DRAFT

CMOM PROGRAM REPORT

Prepared for
City of Portland, Oregon

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LIST OF ACRONYMS

AM	asset management
ASFO	Amended Stipulation and Final Order
ASM	Asset Systems Management
BES	Bureau of Environmental Services
BMPs	best management practices
BRE	business risk exposure
CBWTP	Columbia Boulevard Wastewater Treatment Plant
CBWWTF	Columbia Boulevard Wet Weather Treatment Facility
CCSD #1	Clackamas County Service District #1
CCTV	closed-circuit television
CIP	Capital Improvement Program
CIPP	cured-in-place pipe
City	City of Portland
CMOM	Capacity, Management, Operation, and Maintenance
Code	Portland City Code
Council	City Council
CSMT	Collection System Management Team
CSO	Combined sewer overflow
CWA	Cooperative Work Agreement
DEQ	Oregon Department of Environmental Quality
DME	Data Maintenance Environment
DRSD	Dunthorpe-Riverdale Service District
ECC	Emergency Coordination Center
EDUs	equivalent drainage units
EOC	Emergency Operations Center
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
ESD	Environmental Systems Division
FE	flow estimation
Field Ops	Field Operations Section
FOG	fats, oils, and grease
FTE	full-time equivalent
FY	fiscal year
GIS	geographic information system
GMAs	grease management areas
HYDRA	Hydrologic Data Retrieval and Alarms
I/I	infiltration/inflow
IGA	intergovernmental agreement
ISCD	Industrial Source Control Division
MMS	maintenance management system
NMC	nine minimum controls
NPDES	National Pollutant Discharge Elimination System
O&M	operations and maintenance
OERS	Oregon Emergency Response System
OTJ	on-the-job
PDOTMO	Portland Bureau of Transportation, Maintenance Operations
PFP	Public Facilities Plan
PM	Preventive Maintenance
PPE	personal protective equipment
PUMA	Pump Station Maintenance Operations
PURB	Public Utility Review Board
QA/QC	quality assurance/quality control
RDII	rainfall dependent infiltration/inflow
RUL	remaining useful life
SCADA	supervisory control and data acquisition
SDCs	system development charges
SOPs	standard operating procedures
SPCR	Spill Protection and Citizen Response
SQL	structured query language
SRB	Sewage Release Database
SSO	sanitary sewer overflow
SSOOT	Sanitary Sewer Overflow Oversight Team
SSORT	Sanitary Sewer Overflow Reduction Team
TM	technical memorandum
TMDL	total maximum daily load
UIC	underground injection control
USB	Urban Services Boundary
WASS	Water Services Association of Australia
WCTS	Wastewater Collection and Treatment System

EXECUTIVE SUMMARY

The City of Portland (City) Bureau of Environmental Services (BES) has prepared this Capacity, Management, Operation and Maintenance (CMOM) Program Report for the purpose of improving customer service, reducing the number of sanitary sewer overflows (SSOs), and improving the overall reliability of the wastewater collection system. The strategies and activities defined herein go hand-in-hand with the City's asset management (AM) approach to managing, operating, and maintaining the wastewater collection system. The approach is based upon detailed system information and risk based strategies for the development, reinvestment, and operation and maintenance (O&M) of the system. The City believes that this approach is entirely consistent with the U.S. Environmental Protection Agency's (EPA) CMOM guidelines.

This report describes the vision, mission, goals, activities, cross-bureau coordination, and implementation strategy of the City's CMOM Program. It documents the ongoing multiple business functions, practices and activities the City has implemented to address capacity, operations, maintenance and management needs of the collection system. Most of these activities have been practiced and improved upon over the course of a number of years, resulting in a reduced number of overflows and releases that are comparable to other cities of similar size. The City will use this CMOM Program Report as the baseline upon which all future programs, practices, and activities will be compared. Based on future findings, the City will modify specific CMOM Program elements to better achieve program goals and thus preserve its recognition as clear leader with a reputation for excellence within the wastewater conveyance and treatment community.

This Executive Summary provides a brief description of the various CMOM Program elements and is organized in accordance with the sections of this report.

Introduction, Purpose, and Goals

Section 1 defines the purpose and goals of the CMOM Program. It demonstrates that BES's vision and mission statements are entirely consistent with EPA's CMOM program purpose. Accordingly, the City's CMOM Program is focused on ensuring that sanitary and combined sewage is conveyed safely away from people and water bodies and delivered to the treatment plants where pollutants can be removed before discharge.

BES is steadily progressing toward full implementation of its CMOM Program through an AM-based approach. This approach focuses on level of services provided to customers and triple bottom-line benefits that include:

- **Social**: Protect public health and safety by reducing sewer backups to homes, businesses and streets, prevent catastrophic failures that impact the surface; address nuisances (odors) and promote highly responsive customer service.
- **Environmental**: Protect surface and groundwater from sanitary sewer discharges while promoting applicable watershed improvements in hydrology and habitat.
- **Economic**: Prioritize cost-effective reductions in business risk exposure, which identifies assets in the system that have high likelihood of failure and/or high consequence (in dollars) of failure.

BES has incorporated many of the CMOM strategic objectives into proposed draft language for the renewal of its National Pollution Discharge Elimination System (NPDES) permit. This provides a clear commitment from BES to increase the level of specific activities (over the next 5 years) that target the reduction of sewer releases throughout the system. These increases will be optimized according to AM principles to reach a cost-effective, risk-based approach to O&M.

Service Area and Description

Section 2 provides an overview of the wastewater collection system. The City's detailed knowledge of its collection system assets includes information on the inventory, its condition, current value, and life-cycle costs. This information provides the foundation for the City's AM approach to implementing CMOM. This approach allows the City to make informed strategic, tactical, and operational decisions at all levels of planning, management, and operations.

The wastewater collection system covers a service area of about 96,000 acres, of which 26,000 acres are served by a combined sewerage system and 66,000 acres are served by a separated sanitary sewerage system. Another 8,000 acres outside of the service area is provided with sewage treatment through Intergovernmental Agreements (IGAs). There are approximately 2,323 miles of collection system that include 878 miles of combined sewer, 989 miles of separated sanitary sewer, and 456 miles of storm sewer. The system also includes 96 pump stations, 46 miles of force main, and two wastewater treatment plants.

Organizational Structure and System Elements

Section 3 presents the organizational structure of the City and of the bureaus responsible for implementing the CMOM Program provisions. BES and the Bureau of Transportation make up the primary bureaus charged with implementing CMOM-related activities. In addition, this section provides an overview of Management Information Systems, communication, and training procedures and activities.

The City has a well-established and organized governmental structure which clearly delineates responsibilities and authority in a way that provides for efficient and effective management, operation, and maintenance of the wastewater collection system. Key to that success is the Cooperative Work Agreement (CWA) between BES and Bureau of Transportation's Maintenance Operations (PDOTMO) that defines the roles and responsibilities for at least 48 activities.

A number of management information systems are used to guide and document all facets of CMOM related activities. In addition, internal communication protocols have been established to ensure that information flows freely to those making decisions, regardless of the bureau, division, group, or individual that may be involved. Detailed training programs are in place such that all staff can perform their tasks efficiently and safely.

Legal Authority

Section 4 defines the City's legal authority for enforcing all aspects of wastewater collection system management, including prohibitions or restrictions on the quality and quantity of wastewater discharges, standards for new construction and rehabilitation, and prohibitions on stormwater connections. The legal authority is provided through City Code, ordinances, and IGAs.

BES's Pretreatment Program and Fats, Oils, and Grease (FOG) Program limit the quantity and quality of wastewater discharges to the wastewater collection system. The programs allow for City staff to initiate surveys, perform inspections, determine compliance, conduct enforcement, collect and analyze samples, and prepare and submit annual reports to Oregon Department of Environmental Quality.

To help ensure quality construction and appropriate asset service lives, the City has developed documents that provide guidance on minimum design and construction standards for its sewer projects. These are available in hard-copy and on the City's website.

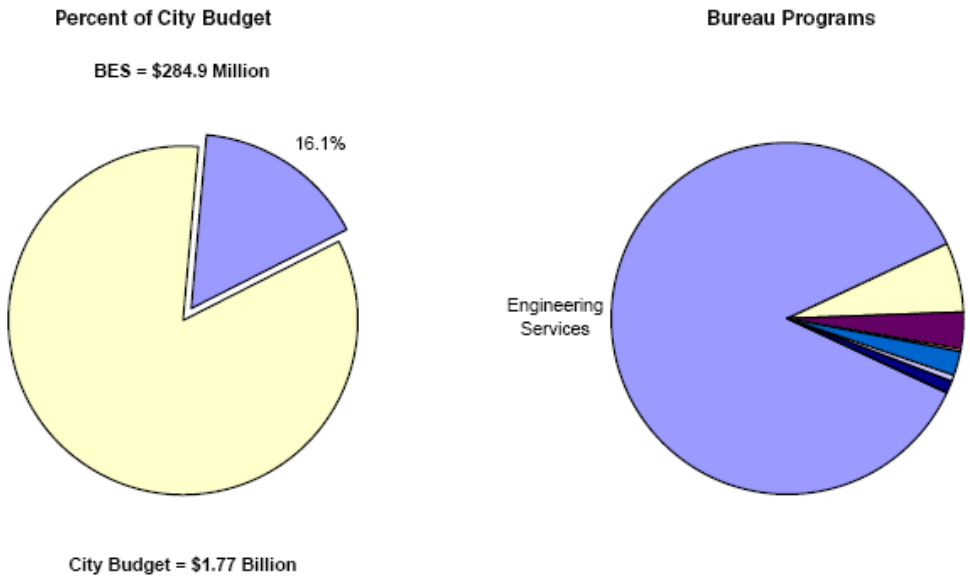
IGAs have been developed between the City and 9 satellite communities. The IGAs are legally binding documents that regulate the quantity and quality of wastewater.

Financial Management

Section 5 defines the budget and financial aspects of managing the City's wastewater collection and treatment system. BES activities are supported with retail sewer and stormwater charges, wholesale contract revenues from surrounding jurisdictions, and reimbursements for services provided to other bureaus.

An overview of the fiscal year (FY) 2008-09 adopted budget is shown in Figure ES-1. The BES FY 2008-09 adopted budget for operating and capital expenditures is $284.9 million.

