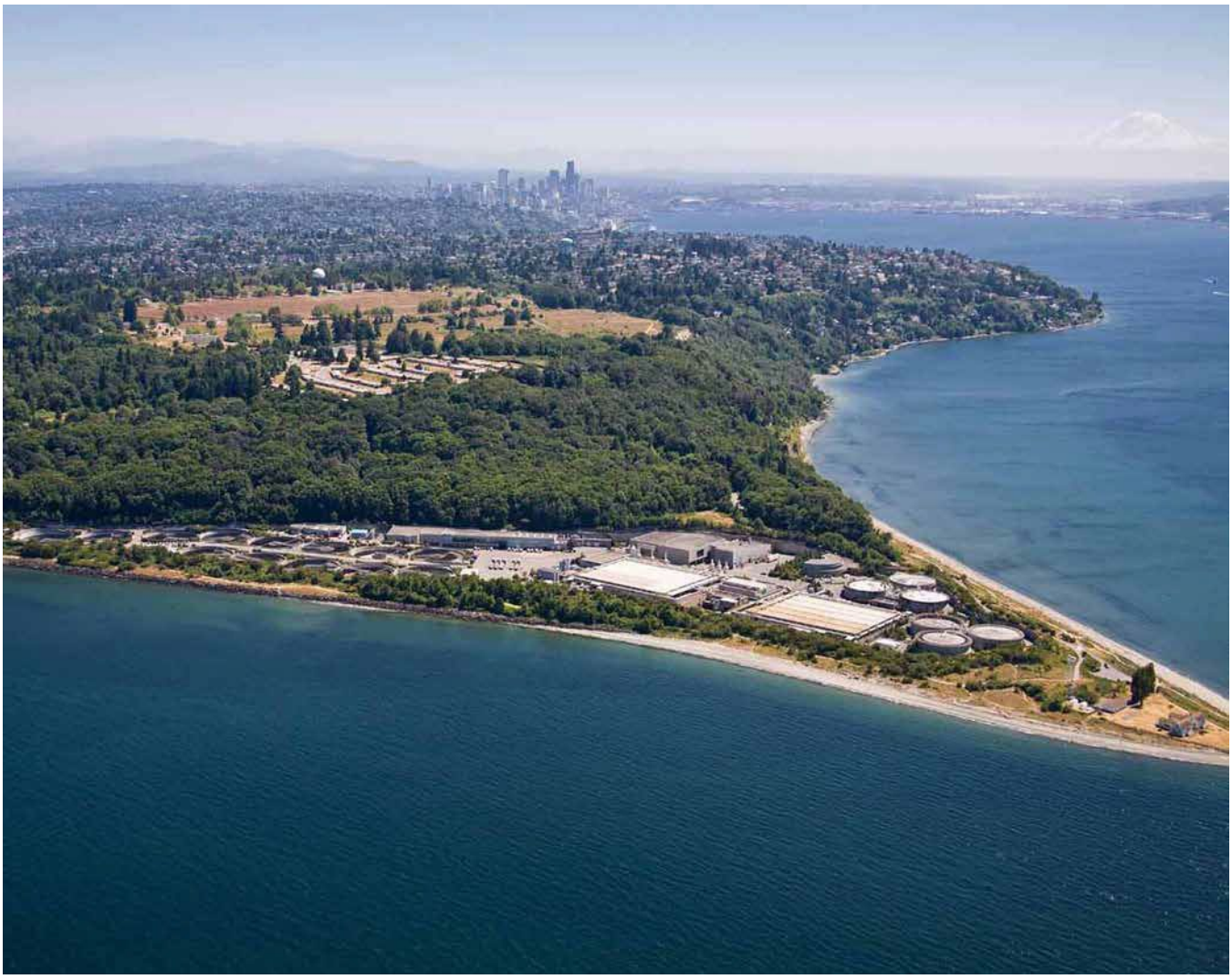


West Section Sewer System Operations Plan

July 2013

King County

Department of Natural Resources and Parks
Wastewater Treatment Division
Combined Sewer Overflow Control Program
Hyperlinks Updated January 2022

Wastewater Treatment Division
Combined Sewer Overflow Control Program
King Street Center, KSC –NR-0512
201 South Jackson Street
Seattle, WA 98104
http://www.kingcounty.gov/environment/wastewater/cso.aspx

Contents

1. INTRODUCTION

EPA policy is to regulate large and complex combined sewer system agencies under federal consent decrees. King County's consent decree (United States of America and the State of Washington v. King County, USDC Civil Action No. 2:13-cv-677 JCC) became effective July 3, 2013. The City of Seattle is also entering into a consent decree. See Section 5.1 for more information on the consent decree. One of the components of the consent decree is the development of a "Sewer System Operations Plan." King County's current "plan" and procedures is made of many separate manuals and sections of the County's intranet site. This approach ensures County staff can quickly assess the most updated documentation from facilities with computers and laptops.

This new Sewer System Operations Plan has been developed as an electronic plan to make all the information accessible from a central document. It summarizes the most pertinent information and provides links to more detailed material. This Plan exists in two forms – one on the County's intranet, which then links to the most current information on the intranet and Internet, as well as another portable version on thumb drives containing the referenced documents. The thumb drive can be carried in the field for use when Internet access is not available, however some of the more general information drawn from the Internet and intranet sites would not be available.

The components of this Plan will stay updated on the intranet site. The central plan document will be reviewed and updated on a schedule described in the section on Plan maintenance.

The components of this Plan reflect the input of the Metropolitan Wastewater Pollution Abatement Advisory Committee (MWPAAC), the organization made up of local upstream sewer agencies that contract for service from King County. They review and provide input to the Wastewater Treatment Division and the County Council on every aspect of wastewater services as plans are developed, projects are proposed and budgets are approved. They were briefed on this Plan specifically in September 2013. The City of Seattle, as the only local agency with a combined sewer system, has a special interest in the operation of the County's West System. Through the Joint Operations and System Optimization Plan (JOSOP) development the two agencies are working closely to better understand each other's systems and operations, and to develop optimum operations benefitting each. This Sewer System Operations Plan is the County's foundation for these discussions. Seattle will receive this Plan on a thumb drive and will be briefed on it throughout that process. The JSOP may lead to modification of this Plan in the future, and JSOP elements will be incorporated in future updates to this Plan.

2. SEWER SYSTEM OPERATIONS PLAN PURPOSE

The purpose of the Plan is to operate the treatment plants and conveyance system together as one dynamic system and so maximize the capture and treatment of service area flows, including combined sewer overflows. Because of the interconnected nature of the King County and the City of Seattle systems the two agencies have agreed on these system operating objectives:

2.1 Higher Priorities

- Protect and maintain plant equipment and biological system
- Prevent sewage backups or overflows to buildings
- Prevent sewage flows into streets
- Prevent sewage flows from non-permitted overflow locations - Sanitary Sewer Overflows (SSOs)
- Meet plant National Pollutant Discharge Elimination System (NPDES) permit requirements including:
    - Combined Sewer Overflow (CSO) discharge requirements
    - Effluent discharge requirements

- Prevent CSOs by capturing and conveying the maximum volume of wet weather flow giving priority to environmentally sensitive needs
- Capture and convey all dry weather flow and prevent dry weather CSOs and SSOs
- Minimize stormwater surface flooding to ensure public safety
- Optimize wet weather treatment capacity at West Point Treatment Plant

2.2 Lower Priorities

- Minimize odor problems using operations
- Minimize energy (electricity) usage
- Minimize settling and sedimentation in conveyance and storage facilities

Fundamental to the County's current operation is the objective to let the system operate on its own as designed and to intervene manually only when needed to meet the other objectives.

This approach may need to change – for example, to include predictive and real-time controls - as the system becomes more complex with the addition of the new CSO control facilities.

The elements making up the County's sewer system operations plan provide guidance on how to operate the collection system, CSO control facilities and the West Point Treatment Plant together to provide maximum capture and conveyance of combined flows for the best treatment. These resources provide guidance on activities to be carried out during dry weather flows, and to prepare for, manage and follow-up on wet weather flow episodes. These resources can be used in basic and refresher training for wastewater division personnel, as well as a reference to be consulted when unusual situations must be managed.

3. QUICK REFERENCE SECTION

This section provides quick access to information that may be needed quickly in circumstances such as emergencies. (*Thumb drive links* are files are located on the thumb drive. *Intranet links* are files on the WTD intranet.)

Facilities	Quick Reference	Full Document
All	Consent Decree & FAQs	Thumb drive link: Consent Decree , FAQs, Internal FAQs Intranet link: Consent Decree and Public FAQs
All	Facilities Interactive Map	Thumb drive link: Facilities Interactive Map
All	King County WTD Facilities and Conveyance System w/Local Agencies Map	Thumb drive link: Conveyance System Map Internet link: Conveyance System Map (pdf) Internet link: Seattle Water & Sewer Map (GIS) SharePoint link: Conveyance Inspection and Flow Monitoring
All	Overflow/ Bypass **Initial Response Procedures**	Thumb drive link: Initial Response Procedures Intranet link: Overflow Manual
All	Overflow/By-pass Procedures and Disinfection System Failure Procedures, **Section 3**	Thumb drive link: Overflow Manual Intranet link: Overflow Manual

Facilities	Quick Reference	Full Document
West Point Treatment Plant		
West Point	Emergency Response Plan	Thumb drive link: Emergency Response Plan Intranet link: Emergency Response Plan
West Point	Plant Evacuation Map	Thumb drive link: Evacuation Map Intranet link: Evacuation Map
West Point	Chemical Storage Locations	Thumb drive link: Chemical Location Map Intranet link: Chemical Location Map
West Point	In Plant Facilities Maps	Thumb drive link: Facility Maps
West Point	West Point Treatment Plant Process Diagram	Thumb drive link: Process Diagram Intranet link: Process Diagram
West Point	West Point Treatment Plant Hydraulic Schematic	Thumb drive link: Hydraulic Schematic Intranet link: Hydraulic Schematic
West Point	Critical Elevations and Set points	Thumb drive link: Critical Elevations and Set Points Intranet link: Critical Elevations and Set Points
West Point	Dry or Wet Weather Situations – WP cannot take any flow - flow chart - Page 7	Thumb drive link: Emergency Flow Management Protocol Intranet link: Emergency Flow Management Protocol
West Point	How to Respond to Unusual Occurrences Procedure	Thumb drive link: Guide to Main Control Intranet link: Guide to Main Control – Unusual Occurrences Intranet, full document: Guide to Main Control
West Point	WP Hydraulic Scenarios – Section 3	Thumb drive link: Plant Hydraulics Manual Intranet link: Plant Hydraulics Manual Intranet, full document: Plant Hydraulics Manual
West Point	WP Control Strategies & Guidelines – Influent Control Structure – Facility 703	Thumb drive link: Guide to Main Control Intranet link: ICS – Facility 703 Full document: Guide to Main Control
West Point	WP Control Strategies & Guidelines – Raw Sewage Pump Building – Facility 704	Thumb drive link: Guide to Main Control Intranet link: RSP – Facility 704 Intranet, full document: Guide to Main Control
West Point	WP Control Strategies & Guidelines – Primary Sedimentation and Pre-Aeration Tanks – Facility 706	Thumb drive link: Guide to Main Control Intranet link: Primary Tanks – Facility 706 Intranet, full document: Guide to Main Control
West Point	WP Control Strategies & Guidelines – Flow Diversion Structure – Facility 721	Thumb drive link: Guide to Main Control Intranet link: FDS – Facility 721 Intranet, full document: Guide to Main Control
West Point	WP Control Strategies & Guidelines – Intermediate Pump Station – Facility 724	Thumb drive link: Guide to Main Control Intranet link: IPS – Facility 724 Intranet, full document: Guide to Main Control
West Point	Sampling – Plant Manual	Thumb drive link: Sampling Manual Intranet link: Sampling Manual

Facilities	Quick Reference	Full Document
West Point	WP Plant Design Data – Appendix B	Thumb drive link: Plant Overview Intranet link: Plant Overview
West Point	Process Safety Management Plan	Thumb drive link: Process Safety Management Manual Intranet link: Process Safety Management Plan
West Point	Guide to Main Control	Thumb drive link: Guide to Main Control Intranet link: Guide to Main Control
West Offsite and Conveyance System		
All		Thumb drive link: Emergency Response Plan Intranet link: Emergency Response Plan
West	Monitoring and Controlling Offsite Facilities	Thumb drive link: Monitoring and Controlling Offsite Facilities Intranet link: Monitoring and Controlling Offsite Facilities
West	System Schematic	Thumb drive link: Offsite Schematic Intranet link: Offsite Schematic
West	High Flow Management Protocol	Thumb drive link: High Flow Management Intranet link: High Flow Management
West	Emergency Flow Management Protocols	Thumb drive link: Emergency Flow Protocol Intranet link: Emergency Flow Protocol
West	Offsite generator list	Thumb drive link: Offsite Generator List Intranet link: Offsite Generator List
West	NPDES Permit	Thumb drive link: NPDES Permit Internet link: NPDES Permit
Modeling for System Optimization		
System	Section and Links to Protocols	Thumb drive link: Appendix B, Hydraulic Modeling Update Evaluations. Modeling and modeling protocols are in the appendix of that technical memorandum.
Alki CSO Treatment Plant		
Safety & Emergency Procedures (See Chapter 3)		Thumb drive link: Alki CSO Operations Manual Intranet link: Alki CSO Operations Manual
Routine Operating Procedures (Chapter 2)		Thumb drive link: Alki CSO Operations Manual Intranet link: Alki CSO Operations Manual
Carkeek CSO Treatment Plant		
Emergency Procedures (See Section 6)		Thumb drive link: Emergency Procedures Intranet link: Emergency Procedures
Lockout/Tagout Procedures		Thumb drive link: Carkeek O&M Manual Intranet link: (Refer to Safety SWP Database)
Confined Space Procedures		Thumb drive link: Carkeek O&M Manual Intranet link: (Refer to Safety SWP Database)
Checklists, Startup, Shutdown & Routine Operating Services		Thumb drive link: Carkeek O&M Manual Intranet link: Carkeek O&M Manual
Operating Procedures		Thumb drive link: Carkeek O&M Manual Intranet link: Carkeek O&M Manual

Facility/Quick Reference	Full Document
Elliott West/Mercer CSO Storage and Treatment Facilities	
Safety & Emergency Procedures (See Chapter 3)	Thumb drive link: Elliott West CSO Manual Intranet link: Elliott West CSO Manual
Routine Operating Procedures (See Chapter 2)	Thumb drive link: Elliott West CSO Manual Intranet link: Elliott West CSO Manual
MLK/Henderson CSO Storage and Treatment Facilities	
Safety & Emergency Response Procedures (See Chapter 3)	Thumb drive link: MLK/Henderson CSO Manual Intranet link: MLK/Henderson CSO Manual
Routine Operating Procedures (See Chapter 2)	Thumb drive link: MLK/Henderson CSO Manual Intranet link: MLK/Henderson CSO Manual

4. REPORT ORGANIZATION

The Plan is organized as follows:

1. Purpose and Operational Objectives
2. Quick reference (for quick and convenient access here, but also included in the specific Plan sections.)
3. How the system currently operates
4. Inspection and Monitoring
5. Background
    a. System Characterization
    b. Coordination with upstream agencies
6. Operating Plan availability, maintenance and update
7. Appendices

5. BACKGROUND

5.1 King County's Regional Wastewater Conveyance and Treatment System (See Figures 1 and 2)

King County protects water quality and public health in the central Puget Sound region by providing high quality and effective treatment to wastewater collected from our local sewer agencies (http://www.kingcounty.gov/environment/wtd/About/SewerAgencies.aspx). The county's Wastewater Treatment Division (WTD) serves about 1.5 million people within a 420-square-mile service area (http://www.kingcounty.gov/environment/wtd/About/System/ServiceAreaMap.aspx), which includes most urban areas of King County and parts of south Snohomish County and northeast Pierce County. More information is available on the Internet at:

http://www.kingcounty.gov/environment/wtd/About/System.aspx

King County's wastewater system includes:

- three large regional wastewater treatment plants; West Point Treatment Plant (http://www.kingcounty.gov/environment/wtd/About/System/West.aspx) in the City of Seattle, the South Plant (http://www.kingcounty.gov/environment/wtd/About/System/South.aspx) in the Cityof Renton, and the Brightwater Plant (http://www.kingcounty.gov/environment/wtd/About/System/Brightwater.aspx) (near Woodinville)

- two small wastewater treatment plants; one on Vashon Island (http://www.kingcounty.gov/environment/wtd/About/System/Vashon.aspx) and one in the City of Carnation http://www.kingcounty.gov/environment/wtd/About/System/Carnation.aspx)
- one community septic system (Beulah Park and Cove on Vashon Island)
- four combined sewer overflow (CSO) treatment facilities (Alki, Carkeek, Mercer/Elliott West, and Henderson/Norfolk--all in the City of Seattle),
- over 350 miles of pipes,
- 19 regulator stations,
- 42 pump stations, and
- 38 CSO outfalls

