

## Fact Sheet



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Quality

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CSO Website at:  
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# Portland Combined Sewer Overflow (CSO) Management

## Background

For many years, a large part of the City of Portland, about 30,000 acres, has been served by a combined sewer system in which sanitary sewage from homes and businesses, and stormwater from streets, roofs and driveways flow into a single set of sewer pipes. During periods of dry weather, all of the sanitary sewage is delivered by the sewer system to the Columbia Boulevard Wastewater Treatment Plant (CBWTP) for proper treatment and discharge to the Columbia River.

However, almost any time it rains, the inflow of stormwater into the combined sewers causes the capacity of the large interceptor sewers that run along the Willamette River to be exceeded, and a combination of stormwater and untreated sanitary sewage is discharged to the river. (In the past, there were similar frequent CSO discharges to Columbia Slough but these have been virtually eliminated as of December 2000.)

While CSO discharges raise several environmental concerns, the most important is the risk of contracting disease from pathogenic organisms that may be found in raw sanitary sewage. Such risk impairs the beneficial use of waters subject to CSOs for safe contact recreation.

In regulatory terms, the CSO discharges result in violation of the Water Quality Standards established by the Environmental Quality Commission (EQC) for bacteria, floatables and solids, and other pollutants. The Wastewater Discharge Permit issued to Portland by DEQ for the CBWTP expressly prohibits violation of Water Quality Standards by the CSO discharges.

To address these violations, the EQC and Portland entered into a mutually agreed upon enforcement order called a Stipulation

and Final Order (SFO) in August of 1991. The SFO was amended in August 1994.

The Amended Stipulation and Final Order (ASFO) requires that the frequency of CSOs to the Willamette River be drastically reduced by the year 2011. A detailed compliance schedule of implementation milestones is set forth, with stipulated penalties identified for failure to meet the schedule or to attain the level of CSO control required.

## Portland complies with CSO Order

The City of Portland has thus far met all CSO compliance schedule milestones set forth in the original and amended versions of the Order.

The City has made substantial progress constructing the stormwater inflow reduction facilities that are intended to reduce combined sewage volume. These "Cornerstone Projects" include stormwater infiltration sumps, down spout disconnections, sewer separations and stream diversions.

Construction of the major CSO control facilities for the Columbia Slough sewer basins--the "Columbia Slough Big Pipe" and appurtenances-- was completed at the end of 2000. Overflows to the Slough will now occur only with the largest storms, averaging about three overflow events per decade.

Construction of the massive CSO control facilities for the west side Willamette River sewer basins--the "West Side Big Pipe"-- was completed in December 2006. Swan Island Pump Station, Phase 1, necessary to convey the west side combined flows, is completed in 2006.

Construction of the even larger CSO control facilities for the east side Willamette River sewer basins began in May 2006. Swan Island Pump Station Phase 2, which will convey the combined flows of the east and west side "Big Pipes" is currently under

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construction and on track for completion in 2011.

## **EQC--Portland CSO chronology**

### August 1991

The EQC and the City execute original SFO to address permit violations caused by CSOs. SFO requires that CSO discharges to Columbia Slough and Willamette River be controlled except when 10 year return summer storm/5 year return winter storm or larger occur. Development of CSO Management Plan is required.

### June 1993

Draft Management Plan is completed. It analyzes facilities and costs needed to meet level of CSO control specified in SFO, and other more and less stringent levels of control for the Willamette River discharges.

### November 1993-March 1994

The non-decision making "Collaborative Process" Committee ( 2 EQC members, 2 City Council members, DEQ Director, a Portland Bureau of Environmental Services senior manager) hold a series of well-attended public meetings to evaluate options identified in the Draft Management Plan. Committee recommends to EQC and City Council that a less stringent level of CSO control than specified in the SFO be adopted for Willamette discharges, but that Columbia Slough control requirement remain as in SFO.

