City of Portland

Annual CSO Performance Report FY-2012

Required by NPDES Permit #101505 for CBWTP & CSO Systems

September 2012

Environmental Services
City of Portland

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Executive Summary

The Annual CSO Performance Report for fiscal year 2012 provides important baseline information that demonstrates how the new CSO system performed during this first pivotal year when it transitioned from an incomplete system (July 1, 2011) to a completed system (December 2011), and during its first seven months of full operations through June 30, 2012. This annual report provides a comprehensive performance review for the overall CSO system, which consists of the collection system, the CSO facilities and the treatment systems at the Columbia Boulevard Wastewater Treatment Plant (CBWTP). The scope covered by this report is described in the July 2011 NPDES permit for CBWTP:

> *"At minimum the report must provide an update regarding activities performed during the year in implementing the Nine Minimum Controls, will identify any CSO outfall not meeting the CSO performance standards, include a summary of the CSO monitoring done and detail the CSO related bypass events in order to assess the CSO reductions observed and the wet weather treatment performance."* *Report Submittals, Item c. from 2011 CBWTP NPDES Permit, page 14.*

In addition to the NPDES Permit, the scope of this report is also informed by four other important regulatory and programmatic documents:

- The Mutual Agreement & Order (MAO) that is attached to the permit and prescribes projects to be completed to improve CSO treatment and develop specific information in preparation for the next permit renewal in 2016.
- No Feasible Alternative Analysis (NFAA, December 2009) which established the methods for analyzing secondary bypass events as well as the annual, monthly and weekly peak flow treatment performance characteristics. The FY2012 Annual Report starts the process of building the performance record that will be used in the next NFAA in 2016.
- Nine Minimum Controls (NMC) Report, December 2010 Update which provides the framework and key information for documenting how NMCs are being implemented by Portland in an on-going, continuous manner.
- Post-2011 CSO Facilities Plan (September 2010) which identifies the projects Portland is pursuing that will enable "further CSO reductions" to be achieved and ensure the level of CSO control for the Willamette River exceeds the 4-per-winter, 3-year summer standards.

CSO System Performance

Fiscal Year 2012 was a wet 12-month period in which Portland received 47 inches of rainfall compared to the annual average of 37 inches. In addition, the CSO system was in transition from July to December 1 as the new East Side CSO system (new tunnels, pumps, force main, etc.), was brought online. Nonetheless, the CSO system successfully captured all but three storms, and captured storms that exceeded the 4-per-winter standard. All of the active CSO outfalls were found to meet and exceed the control standards in the permit. The three storms that caused CSO events to occur resulted in 435 million gallons of CSO discharged for the fiscal year. These three extreme storms approached or exceeded the 5-year winter and 10-year summer storm standards.

- November 22, 2011: 115 million gallons of CSO discharged for about 6 hours from the nearly completed East Side and West Side Willamette CSO system.
- January 18-19, 2012: 305 million gallons of CSO discharged for about 10 hours from the Willamette CSO system.
- May 26, 2012: 15 million gallons of CSO discharged for less than one hour to the Willamette River and 0.02 million gallons discharged to the Columbia Slough during this intense cloud-burst that exceeded the 100-year storm standards.

The CSO system was able to capture two large storms that occurred during March 2012 that nearly filled the CSO tunnels (85% to 96% full) but did not overflow. The two storms had rainfall depths that matched or exceeded the 2-per-winter design storm characteristics. Therefore, just as expected in the Post-2011 CSO Facilities Plan, the completed system has immediately provided “further CSO reductions” that went beyond the 4-per-winter design storm criteria and is tracking at about the 2-per-winter design storm level of control.

CSO Treatment Performance

The performance standards for treating dry weather and wet weather (captured CSO) flows at CBWTP are identified in the NPDES permit Schedule A. The requirements are focused on maximum-monthly and peak-week effluent loads discharged from Outfalls 001 and 003, and the effluent loads from the two treatment trains – Dry Weather / Secondary system and the Wet Weather treatment train. Annual percent removals are also specified for the Wet Weather Treatment train.

During this transition year, the CBWTP system met the total mass load limits for BOD and TSS at the Outfall 001 and 003 discharge points into the Columbia River. This was a result of the Operations staff successfully increasing the flow rate and volume treated through the secondary treatment system which continually exceeded the 100 MGD minimum requirement established in the permit. However, the average concentration limits for TSS were exceeded due to the inability of the existing Wet Weather Treatment Facility (WWTF) to achieve the permit’s high treatment requirements given the new CSO loads from the East Side CSO system. The Max-Month and Peak-Week values from the CBWTP outfalls are shown in Table ES-1.

Table ES-1: FY2012 Effluent Limit Concentrations for Outfall 001 & 003

Parameter	Permit Maximum Concentration (mg/l)	Average Actual Concentration (mg/)
Maximum 30-Day Performance		
BOD5	30	29
TSS	30	38
Peak 7-Day Performance		
BOD5	45	36
TSS	45	49

The fact that the existing Wet Weather Treatment Facility was overwhelmed by the CSO flow rates from the completed system was also observed in the annual percentage removal rates. The annual TSS removal was 63% and BOD removal was 34%, which did not meet the permit required 70% TSS removal and 50% BOD removal. However, these results were expected and formed the basis for why the MAO specifically required Chemically Enhanced Primary Treatment (CEPT) to be implemented for the Wet Weather Treatment train by September 30, 2012. This project is on schedule and is expected to bring the wet weather system up to the permit-required performance standards.

Analysis of the CSO treatment data from this wet FY2012 also revealed that CBWTP received 8.6 billion gallons of captured CSO compared to the average year volume of 6.2 billion gallons. CBWTP Operators were able to treat 64% of this CSO volume through the Secondary system, with 36% treated in the WWTF. There were 29 events in which flows were "bypassed" to the wet weather system. The average bypass event lasted 25 hours and sent 108 million gallons through the WWTF and Outfalls 001 & 003. During these events, the average flow rate through the secondary system was 120 MGD, which is significantly higher than the 100 MGD required in the NPDES permit.

Nine Minimum Controls (NMC)

This FY2012 Annual CSO Performance Report continues to add to the information provided in the 2010 Nine Minimum Controls Update Report for those best management practices implemented on an on-going basis (compared to one-time capital investments). The annual report picks up where the 2010 NMC Update Report left off by including information for fiscal years 2011 and 2012 to provide a continuous view of the NMC implementation. In this manner (as envisioned in the permit), the annual CSO performance report provides the necessary documentation of the NMC implementation, thereby eliminating the need for large periodic NMC Update reports.

In examining the performance data for NMC #1, Operations & Maintenance, the priorities for the City's work at this new stage of the CSO Program are evident. Asset Management principles and practices are being used to highlight sewer system risks to public health and the environment, and identifying cost-effective projects to reduce that risk. The result is a significant shift in capital and operating expenditures and budgets:

- Capital expenditures in Pipe Rehabilitation programs have more than tripled from about $10 million average per year to more than $35 million average per year. This trend continues into the next 10-year CIP, reflecting the City's focus on risk-based priorities.
- Expenditures for Sewer Capacity projects to relieve sewer backups by integrating grey and green infrastructure continue to increase over the next 10 -year CIP as well. These projects are identified in the Post-2011 CSO Facilities Plan and are ahead of the schedule needed to maintain the higher level of CSO control.
- Expenditures have also increased for collection systems pipe cleaning and pipe inspections. The inspection data have been critical for providing up-to-date information on the

condition and remaining useful life of individual pipes and have helped identify the scope and scale of the newest phase of the Pipe Rehab program.

- Treatment & Pump Station capacity and maintenance work is at a peak level due to the improvements needed to support the CSO program, including increased capacity for hydraulic, solids and wet weather treatment needs.

Many additional NMC#1-related activities are better covered under the Capacity, Maintenance, Operations and Management (CMOM) Program Report that will be submitted to DEQ in June 2013 as required in the permit.

The other NMC requirements that are actually components of the overall System Operations, including Maximizing Storage and Maximizing Flow to Treatment, are discussed together in this report because their implementation is best understood in the context of the operating strategy for the entire system.

Water Quality Results

The last section in this report presents the results of the Willamette River and the Columbia River water quality monitoring programs. The data for the CSO pollutants of concern are shown in data plots with data from past years provided to give context. In both programs, long-term trends as well as data from the past year show no problems with meeting water quality standards and protecting beneficial uses.

Section 1: Introduction

The purpose of the Combined Sewer Overflow (CSO) Control Program is to reduce the magnitude, frequency and duration of wet weather induced CSOs in accordance with a 1994 Amended Stipulation and Final Order (ASFO) issued by the State of Oregon, which amended a 1991 Stipulation and Final Order. The end goal of Portland's CSO Control Program is compliance with water quality standards, the Clean Water Act (Act) and the requirements of the ASFO.

The ASFO required Portland to implement a 20-year CSO Control Program as presented in its 1994 CSO Control Facilities Plan (called the Long-term Control Plan or LTCP in the CSO Policy). The LTCP identified how Portland would comply with specified CSO overflow limits into the Willamette River and the Columbia Slough, which are:

- CSO discharges to the Columbia Slough are eliminated except during storms that are larger than the 5-year winter[1] and the 10-year summer[2] design storms.
- CSO discharges to the Willamette River are eliminated except during storms that are larger than the 4-per-winter and the 3-year summer design storms.

With the completion of Portland's CSO Control Program in 2011, and the pending expiration of the ASFO (January 30, 2013), the CSO control requirements were incorporated into the Columbia Boulevard Wastewater Treatment Plant (CBWTP) discharge permit. The National Pollutant Discharge Elimination System (NPDES) permit requires BES to submit annual CSO reports to the Oregon Department of Environmental Quality (DEQ) that document the performance of the overall CSO system. The Annual CSO Performance report covers CSO capture, conveyance, overflow characteristics, treatment efficiencies and on-going implementation of the Nine Minimum Controls (NMC) including Post-Construction Monitoring.

1.1 Purpose

This report is intended to meet the CSO-related reporting requirements in the CBWTP NPDES permit. The report documents the performance of the CSO capture, conveyance and treatment systems over the past fiscal year (July 1 2011 through June 30, 2012), as well as the activities performed by the City of Portland to improve on the already high level of CSO control. The report also examines the major storm events that caused CSO to be discharged, and examines the wet weather treatment performance at CBWTP. In addition, the report documents the ongoing implementation of Portland's robust Nine Minimum Control Technologies (NMCs) program. This

[1] Winter is defined as November 1 through April 30.
[2] Summer is defined as May 1through October 31.

program consists of appropriate, and cost-effective best management practices that make up the EPA-specified NMCs, which have been integrated into the City's CSO Control Program.

1.2 Regulatory & CSO Program Background for Report

This Annual CSO Performance Report provides a summary of important performance measures derived from five major regulatory and CSO program documents:

- 2011 CBWTP NPDES Permit
- 2011 CBWTP Mutual Agreement & Order (MAO) that is coupled with the permit
- No Feasible Alternative Analysis (NFAA) Report dated December 2009
- Nine Mininum Controls Report dated December 2010
- Post-2011 CSO Facilities Plan dated September 2010

These regulatory and programmatic documents are also derivatives of the long-term CSO control process Portland has followed over the past 20+ years. This context and the flow of information and requirements through time is displayed Figure 1-1 in below. The figure highlights the five documents that most directly inform this Annual CSO report.

1.2.1 2011 CBWTP NPDES Permit

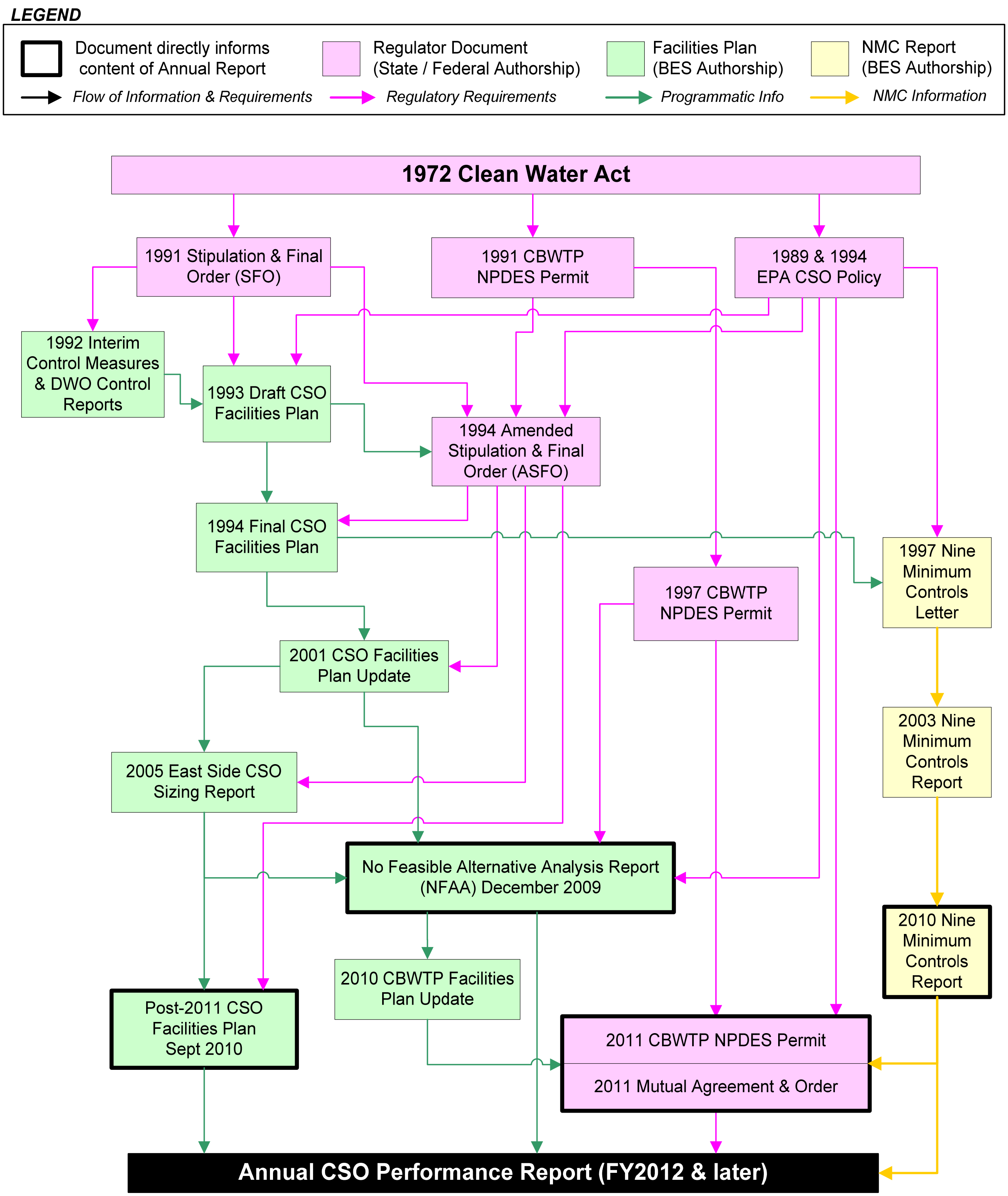
The Columbia Boulevard NPDES Permit (effective July 1, 2011) is the primary regulatory document that prescribes most of the Annual CSO Performance report content. Permit requirements include:

- Long-term CSO Control Program Performance (provided in Section 2 of this report)
- Wet Weather CSO Treatment Performance (Section 2.5)
- Nine Minimum Controls (Sections 3 through 8)
- Post-Construction Monitoring Plan (Sections 2 and 8)

1.2.2 2011 CBWTP Mutual Agreement & Order

The July 2011 MAO was signed with the CBWTP NPDES Permit to document agreement on the specific efforts and schedule the City will follow to provide additional facilities and monitoring data to ensure compliance with the requirements identified in the new permit. The MAO sets out the following requirements:

Figure 1-1 Regulatory & Programmatic Context of the Annual CSO Performance Report



- New collection system flow monitoring was installed by June 30, 2012 to identify the dry and wet weather flows from the separated sanitary system into the combined sewer system.
- Chemically Enhanced Primary Treatment (CEPT) to be implemented for the Wet Weather Treatment Facility (WWTF) by September 30, 2012. (Project is on schedule).
- Secondary Treatment Improvements (SVI and Modified Step-Feed) Project to be completed by October 31, 2014[3] to increase the maximum secondary treatment rate reliably to 110 MGD or higher. (Project is on schedule).
- Monitoring & Analysis Report to be submitted to DEQ by December 30, 2015 to evaluate and document the effectiveness of the activities listed above.
- Updated CBWTP Facilities Plan to be submitted to DEQ by December 30, 2016, which will recommend the appropriate amount of secondary treatment capacity based on the effectiveness of the new facilities, the amount of flows received from the separate and combined systems, and the cost-effectiveness of constructing additional capacity.

1.2.3 No Feasible Alternative Analysis (NFAA)

The December 2009 NFAA Report (along with follow-on materials submitted as part of permit negotiations with DEQ and EPA) provides much of the background for the permit requirements for wet weather treatment, including:

- Annual wet weather treatment performance
- Max-Month (30-day) treatment effectiveness and effluent limits
- Peak-Week (7-day) treatment effectiveness and effluent limits
- Secondary system bypass event analysis
- Water quality monitoring in the Columbia River at CBWTP outfalls 001 and 003

This new series of Annual CSO Performance Reports that reflect the completed 20-year CSO Program is designed to support future NFAA reports by providing annual analyses and tracking of these key parameters. It is expected that the next NFAA will be part of the Updated CBWTP Facilities Plan and the next permit renewal process in 2016.

1.2.4 2010 Nine Mininum Controls (NMC) Report

In December 2010, Portland submitted an update report on the Implementation of the Nine Minimum Controls to DEQ. This was the third report provided to DEQ that documented implementation of the EPA-required Nine Minimum Controls . The NMCs are a set of practices that EPA required to be implemented immediately upon EPA's adoption of the CSO Policy. The

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[3] This reflects the new due date as modified by the January 2012 amendment to the MAO.

practices rely on operations, maintenance, pollution prevention and public information to provide the best available CSO control until full implementation of the LTCP. EPA developed a two-phased approach to the implementation of the NMCs: Phase I required CSO communities to implement the NMCs by January 1, 1977, and Phase II requires continued implementation of the NMCs and implementation of the LTCP. With full implementation of the CSO Control Program at the end of 2011, Portland effectively entered Phase III. In this phase the NMCs will continue to be implemented and adjusted to complement and enhance the control provided by the grey and green infrastructure developed as part of the CSO Control Program.

This annual report (Sections 3 through 8) provides summary charts, tables and graphs for each of the NMCs to provide ongoing documentation of the implementation of these NMCs. Similarly, there are annual pretreatment reports required elsewhere that contain information about the status and performance of the pollution prevention program. Consequently, this Annual CSO Report does not include information about the City's pretreatment and pollution prevention programs.

1.2.5 Post-2011 CSO Facilities Plan dated September 2010

Portland's completed 2011 CSO control system meets applicable water quality standards as well as limits established in the Willamette River TMDL for bacteria – primary goals of the CSO progam. The ASFO also requires Portland to continue to examine "further CSO reductions" in the Willamette River. The ASFO specifically required the City to submit a Post-2011 CSO Facilities Plan to DEQ by September 1, 2010 that would identify cost-effective options for controlling CSO beyond the ASFO's level of 4-per-winter. The September 2010 facilities plan outlined likely future sewer system improvements with expansion of the city's green stormwater management infrastructure to reduce CSOs, relieve sewer capacity problems, replenish groundwater, protect water quality and enhance watershed health. The Oregon Environmental Quality Commission (EQC) approved the 2010 facilites plan in February, 2011.

Sewer system modeling indicated that Portland's CSO system will immediately (in December 2011) achieve "further CSO reductions" beyond the level required by the ASFO. The modeling predicted that the Willamette River CSO system will control winter season overflows to approximately two per winter compared to the four per winter established in the ASFO. The results from fiscal year 2012 so far confirm that "further CSO reductions" have been achieved. Over the next 40 years, development pressures will likely increase impervious surfaces and the amount of stormwater runoff reaching the combined system. Therefore, the Post-2011 CSO Facilities Plan focuses on implementing a variety of stormwater policy, program and project improvements that solve both local combined sewer capacity issues and maintain system-wide "further CSO reductions" achieved for the Willamette River. This Annual CSO Performance report describes the status of implementing the components of the Post-2011 CSO Facilities Plan -- specifically the implementation of sustainable stormwater (green infrastructure) to reduce runoff entering the combined sewer system.

Section 2: CSO System Performance for Fiscal Year 2012

The CSO System consists of the combined sewer collection system, the CSO collection, storage & pumping system and the CBWTP treatment systems. This section reports on the performance of the overall CSO system and also presents information about rainfall patterns and the operational issues that drive CSO performance.

2.1 Expected Control Levels for Portland's CSO Outfalls

The specific level of control and the methods used to control CSO discharges from each permitted outfall are summarized in Table 2-1. The CSO Control Standard reflects what BES expects to achieve under its CSO system operational strategy. This level of control equals or exceeds the level required in the NPDES Permit.