Figure ES-1. BES Budget Overview



Bureau Overview

Expenditures	Revised FY 2007–08	Adopted FY 2008–09	Change from Prior Year	Percent Change
Operating	100,962,577	96,932,927	-4,029,650	-4.0%
Capital	195,080,274	187,972,000	-7,108,274	-3.6%
Total Expenditures	**$ 296,042,851**	**$ 284,904,927**	**$ -11,137,924**	**-3.8%**
Authorized Positions	504	524	20.00	4.0%

The City's strategic direction for managing the sewer system is based upon complying with environmental regulations and providing a level of service that is acceptable to the community. The major activities and programs comprising the strategic direction include the Combined Sewer Overflow (CSO) Program, Portland

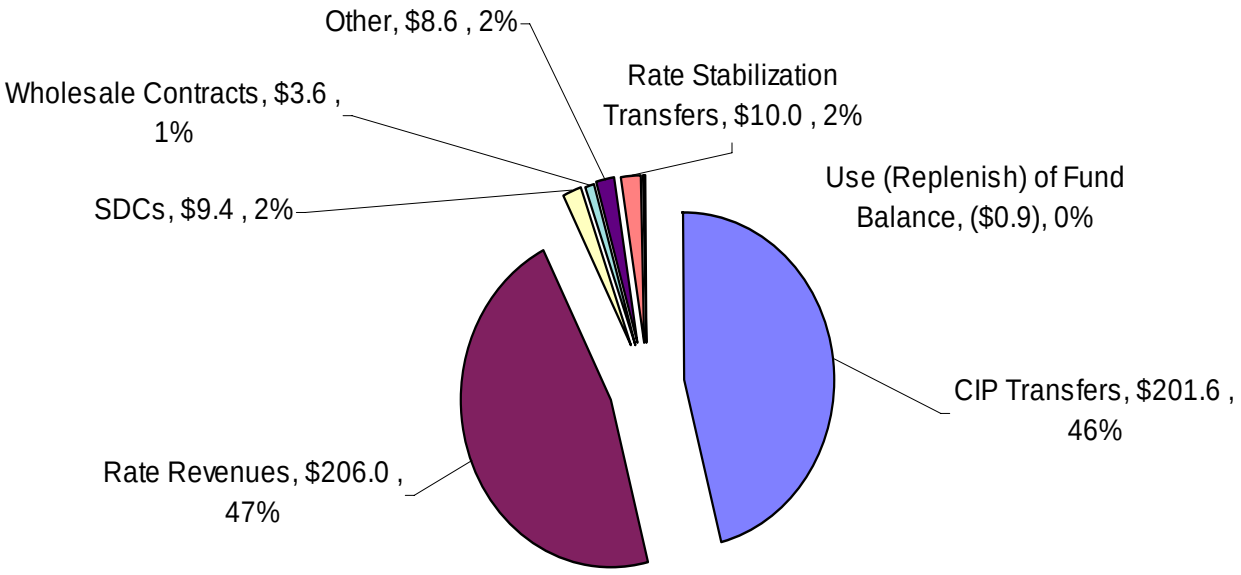
Harbor Superfund, water quality compliance (NPDES stormwater related), Endangered Species Act requirements, watershed restoration and remediation, O&M issues, infrastructure repair and replacement, and watershed enhancement opportunities.

The 5-year financial forecast presents BES's revenue and expenditure plan for the operation, maintenance, expansion, and reconstruction of the City's sanitary sewer and stormwater drainage system. The operations, maintenance, and capital construction programs represented in the plan must provide for operation of the system in a safe, sound, and efficient manner as well as compliance with all applicable health, safety, and environmental laws, regulatory body rules, regulatory body orders, and court orders.

The major sources of funding for operating, maintaining, expanding, and reconstructing the City's sewer collection and treatment systems are shown in Figure ES-2. These sources are described as follows:

- *Revenues from Rates*–Charges to retail sanitary and stormwater customers, represented by approximately 164,000 residential accounts and 13,400 commercial industrial accounts.
- *Capital Improvement Program (CIP) Transfers*–Cash transfers from the Construction Fund to reimburse for CIP expenditures.
- *System Development Charges (SDCs)*–Equity charges applied to new sewer connections meant to recover prior infrastructure investments.
- *Rate Stabilization Transfers*–The Rate Stabilization Fund includes cash accumulated over prior years meant to smooth the peaks and valleys of annual expenditures.
- *Wholesale Contracts*–Charges from neighboring jurisdictions with rates as defined in the IGAs.
- *Other Revenues*–These revenues include service reimbursements from other bureaus within the City and other miscellaneous income sources.

Figure ES-2. FY 2008-09 Projected BES Revenue Overview



Of the approximate $285 million FY 2008-09 budget, approximately $97 million is allocated to Operations and $188 million is allocated to the CIP. The operating budget supports the activities and programs of its seven business units. Wastewater treatment comprises about 48 percent of BES's FY 2008-09 operating budget or $45.6 million. Nearly 99 percent of BES's capital budget of $187.97 million goes to engineering services.

Customer Service and Public Relations

Section 6 presents on overview of the procedures used to process customer service requests. BES has developed an effective customer service program to ensure that all incoming inquiries, requests, and complaints are addressed in a timely fashion. The public relations program helps to educate and inform the public on important matters relating to the management, operation, and maintenance of the wastewater collection and treatment systems.

Citizens who request service have multiple communication tools available for their use, including spill, odor, and sewer back-up telephone hotlines and e-mail reporting. The City has developed formal internal procedures for receiving and responding to these requests, and places a high priority on responding to such requests in a timely manner.

Public education is provided through a variety of media on how the wastewater collection system is operated and managed, and best management practices for improving performance. In addition, "front-line" customer service responders and field maintenance staff are trained in how to deal with the public, whether responding to customer service requests, providing educational information, or performing field maintenance activities.

CSO/SSO Notification and Emergency Response Programs

Section 7 presents the City's procedures for responding CSOs and SSOs and describes highlights of emergency response planning.

Formal response procedures have been developed for CSO and SSO notifications. The PDOTMO dispatch center acts as the initial point of contact for all overflow notifications and the CSO Program Manager reviews rainfall and overflow monitoring data to examine CSO regulatory compliance and verify system performance. CSOs are tracked at controlled outfalls via the CSO monitoring system. Since SSOs can occur unexpectedly at any location, their tracking is more detailed and includes the following: date/time of incident, location, cause, impacts, and response. The current tracking system has been in use since approximately 2002, but BES has had an SSO reporting policy and records retention system in place since 1995.

In general, the City uses the following procedures to alert the public to an SSO: buoys, signage, multiple media (newspapers, radio, and television stations), and the City's Office of Neighborhood Involvement. CSO notification procedures include phone, media outlets, internet, event signage, and permanently posted CSO outfall signage.

The City's Emergency Response Plan describes procedures to be used in responding to emergencies. The plan outlines the appropriate responses for a number of different types of emergencies. These guidelines are documented and located in the Environmental Systems Division office.

Engineering Design and New Construction

Section 8 describes the major elements of engineering design for new public sewer construction. The City's engineering design and construction standards must be met before new sewer facilities can be accepted into the City's wastewater collection system. These standards help to ensure that new facilities satisfy current and future hydraulic capacity requirements, provide long-term service life, and minimize O&M effort.

A number of engineering activities and tools are used to support sewer collection system management and O&M and ensure adequate capacity. The most relevant engineering activities and tools include:

- Design Standards and Guidance Documents—These provide guidance on minimum design and quality assurance/quality control standards for the City's wastewater sewer projects.
- Collection System Plans—BES updates its city-wide facilities plan approximately every 10 to 15 years. The 1999 Public Facilities Plan is currently being updated with completion set for 2009.
- Pump Station Plans—A Pump Station Improvement Plan has been developed that includes an inventory and assessment, and a preventive maintenance plan for all of the City's 94 pump stations.
- New Construction—Procedures are in place to ensure that new sewer construction projects provide adequate capacity for current and planned future conditions and that new construction satisfies all City design and construction standards.

System Evaluation and Capacity Assurance

Section 9 describes the specific methods and activities used to evaluate sewer system performance and to assess the structural and operational condition of the collection system.

The City utilizes a number of tools to measure and predict the hydraulic requirements of the wastewater collection system. Additional activities are performed to evaluate the structural and operational conditions of the collection system. These tools and activities are used to identify the hydraulic, O&M, and rehabilitation needs of the collection system.

A flow monitoring program has been established for both the combined and separated sanitary sewer systems. Both monitoring programs utilize permanent flow monitoring, temporary flow monitoring, and pump station flow/cycle data.

BES carries out water quality monitoring to detect and monitor potential impacts of sewage releases to Portland's water bodies and to comply with NPDES permit requirements.

BES employs a set of robust modeling tools to simulate stormwater runoff, sanitary flow, combined sewage flow, and CSO flow management across the collection system. For example, the combined and sanitary models follow an Explicit Model approach that allows simulation of every pipe, manhole, property, street drainage area, and each specialty structure (diversion, overflow, pump station) in the collection system. This highly detailed set of models has given BES the ability to calibrate the model for both local (small scale) and regional (large scale) areas.

Periodic capacity assessments are performed as part of regularly-scheduled updates of BES's public infrastructure plan, and on an as-needed basis to support design and construction of new connections to the system. The assessments are used to identify pipe capacity issues and include capacity analyses of pump stations and wastewater treatment plants. These updates prioritize and integrate solutions for capacity problems with solutions for structural problems to optimize the maintenance and replacement of the sewer infrastructure.

BES has long used standard industry practices for assessing the structural and operational condition of the wastewater collection system. BES is in the process of expanding these practices to support and implement AM practices such that the risks (likelihood and consequence) of failure can be identified.

The primary assessment tool for identifying structural and operational problems in sewers is closed-circuit television (CCTV) inspection. During inspections, trained staff assign pipe defect codes identifying the type and severity of the defects. The defect codes form the basis for assigning pipe condition grades. Condition grades, in turn, are used to establish the estimated remaining useful life of the pipe. This resulting information is used to schedule future inspections and sewer rehabilitation priorities based on business risk.

Wastewater Collection and Treatment System (WCTS) Operation

Section 10 describes the various operating plans used within the City's WCTS to achieve BES's mission, vision, and goals for protecting human health and the environment in a cost-effective manner. Two primary plans guide BES's efforts:

- *Combined Sewer Overflow (CSO) System Operating Plan*: The purpose of this plan is to describe the major collection system facilities and to outline the operating and monitoring strategy for the entire CSO control system including both existing and future facilities.
- *CBWTP Operations Plan*: This describes the major CBWTP systems, their specific capacity and operational considerations, and strategies for operating under different weather conditions.

O&M Activities

Section 11 describes the primary collection system O&M activities. The City's O&M Program is designed to achieve three major goals: prevent and/or reduce the number and quantity of CSOs and SSOs, minimize life-cycle costs while providing an acceptable level of service, and sustain the public's investment in the sewer infrastructure by ensuring that service lives are extended as long as economically feasible.

PDOTMO performs most of the maintenance activities on the wastewater collection system in accordance with the CWA. The Pump Station Maintenance Operations (PUMA) section of BES's Wastewater Group performs the maintenance at the City's wastewater pump stations and force mains.

BES and PDOTMO manage the broad range of vehicles, equipment, materials, and spare parts necessary to perform O&M activities in a way that minimizes down time and maximizes field work efficiency and effectiveness.

Routine preventive O&M activities for the wastewater collection system include CCTV inspection, main line sewer cleaning, root management, and minor repairs. Section 9 includes a discussion on CCTV inspection. Sewer cleaning for FOG removal is addressed in Section 4 as part of the FOG Program.