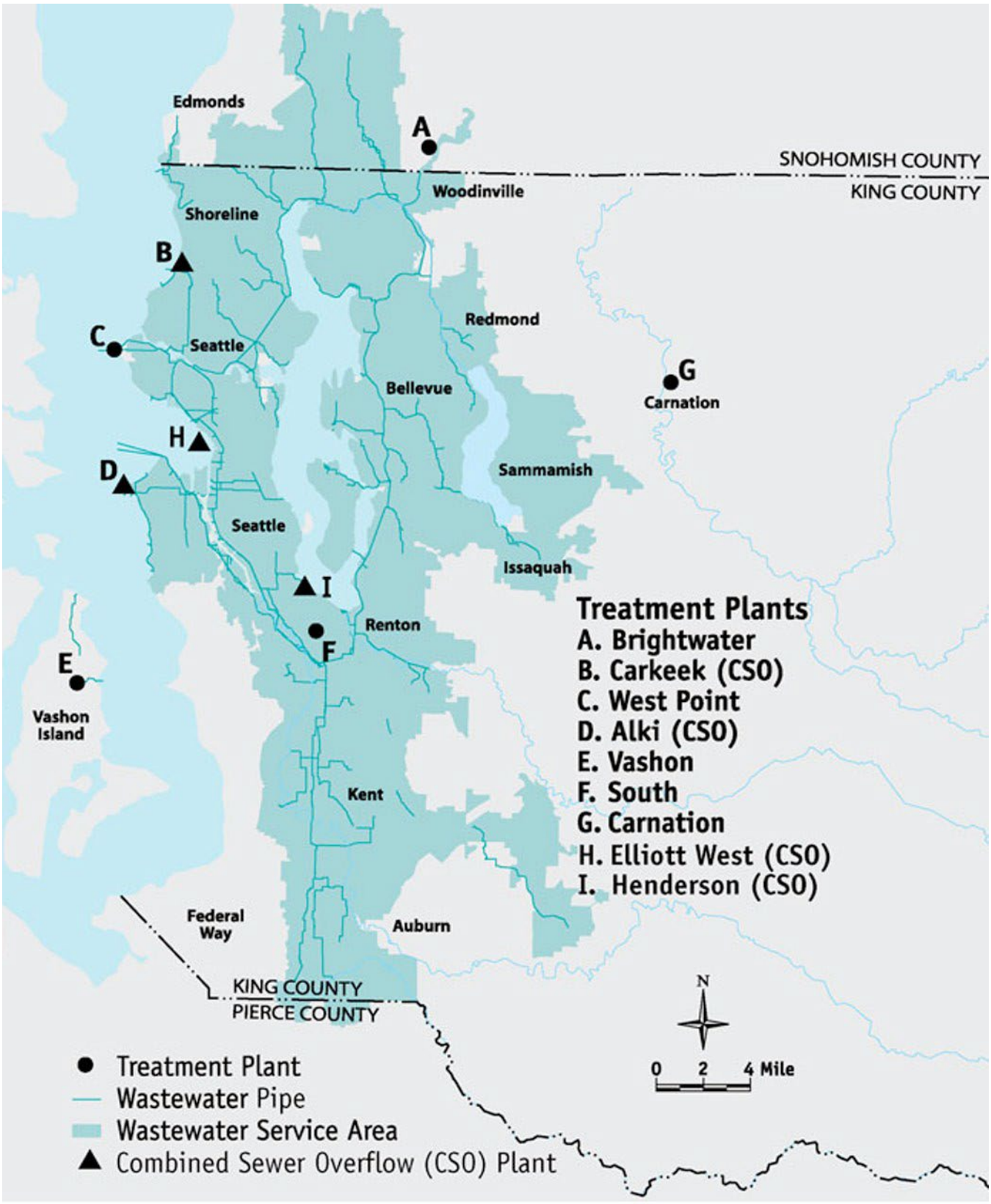


Figure 1. King County Wastewater Treatment Division Service Area

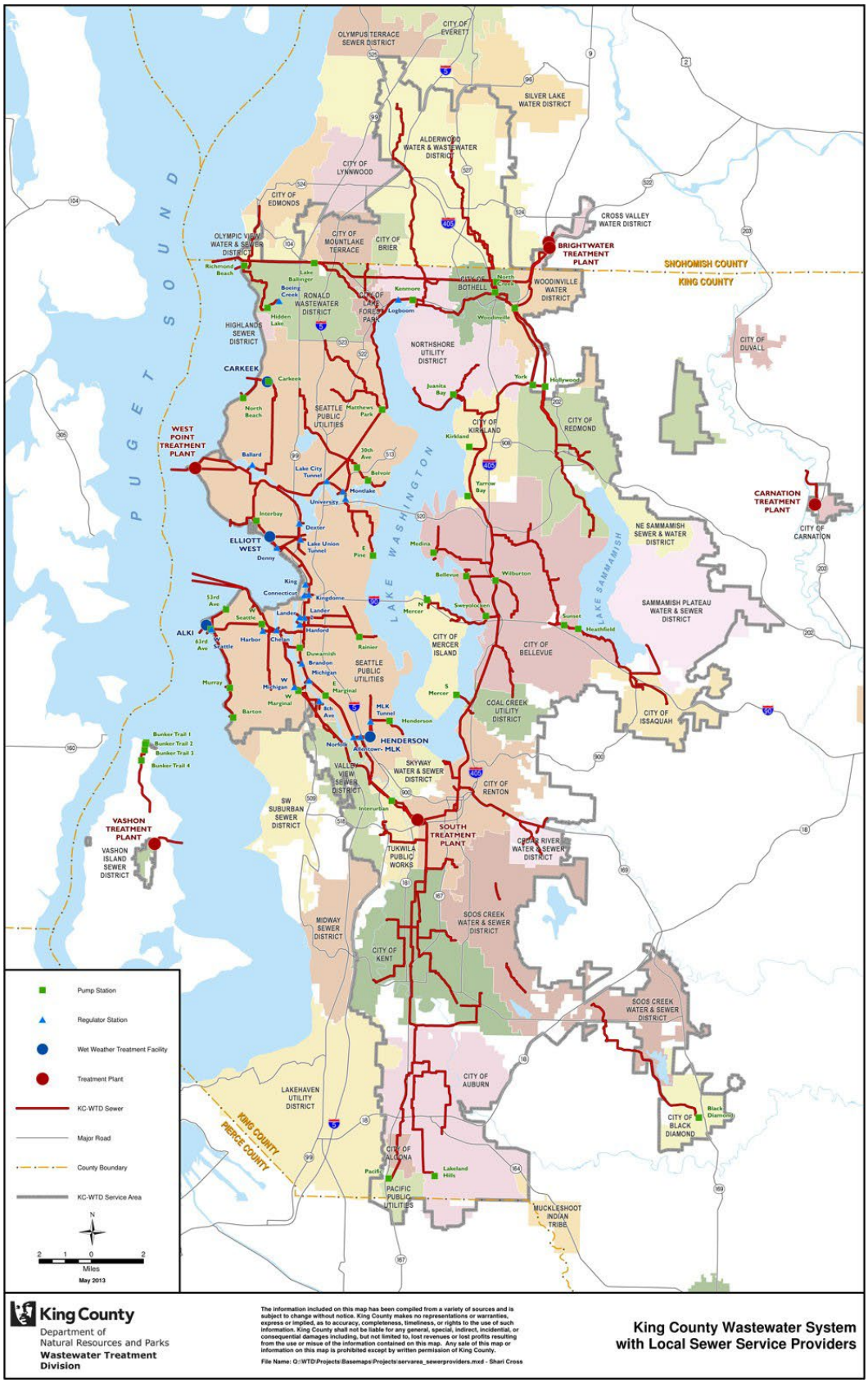


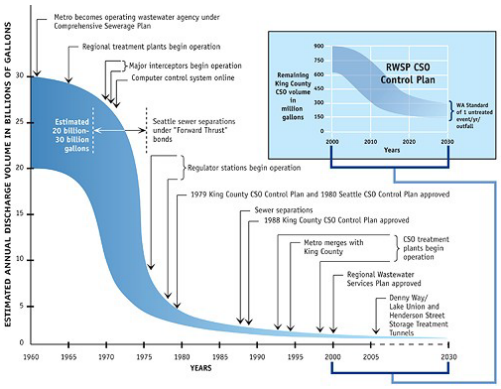
Figure 2. King County Wastewater Treatment Division Service Area and Local Agencies

The operation of the County's wastewater system is regulated by a National Pollutant Discharge Elimination System (NPDES) permit, administered by the Department of Ecology (Ecology) as delegated by EPA. These permits are renewed approximately every five years. The next West Point treatment plant permit will renew in 2014. A copy of the current permit (thumb drive link) is included in the Appendix, and can also be found at this link: https://kc1.sharepoint.com/:b:/r/teams/WTDOPS/WPTS/2017_Flood_Event/WP-Permit%202015.pdf

As of July 3, 2013, the County's wastewater system operation is also regulated by a consent decree with U.S. Department of Justice (DOJ), U. S. Environmental Protection Agency (EPA) and Washington Department of Ecology (Ecology). While the consent decree impacts the implementation of CSO control projects and the operation of the CSO treatment facilities the most, every employee, and entity working for the County, needs to be aware of the consent decree and must understand their responsibilities to help the County comply. The following email has been sent out to all employees by the WTD Director.

On July 3, our agency's consent decree with the EPA and Ecology has been approved by the federal court. Here's some background information and an update:

Background: Our agency has a long proud history of being ahead of the mandate for CSO control. Our program started in the late 1970's prior to the federal and state mandates to take action. Since that time, we have reduced 90% of our overflow volumes and now we are on the last part of the tale.



(See the graphic: www.kingcounty.gov/environment/wastewater/CSO/ControlReq/CostReduction/ReductionTime.aspx)

As part of our final step and to be consistent with recent federal initiatives, King County has signed an agreement with the U.S. Department of Justice, the Environmental Protection Agency (EPA) and WA State Department of Ecology called a "**consent decree**", which supports and formalizes work currently underway and the plan we've long had in place to control the final remaining 14 uncontrolled combined sewer overflows (CSOs) in our system by 2030. The consent decree is a legal settlement that reaffirms King County's plan complies with federal and state standards and meets specific schedule deadlines for completing our nine remaining CSO capital projects by 2030. *(For more background info, please see my previous email to the division, at the bottom of this email/below).*

To view the signed consent decree:
www.kingcounty.gov/environment/wastewater/CSO/ConsentDecree.aspx

What it means for you: While much of our work will continue unchanged as a result of the consent decree, there are important implications for our business. The consent decree is a legal agreement, and it is important that our CSO projects meet the specified milestones. We will be working closely with both EPA and the Department of Ecology and communicating regularly with them through key WTD contacts.

There will also be **training available for everyone in the division.** An internal WTD team will be scheduling time at regular staff meetings to give a presentation on the consent decree and explain more. For units and sections more closely tied to the CSO program, there will be more frequent and detailed training, discussions and information-sharing as we move through project delivery. There is also a KCWeb page that puts a much of the consent decree

information in one place, including FAQs – https://kc1.sharepoint.com/sites/DNRP/wtdweb/csoconsentdecree/Pages/index.aspx

The consent decree language itself requires that it be made available either electronically or hardcopy to our consultants and contractors whose duties might reasonably include compliance with any provision of the decree.

Questions? Jeff Lafer, WTD's Compliance Coordinator, (206) 263-3728, jeff.Lafer@kingcounty.gov

An internal website page has been established to provide employees additional information. It is found at: http://wtdweb/www/wtd/CSOconsentdecree/index.htm. It includes the following Frequently Asked Questions and answers. Contact your supervisor with any questions about your consent decree responsibilities.

Frequently Asked Questions about the Consent Decree.

Q: How will this affect our work - specifically capital projects?

A: Much of our work will continue unchanged as a result of the consent decree, there are important implications for our business. The consent decree is a legal agreement, and it is important that our CSO projects meet the specified milestones (i.e., schedule). We will be working closely with both EPA and the Department of Ecology and communicating regularly with them through key WTD contacts.

Specifically, with the capital CSO projects that are a part of the consent decree, meeting schedule will be essential.

It is the responsibility of every WTD employee to notify their supervisor if they suspect something may impact the schedule of one of these CSO projects.

Q: What projects are included?

A: There are nine projects to control overflows that occur at 14 CSO locations in the regional wastewater system: www.kingcounty.gov/environment/wastewater/CSO/ProgramReview/Plan/9Projects.aspx

Q: Can our CSO consent decree projects be changed?

A: It is highly unlikely. Project changes would need to be approved by our regulators and the courts. A lot of formal justification would be required - without any guarantee changes would be approved. For these reasons, it's best for employees to assume the CSO projects need to stay on schedule and within original parameters.

If you have any reason to think something might impact the schedule of a CSO project or create the need for a project change, please inform your supervisor immediately.

Q: When is a CSO project complete?

A: It is important to note that the CSO projects are defined as complete when we can prove that the facility is achieving the state water quality standard requiring that CSO discharges be reduced to no more than one untreated discharge per year on average at each CSO location.

Q: Will there be training?

A: Yes. During 2013, there will be training for everyone in the division. An internal WTD team will be scheduling time at regular staff meetings to give a presentation on the consent decree and explain more. For units and sections more closely tied to the CSO program, there will be more frequent and detailed training, discussions and information-sharing as we move through project delivery. Please speak to your supervisor if you have questions.

Q: Does WTD follow the public conversations about CSO projects and their role in improving the health of Puget Sound relative to other potential investments?
A: Yes. We track issues that affect our industry and comment where appropriate. It is important for us to be engaged in the discussion on environmental priorities and still meet commitments to CSO control.

The CSO projects will have a positive impact on the quality of water in Puget Sound. While CSOs are more of a concern in their immediate discharge area, reducing any pollution that eventually may make its way to Puget Sound is environmentally beneficial.

Q: What should I do if someone from the public asks me about CSOs?
A: You can give them the web page: www.kingcounty.gov/csocontrol

If a person from the media/reporter contacts you, please direct them to Annie Kolb-Nelson, Media Relations, 206-477-5373. If you have ideas for positive stories, please send them to Annie so she can put them on our WTD Facebook page, King County Twitter, or the King Countyblog.

Q: Who are staff contacts?

- Regulator/general questions: Jeff Lafer, 206-477-6315 or email jeff.lafer@kingcounty.gov.
- Green Stormwater Infrastructure (GSI): Dana.West@kingcounty.gov

Projects: (Note: some projects have been renamed or incorporated into other projects as below)

- Current Projects: https://kingcounty.gov/depts/dnrp/wtd/capital-projects/active.aspx
- Georgetown Wet Weather Treatment Station Project : Bibiana.ocheke-amah@kingcounty.gov
- Michigan / Brandon (Included in Georgetown WWTS Project, above)
- 11th Ave NW Project: Part of joint KC/SPU *Ship Canal Water Quality Project*
- University Project
- Montlake Project:
- 3rd Ave W Project: Part of joint KC/SPU *Ship Canal Water Quality Project*
- Hanford #2, Lander St, King St and Kingdome Project
- Chelan Ave Project: Caryn.Sengupta@kingcounty.gov
- West Michigan & Terminal 115 Project (West Duwamish CSO Control) kristine.cramer@kingcounty.gov

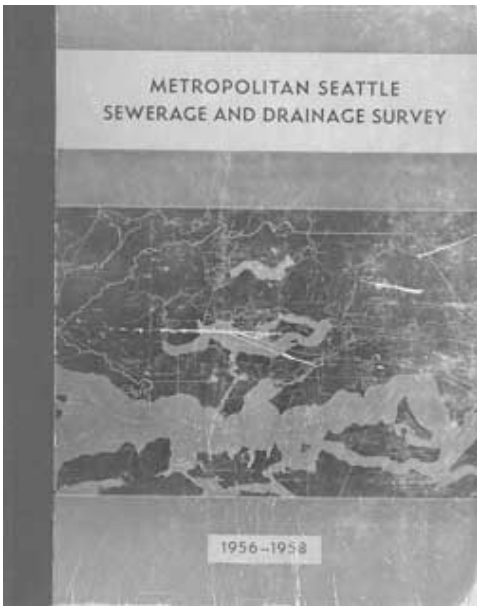
Completed Projects (part of the previous CSO plan):

- Hanford #1 (Rainier Valley Wet Weather Storage Project) Project Completed Fall 2018
- Ballard Siphon Project: Completed Spring 2014
- Murray CSO Control Project: Completed Spring 2017
- Barton CSO Control Project: Completed Summer 2015
- North Beach Project: Completed Spring 2017
- South Magnolia Project: Completed Fall 2019

6. WASTEWATER TREATMENT DIVISION HISTORY

6.1 The History of Our Mission

In the 1950s, wastewater flowed largely untreated into Lake Washington and Puget Sound and many rivers and smaller lakes, fouling water and making a sullied mess of local beaches.



In 1958 the voters created Metro and developed a regional wastewater treatment system based on watersheds as opposed to political boundaries. The first Metropolitan Council adopted the Metropolitan Seattle Sewerage and Drainage Survey as Metro's first Comprehensive Wastewater management plan.

6.2 Metropolitan Seattle Sewerage and Drainage Survey, March 1958

Shortly after Metro was formed, construction began on the county's two existing regional treatment plants, West Point in Seattle's Magnolia neighborhood and South Treatment Plant in Renton, which were officially up and running by 1966. By the late 1960s, regional water quality began improving dramatically. More history can be found at the following link: http://www.kingcounty.gov/environment/wtd/About/History/PlanningSystem/1958Plan.aspx

In 1994, King County assumed authority of Metro and its legal obligation to treat wastewater for 34 local jurisdictions and local sewer agencies that contract with King County.

7. CURRENT WASTEWATER COMPREHENSIVE PLAN RWSP – TREATMENT, CONVEYANCE, CSO CONTROL, BIOSOLIDS, RECLAIMED WATER

7.1 Growth Management

Under the state's Growth Management Act (Wikipedia, external link), local jurisdictions are required to plan essential public facilities such as wastewater treatment to meet their population growth needs. King County is in turn legally required to build wastewater treatment capacity for the jurisdictions and agencies it serves in the central Puget Sound region. More information on the RWSP can be found at this link: http://www.kingcounty.gov/environment/wtd/Construction/planning/rwsp/MajorComponents.aspx#2

To ensure planning decisions reflect the interest of the regional ratepayers, who ultimately pay for these investments, King County carefully reviews local comprehensive plans and compares growth projections to census data and population forecasts prepared by the Puget Sound Regional Council

(external link). The county also looks at its own wastewater flow and monitoring data, and further truth-tests projections by running the data through sophisticated system models to determine where future system capacity might be needed. King County's modeling data has historically proved highly accurate and reliable.

The 34 local sewer agencies that pay King County for safe, environmentally responsible sewage treatment are represented by the Metropolitan Water Pollution Abatement Advisory Committee, or MWPAAC (pronounced "Mew-Pack").

MWPAAC members help ensure we're making cost-effective decisions based on legitimate, emerging needs by working with the county to develop criteria to prioritize and plan projects.

Once project needs are identified, the county develops plans that it shares with MWPAAC's engineering subcommittee and other stakeholders, which might include local elected officials and jurisdiction staff, business leaders, permitting agencies and community members.

The King County Council and County Executive review the comprehensive plans, and only after the council votes its approval do plans for new projects move forward.

7.2 Planning for Growth

For more than 40 years, King County has protected water quality in the Puget Sound region by providing wastewater treatment services to King, Pierce, and Snohomish counties.

In the 1990s, flow estimates based on projected population growth estimates in King County's wastewater service area indicated that King County's regional wastewater treatment system would run out of capacity by 2010 (check out the tutorial). To ensure the continuation of high quality wastewater treatment services in the future, King County carried out an intensive planning effort, involving numerous elected officials, representatives from local sewer agencies, organizations and individuals from around the region. The Regional Wastewater Services Plan (RWSP) resulted from these efforts, which was adopted by the King County Council in November 1999 via Ordinance 13680.

Planning and building new wastewater infrastructure is extremely complex. It can easily take a decade or more to go from identifying a project need to cutting the ribbon on a newly completed facility.

System planning is another area in which King County and its sewer utility customers work together closely.

King County is currently in the midst of the Regional Wastewater Services Plan, or RWSP, adopted in 1999 to ensure the system is meeting growth through 2030. The RWSP includes the many projects listed in the RWSP Annual Report.

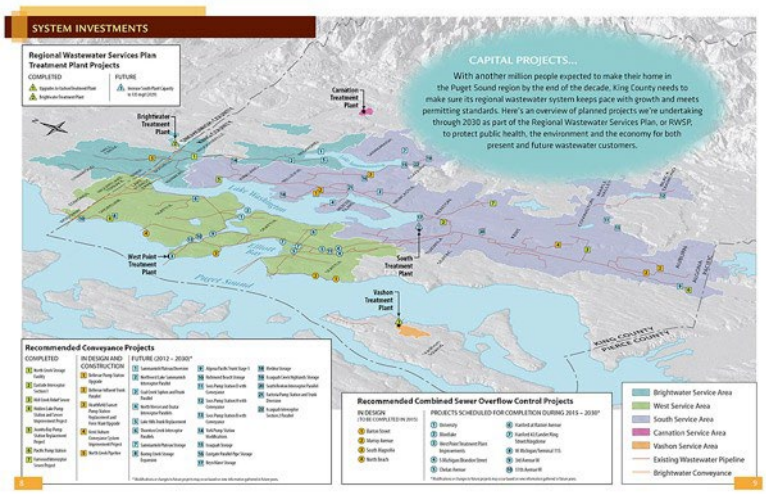
Approximately every three to four years a comprehensive review of the RWSP is conducted. Those reports are available at:
http://www.kingcounty.gov/environment/wtd/Construction/planning/rwsp/Library/CompReview.aspx

Because investments in wastewater infrastructure are significant, the Wastewater Treatment Division's system planning has checks and balances to ensure there is adequate oversight and accountability in carrying out our capital program.

The RWSP requires regular status reports on the projects be delivered to councilmembers. On very large projects, such as Brightwater for example, the King County Council might appoint its own independent monitoring consultant to review project plans, schedules, and associated cost trends during construction.

Additionally, the King County Council presides over the budget process and votes to set sewer rates, providing additional oversight on financial matters.

Though clean water is our ultimate goal, the Wastewater Treatment Division also defines success in running an agency that is well managed, fiscally responsible and compliant with its state and federal pollution control requirements.



7.3 Capital Projects

With another million people expected to make their home in the Puget Sound region by the end of the next decade, King County needs to make sure its regional wastewater system keeps pace with growth and meets permitting standards. Here's an overview of planned projects we're undertaking through 2030 as part of the Regional Wastewater Services Plan, or RWSP, to protect public health, the environment and the economy for both present and future wastewater customers.