Table 2-1: CSO Outfall Control

Basin	CSO Outfall	Method of CSO Control	BES Control Standard[1]
Willamette River CSO Outfalls			
California	1	Sewer Separation, Downspout Disconnection; SWPI	10-Year Summer
Carolina	3	Southwest Parallel Interceptor (SWPI)	10-Year Summer
Sheridan	7 (7B)	West Side CSO Facilities	3-Year Summer
CBD/Ankeny	9	West Side CSO Facilities	3-Year Summer
Nicolai	15	West Side CSO Facilities	3-Year Summer
Balch	17	West Side CSO Facilities, Balch Consolidation Conduit	10-Year Summer
NW 110th	24	Partial Separation & Pump Station Improvements	3-Year Summer
Sellwood	26A	Partial Separation, System Improvements	10-Year Summer
Sellwood/Lents	27	Partial Separation, System Improvements, Storage & Pumping	10-Year Summer
Taggart	30	Cornerstone & East Side CSO Facilities	3-Year Summer
Alder	36	Cornerstone & East Side CSO Facilities	3-Year Summer
Wheeler	43	Cornerstone & East Side CSO Facilities	3-Year Summer
Beech-Essex	46	Cornerstone & East Side CSO Facilities	3-Year Summer
Riverside	47	West Side CSO Facilities	3-Year Summer
St. Johns B	53	Expanded Separation and Downspout Disconnection	3-Year Summer
St. Johns B	52	Expanded Separation and Downspout Disconnection	3-Year Summer
Columbia Slough CSO Outfalls			
St. Johns A	54	Expanded Separation and Downspout Disconnection	10-Year Summer
Oswego	55	Sumps, Expanded Separation, and Downspout Disconnection	10-Year Summer

Table 2-1: CSO Outfall Control

Basin	CSO Outfall	Method of CSO Control	BES Control Standard[1]
Oregonian	56	Sumps, Expanded Separation, and Downspout Disconnection	10-Year Summer
Fiske A	57	Cornerstone Projects & Columbia Slough CSO Facilities	10-Year Summer
Chautauqua	58	Cornerstone Projects & Columbia Slough CSO Facilities	10-Year Summer
Bayard	59	Cornerstone Projects & Columbia Slough CSO Facilities	10-Year Summer
Kenton	60	Cornerstone Projects & Columbia Slough CSO Facilities	10-Year Summer
Albina	62/62A	Cornerstone Projects & Columbia Slough CSO Facilities	10-Year Summer
NE 13th	65	Cornerstone Projects & Columbia Slough CSO Facilities	10-Year Summer

Note #1: The 10-Year Summer Storm is assigned to outfalls where no floatables control is expected or required. The NPDES permit does not require floatables control devices on system that are controlled to the 10-Year Summer and 5-Year Winter Storm levels.

2.2 Rainfall Patterns for the Past Fiscal Year

Fiscal Year 2012 was unusually rainy with several extreme events. The rainfall gauge at the CBWTP measured 46.8 inches over the year, compared with an average rainfall of 37 inches per year for Portland. During this period, five winter storm events occurred that exceeded the 4-per-winter design storms, and one summer storm exceeded the 3-year summer storm depths. Three of the events were large enough to generate CSO discharges:

1. November 22, 2011 – Winter CSO Event
2. December 28-30, 2011 – No Overflows
3. January 17-19, 2012 – Winter CSO Event
4. March 12-13, 2012 – No Overflows
5. March 30, 2012 – No Overflows
6. May 26, 2012 – Summer CSO Event

2.2.1 Winter Storm Review

The five storms that exceeded the 4-per-winter ASFO design depths are shown graphically in Figure 2-1 below. This graph is a "Depth-Duration" chart that displays the maximum depth of rainfall that occurred for the range of storm duration, from 1-hour to 48-hours. The two events that caused CSO to occur are shown with red-tinted lines, and the three storms that had no CSO are shown with the green-tinted lines. These two events are compared to the two Winter Design Storms (4-per-winter and 5-year winter[4]) shown with blue-tinted lines.

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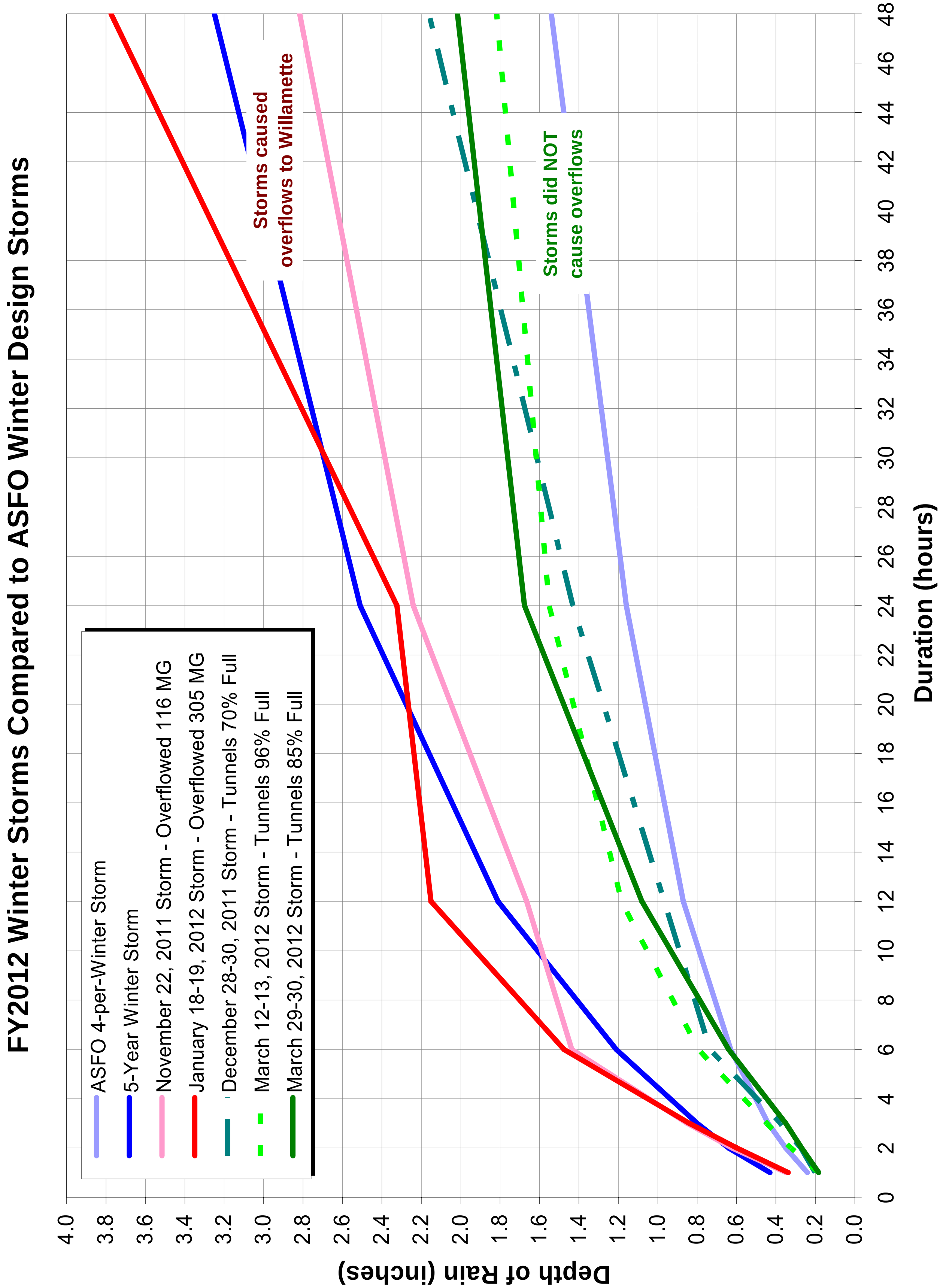
[4] 5-Year Winter Storm is included on the charts for the Willamette CSO System because it is a control standard in the permit for outfalls that are not required to have floatables control devices installed.

Figure 2-1: FY2012 Winter Storms Compared to ASFO Design Storms



The actual depth values used to create the chart are provided in Table 2-2 below. This table shows the various storm frequency values (such as 1-per-winter storm, 2-per-winter storm) that provide the basis for estimating the specific return frequency and duration of a storm (such as a 5-year, 6-hour storm).

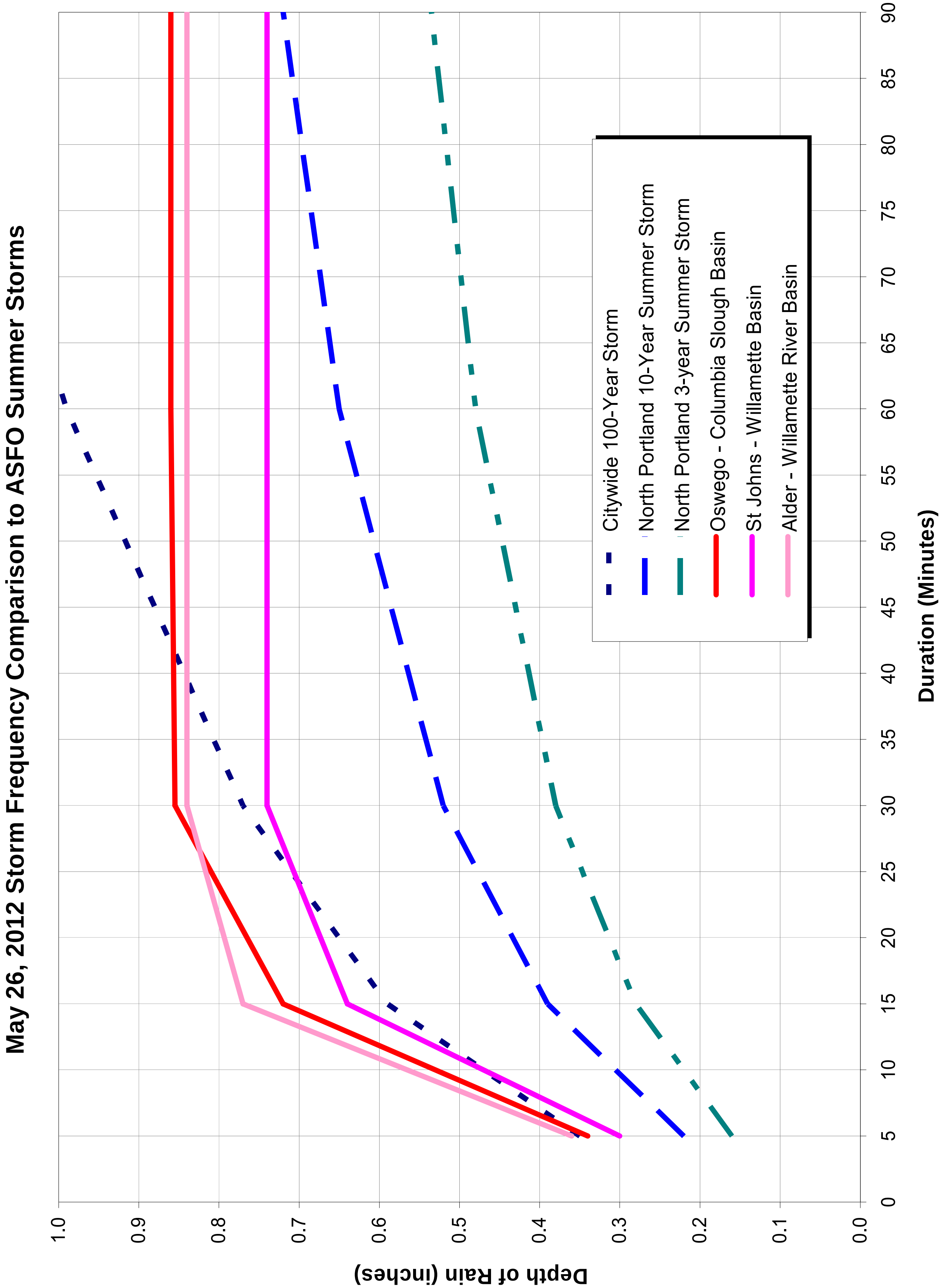
Table 2-2: FY2012 Winter Storms Compared to ASFO Design Storms

Duration (hours)	**1**	**3**	**6**	**12**	**24**	**48**	
Willamette River Winter Design Storms (inches)							
4-per-Winter Design Storm	0.24	0.44	0.65	0.89	1.19	1.53	
3-per-Winter Storm	0.27	0.49	0.72	1.01	1.35	1.74	
2-per-Winter Storm	0.30	0.55	0.81	1.17	1.59	2.07	
1-per-Winter Storm	0.35	0.65	0.97	1.43	1.93	2.55	
5-year Winter Design Storm	0.43	0.8	1.21	1.81	2.51	3.26	
Historical Storms - Average Rainfall over Willamette CSO Basin (inches)							**Notes: Shortest Duration with High Peak Rainfall**
November 22, 2011 ***CSO Event***	0.35	0.85	**1.44**	1.66	2.24	2.82	Exceeds 5-Year, 6-hour
December 28-30, 2011	0.20	0.38	**0.73**	0.97	1.43	**2.16**	Matches 3-per-Winter, 6-hour; Exceeds 2-per-winter 48-hour
January 17-19, 2012 ***CSO Event***	0.34	**0.84**	**1.48**	**2.15**	**2.32**	**3.77**	Exceeds 5-Year, 3 to 48 hours
March 12-13, 2012	0.18	0.45	0.79	**1.18**	1.55	1.82	Matches 2-per-Winter, 12-hours
March 29-30, 2012	0.18	0.35	0.64	1.08	**1.68**	2.02	Exceeds 2-per-Winter, 24-hours

2.2.2 Summer Storm Review

The May 26, 2012 storm was a highly intense, short-duration, and unusual thunderstorm storm. This overwhelming thunderstorm significantly exceeded the City's 100-year design storm data for the Portland area. During this storm, which lasted just over an hour, Portland rainfall gauges measured extreme rainfall from North Portland to Southeast Portland as the storm cell moved down the I-5 corridor from Hayden Island to south of Portland. Several of the rainfall gauges measured 5-minute to 60-minute depths that far exceeded the 100-year design storm characteristics. At the impacted areas, combined sewer overflow was discharged to the Columbia River and to the Willamette River. The rainfall depths measured by the gauges in the overflowing basins all exceeded the 100-year storm level (and the ASFO summer design storms). A comparison of the measured versus the design storms can be seen graphically in Figure 2-2 below, as well as in Table 2-3 below.

Figure 2-2: May 26, 2012 Rainfall Compared to ASFO Summer Storms



As can be seen from the data, the May 26, 2012 rainfall exceeded the 100-year storm for most of the short durations, and exceeded 10-year summer and 3-year summer storm criteria for all the durations from 5-minutes to 120-minutes.

Table 2-3: May 26, 2012 Storm Rainfall Depths vs. Design Storms

Gage #	HYDRA Raingage Name	Areal Weight	Max Rain Depth per Duration (inches)					
			Minutes	5	15	30	60	120
160	WPCL - St Johns Basins	50%		0.3	0.64	0.74	0.74	0.74
107	CBWTP IPS	50%		0.38	0.8	0.97	0.98	0.98
	Oswego-Basin	**100%**		**0.34**	**0.72**	**0.855**	**0.86**	**0.86**
181	Alder Basin - Multnomah Cnty Bldg	100%		0.36	0.77	0.84	0.84	0.84
	City-Wide 100-Year Summer Storm			0.35	0.59	0.77	0.99	1.30
	North Portland 10-Year Summer Storm			0.22	0.39	0.52	0.65	0.79
	North Portland 3-Year Summer Storm			0.16	0.28	0.38	0.48	0.59

2.3 CSO Discharges into the Willamette River and Columbia Slough

The three largest storms of FY2012 were sufficient to exceed the capacity of the CSO system and cause overflows[5] into the Willamette River and Columbia Slough:

- **November 21-23, 2011:** 115 MG discharged over a six-hour period from the nearly-completed East Side and West Side Willamette River CSO Tunnels. The storm included a peak 6-hour rainfall depth that exceeded the 5-year storm and 48-hours of rain that exceeded the ASFO 4-per-winter storm criteria.
- **January 18-19, 2012:** 305 MG discharged over a 10-hour period from the completed East & West Side Willamette River CSO Tunnels. Nearly all the depth-duration points exceeded the 5-year storm and ASFO 4-per-winter storm criteria.
- **May 26, 2012:** 15 MG discharged over less than one hour, mostly to the Willamette River with 0.022 MG discharged to the Columbia Slough. The intense one hour storm exceeded the 100-year criteria in both the Columbia Slough and Willamette basins.

In total, 435 MG of CSO were discharged from the controlled (completed) CSO system outfalls during fiscal year 2012. This CSO volume is 5% of the total 9 billion gallons of stormwater collected by the combined system in FY2012, which represents 95% capture and treatment. A summary of all the past CSO discharges (from the completed and controlled CSO system) as of December 1, 2006 is provided below in Table 2-4. Sixteen CSO events have occurred since the West Side CSO

[5] Each of the three CSO events was fully analyzed and reported to DEQ as required by the permit. Summary information from those more detailed reports is provided here.

system was first brought online. Since completion of the East Side CSO Tunnel system in December of 2011, more CSO has been routed into the tunnel system. The new tunnel provides significantly more storage volume (increase from 25 MG to 105 MG) for containing CSO. Also, the new Portsmouth Force Main and the Phase II Swan Island Pump Station have added significant flexibility and capacity, especially for capturing small storms. The addition of these facilities is part of the reason the two large March 2012 storms did not cause the CSO system to overflow, even though the storms approached the 2-per-winter design storm depths (tunnels approached 96% full but did not overflow).

The overall CSO event statistics for the six years of record is provided at the bottom of Table 2-4. These statistics will change now that the East Side CSO program is part of the calculation. Whereas the statistic for average duration of a CSO event (10.2 hours) will not likely change, clearly the statistic for the volume of overflow will change as the large East Side combined system now brings significant captured CSO into the tunnel system.

Table 2-4: Record of Willamette River CSO Events

				System Totals		West-Side Totals		East-Side Totals	
Event Count	**Year**	**Dates of Storm / Overflow Events**	**Description**	**Overflow (MG)**	**Duration (hrs)**	**Overflow (MG)**	**Duration (hrs)**	**Overflow (MG)**	**Duration (hrs)**
1	2006	December 14-15, 2006	25% larger than ASFO	66.9	24.0	66.9	24.0	East Side Not Fully Controlled until December 1, 2011	
2	2007	January 3, 2007	25% larger than ASFO	5.2	4.4	5.2	4.4		
3	2007	December 2-3, 2007	>10-year Winter Storm	154.5	26.9	154.5	26.9		
4	2008	November 12, 2008	23% larger than ASFO	8.1	4.1	8.1	4.1		
5	2009	January 1-2, 2009	> 5-year, 24-hour Winter Storm	122.6	21.6	122.6	21.6		
6	2009	May 4, 2009	1-in-3 year Summer	5.3	1.1	5.3	1.1		
7	2009	November 7, 2009	30% larger than ASFO	9.6	3.0	9.6	3.0		
8	2010	June 6, 2010	26% larger than 1-in-3 year Summer	26.0	3.1	26.0	3.1		
9	2010	November 17, 2010	> 1-year, 6-hour Winter Storm	11.5	5.6	11.5	5.6		
10	2010	December 9-11, 2010	> 5 year, 6-hour Winter Storm	41.8	8.9	41.8	8.9		
11	2010	December 28, 2010	2-per Winter Storm	6.9	5.5	6.9	5.5		
12	2011	January 16, 2011	2-per Winter Storm	26.3	8.9	26.3	8.9		
13	2011	February 28 - March 1, 2011	5-year, 48-hour Winter Storm	76.0	28.3	76.0	28.3		
14	2011	November 21-23, 2011	> 5-year, 6-hour Winter Storm	115.0	6.3	41.6	6.3	73.4	4.8
15	2012	January 17-21, 2012	> 5-year 12-hour Winter Storm	304.9	10.3	86.4	10.3	218.5	10.3
16	2012	May 26, 2012	> 100-year, 30-minute storm (.85" in 30-min)	14.9	0.8	0.0	0.0	14.9	0.8
Average Overflow Statistics per Event				**62.2**	**10.2**	**43.0**	**10.1**	**102.3**	**5.3**

A more detailed record of these sixteen CSO events, including the specific storm characteristics and the discharges measured at each active outfall, is provided in Appendix A of this report.

2.4 CSO Facilities Operations Monitoring Information

2.4.1 Annual Operations Review

This fiscal year straddles the transition between the December 2006 CSO System configuration (Columbia Slough + West Side only) and the December 2011 final configuration. The 2011 final configuration is dominated by the East Side CSO system coming online, but also includes the Balch Consolidation Conduit and the Sellwood CSO systems becoming active as well.

Because of the unusually extreme storm events in the first few months after the entire CSO system became operational, it is difficult to identify key operational data that reflects the overall CSO control operations for the full year. After more experience with the operation of the system as a whole, we will have sufficient data to highlight the parameters that best illustrate the operational performance of the system. One aspect that will likely change over time is the manner in which flow is routed through the CSO tunnels during dry weather and wet weather operations. Table 2-5 below provides a summary of the total dry and wet weather volume pumped from the Swan Island CSO pump station through its three different force mains, as well as the volume pumped from the CBWTP Influent Pump Station (IPS) that serves the Columbia Slough Consolidation Conduit (CSCC). This table provides a set of baseline values that can be used in the future for tracking the changes in flow routing as well as the magnitude of wet weather inflows to the CSO system.

Table 2-5: FY2012 Volume Pumped from CSO Tunnels

CSO Tunnel Pumping	Total Pumped Volume (MG)
Swan Island CSO Pump Sation	
Forcemain 1 (Peninsular Dry Weather)	2,931
Forcemain 2 (Peninsular Wet Weather)	519
Forcemain 3 (Portsmouth Wet Weather)	919
Total Swan Island CSO Pumping	**4,369**
IPS - CSO Pump Station	**3,162**
Total Volume Pumped to CBWTP from Tunnels	**7,532**

The total volume pumped from the CSO tunnels (7,500 MG) compares in magnitude to the CSO-stormwater volume delivered to CBWTP (8,600 MG) as presented below in Section 2.5. This comparison indicates the degree to which the wet weather flows arriving at CBWTP are due to CSO pumping versus the gravity inputs from the older combined system.

2.4.2 CSO Event Operations Review

Each of the three CSO events that occurred in FY2012 was so unique that it is not useful to evaluate them as a group. The November 2011 event happened during the startup of the new facilities prior to being fully online, and the May 2012 event impacted only a few outfalls and not the overall system. In fact, only the January 2012 CSO event provides useful information about system operations that can be used as a baseline for future event comparisons.