### June-August 1994

EQC and Council concur in Collaborative Process Committee recommendation and execute ASFO. CSO control requirement for Willamette is set at 3 year return summer storm and 4-in-year winter storm because it is the most "cost effective" level of control. This reduces estimated overall CSO control program cost from about \$1billion to about \$700million (in 1993 dollars).

### December 1994

City completes Final CSO Management Plan, which elaborates on facilities needed to meet ASFO. EQC approves "Schedule and Control Strategy" set forth in Final Plan in April 1995.

### January 1996

EQC adopts new "Bacteria Rule" Water Quality Standard which establishes 10 year summer/5 year winter storm prohibition of raw sewage discharges as regulatory standard, but allows EQC to approve less stringent standard for individual CSO systems. DEQ considers prior EQC concurrence in ASFO and Final Management Plan to constitute such approval for Portland's CSOs to Willamette.

### 1995-2007

Ongoing "Cornerstone Projects" (sewer separations, storm water sumps, down spout disconnections, stream diversions, sewer system inline storage optimization) make significant progress to remove storm water from combined sewer system and reduce volume of CSO discharges.

### March 1998

NWEA and City settle 1991 citizen lawsuit on CSOs. Terms of settlement include commitment by City to implement ASFO and plaintiffs standing to seek relief from court for City's failure to comply with ASFO schedule.

### 2000-2001

Columbia Slough CSO control facilities completed December 2000. Seven CSO discharge points on the Willamette eliminated by December 2001

### December 2001

City prepares CSO Management Plan Update pertaining to configuration of Willamette sewer basins control facilities.

### 2001-2010

Construction of major west side Willamette control facilities begun in 2001 with completion in 2006. Construction of major east side control facilities begun with completion by 2011.

## **Alternative Formats**

*Alternative formats of this document can be made available. Contact DEQ Public Affairs for more information (503) 229-5696.*





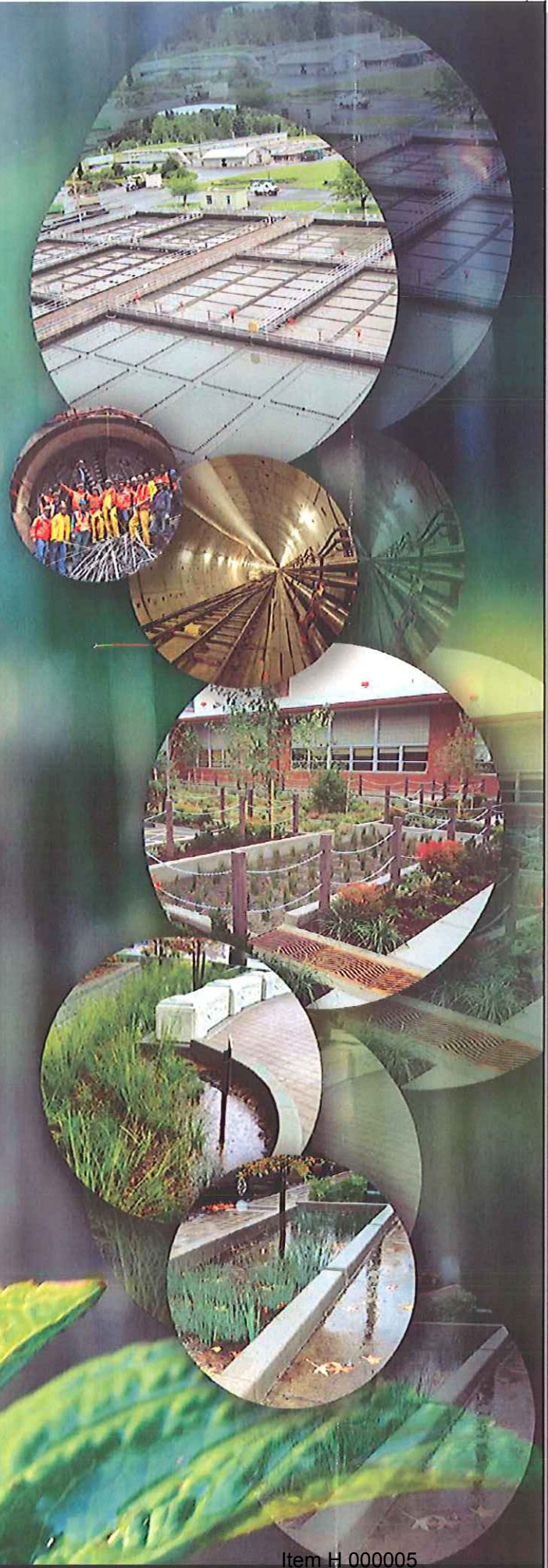
# Post-2011 Combined Sewer Overflow Facilities Plan

