- WTD should collaborate on projects with the City of Seattle when it is cost-effective to do so or when it benefits both agencies.

The community also expressed concerns about the cost of controlling CSOs and the challenge of achieving the best environmental benefit for their investment. This input led the King County Council to recommend conducting the Water Quality Assessment and Monitoring Study (WQA/MS) for the water bodies where CSOs discharge to understand current and future loadings of pollutants from other pathways in comparison to CSOs and to inform this Program Update on the sequence and timing of the remaining CSO projects. The WQA/MS is discussed further in Section 2.6.1.

The content and implementation of the LTCP Public Involvement Plan, discussed further in Chapter 4, reflect the County's Equity and Social Justice (ESJ) commitments and support the CSO Control Program's commitment to ESJ. ESJ considerations are applied throughout the CSO Control Program's long-term planning process, including planning-level reviews of populations in CSO basins and the alignment of alternatives rating criteria with the 14 Determinants of Equity identified in the ESJ Strategic Plan. During implementation of long-term CSO control projects, financial capacity assessments further present opportunities to consider the ways in which CSO control efforts impact communities across King County.

1.2.4 2013 Consent Decree

King County is one of many wastewater utilities across the nation under a CD with EPA. These utilities are typically in older, larger cities in Northern or Midwestern states, where combined

sewer systems create CSO events. King County's CD, finalized on July 3, 2013 (Civil Action No. 2:13-cv-677), is a written agreement between King County, Ecology, EPA, and DOJ that outlines planned actions and provides specific milestones to achieve them in order to resolve alleged violations of the law. After completing the 2012 LTCP, King County worked with EPA and successfully demonstrated that the LTCP met federal requirements and, when fully implemented, would comply with federal and state standards to bring all CSOs under control.

Rather than risk long and costly litigation, in 2013, King County negotiated a settlement in which the 2012 LTCP Amendment formed the basis of our CD. The CD requires the County to implement CSO controls that will reduce direct discharges of all remaining uncontrolled CSOs to waters that reach Puget Sound by 2030 and describes the required projects and a schedule. The CD was modified in 2016 to reflect a joint project with Seattle Public Utilities (SPU) to control two of King County's CSOs as well as four of SPU's CSOs. This joint project, known as the Ship Canal Water Quality Project (Ship Canal Project), is discussed further in Section 3.2.2.2.

1.2.5 Reporting on WTD's CSO Control Program

WTD reports on the progress of its CSO Control Program annually and also undertakes a more comprehensive program review to coincide with the renewal of the West Point TP NPDES permit. As part of the Regional Wastewater Services Plan (RWSP) policies, enacted by the King County Council in 1999, WTD must submit a CSO Control Program update to Ecology and EPA. The history of King County CSO control planning is as follows:

- 1979 – King County's predecessor, Metro, adopted its first CSO Control Plan.
- 1985–1986 – The Plan for Combined Sewer Overflow Control and the Supplemental Plan for Combined Sewer Overflow Control were prepared, integrating the CSO Control Plan into a systemwide planning effort.
- 1987 – Ecology defined "CSO control" as "control of each CSO in such a way that an average of one untreated discharge may occur per year."
- 1988 – The 1988 Combined Sewer Overflow Control Plan was prepared to respond to the new Ecology definition of "CSO control."
- 1995 – As part of the West Point TP NPDES permit renewal, King County prepared an amendment to the 1988 Combined Sewer Overflow Control Plan, called the 1995 CSO Control Plan Update.
- 1999 – As part of the RWSP, King County prepared the 1999 Plan Amendment, listing 21 CSO control projects to bring all CSOs into control by 2030.
- 2000 – As part of the West Point TP NPDES permit renewal, King County prepared the CSO Control Plan Year 2000 Update. No changes to the CSO Control Plan were recommended.

- 2008 – Following a CSO Control Program Review conducted in 2006, and as part of the West Point TP NPDES permit renewal, King County prepared the 2008 CSO Control Plan Update. No changes to the CSO Control Plan were recommended.

- 2012 – From 2008 to 2010, WTD conducted a comprehensive evaluation of conditions, opportunities, science, treatment technology, regulations, and community input that resulted in reprioritization of project order and identified nine projects to control the remaining 14 uncontrolled CSOs in the 2012 LTCP.

- 2013 – The County entered into a CD with EPA, Ecology and EPA, which was based on the 2012 LTCP.

- 2018 – As part of the West Point TP NPDES permit renewal, King County prepared this Program Update. No changes to the LTCP are recommended at this time.

1.2.5.1 Incident at West Point Treatment Plant on February 9, 2017

On February 9, 2017, West Point TP experienced a major equipment failure, resulting in serious flooding at the plant and bypasses of untreated stormwater and wastewater into Puget Sound. This incident is described in more detail in the 2017 CSO Annual Report.

Because of the equipment failure and flooding at West Point TP, several studies were performed to investigate the causes of the incident and ensure the reliability of the entire regional system in the future. The results of these studies that most directly impact the combined sewer system and CSO Control Program, in particular, are the recommendations that address the ability of West Point TP to continue to reliably accommodate combined stormwater and wastewater flows, including stored CSO flows, in the future. These recommendations include having adequate redundancy and reliability at West Point TP to accommodate peak flows and flexibility to treat peak flows, potentially for longer periods of time or more often; addressing the maintenance, rehabilitation, and replacement of aging infrastructure; and continuing to improve WTD's ability to make risk-based asset management decisions. WTD has been addressing these issues through ongoing evaluations and capital project implementation.

1.3 What Is in this CSO Control Program Update?

The remainder of this Program Update is organized in the three following chapters:

- **Chapter 2, Effectiveness of Current CSO Control Plan**, describes King County's wastewater system, including CSO control facilities and practices, and the control status of County CSOs. It also shows how King County is meeting EPA's Nine Minimum Controls, and describes the methods and results of efforts to monitor and model CSO volume and frequency to the water bodies that receive CSOs.

- **Chapter 3, CSO Control Projects**, describes completed, in process, and planned CSO control projects, including projects that will be implemented during the next NPDES permit cycle. It also describes available CSO control strategies and how they apply to County projects.

- **Chapter 4, Public Involvement Activities Related to the CSO Control Program**, presents King County's public involvement policies and planning strategies, public notification program, and public involvement activities.

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Chapter 2

Effectiveness of Current CSO Control Plan

2.1 Combined Sewers in King County's Service Area

Today, King County's wastewater treatment system is the largest in the Puget Sound region and is managed to convey and treat wastewater from 17 cities, 16 local sewer utilities, and one Native American tribe in and adjacent to the County.

Within the King County wastewater treatment service area (Figure 2-1), the combined sewer system exists within the City of Seattle (Seattle). CSOs discharge to Puget Sound, the Duwamish Waterway, Elliott Bay, Lake Union, the ship canal, and Lake Washington. In comparison, separate sewer systems in the regional system are primarily located outside of Seattle in the other 33 jurisdictions in the service area. There are limited areas within Seattle that have separate sewer and stormwater systems.

The City of Seattle, through SPU, also manages its local sewer system within King County's combined sewer service area. Like King County, SPU has CSOs and manages them according to its own CSO LTCP, NPDES permit, and CD (Section 2.1.2).

In 2018, King County estimated the average annual volume of stormwater that is captured within its combined sewer service area. Stormwater that enters King County's combined sewer system is discharged in three ways:

1. after secondary treatment at West Point TP
2. after primary treatment standards at one of King County's WWTSs
3. as an untreated CSO.

The stormwater estimates were based on a 38-year continuous-simulation model run in 2016 (Section 2.4.1.2). King County used the model to determine an average annual dry weather flow. Any flows greater than the average annual dry weather flows were assumed to be stormwater. King County estimates that its facilities treat an average of 12.4 billion gallons of stormwater, and discharges an average of 527.6 MG of stormwater as untreated CSOs.

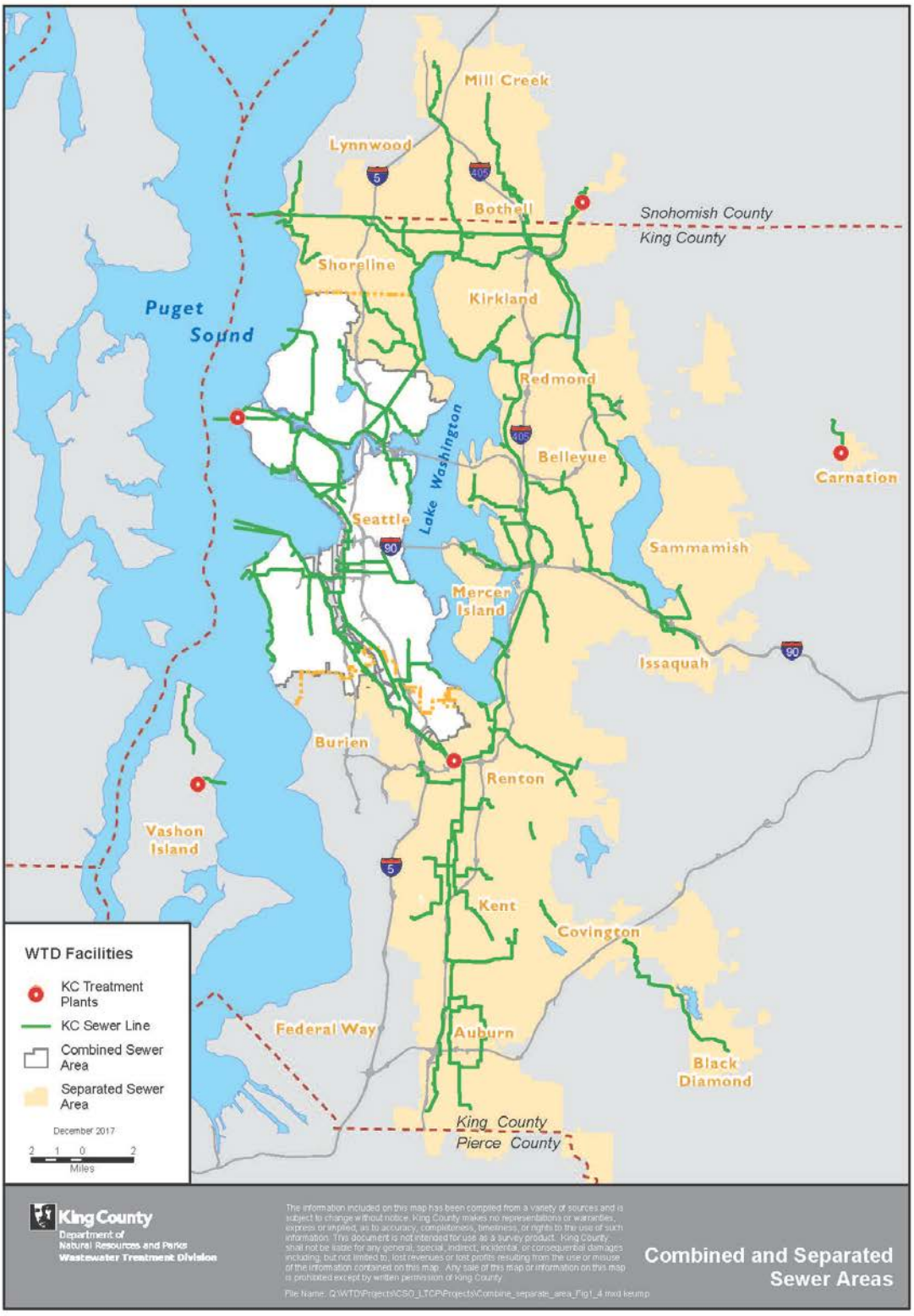


Figure 2-1 King County Wastewater Treatment Service Area

2.1.1 King County's Wastewater System

The wastewater treatment system actually begins in homes, businesses, and industries from sources such as toilets and sinks. Relatively small pipes carry wastewater from these sources to larger, local-agency-owned pipes, and then to even larger County-owned regional interceptor pipes. WTD, alone, operates and manages over 390 miles of sewer pipes. Along the way, automated regulator stations, pump stations, storage tanks, and other facilities help operators manage flows as they move toward wastewater treatment plants.

Most of King County's wastewater goes to three regional treatment plants (Brightwater Treatment Plant, South Treatment Plant [South TP], and West Point TP), where the wastewater flows through a series of treatment processes that remove solids and dissolved organics from the water and provide disinfection before being discharged to Puget Sound. The majority of the wastewater from the County's combined sewer system flows to West Point TP for treatment. In addition, the County owns and operates two local treatment plants (Carnation and Vashon) that serve smaller communities within the County's service area.

Figure 2-1 provides an overview of the County's wastewater treatment service area. Before being released to local waterways, wastewater moves through three treatment stages: primary treatment, secondary treatment, and disinfection (Figure 2-2). These stages are designed to clean the water, removing solids, dissolved organics, bacteria, and viruses. Lightning bolts in the figure indicate energy-conserving processes.