The two-week storm in late January 2012 required the full use of the CSO tunnel system for storage and fully utilized the 220 MGD pumping capacity of the newly expanded Swan Island CSO Pump Station (SI-CSO). This can be seen in the Figure 2-3 system performance chart on the following page. This chart shows the flows to CBWTP, the amount of pumping from SI-CSO, the level at SI-CSO (which is essentially the level in the CSO tunnels), and the overflow measured at Taggart Outfall 30 as representative of the system overflows. The figure shows how the CSO system is operated to maximize flow to CBWTP without overloading it beyond its available capacity at any given time. The pumping from SI-CSO was restricted at times to 50 MGD to prevent sending flows to CBWTP that would exceed its available capacity (up to 350 MGD during this storm). These operational characteristics are consistent with the operational strategy documented in the CSO System Operating Plan submitted to DEQ in December 2011. The CSO System Operating Plan also focused on how CBWTP would be operated during large storm events to maximize the volume treated through the secondary system and minimize bypass to the wet weather treatment facility. Table 2-6 below provides a summary of the volume treated through CBWTP during the January 2012 storm. CBWTP received an average of 242 MGD for the 5-day period. An average of 120 MGD received secondary treatment; the wet weather treatment system received an average of 122 MGD. During this long-duration intense storm, only about 50% of the flow to CBWTP was bypassed to the wet weather system.

The columns to the right in Table 2-6 provide the summary data for all the flow generated in the combined system during the five day storm. The volume of CSO represents only 20% of the total wet weather flow generated during that storm.

Figure 2-3: CSO System Operations During January 2012 Storm

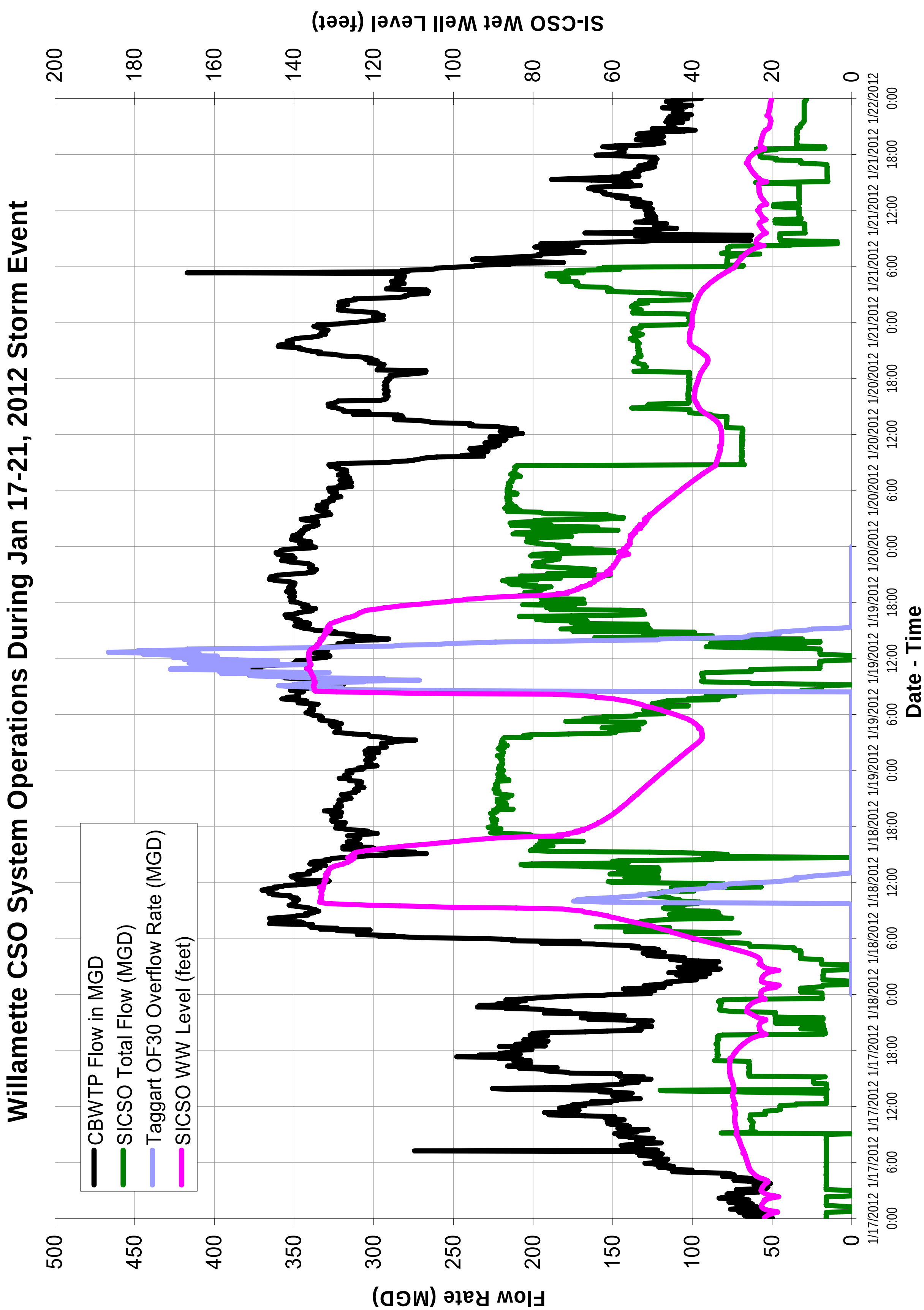


Table 2-6: CSO System Capture & Treatment Performance for January17-21, 2012 Storm

	Avg Flow Rate (MGD)	% of Flow to CBWTP	Volume (MG)	% of Total to Combined System
Total CSO Overflow	n/a	n/a	305	20%
Total Flow to CBWTP Secondary System	120	50%	600	40%
Average Dry Weather Flow (Based on Jan 9, 11 & 12)	*59*	*24%*	*296*	*20%*
Wet Weather Flow Treated	*61*	*25%*	*304*	*20%*
Total Flow to CBWTP Wet Weather System	122	50%	611	40%
Total Flow to CBWTP	242	100%	1,211	80%
Total Flow to Combined System	n/a		1,516	100%

2.5 Wet Weather Treatment Performance and Effluent Quality

2.5.1 Annual CSO Treatment Characteristics

The FY2012 annual CSO treatment characteristics indicate that the Chemically Enhanced Primary Treatment (CEPT) upgrade for the wet weather system required by the Mutual Agreement and Order (MAO) will be necessary for CBWTP to meet its wet weather treatment performance requirements. As expected, the significant increased flow from the East Side CSO system degrades the performance of the wet weather primary tanks such that they cannot reliably meet the permit required 70% TSS removal and 50% BOD removal until CEPT is implemented in September 2012. Information showing this the need for the CEPT system was provided in the December 2009 No Feasible Alternative Analysis (NFAA) as well as the 2010 CBWTP Facilities Plan. For this reason, when the CBWTP NPDES permit was renewed, DEQ issued an MAO requiring the new CEPT system to be online by September 30, 2012 to address the expected wet weather treatment performance.

The preferred route for captured CSO sent to CBWTP is through the secondary treatment system at a minimum rate of 100 MGD. When the CSO flows exceed the secondary capacity, the captured CSO is sent to the Wet Weather Treatment Facility. For FY2012, the volume of flow treated through the two treatment trains is summarized in Table 2-7 for the entire year. , Table 2-7 also compares the annual values estimated and reported in the December 2009 NFAA to the FY2012 flows.

Key values in Table 2-7 for the Annual CSO Treatment Performance include:

- 8,600 million gallons of CSO sent to CBWTP for treatment due to the wet year (47-inches of rainfall fell compared to the average of 37 inches)
- 64% of captured CSO treated with secondary treatment
- Total pollutant removal from CBWTP -- 93% for BOD, 92% for TSS
- Wet weather treatment efficiency -- 34% for BOD and 63% for TSS (which is below the permit-required levels and confirms the need for the CEPT system)

Table 2-7: CBWTP Annual Treatment Performance Summary Data

Annual Treatment Characteristics	NFAA Estimate 2009		Actual FY2012
Annual Rainfall Depth (inches/year)	37		46.8
Flows to CBWTP			
Influent Volume (MG/Year)	28,300		28,800
Influent - Average Daily Flow (MGD)	77		79
Dry Weather Sanitary Volume (MG/Year)	22,100		20,200
Dry Weather Sanitary - Average Daily Flow (MGD)	60		55
Captured CSO Flow - Volume (MG/Year)	**6,200**		**8,600**
Secondary Bypass Events			
Secondary Rate Before Bypass (MGD)	**100**	**110**	**120**
Number of Events / Year	31.8	30.7	29
Bypass Volume / Year	2,857	2,492	3,138
Amount of Captured CSO Treated via Secondary (%)	**54%**	**60%**	**64%**
Duration of Bypass (hours)	919	787	706
Calendar Days of Bypass (days)	---	---	66
Effluent Quality & Treatment Effectiveness: OF 001 & 003			
BOD Loading (pounds / year)	2,510,000	2,390,000	4,000,000
BOD Average Concentration (mg/l)	27	26	16.6
Total Plant BOD Removal Efficiency (%)	**---**	**---**	**93%**
TSS Loading (pounds / year)	2,440,000	2,330,000	5,050,000
TSS Average Concentration (mg/l)	27	26	21.0
Total Plant TSS Removal Efficiency (%)	**---**	**---**	**92%**
Wet Weather Treatment System Effectiveness	**PERMIT - CEPT**		**No CEPT**
BOD TO Wet Weather System (pounds/year)	---		2,290,000
BOD FROM Wet Weather System (pounds/year)	---		1,510,000
Wet Weather BOD Removal Efficiency (%)	**50%**		**34%**
TSS TO Wet Weather System (pounds/year)	---		4,030,000
TSS FROM Wet Weather System (pounds/year)	---		1,480,000
Wet Weather TSS Removal Efficiency (%)	**70%**		**63%**

2.5.2 CBWTP Max-Month and Peak-Week Treatment Performance

The CBWTP NPDES permit lists performance requirements for the CBWTP, the dry-weather/secondary system and the wet-weather treatment trains for monthly and weekly extreme weather conditions. Table 2-8 and Table 2-9 below summarize the effluent BOD and TSS concentrations and loads during the most extreme periods in FY12 for the overall plant site (Outfalls 001 & 003), the Secondary Effluent, and the Wet Weather Effluent.

The most extreme 30-day (Max-Month) period was caused by the large January 2012 storm that lasted approximately two weeks. The CSO system filled throughout the storm and overflowed on January 18 and 19. The Wet Weather treatment system was active for ten out of the thirteen days of the storm.

The 30-day extreme period results shown in Table 2-8 indicate that the two treatment trains were able to meet the permit Mass Load limits to outfalls 001 & 003 and the individual treatment trains. However, the concentration for 30-day TSS exceeded the permit limit of 30 mg/l. In addition, the effluent concentration from the Wet Weather system during this event also did not meet the permit limit of 45 mg/l for either BOD or TSS, although the mass loads permit limits were achieved. As discussed above, these results were expected for the completed CSO tunnel system until the CEPT system is brought online in September 2012.

Table 2-8: CSO Max-Month (30-day) Treatment Performance

Parameters	Maximum Monthly (30-Day)						
	Avg Concentration			Mass Loading			
	Permit Monthly (mg/l)	Max 30-Day (mg/l)	30-Day Avg Flow (MGD)	Permit Monthly (lbs/day)	Max 30-Day (lbs/day)	Date of 30th Day	Notes
Columbia Boulevard WWTP - Outfalls 001 and 003 Effluent Quality							
BOD5	30	29	124	45,000	30,500	26-Jan-12	>5-year storm; 2-weeks of rain Total effluent loads under limit
TSS	30	38	124	45,000	39,500	26-Jan-12	
Secondary Biological Treatment - 100 MGD Instantaneous							
BOD5	30	18	88	22,500	13,100	26-Jan-12	Maximum 30-day flow thru seconary approached 100 MGD
TSS	30	26	88	22,500	19,300	26-Jan-12	
Wet Weather / Chemically Enhanced Primary Treatment (CEPT) System							
		NO CEPT			***NO CEPT***		
BOD5	45	*58*	36	22,500	*17,349*	26-Jan-12	MAO: CEPT online by 9/30/12. Effluent loads under limit.
TSS	45	*67*	36	22,500	*20,213*	26-Jan-12	

Similarly, the extreme 7-day (Peak Week) period was also caused by the same January 2012 storm. The 7-day extreme period results in Table 2-9 indicate that the two treatment systems were able to meet the permit Mass Load limits to outfalls 001 & 003 and for the two treatment trains. Similar to the 30-day results, the 7-day TSS concentration exceeded the permit value of 45 mg/l; the effluent concentration from the Wet Weather system during this event met the BOD permit limit, but did not meet the TSS limit of 65 mg/l. Again, these results were expected and are allowed by the MAO requirement for the CEPT system to be brought online in September 2012.

The Table 2-9 data also illustrate a significant operational achievement during the intense January storm -- total flow through the secondary biological system average was 115 MGD for the 7-day period. This secondary treatment volume is significantly higher than the permit required 100 MGD and was a result of the operators continually maximizing flow through the secondary system.

Table 2-9: CSO Peak-Week (7-day) Treatment Performance

Parameters	Peak Week (7-Day)						
	Avg Concentration			Mass Loading			
	Permit Weekly (mg/l)	Max 7-Day (mg/l)	7-Day Avg Flow (MG)	Permit Weekly (lbs/day)	Max 7-Day (lbs/day)	Date of 7th Day	Notes
Columbia Boulevard WWTP - Outfalls 001 and 003 Effluent Quality							
BOD5	45	36	221	118,800	66,500	24-Jan-12	>5-year storm; 2-weeks of rain Total effluent loads under limit
TSS	45	49	221	118,800	90,200	24-Jan-12	
Secondary Biological Treatment - 100 MGD Instantaneous							
BOD5	45	17	115	37,500	16,800	23-Jan-12	Peak 7-Day flow through secondary exceeded 100 MGD
TSS	45	30	115	37,500	28,900	24-Jan-12	
Wet Weather / Chemically Enhanced Primary Treatment (CEPT) System							
		NO CEPT			***NO CEPT***		
BOD5	65	*57*	106	81,300	*50,600*	24-Jan-12	MAO: CEPT online by 9/30/12. Effluent loads were under limit.
TSS	65	*69*	106	81,300	*61,300*	24-Jan-12	

2.5.3 Characterization of Bypass Events

Table 2-10 lists the bypass events that occurred during fiscal year 2012 in which excess captured CSO was routed to the Wet Weather Treatment Facility.

- Operators were able to keep bypass events to a minimum; only 29 events occurred during this wet fiscal year (47 inches of rainfall compared to average of 37 inches).
- During periods of bypass, operators were able to maintain an average secondary treatment rate of 120 MGD, compared to the permit required 100 MGD.
- The Average/Event rate of 120 MGD treated via the secondary system indicates that 60% of the total Influent (120 MGD of 202 MGD) arriving at the plant during the bypass period was treated through the secondary system, and 40% (81 MGD) was treated through the Wet Weather system.
- The average volume bypassed per event was 108 MG, and the average peak bypass flow rate was 160 MGD.
- Bypass events lasted about 24 hours on average, and typically occurred across two calendar days.
- Secondary bypass event characteristics (Number of Events, Volume, Duration) compare favorably with the characteristics predicted in the December 2009 NFAA.

Table 2-10: Review of "Secondary Bypass Events" for FY2012

CSO Event ?	Date & Time Bypass Event Started (PST)	Event #	Avg Influent During Bypass (MGD)	Avg Secondary Flow During Bypass (MGD)	Avg Bypass Flow (MGD)	Peak Bypass Flow (MGD)	Estimated Bypass Volume (MG)	Duration of Discharge (hrs)	Calendar Days Bypass Occurred
	7/17/11 12:45	1	213	105	115	166	40.4	8.8	1
	10/5/11 0:15	2	165	112	38	82	4.6	3.0	1
	10/11/11 22:30	3	181	123	76	127	16.1	5.3	2
	11/3/11 1:00	4	183	113	71	153	37.8	13.3	1
	11/16/11 12:30	5	169	123	42	136	23.4	14.0	2
CSO	**11/21/11 18:30**	**6**	**219**	**118**	**121**	**268**	**374.9**	**77.0**	**5**
	11/27/11 19:45	7	185	119	61	154	17.3	7.0	2
	12/28/11 0:30	8	268	124	148	260	332.9	55.8	4
CSO	**1/17/12 14:45**	**9**	**276**	**123**	**149**	**279**	**630.8**	**105.0**	**6**
	1/24/12 11:00	10	265	123	131	258	113.1	21.5	2
	1/29/12 18:15	11	219	125	97	154	44.9	11.5	2
	2/22/12 13:45	12	154	123	24	63	6.0	6.3	1
	2/25/12 6:15	13	192	121	85	152	42.9	12.5	1
	2/28/12 21:45	14	259	130	62	188	61.0	24.5	3
	3/5/12 16:15	15	206	122	87	163	17.4	5.0	1
	3/11/12 15:45	16	246	128	118	286	468.6	99.0	7
	3/20/12 22:15	17	213	126	97	161	171.1	44.0	3
	3/29/12 17:30	18	262	128	142	284	357.2	62.5	4
	4/3/12 14:00	19	181	120	50	108	12.0	6.0	1
	4/6/12 0:15	20	172	134	39	54	9.7	6.3	1
	4/16/12 9:30	21	158	129	38	77	18.9	12.5	1
	4/19/12 16:15	22	223	123	123	152	49.6	10.0	2
	5/3/12 7:15	23	243	125	129	221	85.4	16.5	1
	5/21/12 12:45	24	141	105	37	82	23.4	15.8	2
	5/24/12 14:45	25	141	112	29	63	11.1	9.5	2
CSO	**5/26/12 23:00**	**26**	**195**	**111**	**80**	**173**	**48.4**	**15.0**	**2**
	6/5/12 2:00	27	189	113	77	180	66.9	21.5	2
	6/7/12 11:00	28	176	114	58	111	39.7	17.0	3
	6/23/12 13:45	29	155	105	41	74	12.4	7.5	1
Total		29					3,138	706	66
Average/Event			202	120	81	160	108	24.6	2.3

2.5.4 Monthly & Annual Solids Influx and Removal

Removal of solids from the influent is the primary function of the treatment system. Given the dramatic changes that have occurred at CBWTP and those that will be occurring over the next few years (when CEPT and secondary improvements are implemented), it is valuable to establish a baseline record of the solids influx and the solids removal for this first year.

The mass of solids being removed from the influent and eventually leaving the CBWTP site can be accounted for using the basic mass balance equation:

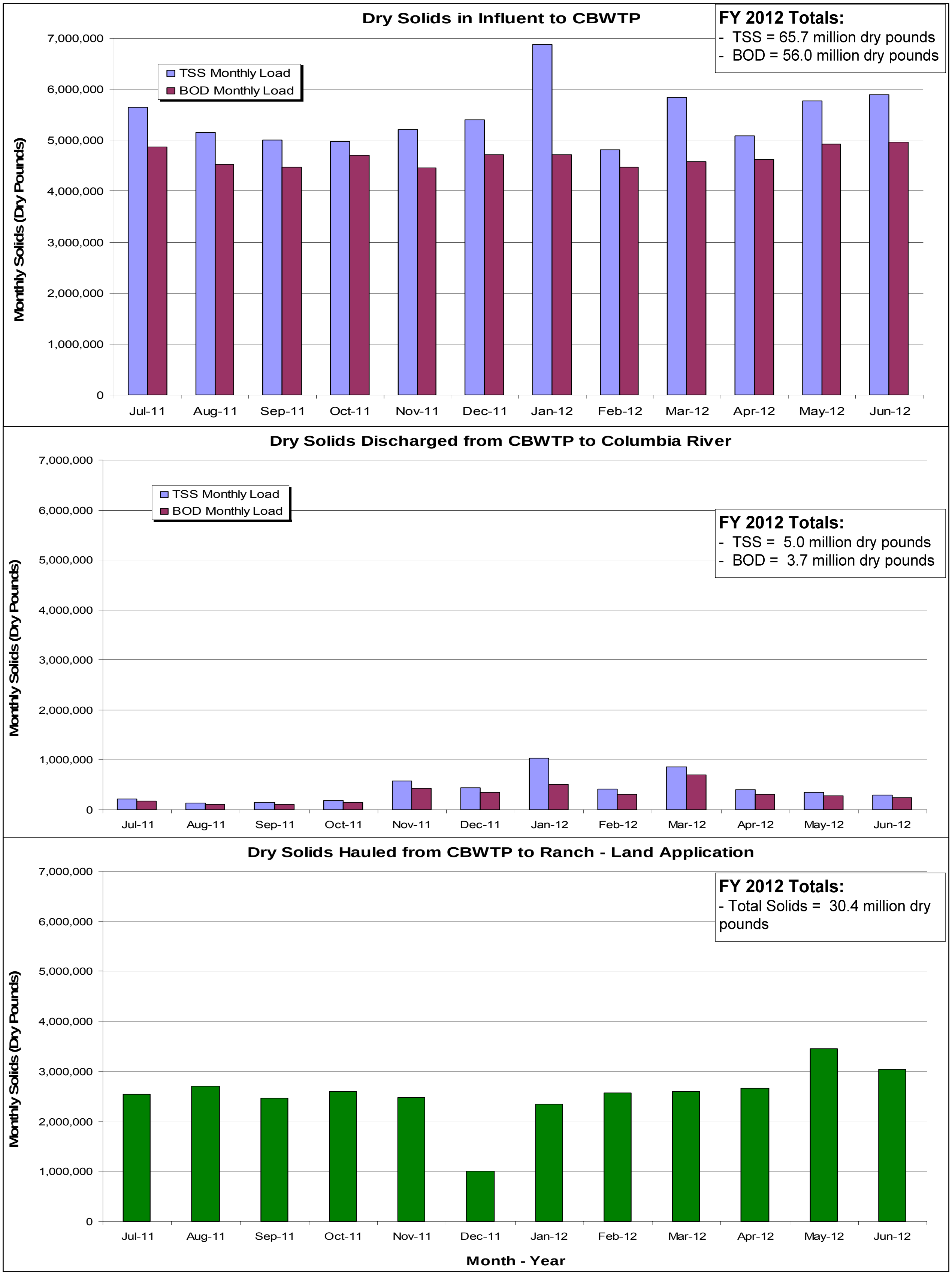
Output = Input – [Digested Amount + Change in Amount Stored Onsite]

Figure 2-4 below provides a three-section chart displaying the dry (no water or moisture) solids that entered and left the CBWTP site. This chart assumes that TSS is a sufficient measure of the total solids entering the plant and does not include the "pounds" of BOD in the mass balance.

