King County
Department of Natural Resources and Parks
Wastewater Treatment Division
King Street Center, KSC-NR-0500
201 South Jackson Street
Seattle, WA 98104-3855

July 30, 2010

Mark Henley
Washington State Department of Ecology
3190 160th Avenue SE
Bellevue, WA 98008-5442

Dear Mr. Henley:

Enclosed is the King County Wastewater Treatment Division Annual Combined Sewer Overflow Report prepared in accordance with the requirements established in the National Pollutant Discharge Elimination System Permit WA-002918-1 and WAC 173-245-090. The report contains an overview and status of King County's Combined Sewer Overflow (CSO) Control Program, and 2009 overflow and frequency information.

The annual rainfall for 2009, as an average over local rain gauges, was 31.47 inches, lower than the long-term average of 37 inches. In addition to the lower than average amount of rain, the rainfall pattern exhibited less intense, steadier precipitation than in recent years. This type of rainfall is more easily assimilated by the combined sewer system. Hydraulic modeling predicts that King County CSOs will discharge 900 million gallons (MG) of untreated CSO in an average year of rainfall. Conditions in 2009 resulted in a discharge of 690 MG over a total of 236 events.

The report also includes event-based data for the year (Appendices A and B) which is also being provided electronically by email. Appendices C through F are the annual reports for the four CSO treatment facilities. On June 16, 2010, the Department of Ecology issued a Notice of Penalty to King County for permit violations that occurred between September 1, 2009, and April 30, 2010 at the four CSO treatment facilities. While these reports cover 2009 activities, most of the causes of the violations were addressed and corrected immediately; corrections for others are under way.

King County is committed to ensuring that its CSO treatment facilities run properly and are in compliance with the NPDES permit. If you have any questions, please contact me at 206-263-3825, or Karen Huber, Wastewater Engineer IV, at 206-684-1246.

Sincerely,

Dan Grenet
West Section Manager

Enclosure

cc: Shirley Marroquin, Manager, Planning and Asset Management Unit (PAM), Project Planning and Delivery Section (PPD), Wastewater Treatment Division (WTD), Department of Natural Resources and Parks (DNRP)
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Combined Sewer Overflow Control Program
2009 Annual Report

July 2010

King County
Department of Natural Resources and Parks
Wastewater Treatment Division

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Contents

Appendices

Tables

Figures

Section 1

Introduction

King County prepares annual reports on its combined sewer overflow (CSO) control program and submits them to the Washington State Department of Ecology (Ecology) to fulfill requirements under the National Pollutant Discharge Elimination (NPDES) permit for the county's West Point Treatment Plant in Seattle and requirements in WAC 173-245-090.[1] This report documents CSO control program activities for calendar-year 2009.

The annual rainfall for 2009, as an average over local rain gauges, was 31.47 inches, lower than the long-term average of 37 inches. In addition to the lower than average amount of rain, the rainfall pattern exhibited less intense, steadier precipitation than in recent years. This type of rainfall is more easily assimilated by the combined sewer system. Hydraulic modeling predicts that King County CSOs will discharge 900 million gallons (MG) of untreated CSO in an average year of rainfall. Conditions in 2009 resulted in a discharge of 690 MG over a total of 236 events.

On June 16, 2010, Ecology issued a Notice of Penalty to King County for permit violations at the four CSO treatment facilities that occurred between September 1, 2009, and April 30, 2010. The penalty assessed was $48,000. The notice covered an alleged 44 violations of effluent limits and monitoring requirements. King County is working with Ecology to clarify the violation count and resolve other issues. Most of the causes of the violations were addressed and corrected immediately; corrections for a few others are under way. King County is committed to ensuring that its CSO treatment facilities run properly and are in compliance with the NPDES permit.

The following sections provide background on King County's wastewater system and its CSO control program and describe new requirements for the program stipulated in the most recent NPDES permit renewal, with particular emphasis on changes to reporting requirements.

1.1 King County CSO Locations

The King County Wastewater Treatment Division (WTD) provides wholesale wastewater conveyance and treatment for flows from 17 cities, 16 local sewer utilities, and 1 Indian tribe.

The City of Seattle's local wastewater collection system contains combined sewers that collect both wastewater and stormwater. Other newer local systems use separate sewers to convey wastewater and stormwater. Seattle's combined sewers convey flows to county trunks and interceptors, which then convey flows to the West Point Treatment Plant located in Discovery Park. A small portion of flows from the combined system is treated at the South Treatment Plant in Renton.

When large storms occur and flows exceed the capacity of county conveyance system pipes, CSOs may occur at some of the 38 county CSO locations that discharge to Lake Washington, Lake Union, the Lake Washington Ship Canal, the Duwamish River, Elliott Bay, and Puget Sound (Figure 1). CSOs also may occur at 88 CSO locations in the City of Seattle's local sewer

[1] WAC = Washington Administrative Code.

system. The city is responsible for these locations. CSOs are a recognized source of water pollution that can result in temporary increases in bacterial counts and aesthetic degradation of shorelines, in long-term adverse effects on sediment quality at discharge points, and in raised public health concerns in areas where there is potential for public contact.

Figure 1. King County CSO Locations

1.2 CSO Control Plans and Updates

Since the 1970s when the basic regional wastewater system infrastructure was in place, King County has been implementing CSO control projects to improve water quality in the Seattle area.

1.2.1 Past and Current Plans

The county first formalized CSO control with the development of the 1979 CSO Control Program (1979 Program). The 1979 Program identified nine projects to reduce the number of CSO events into fresh water (Lake Washington, Lake Union, and the Lake Washington Ship Canal). In 1985, the Washington State Water Pollution Control Act (Chapter 90.48 RCW) introduced new regulations that required all municipalities with CSOs to develop plans for "the greatest reasonable reduction at the earliest possible date." The county prepared the 1986 Final Supplemental Plan for Secondary Treatment Facilities and Combined Sewer Overflow Control (1986 Plan) to meet this requirement.

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

As part of the 1995 NPDES permit renewal for the West Point Treatment Plant, King County prepared an update and amendment to the 1988 Plan. The 1995 CSO Control Plan Update (1995 Plan Update) assessed the effectiveness of CSO reduction efforts to date, reevaluated priorities for control of CSO sites, and identified three control projects for completion in 1995–2000.[2]

In November 1999, the King County Council approved the Regional Wastewater Services Plan (RWSP). The RWSP identifies wastewater projects to be built through 2030 to protect human health and the environment, serve population growth, and meet regulatory requirements. The RWSP includes a CSO control plan that consists of the amended 1988 Plan (1995 Plan Update), a goal for achieving control at each CSO location by 2030,[3] and identification of 21 CSO control projects at a total cost of $378 million (2005 dollars) to meet this goal.

An update of the RWSP's CSO control plan—Control Plan Year 2000 CSO Update (2000 Plan Update)—was included in the June 2000 submission of the West Point Treatment Plant NPDES permit renewal application. The 2000 Plan Update describes King County's progress in implementing its CSO control program, documents its compliance with state and federal CSO control requirements, and identifies two large control projects—Denny Way/Lake Union and Henderson/Martin Luther King (MLK)/Norfolk CSO control projects—for completion in the

[2] Ecology's CSO regulation (Chapter 173-245 WAC) requires that CSO plan updates be submitted with each NPDES permit renewal for the West Point Treatment Plant. Updates are intended to document progress on implementing the county's CSO control program, identify its program for the next five years, and provide a vehicle for making changes in the overall long-term program.

[3] Prior to King County's adoption of the RWSP, Ecology had withdrawn the 1988 Plan's interim goal of 75 percent reduction of CSO volumes by 2005 in favor of allowing the county to prioritize control projects in terms of protection of human health rather than reduction of volumes.

next five-year NPDES permit cycle. The resulting Mercer/Elliott West and Henderson/Norfolk CSO control systems came online in spring 2005.

King County completed the 2008 CSO Control Plan Update (2008 Plan Update) in April 2008. The 2008 Plan Update describes the county's wastewater system and the control status of its CSOs, indicates how the county is meeting the U.S. Environmental Protection Agency's (EPA's) Nine Minimum Controls, and summarizes the scientific studies that have shaped the control program over time. The update also describes completed, in progress, and planned CSO control projects, available CSO control strategies, and how these strategies apply to county projects.

Ahead of each CSO control plan update, the county reviews the plan and its CSO Control Program in general against conditions that have changed since the last update—conditions such as population and flow, scientific developments, regulations, new technologies, and public priorities. Reviews conducted in 2000 and 2006 provided program status and progress. No changes to the RWSP CSO control plan were recommended. In the 2006 review, King County committed to implementing four of the RWSP projects—Barton, Murray, South Magnolia, and North Beach, together known as the Puget Sound beach projects (described in Section 3 of this report).

1.2.2 The Next Plan Update

In early January 2008, EPA conducted an audit of the county's wet-weather management programs. Such audits are occurring across the country under a strategy set by EPA's Office of Enforcement and Compliance Assurance (OECA). Agencies are selected to be audited based on their size, population served, and system complexity. City of Seattle programs underwent a similar audit at the same time. OECA and EPA Region 10 staff, accompanied by Ecology staff, performed an intensive inspection over five days. Since that time, King County has met with EPA many times and has provided additional information on programs and activities. In July 2009, EPA issued an order and request for information that required submittal of three plans—two related to compliance of the Mercer/Elliott West CSO control system and one calling for a floatables observation study. In October 2009, EPA resumed the audit to review the county's CSO control plan for conformance with the elements of EPA's long-term control plan. In May 2010, the county met with EPA and received another request for information. The county is committed to working with regulatory agencies to ensure that its programs comply with regulations.

Results of the EPA audit will inform the next CSO program review and plan update. The current cycle of review will begin in 2010 and will result in submittal of a report to the King County Council in June 2012 recommending any changes to the CSO control plan and program. The adopted update to the plan will then be prepared and submitted to Ecology by June 2013 to meet the deadline set in the NPDES permit renewal.

The review will take into consideration the City of Seattle's CSO control needs. King County recommended a collaborative control project alternative development process to the city in early 2009. The approach was to develop collaborative alternatives in parallel with independent alternatives. Collaborative alternatives that are more cost-effective than independent alternatives will advance into schedule development and rate analysis.

County and city staff participated in four workshops in mid-2009 to brainstorm potential collaborative concepts that may benefit both agencies. Approximately 40 concepts were developed. Further review and screening left approximately 20 concepts, which were divided between the agencies for preliminary development. The development of alternatives began in 2009. Joint management decisions on alternatives will occur in early spring 2011. Any proposed schedules that integrate independent and collaborative projects will undergo wastewater rate analysis by both agencies, and decisions on any integrated schedules will be made in joint management workshops in late spring 2011. The city and county will incorporate any joint control alternatives and integrated schedules into their proposed CSO control plan updates.

1.3 Changes in NPDES Permit Requirements Affecting CSO Control Program

The West Point Treatment Plant NPDES permit was renewed July 1, 2009. The renewed permit contains new requirements for the CSO control program. These changes have led King County to redesign and simplify its annual CSO control program reports.

The sections below describe the new program requirements and then specific requirements for annual reports. The information in parentheses following each requirement refers to the section of the permit where the requirement is located. The permit can be viewed at http://www.ecy.wa.gov/programs/wq/permits/permit_pdfs/west_point/2009/WestPointWWTP_Permit.pdf.

1.3.1 CSO Program Requirements

New requirements for King County's CSO control program that became effective July 1, 2009, include the following:

- Submittal of the next CSO control plan amendment/update as part of the NPDES permit renewal application by June 30, 2013
- Interim and final fecal coliform effluent limits at the Mercer/Elliott West CSO treatment facility (S.1.D)
- Monitoring requirements for all treated CSOs (S.2.A.2−5)
- Monitoring requirements for all untreated CSOs (S.2.A.6)
- Priority pollutant monitoring of the Henderson/Norfolk treated CSO discharge (S.18.F)
- More specific definition of the CSO–related bypass, monitoring, and reporting requirements at the West Point Treatment Plant (S.17)
- New reporting requirements:
  - Monthly CSO reports (S18.B.1)
  - Changes to the annual CSO report (S.18.B.2), described below
  - A new interpretation of the control performance standard of "one untreated event per year per outfall" as a 20-year moving average (S.18.B.2, S.18.C, and S.18.K.1)

- A compliance schedule for the four Puget Sound Beach CSO control projects (S.18.E)
- Slightly changed Nine Minimum Control descriptions (S.18.H)
- Submittal of a receiving water characterization study for the CSO treatment facilities by June 30, 2013 (S.18.I), preceded by a receiving water sampling quality assurance plan for any newly required monitoring submitted June 30, 2010
- Development of a sediment quality summary report for all CSOs and CSO treatment facilities (submitted December 31, 2009) (S.18.J)—preceded by an annotated outline (submitted September 1, 2009); also, submittal of a sediment sampling and analysis plan for any newly required monitoring by December 31, 2010, and a sediment data report for any required sampling by January 1, 2013
- Development of a CSO post-construction monitoring plan (submitted July 1, 2010) (S.18.K.3), followed by a post-construction monitoring data report by August 31, 2012

1.3.2 Annual Reporting Requirements

The renewed NPDES permit includes several requirements for annual CSO control program reports. The requirements and how they are being implemented are as follows:

- Submittal deadline of July 31 each year.
- Reporting of information by calendar year.[4]
- "Event-based" data reporting by CSO site:[5]
  - Include duration of each CSO event. The duration represents the period from the start until the end of the overflow, as defined by a subsequent 24-hour non-overflow period. The overflow itself may be intermittent within this duration period.
  - Include rainfall data for each CSO event as measured by the nearest King County rain gauge. This reporting began with the July 2009 monthly report; data from July through December 2009 are provided in this 2009 annual report.
  - Provide event-based data in electronic form along with the report.
- Reporting of the average of the overflow frequency at each CSO site over the last 20 years. Because 20 years of data are not available for all sites, Ecology has specified that missing data from the early years or pre-control project years will be reported from the hydraulic model for those sites identified as having achieved control to the state standard. Modeled data for some sites are provided in this 2009 report.
- Identification of CSOs considered controlled in both the annual reports and the control plan amendments (S.18.K.2).

[4] The June–May reporting over a wet season has been discontinued.
[5] Reports no longer contain tables providing summary data for CSOs across the system and over the wet season.

1.4 Organization of this Report

Subsequent sections and appendices in this report present the following information:

- Section 2—a report on implementation of the Nine Minimum Controls, as defined in the renewed NPDES permit
- Section 3—status of CSO control projects in progress
- Section 4—discussion of 2009 rainfall and CSO events
- Section 5—a table showing the 20-year average frequency of untreated CSO events for each site
- Appendix A—detailed event-based tables for untreated CSOs in 2009
- Appendix B—detailed event-based tables for treated CSOs in 2009
- Appendices C through F—annual reports for the four satellite CSO treatments facilities—Alki, Carkeek, Mercer/Elliott West, and Henderson/Norfolk

Section 2

Programs to Meet EPA's Nine Minimum Controls

King County has implemented a number of programs to satisfy the requirements of the Nine Minimum Controls, which are a part of EPA's codified CSO Control Policy. The definitions for the controls in the renewed NPDES permit for the West Point Treatment Plant differ slightly from EPA's definitions. The following sections describe King County's programs and activities in regard to each of the Nine Minimum Controls, with emphasis on activities undertaken in 2009.

2.1 Control 1—Reducing CSOs Through Operation and Maintenance

Implement proper operation and maintenance programs for the sewer system and all CSO outfalls to reduce the magnitude, frequency, and duration of CSOs. The program must consider regular sewer inspections; sewer, catch basin, and regulator cleaning; equipment and sewer collection system repair or replacement, where necessary; and disconnection of illegal connections.

Proper facility operation is managed by West Point Treatment Plant staff using SCADA.[6] Asset management programs implemented by West Point Treatment Plant, South Treatment Plant, and collection system staff maintain CSO outfalls, regulator stations, and pump stations. Collection system staff inspect sewers on a specified schedule and perform corrective actions when deficiencies are found. Maintenance schedules and records of visits are available for inspection on request.

Salt water and sand that enter the system can cause corrosion and occupy capacity. In 2007, meters were installed at suspected saltwater intrusion points to better identify the areas of intrusion during high tide cycles in dry-weather months. Monitoring results prompted initiation of a new study in February 2008 to assess the extent of problem and to develop a plan to address it. The study is expected to be completed in 2010.

A review done several years ago indicated that installing permanent backup generators in pump stations that lack reliable dual power feeds could help to prevent overflows. The installation process is nearing completion.

King County's Asset Management Program expanded its use of asset management tools, including a more robust standardized inventory system and condition rating systems, and is developing long-range asset replacement and renewal forecasts, including action plans, to avoid failure of critical assets. An update to WTD's 2005 strategic asset management plan was completed in 2010.

[6] SCADA = Supervisory Control and Data Acquisition system, which provides monitoring and control capabilities for the treatment plant collection systems.

2.2 Control 2—Storing CSOs in Collection System

Implement procedures that will maximize use of the collection system for wastewater storage that can be accommodated by the storage capacity of the collection system in order to reduce the magnitude, frequency, and duration of CSOs.

Under normal and expected conditions, the SCADA system automatically operates the wastewater system based on programmed level setpoints and action sequences. Levels in pump station wet wells and at key points in the conveyance system trigger changes in pump speeds and adjustments of gate positions at pump, regulator, and outfall stations. These adjustments can change the rate and direction of flow through the pipes and optimize storage of flows in the conveyance system. The setpoints are reviewed when the hydraulic model is recalibrated and when other information suggests that more efficient use of the collection system may be possible.

The RWSP CSO control plan also emphasizes collection system storage projects for CSO control.

2.3 Control 3—Optimizing Pretreatment Program

Review and modify, as appropriate, its existing pretreatment program to minimize CSO impacts from the discharges from nondomestic users.

King County's Industrial Waste Program issues approvals that set limits on the chemical contents of industrial discharges. The program includes monitoring and permit enforcement, education, and technical assistance to businesses on appropriate waste pretreatment and disposal techniques. Local discharge limits are reviewed on a regular basis according to Ecology requirements. The county submits an annual pretreatment report to Ecology detailing education, permitting, monitoring and inspections, and enforcement actions taken during the year.

King County also administers and helps fund the Local Hazardous Waste Management Program.

Influent quality at the West Point Treatment Plant is assessed for trends that would suggest concurrent changes in CSO discharges. In addition, biosolids quality data from the West Point Treatment Plant are tracked as an indicator of changed loading to the system that could influence CSO quality. The only trends seen are the slow decrease or stability in pollutant concentrations.

The county is currently performing a pollutant study under the renewed NPDES permit.

2.4 Control 4—Maximizing Flow to Treatment Plant

Operate the POTW treatment plant at maximum treatable flow during all wet weather flow conditions to reduce the magnitude, frequency, and duration of CSOs. The Permittee must deliver all flows to the treatment plant within the constraints of the treatment capacity of the POTW.[7]

SCADA is used to maximize flow to the secondary treatment plants via operation of regulator and pump stations. The West Point Treatment Plant provides secondary treatment for all base

[7] POTW = publicly owned treatment works.

flows (defined by Ecology as 2.25 times the average wet-weather flow) and CSO/primary treatment for flows between 300 million gallons per day (mgd) and the peak hydraulic capacity of 440 mgd.[8] (The parallel Fort Lawton Tunnel was built in 1992 to convey up to 440 mgd to the plant.) After receiving CSO/primary treatment, 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, with a small reduction—80 percent instead of 85 percent removal—in total suspended solids (TSS) percent removal requirements.