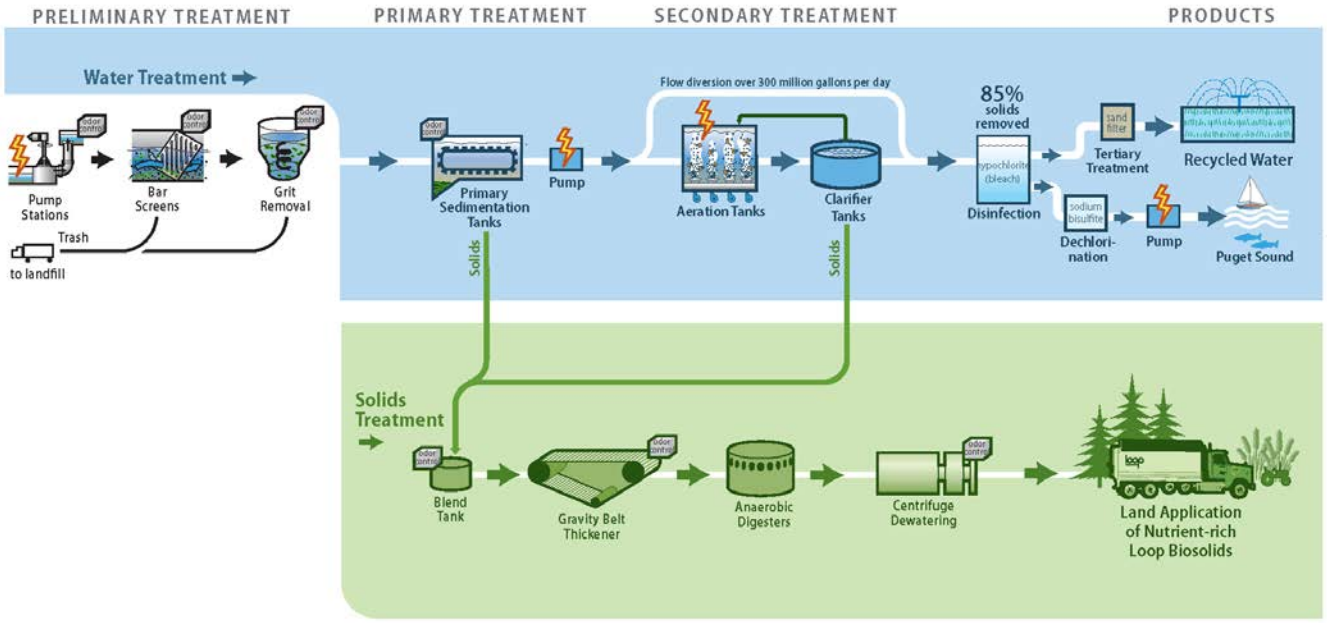


Figure 2-2 Wastewater Treatment Process

2.1.2 Relationship Between King County and City of Seattle Systems

King County operates a regional wastewater utility, providing wastewater conveyance and treatment services to local agencies who manage local conveyance systems for homes and businesses.

The City of Seattle, through SPU, is the largest local agency in WTD's service area and represents a mix of combined, partially separated (i.e., where roads connect to separate stormwater systems, but parcels connect to the combined system), and separated service areas (i.e., where stormwater flows in separate pipes from wastewater). As the regional provider, WTD treats Seattle's service areas as a combined sewer system and manages the system for peak flow during heavy rains. None of the other 33 local agencies has a combined sewer system.

Similar to King County, the City of Seattle is implementing CSO control projects under their CSO LTCP, NPDES permit, and CD. The County and SPU coordinate closely in their respective CSO control efforts and identify opportunities for cost-effective joint measures (operating and capital elements) for CSO control, as encouraged in each agency's CD.

WTD and SPU have both started new phases of planning for their respective wastewater system and wastewater and drainage system. In 2018, WTD started development of a Systemwide Comprehensive Plan to thoroughly assess the complicated demands on its wastewater system and identify a future direction for WTD that ensures the right investments are made at the right time to continue to protect water quality (Section 1.3). SPU's Drainage and Wastewater Integrated System Plan aims to improve water quality by directing future investment in Seattle's drainage and wastewater systems while providing the greatest community value through multiple benefits. WTD and SPU continue to coordinate and are working together to increase collaboration of these planning efforts to improve the results and increase the benefits realized by both agencies and the public.

2.2 CSO Control through Wastewater System Management

The policy set forth in the King County Code states:

> *King County shall construct, operate and maintain facilities to prevent raw sewage overflows and to contain overflows in the combined collection system. In the event of a raw sewage overflow, the county shall initiate a rapid and coordinated response including notification of public health agencies, the media, the public and the affected jurisdiction. Preserving public health and water quality shall be the highest priority, to be implemented by immediately initiating repairs or constructing temporary diversion systems that return flow back to the wastewater system.* (Wastewater Services Policy 8)

WTD's forecasting and demand modeling capabilities, in-field flow monitoring, and ongoing facilities inspection provide essential information to identify and address capacity and operation and maintenance (O&M) needs. The following sections describe WTD's efforts to ensure adequate capacity and to operate and maintain the system to prevent overflows.

2.2.1 Providing Adequate Capacity

Implementation of policies and projects described in the LTCP ensures that adequate wastewater capacity will be available when needed. To assess the need for new capacity, WTD conducts population and flow studies when new or updated census data become available from the Puget Sound Regional Council. In addition, WTD continually works with local component agencies to anticipate changes in flows from local agencies to the County's regional sewer system.

2.2.2 Operating and Maintaining the System

O&M programs for the combined and separate sewer systems are similar to enable efficiencies in sharing expertise and resources and to allow for quick response to unusual circumstances and emergencies. The treatment plants and the conveyance system are operated from main control centers at the treatment plants using a supervisory control and data acquisition system (SCADA). The SCADA system provides real-time flow and volume data that are constantly available, and allows WTD staff to understand and manage conditions in the sewer system.

WTD's operating strategy for its conveyance system is to send as much flow as possible to regional treatment plants while protecting treatment plant secondary biological treatment processes and meeting NPDES permit requirements.

The operating strategy is implemented with the following priority: (1) direct transfer to a regional plant; (2) inline storage, followed by transfer to a regional plant; (3) offline storage in facilities such as tunnels or tanks, followed by transfer to a regional plant; and (4) wet weather treatment and discharge. Using this priority sequence allows WTD to protect West Point TP from excess flows beyond its treatment capacity. Wet weather treatment stations (WWTSs), which handle large volumes of flow, are built to operate in conjunction with regional treatment plants. They operate only when flows cannot be managed immediately at regional plants and may be used only a few times a year to achieve the regulatory control standard (defined in Section 1.2.1).

Flows into the combined sewer system are also reduced through the use of green stormwater infrastructure (GSI), which functions to manage stormwater through groundwater infiltration and evapotranspiration before it enters the combined sewer system (Section 3.1.2). Reducing stormwater flows into the combined sewer system effectively increases the capacity of the system and can result in decreased CSO discharge events and volumes.

2.3 Implementation of EPA's Nine Minimum Controls

The EPA's Nine Minimum Controls are actions that can be taken to minimize CSO impacts while long-term capital projects are underway. When they were published, the Nine Minimum Controls packaged and codified elements, including CSO-specific elements, contained in the O&M programs of well-run wastewater management operations. Most requirements were already standard practice in the King County system. King County meets all Nine Minimum Controls and reports CSO compliance and related activities annually to Ecology and EPA through annual CSO and CD reports available at http://www.kingcounty.gov/services/environment/wastewater/cso/library/annual-reports.aspx.

Table 2-1 EPA Nine Minimum Controls

Minimum Control Name	Minimum Control Description
Control 1: Reducing CSOs through O&M	Implement proper O&M programs for the sewer system and all CSO outfalls to reduce the magnitude, frequency, and duration of CSOs.
Control 2: Storing CSOs in Collection System	Implement procedures that will maximize use of the collection system for wastewater storage to reduce the magnitude, frequency, and duration of CSOs.
Control 3: Optimizing Pretreatment Program	Review and modify, as appropriate, existing pretreatment program to minimize CSO impacts from discharges caused by nondomestic users.
Control 4: Maximizing Flow to Treatment Plant	Operate the publicly owned treatment works at maximum treatable flow during all wet weather flow conditions to reduce the magnitude, frequency, and duration of CSOs.
Control 5: Preventing Dry Weather Overflows	Dry weather overflows from CSO outfalls are prohibited.
Control 6: Controlling Solids and Floatables	Implement measures to control solid and floatable materials in CSOs.
Control 7: Preventing Pollution	Implement a pollution prevention program focused on reducing the impact of CSOs on receiving waters.
Control 8: Notifying the Public	Implement a public notification process to inform the citizens of when and where CSOs occur.
Control 9: Monitoring CSO Outfalls	Monitor CSO outfalls to characterize CSO impacts and the efficacy of CSO controls.

2.4 Monitoring and Modeling CSO Control: CSO Volume and Frequency

2.4.1 Relationship Between CSO Monitoring and Modeling

2.4.1.1 Monitoring Rainfall and CSO Flows

Monitoring rainfall and flows inside the regional system is key to assessing the frequencies and volumes of CSOs. This reliable record informs decision-making and is evaluated to determine compliance with CSO control regulations. Monitoring is carried out in the method most appropriate to the site and conditions considered, which may entail directly measuring overflows with flow meters or measuring the depth or flow level in a pipe with a known geometry and then using the data to calculate flow values.

WTD continuously monitors the frequency and volume of overflows at locations within the wastewater treatment system, such as at regulator or pump stations. Data collected from monitoring actual overflows as they occur are used to determine compliance with Ecology regulations and are included in the County's monthly Digital Monitoring Reports to Ecology and annual reporting to Ecology and EPA.

WTD measures rainfall at 16 rain gauges maintained across the West Point TP conveyance system. Rainfall is measured in many locations because it is not even or consistent throughout Seattle. Rainfall duration and quantity are reported for each CSO event from the nearest gauge.

In addition, rainfall data, including rain gauge data from the City of Seattle and Sea-Tac Airport, are used in calibrating hydraulic models that simulate the flow in the collection system.

In addition to measuring rainfall, the County is working with SPU and the University of Washington (UW) to improve the ability to forecast storms and rainfall intensity regionally. An improved predictive capability of rainfalls allows for tailoring operations to specific storm forecasts and timing of storage use and release to reduce CSOs.

2.4.1.2 Modeling Future Facilities

WTD continues to update its continuous-simulation hydraulic model of its combined sewer system to support the sizing of facilities associated with implementation of its CSO Control Program. Continuous simulation models are based on historical long-term rainfall patterns and more realistically simulate rainfall variability than "event-based" models. In support of this Program Update, WTD completed a 38-year continuous-simulation model run in 2016. Hydraulic modeling provides the key design criteria for CSO control alternatives (i.e., the sizing of facilities required to achieve CSO control).

Because overflows vary with the pattern of rainfall from year to year, it is challenging to use monitored data to assess system capacity, patterns of performance, and progress in CSO control. One way to understand the patterns and trends is to take a longer-term view by using a computer model to estimate the average frequency and volume of overflows that would occur under actual rainfall patterns in the service area measured over many years. Modeled data are compared to monitoring data to calibrate the model to provide more accurate flow predictions for use in CSO Control Program planning and facility design.

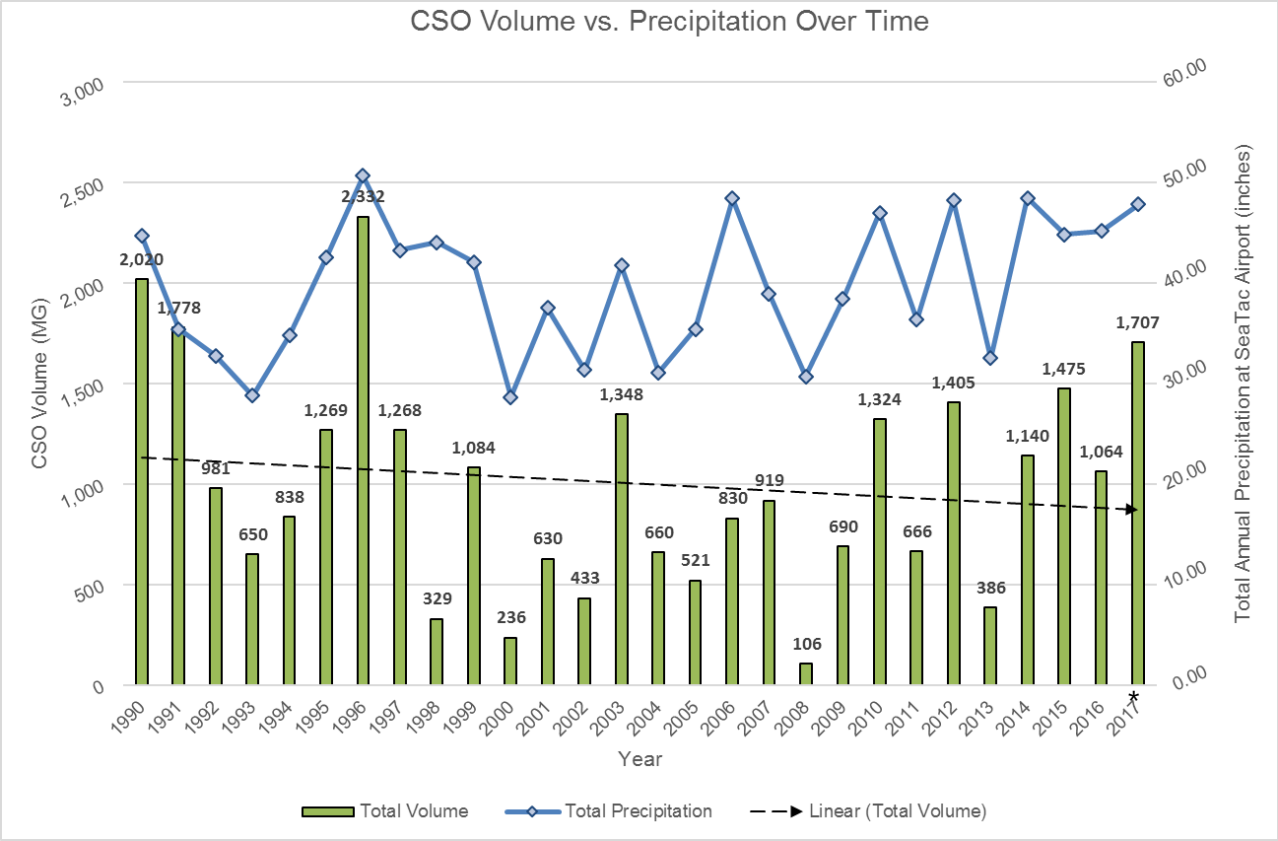
WTD uses computer models to simulate stormwater and wastewater flow contributions to the combined sewer system under various conditions. These simulations, combined with field data and engineering, are used in the design and operation of CSO control facilities. Using models to retrospectively assess system performance after storms and events also informs "lessons learned" analysis and may lead to changes in operational settings to improve system management and optimize system performance. The model can also be used to assess how new or future facilities—including those operated by Seattle—will perform and interact with other parts of the regional wastewater treatment system. These assessments enable WTD to develop strategies to improve new or future facility design or operational coordination.