The overall total TSS "Input" to the CBWTP site was about 65.7 million pounds during FY2012. The total solids TSS "Output" consisted of 5.0 million pounds of TSS in the effluent (7.6% of influent solids) and 30.4 million pounds (46% of influent solids) hauled away from the site as biosolids for land application. The total amount of solids leaving the site was 35.4 million dry pounds or about 54% of the solids measured as influent TSS. This means that 46% of the TSS influent solids entering the plant was digested (consumed) or is still on-site in either one of the digesters or in the Triangle Lake storage pond.

Figure 2-4 also shows that there was not a significant variation in solids loading between months as might be expected for a CSO system. This is because most of the solids entering the plant are from the sanitary sources as opposed to stormwater sources.

Figure 2-4: Solids Loading Into & Out From CBWTP



Section 3: Maintenance

Control #1 of the Nine Minimum Controls – Proper Operation & Maintenance -- is the broadest single "control" or area of best management practices among the NMCs. The practices included under this NMC cover almost all of the collection system components. For these reasons, it is useful to begin shifting the analysis and reporting from "NMC #1" to the "CMOM" or Capacity, Management, Operations and Maintenance program, which addresses the collection system topics more fully and with a more standardized approach.

This Section briefly discusses CMOM program components and documentation of CMOM activities required by the CBWTP NPDES Permit; collection and treatment systems expenditures and work orders for maintenance activities; cleaning and inspection of the collection system; and a future projected CIP budgets for the next 10 years for maintenance of the collection and treatment systems.

3.1 CMOM Program Required Submittals

The 2011 NPDES Permit requires Portland to develop and submit a set of Capacity, Management, Operations and Maintenance (CMOM) program documents for the sanitary and combined sewer collection systems. EPA's CMOM Guidance for Sanitary Sewer Collection Systems (January 2005) sets out the requirements for a CMOM program.

BES is preparing to submit the following documents according to the dates specified in the permit:

- Collection System Inspection & Cleaning Plan: January 1, 2013
- Collection System Assessment & Rehabilitation Plan: January 1, 2013
- Pump Station Reliability Program: July 1, 2013
- Spill Response Tracking & Reporting Procedures: July 1, 2013
- Grease Management & Control Program: July 1, 2013
- Overall CMOM Program Report: July 1, 2013

The data collection, analyses, mapping and initial draft versions of these documents are currently under development. After the final CMOM document is submitted to DEQ, Portland will develop and submit a schedule for implementing CMOM program activities that are not yet being implemented.

3.2 CIP Expenditures for CSO, Collection System and Treatment Maintenance

Portland has always had a significant portfolio of maintenance projects for both the collection system (pipes and pump stations) and the treatment systems. Even during the peak of the CSO program capital expenditures -- when the large tunnels, CSO pump stations and expanded treatment works required most of the CIP budget -- Portland still invested in maintenance of non-CSO systems to ensure that public health and the environment were protected and regulatory requirements were met.

Now that major investment in the CSO system is ending, expenditures for maintenance of the collection and treatment systems will increase. The record of the maintenance-related CIP expenditures for the past five years is shown below in Table 3-1. Notably, this table demonstrates that maintenance-based expenditures over the past five years have increased, especially for pump stations and the collection system. Capital investment for collection, pumping and treatment systems maintenance expenditures has grown from a 3-year average of about $26 million per year to a 3-year average of $40 million per year.

Table 3-1: Capital Expenditures for System-wide Maintenance

Component	Expenditures per Fiscal Year (Millions of Dollars)							
	2007	2008	2009	2010	2011	2012	Total	Average
Sullivan Pump Station	$0.80	$0.00	$0.00	$0.00	$0.00	$0.00	$0.80	$0.13
Ankeny Pump Station	$0.08	$0.08	$0.33	$2.59	$1.83	$1.45	$6.36	$1.06
Guilds Lake Pump Station	$0.00	$0.00	$0.11	$0.22	$0.38	$0.28	$0.99	$0.17
All Other Pump Stations	$2.37	$1.20	$1.73	$1.61	$3.02	$2.30	$12.23	$2.04
Pump Station Total	***$3.25***	***$1.28***	***$2.17***	***$4.42***	***$5.23***	***$4.03***	***$20.38***	***$3.40***
Treatment Plant	$1.66	$1.97	$1.21	$1.75	$1.42	$2.04	$10.05	$1.68
Collection System	$25.30	$17.70	$23.80	$30.89	$42.84	$28.62	$169.15	$28.19
System Totals	***$30.2***	***$21.0***	***$27.2***	***$37.1***	***$49.5***	***$34.7***	***$199.6***	***$33.3***
System Total 3-Year Averages		***$26.1***			***$40.4***			

3.3 Collection System Inspections and Cleaning

BES has modified its inspection and cleaning strategy to improve utilization of inspection data to better prioritize pipe cleaning efforts. This modified approach has achieved a higher rate of CCTV inspection. Over the last 10 years (2003-2012), BES has inspected approximately 87% of the combined and sanitary sewer pipes; 50% of the sewer system has been inspected over the past 5 years (2006-2010). Figure 3-1 illustrates the increased rate of inspection over the past few years.

Figure 3-1: CCTV Sewers Inspections Since 2003

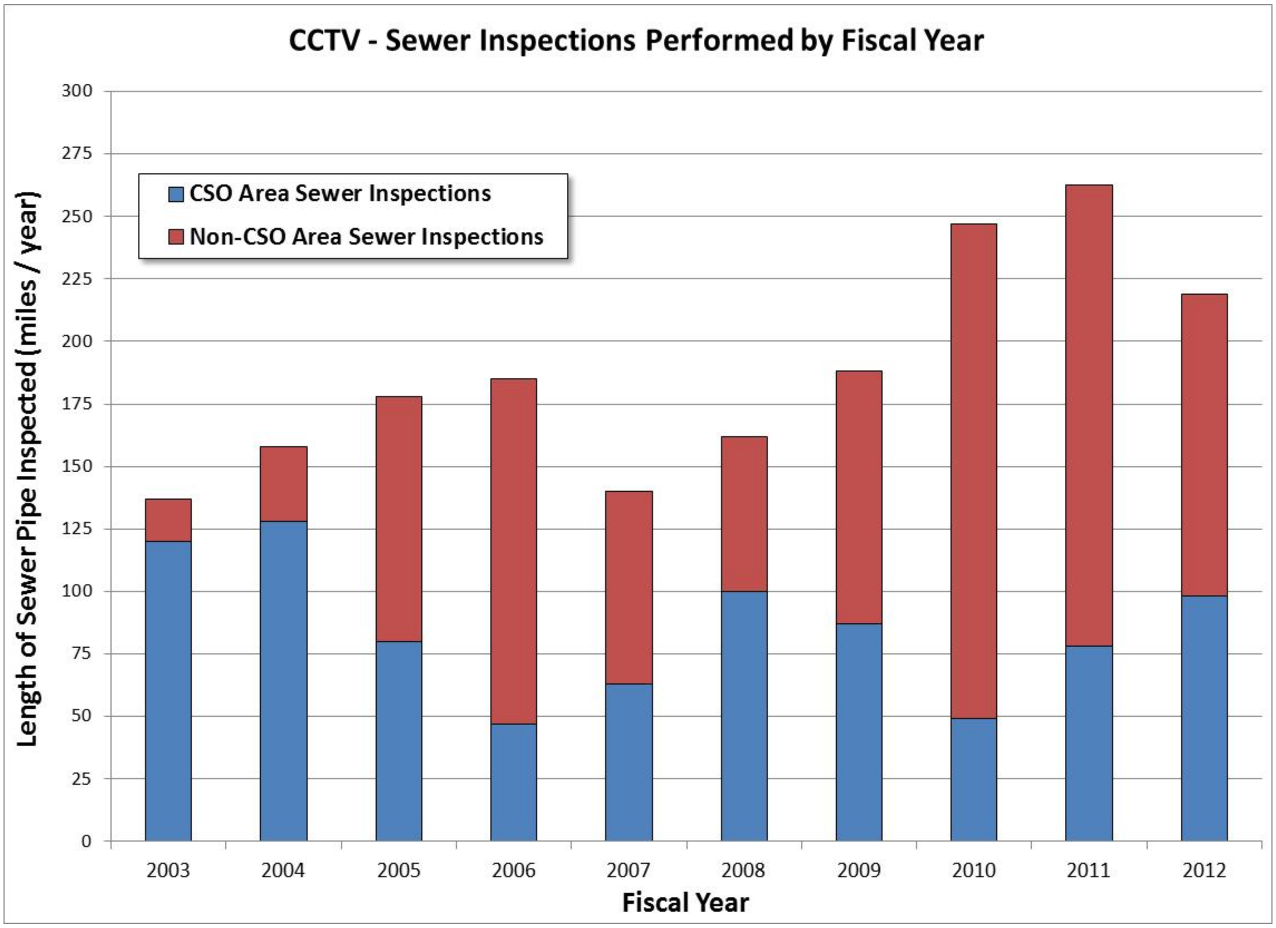


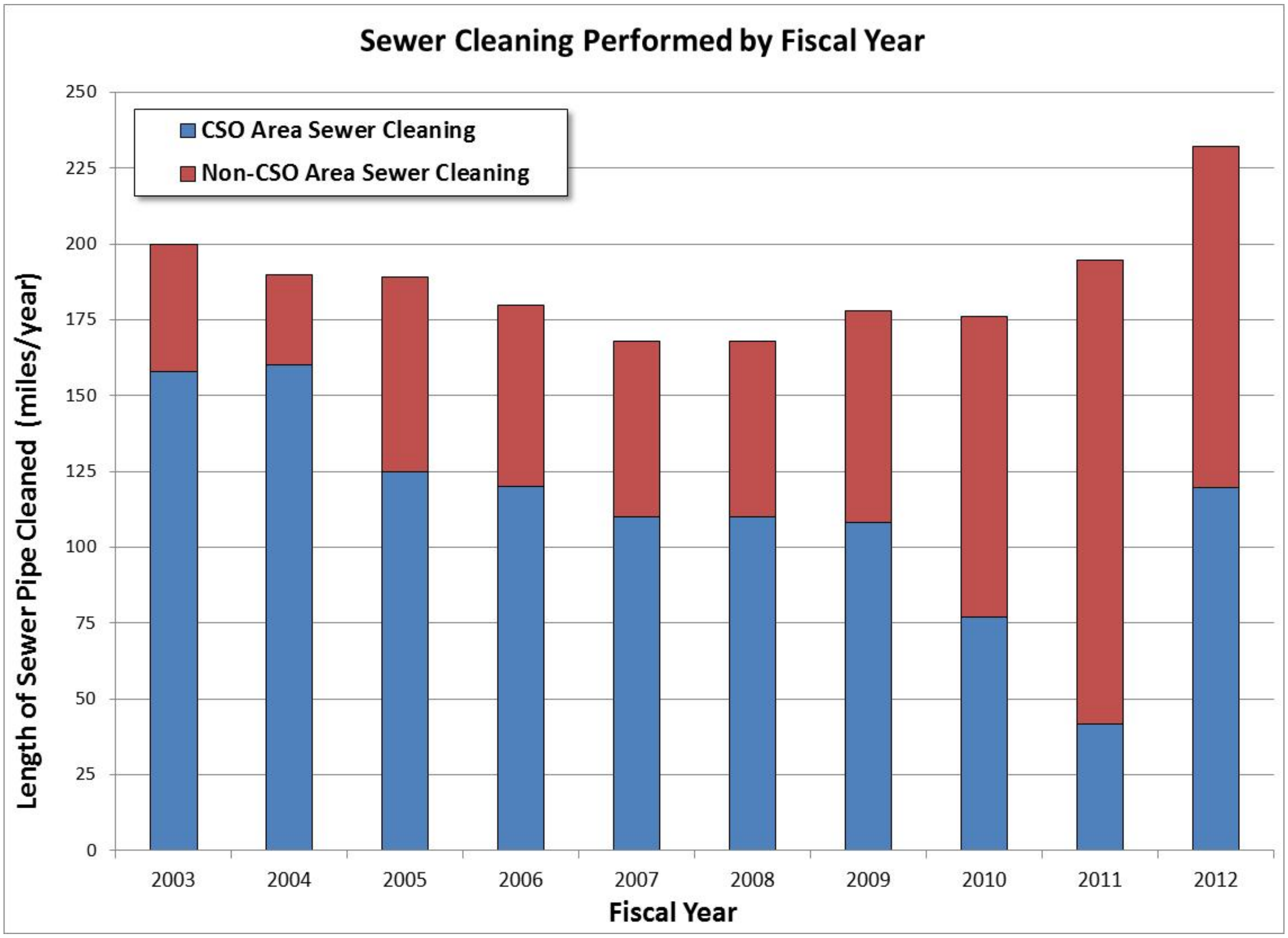
Figure 3-2 documents ongoing collection system cleaning since 2003 for both combined and separated sewer pipes. Between FY 2003 and FY 2012, Portland has cleaned 1900 miles of sewers and averaged 190 miles a year over the past five years.

Collection system inspection, cleaning, and repair are critical aspects of the maintenance program for CSO control facilities that helps to support Minimum Control #2—Maximum Use of the Collection System for Storage.

3.4 Work Orders Completed for Treatment Plants and Pump Stations

Maintenance activities are also reflected in the operations-based work order system. Although the City's Operating budgets have been constrained over the past few years of economic difficulties, staff have continued to focus on completing critical tasks as seen in the work order records.

Figure 3-2: Ongoing Collection System Cleaning Since 2003



3.4.1 Pump Station Maintenance

Figure 3-3 shows the completed work orders for pump station maintenance recorded in the Synergen CMMS since 2006. Synergen was brought online in 2005. The data show that the number of work orders performed over the past seven years on average is about 3,100. During FY2012, the City performed 3, 786 work orders for the 98 pump stations, indicating that the recent annual level of maintenance activities for pump stations continue to be funded at similar levels.

3.4.2 Treatment Maintenance

Figure 3-4 shows the completed maintenance work orders for the two wastewater treatment plants, Columbia Boulevard and Tryon Creek, as recorded in the Synergen CMMS. The data show that about 6,900 work orders per year are completed for the two plants. The chart also shows that the number of work orders completed in FY2012 was about average at 6,836.

Figure 3-3: Pump Station Work Orders Completed Each Year

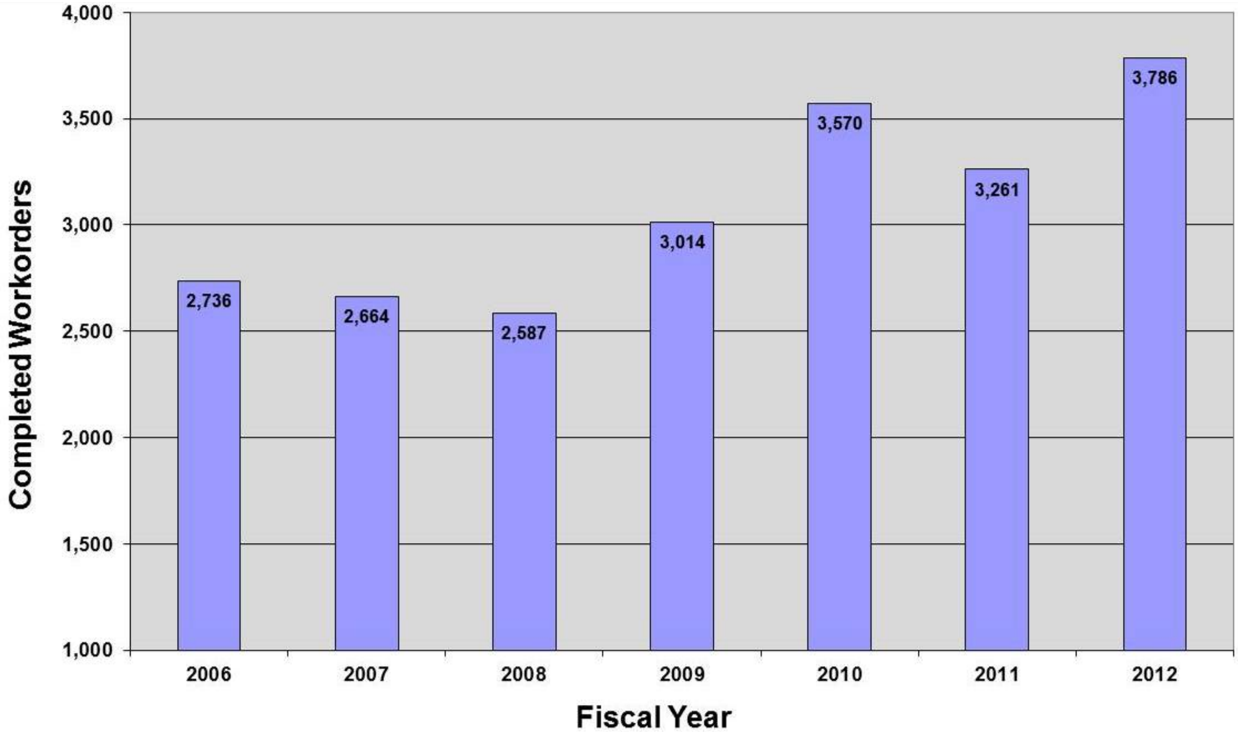
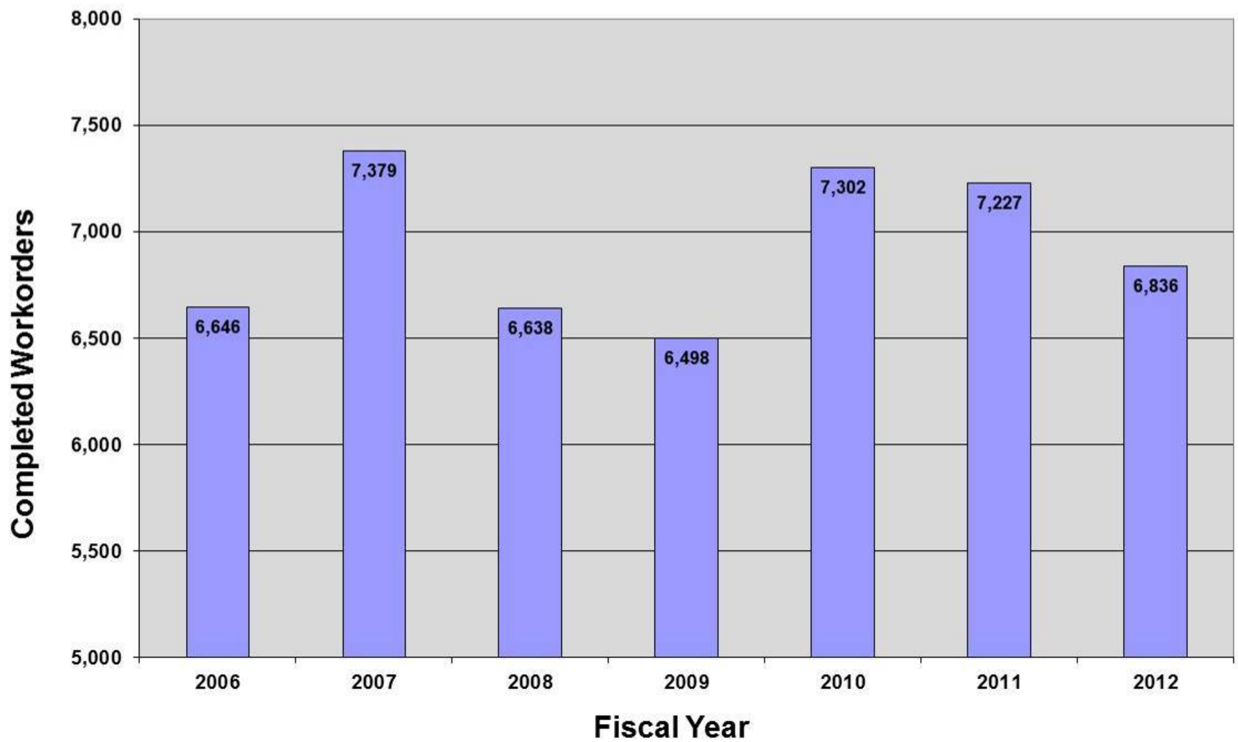