Routine main line sewer cleaning includes the removal of sediment, FOG, and debris from the sewer using vacuum and/or jet cleaning equipment. The City's sewer cleaning program is set up to work in concert with that of the CCTV inspection program. BES establishes the areas or basins to be cleaned and PDOTMO performs most of the cleaning.

The Root Control Program focuses on minimizing the potential for backups and SSOs due to blockages created by roots. The program's root abatement techniques include chemical treatment and mechanical removal of roots, and in severe cases, sewer rehabilitation. Roots in sewers are identified through routine

cleaning and CCTV inspection, and from repair activities. A priority ranking system has been developed so that sewers with the greatest need for root treatment are addressed first.

PDOTMO has 11 repair crews to perform sewer repairs within the City. Seven crews do standard sewer repairs, one crew does spot lining, and three crews fix manholes and storm inlets. Sewers that need repair are identified through the inspection and condition assessment program, and from customer complaints. For pipes that require more repair effort than can provided by spot repair, the PDOTMO Repair Group can install a cured-in-place-pipe (CIPP) liner system. CIPP liner systems can be installed on the main line and on service laterals.

Planning standards were prepared in the mid-1990s for all major PDOTMO collection system work activities. As methods, materials, and needs have changed over the years, they have been updated.

PUMA maintains all pumping systems, force mains, structures, and grounds not handled by another agency. Its aim is to ensure that the general condition of the facilities remains equal to, or better than, its condition as of July 1, 2001.

The CWA defines the type and quantity of work that is to be provided by PDOTMO. BES establishes the basins to be inspected and cleaned. PDOTMO sets schedules and daily work priorities in accordance with the agreement. The scheduling of repairs is based on observations made in the field (via CCTV inspections).

Information developed through the weekly pump station inspections and maintenance activities is used to assess the condition of pumps and equipment. This information provides the foundation for the preventive maintenance program developed for each pump station and its O&M and replacement schedules.

PDOTMO is the contractor of choice for performing many of the City's required collection system O&M services. However, BES retains the right to contract out to the private sector or to other public agencies. BES works with other agencies to determine how the City's costs compare with other agencies and to identify best management practices that may help the City be more competitive. BES contracts out to private vendors the following work: root chemical treatment, vector control, and certain types of CCTV inspection in support of basin relief and reconstruction predesign projects.

Monitoring, Measurement, and Program Modification

All elements of the CMOM Program have been assigned to a manager/supervisor who will be responsible for monitoring each element and reporting the results on an annual basis. Accomplishments will be measured against the goals for each element to determine their effectiveness. Changes to the program will be made as required to achieve program goals.

Toward that end, over the next 5-year cycle of the renewed NPDES Permit, the City is expanding the cleaning and inspection programs to reach a more optimal level of performance. The increased effort is targeted to reduce SSOs and to provide additional data as required for condition assessment and maintenance planning. Based on AM principles, this additional information will help determine the optimal level for sewer pipe reinvestment and rehabilitation that will reduce overall business risk in a cost-effective manner.

1: INTRODUCTION, PURPOSE, AND GOALS

The City of Portland (City) Bureau of Environmental Services (BES) has prepared this Capacity, Management, Operation, and Maintenance (CMOM) program documentation for the purpose of improved customer service, to reduce the number of sanitary sewer overflows (SSOs), combined sewer overflows (CSOs) and to improve the overall reliability of the sanitary and combined sewer system. The strategies and activities defined herein go hand-in-hand with the City's asset management approach to managing, operating, and maintaining the wastewater collection system. The approach is based on detailed information and risk-based strategies for the development, reinvestment, operation, and maintenance of the system. The City believes that this approach is entirely consistent with the U.S. Environmental Protection Agencies (EPA) CMOM guidelines.

The CMOM Program Report describes the vision, mission, goals, activities, cross-bureau coordination, and implementation strategy of the City's CMOM Program. The report documents the multiple business functions and practices the City has implemented to address the CMOM needs of the collection system. Finally, the report provides details about the various means and methods, either currently in place or under development, by which the City continues to be recognized as a clear leader with a reputation for excellence in the wastewater conveyance and treatment community.

CMOM Program Report Development

The City retained Brown and Caldwell in 2008 to compile and publish this report describing all the various aspects of the City's CMOM Program. Brown and Caldwell has extensive experience assisting utilities/cities across the U.S. with CMOM issues. City staff were actively involved in developing this report.

Prior activities and reports related to the City's CMOM Program include:

- Implementation of the Nine Minimum Controls, The City of Portland CSO Program, 2003 Update, BES and CDM
- CSO System Operating Plan, July 2005, BES
- CMOM Self Assessment Checklist, Environmental Protection Agency, April 2004, BES
- *Interview Summary Technical Memorandum, Task 2.0 CMOM Program Plan Strategy, Systems Planning Project,* September 2006, Brown and Caldwell/CH2M Hill
- *Workshop Summary Technical Memorandum Task 2.05 CMOM Workshop Summary Final, Systems Planning Project,* June 2007, Brown and Caldwell/CH2M Hill

The structure of this report is based on the program components as presented in the EPA's *Guide for Evaluating Capacity, Management, Operation, and Maintenance (CMOM) Programs at Sanitary Sewer Collection Systems* (EPA 305-B005-002, January 2005). Some tailoring of the CMOM report format organization was conducted to meet the needs of the City and improve readability.

BES Vision

BES protects Portland's environment which supports a healthy economy by providing excellent service, being cost-effective, and demonstrating environmental leadership.

BES Mission

BES's mission focuses on providing essential services to the public while protecting the environmental community in which we all live. The mission is as follows:

- BES serves the Portland community by protecting public health, water quality and the environment.
- It provides sewage and stormwater collection and treatment services to accommodate Portland's current and future needs.
- It protects the quality of surface and ground waters and conduct activities that plan and promote healthy ecosystems in our watersheds.

The CMOM Program supports each element of the BES Mission by ensuring that sanitary and combined sewage is safely conveyed away from people and water bodies and delivered to the treatment plants where pollutants can be removed before discharge. BES is steadily progressing toward implementing CMOM through an asset management (AM)-based approach that focuses on level of services provided to our customers and triple bottom-line benefits:

- **Social**: Protect public health and safety by reducing sewer backups to homes, businesses, and streets; prevent catastrophic failures that impact the surface; address nuisances (odors) and promote highly responsive customer service.
- **Environmental**: Protect surface and groundwater from sanitary sewer discharges while promoting applicable watershed improvements in hydrology and habitat.
- **Economic**: Prioritize cost-effective reductions in business risk exposure, which identifies assets in the system that have high likelihood of failure and/or high consequence (in dollars) of failure.

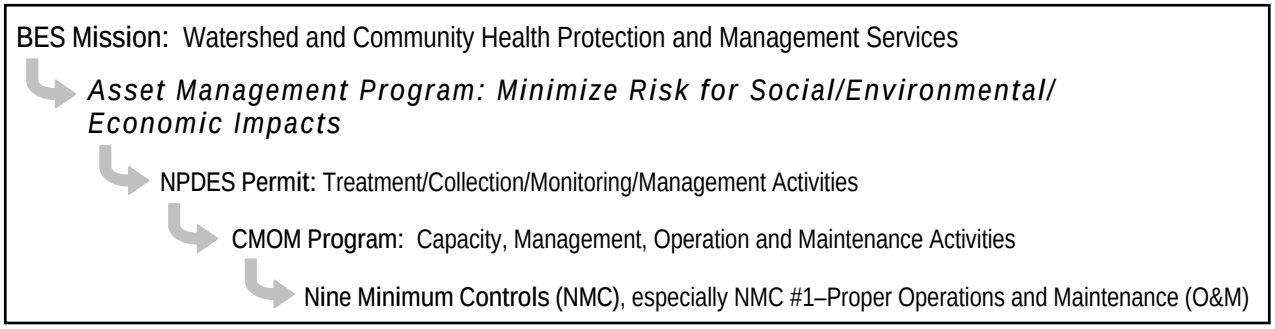
CMOM Program Goals

Portland's CMOM Program has specific goals that are addressed in this report through the actions of several groups across the City. The goals of the CMOM program are derived from BES-specific programs as well as the regulatory environment within which BES operates. These goals are:

- Incorporate AM principles and practices to reduce BES's business risk exposure (BRE)
- Address SSO/basement backups in sanitary and combined areas
- Fulfill CMOM-related requirements specified in National Pollutant Discharge Elimination System (NPDES) permits
- Ensure consistency and unified direction across BES's CMOM-related activities
- Meet EPA CMOM guidance

Figure 1-1 shows the context of the CMOM Program with respect to the BES Mission, AM, and related regulatory requirements.

Figure 1-1. Simplified View of Context for CMOM-Related BES Programs



As a result of this program context, BES has incorporated many of the CMOM strategic objectives into proposed draft language for the renewal of its NPDES permit. This provides BES and the regulators clear commitment for increased condition assessment and preventive maintenance activities over the next 5 years that target the reduction of sanitary sewer releases throughout the system. These increased activities over the 5-year cycle of the renewed NPDES permit will be optimized according to AM principles to reach a cost-effective, risk-based level of cleaning and sewer inspection. This increased data capture will support higher optimization of cleaning, inspections/condition assessments, and planning activities for guiding reinvestment and rehabilitation and ensuring improved reliability within the system.

CMOM Strategy

The CMOM Strategy is founded on the City's extensive experience at successfully and efficiently operating and maintaining the wastewater collection system. In short, practices and procedures that worked in the past are continued. Those that did not work are modified to provide the required utility or discontinued if they are no longer necessary. The key to the strategy and overall program success is the City's ability to adapt to change and to make changes as necessary to ensure program success. The background for this strategy and a discussion on how the CMOM Strategy overlaps with the City's AM Program are discussed in the following paragraphs.

Background

BES has a long history of managing the combined and sanitary collection system, providing new and expanded capacity, and operating and maintaining the system since its creation as a public works agency. Through both capital and operating programs, BES implements projects that enable it to:

- Identify hydraulic capacity and structural condition problems in the existing and predicted future conditions through the Public Facilities Plans/System Plans.
- Invest an average of $18 million per year in design and construction of projects that rehabilitate, repair, or replace pipes to provide new capacity and reliable conveyance systems under the Capital Improvement Maintenance and Reliability Program.
- Perform on-the-spot maintenance and quick-turn-around repair projects through flexible capital and operating programs.
- Provide rapid response to sewer releases, reporting and public notification through an organization that has proven its ability to tackle and address CSO and SSO problems.

Many of BES's excellent programs have been derived from investments in CSO control, public facilities planning, maintenance and reliability projects, and long-term inter-agency work with the Bureau of Transportation that performs most collection system maintenance. As a result of these programs, BES maintains its 2,600 miles of pipe in a manner that the City experiences about 4 sewage releases per 100 miles per year on average. Based on a variety of surveys, this level of performance is in the median range compared to other cities. Although there is clear room for improvement, this level of performance would not indicate a high profile problem that requires aggressive enforcement.