7.4 RWSP Major Components

The RWSP outlines a number of important projects, programs, and policies for King County to implement through 2030, and work is well underway. Summary of the major components of the RWSP follows:

Brightwater Treatment System

The RWSP called for building a new treatment plant by 2010, now known as 'Brightwater', to accommodate growth in the northern portion of our wastewater service area. The Brightwater System includes a 36 million gallons per day (mgd) treatment plant, conveyance (pipes and pumps that take the wastewater to and from the plant), and a marine outfall that will discharge effluent (treated wastewater) from the Brightwater Treatment Plant into Puget Sound. The Brightwater conveyance system consists of approximately 14 miles of pipeline built in underground tunnels. See the Brightwater project Web site for more information: http://www.kingcounty.gov/environment/wtd/Construction/North/Brightwater.aspx

Conveyance System Improvements

King County's regional wastewater conveyance system consists of more than 350 miles of pipes and 42 pump stations that move wastewater from local communities to the county's two regional wastewater treatment plants. The RWSP calls for improvements to our conveyance system to meet the twenty-year design storm and accommodate increased flows where needed. See the Conveyance System Improvement Program's Web site for more information: http://www.kingcounty.gov/environment/wastewater/CSI.aspx

Regional Infiltration and Inflow Control

The RWSP calls for improvement to reduce existing and future levels of infiltration and inflow (I/I) into local collection systems. I/I is clean stormwater and groundwater that enter the sewer system through cracked pipes, leaky manholes, or improperly connected storm drains, down spouts, and

sump pumps. Most inflow comes from stormwater and most infiltration comes from groundwater. I/I affects the size of King County conveyance and treatment systems and, ultimately, the monthly rates that businesses and residents pay to operate and maintain them. See the Regional I/I Control Program's Web site for more information:
http://www.kingcounty.gov/environment/wastewater/II.aspx

Odor Control Program

The RWSP includes policy guidance to achieve King County's odor control goal to prevent and control nuisance odor occurrences at all treatment plants and associated conveyance facilities and to carry out an odor prevention program that goes beyond traditional odor control. See the Odor Control Program's Web site for more information:

http://www.kingcounty.gov/environment/wtd/Response/OdorControl/GoodNeighbor.aspx

Biosolids Recycling

The RWSP policies guide the county to continue to produce and market Class B biosolids and to evaluate alternative technologies to produce the highest quality marketable biosolids. Biosolids are the nutrient-rich organic material produced by treating wastewater solids. After processing and treatment, they can be beneficially recycled as a fertilizer and soil amendment. See the Biosolids Program Web site for more information:
http://www.kingcounty.gov/environment/wastewater/Biosolids.aspx

Reclaimed Water

The RWSP calls for the county to pursue and explore opportunities for expanded water reuse at the county's existing treatment facilities. The policies also call for the county to explore water reuse opportunities at all new treatment facilities. See the Reclaimed Water Program Web site for more information:
http://www.kingcounty.gov/environment/wastewater/ResourceRecovery/ReWater.aspx

Combined Sewer Overflow Control

The RWSP calls for the control of all county combined sewer overflows (CSOs) by 2030. Combined sewer overflows (CSOs) are events where untreated wastewater and stormwater from combined sewers discharge directly from outfall pipes into water bodies during heavy rainstorms when sewers are full.

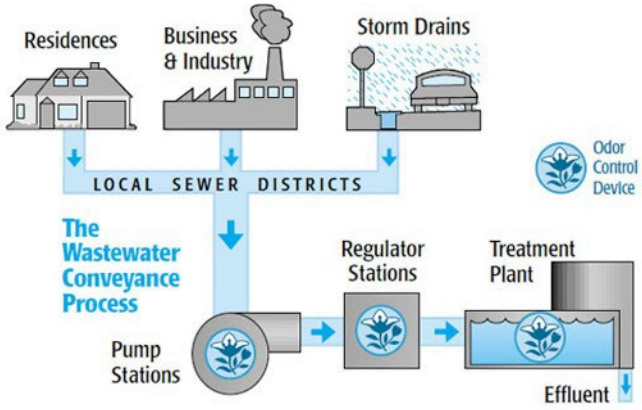
Combined sewers, which carry both wastewater and clean stormwater, exist in many parts of older cities across the nation, including Seattle. To protect treatment plants and avoid sewer backups into homes, businesses, and streets, combined sewers in Seattle sometimes overflow at specific locations (CSOs) into Puget Sound, the Duwamish Waterway, Elliott Bay, Lake Union, the Lake Washington Ship Canal, and Lake Washington. Although the wastewater in CSOs is greatly diluted by stormwater, CSOs may be harmful to public health and aquatic life because they can carry chemicals and disease-causing pathogens.

16 of King County's 38 CSOs are controlled, with another three being adjusted to complete control. Efforts to control CSOs began in the late 1970s. Since 1988, when monitoring and measuring of CSO flows began, these control efforts have reduced CSO volumes by nearly 60 percent. See the CSO Control Program Web site for more information:
http://www.kingcounty.gov/environment/wastewater/CSO.aspx

The RWSP CSO control policies also call for development of a long-range sediment management strategy to prioritize cleanup of contaminated sediments at specific CSO locations. See the Sediment Management Program Web site for more information on the efforts to clean up contaminated sediments:
http://www.kingcounty.gov/environment/wastewater/SedimentManagement.aspx

8. UPSTREAM LOCAL SEWER AGENCIES

King County provides wholesale wastewater treatment services to 17 cities and 17 local sewer utilities in King, Snohomish and Pierce counties. These local agencies own and operate independent collection systems, which include pipelines and pump stations to collect and carry wastewater flows in their service area to King County's regional system for treatment and disposal. The local agencies have 30-year agreements with King County for this service. King County owns and operates the regional treatment plants, pipelines, pump stations and other related facilities. More information can be found at the following link:



http://www.kingcounty.gov/environment/wtd/About/SewerAgencies.aspx

The county does not bill individual property owners for sewer service. Instead, it charges the local agencies an amount that is based on the county's monthly rate and the number of customers the agency serves. In turn, the local agencies bill their customers to recover the county charge plus the amount needed to operate and maintain their collection systems.

8.1 Local Sewer Agencies served by King County Wastewater Treatment Division

Alderwood Water & Wastewater District
City of Algona, Public Works
City of Auburn, Public Works
City of Bellevue, Utility Services
City of Black Diamond, Public Works
City of Bothell, Public Works
City of Brier, Public Works
City of Carnation, Public Works
Cedar River Water & Sewer District
Coal Creek Utility District
Cross Valley Water District
Highlands Sewer District
City of Issaquah, Public Works
City of Kent, Public Works
City of Kirkland, Public Works
City of Lake Forest Park, Public Works
Lakehaven Utility District
City of Mercer Island, Sanitary Sewer Utility
Muckleshoot Indian Tribe
Northeast Sammamish Sewer & Water District
Northshore Utility District
Olympic View Water and Sewer District
City of Pacific, Public Utilities

City of Redmond, Public Works
City of Renton, Public Works
Ronald Wastewater District
Sammamish Plateau Water & Sewer District
City of Seattle, Public Utilities
Skyway Water and Sewer District
Soos Creek Water & Sewer District
City of Tukwila, Public Works
Valley View Sewer District (formerly Val Vue Sewer District)
Vashon Sewer District
Woodinville Water District

8.2 Interagency Coordination

Coordination between the Wastewater Treatment Division and the local agencies occurs through the **Metropolitan Water Pollution Abatement Advisory Committee**, or **MWPAAC**. The committee advises the King County Council and Executive on matters related to water pollution abatement. It was created by state law (RCW 35.58.210) and consists of representatives from cities and local sewer utilities that operate sewer systems within King County's service area. The committee is directed by an executive board and is supported by subcommittees. The general meeting occurs monthly.

8.3 Executive Board

The Executive Board is comprised of the elected officers, the various elected sub-committee chairs and the immediate past Chair of the Committee (refer to Article IV of the Bylaws).

8.4 Engineering and Planning

The Engineering and Planning Subcommittee makes recommendations to WTD on scope of comprehensive system planning efforts such as the Regional Wastewater Services Plan, WTD policies, and future amendments thereto. The subcommittee also reviews implementation plans such as operational master plan updates, asset management plans and conveyance system improvement updates. The subcommittee meets twice per month.

8.5 Rates and Finance

The Rates and Finance Subcommittee reviews and evaluates financial policies and WTD assumptions used in determining King County's established sewer rates, capacity charge, operating budget and capital programs. The subcommittee meets monthly.

8.6 Advisory Subcommittee on Sewage Disposal Agreements

The Sewage Disposal Agreement Advisory subcommittee reviews and evaluates issues relevant to the sewage disposal agreements and makes recommendations to the full committee. The subcommittee meets monthly.

Information on MWPAAC and its subcommittees can be found at:
http://www.kingcounty.gov/environment/wastewater/MWPAAC.aspx

9. FACTS ABOUT THE KING COUNTY REGIONAL WASTEWATER CONVEYANCE AND TREATMENT SYSTEM

9.1 System and Treatment Plant Data (2012)

This section provides a high-level summary of system information – it is taken from the County's Wastewater Treatment Division Web site.
http://www.kingcounty.gov/environment/wtd/About/System/Facts.aspx

(Reporting year 2013 unless otherwise noted. See website for most recently reported data)

-- = not applicable

mgd = million gallons per day

mg/yr = million gallons per year

Customers and Service Area						
	System	**West Point**	**South**	**Vashon**	**Carnation**	**Brightwater**
Wholesale Customers	34 local agencies (includes 17 cities, 16 sewer districts, and the Muckleshoot Indian Tribe)	--	--	1 sewer district	City of Carnation	--
Population Served (estimated)	1.5 million residents	660,000 (varies summer to winter)	610,000 (varies summer to winter)	1,000 (based on census data)	2,000	190,000
Area Served	415 square miles	105 square miles	241 square miles	660 acres (by 2050)	832 acres (in city and surrounding Urban Growth Area)	67 square miles
Sewage Treated						
	System	**West Point**	**South**	**Vashon**	**Carnation**	**Brightwater**
Sewage Treated (Volume expected in Average Rainfall Year)	About 180 mgd (average)	96 mgd	67 mgd	0.12 mgd	0.09 mgd	17 mgd
Sewage Treated (2012)	187.8 mgd	102.2 mgd	83.7 mgd (9.0 mgd due to Brightwater effluent recycle and 74.7 due to raw sewage)	0.126 mgd	0.09 mgd	Averaged 10.8 mgd when sending effluent to South Plant until Oct. 31. Averaged 11.4 mgd when discharging effluent to Puget Sound via effluent tunnel.
Septage Treated			26.46 million gallons			

Facilities and Equipment						
	System	**West Point**	**South**	**Vashon**	**Carnation**	**Brightwater**
Treatment plants	5	West Point Treatment Plant, Seattle	South Treatment Plant, Renton	Vashon Treatment Plant, Vashon Island	Carnation Treatment Plant, Carnation	Brightwater Treatment Plant, Snohomish County north of Woodinville
Pump stations	42	--	--	4	--	1
Regulator stations	--	19	--	--	--	--
CSO treatment facilities	4: Alki, Carkeek, Mercer/Elliott West, Henderson/Norfolk	--	--	--	--	--
King County sewer conveyance lines	about 389 miles	--	--	3.2 miles	1.6 miles	--
Sewer pipe diameter	6 inches to 17 feet	--	--	2.5 to 8 inches	12 inches	36 to 66 inches
Outfalls, length and depth	--	3,600 ft long, 240 ft deep, 600 ft diffuser (500 ft plus a 100 ft extension)	10,000 ft long, 625 ft deep, 4 diffusers @ 500 ft long	2,850 ft long, 200 ft deep, no diffuser	*Primary*: Chinook Bend Wetland Enhancement Project. *Backup*: Snoqualmie River at Carnation Farm Rd Bridge.	2 parallel pipes 4,600 ft long, 600 ft deep, 2 diffusers @ 250 ft long
Design Criteria						
System		**West Point**	**South**	**Vashon**	**Carnation**	**Brightwater**
Average wet-weather flow (non-storm): This number is often used to describe the size of the treatment plants. It is based on average wet-season flow (November through April) but does not include extraordinarily large storms in the average. It is based on an average that does not show the maximum flows that can be handled at a plant.		133 mgd	115 mgd	0.26 mgd (est.)	0.22 mgd	30 mgd (2012 to 2016)
Maximum monthly average flow		215 mgd	144 mgd	0.52 mgd	0.27 mgd	40.9 mgd (2012 to 2016)
Average dry-weather flow		110 mgd	96 mgd	--	0.21 mgd	25.2 mgd (2012 to 2016)
Biological oxygen demand (BOD) influent loading (annual average)		168,000 lbs/day	220,000 lbs/day	526 lbs/day	314 mg/L	66,063 lbs/day (max. month, 2012 to 2016)
Total suspended solids (TSS) influent loading (average annual)		181,000 lbs/day	201,000 lbs/day	526 lbs/day	314 mg/L	61.400 lbs/day (max. month, 2012 to 2016)

Design Criteria						
System		**West Point**	**South**	**Vashon**	**Carnation**	**Brightwater**
Instantaneous maximum capacity: Maximum flows that can be handled at the plants--often for short periods; some portions of these flows get minimal treatment.		440 mgd	325 mgd	1.14 mgd (2.05 mgd with on-site storage)	1.4 mgd	130 mgd
Permit Information						
	System	**West Point**	**South**	**Vashon**	**Carnation**	**Brightwater**
Permit (NPDES) renewal dates: View permit limits (BOD, TSS, fecal coliform, chlorine residual) for each treatment plant.	--	NPDES permit 6/30/2014	NPDES permit 10/31/2014 Reclaimed Water permit 10/31/2014	NPDES permit 8/31/2011	River (NPDES) Administratively extended till new permit issued – expected in late 2013. Reclaimed Water permit 12/30/2013	NPDES permit 7/31/2016 Reclaimed Water permit 8/1/2016
Resource recovery						
	System	**West Point**	**South**	**Vashon**	**Carnation**	**Brightwater**
Electricity produced annually	--	.194 million kilowatt hours	1.105 million kilowatt hours	--	--	--
Methane gas sold annually (Both West Point & South Plant also use digester gas to power plant equipment, such as boilers and digesters)	--	Not applicable	1.83 million therms	--	--	--
Biosolids produced annually	117,934 wet tons (or 28,108 dry tons)	45,231 wet tons (or 12,568 dry tons @ 27.79% solids)	60,802 wet tons (or 13,891 dry tons @22.85 % solids) Note: South Plant receives sewage sludge from Vashon and Carnation plants.	66,024 gallons (about 20 dry tons) of solids of sewage sludge hauled to South Plant for further treatment	557,419 gallons (about 35 dry tons) of solids hauled to South Plant for further treatment	8,220 wet tons (or 1,591 dry tons @ 19.36%)

Resource recovery						
	System	**West Point**	**South**	**Vashon**	**Carnation**	**Brightwater**
Reclaimed water (used)	About 324.75 million gallons used for landscape irrigation, wetland enhancement, industrial processes, heating/cooling	192.5 million gallons	95.5 million gallons 4.14 million gallons distributed to customers	--	32.61 million gallons of reclaimed water to Chinook Bend wetland enhancement site	0.003 million gallons distributed to the Environmental and Education Center in December 2011

9.2 Financial and Budget Information (2013 – refer to links for updated information)

Wholesale sewer rate	$39.79 per month (1/1/2013)
Sewer treatment capacity charge	$53.50 per month (beginning 1/1/2013)
Annual budget (2013)	Operating: $121.5 million Capital related: $294.5 million
Number of employees (as of January 2012)	About 560 full-time equivalents (FTEs); 20 term-limited temporary (TLT) employees, and 7 temporaries (two interns, two veterans in the HERO program and three administrative staff).
Brightwater Treatment Plant estimates	Cost: $1.889 billion (with inflation) Serves: South Snohomish and North King counties Capacity: 30 mgd, 2012; 54 mgd, 2040
WTD expenditures for capital facilities through 2030 (View projects under construction)	$2.8 billion (2013 to 2030)

9.3 Other Data (rainfall, industrial pretreatment, combined sewer overflows)

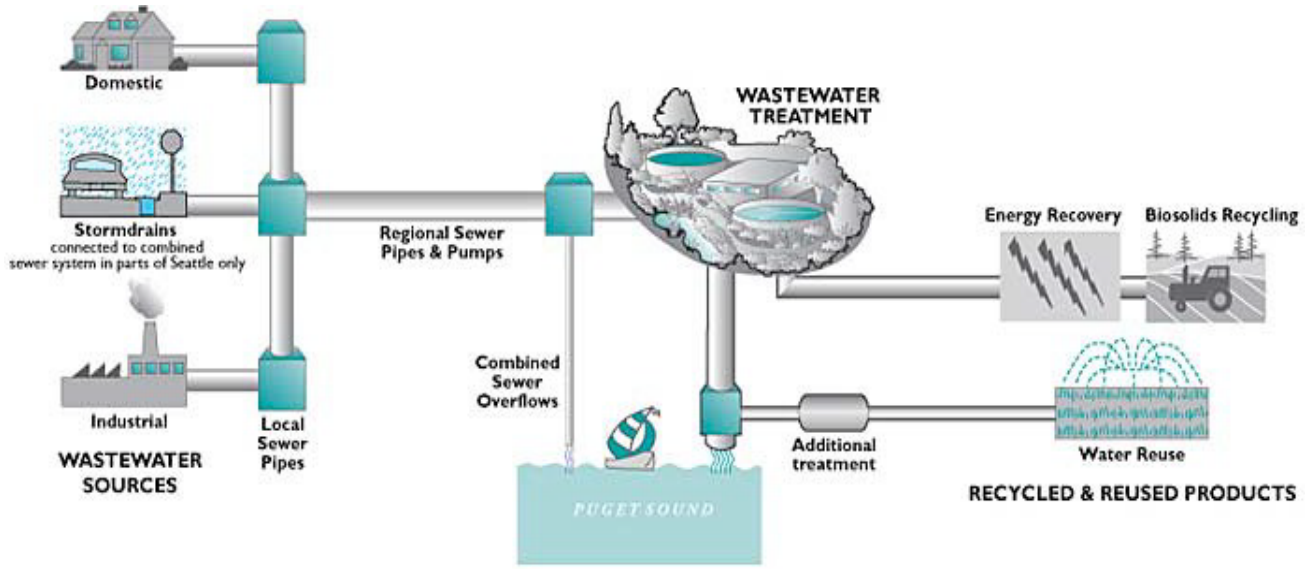
Total Rainfall (measured at SeaTac)	Total rainfall 2012 Water Year, 37.27 inches Long-term average annual rainfall 38.22 inches
Industrial Pretreatment Program	
Significant industrial users	120
Industrial/Commercial facilities with discharge authorizations	312
Approximate number of compliance samples taken	1,998
Inspections conducted	424
Combined Sewer Overflows (CSOs) **CSO Control Program**	
Baseline volume (1980-83	2.3 billion gallons per year
Current volume (Jan.-Dec. 2012)	1,045 million gallons per year (view CSO reduction graph)
Number of King County CSOs	38 (view CSO location map)

10. KING COUNTY'S WASTEWATER TREATMENT PROCESS

The process used at our two regional treatment plants that receive combined flows provides secondary treatment (preliminary, primary and secondary treatment, and disinfection). A third regional plant – Brightwater – does not receive combined flows, however, it uses membrane bioreactor technology to create very high-quality effluent that can be used as reclaimed water. The image below shows the basic steps in the treatment process. At the following Web page you can

move your mouse over the image and click on the "hot links" to view more information about programs and processes:
http://www.kingcounty.gov/environment/wtd/About/System/TreatmentProcess.aspx

Note: *Storm drains are connected to the sewer system only in the combined sewer system in parts of Seattle.*



10.1 Current System Operating Approach

King County operates the wastewater system to optimize the conveyance and treatment of combined and separated flows from the service area. Secondary treatment is provided at both regional treatment plants serving combined areas – high purity oxygen activated sludge at West Point, and conventional activated sludge at the South Plant at Renton. West Point is allowed a CSO related bypass around secondary treatment when flows exceed the capacity of the secondary system (300 mgd) but are less than total hydraulic capacity of (440 mgd). Within the combined sewer areas conveyance, storage and satellite treatment are provided to achieve the state standard of no more than one untreated overflow per designated CSO outfall per year on a 20-year moving average.