Up to 24 mgd of combined flows are conveyed to South Treatment Plant from southeast Seattle to receive full secondary treatment. This conveyance minimizes CSOs to the Duwamish River along the Elliott Bay Interceptor.

Treatment process stability is monitored and optimized to manage flows based on information from automatic sensors and a battery of analytical tests. Process control laboratories at each plant conduct the testing and analysis and then recommend adjustments to the processes if necessary.

All analyses for CSO control project alternatives include storage and transfer to the secondary and CSO treatment plants.

2.5 Control 5—Preventing Dry-Weather Overflows

Dry weather overflows from CSO outfalls are prohibited. The Permittee must report each dry weather overflow to the permitting authority as soon as it becomes aware of the overflow. When it detects a dry weather overflow, the Permittee must begin corrective action immediately and inspect the dry weather overflow each subsequent day until it has eliminated the overflow.

King County CSOs do not occur as a result of inadequate dry-weather flow capacity. The county provides enough capacity in the combined sewer system to transfer 2.25 times the average wet-weather flow to secondary treatment, as negotiated with Ecology. The only overflows seen in the combined system during dry weather result from problems such as power outages, mechanical failures, or human error. These events are rare and are immediately reported to Ecology.

Operation and maintenance programs, as described for Control 1, focus on preventing dry-weather overflows and exacerbated CSOs.[9] The conveyance system is monitored through SCADA and direct observation; corrective action is taken immediately if a problem occurs. Equipment problems are immediately reviewed, and repair or replacement is undertaken in a timely manner.

2.6 Control 6—Controlling Solids and Floatables

Implement measures to control solid and floatable materials in CSOs.

The majority of floatables in the King County system are captured in the large volume of wastewater transferred to the treatment plants before overflows occur.

[8] mgd = million gallons per day.

[9] Exacerbated CSOs occur during precipitation but are worsened by mechanical failures, power outages, and human error.

The county engages in the following practices to control floatables:

- Capturing the "first flush" (maximizing flow to treatment plants) so that most solids and floatables that do enter the sewer are conveyed to the plant for removal and disposal before pipelines reach overflow conditions.
- Constructing facilities with gates and weirs that retain and minimize the release of solid and floatable materials. Gates are set to maximize flow containment. Baffles are used in front of weirs to help hold back all but the smallest items in the flow that passes over them.
- Coordinating with the City of Seattle on measures to reduce the washing of street solids and trash into sewers via stormwater and to promote proper disposal of trash so that it is not flushed down toilets.
- Building CSO control projects so that floatables and solids are retained in the sewer.
- Encouraging wise water use to reduce unnecessary flows in the sewer that contribute to overflows.
- Monitoring development of new floatables control technologies.

The City of Seattle's catch basin maintenance program limits the introduction of floatable materials to sewers. King County developed an information campaign with brochures and TV spots to educate the public that trash should not be flushed to the sewers. Information is available at http://www.kingcounty.gov/environment/wastewater/CSO/Library/ResourcesLinks.aspx.

Observations of the quantity of floatables are noted in logs at each facility and are available for inspection on request. These observations have indicated that additional floatables and solids controls are not needed at this time. To supplement this effort, King County began a three-year project in 2009 to observe the floatables in water bodies near nine CSOs within four hours of an overflow. Observations will be compared to photos of each area during summer non-overflow periods. If additional floatables control is found to be needed in the future, the needs will be addressed in the CSO control projects implemented under the county's long-term control plan. The report for the first year is being submitted to Ecology and EPA concurrent with this 2009 annual report.

2.7 Control 7—Preventing Pollution

Implement a pollution prevention program focused on reducing the impact of CSOs on receiving waters.

King County has implemented the Industrial Waste Program (IWP) and has been a major participant in the Local Hazardous Waste Management Program. Both programs serve to reduce discharge to sewers of chemicals and other substances that adversely impact the environment and the wastewater treatment process.

IWP limits the discharge of fats, oil, and grease (FOG) from a petroleum or mineral origin (nonpolar FOG) to 100 milligrams per liter. Industries must use oil/water separators to pretreat oily wastewater to prevent harm to the biological phase of wastewater treatment and must submit plans for the separators to the local sewer utility or to IWP for review and approval before installing the separators. FOG from an animal or a vegetable origin (polar FOG) can block sewer

lines. Although polar FOG has no numerical limit, dischargers are required to minimize free-floating polar FOG and may be required to complete a FOG control plan for IWP's review and approval.

King County also prohibits discharge to the sewer of materials such as ashes, sand, grass, and gravel. Industrial wastewater must contain less than 7 milliliters per liter of solids capable of settling. Food waste, including food-grinder waste, must be capable of passing through a 0.25-inch sieve.

Educational materials on controlling trash disposal to sewers are a part of the larger public information program.

2.8 Control 8—Notifying the Public

Implement a public notification process to inform the citizens of when and where CSOs occur. The process must include (a) mechanism to alert persons of the occurrence of CSOs and (b) a system to determine the nature and duration of conditions that are potentially harmful for users of receiving waters due to CSOs.

King County operates a CSO Notification and Posting Program as a joint project with the City of Seattle and Public Health–Seattle & King County. This program includes the posting of signs at publicly accessible CSO locations, an information phone line, websites, a brochure, and other public outreach activities. A website providing real-time notification of recent and current CSO discharges went live December 2007.[10] In 2009, King County started the process to incorporate City of Seattle real-time overflow information on this site. The webpage will be converted to a joint presentation of overflow status with links to and from each agency's independent website. In this way, the community will have access to consolidated information to assist in making choices about use of local waters. Completion of a joint site is targeted for early 2011. An automated e-mail notification system is also being tested and is looking promising.

Ongoing community involvement programs help to keep the public informed of CSO-related conditions. Specific efforts are being implemented to involve communities near the Puget Sound beach projects in the decisions for those projects. The public involvement plan for the next CSO control program review and plan update will be developed in 2010, and meetings with organizations will be scheduled.

2.9 Control 9—Monitoring CSO Outfalls

Monitor CSO outfalls to characterize CSO impacts and the efficacy of CSO controls. This must include collection of data that it will use to document the existing baseline conditions, evaluate the efficacy of the technology-based controls, and determine the baseline conditions upon which it will base the long-term control plan. This data must include:

- ***a. Characteristics of the combined sewer system including the population served by the combined portion of the system and locations of all CSO outfalls in the CSS.***
- ***b. Total number of CSO events and the frequency and duration of CSOs for a representative number of events.***
- ***c. Locations and designated uses of receiving water bodies.***

[10] http://www.kingcounty.gov/environment/wastewater/CSO/RealTime/SeattleOverview.aspx.

d. Water quality data for receiving water bodies.

e. Water quality impacts directly related to CSO (for example, beach closing, floatables, wash-up episodes, fish kills).

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

Under the renewed NPDES permit for the West Point Treatment Plant, King County developed a comprehensive sediment quality summary report for all CSO discharge locations (submitted December 2009) and a CSO post-construction monitoring plan (submitted July 2010).[11] The county will submit ambient monitoring data near CSO plant outfalls by June 30, 2013, and will implement additional sediment sampling if required by Ecology.

[11] The sediment report is available at http://www.kingcounty.gov/environment/wastewater/CSO/Library/SedQualSum.aspx.

Section 3

Status of Current CSO Control Projects

This section describes the progress made on implementing current CSO control projects and projects that affect CSO control.

3.1 Puget Sound Beach Projects

Four CSO control projects are currently in predesign: South Magnolia, North Beach, Barton Street, and Murray Avenue. These four projects are referred to as the Puget Sound Beach projects. The recently renewed NPDES permit for the West Point Treatment Plant set the following compliance schedule for these projects:

- Submit for approval a Facilities Plan by December 31, 2010
- Submit for review and approval final plans and specifications by December 31, 2012
- Begin construction by December 31, 2013

Storage was identified in the RWSP as the method for control for these projects. An initial assessment, however, indicated that reducing upstream sources may be a cost-effective solution. Flow meters were installed in the project basins in December 2007, and data were collected in 2008. Detailed sub-basin models were created and calibrated to the flow data. Approaches for each basin were identified using this information. Four approaches were chosen for further evaluation:

- Conveyance/treatment—sending flows from the basin to a secondary or CSO treatment plant
- Storage—retaining flows during storms to prevent CSOs
- On-site treatment—providing primary treatment for flows exceeding system capacity during large storms
- Demand management (stormwater flow reduction)—implementing one or more methods of limiting stormwater flow into the sewer system; green stormwater infrastructure (GSI) may be considered to manage the stormwater

Up to nine alternatives, representing a combination of approaches and potential sites, were developed for each basin. In autumn 2009, the project team evaluated the alternatives using basin-specific criteria. The use of GSI is one of three alternatives for the Barton basin. Final alternatives for each basin will be identified in fall 2010. The preferred alternative and alternative development process will be documented in the Facilities Plan that is due to Ecology by the end of 2010.

Extensive coordination with the public is occurring throughout the alternatives selection process through public meetings, community group meetings, e-mail, and letters. Information on the county's CSO control program and progress on the Puget Sound beach projects is available at http://www.kingcounty.gov/environment/wtd/Construction/Seattle/BeachCSO.aspx.

3.2 Ballard Siphon Replacement

The Ballard Siphon, built in 1935, consists of two woodstave siphon barrels that rest on the bottom of the Lake Washington Ship Canal. The siphon carries flows collected from Seattle's north end near Carkeek Park and from the Ballard area across the Ship Canal. From there, the flows are conveyed to the West Point Treatment Plant.

In November 2005, King County conducted a sonar inspection of the Ballard Siphon. The inspection showed spots of abnormalities in the integrity of the pipe. Because sonar inspections are a new technology, it is unclear how long the abnormalities had been present and how high the risk of failures. Subsequent analyses and inspections indicated that the anomalies were not threatening; however, replacing the siphon is continuing forward as a high priority project in order to maintain siphon integrity and function and because the project will yield CSO control benefits. The completed project will eliminate CSO events at the Ballard Regulator Station earlier than planned. It will also reduce overflows at the 11th Avenue NW CSO site, likely reducing the scope of a future control project at this site.

The Ballard Siphon Replacement project includes two major components: (1) slip-lining the existing woodstave siphon barrels to extend their useful life, and (2) tunneling an 84-inch-diameter pipe below the canal. Design was completed in May 2009; construction is expected to begin in first quarter 2011 and be substantially complete in 2014.

3.3 Ravenna Creek Diversion

Since 2008, King County has been working with Seattle Public Utilities, Seattle Parks and Recreation, and the Washington State Department of Fish and Wildlife (WDFW) to identify a project design that will correct an overflow point from the county's wastewater conveyance system to the stormwater system in the University Slough area. This overflow point was created incidental to the Ravenna Creek daylighting project to divert high creek flows to the wastewater system and limit the potential for downstream flooding.

The project will extend the existing 18-inch-diameter stream transfer pipe, connect it directly to the existing Ravenna Creek discharge pipe, and minimize the potential for wastewater cross-contamination of the stormwater system. In addition, the inlet capacity to the Lake City Tunnel at the 24th Avenue NE Diversion Structure will be increased to improve system hydraulics. Construction of the project is scheduled to be completed in fourth quarter 2010. King County staff has worked closely with park user groups, community stakeholders, the University of Washington, and project neighbors to provide information and to address concerns. The county will continue to coordinate with the university, community, and WDFW on mitigation projects associated with the wastewater spill that occurred in May 2008 and with project construction. This project is not considered a CSO control project but will eliminate the potential for releases from the combined sewer system associated with creek daylighting structures.

Section 4

Summary of Rainfall and CSO Events

King County measures rainfall in the Seattle area at several of its regulator and pump stations and at the West Point Treatment Plant. It also monitors the frequencies and volumes of both untreated and treated CSOs at all its CSO discharge sites.

This section describes rainfall data, reports on unpermitted overflows, and summarizes frequency and volume for all untreated and treated CSO discharges in 2009. More information can be found in the appendices.

4.1 Annual Rainfall

The 2009 renewed NPDES permit requires that rainfall data be reported for each CSO event as measured by the nearest King County rain gauge. King County began this rainfall reporting with the July 2009 monthly report; data from July through December 2009 are included in Appendices A and B of this annual report.

The annual rainfall for 2009, as an average over local rain gauges, was 31.47 inches, lower than the long-term average of 37 inches. In addition to the lower than average amount of rain, the rainfall pattern exhibited less intense, steadier precipitation than in recent years.

4.2 Unpermitted Overflows

Overflows can occur from CSO structures, broken pipelines, and manholes. Overflows that are not caused by rainfall are called dry-weather overflows (DWOs). In King County's system, DWOs usually result from mechanical failures, power outages, or human error. Under EPA's Nine Minimum Controls, DWOs are to be prevented. Overflows that occur during precipitation, but are worsened by mechanical failures, power outages, or human error, are referred to as "exacerbated CSOs." No dry-weather overflows occurred from the county system in 2009. One exacerbated overflow occurred during the year (Table 1).

Table 1. Exacerbated CSO Events, 2009

Date	Location	Estimated Volume	Estimated Duration	Receiving Water	Cause and Resolution
October 14	Murray Pump Station	75,000 gallons	38 minutes	Puget Sound	Area-wide power outage during precipitation

Note: This overflow was initially estimated at 36,000 gallons. Review of the data and weir equation now indicates that the volume was approximately 75,000 gallons. The Murray weir is very long (72 feet), which makes the calculation sensitive to small changes in the measured level.

4.3 Annual Untreated CSO Events

West Point's SCADA system monitors the volume and frequency of CSOs at regulator and pump stations. Portable flow meters are deployed at seven CSO locations not currently monitored by SCADA: 11th Avenue NW, SW Alaska Street, Hanford at Rainier, South Magnolia, North Beach Pump Station, West Duwamish Siphon, and Terminal 115. Portable meters also supplement SCADA in a few locations.

King County CSOs discharged 690 MG over a total of 236 untreated events during 2009. This volume is less than predicted by the hydraulic model for average conditions and represents a 70.4 percent reduction from the 1981–1983 baseline volume of 2,339 MG.

The renewed NPDES permit now requires "event-based" data reporting by CSO site. Appendix A lists the untreated events from county CSOs during 2009. These data are also provided in electronic form to Ecology along with this report.

The permit also requires reporting against the performance standard of no more than one untreated event per year by site as a 20-year moving average. Section 5 of this report presents performance against this 20-year standard.

4.4 CSO Treatment

King County provides CSO treatment, defined in Chapter 173-245 WAC as "equivalent to primary" treatment, at the West Point Treatment Plant and at four satellite facilities: Alki, Carkeek, Mercer/Elliott West, and Henderson/Norfolk.

On June 16, 2010, Ecology issued a Notice of Penalty to King County for permit violations at the four CSO treatment facilities that occurred between September 1, 2009, and April 30, 2010. The penalty assessed was $48,000. The notice covered an alleged 44 violations of effluent limits and monitoring requirements. King County is working with Ecology to clarify the violation count and resolve other issues. Most of the causes of the violations were addressed and corrected immediately; corrections for a few others are under way. King County is committed to ensuring that these CSO treatment facilities run properly and are in compliance with the NPDES permit.

The following sections summarize performance and compliance at each facility during 2009. Appendix B provides more detail on volumes and events. Appendices C–F contain the annual reports for each satellite CSO treatment facility.

4.4.1 West Point Treatment Plant

In addition to secondary treatment of up to 300 mgd of base wastewater flows (defined as 2.25 times the average wet-weather flow of 133 mgd), the West Point Treatment Plant provides CSO/primary treatment for flows between 300 mgd and the peak of 440 mgd. Combined sewer flows that would otherwise overflow to the Lake Washington Ship Canal are transferred to the West Point Treatment Plant. 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, with a small reduction—80 percent instead of 85 percent—in TSS percent removal requirements.

During 2009, 257.8 MG received CSO/primary treatment at West Point during parts of 27 days. These occurrences are recorded in Appendix B.

4.4.2 Alki CSO Treatment Plant

The transfer of Alki area base flows to the West Point Treatment Plant was completed in 1998, and conversion from a continuously operating primary plant to a CSO treatment plant was completed in 2001. There were ten filling events and four discharge events at the Alki CSO Treatment Plant during 2009. The plant received a total inflow of 48.60 MG and discharged 37.07 MG. The monthly and event-based limits for settleable solids were met. The annual 50 percent TSS removal limit was also met; TSS removal was 62 percent. The plant did not meet the monthly limit for fecal coliform bacteria in October, nor did it meet the daily limit for chlorine residual on two days in January and two days in November.

Activities to correct challenges with the sodium bisulfite dechlorination system and chlorine analyzers, to improve control of the sodium hypochlorite disinfection system, and to address problems caused by startup of the new upstream 53rd Avenue Pump Station and conversion to the new Ovation SCADA system are described in the Alki CSO Treatment Plant annual report in Appendix C.

4.4.3 Carkeek CSO Treatment Plant

The transfer of Carkeek area base flows to the West Point Treatment Plant was completed in 1994, and the conversion from a continuously operating primary plant to a CSO treatment plant was completed around 1997. In 2009, the Carkeek CSO Treatment Plant operated fourteen times with a total inflow volume of 13.75 MG, and discharged nine times with a total discharge volume of 8.1 MG. The plant operated well during the year. Apart from data lost when the effluent monitor failed in November, all permit limits were met. TSS removal was 76 percent. Maintenance activities included repair of the effluent sampler pump and installation of alarms for high effluent chlorine residuals. One of the pump sets is scheduled for replacement in summer 2010. More detail is available in the Carkeek CSO Treatment Plant annual report in Appendix D.

4.4.4 Mercer/Elliott West CSO Treatment and Storage Facilities

The Mercer/Elliott West tunnel storage and treatment system was brought online in May 2005 as a joint project with Seattle's East Lake Union CSO control projects. In 2009, the system's fourth full year of operation, there were twenty-four filling events totaling 371 MG and ten discharge events with a total discharge volume of 195.5 MG. The system did not meet some permit limits during the year: (1) excluding the event designated as the one untreated event, the annual TSS removal was 42 percent, below the 50 percent removal limit; (2) the annual settleable solids in the effluent was 2.3 mL/L/hr, which exceeded the annual limit of

0.3 mL/L/hr and the event maximum limit of 1.9 mL/L/hr; and (3) the maximum month fecal coliform bacteria effluent limit was exceeded.

Investigations suggest that sampling for these parameters is not representative of actual performance. Solids may remain in the Mercer Tunnel after low-intensity rainfall events, skewing the removal measurements. Seawater intrusion appears to bringing marine solids up the outfall to where they are measured by the effluent sampler. Samples were not taken in November when the effluent sampler pump failed. Extensive efforts under way to correct these problems, including improvements to tunnel flushing and sampling, are described in the Mercer/Elliott West annual report in Appendix E.

4.4.5 Henderson/Norfolk CSO Treatment and Storage Facilities

The Henderson/Norfolk tunnel storage and treatment system was brought online in May 2005, and 2009 marked its fourth full year of operation. As is typical of intermittently operated facilities, adjustments to systems and operations to achieve intended performance have continued during the first few years. The Henderson/Norfolk system had two inflow events totaling 5.41 MG and one discharge event of 1.64 MG. TSS removal was 61.1 percent during 2009, meeting the 50 percent removal limit. The annual report for system is provided in Appendix F.