Another result of the large capital programs is that dry weather overflows from Portland's combined system have been significantly reduced and will be effectively eliminated in 2011. In addition, thousands of properties in the combined system are no longer subject to frequent sewer backups.

However, sanitary sewer releases to local streams and sewer backups into homes in the separated system have continued to occur. In February 2008, the Oregon Department of Environmental Quality cited the City for multiple discharge violations for sewage releases into the waters of the state that occurred over the period of 2001 to 2007. The state levied a $586,600 fine against the City with mitigation of the total amount allowed through supplemental environmental projects.

From ongoing reviews of the sewage releases, it is clear that the cause of the releases is from a variety of sources:

- Debris from construction or third parties
- Debris from condition problems in laterals, pipes, or manholes
- Tree roots
- Grease accumulation
- Sags or restrictions in capacity
- Pipeline or force main failures

Where applicable, BES staff have addressed these issues through changes or increases in the maintenance of specific areas of the system. The next step that appears to be most appropriate is to begin increasing the amount of pipe and manhole inspection and cleaning in order to:

- Identify and remove more blockages before they cause sewage releases.
- Obtain more data on the accumulation of debris, roots, and grease that can be used in determining the likelihood or frequency of potential blockages.
- Obtain more data on the condition and rate of change in the condition of pipes for determining the remaining useful service life of the pipes (and derive the likelihood of structural failure of the pipe for AM calculations.)

Based on these findings, BES is implementing an AM approach for increasing and optimizing the level of inspection and cleaning while continuing to develop a more comprehensive AM approach for all the CMOM activities. More detailed information on these next steps is provided in Section 12 of this report.

AM Strategy for Increased CMOM Activities

BES has formally initiated the development of an AM Program that will build on and integrate many of its existing CMOM-related capital, operating, and maintenance activities by incorporating life-cycle costs in a risk-based approach for prioritizing work. The major elements of this early AM Program development include:

- Incorporating into the combined and sanitary sewer system plans and decision-making the concept of BRE in terms of financial, social and environmental costs and benefits.
- Developing new business practices for using BRE to prioritize O&M activities (cleaning, inspection, repair, etc.)
- Fully participating in the international AM Benchmarking project conducted by the Water Services Association of Australia (WSAA)

The first two activities are discussed further in this report. The WSAA AM Benchmarking project, which is currently underway (Summer 2008), will provide BES with the following benefits:

1. Material and support for performing a consistent and comprehensive self-audit along with other international water and wastewater agencies.
2. Expert assessment team of consultants to review and validate the benchmarking self-audit data by conducting interviews with BES staff. The assessment team will also collect relevant documentation, consolidate all analyses, develop a draft report, and provide a final report to BES.
3. A final agency evaluation report, specific to BES, that includes leading participant practices in each AM activity benchmarked, along with an AM Program improvement plan for BES.
4. Later, in the fall of 2008, WSAA shall invite BES to participate in a workshop in Australia following the completion of the benchmarking analysis.
5. Follow-up presentation and workshop for all BES to be provided by the assessment team in December 2008.

Using information and lessons learned from the benchmarking project, BES will develop an AM Program Plan that will identify the next steps that BES sees as the most important elements to implement for improving AM practices and products.

Minimizing Risk through an AM-based Cleaning and Inspection Strategy

One of the key principles in AM is the cost-effective reduction of BRE which is defined as:

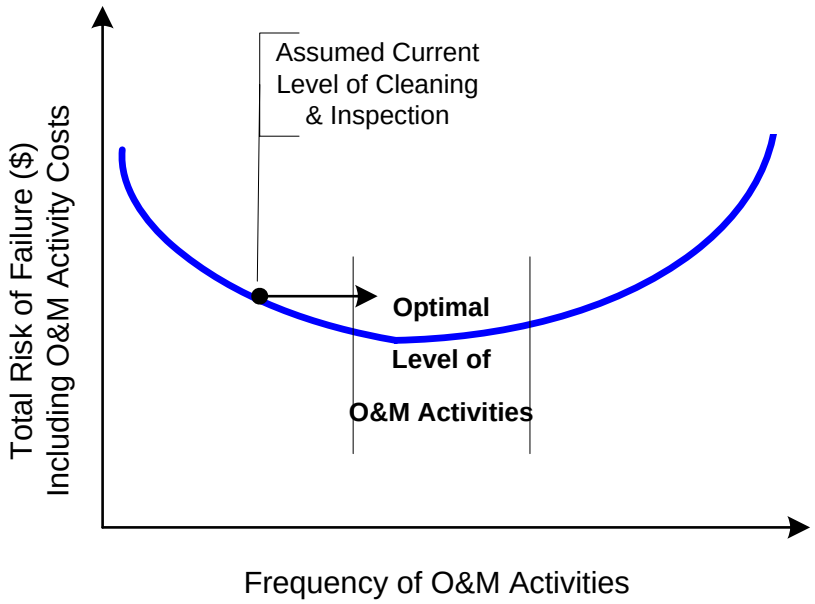
BRE ($) = Likelihood (probability) of Failure x Consequence (impacts in $) of Failure

There are four primary modes of failure. For the collection system, the modes are:

- Capacity, which can be exceeded during extreme storm events
- Mortality, which is due to the structural condition of the pipe
- O&M, which shows up as a variety of blockages
- Level of Service, which occurs due to a sudden change in requirements

The sewage releases experienced in the City's combined and sanitary system (other than the expected CSO discharges) would mostly be characterized by the O&M failure mode, with a smaller group failing under the mortality mode. The risk or BRE for both of these types of failure modes can be cost-effectively reduced by optimizing the level of cleaning and inspection performed in the combined and sanitary system. Figure 1-2 provides a graphical view of this concept.

Figure 1-2. Determining the optimal (minimum risk) level through O&M activities



The optimal level of O&M activity is the state at which a dollar increase in cleaning and inspection results in a dollar reduction in total risk (where cost = benefit). This is also the point where the O&M activities have achieved the lowest risk possible by that means. At this time, BES is assuming that its current level of cleaning and inspection is less than the optimal level, and that an incremental increase in cleaning and inspection will provide an equal or greater reduction in BRE. For this reason, BES is proposing to increase the cleaning and inspection level of effort incrementally in the combined and sanitary system in conjunction with an analysis of costs and reductions in BRE to better determine the optimal level of O&M activity. The proposed increase is presented further in Section 12 of this report.

2: SERVICE AREA AND SYSTEM DESCRIPTION

This section provides an overview of the City of Portland's (City) wastewater collection system. The City's detailed knowledge of its collection system assets includes information on the inventory, its condition, current value, life-cycle costs, and suitability for intended use. This detailed information provides the foundation for the City's asset management (AM) approach to managing, operating, and maintaining the wastewater collection system. The AM approach along with the detailed knowledge and information base supporting it, allows the City to make informed strategic, tactical, and operational decisions at all levels of planning, management, and operations.

General System Description

The City owns, operates, and maintains all public wastewater (separated sanitary and combined sewer) collection systems, two wastewater treatment plants, and the stormwater collection and treatment systems. The Bureau of Environmental Services (BES) is responsible for meeting all regulations and for the safe and effective operation, maintenance, and management of those systems including providing adequate capacity. Programs include wastewater collection and treatment; stormwater management; and protection, enhancement, and restoration of natural waterways. BES designs and installs new sewers, rehabilitates and/or replaces existing sewers, and monitors residential and industrial wastewater discharges to the sewers, streams, and rivers. BES staff operate and maintain the City's pump stations.

The Portland Bureau of Transportation, Maintenance Operations (PDOTMO) plans, builds, manages, and maintains the transportation system to provide effective and safe access and mobility about the city. PDOTMO responsibilities include maintaining $5.4 billion worth of infrastructure investment in streets, traffic signals, streetlights, associated signage, and the stormwater and wastewater collection systems. Maintenance of stormwater and wastewater collection systems is performed by PDOTMO staff and is funded through a Cooperative Work Agreement with BES. PDOTMO staff do not operate or maintain the City's pump stations. Pump stations and force mains are the responsibility of the BES Pumping and Treatment Division in the Wastewater Group.

Figure 2-1 shows the City's Urban Services Boundary (USB). Properties inside the USB are within the City's sewer service area, and may receive sewer service from the City. Connections to serve properties outside the city limits, but inside the City's USB are subject to the City's Urban Services policies, and review and approval by BES's Chief Engineer.

The service area is located on both sides of the Willamette River and south of the Columbia River. The area generally is bound by low-lying hills paralleling the Willamette River on the west, other service areas outside the city limits to the south, the City of Gresham to the east, and the Columbia River to the north.

The service area covers about 96,000 acres, of which 26,000 are served by a combined sewerage system and 66,000 are served by a separated sanitary sewerage system. Another 8,000 acres outside of the service area are provided with sewage treatment through Intergovernmental Agreements (IGAs). There are approximately 2,323 miles of collection system that include 878 miles of combined sewer, 989 miles of separated sanitary sewer, and 456 miles of storm sewer. The system also includes 96 pump stations, 46 miles of force main, and two wastewater treatment plants.

City responsibility for the wastewater collection system includes all main lines, trunk lines, interceptors, pump stations, force mains, and service laterals from the sewer main up to the curb line. Service laterals on private property are the responsibility of the property owner.

Wastewater Collection System

Wastewater is collected by either a combined sewer or a separated sanitary sewer system. Each system collects and transports wastewater to major interceptors that convey sewage to the wastewater treatment plants.

Combined Sewer System

The combined sewer system collects and transports sewage and stormwater flow in a single pipe network to the Columbia Boulevard Wastewater Treatment Plant (CBWTP) for treatment. The combined sewer system contains two primary components: basins and interceptors. The combined sewer basins represent the area over which sewage is collected, and the interceptors transport it to the treatment plant. Basins are generally assigned names based on the street name under which the outfall (discharge pipe to river) is located. The tributary to these outfalls determines the geographic delineation of each basin.

The combined sewer system comprises 39 basins that serve a total of 26,000 acres. The combined sewer system service area is shown in Figure 2-1.

The major elements of the combined sewer system are shown in Figure 2-2. The combined basin system contains a series of sewer pipelines (4,639,000 linear feet total) and small pump stations (11 total) that collect raw sewage from local residences and transport it through a series of collector and trunk sewers to diversion structures located at the downstream portion of each basin. The diversion structures serve as the hydraulic control points for the basins, distributing flow to either the interceptor system or the basin outfall. Diversion structures are designed to divert, at a minimum, three times average dry weather flow to the interceptor system. Flows in excess of diversion structure capacity are discharged, untreated, through basin outfalls to the Willamette River or the Columbia Slough.

Constructed in the late 1940s, the interceptor systems consist of a series of sewer pipelines and large pump stations (three total) that serve to collect flow from individual combined basins and transport it across basins for processing at CBWTP. The interceptor system is designed to convey up to three times the dry weather flow to the CBWTP for treatment.