SEPTEMBER 2010

## EQC Executive Summary



ENVIRONMENTAL SERVICES  
CITY OF PORTLAND  
working for clean rivers







## EQC Executive Summary

### Introduction

In 1994, the City of Portland and the Environmental Quality Commission (EQC) agreed to an Amended Stipulation and Final Order (ASFO) that required the city to reduce annual combined sewer overflow (CSO) volume to the Willamette River and Columbia Slough by 96%. In December 2011, the city will complete its CSO control program and fulfill the terms of the ASFO.

The ASFO required the Bureau of Environmental Services to develop a facilities plan that outlines city projects to further reduce CSO volume after 2011. The city submitted the post-2011 CSO facilities plan to the Oregon Department of Environmental Quality (DEQ) on September 1, 2010. The plan is subject to EQC approval. The facilities plan outlines future sewer system improvements and expansion of the city's green stormwater management infrastructure. Managing stormwater at its source keeps runoff out of the combined sewer system to reduce CSOs, relieves sewer capacity problems, replenishes groundwater, protects water quality and enhances watershed health.



**Portland's East Side CSO Tunnel During Construction**

### Further Willamette River CSO Reductions

The ASFO requires the city to reduce CSO volume to the Willamette River by 94% and CSO events on the river from about 50 per year to an average of four per winter and one every three summers. The ASFO requires a more than 99% level of control on the Columbia Slough because the slough is a much smaller and more sensitive waterway. When completed in December 2011, the CSO control system will meet applicable water quality standards and the Willamette TMDL for bacteria.

The ASFO requires the city to determine cost-effective methods to achieve more Willamette River CSO reductions after 2011. Sewer system modeling indicates that green stormwater infrastructure improvements can eventually reduce CSOs to the Willamette to an average of two per winter.

### CSO Control Milestones

Environmental Services began work on its CSO control program in 1993 by implementing the Cornerstone Projects to remove stormwater flow from the combined sewer system. Cornerstone Projects included sewer separation in key neighborhoods, diverting streams from combined sewer pipes, installing sumps and sedimentation manholes to collect stormwater runoff, and disconnecting residential downspouts from combined sewers.

Larger CSO construction projects followed the Cornerstone Projects. CSO control projects include the 12-foot diameter Columbia Slough Consolidation Conduit, completed in 2000; the Southwest Parallel Interceptor, the 14-foot diameter West Side CSO Tunnel and the Swan Island CSO Pump Station, completed in 2006; and the 22 foot diameter East Side CSO Tunnel, which will be completed in 2011.

### Future Conditions

Environmental Services estimates that future development will add 600 acres of impervious area to the city by 2050, which would generate an additional 22.4-million gallons of stormwater runoff during a three-year summer storm. Constructing green stormwater management facilities, such as swales, green streets and rain gardens, will allow the city to keep pace with community growth and sustain CSO reductions.

### Recommended Projects

To establish a comprehensive framework for future CSO reductions, Environmental Services has developed a suite of methods to control stormwater inflow from impervious surfaces as circumstances dictate. Following an adaptive management approach will provide Environmental Services the flexibility to cost-effectively address evolving regulatory requirements, community values, and economic constraints. Methods include specific recommended projects and activities:

- Combined Sewer System Plan Projects that incorporate maintenance and rehabilitation activities along with green infrastructure stormwater controls to address structural and



SW 12<sup>th</sup> Avenue Green Street



capacity problems that cause local street flooding and basement sewer backup risk. (The Tabor to the River program is an example collection of these types of projects.)