Section 5

Twenty-Year Moving Average of Event Frequencies

The renewed NPDES permit for the West Point Treatment Plant, effective July 1, 2009, implements a new interpretation of the performance standard for CSO control derived from the state regulatory requirements for "greatest reasonable reduction" as specified in WAC 173-245-022(22).

The standard of "not more than one untreated discharge event per year per outfall on average" is now based on a 20-year moving average. The number of untreated discharges that occurred over each of the previous 20 years is reported for each CSO site and then averaged (Table 2). This average will be used each year to assess compliance with the performance standard for CSOs identified as controlled. However, a full 20 years of data are not available because the upgraded SCADA system was brought online and began to report data for an increasing number of sites in 1991. For sites that are identified as controlled, modeled data have been substituted for the early missing data. For sites not identified as controlled, only available measured data are reported. Ecology has directed that discharges from the CSO treatment facilities that are designated as the "one untreated event" for permit limit compliance purposes should be considered as treated and should not be counted in the 20-year data.

The following 16 sites were identified as controlled through the monitoring and modeling data:

- 30th Avenue NE Pump Station
- 53rd Avenue SW Pump Station
- 63rd Avenue SW Pump Station
- 8th Ave S Regulator[12]
- SW Alaska Street
- Belvoir Pump Station
- Canal Street[13]
- East Duwamish Pump Station and Siphon
- West Duwamish Siphon
- Henderson Pump Station
- East Marginal Pump Station
- Matthews Park Pump Station
- Martin Luther King Way (MLK)
- Norfolk
- E Pine Street Pump Station
- Rainier Avenue Pump Station

The Denny Way, Dexter Avenue, and Harbor Avenue Regulators are nearly controlled. Associated control projects are undergoing operational adjustments.

[12] King County is in the process of recalibrating its hydraulic model. The control status of the 8th Avenue South Regulator Station will be confirmed by the recalibrated model.

[13] The Canal Street CSO shows an average of 0.9 event, which is shaped by the early part of the 20 years of data; 0 to 1 overflow has occurred annually since 1999.

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Table 2. Untreated CSO Events, Averages and Baselines, 1991–2009

CSO Site	Discharge Serial Number (DNS)	1990	1991	1992	1993	1994	1995	1996[a]	1997[b]	1998	1999	2000[c]	2001	2002	2003	2004	2005	2006	2007	2008	2009	Up to 20-yr Average	Controlled CSO: 20-yr Average for Compliance	1983 Baseline (24-hr inter-event)
11th Avenue NW	004		7	16	7	20	30	18	21	10	12	14	14	8	8	6	11	22	10	7	16	13.5		16
30th Avenue NE PS[d]	049		NM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	**0.0**	<1
3rd Avenue W PS	008		6	5	0	4	10	15[e]	9	8	4	1	11	4	6	4	5	13	6	3	9	6.5		17
53rd Avenue SW[f]	053		NM	NM	NM	NM	NM	NM	NM	NM	NM	0	0	0	0	0	0	2	1	0	0	0.3	**0.3**	<1
63rd Avenue PS[f]	054		NM	NM	NM	NM	NM	NM	NM	NM	NM	0	0	0	2	0	1	0	0	0	0	0.3	**0.3**	2
8th Avenue/ W Marginal Way PS	040		5	3	1	2	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0.7	**0.7**	6
Alaska Street, SW[d]	055		NM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0.1	**0.1**	1
Ballard	003		5	0	4	11	12	11	8	3	5	2	2	0	4	2	1	5	2	1	8	4.5		13
Barton[f]	057		NM	NM	NM	NM	NM	NM	NM	NM	NM	0	0	0	3	4	5	11	3	1	2	2.9		9
Belvoir PS[g]	012		NM	0	1	0	0	1	1	0	1	0	0	0	2	2	0	1	1	0	0	0.6	**0.6**	<1
Brandon Street	041		36	41	133	37	53	55	40	31	32	30	30	21	28	21	27	11[g]	NM[g]	0[g]	16	35.7		36
Canal Street	007		5	3	0	0	0	3	1	2	0	1	0	0	0	0	0	0	1	0	1	0.9	**0.9**	<1
Chelan Avenue	036		5	5	5	15	8	15	8	5	5	2	7	2	3	1	2	5	2	0	0	5.0		7
Denny Way	027a		42	39	38	33	49	54	37	23	23	25	26	15	25	20	11	9	1	2	4	25.1		32
Dexter Avenue	009		8	9	4	10	23	22	21	13	10	10	12	9	15	8	12	20	9	3	11	12.1		15
Duwamish, W	035		NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	1[h]	0	1	0	0	0.4	**0.4**	<1
Duwamish PS, E	034		0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0.1	**0.1**	<1
Hanford #1 (Hanford @ Rainier)	031		0	0	0	0	0	20[i]	14	17	5	0[j]	0	3	6	8	NM	16	4[k]	6	14	6.3		30
Hanford #2	032		11	10	10	17	32	20	17	17	18	17	13	10	12	16	15	26	12	8	17	15.7		28
Harbor Avenue	037		51	58	39	13	47	39	1	1	0	0	2	0	2	0[l]	3	5	2	0	0	13.8		30
Henderson[d,m]	045		*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	0	0	0	0	0	**0**	12
Kingdome (formerly Connecticut)	029		31	28	15	8	15	14	11	3	0	1	0	0	0	2	5	4	5	1	8	7.9		29
King Street	028		23	30	20	19	27	17	18	11	14	10	14	12	16	15	20	27	7	3	15	16.8		16
Lander Street	030		8	0	0	7	26	16	12	10	15	11	10	10	12	9	8	28	8	6	19	11.3		26
Magnolia, S[d]	006		0	4	20	28	39	48	34	19	5	0	0	5	18	17	26	30	21	26	25	19.2		25
Marginal, E.[d]	043		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	**0.0**	<1
Matthews Park PS[d]	018		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	**0.0**	<1
Michigan Street	039		6	15	9	13	0	0	0	0	10	8	12	8	9	6	5	13	5	3	10	6.9		34
Michigan, W	042		7	8	12	2	5	6	6	3	3	2	7	5	4	1	3	8	4	0	8	4.9		5
MLK Jr. Way[d,m]	013		*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	0	0	0	0	0.8	**0.0**	16
Montlake	014		11	13	3	4	11	7	2	7	0	2	0	5	11	5	6	NM	0	1	3	5.1		6
Murray Street PS[f]	056		NM	NM	NM	NM	NM	NM	NM	NM	NM	0	0	0	3	5	10	10	3	1	11	4.3		5
Norfolk[m]	044a		*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	0	0	0	0	0.0	**0.0**	20
North Beach PS Wet Well	048a		w/ inlet	w/ inlet	w/ inlet	w/ inlet	w/ inlet	w/ inlet	w/ inlet	w/ inlet	w/ inlet	w/ inlet	w/ inlet	w/ inlet	w/ inlet	w/ inlet	3[n]	15	6	3	14	8.2		18
North Beach PS Inlet[d]	048b		0	1	5	13	19	22	20	13	9	11	10	1	6	6	10	13	4	3	13	9.4		18
Pine Street, E, PS[d]	011		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	**0.0**	<1
Rainier Avenue PS[d]	033		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	**0.0**	<1
Terminal 115	038		NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	2[o]	0	2	7	4	0	3	2.6		4
University	015		7	6	2	10	15	13	9	10	4	3	5	4	4	4	3	12	5	3	16	6.7		13
Rainfall (inches)			8.19[p]	27.45	24.91	32.37	39.34	42.28	35.23	41.32	33.81	29.82	35.99	27.39	34.46	27.79	31.32	42.82	31.11	24.90	**31.47**	33.0		**37.00**

PS = pump station.

[a] The West Point computers (SCADA) were down from 10/17/1996–11/1719/96.
[b] CSO “event” definition changed to be based on a 48-hour dry period.
[c] CSO “event” definition changed to be based on a 24-hour dry period.
[d] Belvoir, 30th Avenue, Alaska, Magnolia, Marginal, Matthews, MLK, Pine, Rainier, Henderson, and North Beach were monitored beginning 6/1992.
[e] The 3rd Ave. W. monitor was down 6/2006–11/2006.
[f] Barton, Murray, 63rd Avenue, & 53rd Avenue began monitoring 6/2000.
[g] The Brandon meter was out 6/2006–3/2008.
[h] W. Duwamish started monitoring 6/2005.
[i] Hanford #1 began monitoring 1/1996.
[j] The Hanford @ Rainier meter was out 6/2000–5/2001.
[k] The Hanford @ Rainier meter was not operating properly 6/1/2007–12/17/2007.
[l] Harbor was missing data 4/2004–5/2004.
[m] This CSO was controlled beginning in 2006. Modeled data through 2005 (in italics) have been substituted to simulate how current facilities would have performed under rain patterns during that time.
[o] Terminal 115 monitoring began 6/2003.
[p] Rainfall data were not reported the first 6 months of 1991.

Appendices

Appendix A. Untreated CSO Events, January–December 2009

Appendix B. Treated CSO Events, January–December 2009

Appendix C. Alki CSO Treatment Plant Annual Report

Appendix D. Carkeek CSO Treatment Plant Annual Report

Appendix E. Mercer/Elliott West CSO Control Facilities Annual Report

Appendix F. Henderson/Norfolk CSO Control Facilities Annual Report

Appendix A
Untreated CSO Events
January–December 2009

Outfall DSN #	CSO Name	Receiving Water	Event Starting Date/ Time	Event Ending Date/ Time	Duration (hours)	Volume (gallons)	Precipitation (inches)	Storm Duration (hours)	Note if DWO
003	Ballard Siphon Regulator via Seattle Storm Drain	Lake Wa Ship Canal	1/7/09 7:01 PM	1/7/09 11:53 PM	4:52	409,881			
003	Ballard Siphon Regulator via Seattle Storm Drain	Lake Wa Ship Canal	4/2/09 7:07 PM	4/2/09 7:25 PM	0:18	18,466			
003	Ballard Siphon Regulator via Seattle Storm Drain	Lake Wa Ship Canal	5/19/09 8:09 PM	5/19/09 8:40 PM	0:31	27,060			
003	Ballard Siphon Regulator via Seattle Storm Drain	Lake Wa Ship Canal	9/6/09 11:34 AM	9/6/09 11:37 AM	0:03	189	0.85	31:21	
003	Ballard Siphon Regulator via Seattle Storm Drain	Lake Wa Ship Canal	10/14/09 2:23 PM	10/14/09 2:32 PM	0:09	14,047	0.74	26:09	
003	Ballard Siphon Regulator via Seattle Storm Drain	Lake Wa Ship Canal	10/16/09 8:03 PM	10/17/09 9:53 AM	13:50	90,039	2.53	93:38	
003	Ballard Siphon Regulator via Seattle Storm Drain	Lake Wa Ship Canal	11/22/09 12:49 AM	11/22/09 2:10 AM	1:21	27,328	0.75	7:17	
003	Ballard Siphon Regulator via Seattle Storm Drain	Lake Wa Ship Canal	11/26/09 4:14 AM	11/26/09 5:41 AM	1:27	73,802	1.16	11:56	
004	East Ballard (AKA 11th Ave NW)	Lake Wa Ship Canal	1/7/09 6:52 PM	1/8/09 12:17 AM	5:25	2,148,042			

Outfall DSN #	CSO Name	Receiving Water	Event Starting Date/ Time	Event Ending Date/ Time	Duration (hours)	Volume (gallons)	Precipitation (inches)	Storm Duration (hours)	Note if DWO
004	East Ballard (AKA 11th Ave NW)	Lake Wa Ship Canal	4/2/09 6:02 PM	4/2/09 8:27 PM	2:25	781,027			
004	East Ballard (AKA 11th Ave NW)	Lake Wa Ship Canal	4/28/09 8:07 PM	4/28/09 8:22 PM	0:15	47,122			
004	East Ballard (AKA 11th Ave NW)	Lake Wa Ship Canal	5/2/09 7:47 PM	5/2/09 7:57 PM	0:10	15,828			
004	East Ballard (AKA 11th Ave NW)	Lake Wa Ship Canal	5/5/09 4:37 AM	5/5/09 10:47 AM	6:10	406,821			
004	East Ballard (AKA 11th Ave NW)	Lake Wa Ship Canal	5/19/09 7:57 PM	5/19/09 9:07 PM	1:10	812,107			
004	East Ballard (AKA 11th Ave NW)	Lake Wa Ship Canal	9/6/09 2:03 AM	9/6/09 12:03 PM	10:00	399,918	0.85	31:21	
004	East Ballard (AKA 11th Ave NW)	Lake Wa Ship Canal	10/14/09 1:18 PM	10/14/09 2:58 PM	1:40	240,500	0.75	26:22	
004	East Ballard (AKA 11th Ave NW)	Lake Wa Ship Canal	10/16/09 8:03 PM	10/17/09 10:18 AM	14:15	1,639,178	2.53	93:38	
004	East Ballard (AKA 11th Ave NW)	Lake Wa Ship Canal	10/26/09 7:53 AM	10/26/09 10:33 AM	2:40	259,696	0.68	19:51	
004	East Ballard (AKA 11th Ave NW)	Lake Wa Ship Canal	11/5/09 11:58 AM	11/7/09 11:53 AM	47:55	570,749	1.63	49:09	
004	East Ballard (AKA 11th Ave NW)	Lake Wa Ship Canal	11/16/09 5:23 PM	11/16/09 7:23 PM	2:00	106,091	0.85	32:54	
004	East Ballard (AKA 11th Ave NW)	Lake Wa Ship Canal	11/19/09 12:38 PM	11/19/09 1:08 PM	0:30	9,893	2.11	98:36	
004	East Ballard (AKA 11th Ave NW)	Lake Wa Ship Canal	11/21/09 10:43 PM	11/22/09 8:33 AM	9:50	498,047	0.96	13:45	
004	East Ballard (AKA 11th Ave NW)	Lake Wa Ship Canal	11/25/09 7:13 PM	11/26/09 7:03 AM	11:50	845,828	1.25	13:10	
004	East Ballard (AKA 11th Ave NW)	Lake Wa Ship Canal	12/21/09 3:18 AM	12/21/09 3:33 AM	0:15	134,059	0.62	55:09	
006	Magnolia Overflow	Elliot Bay/Puget Sound	1/5/09 7:15 AM	1/5/09 7:30 AM	0:15	606			
006	Magnolia Overflow	Elliot Bay/Puget Sound	1/7/09 5:50 PM	1/8/09 12:45 AM	6:55	1,289,625			

Outfall DSN #	CSO Name	Receiving Water	Event Starting Date/ Time	Event Ending Date/ Time	Duration (hours)	Volume (gallons)	Precipitation (inches)	Storm Duration (hours)	Note if DWO
006	Magnolia Overflow	Elliot Bay/Puget Sound	2/23/09 4:18 PM	2/23/09 4:38 PM	0:20	20,805			
006	Magnolia Overflow	Elliot Bay/Puget Sound	3/15/09 10:45 AM	3/15/09 11:05 AM	0:20	223			
006	Magnolia Overflow	Elliot Bay/Puget Sound	4/2/09 6:15 PM	4/3/09 6:05 AM	11:50	86,668			
006	Magnolia Overflow	Elliot Bay/Puget Sound	4/28/09 8:35 PM	4/28/09 9:10 PM	0:35	48,109			
006	Magnolia Overflow	Elliot Bay/Puget Sound	5/2/09 7:45 PM	5/2/09 8:25 PM	0:40	118,050			
006	Magnolia Overflow	Elliot Bay/Puget Sound	5/4/09 8:35 PM	5/5/09 11:25 AM	14:50	630,626			
006	Magnolia Overflow	Elliot Bay/Puget Sound	5/7/09 4:25 PM	5/7/09 4:45 PM	0:20	3,167			
006	Magnolia Overflow	Elliot Bay/Puget Sound	5/18/09 9:25 PM	5/19/09 9:35 PM	24:10	346,859			
006	Magnolia Overflow	Elliot Bay/Puget Sound	8/13/09 5:45 PM	8/13/09 6:05 PM	0:20	26,407	0.17	0:51	
006	Magnolia Overflow	Elliot Bay/Puget Sound	9/5/09 8:00 AM	9/6/09 12:05 PM	28:05	385,588	0.82	31:37	
006	Magnolia Overflow	Elliot Bay/Puget Sound	10/2/09 11:05 AM	10/2/09 11:50 AM	0:45	24,657	0.4	17:03	
006	Magnolia Overflow	Elliot Bay/Puget Sound	10/14/09 12:50 PM	10/14/09 2:50 PM	2:00	154,717	0.51	26:08	
006	Magnolia Overflow	Elliot Bay/Puget Sound	10/16/09 9:05 AM	10/17/09 3:45 PM	30:40	775,007	1.49	50:37	
006	Magnolia Overflow	Elliot Bay/Puget Sound	10/26/09 7:30 AM	10/26/09 10:40 AM	3:10	404,656	0.63	19:49	
006	Magnolia Overflow	Elliot Bay/Puget Sound	11/5/09 12:05 PM	11/7/09 11:55 AM	47:50	329,852	1.36	49:18	
006	Magnolia Overflow	Elliot Bay/Puget Sound	11/9/09 12:25 PM	11/9/09 12:30 PM	0:05	196	0.24	3:56	
006	Magnolia Overflow	Elliot Bay/Puget Sound	11/10/09 7:10 PM	11/10/09 8:30 PM	1:20	12,976	0.7	36:02	