The system has been built to operate based on gravity flow as much as is possible, and so on levels in the interceptors and trunks, with little operator intervention. When levels reach pre-determined set points, programmable logic controllers (PLCs) will automatically adjust gates and pumps to manage the flows. These set points have been determined over the years by hydraulic analysis and modeling to balance maximizing conveyance to the plant while maximizing storage in the pipelines and off-line storage facilities and, minimizing overflows and backups. Operators at West Point's Main Control will remotely take control of certain facilities – primarily Interbay pump station and West Seattle pump station - to manage flows to and through the West Point Treatment Plant to avoid surges and oscillations, and so to protect the biological system and avoid plant shut-down. Senior operators assess a range of system factors in making decisions to begin manual control. Which factors are most important depends on the direction storms come from, how fast flows are changing and antecedent conditions. For example, the decision to reduce Elliott Bay Interceptor (EBI) flows to West Point by manually controlling the Interbay Pump Station may be based on factors similar to the following:

- Fremont siphon flow at 150 mgd and increasing.
- Either north-end rain at or above 0.2 inches in 10 minutes

- Or, remaining service area rain is at or above 0.2 inches in 10 minutes.
- Based on weather radar, rainfall is anticipated to hold steady for at least four hours.

These factors should allow the decision to manually control Interbay Pump Station to be made three to four hours before the Fremont siphon experiences peak flows. Such decisions are a delicate balance to achieve and require much system experience, a sense for antecedent conditions and the ability to anticipate changing flows.

10.2 System Operating Objectives

Because of the interconnected nature of the King County and the City of Seattle systems, the two agencies are developing a joint operations and system optimization plan. As part of this plan they have developed a set of prioritized joint operating objectives based on the overarching principles (e.g., mission, goals) of Seattle Public Utilities (SPU) and the King County Wastewater Treatment Division (KC WTD). The prioritized joint operating objectives will be used to evaluate operational alternatives during peak flow conditions. The prioritized operating objectives will not be used for capital planning purposes because the intent during planning is to develop alternatives that align with all of the operating objectives. The operating objectives may change as the joint plan is developed, but are currently the following:

1. Protect Human Health

- Objective #1 - Prevent sewage backups (SSOs) into buildings
- Objective #2 – Prevent sewage overflows into non-permitted locations (SSOs, e.g., streets, parks), which includes dry weather overflows, which are not permitted
- Objective #3 – Protect West Point Treatment Plant so that it remains operational at all times
- Objective #4 – Prevent stormwater surface flooding that endangers public health and safety

2. Protect and Enhance the Environment

- Objective #5 – Prevent CSOs by capturing and conveying the maximum volume of wet weather flow, giving priority to environmentally sensitive areas
- Objective #6 – Maximize the volume of wet weather flow exposed to secondary treatment while protecting West Point Treatment Plant's (WPTP) biological system and meeting effluent discharge requirements
- Objective #7 – Maximize the volume of wet weather flow exposed to primary treatment (WPTP and CSO treatment facilities) and meet effluent discharge requirements

3. Manage Ratepayer Investments Wisely

a. Maintain stable and affordable rates

b. Protect public investment

- Objective #8 – Protect and maintain the City's collection system, the regional conveyance system, and regional treatment plant equipment
- Objective #9 – Minimize energy usage in the collection, conveyance, and treatment of combined wastewater flows

10.3 System View of the West Point Treatment Plant

In operating the system as a whole to optimize the capture of CSO for treatment, one has to start with the West Point Treatment Plant and work upstream. The system is operated to maximize conveyed flow to treatment without overloading the process and decreasing its effectiveness.

West Point utilizes high-purity oxygen activated sludge for its biological treatment. An oxygen generation system provides high-purity oxygen to the secondary aeration tanks. There, the oxygen

is dissolved into wastewater to help sustain the aerobic bacteria used to break down organic pollutants. Using high-purity oxygen instead of ambient air reduces *mean cell retention time* in the aeration tanks by accelerating the rate at which aerobic bacteria can consume organic pollutants.

As oxygen is fed to the covered aeration tanks, surface aerators mix and splash wastewater (mixed liquor) into the gas space above the liquid surface of the tank. This agitation helps oxygenate the wastewater and disperse oxygen-rich liquid throughout the tank. Most of the oxygen is dissolved into the wastewater flowing through the stages of the tank, but a portion is also vented from the last stage, along with trace amounts of nitrogen and carbon dioxide.

Detailed information on the oxygen system can be found in the Plant Manual (thumb drive link) section at: https://kc1.sharepoint.com/teams/WTDOPS/WPTS/WPTP_Manual/WPTP_Manual/Oxygen/Oxygen.aspx (intranet link)

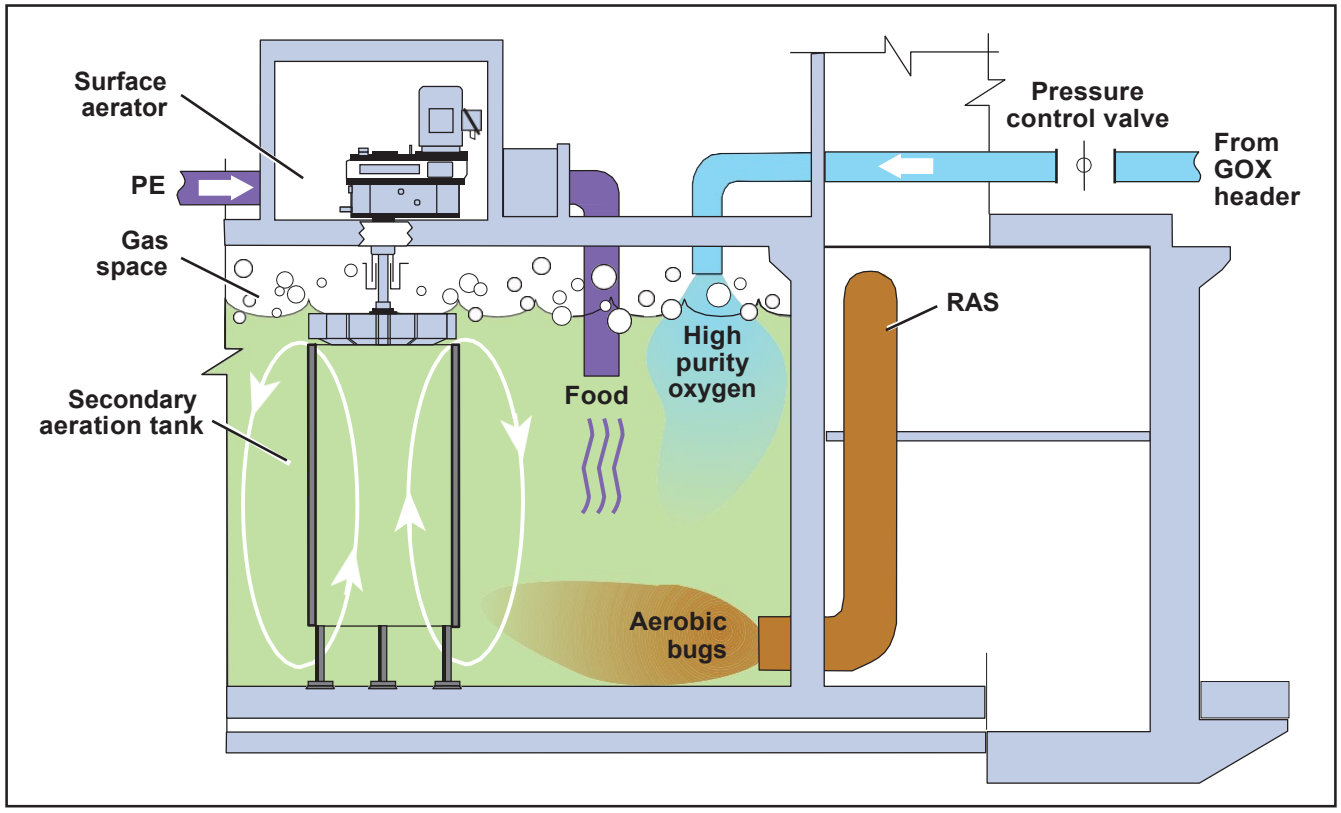


Figure 3. High Purity Oxygen Process

Effective treatment must achieve specific pollutant removal as measured by the following permit effluent limits or better (from the 2009 NPDES permit)

Pollutant Removal per NPDES Permit

Parameter	Average Monthly	Average Weekly
Carbonaceous Biochemical Oxygen Demand b (5-day)	25 mg/L, 44,800 lb/day	40 mg/L, 71,700 lb/day
Total Suspended Solids	30 mg/L, 53,800 lb/day	45 mg/L, 80,700 lb/day
Fecal Coliform Bacteria	200/100 mL	400/100 mL
pH	Daily minimum is equal to or greater than 6.0 and the daily maximum is less than or equal to 9.0	

Parameter	Average Monthly	Maximum Daily
Total Residual Chlorine	139 µg/L	364 µg/L
Because the plant treats CSO some of the effluent limits vary by season: During *May through October*, the average monthly effluent concentration for **CBOD5** must not exceed 25 mg/L or 15 percent of the respective monthly average influent concentrations, whichever is more stringent. During *November through April*, the average monthly effluent concentration for **CBOD5** must not exceed 25 mg/L or 20 percent of the respective monthly average influent concentrations, whichever is more stringent. During *May through October*, the average monthly effluent concentration for **TSS** must not exceed 30 mg/L or 15 percent of the respective monthly average influent concentrations, whichever is more stringent. During *November through April*, the average monthly effluent concentration for **TSS** must not exceed 30 mg/L or 20 percent of the respective monthly average influent concentrations, whichever is more stringent.		

During each renewal of the West Point NPDES permit, effluent quality is reviewed. Ecology then uses a statistical model to identify if new permit limits must be added to ensure that the water quality standards are met.

The West Point Treatment Plant operates under unique dynamics that include:

- Complex hydraulics
- Three lift stations and three regulator stations within the plant
- Sensitive biological treatment process

The extreme hydraulic variations characteristic of the combined system affects biological processes, decreases treatment effectiveness, and cause violations of the permit limits if not expertly managed. It is especially important to control the rate of change in flow throughout the plant to avoid surges or flow oscillations that can trigger a protective automatic shut-down. Therefore, effective treatment results requires good flow management into and through the plant.

10.4 Wastewater Flow Control Begins at West Point

West Point Treatment Plant

For over 40 years, the West Point Treatment Plant has provided wastewater treatment for our region. The average capacity for wet weather flow is 133 million gallons per day. The maximum capacity is 440 million gallons per day during peak storms.

Wastewater coming into the plant undergoes a series of treatments, including the following:

Preliminary treatment: where large debris like rags, paper, and leaves are removed

Primary treatment: skimming and settling to remove sludge (heavy materials) and scum (lighter materials), which are sent onto the solids handling process

Secondary treatment: a biological process that consumes suspended and dissolved organic material, leaving the remaining water or secondary effluent at least 85 percent cleaner than when it entered the plant

Disinfection destroys most remaining pathogens, or disease-causing bacteria before the final effluent is released through an outfall pipe and diffuser into Puget Sound.

West Point's wastewater treatment process produces valuable byproducts that can be reused within the plant and throughout the region, including:

Biosolids -- the nutrient-rich organic matter produced by treating wastewater solids, are used as a soil amendment for dryland and irrigated agriculture, forest fertilization and is composted for landscaping and gardening.

Reclaimed water -- after disinfection, some secondary effluent undergoes advanced treatment and is reused on site in-plant processes also used off-site for landscape irrigation and to replace drinking water use in industrial processes.

Energy recovery -- digester gas, or methane is a byproduct of the biosolids digestion process, and is captured, separated, and cleaned, then either sold to Puget Sound Energy or used on-site as an energy source for a cogeneration system to produce electricity and heat for plant use.

West Point provides secondary treatment of up to 300 mgd of wastewater and stormwater flows defined as "base flow" (2.25 times the average wet-weather flow of 133 mgd). Combined sewer flows that would otherwise overflow at points around the combined system are also transferred to the West Point Treatment Plant for CSO treatment (equivalent to primary treatment) for flows between 300 mgd and the peak of 440 mgd. After receiving CSO treatment, these flows are mixed with secondary effluent for disinfection, dechlorination, and discharge from the deep marine outfall. The resulting effluent must meet secondary effluent quality limits, however, during wet weather months the NPDES permit allows a small reduction in total suspended solids (TSS) and 5-day carbonaceous biochemical oxygen demand (CBOD5) percent removal requirements.
A brochure on the treatment process is available at:
http://your.kingcounty.gov/dnrp/library/wastewater/wtd/about/WestPoint/0909WP_Brochure WebProcess.pdf

A video tour of the treatment process at West Point can be found at:
http://your.kingcounty.gov/dnrp/library/wastewater/wtd/about/WestPoint/animation/Flash_splash1 .htm

Flow and Process Control

West Point Treatment Plant (WPTP) receives flows from trunks, interceptors, pump stations, and regulator stations that make up the King County Wastewater Treatment Division's west section wastewater collection system. Two influent tunnels—the Fort Lawton Parallel tunnel and the Old Fort Lawton tunnel—convey the collected wastewater to West Point. The tunnels also provide a place for storing wastewater.

Flows through the conveyance system and plant are monitored and controlled automatically by a supervisory control and data acquisition system (SCS) or SCADA system – also sometimes called computer augmented treatment and disposal computer system (CATAD) - that monitors and controls a combination of fixed weirs, adjustable weir gates, and variable speed pumps located at the critical hydraulic structures. The SCS consists of 12 programmable logic controllers (PLCs), seven host computers, 20 operator consoles, and a fiber optic cable network that links everything together. The SCS host computers manage the data gathered by the PLCs. The SCS operator consoles enable operators to monitor how the PLCs are controlling the processes and to exercise manual control when necessary by manipulating set points and outputs to equipment. The system also manages alarm information and stores and retrieves data for historical trending and report generation. The PLCs are the workhorses of the SCS; the PLCs evaluate inputs from sensor/transmitters in the field and commands from SCS operator consoles, and then execute control according to preprogrammed control strategies. These control strategies determine how equipment and systems respond to various process changes.

There are three types of control strategies—set point control, equipment control, and system control—and each of these strategy types presents the operator with a specific set of control options and requirements.

Set point control includes all strategies used to maintain a process variable. A sensor/transmitter measures the variable (pressure, flow, temperature, pH) and transmits a corresponding signal to the PLC and to the Moore controller (therefore, if the PLC fails, the Moore controller continues to receive the signal). The PLC compares the signal to a pre-programmed set point and, based on the difference, transmits a signal to a controlled field device (pump, valve, gate). The device responds accordingly to bring the process variable in line with the set point. The set point control options available to the operator are limited to modifying the set point or manually controlling the output of the controlled device. These options can be implemented at an SCS console or from a local panel.

Equipment control includes strategies that exercise discrete control over field devices, such as starting and stopping a pump, or opening and closing a gate or valve. The equipment control options available to the operator are limited to manually starting, stopping, opening, or closing equipment and changing equipment modes between auto and manual. Equipment control employs permissives, or interlocks: a piece of equipment is controlled according to the status of another piece of equipment or the status of a process. These interlocks can be either PLC-based, or hardwired. PLC-based interlocks rely upon logic or programming in the PLC. Hardwired interlocks use electro/mechanical switches.

System control refers to the control strategies that enable multiple pieces of equipment to operate in a coordinated fashion. System control strategies must often be set up and then initiated by an operator using the SCS displays. Once initiated, the control strategy is executed by the PLC using the operator-entered criteria and according to the PLC's programming. The range of options available to the operator include the ability to start and stop a sequence, jog through sequence steps, change set points, and determine pump (lead/lag) and valve sequences.

In 2003, WTD embarked on a division-wide effort to improve and optimize operations by developing instrumentation and control standards that would be applied to all of its existing facilities. After developing the standards, Ovation by Emerson Process Management was selected as the new control system. The control system was designed to enable regional monitoring of pump stations feeding the County's treatment plants, control of processes at each of the treatment plants, and remote or unattended operation of the Brightwater Treatment Plant from the South Treatment Plant at night and during weekends. It is installed to match plant process redundancies, which allow process units to be taken out of service for maintenance without affecting large portions of plant operations. The Brightwater Treatment Plant was designed and constructed using the Ovation control system and Rockwell ControlLogix programmable logic controllers (PLCs). The South Treatment Plant and West Point Treatment Plant are undergoing projects to install the system. It is anticipated that the South Treatment Plant will be on the Ovation control system by the end of 2013, and the West Point Treatment Plant by the end of 2015. More information on the SCS is available in the Plant Control Manual (intranet link) or (thumb drive link).

While the Ovation system is being brought on-line the original and new system are running in parallel to enable fine-tuning of Ovation. Operating manuals for Ovation are being developed and will replace existing information in the Plan Control Manual.

Since the early 1970s, one of King County's major tools in achieving CSO control has been the SCADA system. The new SCADA system - called Ovation - also monitors rainfall and conditions in major pipelines and then adjusts in-line regulator gates and pump speeds when flows reach predetermined "set points." The automatic control of the regulator stations significantly reduces CSOs by maximizing storage during a storm and then conveying the flows to the West Point Treatment Plant for treatment when the storm subsides. When needed, the automatic controls can be overridden by experienced operators at the West Point Treatment Plant main control center.

Operational controls maximize the use of existing conveyance systems and facilities through active management of the facilities. This often includes controls that dynamically operate gates and

weirs in response to field measurements of flows and levels. This process directs flows to parts of the system with spare capacity, thus reducing or eliminating CSOs. Maximizing flows in the existing conveyance system requires a thorough understanding of the sewer system and how it functions during wet weather.

Use of Hydraulic Models

Such understanding of hydraulics is critical to ensure that increased flows do not have adverse consequences at the treatment plant and far upstream in the conveyance system. Because system performance varies with the pattern of rainfall from storm to storm, measured data is not sufficient to optimize the system and plan operating strategies, to assess longer term system capacity for facility planning or to measure progress in CSO control. In order to project system performance over a range of storm scenarios and to have consistency in project design, modern wastewater management agencies use computer models.

WTD uses models to simulate flow contributions (wastewater, stormwater, inflow and infiltration, etc.) to the sewer system under various conditions and control strategies. The model is calibrated, or adjusted to match measured data, to provide more accurate predictions for use in optimization of controls and CSO Control Program planning and facility design. A range of simulations, combined with field data and engineering judgment, are used in the design and operation of facilities, such as CSO control facilities. They can also be used to evaluate performance under high flow, unusual and emergency conditions. Using models to retrospectively assess system performance after storms and events also contributes to lessons learned and may lead to changes in operational settings to improve system management and optimize function. The model can also be used to assess how new facilities – including those of Seattle - will interact with other parts of the system and to develop strategies to improve their coordination.

The models that WTD has used over the past 30 years are described in Appendix B (thumb drive link). The Hydraulic Modeling and Monitoring Protocols are also presented in Appendix B.

Each treatment plant has offsite conveyance and pump stations that feed flows to the plant. PLC-based control systems at these offsite facilities are connected to the Ovation control system to monitor and, in some cases, control the flow and so optimize conveyance to the plant for treatment and the use of system storage capacity. In the West Point system this will minimize CSOs. Critical alarms and process data are communicated to the plant operators using monitoring systems that report data in independent communication pathways from the control system.

The County installed the OSI PI process data historian for long-term trending of all key WTD process, operational, and monitoring data (treatment plants, conveyance facilities, CSO control facilities, and offsite pump stations). The OSI PI system has been in service since 2005, but we also have data available from previous historian systems.

The County continually modifies the SCADA systems and modeling to take into account advances in computer technology, to incorporate more recent field data, and to reflect modifications to the wastewater system. Modeling, in combination with the OSI PI data, provides a powerful tool for optimizing system operation.