Modeling is also used to determine compliance with CSO control regulations if less than 20 years of actual monitoring data exist for a particular system component, such as after a new CSO control project is constructed. Models are used to predict how a CSO control facility would have performed over the 20-year period so an overflow average can be calculated and compared to Ecology's performance standard. Section 2.5 presents more information on how WTD uses monitoring and modeling data to determine control status of its CSOs.

2.4.2 Relationship Between Measured Rainfall and CSO Volume

Figure 2-3 shows the relationship between recorded rainfall and overflow volumes over time. Rainfall amounts have fluctuated between wetter and drier years, whereas CSO volumes have trended downward because of the construction of new CSO projects. In wetter years, compliance to the one-year overflow per year (on a 20-year moving average) standard has

historically been attainable with higher volumes of overflows, whereas, in drier years, compliance is easier to attain with extra capacity available in the existing sewer system.



*2017 CSO volumes were exacerbated to some extent due to the West Point TP incident described in Section 1.2.5.1.

Figure 2-3 King County CSO Volume and Precipitation Over Time

Over the last two decades, there has been a downward trend for total annual CSO volume discharged. This successful trend is a direct result of implementation of the CSO Control Program and other CSO control projects by King County.

2.5 Control Status of King County CSOs

The NPDES permit for the West Point TP, effective July 1, 2009, implemented a new interpretation of the performance standard for CSO control, which is derived from the Washington state regulatory requirements for “greatest reasonable reduction” as specified in WAC 173-245-020(22).

The performance standard of “not more than one untreated discharge event per year per outfall on average” is based on a 20-year moving average. The number of untreated discharges that occurred over each of the previous 20 years is reported for each CSO site and then averaged. This average is used to assess each CSO site’s control status with the performance standard, and is reported to Ecology annually.

King County uses a combination of monitoring and modeling data to track and report the 20-year average CSO frequency for each of the County's CSO sites. This moving average is used each year to assess CSO control status with the performance standard. As a result of monitoring system improvements, such as the upgraded SCADA system that was fully brought online in 2005, a full 20 years of measured data are not available for all CSO locations. CSO locations lacking a full 20 years of monitored data use a combination of monitored and modeled data to determine control status.

For CSOs where new control facilities have been built and, thus, lack the 20 years of measured data, modeled data of how the new facilities would have performed with the historic rainfall over those years have been substituted for the unavailable measured data. For CSOs not identified as controlled, only available measured data are reported.

Table 2-2 shows the CSO frequency 20-year average (1998–2017) as reported in the 2017 Annual CSO and Consent Decree Report and identifies the control status of each site. CSO sites that lack a full 20 years of measured data and CSO sites that use a combination of monitoring and modeled data are identified in the table. King County is addressing each of the uncontrolled CSOs identified in Table 2-2 through operational adjustments, supplemental compliance plans, and capital projects through the CSO LTCP. Descriptions of current and planned actions are described in Sections 2.5.1, 2.5.2, and 3.2.

Table 2-2 CSO Event Averages and Control Status

CSO Name	20-year Average of Events (1998–2017)	Current Control Status
11th Ave. NW	14.5	Uncontrolled
30th Ave. NE[a]	0.8	Controlled
3rd Ave. W	6.9	Uncontrolled
53rd Ave. SW PS[a]	0.3	Controlled
63rd Ave. SW[a]	1.4	Uncontrolled
8th Ave. S	0.1	Controlled
Ballard Siphon[b]	0.2	Controlled
Barton St. PS	1.6	Uncontrolled
Belvoir PS	1.5	Uncontrolled
Brandon St. RS[a]	17.6	Uncontrolled
Canal St.	0.5	Controlled
Chelan Ave. RS	5.2	Uncontrolled
Denny Way RS	10.1	Uncontrolled
Dexter Ave. RS	0.3	Controlled
E Duwamish PS	0.2	Controlled
E Marginal Way PS	0	Controlled
E Pine St.	0	Controlled

Hanford #1[a]	11.1	Uncontrolled
Hanford #2 RS	16.5	Uncontrolled
Harbor Ave. RS	1.6	Uncontrolled
Henderson St. PS[b]	0	Controlled
King St. RS	13.6	Uncontrolled
Kingdome RS	6.1	Uncontrolled
Lander St. RS	15.2	Uncontrolled
Matthews Park PS	0	Controlled
MLK Jr. Way	0	Controlled
Montlake RS[a]	7.7	Uncontrolled
Murray St. PS	0.9	Controlled
Norfolk St.	0.1	Controlled
North Beach PS Inlet Overflow[b]	0.1	Controlled
North Beach PS Wet Well Overflow	0.8	Controlled
Rainier Ave. PS	0	Controlled
S Magnolia	20.5	Uncontrolled
S Michigan St. RS	10.6	Uncontrolled
SW Alaska St.	0.3	Controlled
Terminal 115[a]	1.8	Uncontrolled
University RS	6.9	Uncontrolled
W Duwamish[a]	0.4	Controlled
W Michigan St.	4.6	Uncontrolled

[a] CSO site is missing one or more years of monitoring data used to determine CSO control status.
[b] New facility where a combination of modeling and monitoring data were used to determine CSO control status.

2.5.1 CSO Control Status Changes and Reporting

Upon identifying the changes in control status for CSOs reported as controlled in the CD, WTD notifies Ecology and EPA in accordance with the reporting and recording requirements outlined in Section S3 of the NPDES permit for West Point TP. Recently, modeling and monitoring data showed the Belvoir Pump Station Overflow (Belvoir PS Overflow) and the 63rd Avenue Southwest Pump Station Overflow (63rd Ave. SW PS Overflow) as not meeting Ecology's CSO performance standard. These two sites have historically been reported as controlled. WTD submitted notification letters to Ecology outlining actions for each of the CSOs to meet the

performance standard in accordance with NPDES permit requirements and are described below.

2.5.1.1 Belvoir Pump Station

The Belvoir PS Overflow has historically been reported as controlled. However, updated modeling indicates that the CSO frequency has increased due to 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 Belvoir. 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.

2.5.1.2 63rd Avenue Southwest Pump Station

In May 2018, monitoring data for the 63rd Avenue Southwest Pump Station (63rd Ave. SW PS) indicated that the CSO frequency increased because of hydraulic changes and no longer meets Ecology's CSO control performance standard. WTD is currently optimizing the West Seattle portion of its CSO system, which includes operating the Alki WWTS more frequently. Recent improvements have also been made to the 63rd Ave. SW PS, including changing two constant speed pumps to variable speed pumps and performing electrical and control upgrades. A comprehensive computer model of the West Seattle System will be completed by the end of 2018 and will be used to optimize operations by 2020. These upgrades and optimizations will increase operating flexibility and improve performance of the 63rd Ave. SW PS and the Alki WWTS. Operations staff will work to maintain control of the 63rd Ave. SW PS during the optimization period.

2.5.2 Supplemental Compliance Plans

Projects previously completed at four CSO sites—Denny Way Regulator Station Overflow (Denny Way RS Overflow), Harbor Avenue Regulator Station (Harbor Ave. RS), South Magnolia Wet Weather Storage (S Magnolia WWS), and Barton Street Pump Station Overflow (Barton St. PS Overflow)—have not fully achieved control to meet Ecology's CSO performance standard. The CD requires supplemental compliance plans for these projects. Supplemental compliance plans and work completed or currently underway to complete control at these four locations is described in the following sections.

Supplemental compliance plans are required for any CSO control measures identified in the CD if, at any time before the CD terminates, information becomes available that King County

- did not construct all CSO control measures in accordance with the design criteria set forth in the respective approved LTCP;
- has not achieved the performance criteria for the CSO control measures identified in the respective approved LTCP;

- is not complying with all the requirements of the respective NPDES permits pertaining to CSOs.

Supplemental compliance plans include descriptions of the remedial measure King County will take to ensure that compliance will be achieved; a schedule that is as expeditious as possible for design, construction, and implementation of the measures; a description of additional post-construction monitoring and modeling needed to assess whether King County has achieved compliance; and a schedule for performing monitoring and modeling.

WTD has four projects with active supplemental compliance plans:

- Denny Way RS Overflow
- Harbor Ave. RS Overflow
- S Magnolia WWS and Pipeline
- Barton St. PS Overflow

2.5.2.1 Denny Way Regulator Station Overflow

The Denny Way Regulator Station (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 Wet Weather Treatment Station (Elliott West WWTS) was constructed to control the Denny Way CSOs and multiple CSOs around Lake Union. An 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.

2.5.2.2 Harbor Avenue Regulator Station Overflow

The Harbor Ave. RS CSO gate diverts excess flow to the West Seattle Tunnel for storage and operates based on the water surface level of the tunnel; that is, when the tunnel gets too full, the gate closes, stopping the diversion. The design for the West Seattle Tunnel was intended to reserve half of the tunnel capacity for Harbor Ave. RS by modulating the Alki regulator sluice gate. With the current actuator, the gate opens and closes too slowly to match the high peak volumes experienced by the regulator station.

Modeling indicates that increasing the Alki gate speed will enhance the ability to improve and/or achieve control at the Harbor Ave. RS. The selected correction is to replace the existing CSO gate electric actuator to accommodate full travel (open/close) in approximately one minute. A project was initiated to install a new actuator on the CSO gate, and a supplemental compliance plan was submitted to Ecology and EPA on August 31, 2016. Following installation of the

actuator, the Harbor Ave. RS will be monitored for two wet seasons and compliance will be assessed in 2021.

2.5.2.3 South Magnolia Wet Weather Storage and Pipeline

The S Magnolia WWS CSO control project was completed and became operational in December 2015. In October 2016, during a review of monitoring data, King County staff identified flow-level anomalies in the diversion structure and storage tank, indicating a potential issue. The County subsequently confirmed that a pipeline blockage in the CSO conveyance pipeline was preventing flows to the new facility's storage tank during significant storm events. A supplemental compliance plan was submitted in January 2017 (with an addendum containing the specific plan and schedule submitted in April 2018) to comply with the CD requirements for notifications. In 2018, King County continued implementing a project to replace the pipe with a new high-density polyethylene pipe using a pipe-bursting method. The S Magnolia WWS is expected to be in operation by the close of 2018 and will monitor for compliance in early 2019.

For more information, see:
http://www.kingcounty.gov/environment/wtd/Construction/Seattle/SMagnoliaCSOStorage.aspx.

2.5.2.4 Barton Street Pump Station Overflow

In 2017, post-construction monitoring and modeling indicated that the Barton Street Pump Station (Barton St. PS) was not performing at its design capacity of 33 MGD. Further investigation found that pump controls were set to a pump capacity of 30 MGD. A supplemental compliance plan was submitted in April 2018. In 2018, pump controls were reprogrammed to increase pumping capacity to 33 MGD and achieve designed pump capacity. Performance of the Barton St. PS will be monitored over the next two wet seasons, 2018 to 2019 and 2019 to 2020, and control status will be reported as part of the annual reports.

2.5.3 Planning-level Control Volume Updates

In preparation for this Program Update, WTD modelers updated volume and flow rate data from previously completed modeling results in 2010 for the remaining CSO control projects that were in the planning-level phase. The modeled volume and flow rates are used to develop the planning-level control volumes of alternatives for the remaining CSO control projects to meet the requirements in the 2013 CSO CD. These projects include University, Montlake, and a combined project to control Hanford #2, Lander St., King, and Kingdome (HLKK).

Table 2-3 Summary of CSO Control Volume and Peak Flow Rate (2010 and 2016)

CSO Basin	2010 Control Volume (MG)	2010 Peak Flow Rate (MGD)	2016 Control Volume (MG)	2016 Peak Flow rate (MGD)	Percent Change in Control Volume
University	5.23*	74.9	16.1	156.5	+208%
Montlake	7.87*	93.5	8.6	92	+9%
HLKK	103.5	151*	79.5	215.3	-11%

* Design criteria in the CD

A 32-year continuous-simulation model run of the combined sewer system was conducted in 2010 to establish project sizing and project definitions for the 2012 LTCP. The 2010 model used a 32-year rainfall record long-term average to provide a long simulation period for planning purposes. The 2010 model CSO control volumes and CSO peak flow rates were subsequently referenced in the 2013 CSO CD.