Outfall DSN #	CSO Name	Receiving Water	Event Starting Date/ Time	Event Ending Date/ Time	Duration (hours)	Volume (gallons)	Precipitation (inches)	Storm Duration (hours)	Note if DWO
006	Magnolia Overflow	Elliot Bay/Puget Sound	11/16/09 4:45 PM	11/17/09 5:00 AM	12:15	298,816	0.89	47:28	
006	Magnolia Overflow	Elliot Bay/Puget Sound	11/19/09 9:10 AM	11/19/09 1:10 PM	4:00	38,694	1.52	103:16	
006	Magnolia Overflow	Elliot Bay/Puget Sound	11/21/09 8:40 PM	11/22/09 8:55 AM	12:15	420,972	0.89	14:35	
006	Magnolia Overflow	Elliot Bay/Puget Sound	11/25/09 7:05 PM	11/26/09 7:20 AM	12:15	532,910	0.99	12:49	
006	Magnolia Overflow	Elliot Bay/Puget Sound	12/14/09 8:25 PM	12/14/09 9:25 PM	1:00	20,336	0.27	10:38	
006	Magnolia Overflow	Elliot Bay/Puget Sound	12/21/09 3:05 AM	12/21/09 3:30 AM	0:25	91,362	0.47	55:04	
007	Canal Street Overflow	Lake Wa Ship Canal	10/16/09 8:31 PM	10/17/09 11:43 AM	15:12	418,355	2.53	93:37	
008	3rd Ave W and Ewing St	Lake Wa Ship Canal	1/7/09 6:28 PM	1/8/09 12:39 AM	6:11	3,911,700			
008	3rd Ave W and Ewing St	Lake Wa Ship Canal	4/2/09 7:12 PM	4/2/09 8:26 PM	1:14	119,877			
008	3rd Ave W and Ewing St	Lake Wa Ship Canal	5/5/09 4:33 AM	5/5/09 6:59 AM	2:26	510,631			
008	3rd Ave W and Ewing St	Lake Wa Ship Canal	5/19/09 8:23 PM	5/19/09 9:47 PM	1:24	551,617			
008	3rd Ave W and Ewing St	Lake Wa Ship Canal	9/6/09 11:08 AM	9/6/09 12:25 PM	1:17	423,937	0.85	31:21	
008	3rd Ave W and Ewing St	Lake Wa Ship Canal	10/16/09 7:58 PM	10/17/09 10:34 AM	14:36	2,658,334	2.53	93:38	
008	3rd Ave W and Ewing St	Lake Wa Ship Canal	10/26/09 8:32 AM	10/26/09 10:51 AM	2:19	458,426	0.68	19:51	
008	3rd Ave W and Ewing St	Lake Wa Ship Canal	11/22/09 12:51 AM	11/22/09 2:39 AM	1:48	728,468	0.76	7:28	
008	3rd Ave W and Ewing St	Lake Wa Ship Canal	11/26/09 2:26 AM	11/26/09 6:45 AM	4:19	1,215,317	1.24	13:00	
009	Dexter Ave Regulator	Lake Union	1/7/09 9:08 PM	1/8/09 12:05 AM	2:57	709,171			
009	Dexter Ave Regulator	Lake Union	5/2/09 7:39 PM	5/2/09 7:54 PM	0:15	16,604			
009	Dexter Ave Regulator	Lake Union	5/5/09 4:36 AM	5/5/09 6:21 AM	1:45	1,624,352			
009	Dexter Ave Regulator	Lake Union	5/19/09 8:15 PM	5/19/09 9:30 PM	1:15	1,288,755			

Outfall DSN #	CSO Name	Receiving Water	Event Starting Date/ Time	Event Ending Date/ Time	Duration (hours)	Volume (gallons)	Precipitation (inches)	Storm Duration (hours)	Note if DWO
009	Dexter Ave Regulator	Lake Union	8/13/09 5:53 PM	8/13/09 6:06 PM	0:13	4,212	0.21	0:53	
009	Dexter Ave Regulator	Lake Union	9/6/09 11:00 AM	9/6/09 12:05 PM	1:05	751,736	1.02	31:34	
009	Dexter Ave Regulator	Lake Union	9/29/09 5:48 PM	9/29/09 6:25 PM	0:37	372,447	0.4	21:47	
009	Dexter Ave Regulator	Lake Union	10/16/09 8:04 PM	10/17/09 4:11 PM	20:07	2,731,494	1.87	47:30	
009	Dexter Ave Regulator	Lake Union	11/6/09 2:13 AM	11/7/09 11:24 AM	33:11	93,320	2.04	49:38	
009	Dexter Ave Regulator	Lake Union	11/22/09 12:57 AM	11/22/09 2:00 AM	1:03	30,173	0.88	7:45	
009	Dexter Ave Regulator	Lake Union	11/26/09 5:04 AM	11/26/09 5:54 AM	0:50	502,387	1.35	13:01	
011	E Pine St. Pump Station Emergency Overflow	Lake Wa			0:00	0			
012	Belvoir Pump Station Emergency Overflow	Lake Wa			0:00	0			
013	Martin Luther King Way Trunkline Overflow	Lake Wa via storm drain			0:00	0			
014	Montlake Overflow	Lake Wa Ship Canal	9/6/09 11:20 AM	9/6/09 12:07 PM	0:47	1,684,314	0.93	31:30	
014	Montlake Overflow	Lake Wa Ship Canal	10/16/09 8:28 PM	10/17/09 10:12 AM	13:44	5,262,834	2.51	93:53	
014	Montlake Overflow	Lake Wa Ship Canal	10/26/09 8:54 AM	10/26/09 10:37 AM	1:43	1,768,965	0.81	20:18	
015	University Regulator	Lake Wa Ship Canal	1/7/09 7:05 PM	1/8/09 1:26 AM	6:21	27,755,545			
015	University Regulator	Lake Wa Ship Canal	4/2/09 7:22 PM	4/2/09 8:50 PM	1:28	3,222,617			
015	University Regulator	Lake Wa Ship Canal	5/5/09 5:03 AM	5/5/09 7:53 AM	2:50	3,863,445			
015	University Regulator	Lake Wa Ship Canal	5/19/09 8:26 PM	5/19/09 9:22 PM	0:56	3,532,417			
015	University Regulator	Lake Wa Ship Canal	9/6/09 11:42 AM	9/6/09 12:07 PM	0:25	1,261,504	0.93	31:30	
015	University Regulator	Lake Wa Ship Canal	10/16/09 8:25 PM	10/17/09 4:22 PM	19:57	9,115,186	2.67	99:40	

Outfall DSN #	CSO Name	Receiving Water	Event Starting Date/ Time	Event Ending Date/ Time	Duration (hours)	Volume (gallons)	Precipitation (inches)	Storm Duration (hours)	Note if DWO
015	University Regulator	Lake Wa Ship Canal	10/26/09 9:37 AM	10/26/09 10:49 AM	1:12	1,994,126	0.81	20:18	
015	University Regulator	Lake Wa Ship Canal	11/22/09 1:33 AM	11/22/09 2:46 AM	1:13	2,830,095	0.89	8:00	
015	University Regulator	Lake Wa Ship Canal	11/26/09 4:34 AM	11/26/09 7:32 AM	2:58	8,323,859	1.47	14:38	
018	Matthews Park Pump Station Emergency Overflows	Lake Wa			0:00	0			
027a	Denny Way Regulator	Elliott Bay	1/7/09 7:12 PM	1/7/09 11:50 PM	4:38	157,090			
027a	Denny Way Regulator	Elliott Bay	5/5/09 4:29 AM	5/5/09 6:07 AM	1:38	521,056			
027a	Denny Way Regulator	Elliott Bay	10/16/09 8:01 PM	10/17/09 9:50 AM	13:49	274,464	1.36	44:26	
027a	Denny Way Regulator	Elliott Bay	10/26/09 9:52 AM	10/26/09 9:54 AM	0:02	696	0.56	19:10	
028	King Street Regulator	Elliott Bay	4/2/09 7:14 PM	4/2/09 10:23 PM	3:09	1,956,561			
028	King Street Regulator	Elliott Bay	5/5/09 4:43 AM	5/5/09 9:49 AM	5:06	1,913,133			
028	King Street Regulator	Elliott Bay	5/6/09 2:56 PM	5/6/09 6:56 PM	4:00	659,203			
028	King Street Regulator	Elliott Bay	5/19/09 8:20 PM	5/19/09 10:40 PM	2:19	269,714			
028	King Street Regulator	Elliott Bay	9/6/09 11:23 AM	9/6/09 1:42 PM	2:19	459,892	0.8	31:19	
028	King Street Regulator	Elliott Bay	9/29/09 5:58 PM	9/29/09 6:08 PM	0:10	54,732	0.19	19:55	
028	King Street Regulator	Elliott Bay	10/14/09 4:19 PM	10/14/09 5:06 PM	0:46	55,631	0.62	26:41	
028	King Street Regulator	Elliott Bay	10/16/09 8:07 PM	10/17/09 4:01 PM	19:54	3,366,170	2.57	99:24	
028	King Street Regulator	Elliott Bay	10/26/09 8:42 AM	10/26/09 2:10 PM	5:28	2,331,677	0.86	14:39	
028	King Street Regulator	Elliott Bay	11/6/09 2:14 AM	11/7/09 1:58 PM	35:43	7,219,313	1.81	48:57	
028	King Street Regulator	Elliott Bay	11/16/09 4:57 PM	11/17/09 7:48 AM	14:51	13,113,011	1.06	46:59	
028	King Street Regulator	Elliott Bay	11/19/09 11:10 AM	11/19/09 3:09 PM	3:58	1,345,744	1.8	103:40	
028	King Street Regulator	Elliott Bay	11/22/09 12:42 AM	11/22/09 12:02 PM	11:19	11,941,100	1	16:41	
028	King Street Regulator	Elliott Bay	11/26/09 1:55 AM	11/26/09 9:54 AM	7:58	2,865,948	1.16	15:26	

Outfall DSN #	CSO Name	Receiving Water	Event Starting Date/ Time	Event Ending Date/ Time	Duration (hours)	Volume (gallons)	Precipitation (inches)	Storm Duration (hours)	Note if DWO
028	King Street Regulator	Elliott Bay	12/21/09 7:13 AM	12/21/09 10:11 AM	2:57	8,686,337	0.85	76:39	
029	Connecticut St. Regulator (AKA Kingdome)	Elliott Bay	1/7/09 8:49 PM	1/7/09 11:39 PM	2:50	272,462			
029	Connecticut St. Regulator (AKA Kingdome)	Elliott Bay	5/5/09 5:02 AM	5/5/09 6:15 AM	1:13	1,383,580			
029	Connecticut St. Regulator (AKA Kingdome)	Elliott Bay	9/6/09 11:45 AM	9/6/09 12:21 PM	0:36	129,097	0.8	31:19	
029	Connecticut St. Regulator (AKA Kingdome)	Elliott Bay	10/17/09 9:25 AM	10/17/09 10:11 AM	0:46	483,265	2.33	93:37	
029	Connecticut St. Regulator (AKA Kingdome)	Elliott Bay	10/26/09 8:59 AM	10/26/09 10:45 AM	1:46	1,062,411	0.85	14:03	
029	Connecticut St. Regulator (AKA Kingdome)	Elliott Bay	11/7/09 12:11 AM	11/7/09 12:31 AM	0:20	42,702	1.5	37:37	
029	Connecticut St. Regulator (AKA Kingdome)	Elliott Bay	11/22/09 1:20 AM	11/22/09 1:48 AM	0:28	82,158	0.69	7:08	
029	Connecticut St. Regulator (AKA Kingdome)	Elliott Bay	11/26/09 5:16 AM	11/26/09 5:43 AM	0:27	89,011	1.01	11:42	
030	Lander St Regulator	Elliott Bay	1/1/09 7:52 AM	1/1/09 9:57 AM	2:05	2,452,091			
030	Lander St Regulator	Elliott Bay	1/7/09 5:08 PM	1/8/09 4:52 AM	11:44	16,441,009			
030	Lander St Regulator	Elliott Bay	4/2/09 7:28 PM	4/2/09 10:41 PM	3:13	11,860,961			
030	Lander St Regulator	Elliott Bay	4/12/09 5:19 PM	4/12/09 7:20 PM	2:01	3,457,456			
030	Lander St Regulator	Elliott Bay	5/5/09 5:01 AM	5/5/09 11:16 AM	6:15	27,042,001			
030	Lander St Regulator	Elliott Bay	5/6/09 3:09 PM	5/6/09 7:54 PM	4:45	7,625,380			
030	Lander St Regulator	Elliott Bay	5/13/09 7:55 PM	5/13/09 8:06 PM	0:11	31,648			

Outfall DSN #	CSO Name	Receiving Water	Event Starting Date/ Time	Event Ending Date/ Time	Duration (hours)	Volume (gallons)	Precipitation (inches)	Storm Duration (hours)	Note if DWO
030	Lander St Regulator	Elliott Bay	5/19/09 12:09 AM	5/19/09 11:38 PM	23:29	559,871			
030	Lander St Regulator	Elliott Bay	9/6/09 12:03 PM	9/6/09 12:55 PM	0:52	1,009,878	0.91	45:53	
030	Lander St Regulator	Elliott Bay	10/14/09 3:49 PM	10/14/09 5:01 PM	1:12	1,406,783	0.57	26:59	
030	Lander St Regulator	Elliott Bay	10/16/09 8:03 PM	10/17/09 1:37 PM	17:34	19,869,366	2.03	96:28	
030	Lander St Regulator	Elliott Bay	10/26/09 8:55 AM	10/26/09 2:38 PM	5:43	11,522,382	0.76	14:31	
030	Lander St Regulator	Elliott Bay	11/6/09 3:37 AM	11/7/09 12:50 PM	33:13	30,398,967	2.26	48:49	
030	Lander St Regulator	Elliott Bay	11/10/09 9:33 PM	11/10/09 9:50 PM	0:17	23,371	0.77	36:11	
030	Lander St Regulator	Elliott Bay	11/16/09 4:08 PM	11/17/09 8:52 AM	16:44	80,668,281	1.4	50:49	
030	Lander St Regulator	Elliott Bay	11/19/09 10:28 AM	11/20/09 10:50 AM	24:22	25,159,138	2.5	123:03	
030	Lander St Regulator	Elliott Bay	11/21/09 11:05 PM	11/22/09 12:44 PM	13:39	45,029,450	0.96	16:38	
030	Lander St Regulator	Elliott Bay	11/26/09 1:02 AM	11/26/09 1:47 PM	12:45	56,011,239	1.1	17:56	
030	Lander St Regulator	Elliott Bay	12/21/09 8:23 AM	12/21/09 11:17 AM	2:54	15,358,596	0.88	61:03	
031	Hanford #1 Overflow	Duwamish River via Diagonal Storm Drain	1/7/09 5:00 PM	1/8/09 4:20 AM	11:20	10,341,406			
031	Hanford #1 Overflow	Duwamish River via Diagonal Storm Drain	4/2/09 7:20 PM	4/2/09 8:30 PM	1:10	950,963			
031	Hanford #1 Overflow	Duwamish River via Diagonal Storm Drain	5/5/09 4:55 AM	5/5/09 6:40 AM	1:45	2,431,042			
031	Hanford #1 Overflow	Duwamish River via Diagonal Storm Drain	5/19/09 8:40 PM	5/19/09 9:40 PM	1:00	1,119,566			
031	Hanford #1 Overflow	Duwamish River via Diagonal Storm Drain	8/13/09 6:15 PM	8/13/09 6:25 PM	0:10	100,911	0.23	1:10	

Outfall DSN #	CSO Name	Receiving Water	Event Starting Date/ Time	Event Ending Date/ Time	Duration (hours)	Volume (gallons)	Precipitation (inches)	Storm Duration (hours)	Note if DWO
031	Hanford #1 Overflow	Duwamish River via Diagonal Storm Drain	9/6/09 11:00 AM	9/6/09 12:10 PM	1:10	1,475,076	0.9	45:14	
031	Hanford #1 Overflow	Duwamish River via Diagonal Storm Drain	10/16/09 7:05 PM	10/17/09 10:30 AM	15:25	4,784,675	1.93	94:30	
031	Hanford #1 Overflow	Duwamish River via Diagonal Storm Drain	10/26/09 8:10 AM	10/26/09 11:15 AM	3:05	3,161,158	0.76	14:31	
031	Hanford #1 Overflow	Duwamish River via Diagonal Storm Drain	11/6/09 2:35 AM	11/7/09 12:10 PM	33:35	3,600,518	2.26	48:49	
031	Hanford #1 Overflow	Duwamish River via Diagonal Storm Drain	11/16/09 5:05 PM	11/17/09 5:55 AM	12:50	2,436,195	1.39	47:57	
031	Hanford #1 Overflow	Duwamish River via Diagonal Storm Drain	11/19/09 12:10 PM	11/19/09 1:25 PM	1:15	849,600	2.23	104:05	
031	Hanford #1 Overflow	Duwamish River via Diagonal Storm Drain	11/22/09 1:00 AM	11/22/09 8:50 AM	7:50	5,561,137	0.9	14:18	
031	Hanford #1 Overflow	Duwamish River via Diagonal Storm Drain	11/26/09 2:00 AM	11/26/09 8:50 AM	6:50	4,886,077	1.08	14:46	
031	Hanford #1 Overflow	Duwamish River via Diagonal Storm Drain	12/21/09 7:35 AM	12/21/09 8:50 AM	1:15	313,204	0.88	61:03	
032	Hanford #2 Regulator	Duwamish River - East Waterway	1/6/09 11:55 PM	1/8/09 1:14 AM	25:19	670,930			
032	Hanford #2 Regulator	Duwamish River - East Waterway	4/2/09 7:29 PM	4/2/09 11:48 PM	4:19	879,663			
032	Hanford #2 Regulator	Duwamish River - East Waterway	4/12/09 5:15 PM	4/12/09 7:33 PM	2:18	430,019			
032	Hanford #2 Regulator	Duwamish River - East Waterway	5/5/09 5:04 AM	5/6/09 8:48 PM	39:44	1,547,938			
032	Hanford #2 Regulator	Duwamish River - East Waterway	5/13/09 7:54 PM	5/13/09 8:27 PM	0:33	241,838			

Outfall DSN #	CSO Name	Receiving Water	Event Starting Date/ Time	Event Ending Date/ Time	Duration (hours)	Volume (gallons)	Precipitation (inches)	Storm Duration (hours)	Note if DWO
032	Hanford #2 Regulator	Duwamish River - East Waterway	5/19/09 12:05 AM	5/20/09 12:15 AM	24:10	631,223			
032	Hanford #2 Regulator	Duwamish River - East Waterway	9/6/09 12:06 PM	9/6/09 2:33 PM	2:27	352,934	0.91	45:53	
032	Hanford #2 Regulator	Duwamish River - East Waterway	10/14/09 4:28 PM	10/14/09 5:22 PM	0:54	125,464	0.57	26:59	
032	Hanford #2 Regulator	Duwamish River - East Waterway	10/16/09 8:08 PM	10/17/09 2:27 PM	18:19	909,432	2.04	97:45	
032	Hanford #2 Regulator	Duwamish River - East Waterway	10/26/09 8:57 AM	10/26/09 2:51 PM	5:54	2,482,083	0.76	14:31	
032	Hanford #2 Regulator	Duwamish River - East Waterway	11/6/09 3:39 AM	11/7/09 3:11 PM	35:32	13,395,032	2.26	48:49	
032	Hanford #2 Regulator	Duwamish River - East Waterway	11/10/09 9:34 PM	11/10/09 10:23 PM	0:49	456,696	0.77	36:11	
032	Hanford #2 Regulator	Duwamish River - East Waterway	11/16/09 4:21 PM	11/17/09 9:30 AM	17:09	1,792,243	1.4	50:49	
032	Hanford #2 Regulator	Duwamish River - East Waterway	11/19/09 10:28 AM	11/20/09 11:21 AM	24:53	5,134,253	2.5	123:03	
032	Hanford #2 Regulator	Duwamish River - East Waterway	11/21/09 11:07 PM	11/22/09 1:44 PM	14:37	6,629,553	0.96	16:38	
032	Hanford #2 Regulator	Duwamish River - East Waterway	11/26/09 1:02 AM	11/26/09 5:27 AM	4:25	198,775	0.93	11:58	
032	Hanford #2 Regulator	Duwamish River - East Waterway	12/21/09 9:37 AM	12/21/09 12:02 PM	2:25	463,873	0.88	61:03	
033	Rainier Ave. Pump Station	Lake Wa			0:00	0			
034	E. Duwamish Pump Station	Duwamish River			0:00	0			
035	W. Duwamish Pump Station	Duwamish River			0:00	0			
036	Chelan Ave. Regulator	West Waterway of Duwamish River			0:00	0			