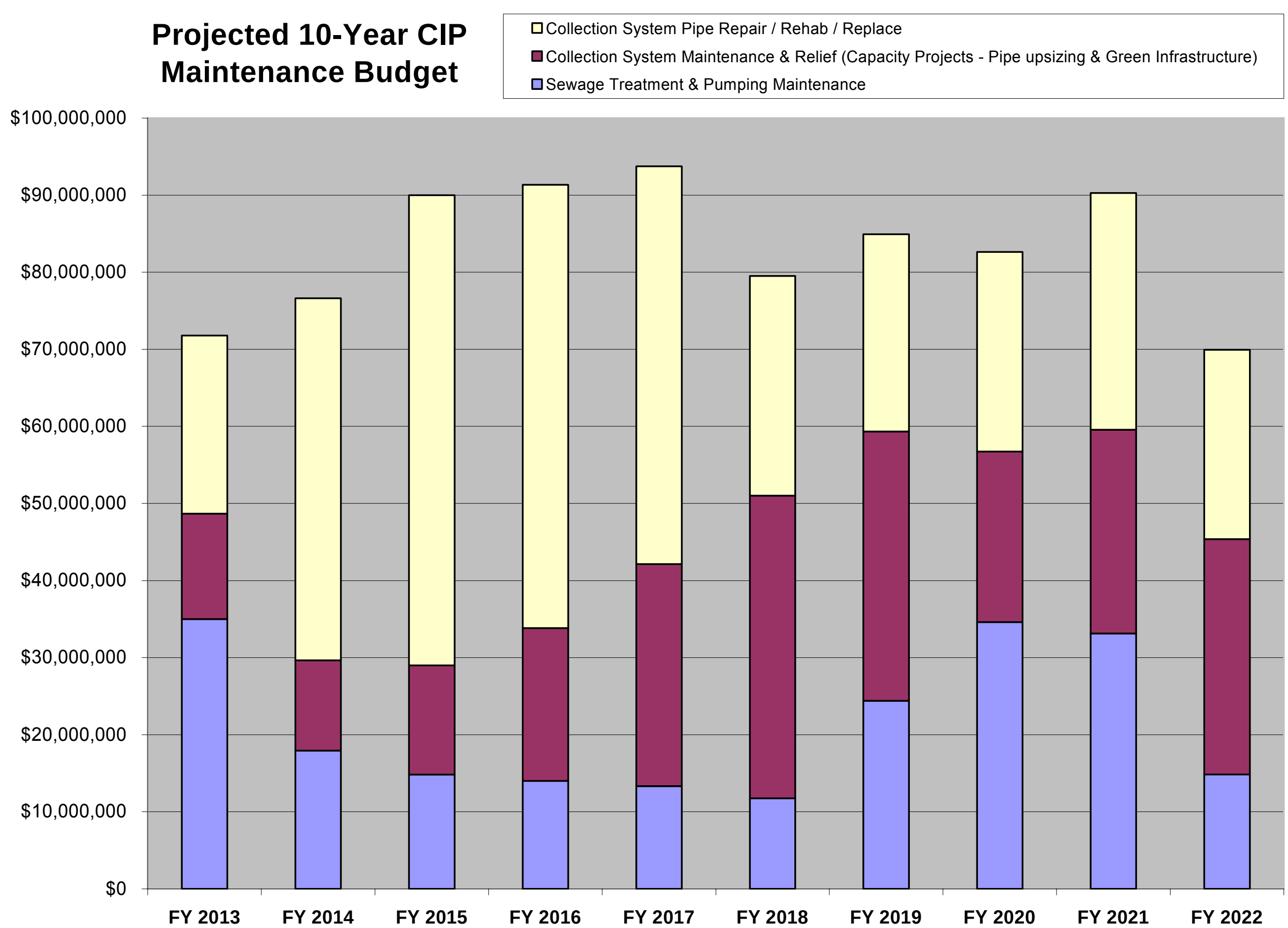
Figure 3-4: Number of Treatment Plant Work Orders Completed Each Year



3.5 CIP Budgets for CSO, Collection System and Treatment Maintenance

Figure 3-5 illustrates BES's 10-year capital improvement program (CIP). The 10-year CIP clearly anticipates ongoing and significant investments for all the collection system and pumping and treatment facilities necessary to maintain the functioning and useful life of these systems. The near-term increase in collection system rehabilitation addresses the large number of high-risk pipes (high likelihood, high consequences of potential failure) that were identified in the Phase II Pipe Rehabilitation Plan effort.

Figure 3-5: Projected 10-Year CIP Budget for System Maintenance



Section 4: Maximize Storage in the Collection Systems

The purpose of this Control is to ensure that combined sewage is kept in the sewer system for as long as possible using available in-system storage without adding new storage facilities. The available storage is used for minimizing secondary bypasses and overflow events. Portland's CSO tunnels and consolidation conduits have provided significant additional storage volume. This requirement originally focused on keeping sewers free of blockages to allow full utilization of sewer capacity; removing clean stormwater from the collection system also contributes to maximizing available conveyance capacity.

4.1 Collection System & CSO Storage

4.1.1 Trunkline and Interceptor Storage

Prior to completing the CSO control system, Portland maintained high weirs at pump stations and relief structures in order to surcharge the interceptor pipes and utilize as much in-system storage as possible. These practices helped to reduce CSO discharges to the receiving streams, but also resulted in increased risk of basement backups and street flooding when the trunklines and interceptors were overloaded during large storms. Such events are considered sanitary sewer overflows (SSOs).

As a result of full implementation of the CSO system at the end of 2011, the frequency of CSO discharges has been reduced dramatically. Since the full system has been operational, keeping the relief weirs at a high setting is no longer necessary. In contrast, the "SSO risk" created by having the relief weirs too high and surcharging the interceptor system is a concern in certain locations. For this reason, relief structures are being modified as needed to provide local hydraulic relief where the risk of SSO is high enough to justify the insignificant risk of sending the excess wet weather flow into the tunnel system.

In fiscal year 2012, the Sullivan Pump Station weir was lowered from Elevation 25.0 feet to about 23.5 feet to reduce backwater in the SE Interceptor. In addition, a new relief pipe was installed at SE Alder & 3rd to reduce surcharge in the local system that in the past had caused releases to a local basement and the street. A new relief structure is also being designed and built at Alder and 7th to relieve the large 36-inch trunkline where it connects into the SE Interceptor. These measures will reduce the level of surcharge in the interceptor and reduce the risk of SSOs in the SE Oak and SE Alder local collection systems without measurably impacting the on going reduction of CSO.

4.1.2 CSO System Storage

The CSO tunnel and consolidation conduit system storage are designed to be fully utilized and filled to elevation 18.0 feet before discharges to the Willamette River can occur. The use of storage capacity to minimize CSO discharges is part of the balance between maximizing the system storage volume and maximizing flow to the treatment plant. The potentially conflicting CSO and treatment objectives are optimized in the CSO System Operating Plan, which is discussed more fully in Section 5 on NMC #4 - Maximizing flow to treatment.

The CSO system has been designed to ensure that the tunnels are almost always completely full before overflows can occur. This was accomplished by designing both the consolidation conduits that connect the outfalls to the drop shafts and the drop shafts themselves to be able to convey the 25-year storm peak flow rates into the tunnels. This system has worked successfully for the first 15 CSO events that have occurred since December 2006, as listed in Table 2-4 above. The 100-year storm that occurred on May 26, 2012, however, generated peak flows that far exceeded the 25-year design storm capacity of the Alder OF36 drop shaft. As a result, the Alder OF36 discharged excess peak CSO flows (15 MG) even though the CSO tunnel storage was not fully used because the shaft couldn’t deliver all of the intense high flow rate into the tunnel.

4.2 Stormwater Management Program Accomplishments

Portland’s major objective and for stormwater control in the combined sewer area is focused on continuing to reduce stormwater runoff into the combined sewer system. This effort will result in reduced basement backups, retain the high level of CSO control, and provide stormwater as a resource for vegetated facilities to capture and infiltrate clean water into the ground.

4.2.1 Downspout Disconnection Program (1993 – 2011)

The Downspout Disconnection Program ended active outreach in June 2011 after 18 years of partnering with property owners, contractor, and community organizations to disconnect downspouts in Eastside Combined Sewer Basins. The final accomplishments include 54,509 disconnected downspouts at 26,529 properties. In addition, more than 35,000 properties were found to have one or more downspouts already disconnected or were already managing stormwater onsite. In total, the Downspout Disconnection Program implemented or documented 1.2 billion gallons of stormwater removed per year from the combined sewer system

Although the Downspout Disconnection Program is no longer doing active outreach and has ended all financial incentives for disconnection work, the Program continues to provide customer service support and technical assistance to property owners in the program area. Program staff are also systematically tracking redevelopment at properties in the program area, as the stormwater requirements for redevelopment will provide an even higher level of stormwater management.

To ensure that downspouts disconnected through the Program are remaining disconnected, the Downspout Disconnection Program is conducting ongoing maintenance and reliability outreach. This effort includes sending maintenance postcards to all past program participants and doing spot surveys of previously completed work. The results of the spot survey indicate that disconnections are being maintained and the disconnection rate is actually increasing. The survey results (dated August 13, 2012) indicate that for the surveyed properties:

The estimated disconnection rates from the survey are 77% with a 95% confidence interval (69.7, 84.2). The best estimate [of the disconnection rate of those same surveyed properties] using previous DISCO data is 76.8%. This is an estimated increase of 0.2% in the disconnection rate.

4.2.2 Private Property RetrofitProgram (2010-Current)

As part of the Tabor to the River Program's integrated approach, Environmental Services works with targeted private property owners to manage stormwater on their properties to help keep runoff out the combined sewers. These stormwater facilities help reduce local sewer capacity problems and also provide CSO system capacity benefits. Environmental Services helps property owners install rain gardens, stormwater planters, swales, ecoroofs, and pervious pavement on sites that meet program criteria. Participation is entirely voluntary and all stormwater facilities are privately owned and maintained, backed by an enforceable Operations and Maintenance agreement on the property's title and deed. For completed projects, maintenance outreach includes personal follow up for two years and ongoing seasonal maintenance task reminder postcards.

Since the program began in 2010,

Figure 4-1: Examples of Private Property Retrofits

Residential Rain Garden

Stormwater Planter at Institution (Western Seminary)

Stormwater Planters, Pervious Pavers, and Pervious Concrete at Commercial Site (Nuestra Cocina) twenty-one private property stormwater retrofit projects have been completed to manage 1.54 acres of impervious area. In addition, site assessment and records research found 4.4 acres not connected to the combined sewer due to new development requirements for stormwater control, existing onsite stormwater control previously unaccounted for, or connections to storm only sewers. Examples of private property stormwater retrofit projects are shown in Figure 4-1.

4.2.3 Sustainable Stormwater Projects in Combined Sewer Area

In addition to the Downspout Disconnection Program, Portland is a leader in implementing various sustainable stormwater programs that use green infrastructure stormwater controls in the public right-of-way, as well as on private properties through partnerships with private and institutional property owners. These stormwater controls use natural vegetated facilities to act as small constructed wetlands that capture stormwater for infiltration and evapotranspiration.

City staff and residents promote the use of green street facilities for the protections they afford for local sewer capacity relief, public health, and water resources, as well as for providing community benefits including green space and habitat connectivity, enhancement of the bicycle and pedestrian environment, and neighborhood livability and vitality.

4.2.3.1 Ecoroofs

Ecoroofs replace conventional roofing with a layer of vegetation over a growing medium on top of a synthetic, waterproof membrane. An ecoroof significantly decreases stormwater runoff, saves energy, reduces pollution and erosion, absorbs carbon dioxide, and reduces heat island effects.

The City of Portland strongly supports the installation of ecoroofs through the City's Green Building Policy, Stormwater Management Manual, developer floor area ratio bonuses in specific portions of the city, and the Ecoroof Incentive Program, part of the Grey to Green Initiative, which provides grants of up to $5 per square foot for qualifying ecoroof projects.

As of June 2012, Portland has over 350 ecoroofs installed throughout the city, managing almost 18 acres of roof. Approximately 250 of those ecoroofs are in the combined sewer area.

During Fiscal Year 2011-12, 14 new ecoroofs were installed in the combined sewer area, managing approximately 0.37 acres of roof. This roof area represents 370,000 gallons of rainfall to the combined system annually, and Portland's monitoring data indicates that approximately 185,000 gallons are retained by the roofs and returned to the atmosphere through evapotranspiration.

4.2.3.2 Green Streets

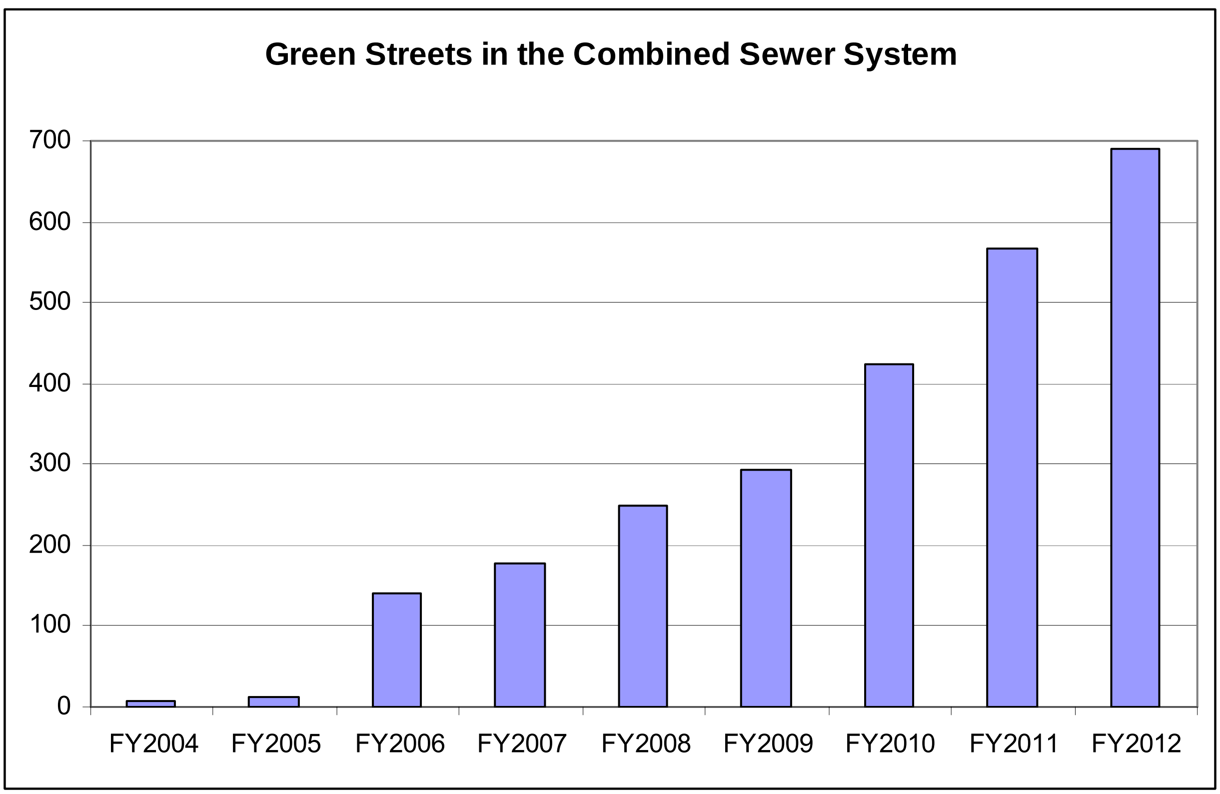
As of June 2012, Portland has implemented almost 1,200 green streets in the right of way, with close to 700 in the combined sewer area. The *Post-2011 Combined Sewer Overflow Facilities Plan* identifies specifically how Portland will continue to implement both public and private stormwater controls to further reduce stormwater entering the combined sewer system and thereby increase the storage available for capturing CSO discharges.

Specific benefits of green street facilities in the combined sewer system area include:

- Reducing the amount of stormwater that enters the city's sewer collection system, which can help to minimize basement sewer back-ups and combined sewer overflows (CSOs).
- Allowing clean, cool stormwater to soak into the ground, which helps recharge groundwater.
- Increased green space, improved air quality and reduced air temperature.
- A more cost-effective way to manage stormwater than upsizing existing sewer pipes or building new pipes in many cases.

The City promotes the use of green street facilities through a variety of methods including the Stormwater Management Manual for private development and public right-of-way improvements, the City's Green Street Policy, the Grey to Green Initiative, internal design teams, and long-term facilities planning efforts.

Figure 4-2: Numbers of Green Streets in the Combined Sewer Area



During Fiscal Year 2011-12, 122 new green street facilities were installed in the combined sewer area. Some projects were implemented by private development, some were CIP-budgeted cost-beneficial combined sewer system plan projects, and some were PBOT projects that required stormwater management. Collectively, these facilities manage approximately 16 acres of impervious area that generates 16.1 million gallons of stormwater to the combined sewer system annually. Based on the City's performance monitoring of green street facilities, these facilities will remove 11.1 million gallons of runoff annually from the combined sewer system through infiltration and evapotranspiration.

City staff also initiated multiple efforts in Fiscal Year 2011-12 to improve design and long-term performance of green street facilities, including:

- Investigating soil characteristics for all facilities and drainage systems for lined facilities to improve overall flow control.
- Launching the Green Street Stewards program which allows members of the public – individual property owners, business associations, or neighborhood associations – to adopt green street facilities and perform basic maintenance tasks. Neighborhood involvement provides a local presence and more day-to-day facility observation to ensure that facilities are functioning at peak efficiency during storm events. Seventy-six green streets were adopted during the first nine months of the program.
- Exploring different material and design options for check dams in green street facilities to improve reliability and maintenance, which will allow more infiltration
- Development of a green street design guidance document to capture lessons learned from past projects and provide more standardization for future green street facilities.

Section 5: Maximize Flow to the POTW

Maximizing flow to the treatment plant, as well as maximizing the use of storage, are both part of the overall system operations strategy. The method by which these elements of the NMCs are implemented must be viewed in the context of how the overall CSO system is operated to achieve multiple but prioritized objectives.

5.1 CSO System Operating Plan – December 2011

The CSO System Operating Plan (submitted to DEQ in December 2011) presents the strategy and procedures for operating Portland's CSO controls by integrating three major systems – the collection system, the CSO facilities and the CBWTP treatment trains. Three major documents -- the CBWTP NPDES Permit, the ASFO and EPA Guidance for CSO Programs -- set out the objectives for the System Operating Plan.

Nine System Operating Objectives were developed and are presented below in a prioritized list. The prioritization is important because CSO control and treatment objectives can often conflict and operations staff must know what is more important to achieve when a conflict arises. The prioritized list of objectives first protects the treatment processes as the top priority, followed by protecting human health and then the environment. Protection of the treatment processes is the first priority because the highest risks facing the overall system is the risk of damaging the treatment processes. If the treatment plant is damaged by washing out biosolids or flooding the plant, then major environmental harm that impacts human health could occur. Similarly, the collection system must be kept intact to keep sewage away from the public. Finally, the lower risk issues of energy cost savings, odor control and maintenance costs are discussed.

5.1.1 CSO Operating Objectives by Priority

1. **Protect & Maintain Biological System and Meet Effluent Discharge Limits**
   - Maintain and/or limit flow to 100 or 110 MGD through secondaries in wet weather
   - Meet secondary effluent limits: Maximum Month: < TSS 30 mg/l; < BOD 30mg/l
2. **Capture and convey all dry weather flow**
   - Treat all through primary & secondary system
3. **Prevent Releases to Streets & Basements (SSOs)**
   - Control pumping rates to keep sewage away from human contact
4. **Capture & convey maximum volume of wet weather flow**
   - Optimize capacity of conveyance and storage system

- Treat all CSO via screening, primary treatment & disinfection at a minimum

5. **Protect Columbia Slough (Sensitive Area)**
   - Give priority to the Columbia Slough Influent Pump Station to pump high rates and close the Argyle gate to eliminate excess inflows from the Willamette system.
6. **Treat as much CSO through secondary as possible**
   - Dewater CSO tunnels and Wet Weather primaries slowly enough to treat more through secondary system but soon enough to avoid septic conditions (within 24 hours)
7. **Minimize energy usage & pumping costs**
   - Keep flows moving through the collection system at the highest elevation possible and prevent sending flow to tunnel where possible
   - Pump at rates and times that reduce chemical and electrical costs
8. **Minimize Odor problems via Operations**
   - Direct dry weather sewage away from neighborhoods and odor generating facilities
   - Activate odor control facilities when pumping through neighborhoods
9. **Minimize sedimentation / settling in tunnels and maintenance problems**
   - Keep flows at high rate through interceptors and tunnels to prevent sedimentation
   - Employ self-cleaning cycles at CSO pump stations

5.1.2 Integrating Permit & Regulations via CSO Operating Strategy

The CSO system operating strategy is Portland's best method of achieving NPDES permit requirements for CBWTP, the Nine Minimum Controls, and CMOM requirements related to operations. These regulatory requirements are addressed in the nine prioritized objectives outlined above, which give the highest priority to protection of treatment process to mitigate the highest risks in an integrated CSO system.

The comprehensive communications and controls that serve the collection system, CSO system and the treatment system have been programmed to follow these prioritized objectives. The detailed strategy for controlling specific facilities and sub-systems within these larger systems is presented fully in the December 2011 CSO Systems Operating Plan. The City is currently in the process of updating the CSO Systems Operating Plan based on the experience and observations over the past few months since the overall CSO system was completed in December 2011.

Section 6: Eliminate Dry Weather Overflows

6.1 Summary of Sewer System Releases & Response

Dry weather overflows (DWOs) have effectively been eliminated from the Portland system with the completion of the 2011 CSO facilities. It is now extremely unlikely that a diversion structure can become blocked to the degree that it could cause a DWO because the overflow would instead be captured by the large CSO facilities downstream of the diversions. In addition, all overflow points (whether drop shaft structures or large diversion structures) that can overflow to the Willamette River or the Columbia Slough have level monitoring and alarms to signal if the water in the structure approaches the overflow level. As a result, no dry weather overflows occurred in fiscal year 2012.

The BES Duty Officer and Spill Response Team reported two sanitary sewer overflows (SSOs) during FY2012, which were discharged from Alder OF36 but that were not DWOs:

- 5/22/2012 –Sewage was discovered slowly leaking from a deteriorated sanitary pipe in the separated area near SE Alder & 1st Street. The release was into a nearby storm sewer that discharged into the Willamette River via OF36. An emergency repair was conducted.
- 5/30/2012 – Pump Station Maintenance Crew reported an accidental discharge to the Willamette River from the Alder Pump Station when the storm pumps were inadvertently activated and approximately 3000 gallons was pumped to OF36.