- Projects that manage impervious areas from commercial, educational and religious institutional properties in the East Willamette basins by directing stormwater runoff to vegetated infiltration facilities.
- Evaluation and possibly modification of designs and implementation of the Stormwater Management Manual (SWMM) for increased volume control effectiveness

### Example Project: Tabor to the River

This innovative program combines stormwater management techniques with sewer repairs and improvements to solve a variety of urban challenges. It integrates pipe repairs with over 500 hundred green streets as well as tree planting projects to improve sewer system reliability, control sewer backups, reduce CSOs to the Willamette River, and improve watershed health.

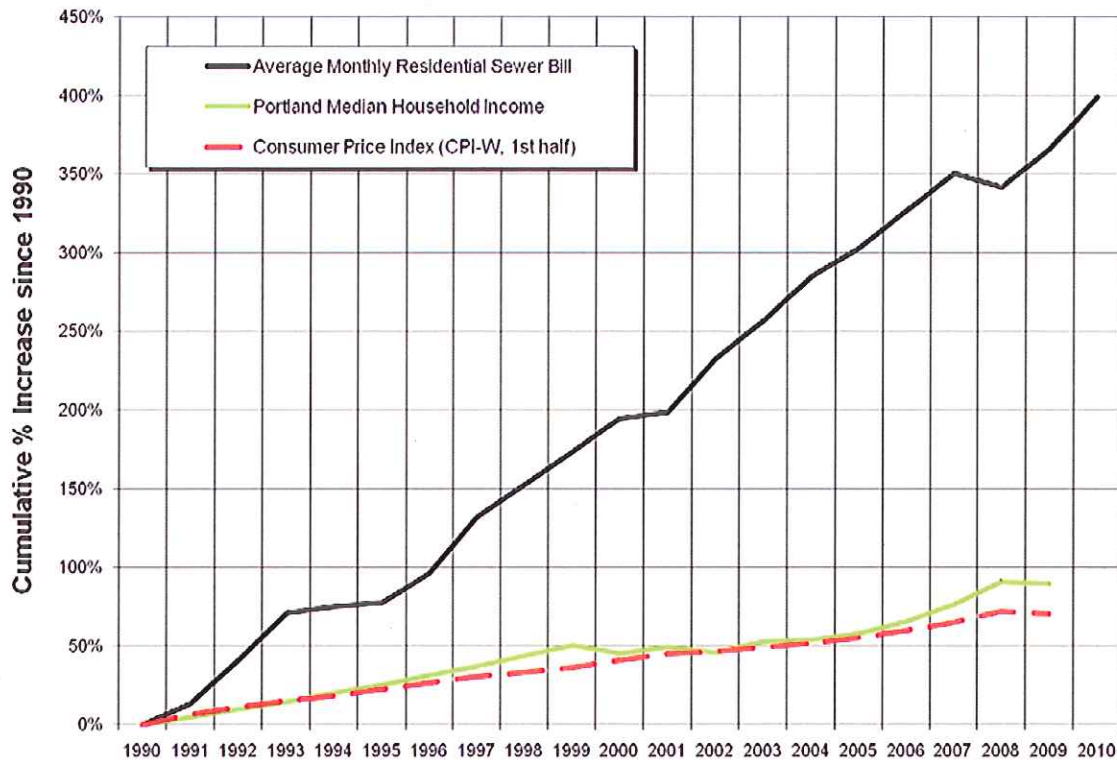


Tabor to the River Project Areas

### Financial Planning

Environmental Services is well positioned to financially manage future sewer and water quality programs. Sewer fees, system development charges and bond sales finance bureau operations, maintenance and capital projects. The bureau's reliance on revenue bond financing for capital expenditures will gradually decrease over the next 15 years.