Outfall DSN #	CSO Name	Receiving Water	Event Starting Date/ Time	Event Ending Date/ Time	Duration (hours)	Volume (gallons)	Precipitation (inches)	Storm Duration (hours)	Note if DWO
037	Harbor Avenue Regulator	Duwamish River into Elliott Bay			0:00	0			
038	Terminal 115 Overflow	Duwamish River	1/7/09 8:20 PM	1/8/09 2:15 AM	5:55	1,034,004			
038	Terminal 115 Overflow	Duwamish River	10/17/09 9:10 AM	10/17/09 11:15 AM	2:05	67,500	2.42	94:08	
038	Terminal 115 Overflow	Duwamish River	10/26/09 11:05 AM	10/26/09 11:55 AM	0:50	44,965	1.02	20:25	
039	Michigan Regulator (AKA S. Michigan Regulator)	Duwamish River	1/7/09 7:28 PM	1/8/09 12:35 AM	5:07	4,806,142			
039	Michigan Regulator (AKA S. Michigan Regulator)	Duwamish River	4/2/09 6:14 PM	4/2/09 7:16 PM	1:02	383,193			
039	Michigan Regulator (AKA S. Michigan Regulator)	Duwamish River	5/5/09 4:56 AM	5/5/09 5:51 AM	0:55	1,666,696			
039	Michigan Regulator (AKA S. Michigan Regulator)	Duwamish River	5/19/09 8:38 PM	5/19/09 9:02 PM	0:24	13,845			
039	Michigan Regulator (AKA S. Michigan Regulator)	Duwamish River	9/6/09 11:11 AM	9/6/09 11:56 AM	0:45	745,150	1.06	32:03	
039	Michigan Regulator (AKA S. Michigan Regulator)	Duwamish River	10/17/09 8:37 AM	10/17/09 9:58 AM	1:21	3,456,813	2.41	94:02	
039	Michigan Regulator (AKA S. Michigan Regulator)	Duwamish River	10/26/09 8:51 AM	10/26/09 11:01 AM	2:10	882,125	1.01	19:45	
039	Michigan Regulator (AKA S. Michigan Regulator)	Duwamish River	11/6/09 2:44 AM	11/7/09 11:47 AM	33:03	426,427	2.73	48:30	

Outfall DSN #	CSO Name	Receiving Water	Event Starting Date/ Time	Event Ending Date/ Time	Duration (hours)	Volume (gallons)	Precipitation (inches)	Storm Duration (hours)	Note if DWO
039	Michigan Regulator (AKA S. Michigan Regulator)	Duwamish River	11/22/09 1:04 AM	11/22/09 1:44 AM	0:40	13,124	0.7	17:02	
039	Michigan Regulator (AKA S. Michigan Regulator)	Duwamish River	11/26/09 5:28 AM	11/26/09 6:10 AM	0:42	41,380	0.91	70:48	
040	8th Ave South Regulator (AKA W. Marginal Way Pump Station)	Duwamish River			0:00	0			
041	Brandon Street Regulator	Duwamish River	1/7/09 6:18 PM	1/8/09 4:26 AM	10:08	480,049			
041	Brandon Street Regulator	Duwamish River	4/2/09 6:28 PM	4/2/09 9:16 PM	2:48	910,877			
041	Brandon Street Regulator	Duwamish River	5/2/09 9:47 PM	5/2/09 9:59 PM	0:12	3,912			
041	Brandon Street Regulator	Duwamish River	5/4/09 8:31 PM	5/5/09 1:26 PM	16:55	3,084,308			
041	Brandon Street Regulator	Duwamish River	5/6/09 3:08 PM	5/6/09 6:25 PM	3:17	568,409			
041	Brandon Street Regulator	Duwamish River	5/18/09 11:11 PM	5/19/09 9:24 PM	22:13	517,000			
041	Brandon Street Regulator	Duwamish River	9/6/09 11:01 AM	9/6/09 12:11 PM	1:10	995,298	0.9	45:14	
041	Brandon Street Regulator	Duwamish River	10/2/09 3:05 AM	10/2/09 3:18 AM	0:13	186,093	0.04	1:33	
041	Brandon Street Regulator	Duwamish River	10/14/09 2:43 PM	10/14/09 3:42 PM	0:59	1,548,727	0.57	26:59	
041	Brandon Street Regulator	Duwamish River	10/16/09 8:26 PM	10/17/09 11:45 AM	15:19	3,814,590	1.93	94:30	
041	Brandon Street Regulator	Duwamish River	10/26/09 8:47 AM	10/26/09 1:23 PM	4:36	2,321,894	0.76	14:31	

Outfall DSN #	CSO Name	Receiving Water	Event Starting Date/ Time	Event Ending Date/ Time	Duration (hours)	Volume (gallons)	Precipitation (inches)	Storm Duration (hours)	Note if DWO
041	Brandon Street Regulator	Duwamish River	11/6/09 2:30 AM	11/7/09 2:18 PM	35:48	3,468,418	2.26	48:49	
041	Brandon Street Regulator	Duwamish River	11/16/09 4:58 PM	11/17/09 6:57 AM	13:59	4,033,149	1.39	47:57	
041	Brandon Street Regulator	Duwamish River	11/19/09 12:18 PM	11/19/09 1:49 PM	1:31	502,296	2.23	104:05	
041	Brandon Street Regulator	Duwamish River	11/22/09 1:06 AM	11/22/09 4:07 AM	3:01	852,291	0.69	8:38	
041	Brandon Street Regulator	Duwamish River	11/26/09 2:40 AM	11/26/09 9:25 AM	6:45	862,614	1.09	15:55	
042	West Michigan (AKA SW Michigan St regulator)	Duwamish River	1/7/09 6:51 PM	1/8/09 2:26 AM	7:35	313,574			
042	West Michigan (AKA SW Michigan St regulator)	Duwamish River	5/19/09 8:34 PM	5/19/09 8:39 PM	0:05	182			
042	West Michigan (AKA SW Michigan St regulator)	Duwamish River	10/17/09 8:28 AM	10/17/09 10:38 AM	2:10	74,331	2.42	94:08	
042	West Michigan (AKA SW Michigan St regulator)	Duwamish River	10/26/09 9:59 AM	10/26/09 11:27 AM	1:28	33,420	1.02	20:25	
042	West Michigan (AKA SW Michigan St regulator)	Duwamish River	11/6/09 2:40 AM	11/7/09 11:39 AM	32:59	8,184	2.73	48:30	
042	West Michigan (AKA SW Michigan St regulator)	Duwamish River	11/19/09 11:53 AM	11/20/09 8:15 AM	20:22	6,595	2.71	125:16	
042	West Michigan (AKA SW Michigan St regulator)	Duwamish River	11/22/09 12:40 AM	11/22/09 9:26 AM	8:46	17,601	0.99	24:14	

Outfall DSN #	CSO Name	Receiving Water	Event Starting Date/ Time	Event Ending Date/ Time	Duration (hours)	Volume (gallons)	Precipitation (inches)	Storm Duration (hours)	Note if DWO
042	West Michigan (AKA SW Michigan St regulator)	Duwamish River	11/26/09 2:06 AM	11/26/09 7:52 AM	5:46	20,794	0.98	72:32	
043	East Marginal Pump Station	Duwamish River			0:00	0			
044c	Norfolk local drainage	Duwamish River			0:00	0			
045	Henderson Pump Station	Lake Washington			0:00	0			
048a	North Beach Pump Station (wet well)	Puget Sound	1/7/09 8:14 PM	1/7/09 11:28 PM	3:14	8,104			
048a	North Beach Pump Station (wet well)	Puget Sound	4/2/09 6:29 PM	4/2/09 6:59 PM	0:29	1,287			
048a	North Beach Pump Station (wet well)	Puget Sound	5/2/09 7:30 PM	5/2/09 8:05 PM	0:35	45,264			
048a	North Beach Pump Station (wet well)	Puget Sound	5/4/09 8:37 PM	5/5/09 9:23 AM	12:45	174,527			
048a	North Beach Pump Station (wet well)	Puget Sound	5/19/09 7:51 PM	5/19/09 8:13 PM	0:22	237			
048a	North Beach Pump Station (wet well)	Puget Sound	9/6/09 1:39 AM	9/6/09 11:44 AM	10:04	3,885	0.85	31:21	
048a	North Beach Pump Station (wet well)	Puget Sound	10/14/09 2:15 PM	10/14/09 2:26 PM	0:11	280	0.74	26:08	
048a	North Beach Pump Station (wet well)	Puget Sound	10/16/09 10:03 AM	10/17/09 9:02 AM	22:58	1,178	2.38	92:47	
048a	North Beach Pump Station (wet well)	Puget Sound	10/26/09 7:52 AM	10/26/09 8:39 AM	0:46	76	0.45	18:03	

Outfall DSN #	CSO Name	Receiving Water	Event Starting Date/ Time	Event Ending Date/ Time	Duration (hours)	Volume (gallons)	Precipitation (inches)	Storm Duration (hours)	Note if DWO
048a	North Beach Pump Station (wet well)	Puget Sound	11/5/09 11:43 PM	11/6/09 6:19 PM	18:35	30,308	1.06	31:54	
048a	North Beach Pump Station (wet well)	Puget Sound	11/16/09 6:01 PM	11/17/09 1:16 AM	7:15	1,033	1.13	38:45	
048a	North Beach Pump Station (wet well)	Puget Sound	11/22/09 1:03 AM	11/22/09 1:54 AM	0:51	4,162	0.74	7:05	
048a	North Beach Pump Station (wet well)	Puget Sound	11/26/09 4:11 AM	11/26/09 5:29 AM	1:17	10,759	1.15	11:44	
048a	North Beach Pump Station (wet well)	Puget Sound	12/21/09 2:51 AM	12/21/09 3:08 AM	0:17	2,030	0.62	55:09	
048b	North Beach Pump Station (inlet structure)	Puget Sound	1/7/09 8:21 PM	1/7/09 11:51 PM	3:30	239,202			
048b	North Beach Pump Station (inlet structure)	Puget Sound	4/2/09 6:41 PM	4/2/09 7:16 PM	0:35	35,227			
048b	North Beach Pump Station (inlet structure)	Puget Sound	5/5/09 4:36 AM	5/5/09 7:36 AM	3:00	53,334			
048b	North Beach Pump Station (inlet structure)	Puget Sound	5/19/09 8:01 PM	5/19/09 8:51 PM	0:50	53,859			
048b	North Beach Pump Station (inlet structure)	Puget Sound	9/6/09 1:51 AM	9/6/09 11:56 AM	10:05	43,609	0.85	31:21	
048b	North Beach Pump Station (inlet structure)	Puget Sound	10/14/09 2:17 PM	10/14/09 2:42 PM	0:25	19,183	0.75	26:21	
048b	North Beach Pump Station (inlet structure)	Puget Sound	10/16/09 8:22 PM	10/16/09 8:57 PM	0:35	30,532	1.99	80:36	
048b	North Beach Pump Station (inlet structure)	Puget Sound	10/26/09 8:02 AM	10/26/09 8:57 AM	0:55	1,829	0.49	18:22	

Outfall DSN #	CSO Name	Receiving Water	Event Starting Date/ Time	Event Ending Date/ Time	Duration (hours)	Volume (gallons)	Precipitation (inches)	Storm Duration (hours)	Note if DWO
048b	North Beach Pump Station (inlet structure)	Puget Sound	11/6/09 12:27 PM	11/6/09 5:47 PM	5:20	87,437	0.96	31:26	
048b	North Beach Pump Station (inlet structure)	Puget Sound	11/16/09 6:02 PM	11/17/09 12:47 AM	6:45	8,310	1.08	38:20	
048b	North Beach Pump Station (inlet structure)	Puget Sound	11/22/09 1:07 AM	11/22/09 2:07 AM	1:00	39,161	0.75	7:17	
048b	North Beach Pump Station (inlet structure)	Puget Sound	11/26/09 4:27 AM	11/26/09 5:42 AM	1:15	59,816	1.16	11:55	
048b	North Beach Pump Station (inlet structure)	Puget Sound	12/21/09 3:07 AM	12/21/09 3:22 AM	0:15	11,347	0.62	55:09	
049	30th Avenue NE Pump Station	Lake Wa			0:00	0			
052	53rd Avenue SW Pump Station	Puget Sound			0:00	0			
054	63rd Avenue SW Pump Station	Puget Sound			0:00	0			
055	SW Alaska Street Overflow	Puget Sound			0:00	0			
056	Murray Street Pump Station	Puget Sound	1/7/09 5:59 PM	1/8/09 1:01 AM	7:02	23,968,082			
056	Murray Street Pump Station	Puget Sound	5/2/09 7:33 PM	5/2/09 7:44 PM	0:11	513,342			
056	Murray Street Pump Station	Puget Sound	5/5/09 4:48 AM	5/5/09 5:58 AM	1:10	4,762,729			
056	Murray Street Pump Station	Puget Sound	5/19/09 8:19 PM	5/19/09 8:33 PM	0:14	1,002,344			
056	Murray Street Pump Station	Puget Sound	9/6/09 11:00 AM	9/6/09 11:52 AM	0:52	2,554,662	0.9	45:14	
056	Murray Street Pump Station	Puget Sound	10/14/09 7:18 PM	10/14/09 7:56 PM	0:38	2,277,996	0.57	26:59	Exacerbated

Outfall DSN #	CSO Name	Receiving Water	Event Starting Date/ Time	Event Ending Date/ Time	Duration (hours)	Volume (gallons)	Precipitation (inches)	Storm Duration (hours)	Note if DWO
056	Murray Street Pump Station	Puget Sound	10/16/09 8:12 PM	10/17/09 12:40 PM	16:28	6,391,448	2.03	96:28	
056	Murray Street Pump Station	Puget Sound	10/26/09 10:12 AM	10/26/09 10:22 AM	0:10	756,058	0.73	13:49	
056	Murray Street Pump Station	Puget Sound	11/6/09 2:30 AM	11/7/09 11:40 AM	33:10	4,863,408	2.26	48:49	
056	Murray Street Pump Station	Puget Sound	11/22/09 12:59 AM	11/22/09 1:47 AM	0:48	2,750,308	0.66	7:13	
056	Murray Street Pump Station	Puget Sound	11/26/09 5:18 AM	11/26/09 6:05 AM	0:47	2,860,412	0.99	12:36	
057	Barton Street Pump Station	Puget Sound	1/7/09 8:56 PM	1/7/09 10:48 PM	1:52	62,683			
057	Barton Street Pump Station	Puget Sound	5/5/09 4:46 AM	5/5/09 5:09 AM	0:23	94,709			

Appendix B
Treated CSO Events
January–December 2009

NPDES	Outfall #	CSO Name	Event Ending Date/Time	Event Starting Date/Time	Duration (hours)	Volume (gallons)	Precipitation (inches)	Storm Duration (hours)	Note if DWO	Comments
WA0029182	001	West Point CSO-Related Bypass	1/1/09 8:27 AM	1/1/09 7:42 AM	0.51	100,000				CSO - Flow exceeded 300 MGD
WA0029182	001	West Point CSO-Related Bypass	1/5/09 9:20 AM	1/5/09 7:28 AM	1.57	150,000				CSO - Flow exceeded 300 MGD
WA0029182	001	West Point CSO-Related Bypass	1/8/09 5:31 AM	1/7/09 5:40 PM	11.81	46,300,000				CSO - Flow exceeded 300 MGD
WA0029182	001	West Point CSO-Related Bypass	1/13/09 9:38 AM	1/13/09 9:29 AM	0.14	240,000			Not a permitted bypass	Power failure to IPS (Intermediate Pump Station)
WA0029182	001	West Point CSO-Related Bypass	1/28/09 10:13 AM	1/28/09 10:08 AM	0.08	100,000			Not a permitted bypass	Incorrect set point level for Primary Sedimentation Tanks
WA0029182	001	West Point CSO-Related Bypass	2/11/09 6:23 PM	6/11/09 6:20 PM	0.04	20,000			Not a permitted bypass	Incorrect set point level for Primary Sedimentation Tanks
WA0029182	001	West Point CSO-Related Bypass	3/15/09 12:53 PM	3/15/09 11:25 AM	1.41	50,000				CSO - Flow exceeded 300 MGD
WA0029182	001	West Point CSO-Related Bypass	4/3/09 8:05 AM	4/2/09 7:15 PM	6.91	11,450,000				CSO - Flow exceeded 300 MGD
WA0029182	001	West Point CSO-Related Bypass	4/12/09 6:51 PM	4/12/09 4:36 PM	1.89	500,000				CSO - Flow exceeded 300 MGD

NPDES	Outfall #	CSO Name	Event Ending Date/Time	Event Starting Date/Time	Duration (hours)	Volume (gallons)	Precipitation (inches)	Storm Duration (hours)	Note if DWO	Comments
WA00 29182	001	West Point CSO-Related Bypass	5/5/09 12:12 AM	5/4/09 9:16 PM	7.16	44,800,000				CSO - Flow exceeded 300 MGD
WA00 29182	001	West Point CSO-Related Bypass	5/13/09 10:18 AM	5/13/09 10:13 AM	0.08	150,000			Not a permitted bypass	IPS level control during the plant start up
WA00 29182	001	West Point CSO-Related Bypass	5/20/09 12:22 AM	5/19/09 9:21 AM	2.93	4,800,000				CSO - Flow exceeded 300 MGD
WA00 29182	001	West Point CSO-Related Bypass	8/9/09 9:55 AM	8/9/09 9:53 AM	0.02	10,000	No Rain.	N/A	Not a permitted bypass	Primary Sedimentation Level Control during the draining
WA00 29182	001	West Point CSO-Related Bypass	9/6/09 2:58 PM	9/6/09 12:01 PM	2.87	3,400,000	0.87	33.83		CSO - Flow exceeded 300 MGD; Precipitation from Ballard Rain Gauge
WA00 29182	001	West Point CSO-Related Bypass	10/14/09 5:23 PM	10/14/09 2:17 PM	2.40	6,090,000	0.75	26.37		CSO - Flow exceeded 300 MGD; Precipitation from Ballard Rain Gauge
WA00 29182	001	West Point CSO-Related Bypass	10/17/09 6:23 PM	10/16/09 11:02 AM	12.20	29,000,000	2.63	99.20	exacerbated bypass	Flow exceeded 300 MGD and 800,000 gals bypass caused by IPS failure; Precipitation from Ballard Rain Gauge
WA00 29182	001	West Point CSO-Related Bypass	10/26/09 1:02 PM	10/26/09 8:18 AM	4.64	14,500,000	0.68	19.85		CSO - Flow exceeded 300 MGD; Precipitation from Ballard Rain Gauge
WA00 29182	001	West Point CSO-Related Bypass	11/7/09 2:56 AM	11/5/09 1:36 PM	10.46	11,960,000	1.40	40.25		CSO - Flow exceeded 300 MGD; Precipitation from Ballard Rain Gauge
WA00 29182	001	West Point CSO-Related Bypass	11/9/09 2:13 PM	11/9/09 12:34 PM	1.44	1,130,000	0.33	5.20		CSO - Flow exceeded 300 MGD; Precipitation from Ballard Rain Gauge