6.2 Diversion Structure Modifications

Prior to December 1, 2011, diversion structures were critical in preventing dry weather overflows and minimizing CSO discharges by maximizing flow to the interceptor and accessing available inline storage upstream of diversion dams. The 1991 SFO required diversion structure improvements and subsequent NPDES permits have required weekly inspections of diversion structures. After completion of all CSO control facilities in December of 2011, diversion structures became simply flow-split manholes that divide the flow between the interceptors and the CSO tunnels. The diversions are no longer critical for dry weather overflow control and no longer reduce CSO in a measurable amount compared to the overall CSO tunnel system. For these reasons, most diversion structure changes will not affect CSO control performance. Only diversion structures that directly overflow to the river or slough are reviewed in the Annual CSO Performance report. In FY2012, there were no modifications to those diversion structures that would affect their level of CSO control.

Section 7: Update of the Public Notification Program

The goals of the CSO public notification program are to:

1. Make the public aware that the City has a combined sewer system that can overflow.
2. Explain what CSO is and how it impacts water and can threaten public health.
3. Inform the public when a CSO has occurred and warn against contact with the receiving waters.
4. Raise public awareness of the benefits to the community of the City's investment in CSO Control.

When the CSO Policy was adopted, this element of the NMC focused mostly on outreach through brochures and public meetings and posting warnings at public access points on the Willamette River and Columbia Slough.

With changing communication technology, public notification is more diverse.

Portland's CSO notification procedures changed with completion of the CSO abatement program in December 2011. Throughout the 20-year program, the City relied on its HYDRA System to measure rainfall and trigger the CSO notification process. As of December 2011, all combined sewer outfalls that can discharge are monitored and public notification takes place when an overflow is measured at a specific location.

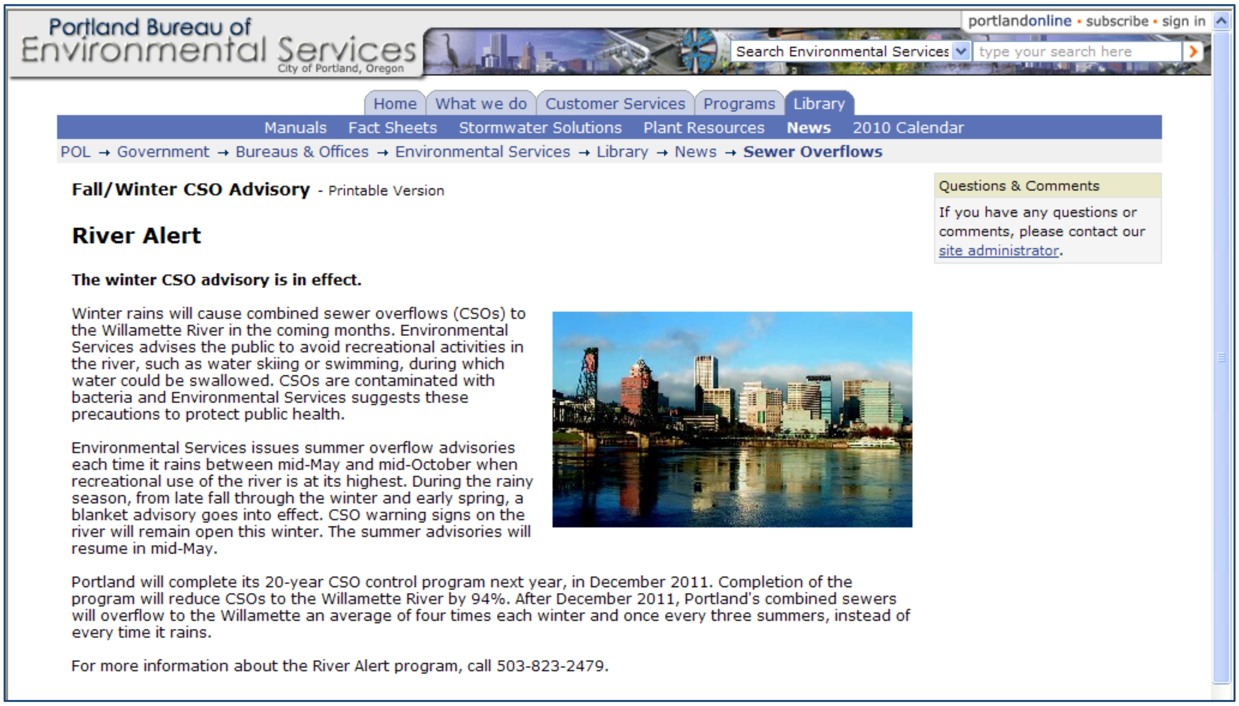
7.1 Public Notification/River Alert Program

The River Alert system notifies the public of CSO events. The system includes ten permanent, folding signs installed at public access points to the Willamette River. A contractor travels the river by boat and opens the warning signs each time there is a CSO. Forty-eight hours after each CSO event ends, the contractor closes the warning signs. Signs identifying CSO outfall pipes are posted at each outfall.

The warning signs display the phone number of the River Alert Hotline, a 24-hour recorded message the public can call to learn if a CSO advisory is in effect and to hear a message about the CSO Control Program. The hotline number is 503-823-2479.

The River Alert program notifies the media by email every time there is CSO event. Internet users can go to www.portlandonline.com/bes/overflow (Figure 11-1) to learn if a CSO advisory is in effect. Internet users can also subscribe to automatic email notification (Figure 11-2) each time BES issues a CSO advisory. BES issues CSO alerts on https://twitter.com/BESPortland and the notifications are re-tweeted by PublicAlerts.org.

Figure 7-1: Clean River Program Web Page with CSO Advisory Information - http://www.portlandonline.com/bes/index.cfm?c=36989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Fall/Winter CSO Advisory - Printable Version

River Alert

The winter CSO advisory is in effect.

Winter rains will cause combined sewer overflows (CSOs) to the Willamette River in the coming months. Environmental Services advises the public to avoid recreational activities in the river, such as water skiing or swimming, during which water could be swallowed. CSOs are contaminated with bacteria and Environmental Services suggests these precautions to protect public health.

Environmental Services issues summer overflow advisories each time it rains between mid-May and mid-October when recreational use of the river is at its highest. During the rainy season, from late fall through the winter and early spring, a blanket advisory goes into effect. CSO warning signs on the river will remain open this winter. The summer advisories will resume in mid-May.

Portland will complete its 20-year CSO control program next year, in December 2011. Completion of the program will reduce CSOs to the Willamette River by 94%. After December 2011, Portland's combined sewers will overflow to the Willamette an average of four times each winter and once every three summers, instead of every time it rains.

For more information about the River Alert program, call 503-823-2479.

Questions & Comments
If you have any questions or comments, please contact our site administrator.

Figure 7-2: River Alert E-Mail Subscribe Website - http://www.portlandonline.com/bes/index.cfm?c=36989&a=375566


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POL → Government → Bureaus & Offices → Environmental Services → Library → News → Sewer Overflows

River Alert Notification - Printable Version

To receive email notification of combined sewer overflows (CSO) and other sewage releases:

1. You must be logged in to PortlandOnline to subscribe. Click "sign in" in the top right corner of your screen and log on. If you don't yet have a PortlandOnline account, follow the prompts to sign up.
2. When you've logged on, click "subscribe" in the top right corner of the screen to open the Personalization Options box.
3. Check the "Sewer Overflow Notification" box. Choose options for email format and notification freqency at the bottom of the list.

You will receive email notification each time Environmental Services issues a CSO or sewage release advisory.

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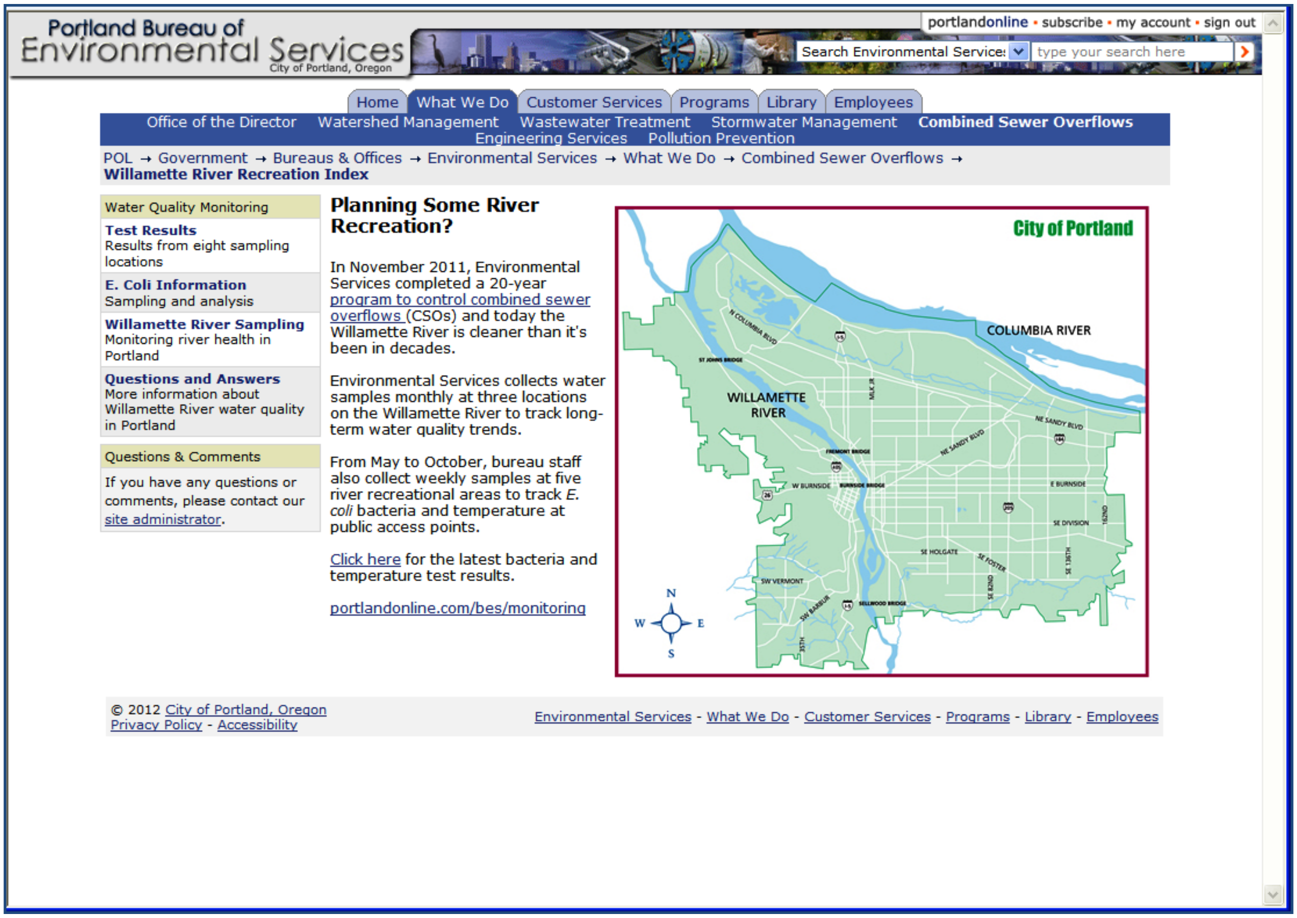
In addition to public CSO notification, other activities that include public information and education about CSOs have also been extensively implemented by BES since 2003. In spring 2012, the city began posting water quality information on Portland Online:

Figure 7-3: Water Quality Monitoring Website - http://www.portlandonline.com/bes/?c=57781



The webpage displays current information about *E. coli* counts and water temperature at recreational access points on the Willamette River. As part of their ongoing science education program, BES educators make classroom presentations to Portland school students in the fifth through twelfth grades about the combined sewer system and how Portland controls CSOs. Educators reach about 350 students a year with the CSO presentation.

Section 8: CSO System & Water Quality Monitoring

The NPDES Permit and the MAO require that specific Post-Construction Monitoring Program (PCMP) activities be implemented to ensure that the CSO Control Program complies with the NPDES permit and water quality standards. The PCMP includes monitoring for:

- Rainfall across the service area for comparison against design storm event frequency criteria for compliance
- CSO discharges with alarms to determine occurrence, duration, volume and peak rates
- CSO system and treatment facilities operations to confirm performance compared to design expectations and permit limits
- Separated sanitary flows into the combined sewer system (new requirement in MAO)

In addition to CSO discharge monitoring, CSO system operations and treatment process monitoring discussed earlier in this report, the PCMP also includes three areas of water quality monitoring:

- Water quality sampling of CSO discharges at overflow structures to confirm that water quality will be achieved outside of permitted mixing zones.
- Routine monthly in-stream water quality sampling in the Willamette River to support analysis of completed CSO control facilities, and to demonstrate compliance with water quality standards and TMDL allocations, as applicable.
- Routine monthly in-stream water quality sampling in the Columbia River to demonstrate efficacy of the CSO treatment system and compliance with water quality standards.

The NPDES permit requires receiving stream sampling to be conducted as described in the December 2010 Nine Mininum Controls Update report. The Willamette River in-stream sampling program is to continue for five years after controlling all CSO outfalls to the required performance standard.

8.1 Separated System Flow Monitoring (MAO Required)

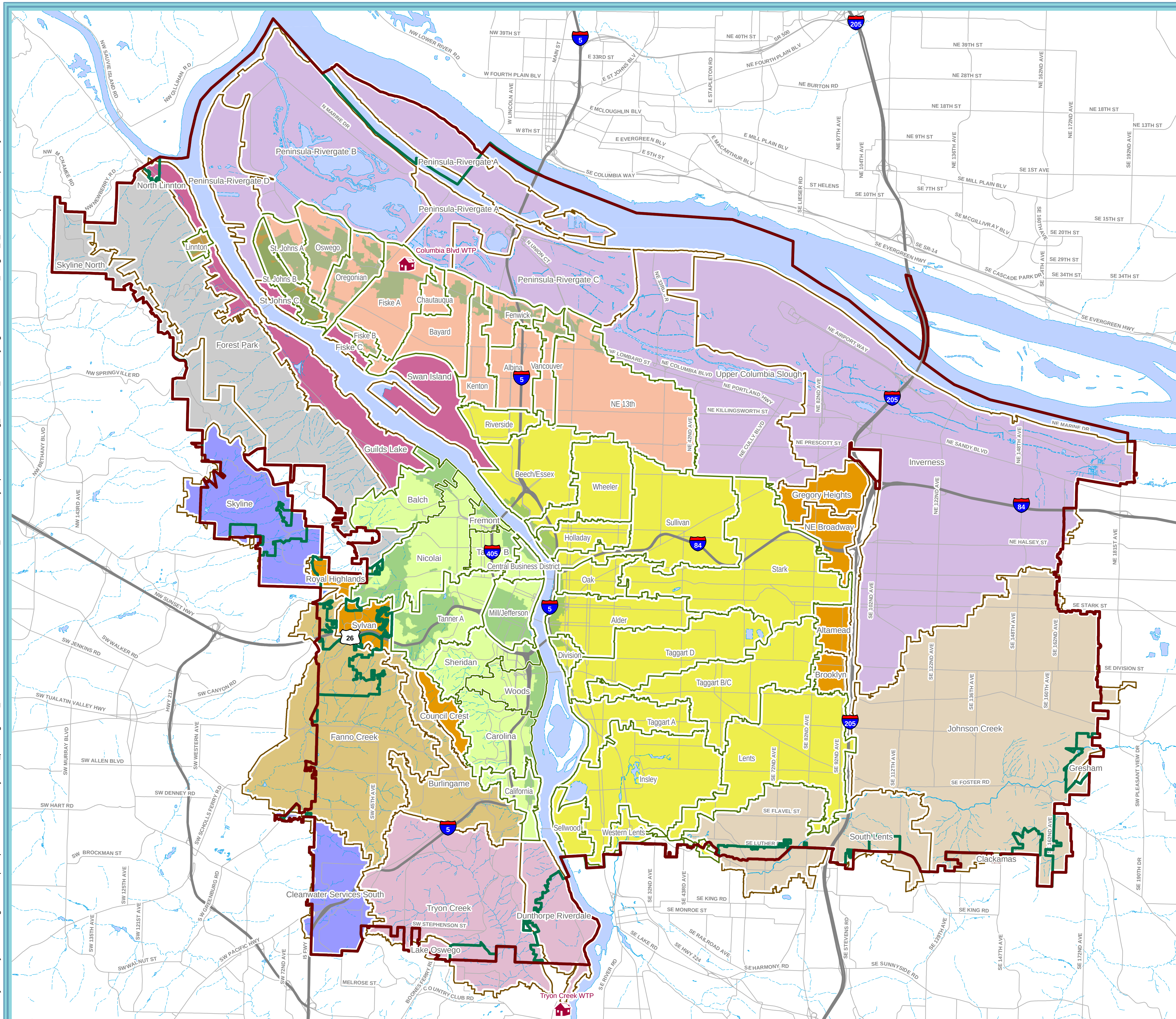
One of the goals of the Monitoring and Analysis Program in the MAO is to “Provide data to inform CBWTP Facilities Plan Update and the NFAA for determining adequate secondary capacity.” Part of achieving that goal is to reliably quantify the dry and wet weather flows from the separated portion of sanitary sewer collection systems that send flows directly into the combined sewer system. The sanitary basins are shown in Figure 8-1 below. The basins that flow into the CBWTP system are listed on Table 8-1 along with the mechanism by which the sanitary flows are being measured, including flow monitors installed by the June 30, 2012 deadline.

Table 8-1: Sanitary Flow Monitoring for Separated Areas Contributing to CBWTP (MAO Requirement)

Sewer Sub-Basin Name (See Figure 8-1)		Discharge Mechanism	Flowrate Measurement Mechanism	Notes
Willamette River Sanitary Area				
	Royal Highlands	Royal Highlands PS to NW Interceptor	n/a	Too small of separated area to justify monitoring; use model to estimate flows
	Sylvan	Gravity to Combined System	n/a	More a part of the combined sewer system than separated
	Council Crest	Gravity to Combined System	n/a	Too small of separated area to justify monitoring in SW Capitol Highway; use model to estimate flows
	Brooklyn	Brooklyn PS to Combined Sewer system	Cycle data	SE Brooklyn & 89th; 2 pumps, 1000 gpm each, 1000 gpm FIRM
	Altamead	Altamead PS to Combined Sewer system	Cycle data	2 pumps, 1900 gpm each, 1900 gpm FIRM
	NE Broadway	NE Broadway PS to Combined Sewer system	Cycle data	Broadway & 87th PS: 3 pumps, 1300 gpm each; 2600 gpm FIRM
	Gregory Heights	Fremont PS to Combined Sewer system	Cycle data	Fremont PS: 3 pumps, 800 gpm each; 1600 gpm FIRM
North Willamette Sanitary Area				
	Guilds Lake	GLPS Pumps to Portsmouth Tunnel	Cycle Data, then New Mag Meters	GLPS: 3 pumps; 2@12000 gpm; 1@5000 gpm; 30 MGD FIRM
	North Linnton	Pumps to GLPS	GLPS	Measured via Guilds Lake PS
	Swan Island	Mocks Bottom PS to Swan Island PS (sanitary)	Cycle data	SIPS: 4 pumps @2800 gpm; 6300 gpm FIRM
	St Johns C	St Johns PS Pumps to St Johns Interceptor	Cycle data	SJPS: 3 pumps @650 gpm; 1300 gpm FIRM
West Side Sanitary Area				
	Burlingame	Drains into Burlingame Trunk	Flow meter in SWPI	SWPI Project (E09171) currently has monitor in best location.
	Fanno Creek	FABA PS pumps into Buringame Trunk	FABA PS Mag Meters	
Southeast Sanitary Area				
	South Lents	Gravity to Lents Trunk	HYDRA SLRT and Temporary Flow Monitor	HYDRA added velocity meter to Lents Trunk SLRT #35 on 57-inch pipe. Field Operations installed two temporary flow monitors - One on the 21-inch pipe leaving ACZ091 to the south, second is further upstream either on the Lents Trunk (ACU090).
	Johnson Creek	Johnson Creek Interceptor Gravity to Lents Trunk	Temp. Flow Monitor	Field Operations installed temporary monitor in ACU211.
Columbia Slough Sanitary Area				
	Inverness	Inverness pumps to CBWTP	Inverness Mag Meters	
	Upper Columbia Slough	Gravity to Lombard Interceptor, NE 59th PS, 33rd PS, and Argyle & 13th PS	Tempory Flow Monitor, Cycle Data for PS	Field Operations installed a temporary flow monitor into AAK923 on 24-inch interceptor in Lombard east of NE13th. Cycle Data from Argyle & 13th for full sanitary flow measurement.
	Peninsular River Gate A	Force Pump Station pumps to Columbia Interceptor	Cycle data	Force PS: 2 pumps @ 1400 gpm; 1400 gpm FIRM
	Peninsular River Gate B	Oregonian, Refuse and Lombard Pump Stations	Cycle data	Oregonian: 2 pumps @650 gpm; 650 FIRM Refuse Disposal: 2 pumps @350 gpm; 350 FIRM Lombard PS: 2 pumps @6700 gpm; 6700 FIRM
	Peninsular River Gate C	Montana and Schmeer Pump Stations	Cycle data	Montana PS: 3 pumps; 2@1500; 1@1650; 2950 FIRM Schmeer PS: 3 pumps @2000; 3600 FIRM
	Peninsular River Gate D	Rivergate and Shipyard Pump Stations	Cycle data	Rivergate PS: 3 pumps @250 gpm; 500 FIRM Shipyard PS: 2 pumps @1200 gpm; 1200 FIRM

8.2 CSO Discharge Sampling

The CBWTP NPDES permit requires opportunity-based sampling of CSO discharges to the Willamette River. The purpose of this sampling is to confirm that the remaining CSO discharges protect beneficial uses and provide for attainment of the Willamette River water quality standards consistent with permit requirements for overflows from storms exceeding the CSO control standards. In the years that the sampling is performed, the results are to be included in the annual CSO report.