Separated Sanitary Sewer System

The separated sanitary sewer system receives domestic sanitary and industrial wastewater flows via building service connections. Areas served by separated sanitary sewers have been divided into 15 basins, totaling 60,000 acres. The service area for the separated sanitary sewer system is shown in Figure 2-1. The basins are defined by the network of sanitary sewers (5,222,000 linear feet total) that collect wastewater and convey it to either a major sanitary trunk sewer or a combined interceptor sewer. The sanitary flow from these basins is treated at the CBWTP or the Tryon Creek Wastewater Treatment Plant, or, for selected areas, through contract arrangement at facilities operated by Clean Water Services or the City of Gresham.

The major features of the separated sanitary sewer system, pump stations and force mains are shown in Figure 2-3.

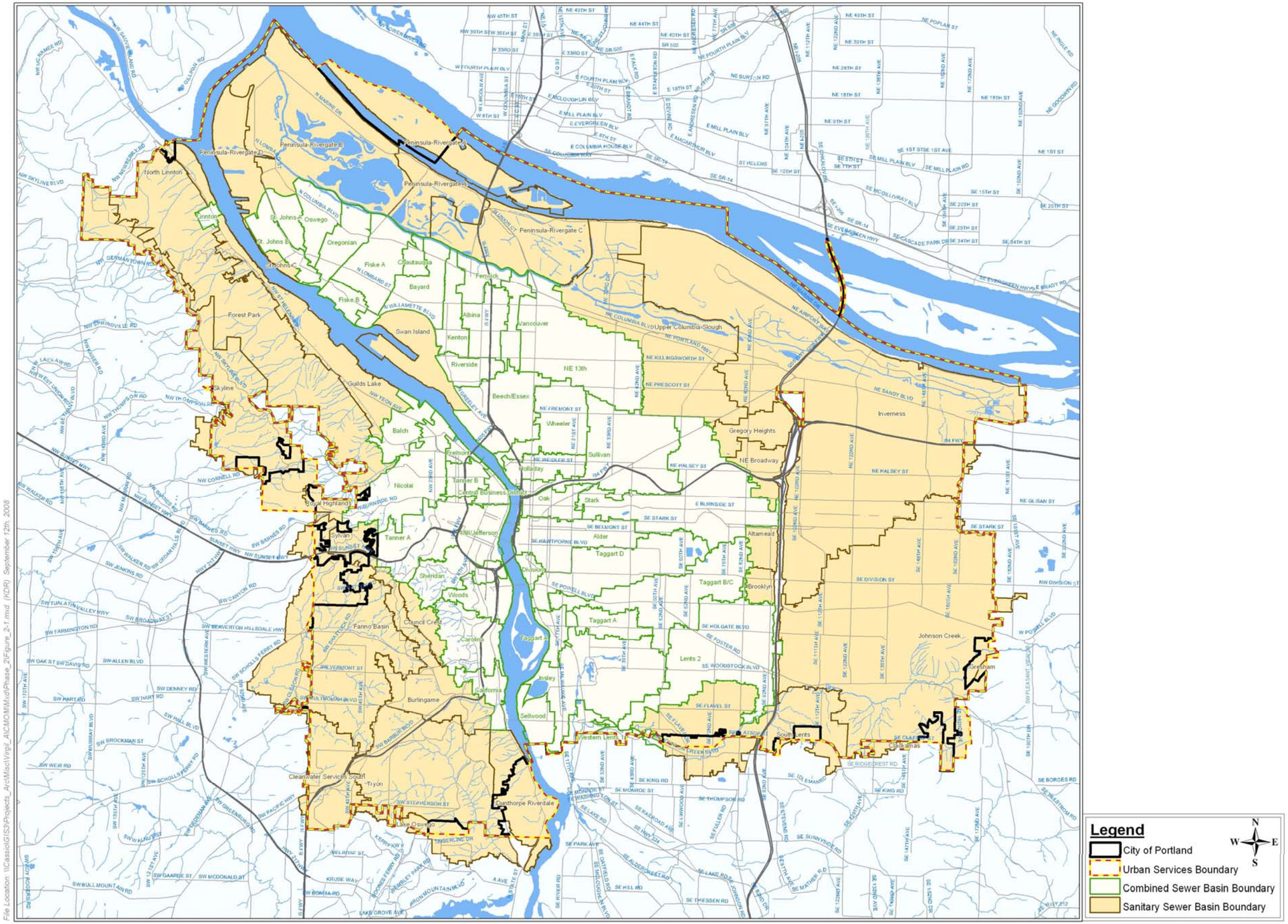


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Figure 2-1. City of Portland Urban Services Boundary