NPDES	Outfall #	CSO Name	Event Ending Date/Time	Event Starting Date/Time	Duration (hours)	Volume (gallons)	Precipitation (inches)	Storm Duration (hours)	Note if DWO	Comments
WA00 29182	001	West Point CSO-Related Bypass	11/10/09 10:42 PM	11/10/09 8:34 PM	2.00	1,510,000	0.84	36.12		CSO - Flow exceeded 300 MGD; Precipitation from Ballard Rain Gauge; this storm event includes the previous storm event
WA00 29182	001	West Point CSO-Related Bypass	11/16/09 9:58 PM	11/16/09 5:07 PM	4.66	14,500,000	0.89	34.68		CSO - Flow exceeded 300 MGD; Precipitation from Ballard Rain Gauge
WA00 29182	001	West Point CSO-Related Bypass	11/19/09 3:28 PM	11/19/09 9:06 AM	5.75	15,210,000	2.14	101.02		CSO - Flow exceeded 300 MGD; Precipitation from Ballard Rain Gauge; this storm event includes the previous storm event
WA00 29182	001	West Point CSO-Related Bypass	11/22/09 2:58 PM	11/21/09 9:39 PM	12.99	29,920,000	1.04	17.12		CSO - Flow exceeded 300 MGD; Precipitation from Ballard Rain Gauge
WA00 29182	001	West Point CSO-Related Bypass	11/26/09 11:14 AM	11/25/09 8:58 PM	14.11	50,490,000	1.30	15.47		CSO - Flow exceeded 300 MGD; Precipitation from Ballard Rain Gauge
WA00 29182	001	West Point CSO-Related Bypass	12/21/09 11:02 AM	12/21/09 9:22 AM	1.48	2,800,000	0.75	61.25		CSO - Flow exceeded 300 MGD; Precipitation from Ballard Rain Gauge
WA00 29182	027b	Elliott West CSO Treatment Facility	1/8/09 21:06	1/7/09 19:11	19.25	38,890,000				
WA00 29182	027b	Elliott West CSO Treatment Facility	4/3/09 8:37	4/2/09 23:19	5.63	4,210,000				

NPDES	Outfall #	CSO Name	Event Ending Date/Time	Event Starting Date/Time	Duration (hours)	Volume (gallons)	Precipitation (inches)	Storm Duration (hours)	Note if DWO	Comments
WA0029182	027b	Elliott West CSO Treatment Facility	5/6/09 23:51	5/5/09 5:09	22.48	33,490,000				
WA0029182	027b	Elliott West CSO Treatment Facility	10/17/09 19:04	10/16/09 20:49	13.90	19,160,000	1.46	51.4		Precipitation from Denny Rain Gage
WA0029182	027b	Elliott West CSO Treatment Facility	10/26/09 16:51	10/26/09 9:49	7.10	12,190,000	0.49	31.5		Precipitation from Denny Rain Gage
WA0029182	027b	Elliott West CSO Treatment Facility	11/7/09 17:07	11/6/09 20:32	16.28	23,620,000	0.84	48.9		Precipitation from Denny Rain Gage
WA0029182	027b	Elliott West CSO Treatment Facility	11/17/09 10:12	11/16/09 19:16	14.95	16,340,000	0.87	106.6		Precipitation from Denny Rain Gage
WA0029182	027b	Elliott West CSO Treatment Facility	11/19/09 18:39	11/19/09 12:51	5.82	6,510,000	0.54			Precipitation from Denny Rain Gage
WA0029182	027b	Elliott West CSO Treatment Facility	11/22/09 15:07	11/22/09 1:09	13.08	18,290,000	0.91	17.5		Precipitation from Denny Rain Gage
WA0029182	027b	Elliott West CSO Treatment Facility	11/26/09 13:18	11/26/09 2:21	10.97	22,770,000	1.09	15.2		Precipitation from Denny Rain Gage
WA0029182	044b	Henderson/MLK CSO Treatment Facility	1/8/09 5:33 AM	1/7/09 11:55 PM	5.63	1,640,000				

NPDES	Outfall #	CSO Name	Event Ending Date/Time	Event Starting Date/Time	Duration (hours)	Volume (gallons)	Precipitation (inches)	Storm Duration (hours)	Note if DWO	Comments
WA0029182	046b	Carkeek CSO Treatment Facility Outfall	1/8/09 9:36	1/7/09 21:07	12.48	2,040,000				
WA0029182	046b	Carkeek CSO Treatment Facility Outfall	4/2/09 21:40	4/2/09 20:18	1.37	80,000				
WA0029182	046b	Carkeek CSO Treatment Facility Outfall	5/5/09 15:19	5/5/09 8:50	6.48	270,000				
WA0029182	046b	Carkeek CSO Treatment Facility Outfall	9/6/09 13:59	9/6/09 12:19	1.67	45,000	0.87	31.35		Precipitation data based on Ballard Rain gage
WA0029182	046b	Carkeek CSO Treatment Facility Outfall	11/7/09 1:48	11/6/09 18:00	3.57	161,000	1.41	38.30		Precipitation data based on Ballard Rain gage
WA0029182	046b	Carkeek CSO Treatment Facility Outfall	11/17/09 9:39	11/17/09 0:15	9.42	754,000	2.28	101.77		Precipitation data based on Ballard Rain gage
WA0029182	046b	Carkeek CSO Treatment Facility Outfall	11/19/09 18:41	11/19/09 12:46	5.93	397,000				Precipitation data based on Ballard Rain gage
WA0029182	046b	Carkeek CSO Treatment Facility Outfall	11/22/09 18:33	11/21/09 0:43	17.85	1,957,000	1.03	17.12		Precipitation data based on Ballard Rain gage
WA0029182	046b	Carkeek CSO Treatment Facility Outfall	11/26/09 17:38	11/25/09 4:27	13.20	2,384,000	1.38	23.76		Precipitation data based on Ballard Rain gage

NPDES	Outfall #	CSO Name	Event Ending Date/Time	Event Starting Date/Time	Duration (hours)	Volume (gallons)	Precipitation (inches)	Storm Duration (hours)	Note if DWO	Comments
WA0029182	051b	Alki CSO Treatment Facility Outfall	1/9/09 3:30 AM	1/7/09 8:20 PM	31.17	35,250,000				
WA0029182	051b	Alki CSO Treatment Facility Outfall	10/17/09 10:35 AM	10/17/09 10:05 AM	0.50	30,000	2.04	97.75	Exacerbated CSO treatment	PLC error resulted in only one tank filling before discharge - might otherwise have stored more
WA0029182	051b	Alki CSO Treatment Facility Outfall	11/17/09 7:25 AM	11/17/09 5:05 AM	2.33	1,010,000	1.44	50.82		
WA0029182	051b	Alki CSO Treatment Facility Outfall	11/26/2009 2:00PM	11/26/09 7:45 AM	6.25	790,000	1.21	27.35		

Appendix C
Alki CSO Treatment Plant
Annual Report

January–December 2009

This 2009 annual report summarizes performance of King County's Alki CSO Treatment Plant. The plant came online for CSO treatment in 1998. Alki operates under the NPDES permit for the West Point Treatment Plant (WA-0029181-1).

There were 10 filling events and four discharge events during calendar year 2009. The Alki CSO Treatment Plant received a total inflow of 48.60 MG and discharged 37.07 MG. The monthly and event-based limits for settleable solids were met. The annual 50 percent suspended solids removal limit was met at 62 percent. The facility did not meet the monthly limit for fecal coliforms in October and did not meet the daily limit for chlorine residual on four days: twice in January and twice in November.

Weather Conditions

A total of 36.1-inches of rain fell at SeaTac in calendar year 2009. This is slightly less than the historical SeaTac average of 37.1 inches. The largest storm of the year occurred January 6–7, 2009, when 3.5 inches fell over two days.

Operational Challenges (see monthly reports for more details)

Exceptions to the chlorine limit were primarily due to freezing of the sodium bisulfite (SBS) dechlorinating solution and the pumping strategy of the 63rd Avenue Pump Station. Problems with the chlorine residual analyzers and their sample pumps exacerbated the problem.

The SBS facilities were freeze-protected when installed because they sit in an unheated, open space. However, several parts with minimal insulation became frozen in January. Corrective actions included removing SBS crystals, installing additional insulation, installing a recirculation pump in the SBS storage tank (to help heat tank contents), and switching to a 25 percent SBS solution, which freezes at 32°F rather than 42°F for the 38 percent solution.

Though the 63rd Avenue pumps can operate in level control, they often operated in fill-and-draw during November, sending short-bursts of flow to Alki. Because both the hypochlorite and SBS pumps are flow-paced, such flow waves make it difficult to dose either chemical properly (hypochlorite overdosed and SBS underdosed). We are evaluating how to operate the 63rd Ave pumps to smooth the flow to Alki ,which should help the hypochlorite and bisulfite systems meet the chlorine limit.

The chlorine analyzers are used to (1) determine permit compliance with the final effluent Cl_2, and (2) provide feedback for making adjustments to the hypochlorite and SBS systems. Their sample pumps often became clogged with grit and screenings during events in 2009. Staff are currently evaluating modifications to eliminate clogging of the sample pumps while assuring they send a representative sample to the analyzers.

Construction projects in 2009 – the upgrade of the 53rd Avenue Pump Station and installation of a new SCADA system – affected when Alki received flow and the ability of staff to adequately respond. A temporary pump station, which operated while the 53rd Avenue Pump Station was upgraded, sent large flow waves to the 63rd Avenue station during moderate rain storms. This resulted in unexpected flow going to Alki, unexpected because flow usually goes to Alki only when the West Seattle Tunnel is full. On three separate occasions in April, May, and September, the tunnel was not full. These flow waves were eliminated when the upgraded 53rd Avenue Pump Station started operating in fall 2009.

Many offsite facilities were converted to the new "Ovation" SCADA system in the summer of 2009, including Alki and the 63rd Avenue Pump Station. The conversion was essentially completed in late summer 2009. Of the thousands of data points that were connected and calibrated in the new system, some critical elevations and alarms were not converted correctly. Thus, alarms that operators historically relied on to respond to Alki events were not triggered during the initial 2009 fall events. The incorrect elevations and alarms were corrected by November 2009.

Several isolated incidents were responsible for exceeding the fecal coliform limit in October 2009. The hypochlorite disinfection pumps were not returned to service after being turned off to repair a hypochlorite storage tank. Also, it was subsequently discovered that Alki was in manual control rather than programmable logic control (PLC), causing only one of six primary tanks to fill before discharge. The hypochlorite pumps were quickly returned to service and equipment was thereafter returned to PLC control with the proper control program.

Routine Operation and Maintenance Activities (see monthly reports for more details)

Routine operation and maintenance (O&M) activities not directly associated with an event included weekly operator inspections, checklists, equipment and sampler testing, and alarm checks, weekly analyzer preventive maintenance (PM) and calibration, quarterly lubrication and PM of mechanical equipment, annual training and preparation for winter wet weather operation, post-event cleaning of the CSO facilities, and post-event debriefs and corrective work orders as appropriate.

Table C-1. Alki CSO Plant Annual Event Data Summary

Month	Day	Alki Inflow Event Number	Alki Inflow Volume (mgd)	Alki Discharge Event Number	Alki Effluent Volume (mgd)	Total Inf TSS (lbs)	Total Effluent TSS @ Alki + WP (lbs)	TSS % removal	Alki Effluent SS Avg (mL/L/hr)	Alki SS Max event (mL/L/hr)	Min pH	Max pH	Avg Daily Fecal Coliform (#//100 mL)	Monthly Max Cl2 Residual (ug/L)
January														
7-9	Event/Daily Max	1												
	Mon. Total/Avg	1	39.33	1	35.3	40236	16361.0	59.3%	0.3	0.4	7.1	7.1	6	3933
February														
	Event/Daily Max													
	Mon. Total/Avg													
March														
	Event/Daily Max													
	Mon. Total/Avg													
April														
2		1	0.67	0	0	nm								
	Event/Daily Max													
	Mon. Total/Avg													
May														
5	Event/Daily Max	1	0.67	0	0	162	5	97.0%						
	Mon. Total/Avg													
June														
	Event/Daily Max													
	Mon. Total/Avg													
July														
	Event/Daily Max													
	Mon.													

Month	Day	Alki Inflow Event Number	Alki Inflow Volume (mgd)	Alki Discharge Event Number	Alki Effluent Volume (mgd)	Total Inf TSS (lbs)	Total Effluent TSS @ Alki + WP (lbs)	TSS % removal	Alki Effluent SS Avg (mL/L/hr)	Alki SS Max event (mL/L/hr)	Min pH	Max pH	Avg Daily Fecal Coliform (#//100 mL)	Monthly Max Cl2 Residual (ug/L)
	Total/Avg													
August														
	Event/Daily Max													
	Mon. Total/Avg													
Sept.														
6	Event/Daily Max	1	0.18	0	0.0	320	19	94.0%						
	Mon. Total/Avg													
October														
16-17		1	0.55	1	0.028	nm	nm							
26		2	0.80			814	24		0.1	0.1	8.4	8.4	>20,000	100
	Event/Daily Max													
	Mon. Total/Avg		1.35	1				97.0%						
Nov.														
7		1	0.20			nm	0							
17		2	2.60	1	1.0	1409	223		0.1			7.4	1	>234
22		3	0.40			268	13							
26		4	3.20	2	0.79	1490	276		0.1		7.2		1	684
	Event/Daily Max								0.1					
	Mon. Total/Avg		6.40			3167	512	83.8%	0.1	0.1				684
Dec.														
	Event/Daily Max													
	Mon. Total/Avg													
Total		10	48.60	4	37.07	44,699	16921							
Annual Avg/GEM								62.1%	0.30			7.1	6	
Min/Max									0.30			7.1	6	

Month	Day	Alki Inflow Event Number	Alki Inflow Volume (mgd)	Alki Discharge Event Number	Alki Effluent Volume (mgd)	Total Inf TSS (lbs)	Total Effluent TSS @ Alki + WP (lbs)	TSS % removal	Alki Effluent SS Avg (mL/L/hr)	Alki SS Max event (mL/L/hr)	Min pH	Max pH	Avg Daily Fecal Coliform (#//100 mL)	Monthly Max Cl2 Residual (ug/L)
or Max														

Table C-2. Alki Annual Summary

	Number of Discharge Events	Inflow Volume (mgd)	Discharge Volume (mgd)	Total Alki TSS (lbs in)	Total Alki TSS (lbs discharged)	Annual Average Alki %TSS Removal	Annual Average Alki SS (mL/L/lhr)	Event Maximum Alki SS (mL/L/lhr)	Maximum Monthly Geomean Alki Effluent Fecal Coliforms (#/100 mL)	Maximum of Daily Averages of Alki Effluent Residual Cl_2 (ug/L)
Including all Discharge Events	4	48.60	37.07	44699	16921	62.1%	0.30	0.30	>20000	3933

Appendix D
Carkeek CSO Treatment Plant
Annual Report

January–December 2009

Executive Summary

This report is the sixteenth annual report summarizing the performance of the Carkeek CSO Treatment plant. The plant began to operate as a CSO treatment facility on November 1, 1994. The facility operates under the NPDES permit for West Point Treatment Plant, Washington State Department of Ecology permit number WA-0029181-1, in effect from July 1, 2009, through June 30, 2014.

In 2005, a dechlorination system was designed and installed at Carkeek to meet the new residual chlorine limits and the hypochlorite dosage controls were modified to meet the new fecal coliform limits. The 2009 CSO year is the fifth year of operating the modified disinfection system and the newly installed dechlorination system. Both the systems demonstrated that the plant is capable of meeting the effluent fecal coliform and the effluent residual chlorine limits based on past years' performance.

The facility operated under two sets of permit limits during the 2009 year, because the permit was renewed with modifications on July 1, 2009 (Table D-1).

Table D-1. Permit Limits for Carkeek CSO Plant, Effective July 1, 2009

EFFLUENT LIMITS: OUTFALL # 046			
Parameter	**Discharge Limitations (Monthly)**	**Discharge Limitations [a] (Yearly Average)**	**Discharge Limitations [b] (Long–term Average)**
Total Suspended Solids Removal Efficiency [c]	Report	Equal to or greater than 50% removal of the influent TSS	Not Applicable (NA)
Fecal Coliform Bacteria [d]	400/100 mL geometric mean	Report	NA
Settleable Solids	1.9 mL/L/hr (maximum allowable per event)	0.3 mL/L/hr	NA
pH [e]	Daily minimum is equal to or greater than 6.0 and the daily maximum is less than or equal to 9.0.		
Number of Discharge Events	Report	Report	NA
Discharge Volume	Report	Report	NA
Parameter	**Average Monthly**	**Maximum of Daily Average [f]**	
Total Residual Chlorine	NA	490 µg/L	

[a] The yearly limits will be calculated using per-event data points. Data must be collected and reported on a calendar year basis.

[b] Long-term average will be calculated using data collected over a full permit cycle. Data shall be collected and reported for the period of the permit cycle prior to permit renewal.

EFFLUENT LIMITS: OUTFALL # 046			
Parameter	**Discharge Limitations (Monthly)**	**Discharge Limitations [a] (Yearly Average)**	**Discharge Limitations [b] (Long–term Average)**
[c] The total removal efficiency for TSS is to be calculated on a mass balance basis as the percent of solids captured at the CSO Treatment Facility and then permanently removed at the West Point Treatment Plant. The reported daily average(s) of TSS% removal efficiency at West Point WWTP, corresponding to the event, must be used for calculating the total removal efficiency for the CSO Treatment Facility. Note: While % TSS removal is reported on a monthly basis, compliance is based on the yearly average as reported in the annual CSO report as required in S18.			
[d] To calculate the average monthly value for fecal coliform, you must use the geometric mean for the day(s) in which a discharge(s) occurs. Do not include non-discharge days in the calculation. Ecology gives directions to calculate this value in publication No. 04-10-020, *Information Manual for Treatment Plant Operators,* available at: http://www.ecy.wa.gov/pubs/0410020.pdf**.**			
[e] Indicates the range of permitted values. The Permittee must report the instantaneous maximum and minimum pH monthly. Do not average pH values.			
[f] Maximum daily effluent limit means the highest allowable daily discharge. The daily discharge means the discharge of a pollutant measured during a calendar day. The daily discharge is the average measurement of the pollutant over the day.			

Performance for Reporting Period January 1 through December 31, 2009

The total rainfall in 2009 as measured by the Ballard Station rain gauge was 29.99 inches, which is significantly lower than the long-term regional average. During the calendar year, there were 14 inflow events into the Carkeek CSO plant, 9 of which resulted in discharges to Puget Sound out of the Carkeek CSO outfall. The total inflow volume and discharge volume for the reporting period was 13.75 MG and 8.1 MG, respectively. The performance of the plant for the year 2009 is summarized below in Table D-2. All NPDES permit limits were met during the year.

Table D-2. Carkeek CSO Plant Permit Performance in 2009

Parameter	2009 Performance	Permit Conditions
Number of Discharge Events	9	10[a]
Discharge Volume (MG)	8.1	46[a]
Annual Average Settleable Solids (mL/L/lhr)	0.2	0.3
Event Maximum Settleable Solids (mL/L/lhr)	0.8	1.9
Annual Average %TSS Removal	76%	50%
Fecal Coliform, Maximum Monthly Geomean (MPN#/100 ml)	27	400
Instantaneous Minimum/Maximum Effluent pH	6.6 / 8.0	>6.0 / <9.0
Total Residual Chlorine, Maximum of Daily (ug/L)	448	490

[a] Compliance assessed over a 20-year average.