More information on WTDs use of models for CSO control planning is available in Chapter Four (thumb drive link) of the 2012 Amended Long-term CSO Control Plan Amendment, and in Technical Memorandum 970: CSO Control Alternatives Development, October 2011, Appendix B. Modeling and modeling protocols are in the appendix of that technical memorandum.

10.5 Plant Flow Overview

Flow management utilizes strategic storage. During high flows, there is very limited wastewater storage capacity inside or outside the plant. The primary sedimentation tanks can be used to store wastewater *inside the plant*. When flows are below 150 mgd, storage time is approximately 20

minutes. During high flows (400 mgd), storage time in the primary basins becomes approximately three to four minutes.

The Fort Lawton Parallel tunnel, Old Fort Lawton tunnel, and collection system are used to store wastewater outside the plant. When flows are below 150 mgd, these facilities provide storage time of one to four hours. During high flows (400 mgd), their storage time is about 10 to 20 minutes.

The influent control structure (ICS), raw sewage pump (RSP) wet well, primary effluent weir gates, flow diversion structure (FDS), intermediate pump station (IPS), and effluent pump station (EPS) are the critical hydraulic control facilities at the plant. When flows through the plant reach critical elevations specific to those structures, controls will adjust the flow into and through the plant. Ultimately, the control of these structures determines the flow volume that can be accepted from the conveyance system.

Although the plant is designed for peak influent flow of 440 mgd, only some portions of the plant can process the maximum 440 mgd; other portions have a maximum capacity of only 300 mgd, which is the design flow set for secondary treatment. Therefore, whenever possible, the hydraulic loading to the plant must be controlled not to exceed the maximum capacity of any flow-limiting unit process, particularly when pieces of equipment are out of service. For example, if one of the effluent pumps is out of service, the capacity of the EPS—and therefore the entire plant—is limited to 300 mgd, and raw sewage pumping must be controlled accordingly.

These elevations are summarized for different flow scenarios in Tables 1, 2 and 3 (following Figure 5, Hydraulic Profile).

Because these facilities are interconnected, hydraulic activity at one facility usually affects hydraulic activity at the others. For example, if the IPS wet well level rises, so will the level in the FDS. Moreover, because the plant has limited hydraulic storage capacity, this type of hydraulic cause and effect often occurs very rapidly, especially during high flows.

The ICS receives plant influent from the Old Fort Lawton tunnel and the Fort Lawton Parallel tunnel, as well as sidestreams from solids handling. For extreme emergency conditions, the facility includes methods to prevent flow from damaging the plant or personnel or causing long-term damage to the environment: Four influent gates that can stop the flow of influent to the RSP wet well; the 144-inch emergency bypass gate can that divert influent to the emergency bypass channel; an overflow weir that can release wastewater the plant cannot safely take to the bypass channel for discharge out the emergency outfall.

From the ICS, wastewater flows by gravity to the RSP wet well, where the wastewater is screened and then lifted by the RSPs into the division channel. The RSPs can be controlled to pump down or store sewage in the Fort Lawton tunnels.

When flows to the plant are low enough that the level in the RSP wet well is at or below 96.2 feet, the RSPs are not operated until flows increase. When the level is above 96.2 feet, the operator will start the first RSP, bringing on up to three additional raw sewage pumps as needed to maintain a water level of approximately 106.5 feet in the wet well. The four RSPs are rated at 110 mgd and are driven by dual fuel (methane or LPG) engines. The engine starts are done manually so that the operator can adjust the online pump outputs to provide smooth, even flow to the treatment plant. West Point Treatment Plant has 3 lift stations internally, and the primary sedimentation tank levels are controlled by automatic weir gates. This operation provides the smooth, even flows necessary to prevent plant bypasses and to protect plant processes and equipment. The operator monitors the weather and conveyance conditions to anticipate the effects on the plant and when to start and stop additional raw sewage pumps. They will start the RSP engines early enough to prevent the wet well level from increasing rapidly. Lag engines will typically be started when the lead RSP output is 80%. This strategy provides buffer time in case an engine does not start immediately. During moderate to high flows, one strategy is to operate one RSP in MANUAL. This

strategy permits rpm adjustment, if needed. Operators will generally make several small changes instead of large changes in order to allow weir gates, FDS, IPS and EPS to recover between changes.

On occasion, rainfall amounts can be enough to surpass the capacity of the treatment plant and the operator will intervene to protect the plant and meet operating objectives. Usually only the south end flows will be manually controlled, often by reducing flows at West Seattle, Duwamish or Interbay pump stations. But the decision to manage flows is always situational and variable and is done only by experienced Washington State certified Group 3 operators, under the day-to-day supervision of a Group 4 operator.

Figure 4, West Point Treatment Plant Hydraulic Schematic and Figure 5, West Point Treatment Plant Hydraulic Profile, provide an overview of how flow is controlled through the plant.

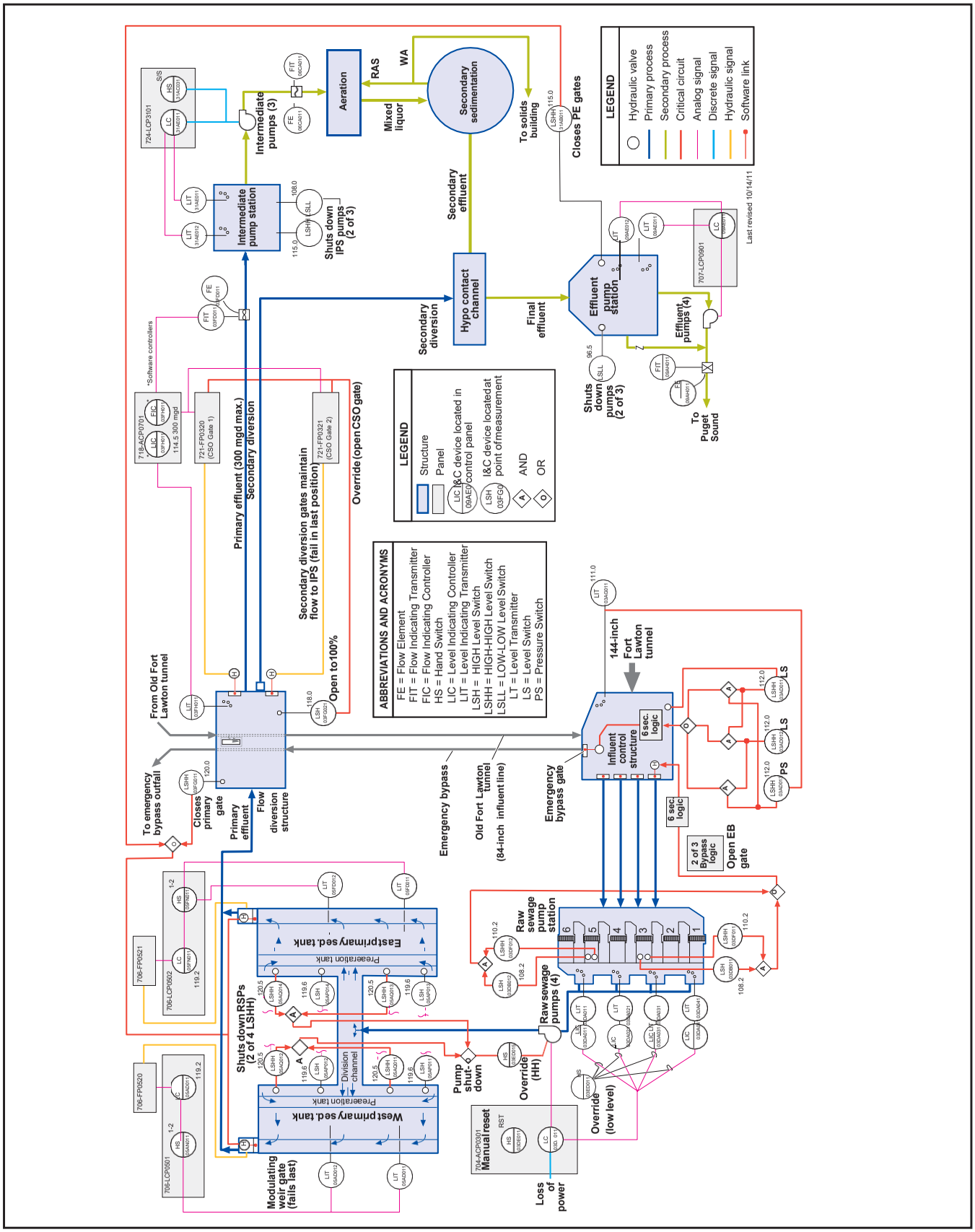


Figure 4. West Point Treatment Plant Hydraulic Schematic

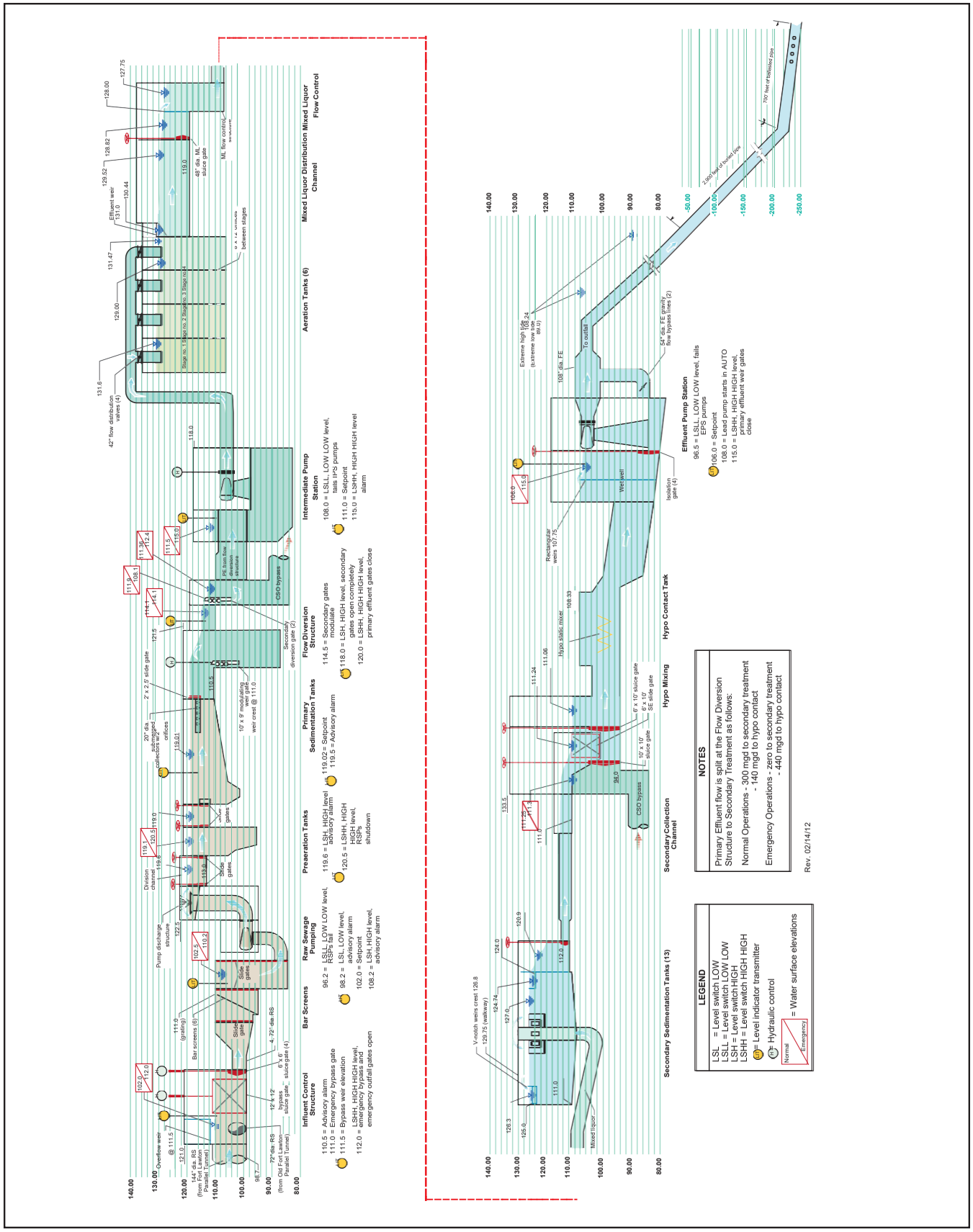


Figure 5. West Point Treatment Plant Hydraulic Profile

The following tables summarize key hydraulic structures within the plant and the levels that initiate flow management actions for normal, CSO-related bypass and flow above the plant's peak hydraulic design of 440 mgd. See the Plant Manual (thumb drive link) Plant Manual (SharePoint link) for more detail and refer to Figure 5, Hydraulic Profile, for Normal Flows to identify the structures and their relationships to each other.

Table 1. Normal Flows Up to 300 mgd

Process Structure	Elevation (feet)	Strategy
Influent Control Structure	106.9 (at 143 mgd)[a]	During the summer, when flows are normally low, the elevation in the ICS may be low.
Raw Sewage Pump (RSP) Wet Well	102.0 (operator discretion)	The RSPs vary speed to maintain the wet well level set point.
Primary Sedimentation Tanks	119.02 (operator discretion)	The level controllers modulate the primary effluent weir gates to maintain the sedimentation tank level set point in both tanks and the east and west primaries.
Flow Diversion Structure (FDS)	114.5 (at 143 mgd)[b]	The elevation at the flow diversion structure varies.
Influent Pump Station (IPS)	111.5 (set point)	The IPS pumps change speeds to maintain the level set point in the IPS wet well.
Effluent Pump Station (EPS)	104.0	The normal elevation at the EPS is 104.0 to 108.0. 106.0 is the set point.
Outfall		Depending on the wet well level, final effluent is either pumped out or leaves by gravity: At elevation 108.0, the pumps start up. At elevation 107.75, the weir in the wet well becomes submerged. At elevation 104.0, the pumps shut down, and the effluent flows out by gravity. ***NOTE**: At low flow and low tide, the elevation may be less than 104.0.*
[a]: This ICS elevation is based on an RSP wet well level set point of 106.5. [b]: This FDS elevation is based on an IPS wet well level set point of 111.5 and an EPS wet well level set point of 106.		

CSO-related bypass, or secondary diversion, may occur when continuous rainfalls exhaust the throughput capacity of the secondary treatment system and the storage capacity of the collection system. Diverted flows receive primary treatment, chlorination, and de-chlorination:

- Wastewater enters the plant at the ICS and is pumped by the RSPs to the division channel and flows by gravity to the pre-aeration and primary sedimentation tanks.
- At the FDS, all flow in excess of 300 mgd is diverted directly to the chlorine mix structures; there, the diverted flow is mixed with secondary effluent, and the recombined flows are chlorinated,

Table 2. CSO-Related Bypass, Between 301 and 440 mgd

Process Structure	Elevation (feet)	Strategy
FDS	114.5 (at 358 mgd)[1]	The secondary diversion gates modulate to maintain a level of 114.0 and divert excess flows to the chlorine mix structures.
IPS	111.5 (set point)	The IPS does not send more than 300 mgd of primary effluent to secondary treatment.
[1]The FDS elevation is based on an IPS wet well level set point of 111.5 and an EPS wet well level set point of 106.0.		

Flows above 440 mgd may be prevented from entering the plant by shutting down the RSPs. Flows in the collection system will back up to reach levels that control regulators and pump stations to store flow in the collection system, and to overflow as a CSO when the storage has been used up. Emergency bypass flows may be discharged directly to Puget Sound without receiving primary treatment, secondary treatment, or chlorination if upstream storage or CSO discharge does not limit the flows coming to the plant sufficiently.

Table 3. Limiting Flow to Plant and Emergency Bypass

Process Structure	Elevation (feet)	Strategy
ICS	111.0 112.0	Opens and modulates the emergency marine outfall gate to maintain elevation 111.0 in the ICS. At elevation 112.0, "full emergency bypass" occurs: The emergency bypass (EB) gate opens completely to divert all incoming flow to the emergency bypass channel.
RSP Wet Well	110.2 (set point)	The influent control gates that are valved in at ICS close
Pre-aeration Tanks	120.5	RSPs are shut down ***NOTE:*** *The Supervisor can decide to override the RSPs from shutting down.*
FDS	120.0	The primary effluent weir gates are raised (closed)
IPS	108.0	Although no more primary effluent is flowing to secondary, the IPS pumps will continue pumping until they have pumped the wet well level down to 108.0.
EPS	115.0 96.5	Closes the primary effluent weir gates. Fails the effluent pumps.

11. KING COUNTY'S CONVEYANCE SYSTEM

The north/south topography, carved out by glaciers over the past ages, requires a significant number of pump stations and tunnels to transport the wastewater west and south so it can be treated and discharged into salt water.

Wherever possible, the County uses gravity to carry wastewater from local drainage basins to the treatment plants. Pump stations are used when necessary to lift sewage over hills and around lakes, to the main interceptors. These stations automatically regulate their pump rates depending on factors such as increased flows caused by heavy rains. The area feeding into the South Treatment Plant in Renton uses pump stations and gravity to transport flows into the plant. The system feeding the West Point Treatment Plant uses pump stations and regulator stations to regulate flows between pump stations and the plant. The regulation is necessary at West Point due to the combined storm drains and sanitary sewage collection system in the older parts of Seattle.

Similarly to the plant, the conveyance system operates automatically in most situations. The system is driven by flow levels, meaning when flow reaches a "set point" level, flow is forced in specific directions, and operable facilities will automatically adjust, and overflows may occur. Operators can intervene and override the automatic controls at a few operable facilities – this is not done often, and is usually in response to complex storm and flow situations. Four types of conveyance facilities exist in the West Point system – pump stations, regulators, weirs and CSO treatment facilities. Information on monitoring and controlling offsite facilities from Main Control is found in the Guide to Main Control Operations (thumb drive link).

King County's West System is operated to maximize the conveyance of wastewater to the West Point Treatment Plant to provide high purity oxygen secondary treatment, while protecting the process and equipment. During large storm events, it's possible that the collection system can convey more flow than the plant is capable of managing and treating. Under most conditions the offsite facilities can automatically control the collection system flows, but during these large storm events operator intervention may be necessary to meet operating objectives. Operators making such decisions are Washington State certified Group 3, under day-to-day supervision of a Group 4 operator.

11.1 Conveyance System Map Areas

The West System is managed in three sections: Ballard Siphon/Richmond Beach System, North Collection System and South Collection System. Information on the individual facilities within each system can be accessed from the map in Figure 6. Figure 7 shows the Ovation overview screen of the West Section System.