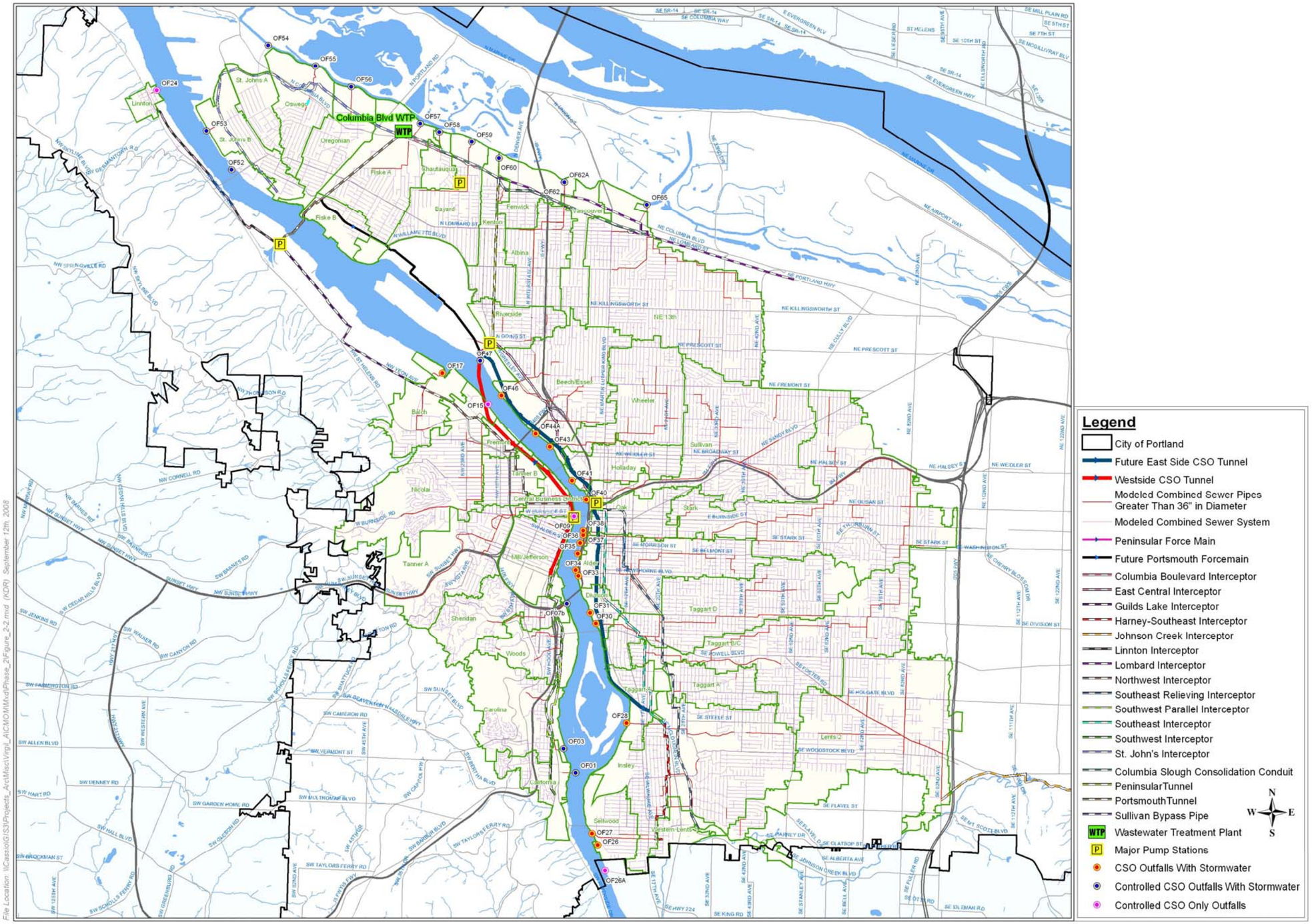


Figure 2-2. Major Combined Sewer System

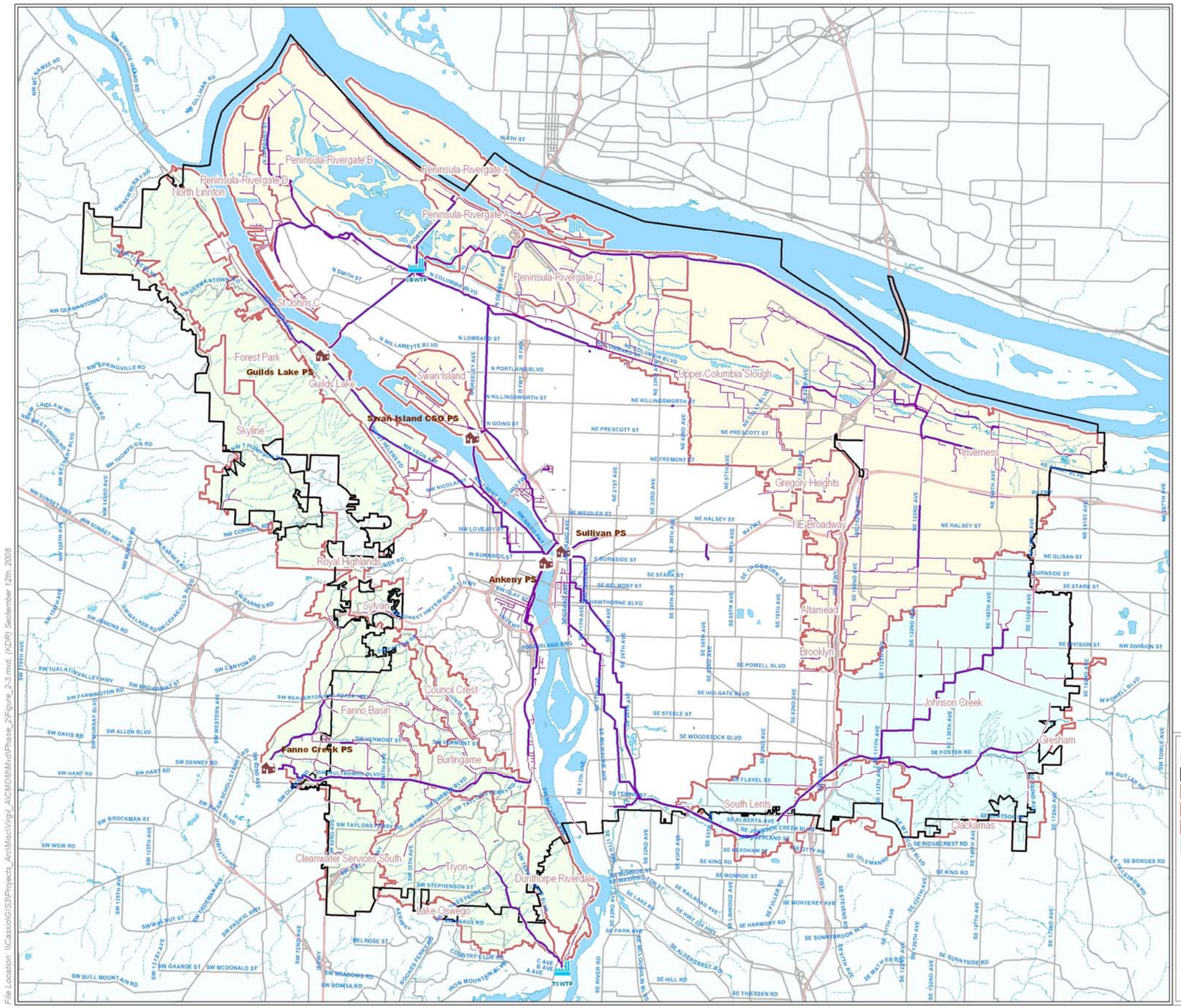


Figure 2-3. Major Sanitary Sewer System

The City has a total of 82 sanitary pump stations that lift sanitary flow from low-lying areas into the gravity portion of the separated system. Two areas, Skyline West and Skyline East, are currently served primarily by septic systems. These areas are largely undeveloped, are very hilly and rocky, and are classified by Metro as open space/urban reserve. At this time, development plans for the two areas are uncertain. Development could occur as individual dwellings constructed on large lots with septic systems, or the collection system could be extended. Using current growth estimates, staff have estimated base flows for these areas in order to estimate the cost of providing sanitary sewers. In the future, if the areas are rezoned for denser development, BES will revise the modeling and Public Facilities Plan to include facilities to accommodate that growth. Based on slope characteristics, it can be assumed that flows from Skyline West would be conveyed to Clean Water Services for treatment and flows from Skyline East would drain into the Guilds Lake Interceptor that connects to CBWTP.

IGAs

The City has IGAs with various municipalities, or jurisdictions, regulating flows that are sent to its treatment system. The agreements define the quality and quantity of wastewater flow that can be accepted by the City. The City's National Pollutant Discharge Elimination System discharge permit requirements are represented in the agreements. The annual pretreatment report submitted to the Oregon Department of Environmental Quality documents the pretreatment program activities and identifies whether there are significant industrial dischargers or categorical industrial dischargers from within the IGA service areas that contribute to the flow in the City's collection system. The City has IGAs with:

- Clackamas County Service District No. 1
- City of Gresham
- Dunthorpe-Riverdale
- City of Lake Oswego
- City of Milwaukie
- Clean Water Services
- Multnomah County Drainage Districts (Multnomah County Drainage District, and Peninsula Drainage Districts Nos. 1 and 2

A summary of the conditions included in the major IGAs is provided in Section 4.

3: ORGANIZATIONAL STRUCTURE AND SYSTEM ELEMENTS

The City of Portland (City) has a well-established and organized governmental structure which clearly delineates responsibilities and authority in a way that provides for efficient and effective management, operation, and maintenance of the wastewater collection system. A number of internal communication protocols have been established to ensure that information flows freely to those decision-makers, regardless of the bureau, division, group, or individual involved. Detailed training programs are in place such that all staff can perform their tasks efficiently and safely. In addition, several management information systems are used that provide current information on the City's sewer collection system assets and financial status.

The section presents the organizational structure of the City and bureaus responsible for implementing the Capacity, Management, Operation and Maintenance (CMOM) Program provisions. In addition, this section provides an overview of management information systems, communication, and training procedures and activities.

City Structure

The City has the last remaining Commission form of government among large cities in the U.S. The Mayor, four Commissioners and the Auditor comprise the City's six elected officials. The Mayor and the Commissioners together make up the City Council (Council). The Council adopts the budget and passes laws, policies, and regulations that govern the City. The Mayor and Commissioners also serve as administrators of City departments, individually overseeing bureaus and carrying out policies approved by the Council. The assignment of departments and bureaus is determined by the Mayor and may be changed at his or her discretion. Bureau assignments do not necessarily correspond to departmental titles.

The City's Bureau of Environmental Services (BES) and Bureau of Transportation make up the primary bureaus charged with implementing CMOM-related activities.

BES Structure

A brief description is provided for each group within BES with a more detailed description provided for each section and division that is involved in the implementation of CMOM activities for the wastewater collection system. Figure 3-1 shows the overall organizational structure.

BES is organized around six groups:

- Office of the Director
- Watershed Services
- Engineering Services
- Business Services
- Pollution Prevention Services
- Wastewater

Office of the Director

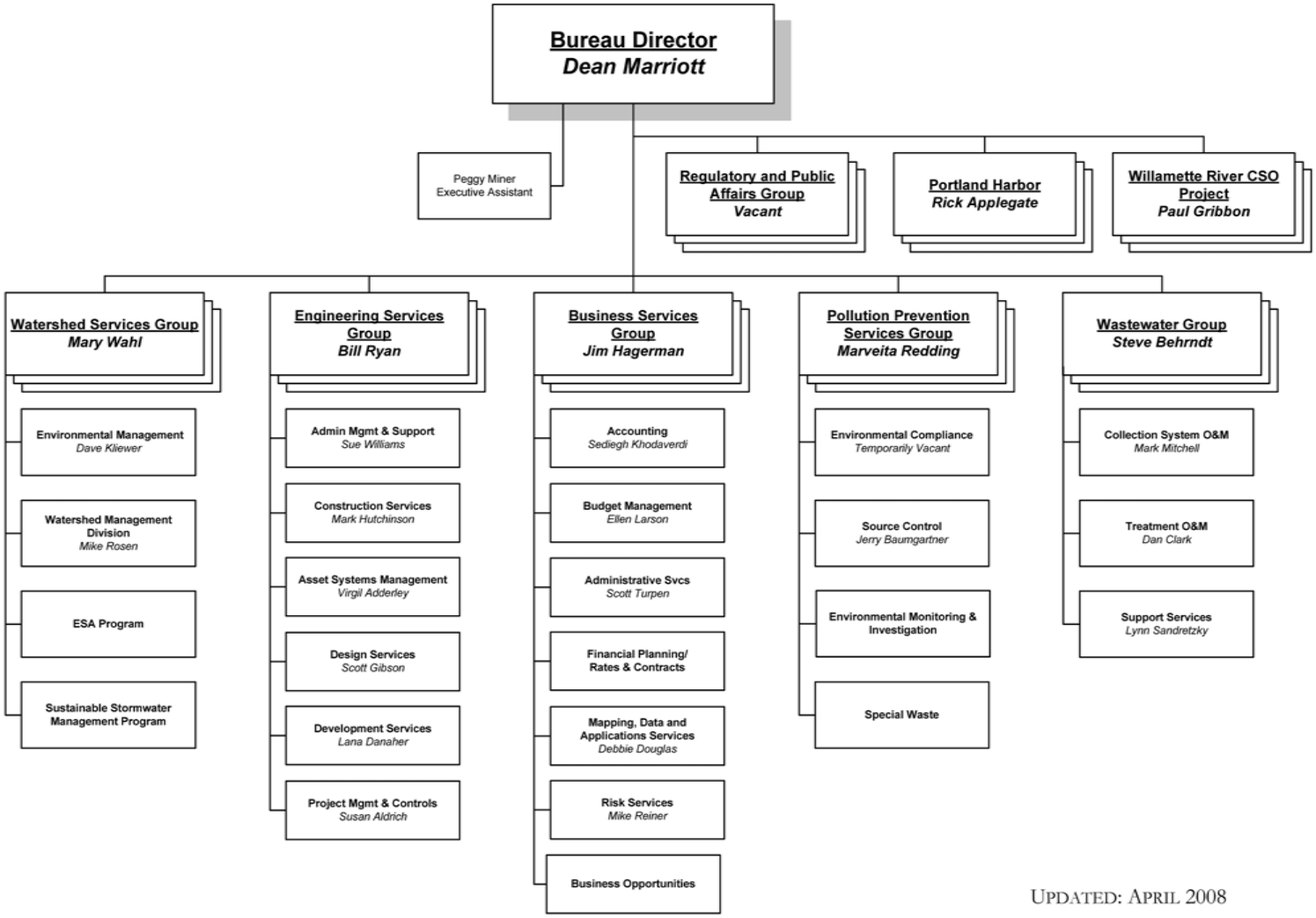
The Office of the Director manages BES, coordinates the activities of BES's five operating groups, and ensures timely and appropriate response to the public, ratepayers, and regulatory agencies. Coordination includes overseeing the development of the bureau budget and managing review of programs, projects, and services offered by the bureau.

The Office of the Director develops and manages bureau and environmental policy recommendations for Council consideration. The office works closely with other City bureaus, regulatory agencies, the Natural Resource Trustees, and tribal governments on local, state, and national environmental issues. The Director provides supervision of the newly formed Regulatory and Public Affairs Group, the Portland Harbor Superfund program, and the Combined Sewer Overflow (CSO) Program. The Office of the Director is funded for 20 full-time equivalent (FTE) positions.

Watershed Services Group

BES's watershed management programs evaluate the condition of the City's watersheds (Willamette River, Columbia Slough, Johnson Creek, Tryon Creek, and Fanno Creek), and implement projects to improve their health. Working closely with River Renaissance, the Endangered Species Act Program, other agencies, and citizens' groups, BES helps protect Portland's natural resources, restore critical ecosystems, and retrofit existing development with innovative technologies to integrate the urban area with the natural environment. The Watershed Services Group is funded for 50 FTE positions.

Figure 3-1. BES Organizational Structure



Engineering Services Group

The Engineering Services Group is responsible for developing BES's Capital Improvement Program (CIP), system planning, managing implementation of capital projects, providing engineering services to all bureau programs, and managing BES's Systems Development Program. The group is divided into the following divisions: Administration Management and Support, Construction Services, Asset System Management, Design Services, Development Services, and Project Management and Controls. The Engineering Services Group is funded for 181 FTE positions.

- *Administration Management and Support*–This division is responsible for managing group operations, operating budget, personnel, and contract services, and providing support to all group programs. The Downspout Disconnect Program and technical assistance for the Clean River Rewards Program are also managed within this division.
- *Construction Services*–This division provides construction management and inspection services for BES projects and provides materials testing services for both BES projects and projects managed by other City bureaus.
- *Asset System Management*–This division is responsible for bureau-wide system planning and CSO program management, and to ensure the requirements of the Amended Stipulation and Final Order are met in a timely, cost-effective, and functional manner.
- *Design Services*–This division provides project management and engineering design services, and is responsible for ensuring that each assigned project accomplishes its intended purpose on schedule, within budget, at best value, and in a manner consistent with City and BES missions and values.
- *Systems Development Services*–This division assists developers and other customers and supports City development goals by reviewing and approving plans and issuing permits. It also has primary responsibility to develop and revise the City's *Stormwater Management Manual* and to implement policies that protect water resources and stream integrity.
- *Project Management and Controls*–This division develops BES's annual capital budget and 5-year CIP. Project schedules and budgets are monitored to ensure timely and cost effective progress towards completion of capital projects.