Table D-3 summarizes the last 16 years of performance. The annual totals for the discharge flow and discharge events include the "one per year untreated event" data.

Table D-3. Carkeek CSO Plant Sixteen-Year Performance Summary

Year	Treated Discharges	Untreated Discharges[a]	One per Year Untreated Event
1994			
1995			
1996	9	1	12/29/1996–1/5/1997
1997	9	1	3/18–21, 1997
1998	6	1	12/12–12/14, 1998
1999	7	0	
2000	1	1	10/20/2000
2001	4	1	12/13–12/18, 2001
2002	4	0	
2003	4	1	10/20–10/21, 2003
2004	4	1	8/22/2004
2005	6	0	
2006	8	1	1/8–1/17, 2006
2007	1	1	12/2–12/5, 2007
2008	0	0	
2009	9	0	
Average	5.1	0.6	

[a] The “one per year untreated event” is the event that may be dropped from the annual solids limit calculations, similar to the one untreated discharge per year state standard. These events are treated, but had the lowest performance of all treated events during the year.

Operation and Maintenance

Pump Set #2 continued to experience high vibration throughout the year but did not result in any shutdowns. Vibration monitoring elements were replaced on the raw sewage main pumps in late September. Pump Set #2 is scheduled for replacement in summer 2010. Storage tank roof coating work was done in summer 2009.

The Hypochlorite tank was replaced with fresh solution early fall 2009.

During the November 19 discharge event, it was discovered that the effluent sample pump was not pumping. Upon investigating the cause of the failure, Maintenance personnel discovered that the relay base and relay had to be replaced. According to the Maintenance personnel, it was possible that the failure could have occurred prior to November 19.

Such a pump failure could potentially cause the city water makeup system controller to activate and the total residual chlorine (TRC) analyzer to erroneously measure the city water's residual as the effluent residual chlorine. The city water makeup system is designed to keep the pH probe and the residual analyzer elements wet during the facility’s dry periods. As a resolution to this problem, a high effluent residual chlorine alarm was installed in December 2009 to alert West Point's Main Control when the effluent residual chlorine is above the permit limit. The alarm allows for a corrective response to be initiated while the discharge event is still in progress.

Based on the experience during the November discharge events, even though the effluent sampling system had worked well most of the reporting period, King County will be pursuing sampling modifications in summer 2010 to further improve the system's reliability.

Currently, the pump-down of stored CSO volumes is done manually by an operator once the CSO event is over. As a part of process improvements, King County is looking at means to automate the pump-down of stored flows to maximize the available storage volume.

Table D-4. Carkeek CSO Plant Annual Event Data Summary

Month	Day	Carkeek Inflow Event Number	Carkeek Inflow Volume (mgd)	Carkeek Discharge Event Number	Carkeek Discharge Volume (mgd)	Total influent TSS (lbs)	Total Effluent TSS Discharge @ Carkeek + WP (lbs)	TSS % Removal	Carkeek Effluent Settleable Solids (mL/L/hr)	Carkeek Effluent pH	Carkeek Avg Daily Effluent Fecal Coliforms (#//100 mL)	Carkeek Effluent Residual Chlorine (ug/L)
January	7	1a	2.44	1a	1.96	3744	1063		0.2	6.9	0.0	11
	8	1b	0.11	1b	0.08	70	40		NS	7.0	0.0	6
	Inst. Min/ Max pH									NA		
	Event/ Daily Max								0.2			11
	Mon. Total/ Avg	1	2.55	1	2.04	3814	1103	71.1%	0.2		1	
February												
	Event/ Daily Max											
	Mon. Total/ Avg											
March												
	Event/ Daily Max											
	Mon. Total/ Avg											
April	2	1	0.49	1	0.08	1255	88		0.8	7.3	0	116
	Inst. Min/ Max pH									6.3/8.1		
	Event/ Daily Max								0.8		1	116

Month	Day	Carkeek Inflow Event Number	Carkeek Inflow Volume (mgd)	Carkeek Discharge Event Number	Carkeek Discharge Volume (mgd)	Total influent TSS (lbs)	Total Effluent TSS Discharge @ Carkeek + WP (lbs)	TSS % Removal	Carkeek Effluent Settleable Solids (mL/L/hr)	Carkeek Effluent pH	Carkeek Avg Daily Effluent Fecal Coliforms (#//100 mL)	Carkeek Effluent Residual Chlorine (ug/L)
	Mon. Total/ Avg	1	0.490	1	0.08	1255	88	93.0%	0.8			116
May	2	1	0.07	ND	ND	90	3		ND	ND	ND	ND
	4	2a	0.27	ND	ND	412	15		ND	ND	ND	ND
	5	2b	0.59	1	0.3	630	121		0.2	7.0	20	30
	19	3	0.15	ND	ND	407	15		ND	ND	ND	ND
	Inst. Min/ Max pH									NA		
	Event/ Daily Max											**30**
	Mon. Total/ Avg	3	1.08	1	0.3	1539	154	90.0%	0.2		20	30
June												
	Event/ Daily Max											
	Mon. Total/ Avg											
July												
	Event/ Daily Max											
	Mon. Total/ Avg											
August												
	Event/ Daily Max											

Month	Day	Carkeek Inflow Event Number	Carkeek Inflow Volume (mgd)	Carkeek Discharge Event Number	Carkeek Discharge Volume (mgd)	Total influent TSS (lbs)	Total Effluent TSS Discharge @ Carkeek + WP (lbs)	TSS % Removal	Carkeek Effluent Settleable Solids (mL/L/hr)	Carkeek Effluent pH	Carkeek Avg Daily Effluent Fecal Coliforms (#//100 mL)	Carkeek Effluent Residual Chlorine (ug/L)
	Mon. Total/ Avg											
Sept.	5	1a	0.03			74	4					
	6	1b	0.36	1	0.05	392	70		NR	0		NR
	Inst. Min/ Max pH									NR		
	Event/ Daily Max								NR			NR
	Mon. Total/ Avg	1	0.39	1	0.05	465	74		NR			NR
October	14	1a	0.04	ND	ND	67	3		ND	ND	ND	ND
	16	1b	0.28	ND	ND	397	12		ND	ND	ND	ND
	17	1c	0.10	ND	ND	68	2		ND	ND	ND	ND
	26	2	0.21	ND	ND	294	29		ND	ND	ND	ND
	Event/ Daily Max											
	Mon. Total/ Avg	2	0.63			826	47		ND	ND	ND	ND
Nov.	5	1a	0.12	ND	ND	196	14		ND	ND	ND	ND
	6	1b	0.79	1	0.16	817	237		0.5	NR	315	NR
	7	1c	0.12	ND	ND	99	3		ND	ND	ND	ND
	16	2a	1.18	2a	0.68	336	205		<0.1	NR	20	NR
	17	2b	0.08	2b	0.08	22	22		<0.1	NR	1	NR
	19	3	0.96	3	0.40	497	139		<0.1	7.1	10	403
	21	4a	1.17	4a	0.71	382	51		<0.1	7.9	1	408
	22	4b	1.29	4b	1.25	644	147		0.2	7.9	300	445

Month	Day	Carkeek Inflow Event Number	Carkeek Inflow Volume (mgd)	Carkeek Discharge Event Number	Carkeek Discharge Volume (mgd)	Total influent TSS (lbs)	Total Effluent TSS Discharge @ Carkeek + WP (lbs)	TSS % Removal	Carkeek Effluent Settleable Solids (mL/L/hr)	Carkeek Effluent pH	Carkeek Avg Daily Effluent Fecal Coliforms (#//100 mL)	Carkeek Effluent Residual Chlorine (ug/L)
	25	5a	1.24	5a	0.89	446	236		<0.1	7.5	1	448
	26	5b	1.63	5a	1.50	653	384		<0.1	6.9	17000	18
	Inst. Min/ Max pH									6.6/8.0		
	Event/ Daily Max								0.5			448
	Mon. Total/ Avg	5	8.58	5	5.65	4091	1438	64.8%	0.2		27	334
Dec.	20	1	0.03	ND	ND	NM	NM		ND	ND	ND	ND
	Event/ Daily Max											
	Mon. Total/ Avg	1	0.03									
Total		14	13.75	9	8.09	11991	2905					
Min/Max or Max								75.8%	0.2		27	448
Annual Avg/GEM									0.8	6.6/8.0		

Table D-5. Carkeek CSO Plant Annual Summary

	No. of Discharge Events	Inflow Volume (mgd)	Discharge Volume (mgd)	Total Carkeek TSS (lbs in)	Total Carkeek TSS (lbs discharged)	Annual Average Carkeek % TSS Recovery	Annual Average Carkeek Settleable Solids (mL/L/lhr)	Event Maximum Carkeek Settleable Solids (mL/L/lhr)	Maximum Monthly Geomean Carkeek Effluent Fecal Coliforms (#/100 mL)	Maximum of Daily Averages of Carkeek Effluent Residual Cl_2 (ug/L)	Instant. Min. pH	Instant. Max. pH
Including all Discharge Events	9	13.75	8.1	11991	2905	75.8%	0.2	0.8	27	448	6.6	8.0

Appendix E
Mercer/Elliott West CSO Control System Annual Report

January–December 2009

Executive Summary

This document constitutes the fifth annual report for the Mercer/Elliott West CSO system (EWCSO). EWCSO treatment plant began to operate in July 2005. The facility operates under the permit for West Point Treatment Plant, Washington State Department of Ecology permit number WA-0029181-1. The current permit went into effect on July 1, 2009, and expires June 30, 2014.

Including 2009, EWCSO has been operating for five years. There were 24 inflow events and 10 discharge events in 2009. During the year, EWCSO received a total of 371.0 MG of CSO flow out of which 195.5 MG were treated and discharged out of the EWCSO outfall at the Denny Regulator Station located in Myrtle Edwards Park. About 44.5 percent of the total discharged CSO flow volume occurred during the month of November 2009. The TSS removal for the reporting period, excluding the November 16-17, 2009, discharge event, was 42 percent.

The fifth year was characterized by higher inflow and discharges compared to the previous reporting period and by continuing challenges with the effluent sampling system and solids capture. The modifications made to the overflow weir at the Valley Street connection appear to have eliminated non-CSO flows into the Mercer tunnel.

Background

In previous reports, this section had provided background information about the facility and its operation. Please refer to the 2007–2008 annual CSO report for this information.

Permit Limits

The facility operated under two sets of permit limits during the 2009 year. The permit limits that became effective on July 1, 2009, are shown in Table E-1.

Table E-1. Permit Limits for the Mercer/Elliott West System, Effective July 1, 2009

EFFLUENT LIMITS: OUTFALL # 027B			
Parameter	**Discharge Limitations (Monthly)**	**Discharge Limitations [a] (Yearly Average)**	**Discharge Limitations [b] (Long–term Average)**
Total Suspended Solids Removal Efficiency [c]	Report	Equal to or greater than 50% removal of the influent TSS	Not Applicable (NA)
Fecal Coliform Bacteria [d]	400/100 mL geometric mean	Report	NA
Settleable Solids	1.9 mL/L/hr (maximum allowable per event)	0.3 mL/L/hr	NA
pH [e]	Daily minimum is equal to or greater than 6.0 and the daily maximum is less than or equal to 9.0.		
Number of Discharge Events	Report	Report	NA
Discharge Volume	Report	Report	NA
Parameter	**Average Monthly**	**Maximum of Daily Average [f]**	
Total Residual Chlorine	NA	104 µg/L	

[a] The yearly limits will be calculated using per-event data points. Data must be collected and reported on a calendar year basis.

[b] Long-term average will be calculated using data collected over a full permit cycle. Data shall be collected and reported for the period of the permit cycle prior to permit renewal.

[c] The total removal efficiency for TSS is to be calculated on a mass balance basis as the percent of solids captured at the CSO Treatment Facility and then permanently removed at the West Point Treatment Plant. The reported daily average(s) of TSS% removal efficiency at West Point WWTP, corresponding to the event, must be used for calculating the total removal efficiency for the CSO Treatment Facility.

Note: While % TSS removal is reported on a monthly basis, compliance is based on the yearly average as reported in the annual CSO report as required in S18.

[d] To calculate the average monthly value for fecal coliform, you must use the geometric mean for the day(s) in which a discharge(s) occur. Do not include non-discharge days in the calculation. Ecology gives directions to calculate this value in publication No. 04-10-020, *Information Manual for Treatment Plant Operators,* available at: http://www.ecy.wa.gov/pubs/0410020.pdf.

[e] Indicates the range of permitted values. The Permittee must report the instantaneous maximum and minimum pH monthly. Do not average pH values.

[f] Maximum daily effluent limit means the highest allowable daily discharge. The daily discharge means the discharge of a pollutant measured during a calendar day. The daily discharge is the average measurement of the pollutant over the day.

This report summarizes the performance and operation of the facility during January - December 2009.

Performance for Reporting Period January 1 through December 31, 2009

From January 1 through December 31, 2009, there were 24 inflow events into the Elliott West CSO Treatment Plant and 10 discharge events out of the Elliott West CSO outfall. The total inflow and discharge volumes for the reporting period were 371.0 MG and 195.5 MG, respectively.

Suspended and Settleable Solids

1. Excluding the one per year discharge event data (November 16–17), the annual TSS removal was calculated to be 42 percent. It is believed that the effluent samples were not

representative of the facility's actual performance. Solids that were captured during fully contained and small magnitude discharge events may be accumulating in the tunnel and being discharged during subsequent high intensity and extended duration events.

Resolution: King County will continue to optimize the tunnel flushing system utilizing the flushing gate at East Portal. King County is also reviewing strategies for an automated flushing program.

In addition, the bent shaft on the drain gate will be replaced in summer 2010 to facilitate quick drainage of the effluent pipe, at the end of a discharge event.

2. The annual settleable solids concentration for the discharge events averaged 2.3 mL/L/hr, and the event maximum was 9.5 mL/L/hr.

   The effluent settleable solids concentrations are from samples that are believed to be non-representative of the facility's performance. The samples are being influenced by one or both of the following:

   a) Marine solids entering the effluent outfall and settling in the transition structure to be picked up by effluent sampling pump that is located in the transition structure.
   b) Scouring of the solids settled in the EWCSO effluent pipe line (from previous events) during the successive discharge events. These solids would have otherwise drained back to the wet well at the end of each discharge event if the drain gate were functioning normally. The bent shaft on drain gate had rendered the actuator inoperable, consequently leading to a very slow drainage increasing the potential for solids settling (SS and TSS) in the EWCSO effluent pipeline.

   Resolution: King County initiated a project in 2010 to improve effluent sampling. The alternatives being explored include moving the effluent sample pump or its intake line upstream of the flap gate to eliminate the impact of any tidal influx of marine sediments on the effluent TSS and SS. The scope of this project also includes installation of a means to collect manual grab samples that does not pose the risk of surface discharges or endangering personnel safety, so that grab samples can be obtained in instances of sample pump failure or low flows.

   Also, as mentioned earlier, the bent shaft on the drain gate will be replaced in summer 2010 to facilitate quick drainage of the effluent pipe after a discharge event.

Fecal Coliform Bacteria

The maximum monthly geomean during the 2009 reporting period was 18,396 counts/100 mL. The samples are believed to be non-representative of the actual discharge. We are attributing the following as potential contributing factors to high effluent fecal coliform counts:

a) Frequent plugging of effluent sample pump that is located in the transition structure
b) Influence of marine sediment in the transition structure
c) Solids settled in the effluent pipeline from previous discharge events as a result of slow drainage due to the bent shaft on the drain gate

Resolution: The effluent sampling improvement project will eliminate or greatly minimize the potential for sample line plugging and the influence of marine sediment. The drain gate shaft replacement will eliminate or greatly minimize the potential for solids settling out in the effluent pipeline after a discharge event.

There is a Chlorination-Dechlorination Improvements project under way (currently at 60 percent design stage) that is looking at means of optimizing the disinfection and dechlorination processes. Included in the scope of this project is the installation of an initial chlorine residual analyzer at EWCSO to measure the initial chlorine demand. Estimating the initial chlorine demand and incorporating it into the hypochlorite dosing loop controls significantly optimize the disinfection process in response to variations in flow and/or chlorine demand.

Total Residual Chlorine

Maximum of daily average effluent total residual chlorine (TRC) during the 2009 reporting period was 69 μg/L, based on the discharge events data from January through October. The effluent sample pump motor was found burned out in November resulting in loss of ability to measure effluent residual during the entire month of November. There were no discharge events in December 2009.

Resolution: The pump motor was rebuilt and installed in December 2009. In addition, a Supervisory Control And Data Acquisition (SCADA) alarm was created in December 2009. The alarm will notify West Point Main Control any time the effluent residual exceeds the permit limit during a discharge so off-site operators can initiate troubleshooting and appropriate corrective measures as soon as possible. Another step that had since been instituted is to manually close the makeup city water supply valve (with the float mechanism) during the discharge event. This would ensure there will not be unintended dilution of the effluent sample in the event that flow were to drop or stop as a result of plugging of the sample line. The makeup water supply valve to the sampling well is reopened after the discharge event is over.

Instantaneous Minimum and Maximum Effluent pH

Instantaneous minimum and maximum effluent pH for the 2009 reporting period were 6.02 and 8.46, respectively, based on the discharge events data from January through October. The effluent sample pump motor was found burned out in November, preventing the ability to measure effluent pH during the entire month of November. There were no discharge events in December 2009.

Resolution: The pump motor was rebuilt and installed in December 2009. Another step that has been instituted is to manually close the city makeup water supply valve (with the float mechanism) during the discharge event to prevent unintended dilution of the effluent sample in the event that flow was to drop or stop as a result of plugging of the sample line. The makeup water supply valve to the sampling well is reopened after the discharge event is over.

Operation and Maintenance

This section provides a summary of the other O&M activities improving the facility's performance and compliance.

Hypochlorite System Interlock

There is an interlock between the dechlorination system and the hypochlorite system. The interlock initiates a shutdown of the hypochlorite system if there is a dechlorination system failure to minimize the discharge of flows without any dechlorination. Since the hypochlorination injection point and the dechlorination injection point are nearly 3,000 feet apart, a time delay is needed within the interlock logic to prevent a premature shutdown of the hypochlorination pumps. The time delay for the interlock-initiated shutdown of the hypochlorination pump (in the event of a delay in timely startup of sodium bisulfite dosing pumps) was increased in December 2009. This was done to ensure that the chlorinated discharge flows have adequate time to reach the Dechlorination Structure and the level in the Dechlorination Structure reaches the level permissive set point that initiates the start of the sodium bisulfate (SBS) dosing pumps.

Sodium Bisulfite Conveyance System

King County began using 38 percent solution of SBS, higher than the design concentration of 25 percent SBS, in late 2007 in order to maintain adequate dechlorination capacity in inventory. In past extreme storm conditions, there had been disinfection failures resulting from inventory problems. Switching from a 25 percent to 38 percent solution offered two advantages:

- It increased the available disinfection capacity by 50 percent.
- The 38 percent solution is the industry standard and is thus more readily available.