As part of WTD policy, a continuous-simulation model is run with a full 38-year data set to determine long-term averages for control volumes in planning-level analysis, and further modeling then assesses the maximum 20-year average for further control volume estimates. This policy is under review.

In 2016, WTD ran an updated 38-year continuous-simulation model run to determine current CSO control volumes and peak flow rates as part of this update. The updated modeling results are based on the 38-year rainfall record long-term average and incorporate improvements in basin calibrations. Table 2-3 compares all of the remaining uncontrolled CSO projects (except those under Supplemental Compliance Plans) and the associated volume and flow rate information referenced in the CD with the updated modeled estimates used for the 2018 Program Update. The revised volume for the University CSO basin is further discussed in Section 3.2.4.5. Revisions to the modeling for all basins will have an impact on project and program sizing and costs. Final control volumes and project sizing are completed as part of the design of any CSO project and documented in the required facility plan submitted to EPA and Ecology before the design of a CSO control project is completed. More information on the revised planning-level volume and project scope for the University CSO basin can be found in Section 3.2.4.5.

2.6 Characterizing Environmental Impacts

King County consistently considers scientific information in making wastewater management decisions, including decisions on CSO control. When required information is not available, King County initiates or participates in special studies with other agencies to develop or ascertain information. This section describes some environmental studies used to inform the CSO Control Program.

2.6.1 Water Quality Assessment/Monitoring Study

In 2012, the King County Council (Ordinance 17413) authorized a study to assess past and present water quality in local waters; review benefits from, and inform decision-making about, planned water quality improvement projects and programs; and identify water quality concerns likely to remain after completion of planned projects and programs unless other actions are taken. The WQA/MS, completed in 2017, was commissioned to inform the CSO Control Program's work to improve water quality and ensure the County's investments in CSO control are well planned, timed, and sequenced. The WQA/MS had a dedicated Science and Technical Review Team made up of independent technical experts in water quality, environmental science, and engineering who are not affiliated with King County. The role of the team was to ensure transparency and lend scientific credibility to the WQA/MS. The WQA/MS focused on the three water bodies where King County's remaining uncontrolled CSOs discharge: Duwamish Estuary, Elliott Bay, and Lake Union/ship canal.

Links to the 12 reports can be found at:

https://www.kingcounty.gov/services/environment/wastewater/cso/projects/water-quality-study.aspx

The WQA/MS addressed the following four questions:

1. What are the existing and projected water quality impairments in receiving waters (water bodies) where King County CSOs discharge?

The WQA/MS identified the following impairments in study area water bodies:

- Bacteria concentrations remain above Washington state standards.
- Summer surface temperatures have been warming over time, especially in Lake Union/ship canal.
- Summer low dissolved oxygen and high salinity levels at depth in Lake Union make the area inhospitable for freshwater aquatic life.
- Multiple metals and organic chemicals in sediments do not meet state standards.

2. How do CSOs contribute to the identified impairments?

King County uncontrolled CSO discharges contribute about 85 percent of the annual loadings of fecal coliform bacteria to the three study areas. City of Seattle uncontrolled CSOs contribute about eight percent, and other pathways combined contribute about seven percent of the annual fecal coliform bacteria loading to the study areas. King County's uncontrolled CSOs contribute a number of additional contaminants to the receiving waters, but at substantially lower annual loads than contributions from other pathways.

3. How do other sources (pathways) contribute to the identified impairments?

The major pathways for contaminant loadings other than bacteria are as follows:

- Direct stormwater discharges to the receiving waters and/or flows from the upstream watersheds contribute the majority of the annual loads of nutrients, polychlorinated biphenyls (PCBs), polybrominated diphenyl ethers, and most metals. The upstream watershed pathway, which accounts for contaminant loads flowing into the study areas from Green River and Lake Washington, represents the combined effect of all sources and pathways in the watersheds.
- Leaching from vessel-bottom antifouling paint contributes the largest known copper loads.
- Leaching from creosote-treated wood pilings contributes the largest known polycyclic aromatic hydrocarbon (PAH) loads.

4. What activities are planned through 2030 that could affect water quality in the receiving waters?

Because of data and scope limitations, the WQA/MS did not estimate changes to future contaminant loadings for all known factors that affect water quality. The following actions are likely to improve water quality in the study areas by 2030:

- *CSO control.* Implementation of King County and City of Seattle CSO control plans by 2030 are projected to reduce annual bacteria loading to the study areas by about 80 percent.

- *Copper source control.* Ecology's oversight and implementation of Washington state's limits on the copper content in antifouling vessel paint for small recreational vessels and in automobile brake pads is projected to reduce copper loading to the study areas by 50 percent.

- *Creosote-treated wood piling removal.* The planned removal of about 11,000 creosote-treated wood pilings is projected to reduce PAH loadings to Elliott Bay and the Duwamish Estuary by about one-third.

- *Contaminated sediment cleanup.* Remediation of contaminated sediment sites is projected to reduce contamination levels in the study areas. In particular, levels of PCBs, other organic chemicals, and metals in Duwamish Estuary sediments are projected to decline as the cleanup plan for the Lower Duwamish Waterway Superfund site is implemented. Less improvement is projected to occur in Lake Union/ship canal than in the other study areas.

- *Stormwater management and treatment.* Improvements in stormwater management by the City of Seattle and other jurisdictions in the study areas and upstream watersheds are projected to reduce loadings of several contaminants. Seattle is planning capital projects that include construction of stormwater treatment systems. Required (by stormwater permits) and discretionary improvements in stormwater management, including both operational and source control efforts, will likely decrease the annual loadings of all contaminants studied to some degree. The WTD Systemwide Comprehensive Plan will evaluate WTD's role in stormwater treatment.

- *Behavioral changes.* The cumulative impacts of changes in behavior by area residents can substantively affect water quality, although the degree of change and impact is not quantifiable. Examples of behaviors that can have a positive impact on water quality include preventing oil leaks through better vehicle maintenance and using nontoxic cleaning products.

WTD is identifying additional water quality projects supplemental to CSO control alternatives to evaluate them for water quality and other co-benefits. The CSO Control Program will answer the following five questions from the WQA/MS during the next phase of CSO long-term planning in conjunction with the systemwide planning effort:

- How can CSO control projects and other planned or potential corrective actions be most effective in addressing the impairments?

- How do various alternative sequences of CSO control projects integrated with other corrective actions compare in terms of cost, schedule, and effectiveness in addressing impairments?

- What other possible ways, such as coordinating projects with the City of Seattle and altering the design of planned CSO control projects, could make CSO control projects more effective and/or help reduce the costs to WTD and the region of completing all required CSO control projects by 2030?

- What regional values, priorities, and objectives should be considered when sequencing CSO control and other corrective actions?

- What is the best way to sequence CSO control projects and integrate them with other corrective actions to meet these regional values, priorities, and objectives?

2.6.2 Climate Change

Climate change impacts are predicted to have an effect on WTD's system and long-term control of CSOs. To better understand climate change impact projections for sea level rise and stormwater flows, WTD's CSO Control Program initiated a study with the University of Washington Climate Impact Group (UW CIG) to inform this Program Update. The UW CIG has worked to evaluate regional precipitation model simulations and develop projections for CSOs in Seattle.

The findings of the study show that heavy precipitation will be more intense over the next century, but that average annual rainfall will stay within historic amounts. It is uncertain how the change in heavy precipitation will impact CSOs because the hydrology and hydraulics of each CSO area varies across the city. WTD is performing long-term simulations of the hydrologic and hydraulic computer models to evaluate this new information over the next few years. The study completed by UW CIG in 2017 only used projections from two global models under two carbon scenarios. This limited modeling was done to reduce cost and decrease the time it took to perform the analysis.

There is still uncertainty in the new projections because of the limited amount of modeling performed. Additional climate modeling downscaled for local conditions is currently being performed by UW CIG, and will be used to inform climate change impacts on CSOs in the next phase of the LTCP. WTD will continue to monitor and incorporate relevant findings from this evolving science.

Because sea level rise rates are increasing, WTD has taken a precautionary approach by evaluating the range of sea level rise and not using one particular projection. By evaluating the range, the division can continue to update the timing of impacts to WTD facilities with a broader perspective. WTD has implemented several small capital projects to address sea level rise at specific facilities and has incorporated sea level rise considerations into the construction of new CSO projects or CSO-related facilities that are in tidally influenced waters. The actions include

raising the elevation of critical components, installing barriers (tide gates and flaps), and siting new facilities at higher ground to protect CSO facilities from possible future intrusion and corrosion.

2.7 Ongoing Water and Sediment Monitoring Programs

In 1986, Metro began a sampling program to characterize each CSO and identify high-priority sites for early control. The program included collecting overflow quality data for five CSO sites per year and collecting sediment samples at each site. In the 1990s, sampling was expanded to assess compliance with Washington State Sediment Management Standards (SMS). The County's extensive monitoring for its 1999 CSO Water Quality Assessment of the Duwamish River and Elliott Bay found that the majority of risks to people, wildlife, and aquatic life would not be reduced by removal of CSOs because most risk-related chemicals come from sources other than CSOs.

Under the previous NPDES permit for West Point TP effective July 1, 2009, King County developed a comprehensive sediment quality summary report for all CSO discharge locations (submitted December 2009). King County's current NPDES permit requires the County to update the 2009 report by December 1, 2018. It can be found at: http://your.kingcounty.gov/dnrp/library/wastewater/cso/docs/SedQuality/0912_CompSedQualSumRptCSODischargeLoc.pdf.

King County's Post-construction Monitoring Plan (PCMP) is designed to assess, document, and report on the effectiveness of its CSO Control Program in achieving performance requirements and complying with state water and sediment quality standards. The King County PCMP was approved on September 28, 2012. As each CSO is brought into compliance, the PCMP requires demonstration that the CSO achieves performance requirements and water and sediment standards and reports those findings to Ecology within a set timeframe. The PCMP can be found at: http://your.kingcounty.gov/dnrp/library/wastewater/cso/docs/ProgramReview/2012/AppH_CSO_PostConstructionMonitoringPlan,Sept2012.pdf.

King County's current NPDES permit required the County to prepare a post-construction monitoring summary report by December 1, 2019, that demonstrates how each CSO outfall listed as "controlled", as well as those brought under control during the permit term, achieves performance requirements and complies with state water and sediment quality standards.

In October 2018, WTD submitted the King County Sediment Management Plan 2018 Update (2018 SMP Update) to Ecology. The 2018 SMP Update amended the 1999 Sediment Management Plan (1999 SMP), which evaluated remediation alternatives for seven sediment cleanup sites located near King County CSOs. The 2018 SMP Update was developed by King County's Sediment Management Program in coordination with the CSO Control Program.

The 2018 SMP Update characterizes sediment at all King County CSOs and the four CSO WWTS outfalls through sampling or modeling, provides sediment deposition models to characterize CSO solids deposition, and identifies appropriate sediment management strategies adjacent to each remaining King County outfall location. Sediment characterization results in the

2018 SMP Update are compared to Washington State SMS (WAC 173-204) except at sites that are already within the boundary of current federal or state cleanup sites. It can be found at: https://www.kingcounty.gov/services/environment/wastewater/sediment-management/plan.aspx.

Sediment quality associated with 14 CSOs and two CSO WWTS outfalls have either been previously remediated, are currently being addressed as part of an area-wide cleanup, or were addressed under the 1999 SMP and, therefore, were not further evaluated in the 2018 SMP Update (See Table 2-4).

The remaining CSOs and CSO WWTS outfalls were evaluated in the 2018 SMP Update (Table 2-4). To characterize the magnitude and extent of sediment deposition of CSO-related solids, King County developed two types of sediment deposition models and verified them with sediment quality data. The sediment characterization from sampling and modeling, along with other lines of evidence, were used to develop appropriate sediment management strategies. All of the following information was considered:

- Existing sediment cleanup actions near the CSO discharge location
- CSO control status
- Model-predicted CSO solids deposition and predicted sediment concentrations near the CSO discharge location
- Sediment concentrations near the CSO discharge location
- Nearby pathways and potential sources

Proposed sediment management strategies for each CSO and CSO WWTS outfall fall into five categories:

- Sediments are addressed as part of an existing cleanup
- No further action required
- Additional monitoring to determine if problems develop
- Further evaluate in the context of future area-wide investigation (problems exist, but are part of widespread contamination)
- Further evaluate cleanup options (preliminary evaluation in the SMP update)

Table 2-4 CSO Sediments Addressed in 2018 SMP Update, Existing Cleanups, or 1999 SMP

CSO Sediments Addressed in Existing Cleanups or the 1999 SMP	CSO Sediments Addressed in 2018 SMP Update
Hanford #1 Overflow	Carkeek Outfall
Duwamish PS Overflow	North Beach PS WW Overflow
W Duwamish Overflow	North Beach PS Inlet Overflow
Brandon St. RS Overflow	S Magnolia Overflow
Terminal 115 Overflow	53rd Ave. SW PS Overflow
S Michigan St. RS Overflow	Alki Outfall
W Michigan St. RS Overflow	63rd Ave. SW PS Overflow
E Marginal Way PS Overflow	SW Alaska St. Overflow
8th Ave. S Overflow	Murray St. PS Overflow
Norfolk St. Overflow	Barton St. PS Overflow
Henderson/MLK Outfall	Kingdome RS Overflow
Hanford #2 RS Overflow	Chelan Ave. RS Overflow
Lander St. RS Overflow	Ballard Siphon Overflow
King St. RS Overflow	11th Ave. NW Overflow
Denny Way RS Overflow	3rd Ave. W Overflow
Elliot West Outfall	Canal St. Overflow
	Dexter Ave. RS Overflow
	University 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
	MLK Jr. Way Overflow
	Henderson St. PS Overflow

2.8 Relationship with WTD Systemwide Planning

The Puget Sound region is facing many complicated and expensive water quality issues. For WTD, these issues include:

- aging infrastructure,
- asset management,
- increasing population,
- secondary treatment plant capacity needs,
- increasing stress on the system from stormwater, including inflow and infiltration,
- future climate change impacts,
- increasing redundancy needs, and
- existing and potential future regulatory requirements, such as nutrient removal.