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Map Elements

- Urban Services Boundary
- City of Portland
- Combined Sewer Basin Boundary
- Sanitary Sewer Basin Boundary
- Columbia Slough CSO Service Area
- West Side Willamette CSO Service Area
- North Willamette CSO Service Area
- East Side Willamette CSO Service Area
- Durham Sanitary Service Area
- Tryon Creek Sanitary Sewer Service Area
- Willamette Sanitary Service Area
- Southeast Sanitary Service Area
- West Side Sanitary Sewer Service Area
- North Willamette Sanitary Service Area
- Columbia Slough Sanitary Sewer Service Area
- No Sewer Service Area
- Partially Separated Areas*

*The partially separated areas are areas where a portion of the stormwater runoff is directed to the CBWTP and a portion is diverted to a receiving water such as the Willamette River or the Columbia Slough

1 in = 1.5 miles

Figure 8 -1

Sewer Basins and Service Areas

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The sampling program will be implemented for five different events throughout the 5-year permit cycle, and is focused on storms that last at least four hours in order to provide sufficient time to mobilize the sampling crew. Grab samples are to be taken and analyzed for the CSO Pollutants of Concern: E-coli, Total Lead and Total Copper. Zinc is typically included in the analyses, but it has not been identified as a CSO Pollutant of Concern.

CSO discharges are considered protective of beneficial uses and do not preclude attainment of water quality standards when monitoring results do not exceed the appropriate numeric standards for the Pollutants of Concern. Standards take into account a 10:1 dilution in the mixing zones with the exception of E. coli, for which a mixing zone is not allowed.

Portland was not able to obtain grab samples of the Willamette River CSO discharges in FY2012 and therefore will need to obtain samples from two or more events in the following four years.

8.3 Willamette River Instream Water Quality Sampling

Since the beginning of the CSO Control Program, Portland has implemented an extensive in-stream water quality monitoring effort to characterize the impacts of CSO and track the benefits of implementing the CSO facilities. Improved water quality in the Willamette is one of the measurable outcomes of Portland's 20-year, $1.4 billion CSO Control Program.

Figures 8-2 through 8-5 below show the water quality trends along the Portland stretch of the Willamette River for four parameters: zinc, lead, copper and E. coli. These metals and bacteria parameters are the pollutants of concern for Portland CSO discharges. The figures provide a view of the four different transects of sampling taken across the river at the far upstream (Waverly), the center of the CSO area (Morrison Bridge), the downstream end of the CSO area (St Johns Bridge), and near the end of the city limits (Kelly Point).

As the Willamette River water quality sampling results show, there has been a steady improvement (reduction) in the concentrations measured for these four parameters for the long-term trending period. The most dramatic improvement is visible in zinc (Figure 8-2), which shows a steady decline through time as seen at the Waverly transect, and so is mostly due to upstream sources and influences. An improvement (reduction) is also noticeable in copper, especially at the St Johns Bridge (Figure 8-4).

Figure 8-2: Willamette River Monitoring Results for Zinc: Pre & Post Ultra-Clean Change

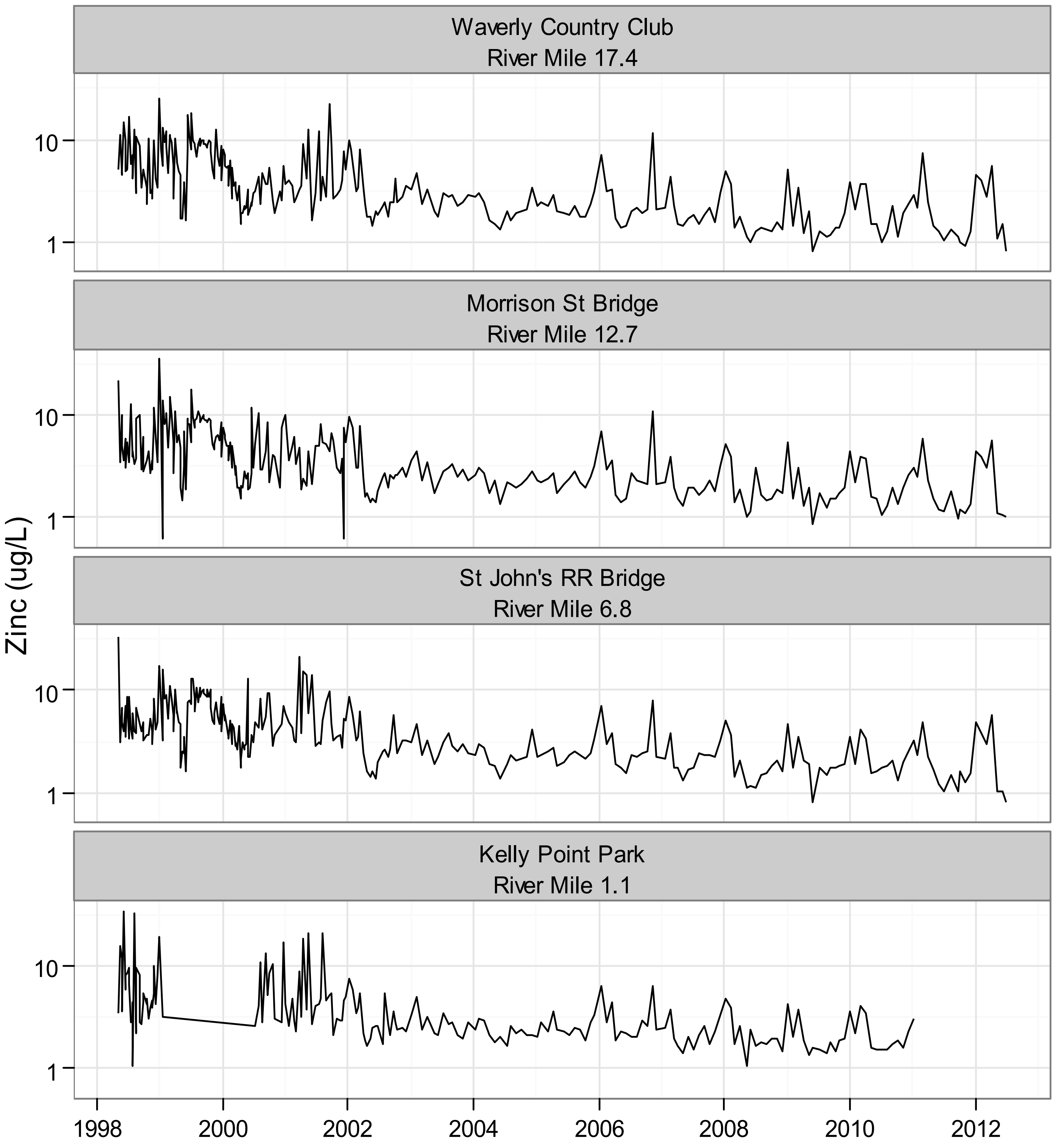


Figure 8-3: Willamette River Monitoring Results for Lead: Pre & Post Ultra-Clean Change

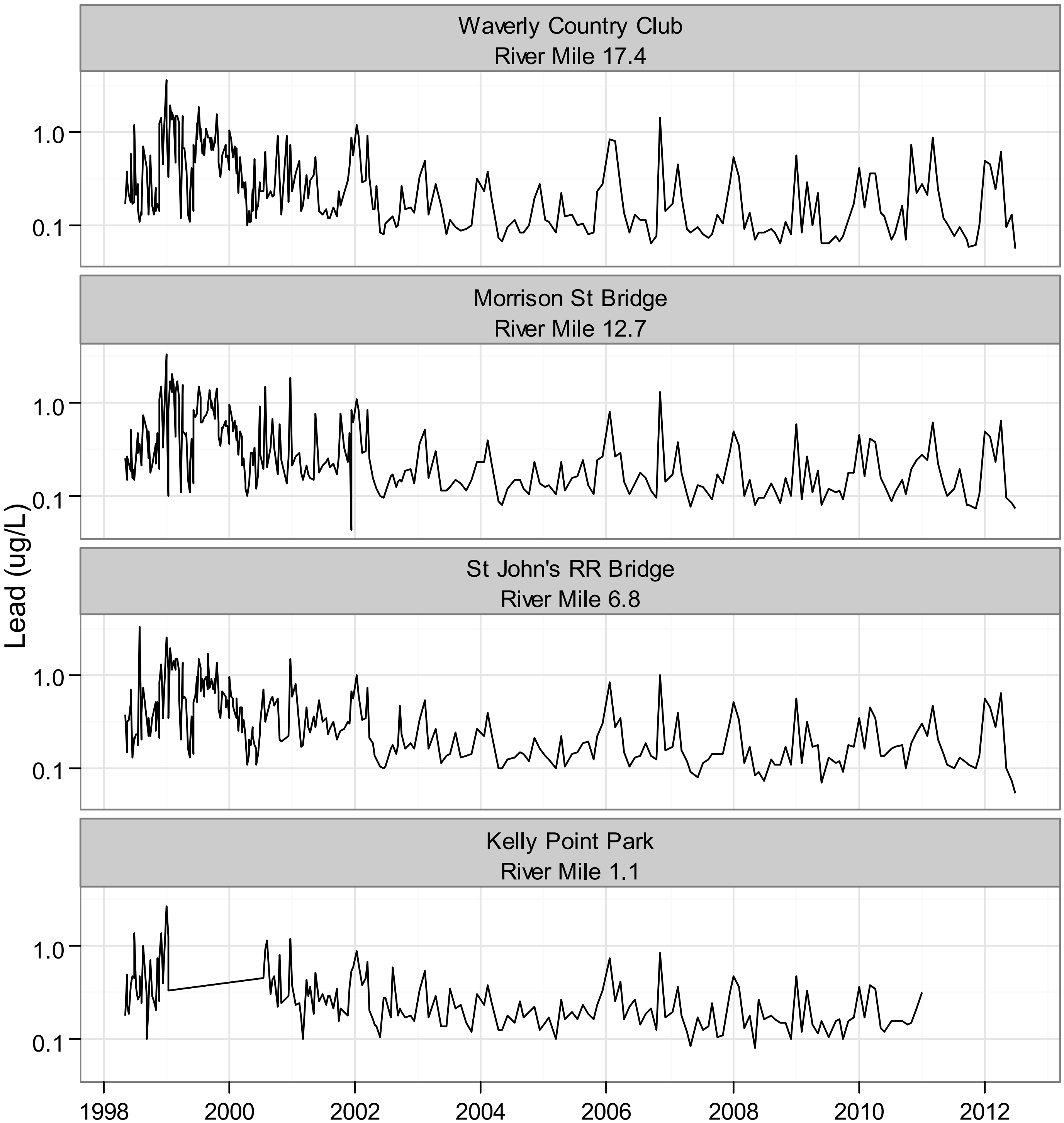


Figure 8-4: Willamette River Monitoring Results for Copper: Pre & Post Ultra-Clean Change

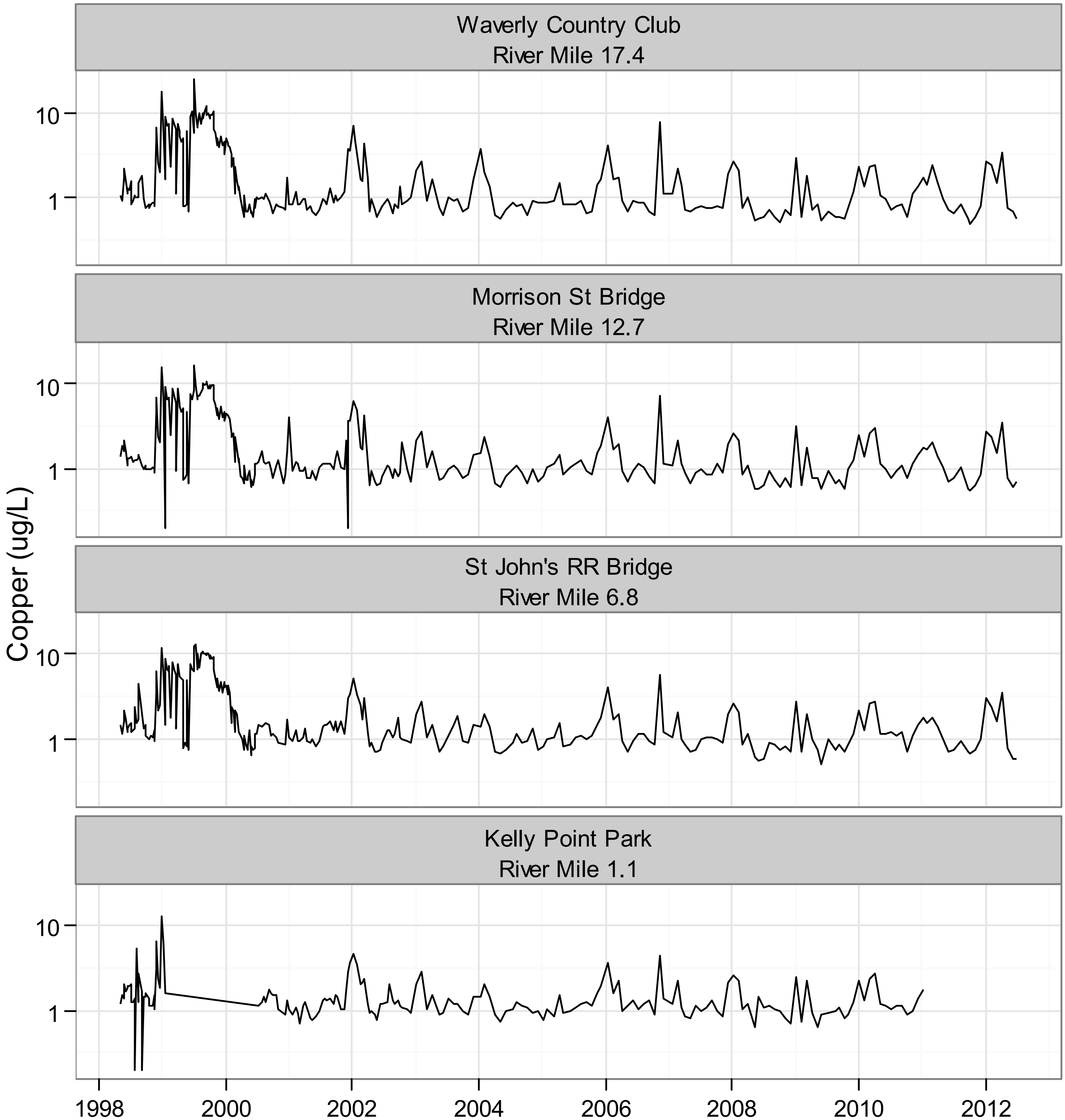
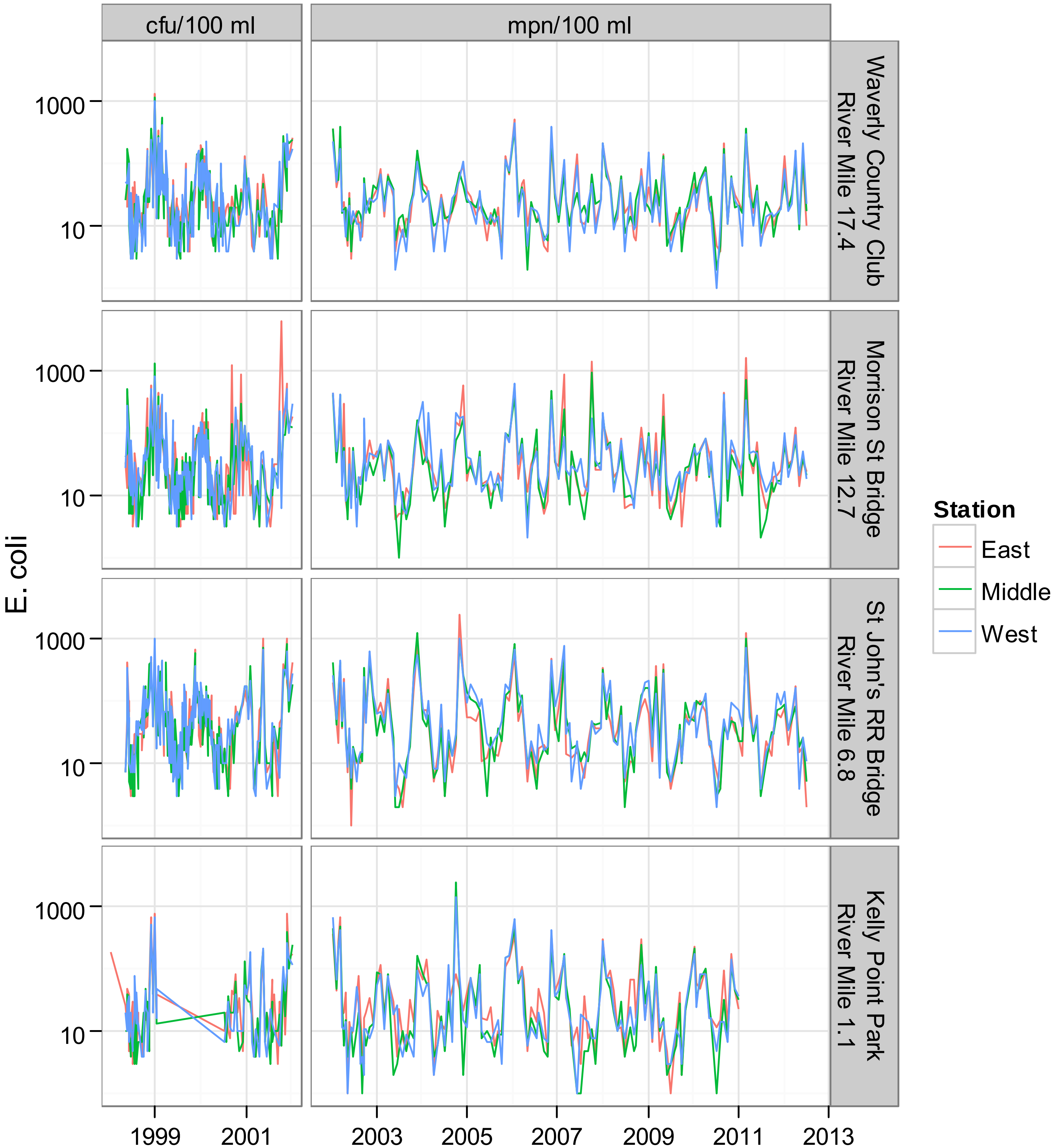


Figure 8-5: Willamette River Monitoring Results for E-Coli



8.4 Columbia River Instream Water Quality Sampling

Portland also has been monitoring the Columbia River water quality upstream and downstream of Outfall 001 & 003 to assess impacts of increased treated CSO effluent to the river. The first sets of results were reported to DEQ in the December 2009 No Feasible Alternative Analysis report to demonstrate that CSO treatment systems at CBWTP meet water quality standards and are protective of beneficial uses.

The main parameters of interest related to CSO treatment and the Columbia River are E. coli, TSS, copper, lead and zinc. The results of a comparison of measurements from upstream of the combined mixing zone versus downstream of the mixing zone (measuring impact of the effluent on the water quality) are provided in Figures 8-6 through 8-10 below. In addition to sampling data, the chart shows the relevant numeric water quality standard for each parameter. For the metals, the range of chronic WQS values is based on the measured total hardness of the river, which varies from a low of 45 to a high of 78; the chart shows the reasonable range of chronic standards based on the hardness values measured in the river during that sampling period.

As can be seen in the charts below, all parameters are well below the numeric water quality standards. In general, apart from noise in the data, there is little difference in the values from upstream to downstream of the Outfalls 001 and 003 combined mixing zone.