Business Services Group

The Business Services Group develops and recommends bureau-wide policies and practices related to all aspects of financial operations and administrative services. The Business Services Group budget funds 48 FTEs. Services provided by the group include:

- Payroll, accounts payable, accounts receivable, grants, project tracking, and year-end financial reporting
- Bureau-wide coordination for the annual budget development process
- Maximum utilization of minority, women, and emerging small businesses in bureau contracting
- Procurement-related services including assistance with solicitation, selection, disputes and protests, and administration of contracts
- Coordination and management of bureau-wide administrative services, including training, human resources administrative support, clerical support, property management and administration, and management of interagency agreements

- Financial planning and forecasting, wholesale service contract development and administration, debt management, and user fee and system development charge ratemaking, and management of the Clean River Rewards stormwater discount program
- Development and provision of spatial data through electronic maps and the geographic information system (GIS), maintenance and provision of collection system asset data, and management of the service level agreement with the Bureau of Technology Services.
- Administration of BES's loss control and safety program and owner-controlled insurance programs for the CIP.

Pollution Prevention Services Group

The Pollution Prevention Services Group focuses on preventing deleterious materials from entering the public collection systems. Responsibilities include the Pretreatment Program and the Fats, Oils, and Grease (FOG) Program. The group is comprised of four functional divisions: Environmental Compliance and Enforcement, Source Control (also referred to as the Industrial Source Control Division), Environmental Investigations, and Special Waste. In addition, this group includes the spill control and citizen response section that tracks and reports all sanitary sewer overflows (SSOs). The Pollution Prevention Services Group is budgeted for 75 FTEs, and its organizational structure is shown in Figure 3-2

Wastewater Group

The Wastewater Group protects public health, water quality, and the environment by operating and maintaining wastewater and stormwater collection and treatment facilities and managing programs in a manner that ensures compliance with applicable permits, regulations, and contracts.

The Wastewater Group operates and maintains wastewater and stormwater conveyance and treatment systems. In addition to two wastewater treatment plants, the system includes 96 active pump stations, approximately 2,300 miles of pipeline, 61,000 manholes, 8,500 stormwater sumps, 122 miles of ditches, 20 miles of culverts, 54,000 stormwater inlets and catch basins, 573 trash racks, 250 pollution reduction facilities, and 161 stormwater detention facilities.

Inspection, cleaning, maintenance, and repair for most sewer and stormwater facilities are provided through a collaborative work agreement with the City's Bureau of Transportation/Maintenance Operations (PDOTMO). PDOTMO also provides collection system customer response and utility locating services.

Services provided by the Wastewater Group include stormwater residuals management, vector control contract management, emergency capital repair, and response to customer inquiries. The group manages a variety of support services including administrative services, computerized asset management, facilities management, and inventory management, as well as acquisition to support wastewater and stormwater collection and treatment operations.

The Wastewater Group budget funds 141 FTEs, and its organizational structure is shown in Figure 3-3.. The two primary divisions of the Wastewater Group relating to wastewater collection system management are the Collection System Operations and Maintenance (O&M) Division and the Pumping and Treatment Division.

- *Collection System O&M Division*—This division has approximately 15 FTEs to support sewer collection system O&M activities, and encompasses three groups: Maintenance Engineering, Stormwater O&M, and Residuals Management. The Collection System O&M Division Manager is a certified Level 4 Collection System Operator and is designated as the official operator to the Oregon Department of Environmental Quality (DEQ).

- *Maintenance Engineering*—Provides technical support for O&M of the sanitary collection systems. This group consists of eight FTEs.
- *Stormwater O&M*—Provides technical support for O&M of the stormwater collection system. This group includes five FTEs.
- *Residuals Management*—Manages the materials removed from sanitary and stormwater sewers and manholes.

- *Pumping and Treatment Division*—This division has 110 FTEs to support the treatment facilities, pump stations and related programs. Within this division, the Pump Station Maintenance Operations (PUMA) section provides staff for O&M of the City's 96 sanitary pump stations. Eleven millwrights are assigned to PUMA. The Electrical and Instrumentation Division provides electrical and instrumentation support for the pump stations, including two technicians who are assigned full time to PUMA.

Figure 3-2. Pollution Prevention Services Group Organization

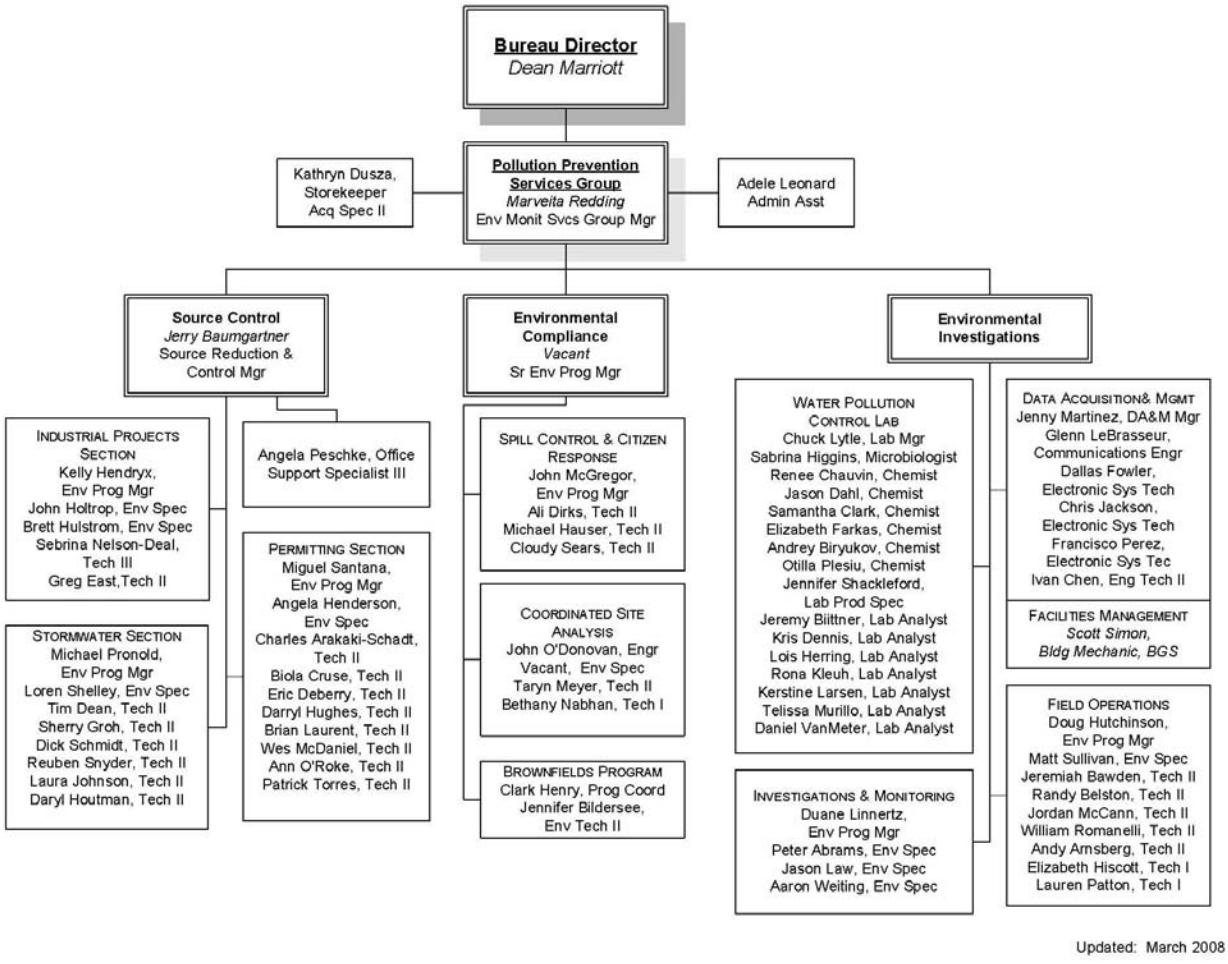
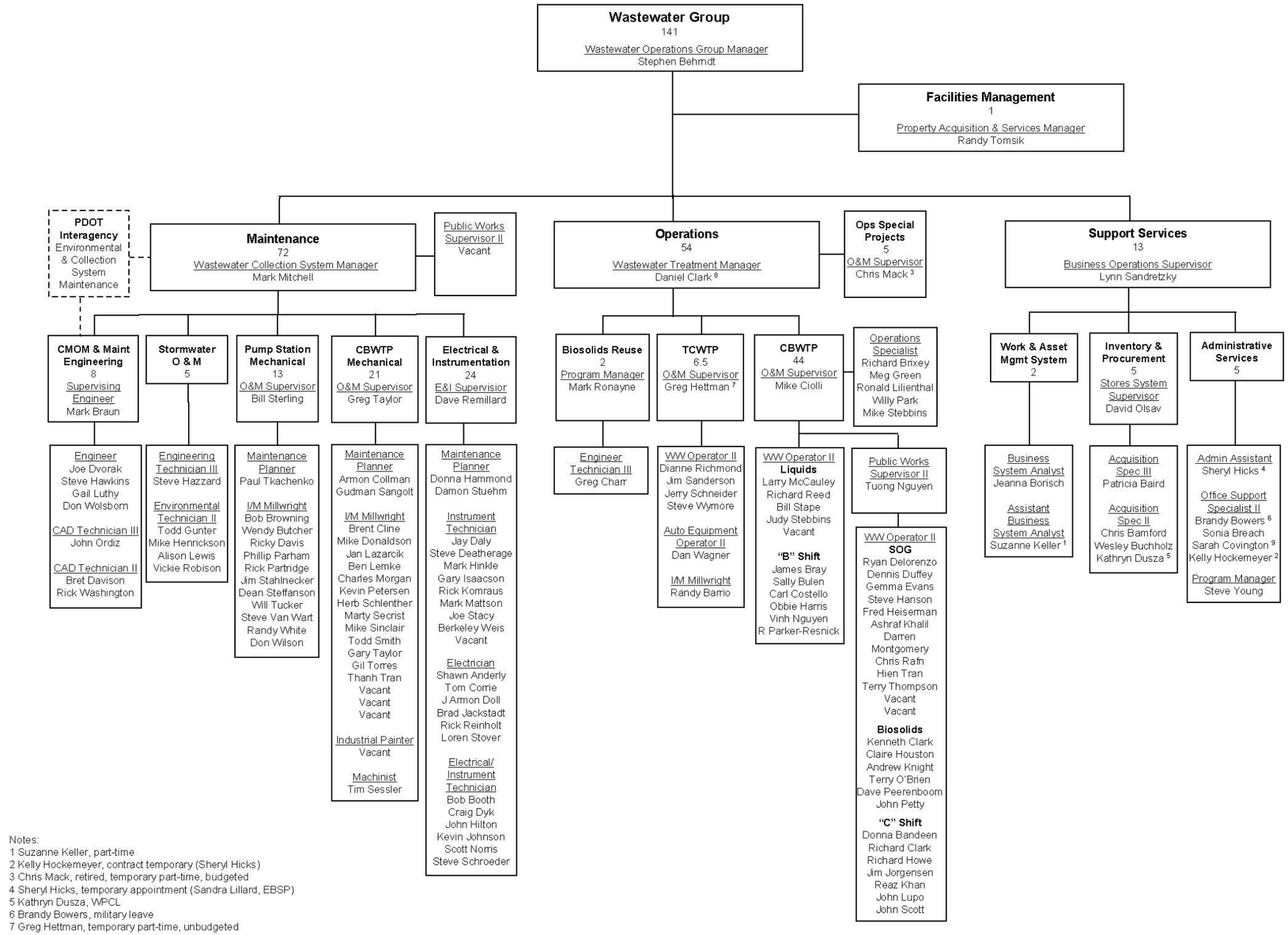