WTD initiated a planning process to update its comprehensive wastewater system plan by thoroughly assessing all the demands on the regional wastewater utility. As one of the demands on WTD, the CSO Control Program will be considered in the planning process. The planning process will use the latest data to comprehensively assess all demands on the regional wastewater system and explore plausible futures. It will also incorporate a fair and inclusive regional discussion to engage people in the region in a values-based conversation about investment priorities and associated tradeoffs, including water quality benefits relative to cost and wastewater treatment rate affordability. The discussion will include long-time participants in water quality issues as well as new, interested parties whose voices may have been unrepresented in the past. Through assessing the demands and discussing plausible futures, priorities, and tradeoffs for the utility, the planning process will result in a systemwide comprehensive plan that will be used to prioritize programs, policies, and projects to benefit regional water quality and make the best use of public funds. The outcome of the systemwide planning process will identify a path forward for WTD that:

- provides a strategic plan to guide future investments,
- allocates the right dollars to the right actions at the right time,
- ensures WTD's core mission to protect water quality and public health,
- achieves the best water quality benefit for the investments made,
- results in an affordable wastewater utility rate into the future,
- reflects the County's initiatives, including ESJ and strategic climate action planning, and

- guides WTD's near-term (up to 10 years) and long-term (10 to 40 years) investments in regional water quality.

In addition, the systemwide planning process may result in recommended changes to the CSO Control Program and projects, as currently conceived.

In 2018, WTD developed the planning and regional engagement approach for the systemwide planning process; briefed elected officials, Ecology, and EPA; and engaged consultant services to assist in the planning and engagement process. The planning process will formally get underway in 2019 and is expected to be completed by the end of 2022.

The next phase of CSO long-term planning (Section 3.2.5) will have strategic linkages to the systemwide comprehensive planning process and identify opportunities for the respective processes to inform each other.

Chapter 3

CSO Control Projects

3.1 Approaches for Consideration in CSO Control Projects

King County's combined sewer system is designed to convey both wastewater and stormwater for treatment, with CSOs occurring at constructed relief points (outfalls) during heavy rainfall when capacity is exceeded in the regional system. A variety of CSO control approaches is being used by other CSO communities throughout the country to reduce the frequency and volume of CSO events. However, not all of these approaches work for King County's system as well as they do for another CSO community and vice versa because of the uniqueness of the overall system requirements, geographic elements, and design and engineering.

This section describes the CSO control approaches considered as part of this Program Update. The approaches considered fall into three broad categories:

1) Preventing stormwater from entering the combined sewer system (i.e., stormwater/sanitary sewer separation and GSI).

2) Managing excess stormwater after it has entered the combined sewer system (e.g., storage or treatment).

3) Optimizing existing facilities to operate more effectively and efficiently with a range of flows, which effectively increases storage and treatment capacity without building new infrastructure.

Since the first metropolitan sewer plan in 1958, WTD has considered and incorporated each of the following control approaches when developing alternatives for CSO control.

3.1.1 Separation

Stormwater runoff that is generated during a rainfall event can enter the combined sewer system from a variety of sources, including private property and a public right-of-way (ROW) such as a road surface. Approaches that prevent some or all of this stormwater from entering the combined sewer system are referred to as "separation approaches," as described below.

3.1.1.1 Full Separation

Full separation approaches prevent all stormwater runoff generated on private property and public ROW areas from entering the combined sewer system. In essence, full separation approaches convert areas served by a single system of combined sewers into areas served by two separate sewer systems—one dedicated to conveying sanitary sewage and one dedicated

to conveying stormwater. A new and separate sanitary sewer system must be built to convey sanitary sewage from homes and businesses to existing wastewater treatment plants. Any stormwater flow separation from a combined sewer system to a separate storm sewer system would result in the regulatory transfer of that flow from CSO regulations to the NPDES stormwater permit system and its water quality compliance requirements.

WTD has modified this approach to separation by using the existing combined sewer pipe to convey stormwater and constructing a new separate sanitary sewer system. However, this separation approach only works if the existing combined sewer system has adequate capacity and is in good condition to be converted to stormwater conveyance.

Full separation is most feasible in areas where there are relatively few privately owned parcels requiring new sewer service and is often difficult to implement in large and densely populated urban areas. The cost and complexity of constructing a new sanitary sewer system in the public ROW and on private property present significant challenges for a full separation approach because of the construction impacts, including opening up many roadways.

3.1.1.2 Partial Separation

While full separation relies on complete removal of stormwater from the combined sewer system, partial separation disconnects a portion of stormwater to lower peak flows during rainfall events, thereby reducing the frequency and volume of CSOs. To limit the complexity and cost associated with work on private property, partial separation approaches typically only target stormwater runoff from the public ROW (i.e., streets, sidewalks, and parking strips). This Program Update evaluated opportunities for partial separation in areas where cost-effectiveness and feasibility of construction were likely to be favorable. These included the following areas:

- An area where a separate storm sewer system already exists, but the separated stormwater currently discharges back into the combined sewer system at some downstream point.

- An area where stormwater currently flowing into a combined sewer system could be re-routed (by constructing minimal below-grade piping improvements and/or through overland flow) into an existing stormwater system with sufficient capacity to handle the increased stormwater flow.

3.1.1.3 Opportunistic Separation

Opportunistic separation can occur in instances where large sections of the combined sewer system can be re-routed to an existing stormwater outfall. Evaluation for this Program Update considered only impervious ROW areas and did not evaluate existing downstream separated storm sewer infrastructure for feasibility to receive the additional runoff. Separating areas that are close to and directly connected to existing overflow locations results in the greatest benefit (i.e., achieves the largest reduction in CSO control volume). Separating areas that are farther from overflow locations and/or separating areas that flow into existing stormwater or CSO detention facilities results in the least benefit.

3.1.1.4 2017 Full Separation Analysis

As part of the alternatives analysis process informing this Program Update, WTD reviewed opportunities to address the remaining uncontrolled CSOs through separation. Table 3-1 reflects the planning-level cost estimate to achieve CSO control through separation.

Table 3-1 Planning Level Cost Estimate of CSO Control through Separation

CSO	Cost estimate (2017$)
University	$2.6 B
Montlake	$813 M
Kingdome/King	$830 M
Hanford/Lander	$1.1 B (plus113M*)

* 113 million dollars is the estimated cost of a 2-MG storage tank.

CSO control through separation was found to be cost-prohibitive. The extent of road reconstruction is extensive and highly disruptive. In the Hanford/Lander basins, there were insufficient areas for separation to achieve control, and an additional storage facility would still be necessary to reach the control volume.

These cost estimates were developed as part of the preparation for this Program Update, and contributed to the alternatives analysis process that confirmed the projects identified in King County's CD continue to reflect the future course of CSO control. The following sections present updated information on current and future projects to control the remaining CSOs.

3.1.2 Green Stormwater Infrastructure

GSI is a stormwater management approach that has proven to be effective in Seattle and other urban areas. In addition to removing stormwater from the combined sewer system, GSI has other social and environmental benefits such as adding additional green space in urban areas. Rather than relying on existing or new pipes and mechanical systems to convey and treat separated stormwater, GSI approaches manage stormwater runoff through a combination of natural and/or low-impact designs (e.g., bioretention, street trees, rain gardens, green roofs, cisterns, permeable pavement) that provide stormwater retention/detention and treatment.

GSI designs that retain stormwater rely on groundwater infiltration, deep well injection, onsite reuse, and/or evaporation for stormwater management. Stormwater can also be detained (i.e., temporarily stored) and slowly released back into the combined sewer system.

In partnership with SPU, WTD has administered the RainWise Program since 2010. This program provides rebates to homeowners living in specific combined sewer areas for installing rain gardens and cisterns on their property. RainWise helps to slow, detain, or retain stormwater, which reduces both the volume and timing of combined sewer flows and reduces sources of pollution into the combined system.

There are a number of GSI facilities throughout the City of Seattle, including King County's completed Barton GSI Project, which controls CSOs in West Seattle's Westwood and Sunrise Heights neighborhoods. This Program Update evaluates GSI as a CSO control approach to be

used alone or in combination with separation, storage, or treatment to reduce flows from entering the system, thereby reducing the size of the downstream gray facilities.

Since 2012, the County has continued to evaluate the feasibility of GSI in basins with CSOs that do not meet the CSO performance standard and has also continued to design and construct GSI projects. A summary of the results is listed in Table 3-2. Based on the geotechnical analyses completed, the County plans GSI projects in the following three basins: Ballard/11th Ave. NW, Montlake, and University. The University GSI project is further described in Section 3.2.2.3.

In 2017, WTD determined that the GSI for W Michigan St., though originally determined to be feasible, was not suitable or cost-effective in conjunction with the storage project. Therefore, further design of GSI in this area was halted.

In addition to GSI capital projects, the County will continue the SPU and WTD RainWise Program in the W Michigan St., 8th Ave., University, and Montlake uncontrolled basins. The County has met the stormwater volume control targets in the 11th Ave. and Barton basins.

GSI projects completed by other agencies, organizations, and individuals affect WTD's system. SPU has completed GSI projects in its Delridge Basin (King County Chelan Basin) and Ballard Basin (King County Ballard Basin). WTD is still assessing the downstream impacts of these projects on its system. WTD will work with SPU to expand GSI in these areas if further downstream benefits to WTD are realized.

The Harbor Basin was evaluated for GSI and found to be feasible; however, the cost benefit of implementing GSI was very low because of the simple fix to the CSO gate identified as part of the supplemental compliance plan (Section 2.5.2.2). If further control is needed for the Harbor CSO, GSI will be evaluated and RainWise Program eligibility will be updated.

Table 3-2 Summary of GSI Feasibility and Project Status by Basin

Uncontrolled Basin*	Feasibility of GSI	WTD-led Project Status (Planning, Design, Construction)	RainWise Program Status
Ballard/11th Ave.	Feasible	In long-term planning	Completed
Barton	Feasible	Completed	Completed
Chelan	Feasible	None planned	Eligible
Harbor	Feasible	None planned	Not eligible
Hanford	Not feasible	Not applicable	Not eligible
King	Not feasible	Not applicable	Not eligible
Kingdome	Not feasible	Not applicable	Not eligible
Lander	Not feasible	Not applicable	Not eligible
Montlake	Feasible	In long-term planning	Eligible
S Magnolia	Feasible	In design	Not eligible
University	Feasible	In design	Eligible
W Michigan	Feasible	Eliminated in project-level alternative analysis	Eligible

* Uncontrolled in 2012

3.1.3 Storage

Once stormwater has entered the combined sewer system, storage can be used at or near designed CSO relief points to reduce the size and frequency of CSOs. When the pipes that carry combined sewage to treatment are full, excess flow is temporarily stored and then returned to the combined sewer system following the peak flow event caused by rainfall. There are two basic ways to store excess flow: inline storage (where storage occurs within the pipes that also convey combined sewage) and offline storage (where storage occurs in tanks or tunnels that are constructed adjacent to the combined sewer system). King County currently manages its wastewater collection system to optimize and maximize inline storage before CSO events. Therefore, this Program Update evaluates offline storage for future CSO control in either buried concrete tanks, large-diameter pipes, or tunnels.

3.1.4 CSO Treatment

Dedicated WWTSs are intermittently operated treatment facilities that treat large volumes of combined stormwater to a quality standard that meets or exceeds regulatory requirements for solids and disinfection, and then discharges the treated water to nearby waterways under a NPDES permit.

WWTSs are commonly located near existing outfalls to reduce the cost and complexity of conveying large volumes of flow to the treatment station. They are often a preferred means of CSO control when the volume of excess combined sewage is too large for a storage option or a combination of storage and GSI. King County operates several dedicated WWTSs, including Alki, Henderson/MLK Jr. Way, Elliott West, and Carkeek. A fifth WWTS (Georgetown) is currently being constructed to control CSOs from the Brandon and S Michigan St. CSO basins.

This Program Update evaluates new WWTSs as a CSO control approach in currently uncontrolled areas of the combined sewer system where flow volumes exceed feasible storage and storage/GSI options. In addition, WTD has initiated a pilot project on a new treatment technology that could potentially be used to enhance treatment at existing WWTSs (see Section 3.2.3).

3.1.5 Conveyance

Installing a new pipe or upsizing an existing pipe may eliminate conveyance capacity limitations where flow is restricted from transferring excess flow to the existing downstream conveyance system. Building new conveyance may be limited by physical constraints, such as downstream elevations. Where feasible, increasing conveyance capacity maximizes the use of existing facilities and typically results in fewer O&M needs. However, potential impacts on downstream system elements must also be considered at an early stage of analysis and may require building new or larger downstream facilities. When increasing conveyance, WTD must consider the impacts to West Point TP and any downstream WWTS to ensure all flows can be managed and treated adequately.