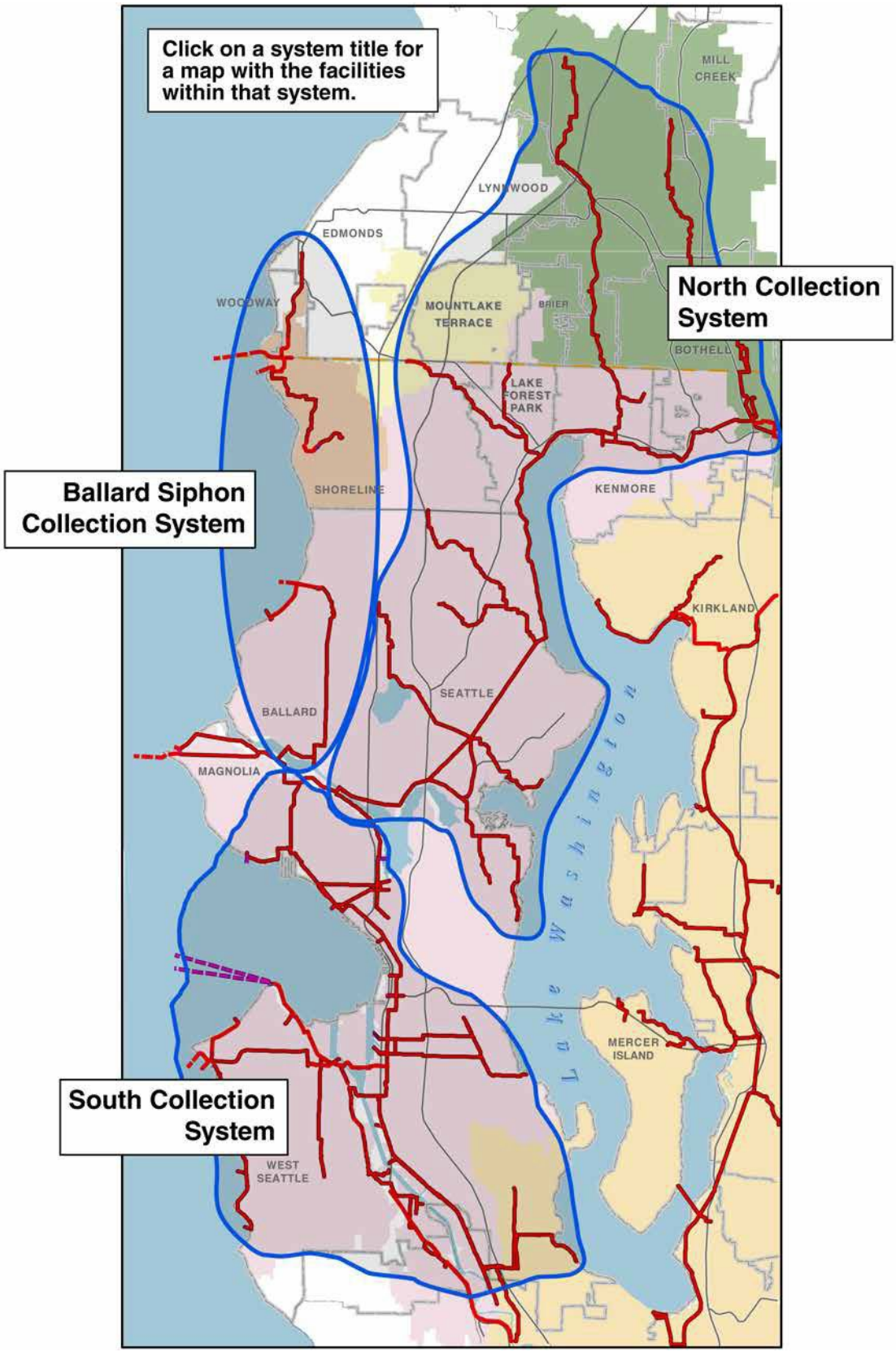


Figure 6. West System Service Areas (Facility Information)

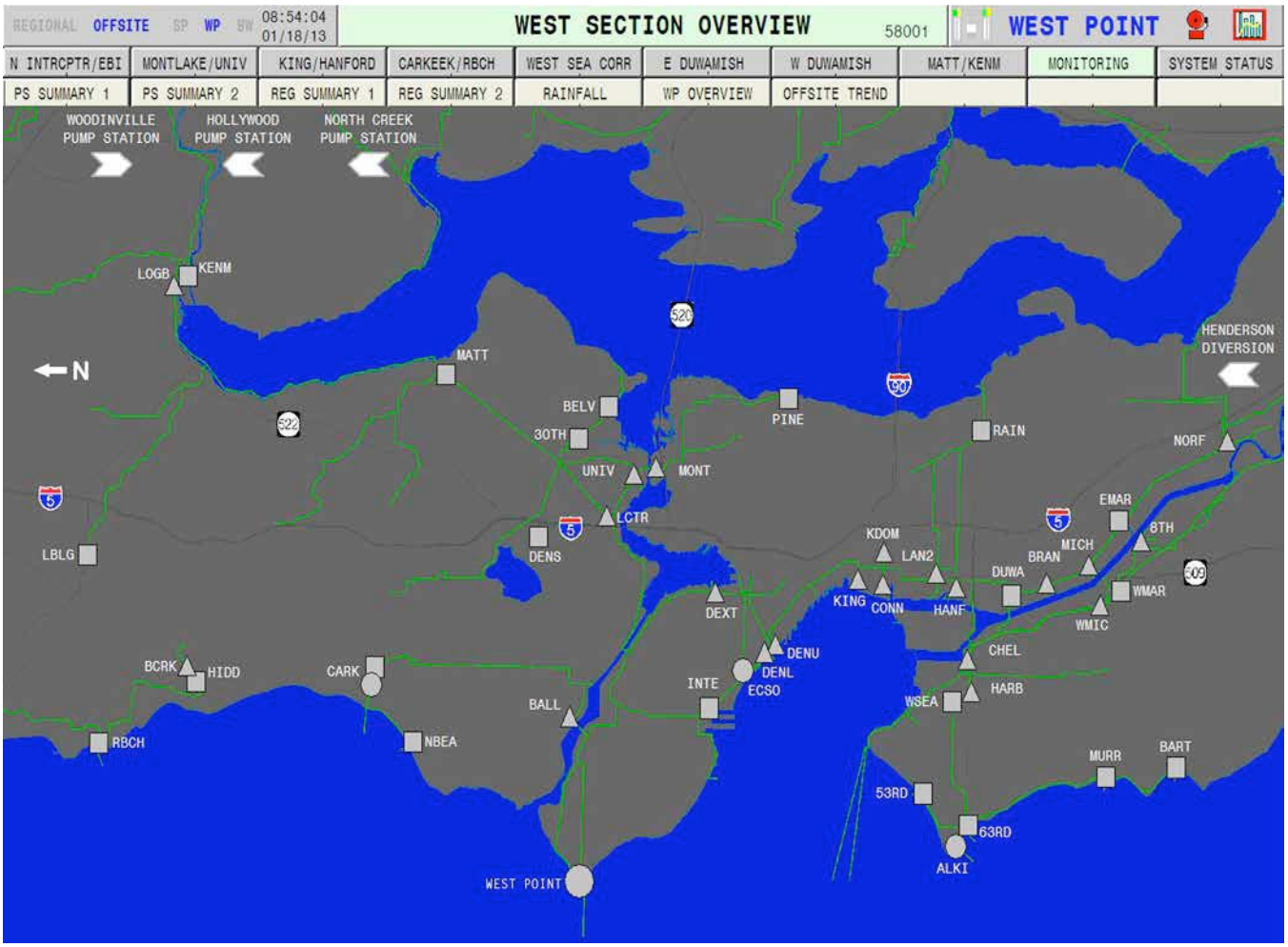


Figure 7. Ovation Overview Screen for the West Section

11.2 Facility Basics

Pump Stations

Pump stations – sometimes called lift stations – enable gravity flow over lengths of conveyance. The pump stations overcome geographical features, confluences of flow and siphons.

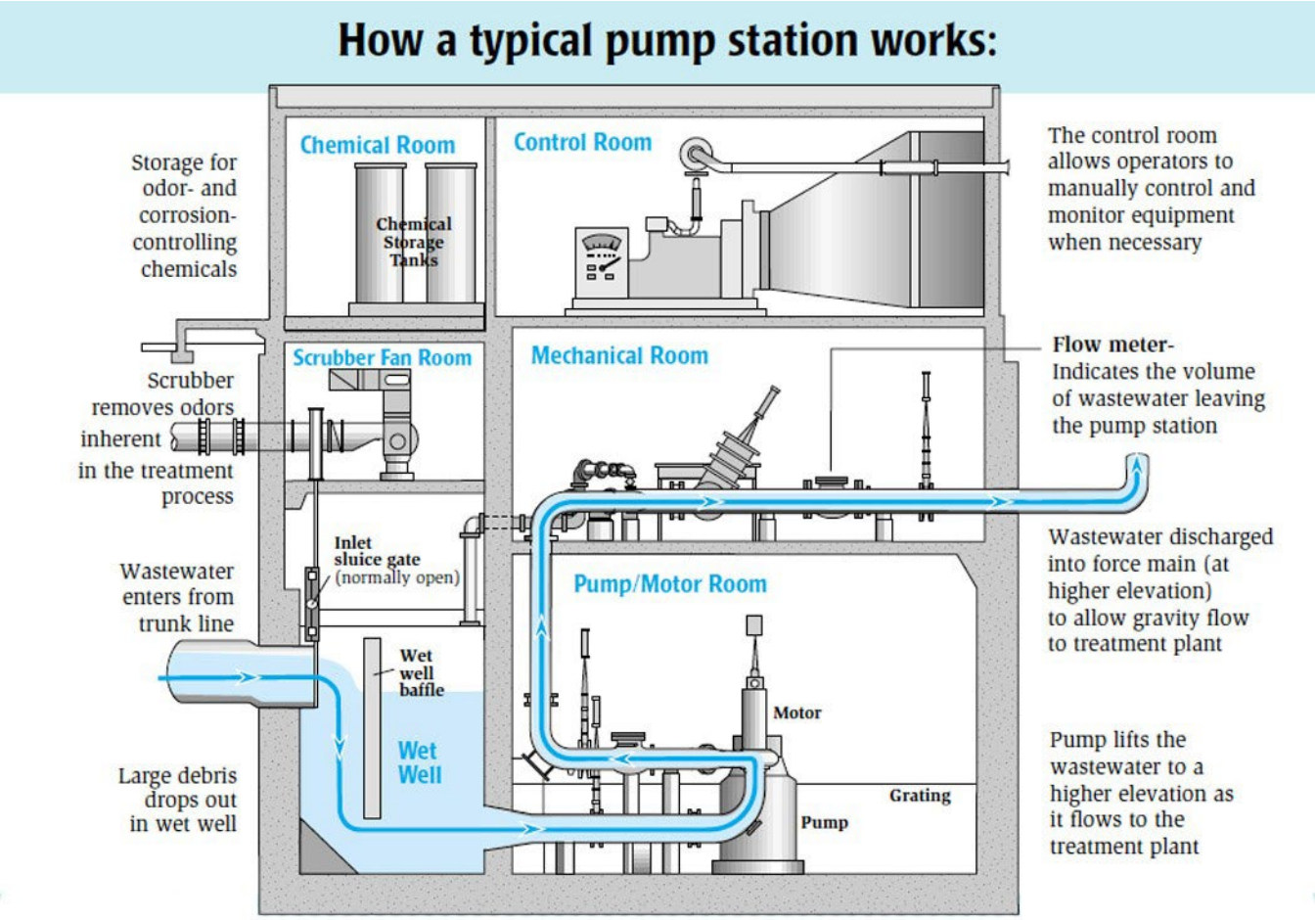
The pump stations range in size from small "package" stations handling about 250,000 gallons of wastewater a day to the largest pump station at Interbay which moves up to 122 million gallons of wastewater per day (being upgraded to 133 mgd by the end of 2015) to the West Point Treatment Plant. The size and number of pump stations is related to topography, population density and service area. In the separated system, stations are designed to handle the peak flow from what is known as a "20-year storm" with all pumps operating. In the combined system, stations are designed to handle the peak “1-year storm” with all pumps running. Each treatment plant also has a very large pump station to bring wastewater into the plant for treatment and another to discharge effluent or treated wastewater, out to Puget Sound.

Operators at West Point continuously monitor operations at each pump station 24-hours-a-day via computerized data and telemetry systems called Ovation, thereby providing quick response to power outages and equipment failures. Crews check each station weekly to ensure that equipment is functioning normally. They regularly lubricate and perform preventive maintenance on equipment and flush the wet well where sewage enters the station.

Most of the pump stations were built in the 1960s when the regional treatment system was first constructed. The West Seattle station came on-line in summer 1998; the North Creek station in

fall 1999; the Henderson and Elliott West stations in spring 2005. Designed with an eye to future expansion, pump stations are improved as needed to increase pump capacity, upgrade control technology, replace old equipment and update odor control units. Architects designing improvements to a pump station consider the station's surroundings to help it blend better with its neighborhood. Many of the new stations incorporate art into the station design.

The West System includes 23 pump stations. Detailed information on all the pump stations, including critical elevations. Operation and Maintenance Manuals, Offsite Facility Manuals and system drawings, can be accessed through the Facility Information interactive map (thumb drive link).

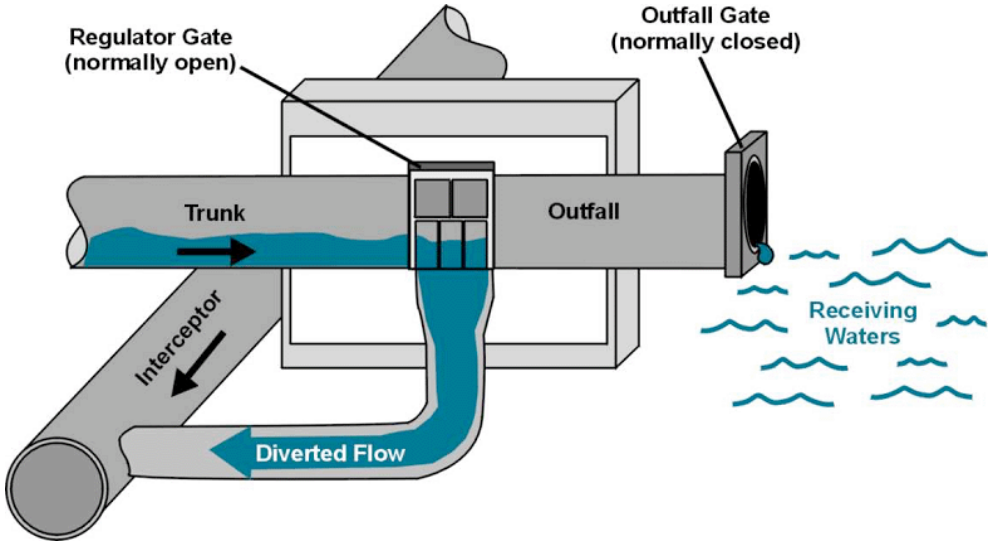


The pump station receives wastewater, (raw sewage, from the local sewer districts, which in tum collect it from local homes, businesses and industry. Wastewater enters the station through the influent, or incoming. sewer and drops to the wet well. It is pumped up and out of the station via the pump/motor room before being discharged through a force main (a large diameter pipe that conveys wastewater under pressure to the treatment plant). The movement of wastewater creates odors, which are captured and scrubbed before air from the station wet well is released to the atmosphere. If there are problems with a station, telemetry systems alert operators at the main treatment plant. There, operators check the alarms via computer and notify crews to respond to the situation.

Regulators

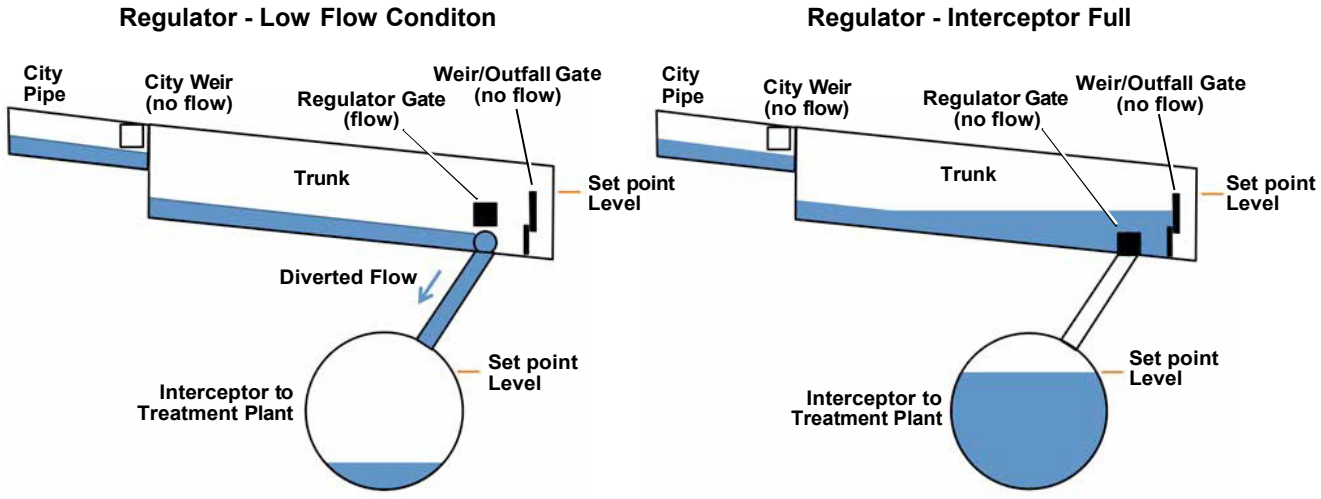
In the system, regulator stations manage flow from the trunks into the main interceptors. Under normal circumstances the regulator gate is open and the outfall gate is closed, directing flow into

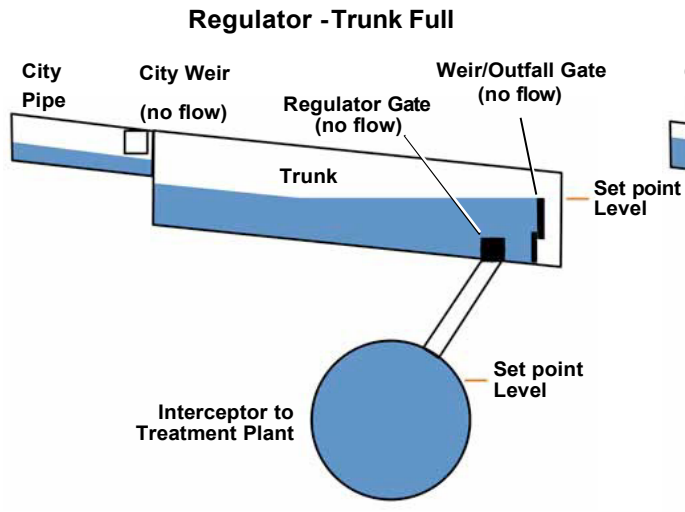
the interceptor. When levels in the interceptor reach a set point, the regulator gate will close, providing some storage, and then the outfall gate will open allowing the release of excess flow as a combined sewer overflow (CSO). These set points are set to allow as much flow as possible to get to the West Point Treatment Plant, and then to store in the conveyance system. The set points are designed to optimally allocate conveyance capacity between upstream and downstream connections. Here is a side view schematic of a regulator station:

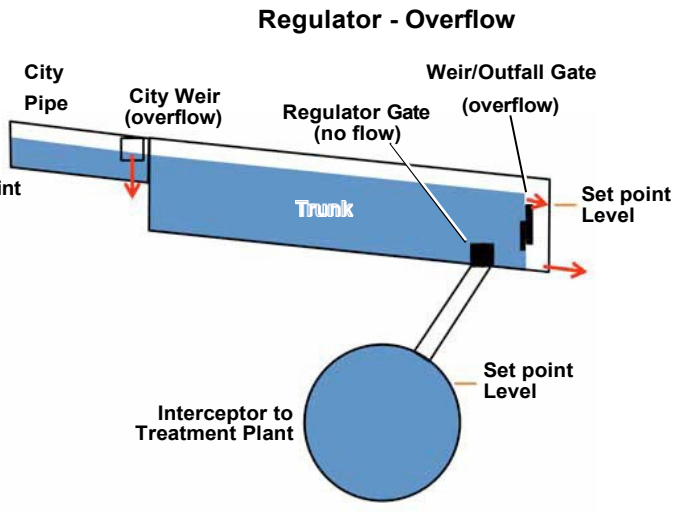


The West Division includes 21 regulator stations. Detailed information on all of the regulator stations, including critical elevations, Operation and Maintenance Manuals, Offsite Facility Manuals and system drawings, can be accessed through the Facility Information interactive map (thumb drive link).

The following sequence of graphics shows another view of the interaction of a regulator and interceptor:







Weirs

Weirs are openings in pipes that allow flow above the opening level to overflow to the receiving water. They are not controllable, though in some cases can be manually adjusted. The West Division includes 11 CSO weir locations (three adjacent weirs in the Hanford 1 system are counted as one). There are also 7 flapgates along the underwater Kenmore Lake Line that are essentially weirs with coverings to allow emergency overflows, but not inflow. These are permitted together as the Matthews Beach CSO at the start of the combined system, however they will only overflow if there has been a critical equipment failure at Matthews pump station, Kenmore pump station or Logboom regulator. Detailed information on each of the weir CSOs, including critical elevations, Offsite Facility Manuals and system drawings, can be accessed through the Facility Information interactive map (thumb drive link).