Environmental Services has consistently raised sewer rates to pay for CSO control projects and other capital improvement program (CIP) investments since 1990. The current financial model requires the city to continue raising rates to retire the substantial debt incurred to finance the CSO program.



**Portland's Average Monthly Residential Sewer Rates Since 1990**

By 2016, the city estimates that 30% of Portland households will exceed the 2.0% EPA affordability guideline for sewer rates. According to EPA's Financial Capability Assessments, that would place the financial burden on Portland sewer ratepayers in the upper range of a "Medium Burden."

### Monitoring and Reporting

Environmental Services developed and submitted a draft *Post-Construction Monitoring Program* to DEQ and EPA Region X in July 2008. The report outlines CSO monitoring and sampling activities the bureau will implement to ensure that the CSO program complies with the conditions of the city's NPDES permit, and to track the performance of the CSO system.

### Public Information and Involvement

Since the CSO control program began, Environmental Services has worked to raise public awareness of CSO issues and alert the public when CSO events occur. In the future, the bureau will implement public involvement activities for specific projects as the city integrates combined sewer service improvements with sustainable stormwater management projects. Environmental Services will continue public notification of future CSO events.



## Summary of BES Presentation to EQC on: Progress for Controlling Portland Combined Sewer Overflows

EQC Meeting Date: December 9-10, 2010

### Presenters

- Dean Marriott, BES Director
- Paul Gribbon, Chief Engineer for Willamette River CSO Program
- Virgil Adderley, CSO Program Manager

### Purpose of Presentation

The Amended Stipulated Final Order (ASFO) requires the City of Portland to “report to the Commission in a public forum its progress for CSO reductions” that meet the specified levels of combined sewer overflow (CSO) control as well as working to achieve higher levels of control through other activities. This presentation will cover the work completed as of December 2010 in meeting and exceeding the ASFO requirements for the Columbia Slough and the Willamette River. We will also present the work underway to complete the control facilities for the East Side Willamette CSO discharges by 2011. Finally, we will present the post-2011 CSO Facilities Plan for activities to further reduce CSO discharges beyond the level required in the ASFO.

### Status of Portland's CSO Program

We are within one year of completing the 20-Year CSO control program begun in 1991. By December 2011, we will control CSO discharges by more than 96% from the original 6 billion gallons/year in 1990

- **Columbia Slough CSO - 13 Outfalls Controlled:** ASFO requires CSO discharges to be eliminated for all storms smaller than a ten-year summer storm and a five-year winter storm by December 2000. This resulted in a 99% annual CSO volume reduction in the Columbia Slough.
  - *13 CSO outfalls controlled as of December 2000*
- **Willamette River CSO - 42 Outfalls Controlled:** ASFO requires CSO discharges to be eliminated for all storms smaller than a three-year summer storm and a four-per-winter storm by December 2011. This will result in a 94% annual CSO volume reduction in the Willamette River.
  - *7 CSO outfalls controlled as of December 2001*
  - *16 CSO outfalls controlled as of December 2006*
  - *19 remaining CSO outfalls in process to be controlled by December 2011*

*The CSO Program has achieved 99% CSO reduction in the Columbia Slough, while today the Willamette River CSO has been reduced by 58% for a current citywide reduction of 66%.*

When completed, Portland will have invested about \$1.4 billion over the span of the 20-year Program.

## **Cornerstone Projects – Initial Green Infrastructure**

The Cornerstone Projects were a set of cost-effective actions that reduced CSO by treating stormwater as a resource to be returned to the watershed via infiltration and kept out of the combined sewer system. Removing stormwater from the combined system also reduced the amount of combined sewage and allowed construction of smaller, less expensive pipes and treatment facilities that helped hold down total program costs. To date, the Cornerstone Projects have removed about 2.2 billion gallons of stormwater annually from the combined sewer system at a cost of approximately \$145 million.