3.1.6 Optimization

WTD continually evaluates its conveyance system to optimize overall system performance. System optimization includes managing the operation of the combined sewer system to maximize existing capacity and minimize overflows. System modifications typically include minor adjustments in the system to better use the existing capacity, such as raising an overflow weir, adjusting gate operational set points, incorporating or adjusting real-time system control points, increasing peak flow from pump station operation, and implementing a maintenance program to optimize system performance. A system with real-time control provides the capacity to adjust the operation of facilities (e.g., gates and weirs) in response to field measurements (flows and levels) to reduce overflows.

Flows through WTD's regional wastewater conveyance and treatment system are monitored by a SCADA system and controlled by local programmable logic controllers (PLCs). Experienced operators have the option of remote control by means of the SCADA system. The local PLCs monitor levels and flows, adjusting gate positions and pump motor speeds to suit the conditions. Many of the controls are governed by determined set points that have been established over the years by hydraulic analysis and modeling to maximize conveyance to West Point TP and storage in pipes and offline storage facilities while minimizing CSOs. The automatic control of the regulator stations reduces CSOs by directing flow to maximize storage during a storm and then later conveying the flows to West Point TP for treatment when the storm subsides.

3.2 Implementation of CSO Control Projects

The approved 2012 LTCP recommended nine alternatives to control overflows from 14 CSO locations. Figure 3-1 summarizes the status of each of these alternatives as of October 2018. Since completion of the approved 2012 LTCP, six of the nine alternatives are in design, under construction, or have been completed, and three alternatives are upcoming. The projects already initiated to control six CSOs are in different phases, ranging from project-level planning to design and construction. The sequence of project implementation closely follows priorities

expressed by the community: controlling CSOs in the ship canal and Duwamish Waterway first, evaluating GSI to divert stormwater from the combined system, and expanding collaboration with the City of Seattle. The projects currently underway to control six CSOs are discussed in more detail below and in Table 3-3.

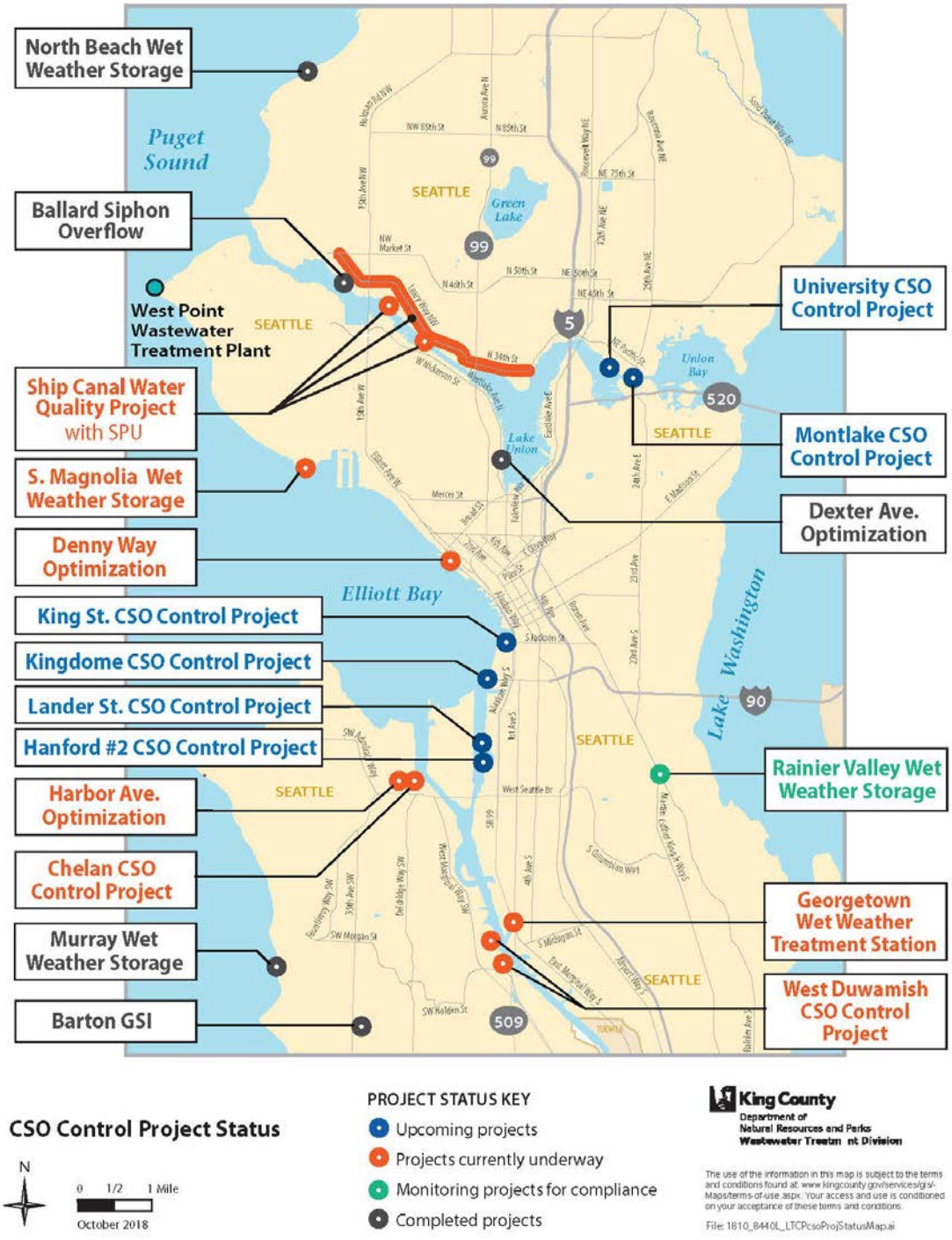


Figure 3-1 Map of CSO Project Status

Table 3-3 Projects in Progress Since 2012

Project (CSOs)	Project Phase*	Affects Lower Duwamish Waterway	GSI Planned	Collaboration with Seattle
Rainier Valley WWS (Hanford #1)	Construction Completed	✓		
Georgetown WWTS (Brandon St./S Michigan)	Construction	✓		
Ship Canal Project (3rd Ave. W)	Design			✓
Ship Canal Project (11th Ave. NW)	Design		✓	✓
W Michigan/ Terminal 115	Complete Facility Plan	✓	✓	
Chelan Ave.	Complete Facility Plan	✓		

* Project phase as of spring 2018

This Program Update describes the status of the following projects for the following CSO sites (in parentheses) that are in the design and project-level planning phases, in implementation, or have been completed since the approval of the 2012 LTCP:

- Ballard Siphon Replacement (Ballard CSO)
- Barton Roadside Garden Project (Barton PS CSO)
- Murray Ave. WWS (Murray Ave. PS CSO)
- North Beach WWS (North Beach PS CSOs)
- Rainier Valley WWS (Hanford #1 and Bayview N. CSOs)
- Georgetown WWTS (Brandon St. and S Michigan CSOs)
- Ship Canal Project (3rd Ave. W and 11th Ave. NW CSOs)
- University GSI
- Chelan Ave. (Chelan Ave RS CSO)
- West Duwamish (W Michigan St. and Terminal 115 CSOs)

Further, this Program Update evaluates the following alternatives from the approved 2012 LTCP, which have not yet started design: University storage, Montlake storage, Hanford #2, Lander St., Kingdome, and King St. CSO treatment (Section 3.2.4).

3.2.1 Completed CSO Control and Associated Projects

The following CSO projects have been completed since 2012 and now meet Ecology's CSO performance standards: the Ballard siphon (Ballard Siphon Replacement Project), Barton St. PS (Barton Roadside Rain Garden Project), Murray Ave. PS (Murray Ave. WWS), and North Beach PS and North Beach Inlet Overflow (North Beach WWS). Hanford #1 Overflow (part of the Rainier Valley WWS) construction was completed in 2018, and the facility is currently undergoing monitoring for compliance. Construction of the South Magnolia Overflow Project (S Magnolia WWS) was completed in 2015; however, the project did not meet performance standards because of a pipe failure post-construction in 2016 and is currently under a supplemental compliance plan. The following subsections give more background and detail on each of these projects.

3.2.1.1 Ballard Siphon Replacement Project

Inspections of the existing Ballard siphon revealed possible structural defects in the 100-year-old wood-stave pipe. The chosen alternative was to construct a new siphon with sufficient capacity to control the Ballard CSO. The Ballard siphon carries flow from Seattle's north end near Carkeek Park and the area in Ballard, sending it under the ship canal to an interceptor and on to West Point TP. The Ballard Siphon Replacement Project constructed a new 85-inch siphon pipe under Salmon Bay between Ballard and Interbay to accommodate growth in north Seattle and to reduce combined overflows into Salmon Bay. The project was completed in 2013 and has met CSO control performance standards since 2014.

3.2.1.2 Barton Roadside Rain Garden

The Barton Roadside Rain Garden Project included construction of 91 roadside rain gardens, a type of GSI, on 15 blocks in the Sunrise Heights and Westwood neighborhoods in West Seattle. Located in the planter strip between the curb and sidewalk, these roadside rain gardens divert stormwater runoff away from the combined sewer system. The project was completed in 2016. In 2017, modeling indicated that the pump station was not reaching the design pump capacity of 33 MGD. Further investigation into the control system confirmed that the controls for the pumps were set to a pump rate of 30 MGD. WTD has since changed the controls to achieve the design pump capacity of 33 MGD and will continue to monitor the overflow as described in the Barton St. PS Overflow Supplemental Compliance Plan (Section 2.5.2.4).

3.2.1.3 Murray Ave. Wet Weather Storage

The Murray Ave. WWS Project, which is one of the Puget Sound Beach Projects, included construction of a million-gallon underground storage tank across the street from Lowman Beach Park in West Seattle. The tank reduces overflows into Puget Sound when the Murray Ave. PS exceeds maximum capacity. The project was completed in 2016 and met CSO control performance standards in 2017.

3.2.1.4 North Beach Wet Weather Storage

The North Beach WWS Project, which is one of the Puget Sound Beach Projects, included an underground storage pipe in the ROW in the North Beach neighborhood. This facility can store up to 380,000 gallons of untreated water when the North Beach PS reaches maximum capacity.

The project was completed in 2015 and has met CSO control performance standards since 2016.

3.2.1.5 Rainier Valley Wet Weather Storage

The approved 2012 LTCP recommended preferred alternative was a 0.34-MG offline storage tank near the Hanford #1 Overflow and related facilities to modify the overflow. The final project consists of a new storage tank with related pipes that keeps stormwater and untreated sewage out of the Duwamish Waterway. This project was completed in mid-2018 and is still undergoing operational testing. In 2020, WTD will report if the project is meeting compliance standards.

3.2.2 CSO Control Projects Currently Underway

Projects are underway to control the following CSOs: 3rd Ave. W and 11th Ave. NW (as part of the joint Ship Canal Project with the City of Seattle), S Michigan and Brandon (Georgetown WWTS), and University GSI.

3.2.2.1 Georgetown Wet Weather Treatment Station

The approved 2012 LTCP recommended preferred alternative was a high-rate clarification WWTS near the South Michigan Street Regulator Station (S Michigan St. RS) and new conveyance from the Brandon St. RS to the WWTS. Through design and siting refinements that reduced overall conveyance and minimized the size of the site, the final WWTS project ultimately is located between the Brandon St. and S Michigan St. regulator stations, with related pipes and a new outfall structure to the Duwamish Waterway. After it is completed, the WWTS will treat up to 70 MGD of combined wastewater and stormwater. Construction on this project began in 2017 and construction completion is anticipated by December 31, 2022 in accordance with the CD.

3.2.2.2 Ship Canal Water Quality Project

The approved 2012 LTCP recommended alternatives for 3rd Ave. W and 11th Ave. NW were, respectively, a 7.23-MG storage tank in cooperation with Seattle to control both WTD and SPU CSOs and a 0.6-mile pipe to increase conveyance capacity to the Ballard Siphon, along with GSI in the Ballard, Phinney, and Crown Hill neighborhoods. In 2012, WTD and SPU began evaluating a joint project option to address multiple WTD and SPU CSOs with one project. For WTD's 3rd Ave. W Overflow and 11th Ave. NW Overflow, the decision was made to initiate a joint project with SPU; King County Council approved the joint project in 2016. Because of the change of design criteria for this project, a modification to the CD was approved in 2016.

The Ship Canal Project is being delivered under multiple construction contracts because of its complexity. Most of these are currently in the design phase, though the initial Ballard Early Works contract (including site preparation and replacement of a pier that will be used for barging construction spoils) began construction in 2018. A significant CD milestone will be achieved with construction of the tunnel itself, expected to begin in 2019. The project will provide 29 MG of offline storage in a deep storage tunnel constructed between the Ballard and Wallingford areas on the north side of the ship canal. Bringing WTD's CSOs into control will require approximately 9.77 MG of the tunnel's capacity. SPU is the lead agency for design and construction of the project and will own, operate, and maintain the tunnel and its related structures, with joint

agency review and cost participation. WTD will continue to report the control status of its two CSOs (3rd Ave. W Overflow and 11th Ave. NW Overflow) in accordance with the West Point TP NPDES permit and CD requirements.

3.2.2.3 University Green Stormwater Infrastructure

The approved 2012 LTCP recommended alternative for University was a storage tank and GSI. To reduce the necessary size of the gray infrastructure, King County is implementing a University GSI project in advance of developing the University CSO storage tank design further. This University GSI project is planned to construct GSI that will manage stormwater from 240 acres in the basin. Further updated information about the storage tank is provided in Section 3.2.4.5.