11.3 CSO Treatment Facilities

The West Section includes four CSO treatment facilities- Carkeek, Elliott West/Mercer, Alki, and Henderson/MLK. Facility performance is reported in annual reports, available at: http://www.kingcounty.gov/environment/wastewater/CSO/Library/AnnualReports.aspx

Alki CSO Treatment Plant

Design for the Alki project began in 1989 and construction was completed in 1999. Flow transfer of the base flows requiring secondary treatment to West Point occurred in 1998. Specific permit conditions for operation of the Alki facility are being negotiated as part of the West Point permit with Ecology.

The Alki system is designed to transfer flows up to 18.9 mgd from the Alki drainage basin to the West Point treatment plant for secondary treatment. During storm events, combined sewer flows above 18.9 mgd, up to a maximum of 55 mgd, will receive primary treatment and disinfection at a modified Alki plant with discharge through the existing outfall. In order to protect the treatment facility, flows in excess of 55 mgd (estimated to occur, on average, about once per year) will be discharged via the 63rd Avenue pump station outfall, which is a permitted CSO

location. The 63rd Avenue pump station CSO has been controlled to the one-year standard as part of this project.

A new tunnel and West Seattle pump station provides conveyance of Alki flows to the Elliott Bay Interceptor (EBI) and West Point Treatment Plant. To avoid exacerbating CSOs in the West Section treatment plant system due to the addition of Alki flows, pipelines were constructed in 1995-96 to transfer at least 18.9 mgd of CSO flows from the southern part of the West Point Treatment Plant service area to the East Section Reclamation Plant at Renton via the Allentown trunk and Interurban pump station.

A pipeline to convey Harbor regulator station CSOs to the new West Seattle tunnel for storage and control to one event per year was added to this project.

Facilities plans for the original project can be found in the documents section of the CSO control program intranet CSO portal site at: http://dnrp-apps2/wtdrecordssearch/Default.aspx?Act=facility (intranet link)

Further information on the Alki CSO treatment facility, including critical elevations, Operation and Maintenance Manual, Offsite Facility Manuals and system drawings, can be accessed through the Facility Information interactive map (thumb drive link).

Carkeek CSO Treatment Plant

The Carkeek project was designed to transfer combined sewer flows up to 8.4 mgd from the Carkeek drainage basin to the West Point Treatment Plant for secondary treatment. In 1994, the existing Carkeek Park wastewater treatment plant was converted into a CSO treatment facility to provide primary treatment and disinfection for flows exceeding 8.4 mgd (to a maximum of 20 mgd) with discharge through the existing outfall. Construction of all elements of the project were completed and the Carkeek CSO Treatment Facility began operation in the fall of 1994. After several years of operation it was determined that the plant was receiving more flow than had been expected. Assessment found that flow meters used in the primary plant topped out at 20 mgd, shaving some peak flow, and that additional flow that may have overflowed to Pipers Creek from manholes during the largest storms was captured in the associated conveyance improvements. Pumping to West Point was increased to 9.2 mgd and the Department of Ecology worked with King County to redefine the NPDES permit conditions to recognize the extra flow to be managed, including an increase in the required transfer to West Point and an increase in the permitted treated annual overflow frequency and volume.

Facilities plans for the original project can be found in the documents section of the CSO control program intranet CSO portal site at: http://dnrp-apps2/wtdrecordssearch/Default.aspx?Act=facility

Further information on the Carkeek CSO treatment facility, including critical elevations, Operation and Maintenance Manuals, Offsite Facility Manuals and system drawings, can be accessed through the Facility Information interactive map (thumb drive link).

Elliott West/ Mercer CSO Storage and Treatment Facilities

In late 1991, the City of Seattle requested that King County participate in a joint analysis of alternatives to control CSO discharges into Lake Union and into Elliott Bay at the Denny Way Regulator Station. A joint project was developed and was awarded a $35 million EPA Federal Infrastructure Grant.

In 1997, the City completed construction of improved conveyance facilities that increase wet-weather capacity in the east and south Lake Union areas. The County constructed a system that will (1) store CSO flows from Lake Union during small to moderate storms and transfer them to the West Point Treatment Plant after the storm subsides, and (2) treat CSO flows during heavy rain conditions (approximately 14 to 20 times per year) and then discharge the treated flows. Major new facilities in the system are as follows:

- Mercer Tunnel—a 6,200-foot long, 14.66-foot diameter tunnel under Mercer Street between Dexter Avenue North and Elliott Avenue West, providing storage, primary clarification, and conveyance
- Elliott West CSO Control Facility—a pump station and CSO treatment system at the west portal of the Mercer Tunnel, providing floatable materials removal, disinfection, and de-chlorination
- Elliott West Outfall—a 96-inch diameter outfall to discharge treated flows from the Elliott West CSO Facility into Elliott Bay at Myrtle Edwards Park near the Denny Way CSO outfall
- Extension of Denny Way CSO outfall—an extension of the existing outfall at the Denny Way Regulator Station to discharge untreated CSO flows into Elliott Bay at Myrtle Edwards Park (expected to occur about once per year)

Construction of the Mercer Tunnel and outfalls was completed in 2002. The Elliott West CSO Facility was essentially complete in spring 2005; construction was complete May 2005.

The facility has two basic modes of operation:

During rainstorms, the facility directs combined stormwater and sanitary sewer flows into the Mercer Street wastewater storage tunnel. That is expected to happen about 50 times a year. After each storm subsides, the CSO control facility will pump the stored flows from the Mercer Street tunnel to the Elliott Bay interceptor, a sewer trunk leading to the West Point Treatment Plant.

During larger storms, about 10 to 20 times a year, the Mercer Street tunnel fills completely. When that happens, the CSO control facility will automatically begin to treat the stored flows and pump them to the new CSO outfall at Myrtle Edwards Park. Treatment includes screening out floatable materials, disinfection, and de-chlorination. Operation of the facility after the storm will be the same as described above.

During very large storms, an average of once a year, flows may exceed the pumping capacity of the CSO control facility. Then, untreated flows will be discharged through the new CSO outfall off Myrtle Edwards Park. New facilities built for this project will thus convey, store and treat combined sewage only during storms. During dry weather, the facilities will be empty, and wastewater will flow through existing pipes to the West Point Treatment Plant.

King County designed this facility with community involvement to ensure its architecture is compatible with the neighborhood. It also incorporates odor control equipment to prevent odors noticeable to nearby businesses and residents.

Additional information on the facility can be found at:
http://www.kingcounty.gov/environment/wtd/Construction/Completed/DennyWayCSO.aspx

Facilities plans for the original project can be found in the documents section of the CSO control program intranet CSO portal site at: http://dnrp-apps2/wtdrecordssearch/Default.aspx?Act=facility

Further information on the Elliott West/Mercer CSO storage and treatment facilities, including critical elevations, Operation and Maintenance Manual, Offsite Facility Manuals and system drawings, can be accessed through the Facility Information interactive map (thumb drive link).

Henderson/ MLK CSO Storage and Treatment Facilities

In 1995, the County evaluated the Henderson Street Pump Station and Martin Luther King Jr. Way CSOs and their interaction with the downstream Norfolk Regulator Station to identify interim and permanent corrective measures to control overflows. The recommended alternative was to construct a 3.2 million gallon storage tank/CSO treatment facility near the Norfolk Regulator Station.

During the 1997 predesign evaluation of alternatives, it was determined that a storage/treatment tunnel would be more cost-effective to build and operate than storage/treatment facilities at the Norfolk site. A storage/treatment tunnel would cause fewer adverse community impacts and would be consistent with the approach being used on the Denny Way/Lake Union CSO control project. In addition, it was determined that an earlier component of the Alki transfer—the southern transfer or Allentown diversion—could be operated to integrate with the Henderson/MLK/Norfolk project. This integrated operation would divert base flows and stored CSO flows to the South Treatment Plant at Renton, benefiting both the Norfolk Regulator Station and the Elliott Bay Interceptor.

Today, the original 1970s brick sculpture on the west side of the Henderson Pump Station, "Quest for Clean Water" by well-known local artist Richard S. Beyer, is more visible for public view and framed by added architectural details and landscaping

The resulting project controls CSOs into Lake Washington from the Henderson Street Pump Station to approximately one untreated discharge every 10 years; from Martin Luther King Jr. Way to approximately zero and untreated CSOs into the lower Duwamish River from the Norfolk location to approximately one per year. This control will be accomplished by new facilities that (1) store CSO flows during small to moderate storms and transfer them to the South Treatment Plant after the storm subsides, and (2) treat and disinfect CSO flows during heavy rain conditions (approximately two to four times per year) and then discharge the treated flows at the Norfolk outfall to the Duwamish River. Major new facilities in the system are as follows:

- Improved Henderson Street Pump Station—a 19 mgd pump station that will transfer flows from the Henderson area
- Henderson Tunnel—a 14-foot diameter, 3,100-foot long tunnel, providing storage, treatment, and disinfection

Construction on the pump station began in November 2001; construction of the tunnel/pipeline began in July 2002. The project was completed in spring 2005. Additional information on the facility can be found at:
https://kc1.sharepoint.com/sites/DNRP/wtdweb/offsite/om/Documents/1314MLK_Ops.pdf

Facilities plans for the original project can be found in the documents section of the CSO control program intranet CSO portal site at: http://dnrp-apps2/wtdrecordssearch/Default.aspx?Act=facility

Further information on the Henderson/MLK CSO storage and treatment facilities, including critical elevations, Operation and Maintenance Manual, Offsite Facility Manuals and system drawings, can be accessed through the Facility Information interactive map (thumb drive link).

11.4 Facility Information

An interactive map (thumb drive link) listing facilities by collection system areas – north collection system, south collection system and the Ballard Siphon collection system – follows. Clicking on a facility will take the reader to summary information for each facility and links to the Operations and Maintenance Manuals, Offsite Facility Manual sections, system and other useful documents.

12. THE CSO CONTROL PROGRAM AND CONTROL PLAN

12.1 Where are King County CSOs?

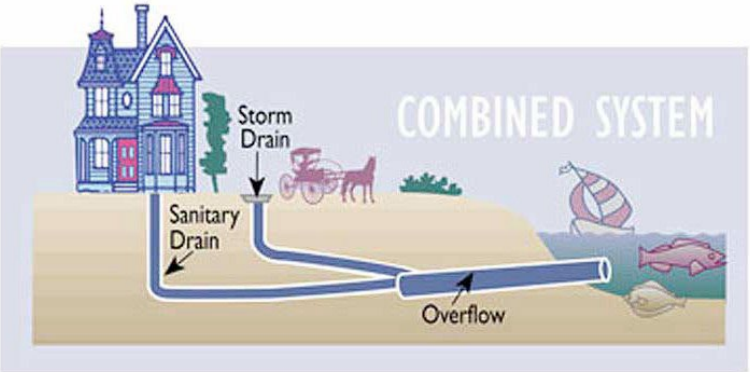
Combined sewers exist in many parts of older cities, including Seattle. During heavy or long storms, the volume of the stormwater runoff may become too much for the combined sewers to handle. To protect treatment plants and avoid sewer backups into homes, businesses and streets, combined sewers sometimes overflow into Puget Sound, the Duwamish Waterway, Elliott Bay, the Lake Washington Ship Canal and Lake Washington. More information on CSOs is available here: http://www.kingcounty.gov/environment/wastewater/CSO/FAQ.aspx#6AA05CFC869F498F87152518B226234F

12.2 What is a CSO?

CSOs are discharges of untreated sewage and stormwater released directly into marine waters, lakes and rivers during heavy rainfall, when the sewers have reached their capacity.

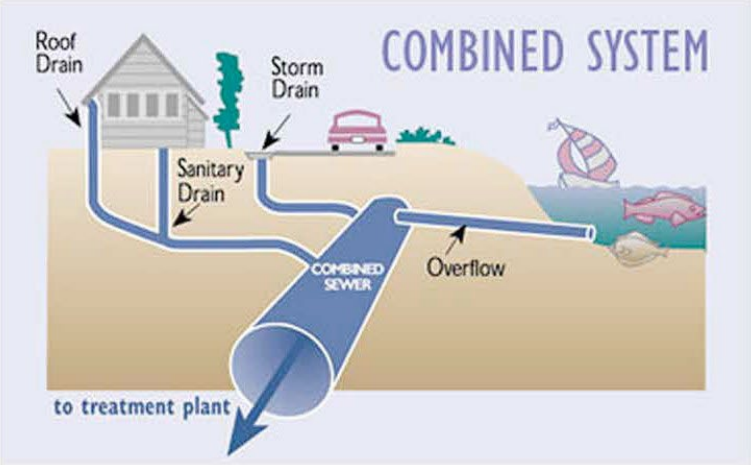
12.3 Why do we have CSOs?

CSOs were built into the system to prevent damage to wastewater facilities and backups into homes and streets from wastewater volumes that have exceeded the capacity of the pipes due to the input of stormwater. Combined sewer systems are a legacy of the original wastewater systems built in the oldest cities. From the late 1800s through the 1940s, engineers designed combined sewers (sewers that carry sewage and stormwater runoff in a single pipe) to convey sewage, horse manure, street and rooftop runoff, and garbage from city streets to the nearest receiving body of water. At the time it was believed that these dilute discharges would not harm the waterbodies. However, by the 1960s mounting scientific information showed there were adverse impacts and the management of these flows needed to change - efforts to control CSOs began. Many of these CSOs have been reduced. Both King County and the City of Seattle manage CSOs within Seattle. King County's Wastewater Treatment Division manages 38 locations and Seattle Public Utilities manages about 90 locations.



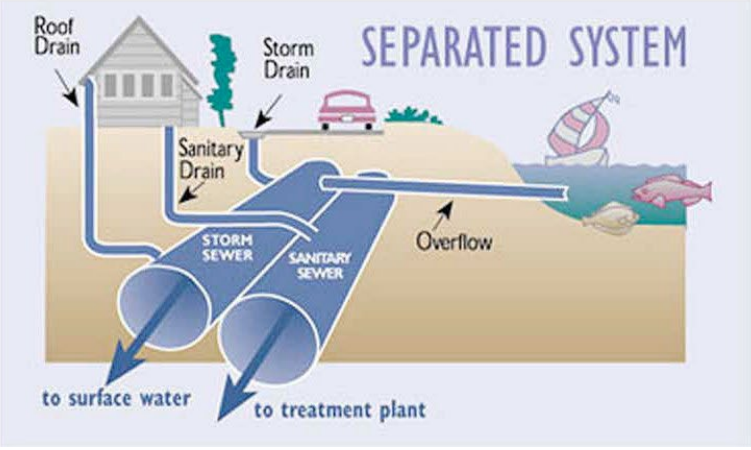
Older combined system (pre-1950s)

From the late 1800s through the 1940s, engineers combined sewers (sewers that carry sewage and stormwater runoff in a single pipe) to convey sewage, horse manure, street and rooftop runoff, and garbage from city streets to the nearest receiving body of water.



Typical modern combined sewer system (post-1950s)

Around the 1950s, most sewer systems were built as separated systems (sewage in one pipe; stormwater in another pipe). In the late 1950s, treating wastewater became the standard. Interceptor pipes were built to transport all wastewater (from either combined or separated systems) to treatment plants.



Typical separated sewer system

Figure 8. Combined and Separated Sewer Systems

Figure 9 shows the historical reduction of untreated and poorly treated wastewater released to local waterways.

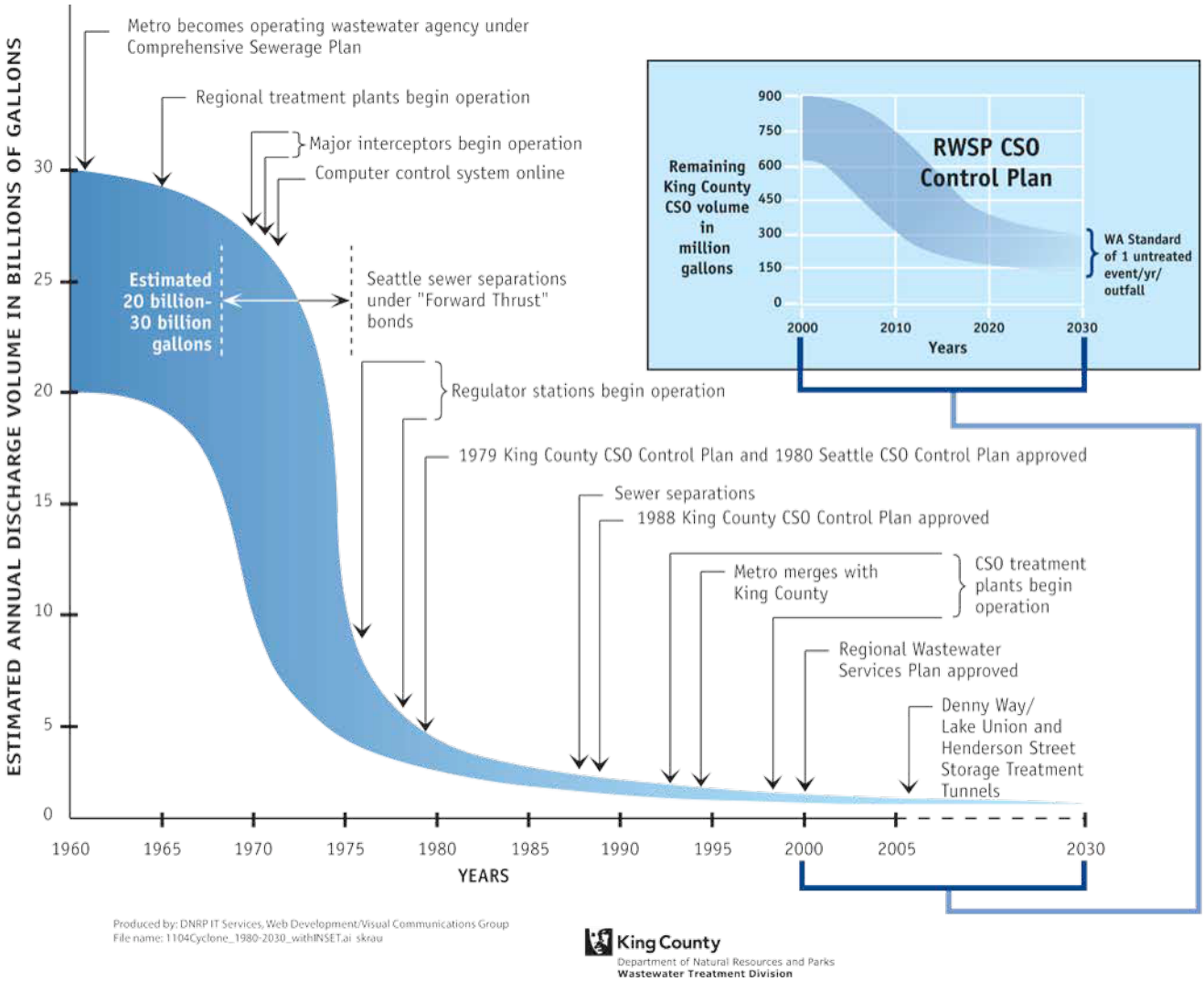


Figure 9. CSO Reduction History

12.4 King County's Plan to Control CSOs

King County has been working to control CSOs since the backbone of the regional system was completed. Plans are dynamic and have to adjust to new information about the system, regulatory requirements, science, regional activities and public preferences. The first CSO control plan was developed jointly with EPA and Ecology in 1979. Since then the plan has been updated and amended as part of a larger system comprehensive plan and as a requirement of 1987 Ecology regulations. Those plans can be found at:
http://www.kingcounty.gov/environment/wastewater/CSO/Library/PlanUpdates.aspx

As of this time, King County has control projects underway at five locations: North Beach, Magnolia, Ballard, Murray and Barton. Previous projects done to control Denny and Dexter are undergoing adjustments to complete control. With 14 uncontrolled CSOs remaining, King County has just completed a major review and amendment of the plan that has now been approved by EPA as a Long-term CSO Control Plan (LTCP). A summary of the recommended plan, the approved LTCP, and eight supporting technical memorandums were produced and can be found at: http://www.kingcounty.gov/csoreview.