There are four categories of Cornerstone Projects designed to address stormwater at the source – Sewer Separation, Stormwater Sumps, Roof Downspout Disconnection, and Stream Diversion. These projects helped with two major challenges in Portland's combined sewer system – they reduced CSO and significantly reduced basement backups.

### **1. Sewer Separation**

In specific Portland neighborhoods, Environmental Services installed new pipes to separate stormwater from sewage and remove stormwater runoff from the combined sewer system. Sewer separation projects are complete in the designated areas of west, north and southeast Portland.

### **2. Stormwater Sump Installation**

Environmental Services has installed sedimentation manholes with infiltration sumps in North/Northeast Portland to collect, treat, and infiltrate stormwater runoff into the ground. More than 2,800 sumps have been installed in areas served by combined sewers. Sump installation projects were substantially completed by the end of 2001.

### **3. Downspout Disconnection**

The Downspout Disconnection Program works with residents of Portland's combined area neighborhoods to disconnect their downspouts from the sewer system and allow their roof water to drain to their gardens and lawns. Over 55,000 residential downspouts have been disconnected through the Program, removing more than 1.2 billion gallons of stormwater per year from the combined sewer system.



### **4. Stream Diversion**

Environmental Services has built new pipelines to divert the large Tanner Creek stream system from the combined sewer. This creek was piped into the sewer system decades ago. Today, this relatively clean source of water has been removed from the combined sewer system and released to the Willamette River.

## **Completed Columbia Slough Projects**

Environmental Services completed a series of projects in north Portland to reduce combined sewer overflows to the Columbia Slough by more than 99 percent as of December 2000. The projects included the Cornerstone Projects described earlier and the Columbia Slough CSO Facilities. The Cornerstone Projects completed in the Columbia Slough consisted of sumps, downspout disconnection and sewer separation in the St Johns, Oswego and Oregonian basins. The stormwater separated from the combined system is treated at the Ramsey Lake wetland that was constructed specifically to treat runoff from these Columbia Slough basins.

The second phase of the Columbia Slough projects created large scale CSO facilities including the 6 to 12-foot diameter Columbia Slough Consolidation Conduit (CSCC) and the Columbia Boulevard Treatment Plant (CBWTP) Additions. These projects included a 105 MGD Influent Pump Station, new and refurbished primary clarifiers, and a new 72-inch outfall line and dechlorination facility. All these facilities were constructed and placed in service by December 2000. The total cost of the Columbia Slough CSO Facilities was \$160 million.



## **Willamette River Projects**

Environmental Services is completing the last of the projects in the Willamette basin designed to control the remaining CSO outfalls by December 1, 2011 as required by the ASFO. The large Willamette River CSO Projects controlled the CSO outfalls on the Willamette by the Year 2011 in two phases. The first phase controlled 16 outfalls (mostly on the west side of the Willamette) by December 2006. The second phase, nearly complete, will control the remaining CSO outfalls on the east side by December 1, 2011.

To meet the December 2006 ASFO milestone, Portland constructed the first phase of the large Willamette CSO facilities, consisting of a 3.5-mile long, 14-foot diameter tunnel, a large 100 MGD pump station on Swan Island, and additional Columbia Boulevard treatment facilities to capture, transport and treat the west side Willamette CSO flows. These facilities were all constructed and operational by December 1, 2006. That same year, construction began on the larger east side Willamette CSO facilities. The east side facilities include a 6-mile long, deep 22-foot diameter tunnel, an expansion to the Swan Island CSO Pump Station from 100 to 220 MGD, a new 3-mile long 66-inch diameter forcemain, a Sellwood CSO storage & pump station, and additional treatment facilities at Columbia Boulevard. Control of the Balch CSO outfall on the west side of the river will be completed by a large consolidation conduit connecting to the West Side tunnel by the December 2011 deadline. All CSO construction is on schedule for completion by 2011. Once these facilities are operational, the CSO volume discharged to the Willamette River will have been reduced by 94% and overflow events will occur less than once in three years during the summer and four times per year during the winter.