The University GSI project, which is currently in the planning phase, will install green infrastructure facilities in north Seattle neighborhoods contributing to the University CSO basin. The project will complete early action projects in 2019, with construction of the full project planned for 2021 to 2023. King County will submit a report to EPA quantifying the co-benefits of the project along with a Green for Gray Partial Substitution proposal by December 31, 2022.

3.2.3 CSO Treatment Technology Pilot Program

King County is investigating options to improve the quality of discharge from its Elliot West WWTS. The County's goals are to meet or exceed requirements of its CD with Ecology and EPA and reduce CSO Control Program capital costs. Ovivo, a manufacturer of wastewater treatment systems, has introduced a new physical chemical treatment process to accommodate higher-volume CSO flows and has conducted its own performance testing of the technology. Based on the positive results of Ovivo's performance testing, King County is interested in completing a pilot test of the technology at a CSO location in King County (Seattle). The goals of the pilot testing include the following:

- Determine the ability of the technology to meet or exceed NPDES requirements given the CSO influent characteristics in King County.
- Develop criteria to guide the design and operational aspects of the treatment in a CSO environment for full-scale application of the technology.
- Review the treatment results and compare them to the manufacturer's recommended design and operational criteria and other observations and recommendations.

If the pilot yields promising results, the CSO Control Program will look to apply the technology at Elliott West WWTS and potentially other CSO WWTSs in future planning efforts.

3.2.4 Remaining Consent Decree Projects

Alternatives developed as part of the approved 2012 LTCP for University, Montlake, and HLKK were reevaluated with updated information in preparation for this Program Update. The analysis considered recent monitoring of control techniques (such as GSI), updated modeling information, and opportunities for collaboration with other agencies. The purpose of re-

evaluating the approved 2012 LTCP alternatives was to identify any changes in conditions that could impact the type, size, and location of the alternatives since 2012.

Additional alternatives, identified through workshops, and the approved 2012 LTCP alternatives were run through high-level screening for feasibility to identify preliminary alternatives. Screening factors were technical complexity, constructability, and O&M complexity. Following high-level screening, a process of rating and ranking alternatives was used to incorporate performance, cost, and risk factors and identify the best value alternative for each basin and planning area.

The results of this risk-based value analysis were similar to the triple bottom line results in the approved 2012 LTCP. One key difference between the approved 2012 LTCP and the value analysis for the 2018 Program Update alternatives is the inclusion of consolidated alternatives that address multiple basins in a single approach. Table 3-4 summarizes the results of the risk-based value analysis for each basin and planning area and identifies the approved alternative from the existing 2012 LTCP for comparative purposes. At this time, WTD is continuing with implementation of the approved 2012 LTCP alternatives.

In the approved 2012 LTCP, the programmatic cost to implement the recommended alternatives was estimated at $711M. Escalated to 2017 dollars, this programmatic cost estimate is $849M. Further refinement of alternatives over the next ten years (when the last project is in design) could significantly increase the programmatic costs. CSO programmatic costs and alternatives that also protect or improve water quality will be evaluated in the WTD Systemwide Comprehensive Plan.

Sections 3.2.4.1 through 3.2.4.5 present updated descriptions of the approved 2012 LTCP alternatives.

Table 3-4 Alternatives Comparison: 2018 Best Value and 2012 LTCP

Basin	CSO Alternative Name	2018 Best Value Alternative Result*	Approved LTCP Alternative
SODO (Hanford #2, Lander St., Kingdome, and King St.)	HLK WWTS & King St. Storage Tank	HLKK WWTS	HLKK WWTS
	HLKK WWTS		
	HLKK Tunnel to Georgetown WWTS		
	HLKK Tunnel to South TP		
	SODO Full Separation		
Combined – Chelan Ave./SODO	HLKK WWTS & Chelan Ave. Storage Tank	CHLKK WWTS	N/A – Not evaluated as part of approved LTCP
	CHLKK WWTS		
Montlake	Montlake Storage Tank	Montlake Storage Tank & GSI & Separation	Montlake Storage Tank & GSI
	Montlake Storage Tank & GSI & Separation		
	Montlake Storage Tunnel		
	Montlake WWTS		
	Montlake WWTS & GSI & Separation		
	Montlake Full Separation		
University	University Storage Tank	University Storage Tank	University Storage Tank & GSI
	University Storage Tank & GSI		
	University Storage Tunnel		
	University WWTS		
	University WWTS & GSI		
	University Full Separation		
Combined - Montlake/University	Consolidated Tunnel for University & Montlake	Consolidated Tunnel for University & Montlake	N/A – Not evaluated as part of approved LTCP
	Consolidated Tunnel for University & Montlake & GSI & Separation		

* Best Value Alternative is a result of a rating and ranking process incorporating performance, cost, and risk factors.

3.2.4.1 Chelan Ave. Storage Tank

The Chelan Ave. Storage Tank alternative consists of an approximately 4.0-MG storage tank to control the WTD Chelan Ave. RS Overflow. During a storm, flow would be conveyed from the new diversion structure to the storage tank via the influent gravity pipe. After a storm, drain pumps would transfer stored combined sewage to the force main discharge maintenance hole via the drain force main when instrumentation in the West Duwamish Interceptor indicated there was downstream capacity available. Because of the potential to site the Hanford #2, Lander Street, Kingdome, and King Street Wet Weather Treatment Station (HLKK WWTS) near the Chelan RS, there is a potential to combine this latter project with HLKK WWTS. A facility plan identifying two possible scenarios is due to Ecology in December 2018.

3.2.4.2 West Michigan/T115

The West Michigan/T115 Storage Tank was previously called the South Park and Highland Park GSI Project. The 2012 LTCP recommended GSI, followed by a storage solution, if necessary. After the problem definition process was completed, the revised control volume range of 0.36 to

0.48 MG indicated that GSI alone could not solve the problem. As indicated in Table 3-2, the technical team determined that Highland Park was not an effective candidate for GSI because there was not sufficient impervious right of way connected to the combined sewer system, so the neighborhood was removed from consideration. Alternatives analysis was completed in 2017, and a storage tank was selected as the most viable solution for this project without GSI. The project is currently in the predesign phase, and a facility plan is being developed for submittal in 2020 per the CD milestone.

3.2.4.3 Hanford #2, Lander St., Kingdome, and King St. WWTS

The alternative for HLKK WWTS consists of an approximately 150-MGD WWTS with an equalization basin to treat combined flow before discharge into the Duwamish Waterway to control the Hanford #2 RS, Lander St. RS, Kingdome RS, and King St. RS overflows. Flows would be diverted from the four new diversion structures near the Hanford #2 RS, Lander St. RS, Kingdome RS, and King St. RS to a common influent gravity pipe. The influent gravity pipe would then convey the combined flows to a centralized WWTS. Because of the potential to site the HLKK WWTS near the Chelan RS, there is a potential to combine the Chelan project with HLKK WWTS.

3.2.4.4 Montlake Storage Tank, GSI, and Separation

The Montlake Storage Tank, GSI, and Separation alternative consists of an approximately 8.0-MG storage tank, GSI, and sewer separation to control the WTD Montlake RS Overflow. In addition to the storage tank, GSI and separation techniques would be integrated into the ROW, including roadway, alley, and landscape areas, to remove connected ROW impervious area and also stream flow from Interlaken Park from the combined sewer system. GSI and separation would mitigate approximately 3.0 MG by removing stormwater runoff and stream flow from the combined sewer system. Based on 2016 modeling by WTD, this 3.0-MG reduction would require effectively removing approximately 123 acres of connected ROW impervious area and stream flow from Interlaken Park from the combined sewer system. For comparison, a planning-level estimate was also developed for an 11-MG storage tank with no GSI and separation.

3.2.4.5 University Storage Tank with SPU

The University Storage Tank planning level size has changed because of a significant control volume increase. Modeling performed in 2010 for the 2012 LTCP indicated that the control volume for University CSO was 5.23 MG for a joint alternative with SPU. The current modeling indicates a 16.97-MG control volume, an approximate 200 percent increase in size from 2012. Based on an analysis by the modeling team, the increase at University was caused by three significant factors.

One factor was an improvement in basin calibrations for the lower University area resulted in a 64 percent increase. WTD installed more flow meters in the basin and calibrated the model to a higher level of detail with help from SPU.

The second factor was the lengthening the available observed rainfall record fed into the model from 32 years (1978 through 2009) to 38 years (1978 through 2015) resulted in an increase of 37 percent. Increased rainfall over the last decade has shown increases in volumes for a number of CSO sites. This is not going to improve over time. This indicates the observed rainfall in recent years is sufficient to drive the long-term average CSO values higher.

The third factor was a decision to include the impacts of anticipated I/I degradation from the separated system upstream of Matthews pump station, resulting in an increase of 107 percent. This more accurately describes future conditions for the areas of the combined sewer system that are influenced by I/I in contributing separated areas. The University CSO is heavily influenced by flows form Matthews Park Pump Station to the North Interceptor. The flows from Mathews Park PS enter the combined system downstream of University CSO through the Lake City Tunnel, thereby using up capacity in the North Interceptor before the University CSO can.

Without GSI, the University CSO Storage Tank alternative would consist of an approximately 16.1-MG storage tank to control the WTD University RS Overflow and SPU North Union Bay overflow locations. With the University GSI project described in Section 3.2.2.3, the University CSO Storage Tank alternative would consist of an approximately 8-MG storage tank. Section 3.2.2.3 describes the University GSI project, currently in design, which will submit a Green for Gray substitution proposal in 2022 in accordance with the CD timeline. The runoff volume reduction managed by University GSI will be modeled to inform the final facility design for the University CSO Storage because there is more complexity than a direct subtraction from the CSO control volume to determine the size reduction for this gray facility.

3.2.5 Advancing Planning for CSO Control

This Program Update documents progress made toward implementation of the County's CSO Control Program and identifies program priorities for the next five years and beyond. As WTD continues implementation of the approved 2012 LTCP alternatives, it will incorporate updated modeling information and cost estimating into project planning and development. In doing so, the CSO Control Program will continue to evaluate CSO control alternatives and opportunities for projects that further benefit water quality in relation to its work.

In its next phase of LTCP implementation, WTD will identify opportunities for project refinement, facility optimization, and new water quality projects. WTD will quantify the potential water quality benefits and costs of these opportunities and evaluate their merits in providing benefits that align with regional values, countywide initiatives, and planning efforts.

Concurrent with LTCP implementation, WTD has initiated a planning process to update its comprehensive wastewater system plan. The purpose of this systemwide comprehensive planning effort is to thoroughly assess all the demands on the regional wastewater utility, including CSOs, and plan a future direction that makes the right investments at the right time. Since CSO investments are among the demands considered in the systemwide planning effort, the CSO Control Program will continue its evaluation of CSO control alternatives and additional water quality improvement opportunities to inform the systemwide planning effort. WTD will continue to work with Ecology, EPA, and stakeholders as these planning processes unfold.

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Chapter 4

Public Involvement Activities Related to the CSO Control Program

Involving the community and interested parties to gain public support is critical to the success of this Program Update and WTD's CSO Control Program as a whole. Public involvement prepares the community to provide informed comments on options for controlling CSOs, siting control facilities, and environmental priorities within the Program Update. This feedback, in turn, fosters respectful, two-way communication about the CSO Control Program public involvement activities and outcomes and also helps inform decision-makers who need to hear from a range of participants before finalizing decisions.

4.1 Public Involvement Plan

The County implemented a public involvement plan to identify and understand impacted communities, use community input to inform an equitable program update, and provide all interested community members the opportunity to participate in CSO control planning.

Objectives of the Public Involvement Plan for the 2018 Program Update included the following:

- Inform interested parties and the general community about the need for the LTCP, its technical goals and constraints, and the decision process; identify and explain King County's iterative, multi-step approach to updating the LTCP.
- Provide equitable opportunities for interested community members to have a say about decisions that affect them.
- Seek timely input from the community at key milestones that can appropriately inform the technical team's work.
- Learn about social conditions, land uses, and future development plans that CSO control projects or future King County property acquisitions may impact during LTCP implementation.
- Meet community involvement expectations of the King County Executive and Council.
- Ensure public involvement activities meet NPDES public involvement requirements.
- Set the stage with the community for future projects identified in the LTCP.

Public involvement for this Program Update was built on groundwork laid during development of the approved 2012 LTCP, including the identification of interested parties, concerns, and values. This allowed for continuity with constituents and a basic understanding of possible community interests. These community values were incorporated into public involvement planning for this Program Update. These values and concerns are being truth-tested through community inquiries to ensure that they are valid, and that other values and concerns have not been missed. WTD sought through meetings, workshops, and interviews with environmental and community groups, tribes, agencies, and the general public.

To address a key WTD goal of stimulating innovation in developing and implementing new approaches and technologies to the delivery of public services, the Public Involvement Plan incorporated new approaches to public involvement for this Program Update, including the following:

- Pubic involvement staff conducted in-depth early research to learn more about the community in the University and Montlake CSO basins where GSI is feasible. Through this research, WTD learned more about how to discuss the problem of CSOs with people, what community members know about GSI, what the community's values and concerns are, and what ESJ opportunities and challenges exist.

- The use of a public involvement management software tool allowed staff to manage and record the results of outreach efforts, and to access the information so they can better communicate with the public about the plan. The tool also allowed staff to integrate information from other relevant projects that share the same communities. Use of this tool also ensured the important feedback loop was closed. Staff carefully recorded and tracked input and responses, sought key information from the project team, and provided in-depth and accurate responses to all queries.