The 38 percent solution has one notable disadvantage: it freezes at a higher temperature. Unusually long ground freezing temperatures in December 2008 through early January 2009 resulted in crystallization of the SBS in the 2,600-foot-long SBS transfer line between the SBS storage tanks located at EWCSO and the day tank located at the Denny Regulator Station. Toward the end of the discharge event on January 8, 2009, the SBS in the day tank was consumed and no transfers could take place between the storage tanks and the day tank as a result of the plugged transfer line. Subsequently, 0.92 MG out of a total of 38.9 MG discharged flows was discharged without disinfection, the result of both the SBS shortage and the hypochlorite system interlock. A report was submitted to Ecology for the untreated discharge volume of 0.92 MG.

King County was able to clear the crystals out of the transfer line by early February 2009. As part of the response, cleanouts were installed at key locations on the transfer line to allow jetting of the line to remove the crystal deposits. These cleanouts will facilitate future jetting, if necessary.

Resolution: To prevent a repeat of this problem, King County initiated flushing of the transfer line prior to cold weather events. First, water is added to the line from the EWCSO, and it is used to push and displace the SBS, in the line, into the day tank at Denny Regulator Station. The line will then be emptied by draining the water.

Chlorination-Dechlorination System Improvements

There is an ongoing project to improve the chlorination-dechlorination system. The project is currently in the design stage, and a number of improvements will be implemented during summer 2010, including the following:

- Installation of flow meters on the hypochlorite and bisulfite pumps
- Chemical dose monitoring
- Installation of an initial chlorine demand analyzer at EWCSO
- Installation of chlorination and dechlorination feedback loop controls
- Improvements to the chlorination injection system

Hydraulic Containment of Treated CSO Conveyance

In past seasons, hydraulic limitations of the EWCSO effluent transfer line have, on occasion, led to surface discharges out of manholes on top of the Dechlorination and Outfall Transition Structures outside of the Denny Regulator Station. To remedy this situation, an aboveground structure was built in fall 2008 to dampen the hydraulic surges. Based on performance during the CSO discharge events that occurred in 2009, the aboveground structure appears to have effectively addressed the hydraulic surge. There were no instances of any surface discharges.

Sampling

King County initiated a project to improve effluent sampling reliability, which would include an evaluation to relocate the effluent sample pump and/or sample intake to eliminate the influence of marine deposits from tidal movements and to ensure collection of effluent samples under low tide conditions. Also included in the scope is to explore and install safe means of collecting manual grab samples without the risk of surface discharges or endangering personnel safety.

The project hopes to address the following issues experienced during the year:

- Some of the discharge events were characterized by loss of effluent sample pumping ability during low tide conditions. In such instances, the pre-dechlorination analyzer sample pump was used to deliver disinfected but un-dechlorinated CSO flows to the effluent sampling setup. Since these flows were deemed representative only for SS, TSS, BOD, and fecal analyses, there were no effluent residual chlorine and pH readings for events impacted by low tide conditions in the transition structure.
- As mentioned previously, there was an issue with non-representative effluent samples. There were two potential causes identified for the high effluent settleable solids concentration. The project will address the latter:
    a) Slow drainage of the effluent between the dechlorination structure weir and the CSO drain gate after the end of a discharge could be resulting in solids settling out and being picked up during the next discharge event. The shaft on the drain gate was bent and as a result does not open completely to allow for quick drainage of the effluent. The bent shaft will be replaced during summer 2010.
    b) Marine sediments are contaminating the effluent samples. The sample pump is currently located in the outfall transition structure and is being influenced by tidal movements since the removal of the duckbill valve on the effluent outfall. The duckbill valve was removed in 2007 as means of addressing the hydraulic grade line issues contributing to surface discharges. An unintended consequence of this modification is that the tidal movements in and out of outfall transition structure are depositing marine sediments. There have been instances of shell fragments in the effluent sample line and effluent sampling well.

Other Improvements

Other Improvements being pursued include the following:

- Update of the O&M manual tentatively scheduled for 2011.
- Installation of a portable level sensor at the EBI Control Structure during summer 2010. The data from the portable sensor will be compared to the Elliott Bay Interceptor levels as measured by the level sensor in Special Manhole 10-128A to determine if further work is necessary following 2010–2011 wet season.

Near Future Operation

Although the Elliott West facility has been in existence for four-and-a-half years as a CSO facility, opportunities to operate and then to optimize have been very limited. The iterative process of improvement for a CSO facility is much longer than for facilities that operate year round. Challenges to its operation need to be identified during an event in the wet season, but any major projects to address the challenges likely have to occur during the following dry season. Then, after the completion of these projects, the opportunities to test the improvements would likely occur in the following wet season. Given the complexity of this facility's design and operation and the “normal” challenges of an intermittently operated facility, King County has essentially had to continually make improvements and a number of improvements need to be addressed during summer 2010.

For future CSO facilities of similar complexity and challenges, King County would be interested in meeting with Ecology to discuss ways to improve the commissioning such facilities.

Table E-2. Mercer/Elliott West CSO Facilities Annual Event Data Summary

Month	Day	EW Inflow Event Number	EW Inflow Volume (mgd)	EW Discharge Event Number	EW Discharge Volume (mgd)	Total Influent TSS (lbs)	Total Effluent TSS Discharge @ Denny + WP (lbs)	% Removal	EW Effluent SS (mL/L/hr)	EW Effluent pH	EW avg Effluent Fecal Coliforms (#/100 mL)	EW Effluent Residual Chlorine (ug/L)
January	1	1	2.09	ND	ND	593	28					
	5	2a	5.58	ND	ND	2423	113					
	6	2b	3.54	ND	ND	1898	89					
	7	2c	34.83	1a	32.33	15679	14870		0.20	6.5	10	19
	8	2d	13.15	1b	6.56	4006	1491		<0.1	NS	0	NS
	9	2e	1.99	ND	ND	282	13					
	Instant. Min/Max pH									6.3/8.1		
	Event/Daily Max								0.2			19
	Monthly Total/Avg/GeoMean	2	61.2	1	38.89	24883	16604	33.3%	0.1		3	
February	23	1	0.35	ND	ND	441	13					
	25	2	0.35	ND	ND	143	4					
	Event/Daily Max											
	Monthly Total/Avg/GeoMean	2	0.70	ND	ND	584	18	96.9%				
March	8	1	0.13	ND	ND	124	4					
	15	2a	1.91	ND	ND	1370	48					
	16	2b	0.07	ND	ND	50	2					
	18	3	0.28	ND	ND	100	3					
	25	4	0.29	ND	ND	244	9					
	Event/Daily Max											
	Monthly Total/Avg/GeoMean	4	2.68	ND	ND	1888	66	96.5%				
April	1	1a	0.26	ND	ND	193	6					

Month	Day	EW Inflow Event Number	EW Inflow Volume (mgd)	EW Discharge Event Number	EW Discharge Volume (mgd)	Total Influent TSS (lbs)	Total Effluent TSS Discharge @ Denny + WP (lbs)	% Removal	EW Effluent SS (mL/L/hr)	EW Effluent pH	EW avg Effluent Fecal Coliforms (#/100 mL)	EW Effluent Residual Chlorine (ug/L)
	2	1b	3.09	1a	3.09	1211	1211		<0.1	7.2	1	26
	3	1c	9.34	1b	1.12	2190	285		<0.1	6.7	7000	6
	4	1d	0.44	ND	ND	55	2					
	12	2a	4.47	ND	ND	1127	35					
	13	2b	0.75	ND	ND	407	13					
	Instant. Min/Max pH									6.1/7.8		
	Event/Daily Max								<0.1			26
	Monthly Total/Avg/ GeoMean	2	18.35	1	4.21	5182	1551	70.1%	<0.1		19	16
May	2	1a	1.16	ND	ND	1026	37.64					
	3	1b	0.72	ND	ND	498	18.29					
	4	1c	11.28	1a	11.28	6115	6114.89		0.6	7.0	3000	2
	5	1d	21.13	1b	15.36	3846	1992.18		<0.10	6.9	5000	8
	6	1e	10.86	1c	6.85	3028	1707.06		<0.10	6.7	415000	3
	7	1f	5.58	ND	ND	1337	49.07					
	13	2a	5.88	ND	ND	1962	71.99					
	14	2b	3.98	ND	ND	1181	43.33					
	15	2c	0.12	ND	ND	203	7.46					
	18	3a	1.79	ND	ND	806	29.59					
	19	3b	5.24	ND	ND	1572	57.70					
	20	3c	4.38	ND	ND	805	29.54					
	Instant. Min/Max pH									5.9/7.8		
	Event/Daily Max								0.6			8

Month	Day	EW Inflow Event Number	EW Inflow Volume (mgd)	EW Discharge Event Number	EW Discharge Volume (mgd)	Total Influent TSS (lbs)	Total Effluent TSS Discharge @ Denny + WP (lbs)	% Removal	EW Effluent SS (mL/L/hr)	EW Effluent pH	EW avg Effluent Fecal Coliforms (#/100 mL)	EW Effluent Residual Chlorine (ug/L)
	Monthly Total/Avg/ GeoMean	3	72.1	1	33.49	22379	10159	54.6%	0.3		18396	4
June												
	Event/Daily Max											
	Monthly Total/Avg/GeoMean											
July												
	Event/Daily Max											
	Monthly Total/Avg/GeoMean											
August												
	Event/Daily Max											
	Monthly Total/Avg/GeoMean											
Sept.												
	Event/Daily Max											
	Monthly Total/Avg/GeoMean											
October	14	1a	5.90	ND	ND	2217	111					
	15	1b	0.44	ND	ND	242	7					
	16	1c	9.64	1a	5.40	13748	7883		5.5	6.4	1650	48
	17	1d	23.31	1b	13.76	8669	4156		NA	6.7	300	69
	18	1e	0.81			290	290					
	26	2	20.4	2	12.19	14181	12215		2.3	6.4	412510	69
	Instant. Min/Max pH									6.0/8.5		

Month	Day	EW Inflow Event Number	EW Inflow Volume (mgd)	EW Discharge Event Number	EW Discharge Volume (mgd)	Total Influent TSS (lbs)	Total Effluent TSS Discharge @ Denny + WP (lbs)	% Removal	EW Effluent SS (mL/L/hr)	EW Effluent pH	EW avg Effluent Fecal Coliforms (#/100 mL)	EW Effluent Residual Chlorine (ug/L)
	Event/Daily Max								5.5			69
	Monthly Total/Avg/ GeoMean	2	60.45	2	31.35	39348	24662	37.3%	3.9		5889	62
Nov.	5	1a	1.52	ND	ND	837	20					
	6	1b	16.26	1a	14.05	12747	121		NS	NS	1100	NS
	7	1c	17.48	1b	9.57	6123	3651		NS	NS	1.0	NS
	8	1d	0.85	ND	ND	284	9					
	9	1e	0.84	ND	ND	1072	46					
	10	1f	1.46	ND	ND	705	45					
	11	1g	0.57	ND	ND	166	6					
	13	2	0.52	ND	ND	1722	38					
	16	3a	14.07	2a	14.07	17719	17719		5.5	NS	150250	NS
	17	3b	10.24	2b	2.27	1994	617		5.5	NS	1	NS
	18	3c	0.78	ND	ND	273	14					
	19	4a	11.74	3	6.51	4014	2445		NS	NS	1	NS
	20	4b	5.77	ND	ND	1444	95					
	21	5a	10.53	4a	10.43	2047	2005		<0.1	NS	1	NS
	22	5b	15.71	4b	7.86	3152	1950		0.2	NS	1	NS
	23	5c	0.91	ND	ND	159	9					
	25	6a	15.60	5a	15.46	16548	16507		9.5	NS	1700	NS
	26	6b	11.65	5b	7.31	10855	5457		4.5	NS	8000	NS
	27	6c	4.42	ND	ND	4412	308					
	Instant. Min/Max pH									NS		
	Event/Daily Max								9.5			NS
	Monthly Total/Avg/ GeoMean	6	140.92	5	87.53	86273	62078	28.0%	5.0		51	

Month	Day	EW Inflow Event Number	EW Inflow Volume (mgd)	EW Discharge Event Number	EW Discharge Volume (mgd)	Total Influent TSS (lbs)	Total Effluent TSS Discharge @ Denny + WP (lbs)	% Removal	EW Effluent SS (mL/L/hr)	EW Effluent pH	EW avg Effluent Fecal Coliforms (#/100 mL)	EW Effluent Residual Chlorine (ug/L)
Dec.	14	1a	1.99	ND	ND	1328	36					
	15	1b	4.87	ND	ND	1242	84					
	16	1c	0.54	ND	ND	567	36					
	17	1d	0.22	ND	ND	79	2					
	20	2a	0.05	ND	ND	25	1					
	21	2b	6.11	ND	ND	1454	209					
	22	2c	0.29	ND	ND	244	8					
	31	3	0.49	ND	ND	821	28					
	Event/Daily Max											
	Monthly Total/Avg/ GeoMean	3	14.56	ND	ND	5760	405	93.0%				
Total		24	370.96	10	195	186297	115451					69
Annual Avg								38.0%	2.3			
Min/Max/ Monthly GEM_{max}									9.50	6.0/8.5	18396	

Table E-3. Elliott West/Mercer CSO Facilities Annual Summary

	Inflow Volume (mgd)	Disch Volume (mgd)	Total EW TSS (lbs in)	Total EW TSS (lbs Discharged)	Annual Average EW % TSS Removal	Annual Average EW SS (mL/L/lhr)	Max Monthly Geomean EW Effluent Fecal Coliforms (#/100 mL)	Max of Daily Averages of EW Effluent Res. Cl_2 (ug/L)	Instant Min/Max pH
Including all Discharge Events	371.0	195.5	186297	115541	38.0%	2.3	18396	69	6.02/8.46
Excluding Discharge Event Nov. 16–17	371.0	195.5	166584	97206	41.6%	9.5	18396	69	6.02/8.46

Appendix F
Henderson/Norfolk CSO Control System Annual Report

January–December 2009

This 2009 annual report summarizes the performance of King County's Henderson/Norfolk CSO treatment facilities. These CSO facilities came online in 2005. They operate under the NPDES permit for the West Point Treatment Plant (WA-0029181-1). There were two filling and one discharge event in 2009.

Season's Weather Conditions

A total of 36.54-inches of rain fell in calendar year 2009. This is slightly less than the historical average of 37.1-inches as measured at SeaTac. The largest storm of the year occurred January 6–7, 2009, when 3.51-inches fell in 48 hours.

Operational Challenges

The Henderson/Norfolk CSO system operated well in 2009. All permit conditions were met. The annual suspended solids removal was 61.1 percent. One influent sample was not collected in 2009 as required because the inflow event lasted only 15 minutes. Also, an influent sample is not easily grabbed because of the physical nature and depth of the tunnel's inlet structure. As a corrective action for similar short-lived events in the future, the operators will grab an influent sample from the tunnel inlet soon after the event by closing the inlet tunnel regulator gate. Closing the gate temporarily will cause the wastewater level in the tunnel inlet to rise sufficiently so that an operator can safely grab a sample.

Routine Operation and Maintenance Activities

The equipment and facilities of the Henderson/Norfolk CSO treatment system were fully functioning and available during 2009. Preventive maintenance was performed routinely. Routine O&M activities not directly associated with an event included weekly operator inspections, checklists, equipment and sampler testing, alarm checks, weekly analyzer PMs and calibrations, quarterly lubrication and PMs of mechanical equipment, annual training and preparation for winter wet weather operation, post-event cleaning of the CSO facilities, and post-event debriefs and corrective work orders as appropriate. More details are available in the monthly discharge monitoring reports.

In late January 2009, a new amperometric low-level chlorine analyzer was installed at the MLK outlet regulator structure. This analyzer will be used to monitor the final effluent chlorine residuals. It is capable of measuring total combined chlorine at or below the permit limit of 39 µg/L. This unit has been used successfully at King County's Carkeek CSO treatment plant. This online analyzer will replace the manual DPD method; however, the manual DPD colorimetric method will be used during a discharge event to verify calibration of the online analyzer.

Table F-1. Summary of Henderson/Norfolk 2009 Event Data

Month	Day	Hen/Nor Inflow Event Number	Hen/Nor Inflow Volume (MG)	Hen/Nor Discharge Event Number	Hen/Nor Discharge Volume (MG)	Total Influent TSS (lbs)	Total Effluent TSS Hen/Nor +WP (lbs)	TSS % Removal	Hen/Nor Effluent SS (mL/L/lhr)	Hen/Nor Effluent pH	Hen/Nor Avg Effluent Fecal Coliforms (#/100 mL)	Hen/Nor Effluent Residual Chlorine (ug/L)
January												
6-7	Event/Daily Max	1	5.34	1	1.64	1692	659		0.1	6.8	44	35
	Mon. Total/Avg							61.1%	0.1	6.7	16	35
February												
	Event/Daily Max											
	Mon. Total/Avg											
March												
	Event/Daily Max											
	Mon. Total/Avg											
April												
	Event/Daily Max											
	Mon. Total/Avg											
May												
	Event/Daily Max											
	Mon. Total/Avg											
June												
	Event/Daily Max											
	Mon. Total/Avg											

Month	Day	Hen/Nor Inflow Event Number	Hen/Nor Inflow Volume (MG)	Hen/Nor Discharge Event Number	Hen/Nor Discharge Volume (MG)	Total Influent TSS (lbs)	Total Effluent TSS Hen/Nor +WP (lbs)	TSS % Removal	Hen/Nor Effluent SS (mL/L/lhr)	Hen/Nor Effluent pH	Hen/Nor Avg Effluent Fecal Coliforms (#/100 mL)	Hen/Nor Effluent Residual Chlorine (ug/L)
July												
	Event/Daily Max											
	Mon. Total/Avg											
August												
	Event/Daily Max											
	Mon. Total/Avg											
September												
	Event/Daily Max											
	Mon. Total/Avg											
October												
26	Event/Daily Max	1	0.07			nm	nm	97.0%				
	Mon. Total/Avg											
November												
	Event/Daily Max											
	Mon. Total/Avg											
December												
	Event/Daily Max											
	Mon. Total/Avg											
Total		2	5.41	1	1.64	>1692	>659					
Annual Avg/GEM								61.1%	0.10	6.7	16	35

Month	Day	Hen/Nor Inflow Event Number	Hen/Nor Inflow Volume (MG)	Hen/Nor Discharge Event Number	Hen/Nor Discharge Volume (MG)	Total Influent TSS (lbs)	Total Effluent TSS Hen/Nor +WP (lbs)	TSS % Removal	Hen/Nor Effluent SS (mL/L/lhr)	Hen/Nor Effluent pH	Hen/Nor Avg Effluent Fecal Coliforms (#/100 mL)	Hen/Nor Effluent Residual Chlorine (ug/L)
Min/Max or Max									0.10	6.8	44	35

Table F-2. 2009 Henderson/Norfolk Annual Values

	Number of Discharge Events	Inflow Volume (MG)	Discharge Volume (MG)	Total Hen/Nor TSS (lbs in)	Total Hen/Nor TSS (lbs discharged)	Annual Average %TSS Removal	Annual Average Hen/Nor SS (mL/L/lhr)	Event Maximum Hen/Nor SS (mL/L/lhr)	Maximum Monthly Geomean Hen/Nor Effluent Fecal Coliforms (#/100 mL)	Maximum of Daily Averages of MLK Effluent Residual Cl_2 (ug/L)
Including all Discharge Events	1	5.41	1.6	1692	659	61.1%	0.10	0.10	44	35