### **West Side CSO Facilities (all operational by December 1, 2006)**

#### **Southwest Parallel Interceptor**

The Southwest Parallel Interceptor (SWPI) is a 15,000 foot pipeline three to six feet in diameter that runs parallel to the river and collects wastewater and CSO flows from the southwest area of the combined system. The original interceptor pipe, built in the 1950's, was too small to handle both wastewater and storm flows. The new interceptor added capacity to handle existing and future combined flows from the west side of the Willamette and transports them to the Columbia Boulevard Wastewater Treatment Plant. The total cost of the Southwest Parallel Interceptor was about \$45 million.

#### **West Side CSO Tunnel**

The City constructed a large, deep tunnel pipeline from SW Clay Street, along Waterfront Park, through the northwest industrial area and under the Willamette River to carry combined sewer flows from the west side of the river to the new Swan Island CSO Pump Station. The tunnel is 18,000 feet in length, 14-feet in diameter, and approximately 120 feet underground.

#### **Swan Island CSO Pump Station**

This facility on Swan Island pumps combined sewage from the West Side CSO Tunnel through a new forcemain to an existing sewer in north Portland. This station was completed in September 2006 and currently pumps up to 100 million gallons per day (MGD) from the west side tunnel into the new Peninsular Forcemain into an existing interceptor to deliver the flows to the Columbia Boulevard Wastewater Treatment Plant. This station is currently being expanded to pump 220 MGD to drain the combined sewer flows from both the west side and the east side tunnels.

#### **Peninsular Forcemain**

This 30 and 48-inch diameter dual forcemain conveys up to 100 MGD of sewage pumped from Swan Island east to a portal that connects into the existing Peninsular Interceptor.

The cost of the West Side Tunnel, the Swan Island CSO Pump Station, and the Peninsular Forcemain was approximately \$350 million.



## **East Side CSO Facilities**

### **East Side CSO Tunnel**

This 120-foot deep, 22-foot internal diameter tunnel will collect combined sewage from southeast to northeast Portland and deliver the flows to the Swan Island CSO Pump Station. The tunnel is approximately 30,000 feet in length and, including seven shafts and associated pipelines and structures, is estimated to cost approximately \$450 million at project completion. The mining of the tunnel itself was completed in October 2010 and the connections of the outfalls, which will put the tunnel into operation, are scheduled for summer 2011.

### **Swan Island CSO Pump Station Expansion**

Three additional wet weather pumps and associated piping and control equipment are currently being added to the existing pump station to increase pumping capacity from 100 MGD to 220 MGD in anticipation of the East Side CSO Tunnel coming on-line in September 2011. With the addition of the Portsmouth Forcemain, this will provide for full operation of the east side CSO system by December 2011. The cost of this additional capacity is \$14 million.

### **Portsmouth Forcemain**

This 16,000 foot long, 66-inch diameter forcemain is being installed from the Swan Island CSO Pump Station north across Swan Island, under Waud Bluff, and then under N. Willamette Blvd to a portal which connects it to the existing Portsmouth Interceptor. Combined with the Peninsular Forcemain completed in 2006, the total CSO transport capacity from Swan Island CSO Pump Station to the Columbia Boulevard Wastewater Treatment Plant will increase to 220 MGD. The forcemain is being installed under two separate construction contracts, one predominantly an open-cut installation and the second a micro-tunnel. The total cost of both segments is approximately \$70 million.





### **Sellwood CSO Storage and Pump Station System**

Construction work is underway on these projects which will eliminate CSOs at Outfall 27. The facilities consist of upgrades of existing sewers to provide CSO conveyance, inline-storage, and an 8 MGD pump station and pressure line to control CSO during the ASFO design storms. Cost of these facilities will be approximately \$25 million.

### **Balch Consolidation Conduit**

This project will control an additional west side outfall and consists of approximately 7000 feet of 84-inch diameter pipeline to convey CSOs from the Balch drainage basin on the west side of the Willamette to the West Side CSO Tunnel through the existing Nicolai Shaft. The cost of this facility when complete will be approximately \$75 million.