Figure 10. King County Recommended CSO Control Plan

The plan proposes to build 9 more projects to control the 14 CSOs by the end of 2030. The map (Figure 10) summarizes the plan.

As part of the U.S. Environmental Protection Agency's (EPA) process to ensure that CSO communities are meeting their requirement for CSO control plans and system control, King County is just completing a performance review by the EPA and is entering into a consent decree to complete the work of the adopted LTCP. EPA requirements differ slightly from those of the Washington State Department of Ecology (Ecology). Ecology passed a CSO control law in 1986 with implementing regulations in 1987. EPA published their CSO control policy in 1994. Through the performance review EPA determined that King County's program under Ecology rules meets their requirements. The City of Seattle, and other CSO cities across the state have also been undergoing performance reviews. Seattle will also be entering into a consent decree. More information on King County's CSO Control Program can be found at:
http://www.kingcounty.gov/CSOcontrol

12.5 What is the Relationship between King County's and the City of Seattle's Management of CSOs?

King County and the City of Seattle share management of the CSOs based on the size of the drainage basin served by each CSO outfall. The county manages CSOs from basins greater than 1,000 acres.

The City of Seattle's combined areas make up about 1/3 of the city's total service area, another 1/3 is partially separated, and 1/3 is separated. Typically, a partially separated area differs from a combined area, in that, the drainage from streets is separated and sent to a storm sewer. Because of the varying amount of separation in the city's system, King County operates CSO control facilities throughout the city's service area. The City of Seattle makes up about 21% of King County's total service area.

Figures 11 and 14 show the locations of King County and Seattle Combined Sewer Overflow (CSO) facilities.

Figure 11. King County and City of Seattle CSO Locations

Like the County, Seattle is implementing a CSO control plan. Their most recent plan (thumb drive link) was adopted in 2010, and a major update as a LTCP is currently underway and will be completed by the end of 2014. Their schedule for completing this amendment is shown in Figure 12, and more information about their plan development and larger program can be found at: http://www.seattle.gov/utilities/about/plans/drainage-and-sewer/waterway-protection

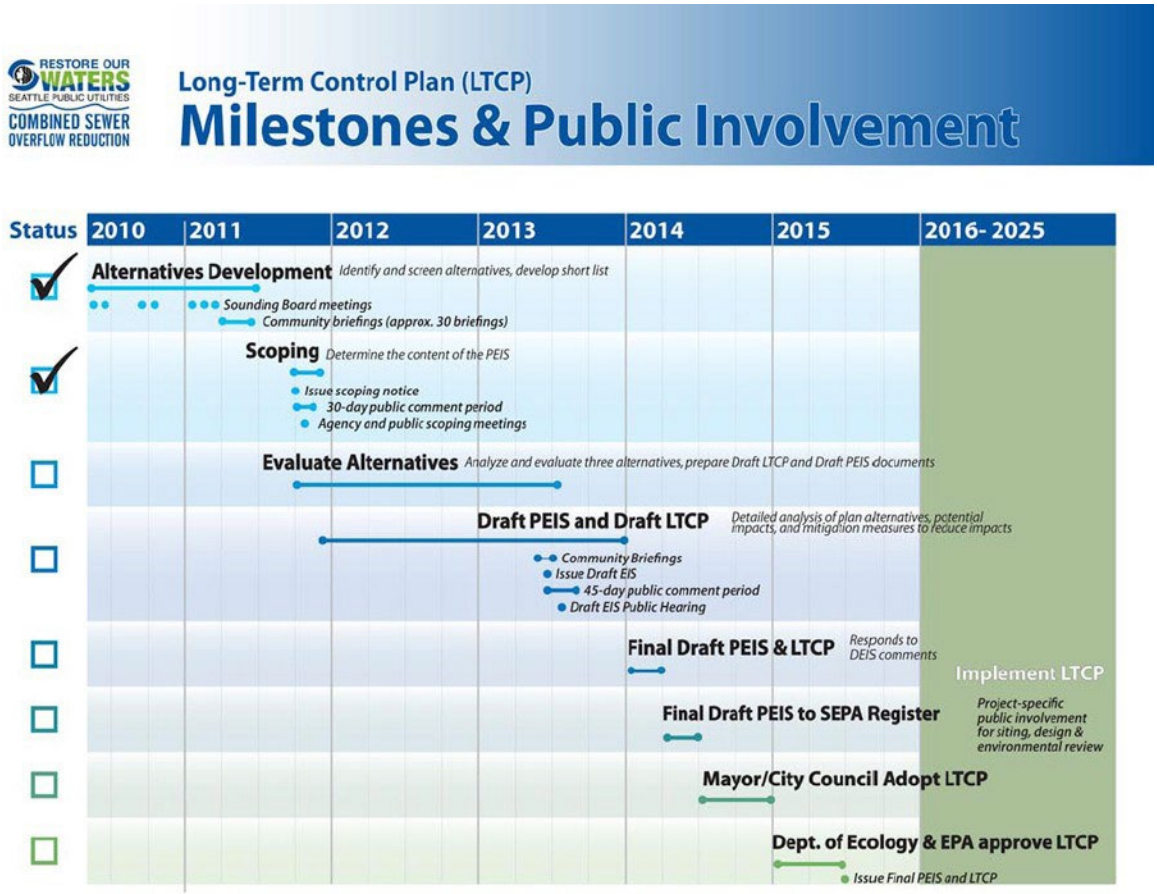


Figure 12. Seattle's Schedule for Development of their Long-term CSO Control Plan

12.6 Joint Operations and System Optimization Plan

Similar to this System Operational Plan, the County and City will be developing a Joint Operations and System Optimization Plan as a consent decree requirement. As both agencies implement their control plans and bring new facilities on-line greater operational coordination will be needed to ensure that each agency's operations of their system does not interfere with the other's achievement of CSO control and compliance, and preferably, also assists the other to meet their goals. King County and Seattle are developing a joint system operational plan to optimize this coordination. The Joint Plan shall include, but not be limited to, the following items:

- Overview of those interdependent portions of the County's regional wastewater, conveyance, and treatment system and the City's Wastewater Collection System;
- Methods to accommodate each agency's operational objectives while complying with their contractual obligations;
- Shared operational objectives for the County and the City's combined systems;
- Organizational structure;
- Modes of operation (dry, wet, transition) for identified CSO facilities;
- Each agency's operational decision hierarchy;

- Identified CSO facilities, if any, that may be beneficial to jointly operate and/or monitor;
- Real-time communication plans/protocols;
- Emergency and special operations protocols;
- A process for incorporating the Joint Plan into the design of new capital projects for the combined system, including the County and City's CSO Long-Term Control Plans; and
- A process for updating the Joint Plan every three years.

These elements meet the minimum requirements of the draft consent decree. King County and Seattle are in negotiations about possible greater interlinking of operations. This plan will be updated to reflect resulting changes to the County's operating approach if and when available.

The Recommended Combined Sewer Overflow Control Plan from the King County Executive is available here.

12.7 Real-Time County CSO Status

The County's new SCADA system called Ovation, displayed at West Point main control and certain other locations (described in a later section) provides definitive information on the status of flows in the conveyance system, through the plant and CSO status. Additional tools in the field of office locations can also be helpful. See *Section 10.4* of this report and the Plant Manual (thumb drive link) – https://kc1.sharepoint.com/teams/WTDOPS/WPTS/WPTP_Manual/Plant_Controls/pltctl2.pdf (intranet link) - for more information on the control system.

Real-time information of King County CSO facilities (status and history information) is provided on a WTD intranet site: http://kcgisinternal/developers/Wastewater/FlowDataPortal/index.html

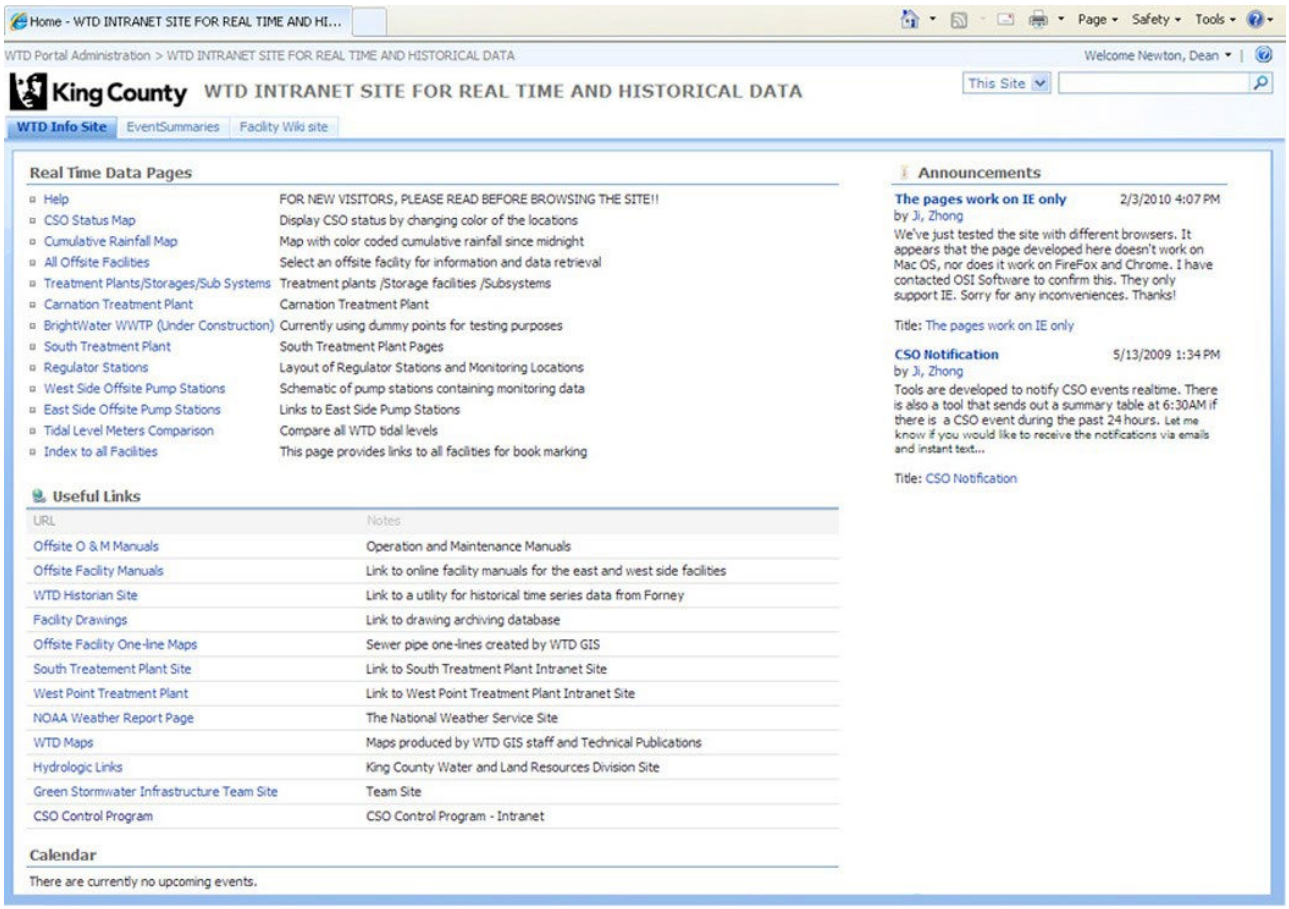


Figure 13. WTD Intranet Site for Real Time Data

12.8 Public Notification of Overflows

Information on CSOs in the field is available to the public and staff. King County has partnered with the City of Seattle, Seattle-King County Health Department, and the Department of Ecology to develop a combined sewer overflow (CSO) public notification program. All publicly accessible CSO locations are posted with warning signs, including a phone number and Web site address for more information. The County's Web site provides significant information on CSOs and the work to control them. It is at: http://www.kingcounty.gov/environment/wastewater/CSO.aspx. King County created a real-time overflow status Web site, later bringing Seattle data into it to provide a fuller picture of CSOs to help people make choices about their use of local waterways: http://www.kingcounty.gov/environment/wastewater/CSOstatus/Overview.aspx

A CSO that is overflowing will display red, and one that has stopped overflowing within the last 48 hours will show yellow. Green indicated no overflow has occurred within 48 hours and blue indicates sites that lack real-time data, but are instead monitored using portable monitors whose data is manually collected.

12.9 Member Community Participation

This Plan is comprised of existing operations information and guidance from many sources. What is new is that the information has been made available from a single plan. The City of Seattle will receive a detailed briefing on the Plan, will receive electronic copies of the plan on thumb drives, and will work with the County to incorporate relevant parts into the Joint Operations and System Optimization Plan. When that Plan is completed in 2016 relevant portions will be incorporated into this Plan. Briefings on the Sewer System Operations Plan will be made to member communities at regular MWPAAC meetings, and on an individual basis if requested. Copies of the electronic plan will also be made available to members on request.

12.10 Sewer System Operations Plan Maintenance

By making this plan an electronic document it will be linked to the most current base documents – such as Operations and Maintenance manuals. Once a year in August, the team (representatives of Operations, Offsite and CSO control planning) will go over the plan to ensure that the electronic links still work. And every third year the team will review to ensure that base documents are being updated as needed, and that any new or changed information is reflected in this plan. Any recommended changes will be shared with the member communities.

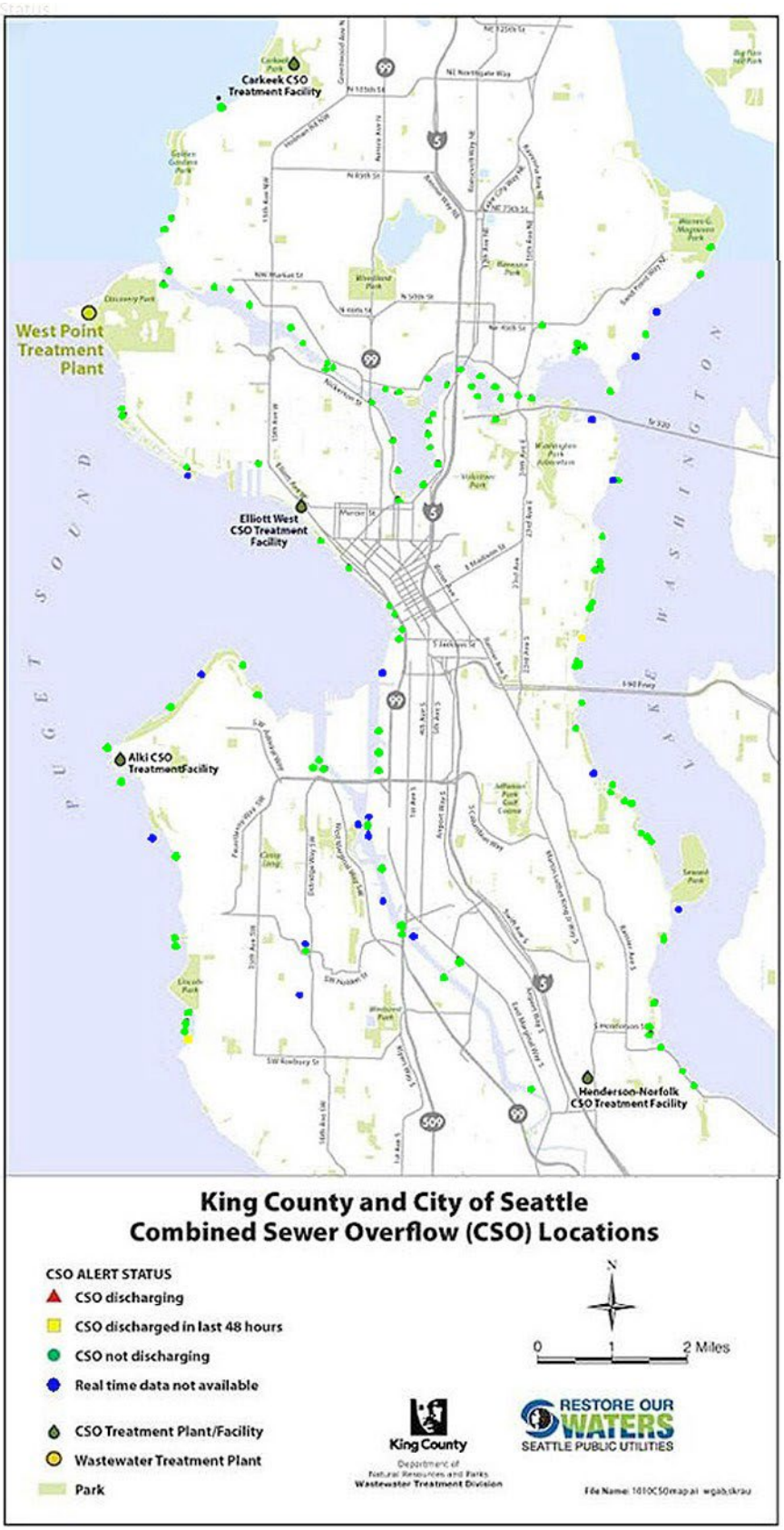


Figure 14. King County and Seattle CSO Facilities Real Time Map

13. APPENDIX

13.1 West Point Treatment Plant Reference Information

King County Internet Site

King County Brochure

Animated Tour of West Point Treatment Plant

Emergency Response Plan (thumb drive link)

Evacuation Map (thumb drive link)

Process Diagram (thumb drive link)

Facility Maps (thumb drive link)

Facility Numbering (thumb drive link)

Process Codes (thumb drive link)

Operations Shift Schedule (thumb drive link)

The following information and procedures can also be found on the intranet site at:

https://kc1.sharepoint.com/teams/WTDOPS/WPTS/WPTP_Manual/WPTP_Manual/Home.aspx

Checklists and Logs (thumb drive links)

Plantwide/Main Control

ACC-1

ACC-2

ACC-3

Expectations and Standards (thumb drive links)

Plantwide/Main Control

ACC-1

ACC-2

ACC-3

Plant Operations and Training Manuals (thumb drive links)

Air Systems

Plant Manual

Disinfection (Hypo) System

SOPs

Drainage System

Plant Manual

SOPs

Effluent System

Plant Manual

SOPs

Electrical Power

Plant Manual

SOPs

Gas Systems

SOPs

Heat Loop System

Plant Manual

HVAC

Plant Manual

SOPs

Main Control

Plant Manual

Odor Control

Plant Manual

SOPs

Oxygen Generation

Plant Manual

Plant Controls

Plant Manual

Plant Hydraulics

Plant Manual

SOPs

Plant Overview

Plant Manual

Preliminary Treatment

Plant Manual

SOPs

Primary Treatment

Plant Manual

SOPs

Sampling

Plant Manual

SOPs

Secondary Treatment

Plant Manual

SOPs

Sludge Digestion

Plant Manual

SOPs

Solids Handling

- Plant Manual
- SOPs

Water Reuse System

- Plant Manual
- SOPs

Water Systems

- Plant Manual
- SOPs

13.2 West System Reference Information (thumb drive links)

Supervisor Contact List

Roster and Phone List

NPDES Permit

Emergency Response Plan Manual

Confined Space Entry Manual

Lockout and Tagout Program Manual

Process Safety Management/Risk Management Program Manual

Overflow Manual

Sewage Bypass/Overflow Report

Overflow/Bypass Incident Debriefing Report

Water Quality Manual

Disinfection System Failure Report

Unusual Occurrence Sampling Form

West Offsite Facilities Status

West Offsite Fire Alarm Monitoring

Overview Maps - Ovation Screens (thumb drive links)

- Carkeek/Richmond Beach
- East Duwamish Interceptor
- King Street to Hanford
- Sammamish/Kenmore
- University/Montlake Area
- West Duwamish Interceptor
- West Seattle Corridor Overview