8.5 Field Study for Outfall 001 Mixing Zone

The NPDES Permit (Schedule D - Special Conditions) required the City to submit a plan for a field study to validate the Outfall 001 modeled dispersion, mixing and dilution characteristics under critical flow conditions. This plan was submitted to DEQ on December 30, 2011, and later approved. The City is now conducting field investigations to evaluate the condition of Outfall 001 and its diffuser system. The next step in carrying out the study is to release a request for proposal (RFP) for professional services to carry out the study, which is due to be completed and submitted to DEQ by January 1, 2014. The objectives of the study are to provide:

- Site-specific field measurements of the dilution performance of the CBWTP Outfall 001 under critical low river flow conditions on the lower Columbia River
- Accurate field measurements of receiving water characteristics and dilutions that will be used to calibrate the dilution model
- Direct measurements of the plume mixing and location
- Dilution modeling results for a range of seasonal discharge and tidal-influenced conditions
- Assessment of discharge compliance with water quality temperature standards

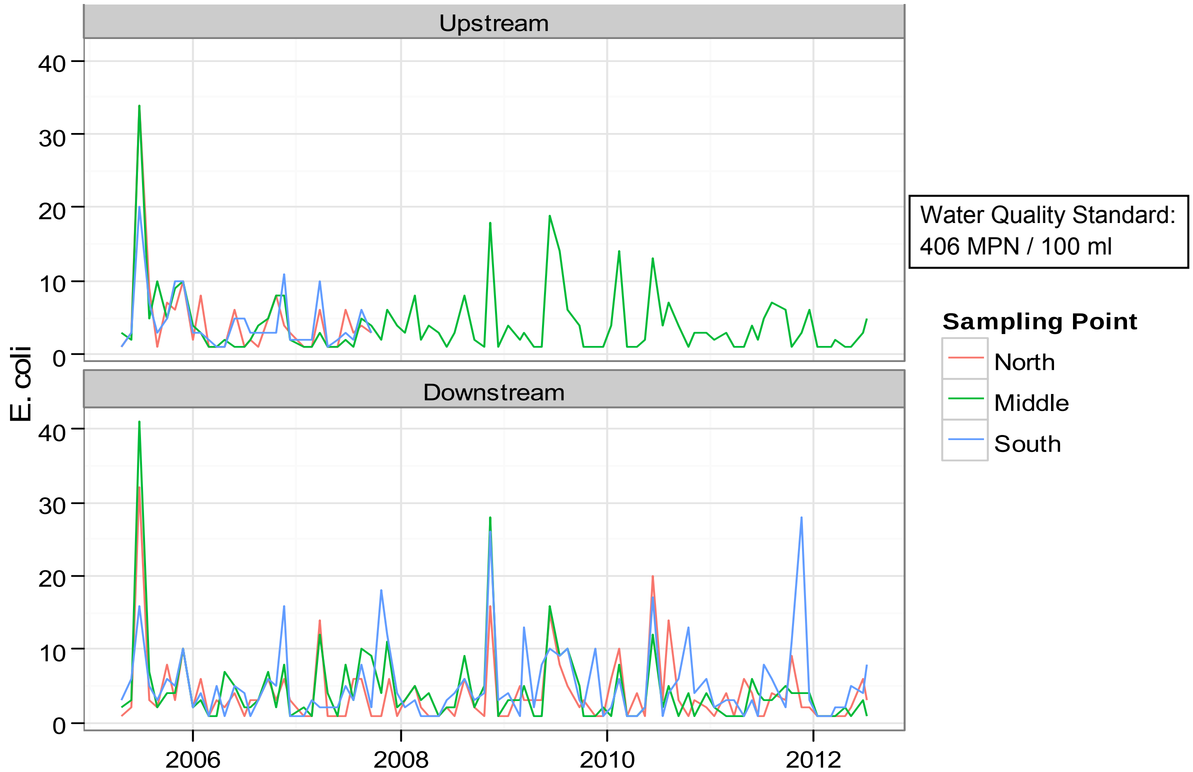


Figure 8-6: Columbia River Mixing Zone Sampling for E. Coli

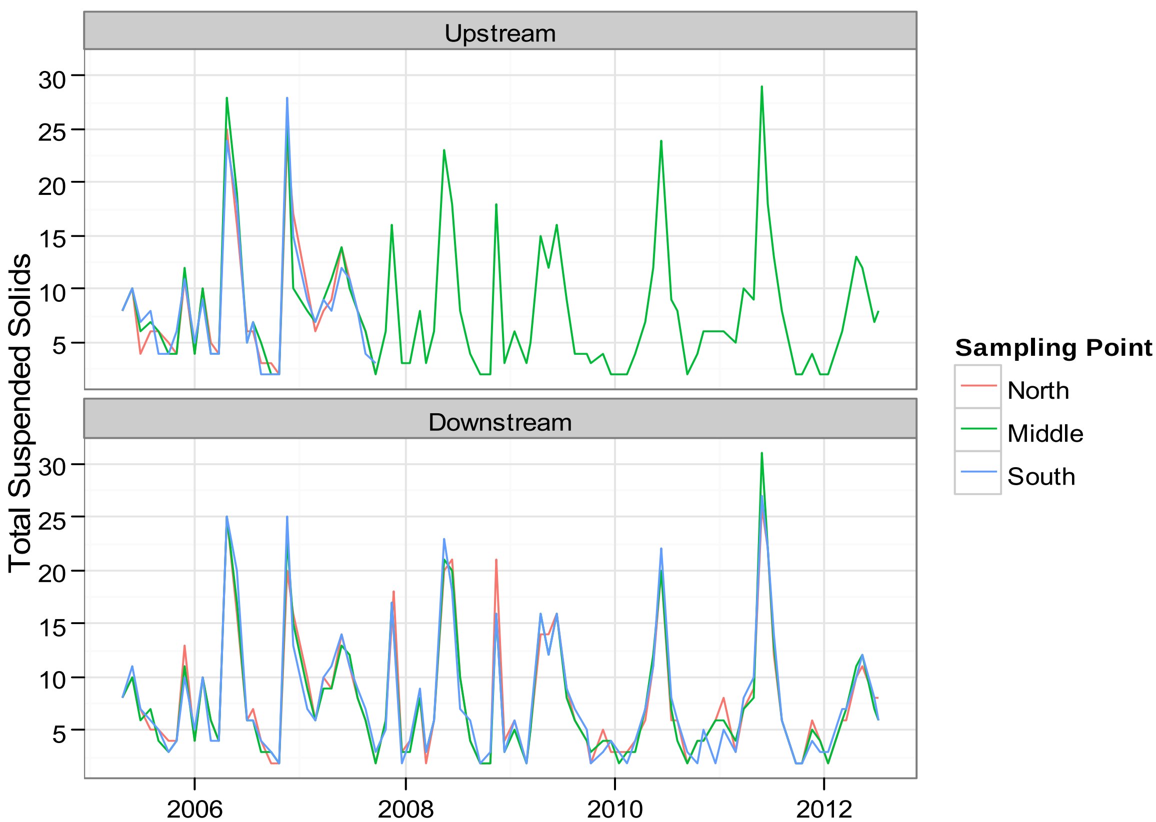


Figure 8-7: Columbia River Mixing Zone Sampling for TSS

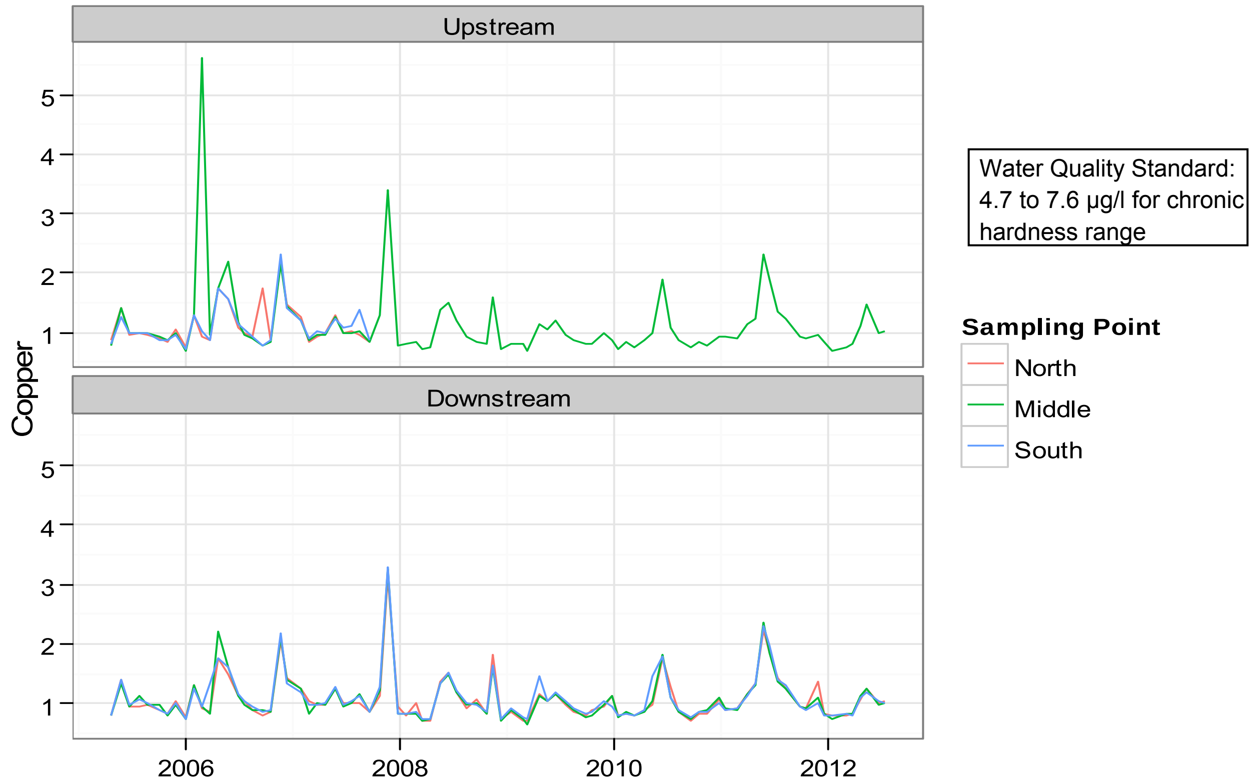


Figure 8-8: Columbia River Mixing Zone Sampling for Copper

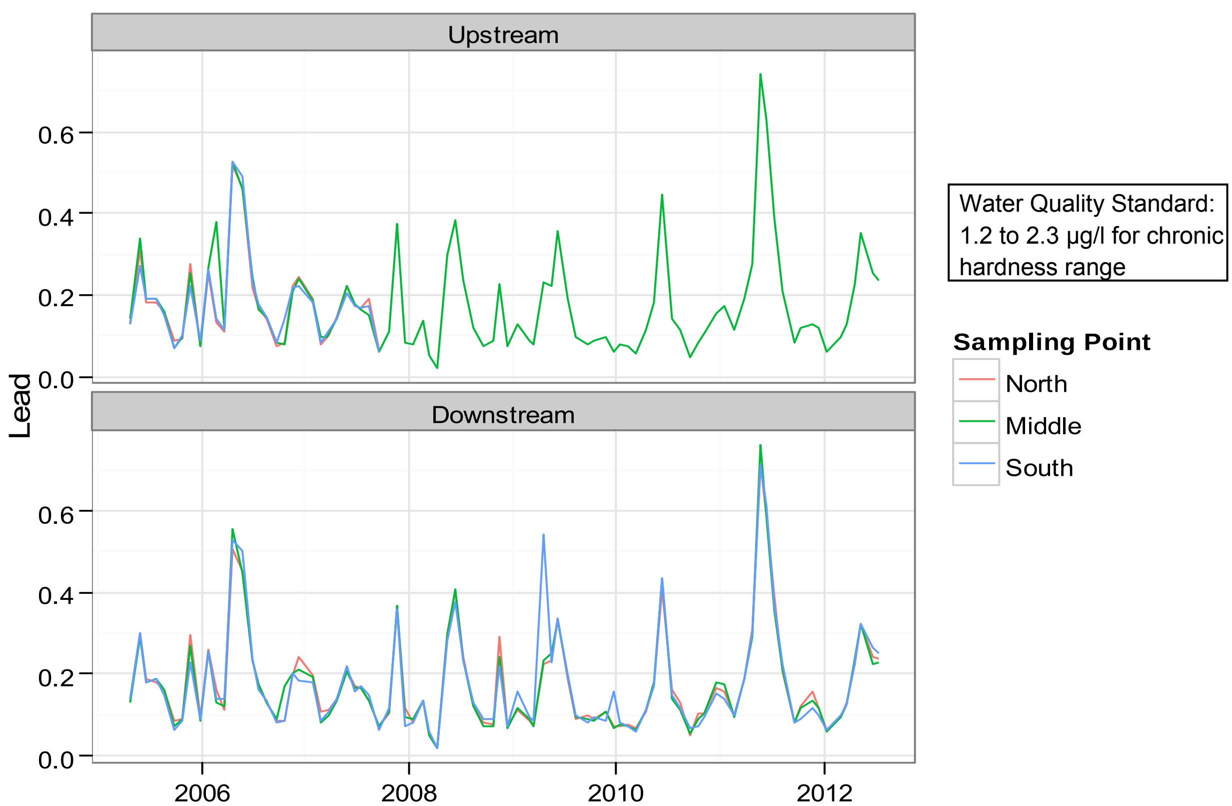


Figure 8-9: Columbia River Mixing Zone Sampling for Lead

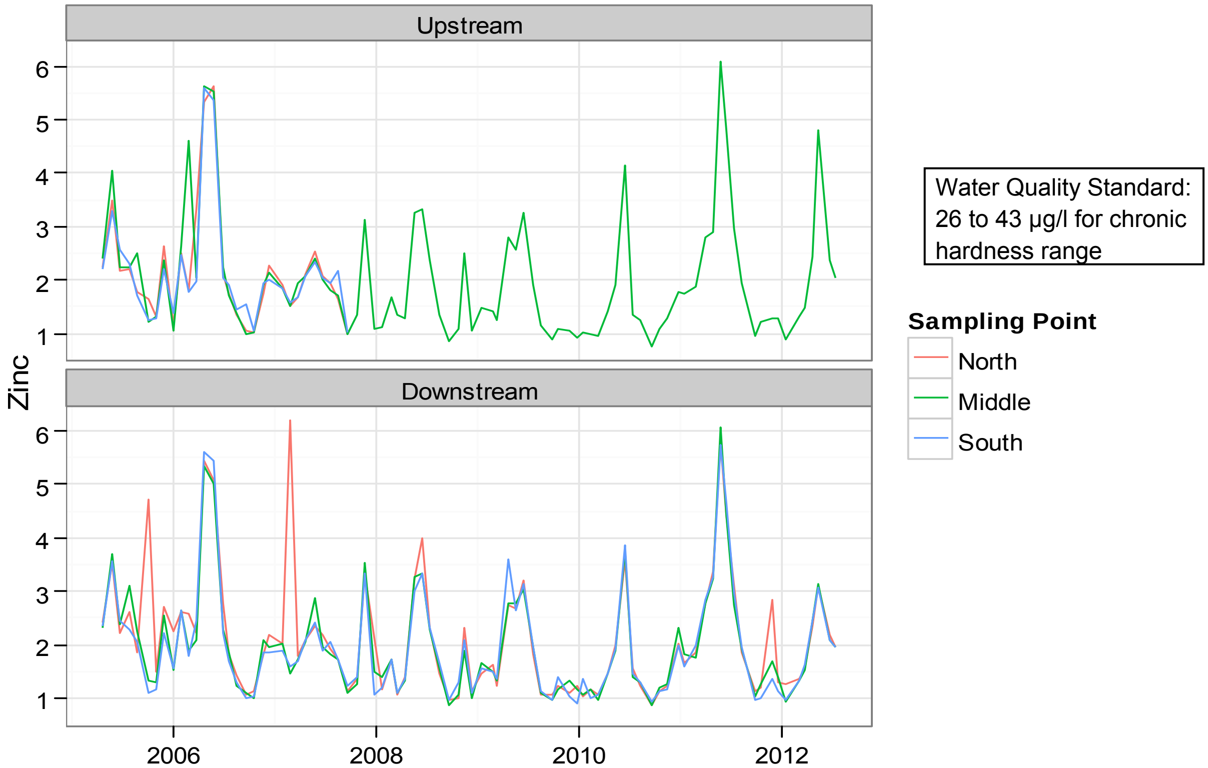


Figure 8-10: Columbia River Mixing Zone Sampling for Zinc

ATTACHMENT #1

Detailed CSO Overflow Record Since December 2006

Portland CSO: Detailed Record of CSO Events: December 2006 - 2012

				Storm Characteristics				System Totals		West-Side Totals		Ankeny PS OF09			Nicolai Shaft OF15			Sheridan OF07			Riverside OF47			Carolina OF0	
Count	Year	Dates of Storm / Overflow Events	*Description*	*6-Hour Rainfall (inches)*	*12-Hour Rainfall (inches)*	*24-Hour Rainfall (inches)*	*48-hour Rainfall (inches)*	Overflow (MG)	Duration (hrs)	Overflow (MG)	Duration (hrs)	Overflow (MG)	Duration (hrs)	Peak Rate (MGD)	Overflow (MG)	Duration (hrs)	Peak Rate (MGD)	Overflow (MG)	Duration (hrs)	Peak Rate (MGD)	Overflow (MG)	Duration (hrs)	Peak Rate (MGD)	Overflow (MG)	Duration (hrs)
1	2006	December 14-15, 2006	25% larger than ASFO	0.81	1.10	1.45	1.97	66.9	24.0	66.9	24.0	34.6	24.0	132	15.9	24.0	72	7.6	24.0	43	8.7	24.0	40		
2	2007	January 3, 2007	25% larger than ASFO	0.70	1.05	1.57	1.94	5.2	4.4	5.2	4.4	5.2	4.4	127											
3	2007	December 2-3, 2007	>10-year Winter Storm	0.97	1.76	3.09	4.61	154.5	26.9	154.5	26.9	99.1	26.9	145	23.5	20.5	93	20.5	20.5	83	11.2	20.5	48	0.1	4.9
4	2008	November 12, 2008	23% larger than ASFO	0.78	1.03	1.42	1.8	8.1	4.1	8.1	4.1	8.1	4.1	121											
5	2009	January 1-2, 2009	> 5-year, 24-hour Winter Storm	1.12	1.53	2.73	3.1	122.6	21.6	122.6	21.6	73.2	21.6	110	17.6	15.8	92	21.6	18.3	139	9.9	15.8	68	0.4	3.6
6	2009	May 4, 2009	1-in-3 year Summer	0.94	1.10	1.41		5.3	1.1	5.3	1.1	3.5	1.1	119	0.7	0.5	60	0.6	0.5	102	0.4	0.5	33		
7	2009	November 7, 2009	30% larger than ASFO	0.93	1.22	1.51		9.6	3.0	9.6	3.0	8.8	3.0	110	0.4	0.7	29	0.1	0.5	13	0.2	0.7	16		
8	2010	June 6, 2010	26% larger than 1-in-3 year Summer	1.07	1.25	1.43	2.10	26.0	3.1	26.0	3.1	20.5	3.1	258	2.6	1.8	65	1.3	1.7	47	1.5	1.8	36	0.1	0.3
9	2010	November 17, 2010	> 1-year, 6-hour Winter Storm	1.03	1.56	1.77	2.24	11.5	5.6	11.5	5.6	11.2	5.6	101	0.19	0.8	9	0.06	0.7	4	0	0.0	0		
10	2010	December 9-11, 2010	> 5 year, 6-hour Winter Storm	1.43	1.52	2.34	2.88	41.8	8.9	41.8	8.9	21.6	8.9	181	8.65	2.8	228	9.12	3.2	229	2.45	1.5	104		
11	2010	December 28, 2010	2-per Winter Storm	0.57	0.89	1.58	2.28	6.9	5.5	6.9	5.5	6.9	5.5	82											
12	2011	January 16, 2011	2-per Winter Storm	0.94	1.21	2.13	2.36	26.3	8.9	26.3	8.9	21.3	8.9	118	2.57	2.9	47	2.22	4.1	41	0.2	0.3	32		
13	2011	February 28 - March 1,	5-year, 48-hour Winter Storm	1.15	1.70	2.41	3.29	76.0	28.3	76.0	28.3	66.7	28.3	129	5.29	5.8	82	3.68	5.9	67	0.36	1.1	20		
14	2011	November 21-23, 2011	> 5-year, 6-hour Winter Storm	1.44	1.66	2.24	2.82	115.0	6.3	41.6	6.3	23.4	6.3	189	11.36	4.8	172	6.81	4.8	103	0.03	1.5	3		
15	2012	January 17-21, 2012	> 5-year 12-hour Winter Storm	1.48	2.15	2.32	3.77	304.9	10.3	86.4	10.3	19.2	9.9	98	32.95	10.0	179	33.15	10.3	209	0.66	4.8	9	0.47	4.0
16	2012	May 26, 2012	> 100-year, 30-minute storm (.85" in 30-min)					14.9	0.8	0.0	0.0														
	Average Overflow Statistics per Event			***1.02***	***1.38***	***1.96***	***2.70***	***62.2***	***10.2***	***43.0***	***10.1***	***28.2***	***10.8***	***135***	***10***	***7.5***	***94***	***9***	***7.9***	***90***	***3***	***6.0***	***34***	***0***	***3.2***

Portland CSO: Detailed Record of CSO

				)3	East-Side Totals		Beech OF46			Wheeler-River OF43			Alder OF36			Taggart OF30			Other WillRiver OFs			Columbia Slough OFs		
Count	Year	Dates of Storm / Overflow Events	*Description*	Peak Rate (MGD)	Overflow (MG)	Duration (hrs)	Overflow (MG)	Duration (hrs)	Peak Rate (MGD)	Overflow (MG)	Duration (hrs)	Peak Rate (MGD)	Overflow (MG)	Duration (hrs)	Peak Rate (MGD)	Overflow (MG)	Duration (hrs)	Peak Rate (MGD)	Overflow (MG)	Duration (hrs)	Peak Rate (MGD)	Overflow (MG)	Duration (hrs)	Peak Rate (MGD)
1	2006	December 14-15, 2006	25% larger than ASFO																					
2	2007	January 3, 2007	25% larger than ASFO																					
3	2007	December 2-3, 2007	>10-year Winter Storm	1																				
4	2008	November 12, 2008	23% larger than ASFO																					
5	2009	January 1-2, 2009	> 5-year, 24-hour Winter Storm	7																				
6	2009	May 4, 2009	1-in-3 year Summer																					
7	2009	November 7, 2009	30% larger than ASFO																					
8	2010	June 6, 2010	26% larger than 1-in-3 year Summer	19																				
9	2010	November 17, 2010	> 1-year, 6-hour Winter Storm																					
10	2010	December 9-11, 2010	> 5 year, 6-hour Winter Storm																					
11	2010	December 28, 2010	2-per Winter Storm																					
12	2011	January 16, 2011	2-per Winter Storm																					
13	2011	February 28 - March 1,	5-year, 48-hour Winter Storm																					
14	2011	November 21-23, 2011	> 5-year, 6-hour Winter Storm		73.4	4.8	8.6	4.3	127	12.57	4.3	159	20.87	4.5	256	31.32	4.8	375						
15	2012	January 17-21, 2012	> 5-year 12-hour Winter Storm	9	218.5	10.3	24.8	9.7	119	34.96	10.0	163	62.18	10.3	292	96.63	10.3	466						
																			St Johns B OF52 & OF 53			Oswego OF55		
16	2012	May 26, 2012	> 100-year, 30-minute storm (.85" in 30-min)		14.9	0.8							14.72	0.8	1,094				0.152	0.5	12	0.022	0.2	6
	Average Overflow Statistics per Event			*9*	*102.3*	*5.3*	*16.7*	*7.0*	*123*	*24*	*7.1*	*161*	*33*	*5.2*	*547*	*64*	*7.5*	*421*	*0*	*0.5*	*12*	*0*	*0.2*	*6*