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## ***Post-2011 CSO Facilities Plan to Achieve Further CSO Reductions***

BES is committed to protecting human health while improving water quality and watershed functions in the Portland area. That commitment is reflected in the implementation of the CSO Program as well as the integration of traditional engineered facilities along with sustainable stormwater projects to control CSO and protect water quality.

When completed in December 2011, Portland's CSO control system will meet applicable water quality standards as well as meet allocation limits established in the Willamette River TMDL for bacteria. The EQC, when it signed the ASFO, established a requirement for the City to examine the potential for additional cost-effective methods for achieving "further CSO reductions" in the Willamette River system beyond the level required by the ASFO. As required, the City submitted the Post-2011 CSO Facilities Plan to the Oregon Department of Environmental Quality (DEQ) on September 1, 2010. The facilities plan outlines future sewer system improvements and expansion of the city's green stormwater management infrastructure. Managing stormwater at its source keeps runoff out of the combined sewer system to reduce CSOs, relieves sewer capacity problems, replenishes groundwater, protects water quality and enhances watershed health. This facilities plan, required by the ASFO, is subject to EQC approval.

The ASFO describes "further CSO Reductions" in terms of additional volume and frequency reductions where cost-effectively possible. Cost-effectiveness is a key criterion due to the fact the level of CSO control established in the ASFO was determined from a "knee-of-the-curve" cost-effectiveness analysis.

Sewer system modeling indicates that after December 2011, Portland's CSO system will immediately achieve "further reductions" of CSO frequency beyond the level required by the ASFO. It is anticipated 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. Over the next 40 years, development pressures could cause the stormwater runoff reaching the combined system to increase and thereby reduce the "further reductions" achieved earlier. Therefore, BES developed the Post-2011 CSO Facilities Plan to implement green stormwater infrastructure improvements that can be adopted to maintain the "further CSO reductions" achieved for the Willamette River to an average of two per winter.

### **Recommended Projects**

To establish a comprehensive framework for future CSO reductions, Environmental Services has developed a suite of methods to control stormwater inflow from impervious surfaces as circumstances dictate. Following an adaptive management approach will provide Environmental Services the flexibility to cost-effectively address evolving regulatory requirements, community values, and economic constraints. Methods include specific recommended projects and activities:

- Combined Sewer System Plan Projects that incorporate maintenance and rehabilitation activities along with green infrastructure stormwater controls to address structural and capacity problems that cause local street flooding and basement sewer backup risk. (The Tabor to the River program is an example collection of these types of projects.)
- Projects that manage impervious areas from commercial, educational and religious institutional properties in the East Willamette basins by directing runoff to vegetated infiltration facilities.
- Evaluation and possibly modification of designs and implementation of the Stormwater Management Manual (SWMM) for increased volume control effectiveness

### **Adaptive Management Strategy**

Further reductions in CSO will be achieved by the 20-year CSO Program, and then sustained by the recommended projects presented above. As these projects are being implemented, additional performance monitoring data will be collected and evaluated to identify potential capacity shortfalls. Also, based on a review of the SWMM program provided in the report, greater CSO reductions may be realized than previously forecasted. As development occurs and recommended projects are implemented, the City will monitor for the following primary triggers to potential activate the appropriate long-term strategies as part of an adaptive management strategy:

- Possible Trigger 1: System performance indicates that winter CSO events are occurring due to storms more frequently than two per winter on average.
- Possible Trigger 2: Community development increases impervious area at a greater rate than anticipated. For this plan, growth is assumed to occur at an average rate of 14 impervious acres a year.
- Possible Trigger 3: Stormwater runoff volume from new impervious area managed onsite as per SWMM requirements is found to exceed expected volumes.

If potential triggers such as these occur, BES will be able to respond by implementing the next set of cost-effective recommended projects identified in the Post-2011 CSO Facilities Plan.