Both the content and the implementation strategy of the LTCP Public Involvement Plan reflect the County's requirement that ESJ be considered for all projects it undertakes. For instance, the plan incorporates a County-directed inclusive project planning process to work toward achieving the vision that a more equitable and socially just workplace and community are just as important as what is accomplished in a project. Collecting the specific demographic information defined in that inclusive process informed all of WTD public involvement efforts and will provide key considerations for capital projects emerging from the LTCP.

To further promote inclusivity, translated materials were available when it was determined that more than 5 percent of the target neighborhood spoke a language other than English. WTD Community Services staff evaluated the need for translations in each project area and provided interpreters as needed for outreach activities.

In addition to language considerations, other cultural sensitivities warranted enhancements to standard outreach techniques. Examples of this include reaching out to underserved communities and identifying and establishing relationships with their trusted liaisons and community organizations to support participation. Communication, in general, avoided complete reliance on digital formats and digital communications were optimized for smart mobile phone usage, a key demographic-based consideration for ESJ communications.

4.2 Public Involvement Implementation

Specific and targeted information-sharing and outreach were conducted to inform the community at large and solicit feedback from community members and community-based organizations on the CSO Program, including:

- Website: WTD's website includes information on CSOs under the umbrella term, "Protecting our Waters." For the Program Update, the website was updated to include information about the update process, the reasons for the update, and a general discussion of the types of solutions under discussion in the 2018 Program Update (https://www.kingcounty.gov/services/environment/wastewater/cso/projects/system-plan.aspx).

- Listserv: WTD sent email newsletters using the GovDelivery platform to a listserv announcing the LTCP Update, background information, and opportunities for involvement.

- Fact Sheet: A fact sheet introduced the Program Update and provided baseline information on CSOs, including what they are and why they need to be addressed. The fact sheet also provided contact information for CSO outreach staff and encouraged people to be involved in the update planning process. In addition to being posted online, the fact sheet was distributed at LTCP-specific events and shared by WTD staff at other division events and activities.

- Community briefings: WTD staff reached out to community organizations in the planning area and offered to provide briefings on the progress of the LTCP implementation and Program Update. Some community organizations even requested return progress update visits. WTD conducted briefings for the following organizations:
  - Stewardship Partners
  - SODO Business Improvement Area
  - Salmon-Safe
  - Futurewise and Duwamish River Cleanup Coalition
  - The Nature Conservancy in Washington
  - Ravenna-Bryant Community Association
  - Montlake Community Club
  - Laurelhurst Community Club
  - Green Lake Community Council
  - Northeast District Council
  - University District Partnership

- Sustainable Ballard
- Phinney Ridge Community Council
- Seattle Yacht Club
- Cascade Bicycle Alliance
- Montlake Community Center Advisory Board
- Roosevelt Neighborhood Association
- Sierra Club
- Puget Soundkeeper Alliance

During the 2012 LTCP update process, a number of organizations were identified as having specific, environmental-based interest in CSOs and plans for how to bring the County's CSOs under control. For the 2018 Program Update, WTD reached out to these highly interested organizations to determine how they would collectively like to be involved in the 2018 Program Update. Workshops were identified as the best way to inform and engage these key environmental organizations and solicit their input on specific elements of the update process.

Environmental Workshop #1: This workshop (repeated twice on June 19 and July 31 to accommodate schedules) was held in the summer of 2017. The workshops were attended by representatives from the following organizations:

- Duwamish River Cleanup Coalition
- Futurewise
- Puget Soundkeeper Alliance
- Salmon Safe
- Seattle 2030 District
- Stewardship Partners
- The Nature Conservancy
- Washington Environmental Council

WTD staff provided information and received feedback from participants about the background of the LTCP, CSO control methods and options, the alternatives selection process, and alternative evaluation steps. Additionally, Water and Lands Resources Division staff shared information about the WQA/MS Study. Specific feedback on evaluation criteria was especially valuable.

Environmental Workshop #2: This workshop was held in July 2018. WTD staff provided updates on the LTCP and ranked alternatives, sought feedback on prioritization of potential water quality projects, and shared next steps for the Program Update and the CSO Control Program.

The workshops were attended by representatives from the following organizations:

- Duwamish River Cleanup Coalition
- Futurewise
- Puget Soundkeeper Alliance
- Salmon Safe
- Seattle 2030 District
- Stewardship Partners
- The Nature Conservancy
- Washington Environmental Council
- SPU

4.3 Public Notification Program

King County operates a CSO Notification and Posting Program as a joint project with the City of Seattle and Public Health–Seattle & King County. This program includes signs at publicly accessible CSO locations, an information phone line, websites, a brochure, and other public outreach activities. These activities provide the community with information on CSOs and their status in relation to public health, water quality, and proposed capital projects, among other factors.

A website providing real-time notification of recent and current CSO discharges went live in December 2007 (http://www.kingcounty.gov/environment/wastewater/CSOstatus.aspx). In April 2011, King County completed the process to incorporate City of Seattle near real-time overflow information on this website. The website presents overflow status for the majority of Seattle and County CSOs and provides links to and from each agency's independent website. The community has access to consolidated information to assist in making choices about the use of local waters. In late 2015, the website was upgraded to be more usable on mobile devices and now allows users to zoom in and out to get more details. This upgrade redesigned the site from a set of five pages (an overview map and four submaps) to a single-page map.

In 2017, the CSO Status Web pages had 8,774 page views (representing 7,583 unique page views, with 86 percent of users viewing and then leaving the page [bounce rate]). This represents a 6.05 percent decrease in page views from 2016, when there were 9,342 page views.

4.4 Capital Projects

King County recognizes that its construction projects can be disruptive to the community. WTD's public outreach during construction considers a project's complexity, location, and potential impacts.

WTD's project teams are committed to keeping the community and local jurisdictions apprised of the project's progress, schedule, milestones, and any unforeseen developments. WTD works directly with the community to minimize construction impacts.

The community can inform the County's decisions about the following:

- Addressing community disruptions
- Safety precautions
- Addressing private property impacts attributable to the project

WTD uses various methods to engage with the public during the design and construction phases of capital projects. Some of the public outreach activities could include:

- Community meetings with the contractor before construction
- Community briefings on project progress during construction
- Advanced written notice of major construction activities
- Project status reports
- Prompt response to all community inquiries
- 24/7 construction hotline
- Project Web pages
- News releases

4.5 General Water Quality Education

Information on the King County CSO Control Program is presented to the public in the context of the County's overall wastewater management programs through various venues, including wastewater treatment plant tours and presentations to community groups, schools, and other entities. Examples of recent education opportunities provided by WTD are shown in Table 4-1.

Table 4-1 WTD Education and Outreach Programs

Program	Description
School Field Trips	Programs conducted at WTD treatment plants and facilities that facilitate STEM education experiences for 3rd–12th graders on topics such as water systems, wastewater processes, stormwater, and the scientific process
In-Classroom Outreach Programs	Classroom presentations (1–2 hours) that provide real-world knowledge for 6th–8th graders on topics such as water systems, wastewater process, stormwater, and the students' connections to their water
Afterschool Programs	Educational activities for 1st–8th graders that support established afterschool programs run by community-based organizations
Summer Day Camps	Summer day camps for 1st–9th graders at the Brightwater Center where students explore the outdoors through hands-on activities
High School Summer Internships	Paid summer internships for six weeks of the summer where high school students build skills and learn about the variety of careers that are needed to keep our water clean
Career Opportunity Events and Career Fairs	Events for teens that increase awareness about the wide variety of jobs in wastewater through school visits, after-school events, and career fairs
Teen Development Programs	Programs that partner with social service organizations to reach at-risk teens; programs build knowledge and skills related to water systems and expose teens to careers
Educational Kits and Curriculum Resources	Resources are available to educators both online and in classroom kits that can be checked out to learn about the region's water resources, wastewater, and the environment
Treatment Plant Tours	Groups from universities, professional groups, or the general community can tour WTD's treatment facilities and learn how wastewater can be recycled into reusable water, energy, and nutrients for plants and soil
Senior Center Outreach Programs	Lectures for senior citizens that are conducted at senior centers; presentations explore the wastewater treatment process in addition to discussing the "do's" and "don'ts" of the sewer system
Adult and Professional Development Workshops	Workshops are available for adults on a variety of environmental topics; workshops for educators allow them to learn more about water systems and ways to integrate into classroom curriculum
Career Opportunity Event and Career Fairs	Events that increase awareness about the wide variety of jobs in wastewater through career exposure events and career fairs
Summer and Year-round Internships	Internships for fully enrolled college students that provide experiences in a number of environmental fields
Family Programs	A variety of community and family event programs throughout the year that combine outside exploration with hands-on activities
Community Festivals	Educational booths and activities that support community festivals
Stewardship and Volunteer Opportunities	Opportunities for local community groups, businesses, and organizations to learn more about the environment and take part in service learning projects at King County WTD facilities

The King County Wheels to Water Program provides free bus transportation for wastewater-related field trip programs for qualifying schools in King County. In 2017, WTD reached 17,578 students through these types of education programs, providing information that helps protect regional water systems, the local environment, and the health of communities.

In addition, WTD's industrial pretreatment program and the County's local hazardous waste, natural yard care, and related programs educate businesses and residents on what they can do to protect water quality.

4.6 Funding Community-led Water Quality Efforts

4.6.1 Green Grants Program 2011–2015

From 2011 to 2015, the King County Green Grants Program provided funding to nonprofit organizations, local government, schools, and tribes for projects to improve and protect air and water quality in the Duwamish watershed. In partnership with SPU and the Puget Sound Clean Air Alliance, the King County Green Grants Program awarded $561,300 over five rounds of funding. The grants promoted partnerships in the Duwamish area that prevented pollution and provided small-scale environmental and economic opportunities for creative solutions.

4.6.2 WaterWorks Grant Program 2015–2018

WTD manages the WaterWorks Grant Program, established by King County Council in 2015. The purpose of WaterWorks is to support sound investments in clean water and the community. WaterWorks provides funding to organizations for projects that benefit or improve water quality within WTD's service area and that also benefit its ratepayers. Approximately $2 million is awarded every two years for organizations implementing a variety of projects. A total of 82 projects to date have been awarded funding (Figure 4-1).

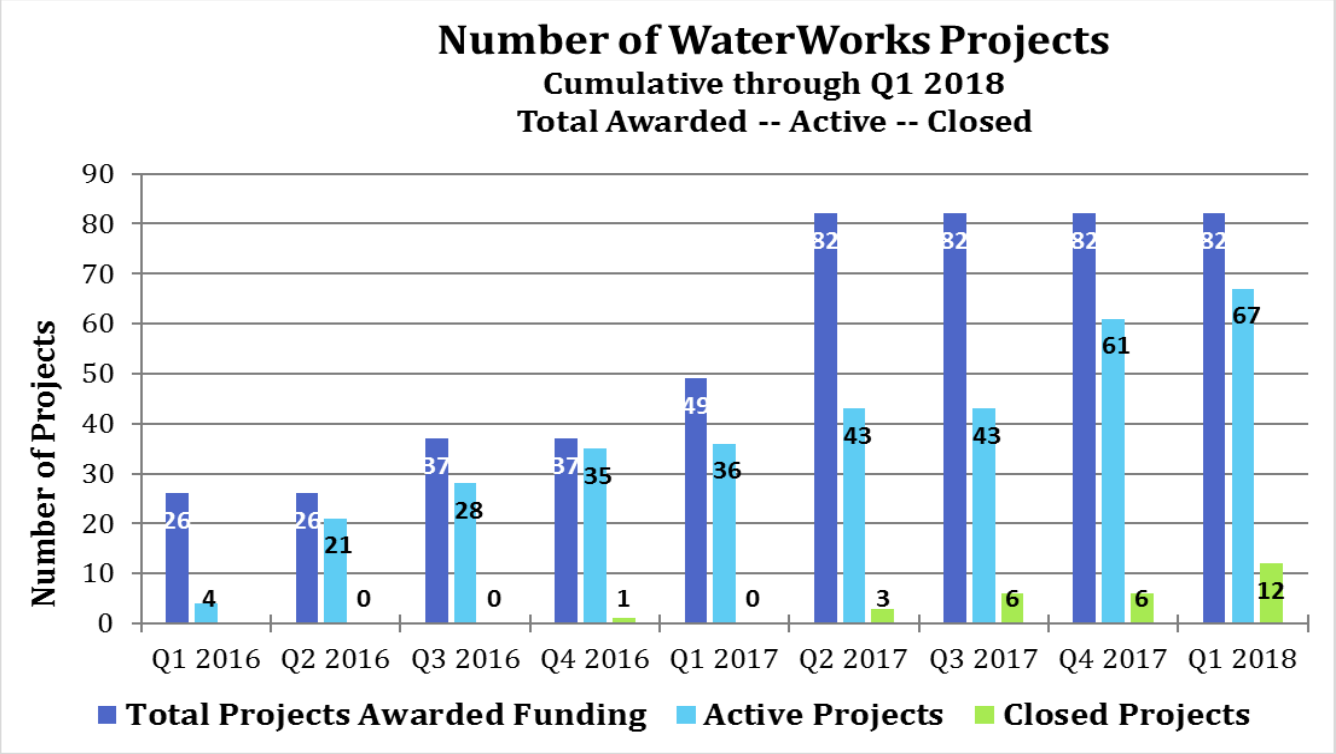

Figure 4-1 WaterWorks Grants Awarded in the Past Five Years