Figure 3-3. Wastewater Group Organization



Notes:
1 Suzanne Keller, part-time
2 Kelly Hockemeyer, contract temporary (Sheryl Hicks)
3 Chris Mack, retired, temporary part-time, budgeted
4 Sheryl Hicks, temporary appointment (Sandra Lillard, EBSP)
5 Kathryn Dusza, WPCL
6 Brandy Bowers, military leave
7 Greg Hettman, temporary part-time, unbudgeted
8 Dan Clark, temporary, budgeted
9 Sarah Covington, contract temporary part-time (Brandy Bowers)

07/01/08

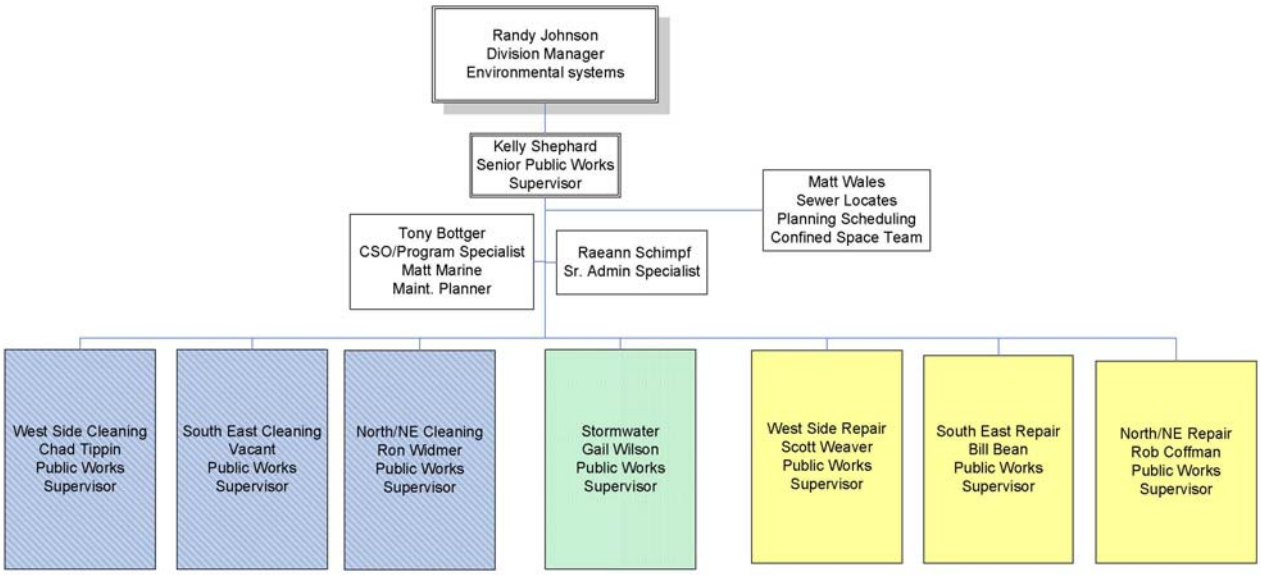
PDOTMO Structure

PDOTMO's Environmental Systems Division (ESD) has a staff of more than 120 employees that provide O&M services for both the wastewater and stormwater collection systems. ESD is divided into five groups, as shown in Figure 3-4 and described below:

- *One-Call/Locates*—Four FTEs provide sewer locate services.
- *Sewer Cleaning*—48 FTEs provide sewer cleaning and closed-circuit-television (CCTV) inspection services. Sewer cleaning and inspection crews are assigned to one of three geographical areas that divide up the entire city: west, north, northeast, and southeast. Of these, two are special investigators who perform more difficult investigations into the causes of problems in the collection system.
- *Planning and Scheduling*—Two FTEs are responsible for making work assignments for preventive maintenance activities, such as sewer cleaning and inspection based on the maintenance targets.
- *Sewer Repair*—50 FTEs provide minor repair services for the City. Staff members are assigned to one of three groups based on geographical area.
- *Stormwater*—16 FTEs maintain the City's stormwater conveyance and management facilities.

The head of PDOTMO ESD is a certified Level 4 Collection System Operator and is designated as the back-up operator to DEQ.

Figure 3-4. PDOTMO Environmental Systems Division Organization



BES/PDOTMO Cooperative Work Agreement (CWA)

BES and PDOTMO work closely together to efficiently and effectively operate and maintain the wastewater collection system. A CWA between BES and PDOTMO has been developed that defines the roles and responsibilities for at least 48 activities.

In summary, the agreement outlines five sections that define the roles for each bureau as follows:

- *Administration*–Tasks include maintaining the cooperative work agreement, process improvement, benchmarking, equipment purchasing, and responding to claims. Responsibility is mostly shared between the two bureaus.
- *Preventive Maintenance Schedules and Work Orders*—BES is responsible for establishing the overall preventive maintenance approach and time-frame. PDOTMO is responsible for translating that information into schedules and preparing and managing the work orders. Both bureaus write work orders in response to customer complaints and problems discovered in the field.
- *O&M Activities*—Responsibility is shared between BES and PDOTMO.
  - *Planning*—BES establishes system maintenance standards and targets. PDOTMO is responsible for maintaining the planning standards and developing the PDOTMO work plan and budget.
  - *Programs*—PDOTMO is responsible for managing the inspection, cleaning, repair, and One-Call programs.
- *Engineering*—BES is responsible for providing all engineering services needed for system maintenance, either through in-house staff or outside consulting services.
- *Program Support*—BES is responsible for maintaining all data systems related to the system, including maps, as-built drawings, the Hansen® computerized maintenance management system (MMS), records of connection, and other historical documents. The two bureaus share responsibility for establishing and implementing business practices.

Excerpts from the cooperative work agreement are included in Section 11.

Labor Union Representation

BES engineers and technicians are represented by the City of Portland Professional Employees Association. The treatment plant and pump station O&M millwrights are represented by the Laborers' International Union of North America, Local 483. The electrical and instrumentation staff supporting the pump stations belong to the International Brotherhood of Electrical Workers, Local 48.

PDOTMO staff is unionized under Laborers' International Union, Local 483. PDOTMO Public Works Supervisors are exempt.

Job Descriptions Relevant to CMOM

BES has funding for approximately 531 FTEs for fiscal year (FY) 2008-09. Of the total funded positions, 33 are currently vacant. On average, they have been vacant for approximately 4 months.

Job descriptions for BES-funded positions are available on the City's website (www.portlandonline.com). Job descriptions are reviewed and updated every few years. Each job description includes an explanation of the nature of the work and the minimum requirements for fulfilling the position, and identifies any special qualifications and/or certifications required for filling the position.

PDOTMO has funding for approximately 124 FTEs for FY 2008-09 that are involved with the wastewater collection systems. Of the total funded positions, nine are currently vacant. On average, they have been vacant for approximately 5 months.

Job descriptions for PDOTMO-funded positions are available on the City's website (www.portlandonline.com). Job descriptions are reviewed and updated every few years. Each job description includes an explanation of the nature of the work and the minimum requirements for fulfilling the position, and identifies any special qualifications and/or certifications required for filling the position.

Communication

BES has established protocols to ensure open communication within the bureau and with PDOTMO. These communication systems and procedures provide efficient and effective management, operation, and maintenance of the wastewater collection system. Descriptions of communication protocol used to interact with the public are provided in Sections 6 and 7.

BES Internal Communication

BES uses many forms of communication to operate and maintain the wastewater collection system, including top-down, bottom-up, and lateral exchanges of information. Examples of communication protocol that are in effect, include the following:

- The Communications Division publishes *The Clarifier*, an employee newsletter, monthly.
- The Engineering Services Group publishes *Engineering News*, a group newsletter, on a monthly basis.
- BES's Management Team meets monthly.
- BES staff provide frequent brown bags and tours for staff regarding specific issues or projects.
- The Communications Division holds monthly staff meetings.
- BES encourages a supportive and respectful workplace where employees honor diversity and help each other to succeed.

To improve internal organizational performance, the following measures have been implemented:

- A set of 10 Management Principles have been adopted that set parameters for how managers carry out work.
- Several volunteer committees meet regularly to address the quality of the BES workplace in terms of management practices, diversity, and peer support programs.
- The Business Services Group conducts two surveys on behalf of these volunteer committees. Results of both surveys guide committee planning for improving the BES workplace.
- The annual Workplace Environment Survey asks all employees to anonymously rate 16 components of the BES workplace, e.g., clarity of direction, employee recognition, safety, access to information, and others.
- In the biennial Management Excellence 360 Degree Survey, all managers receive individualized, anonymous feedback from peers, supervisor, and subordinates on how their performance reflects the 10 Management Principles.
- Employees receive annual performance evaluations.

- There are three major award programs:
  - *Blue Heron Award*—Annual award given to one individual and one section for outstanding work and dedication to BES's goals.
  - *Value Statement Award*—Recognition award given to nominated individuals whose work exemplifies one of the 11 BES Value Statements.
  - *Shining Star Award*—Recognition of achievement or excellence by coworkers.

BES-PDOTMO Interagency Communication

Formal and informal lines of communication have been established in support of the CWA between BES and PDOTMO. The purpose of this communication is to ensure effective implementation of work elements between the two organizations.

A cooperative management team has been established to effectively implement the work agreement. The Collection System Management Team (CSMT) addresses day-to-day collection system issues, develops and manages the interagency budget and the work agreement, develops and implements long-range plans, oversees joint BES/PDOTMO work improvement processes, and represents common interests in interactions with other programs, bureaus, and agencies. The CSMT has a standing weekly, 2-hour meeting to ensure that the agencies' work teams have all of the support and input necessary to keep the work and communication on track at all times.

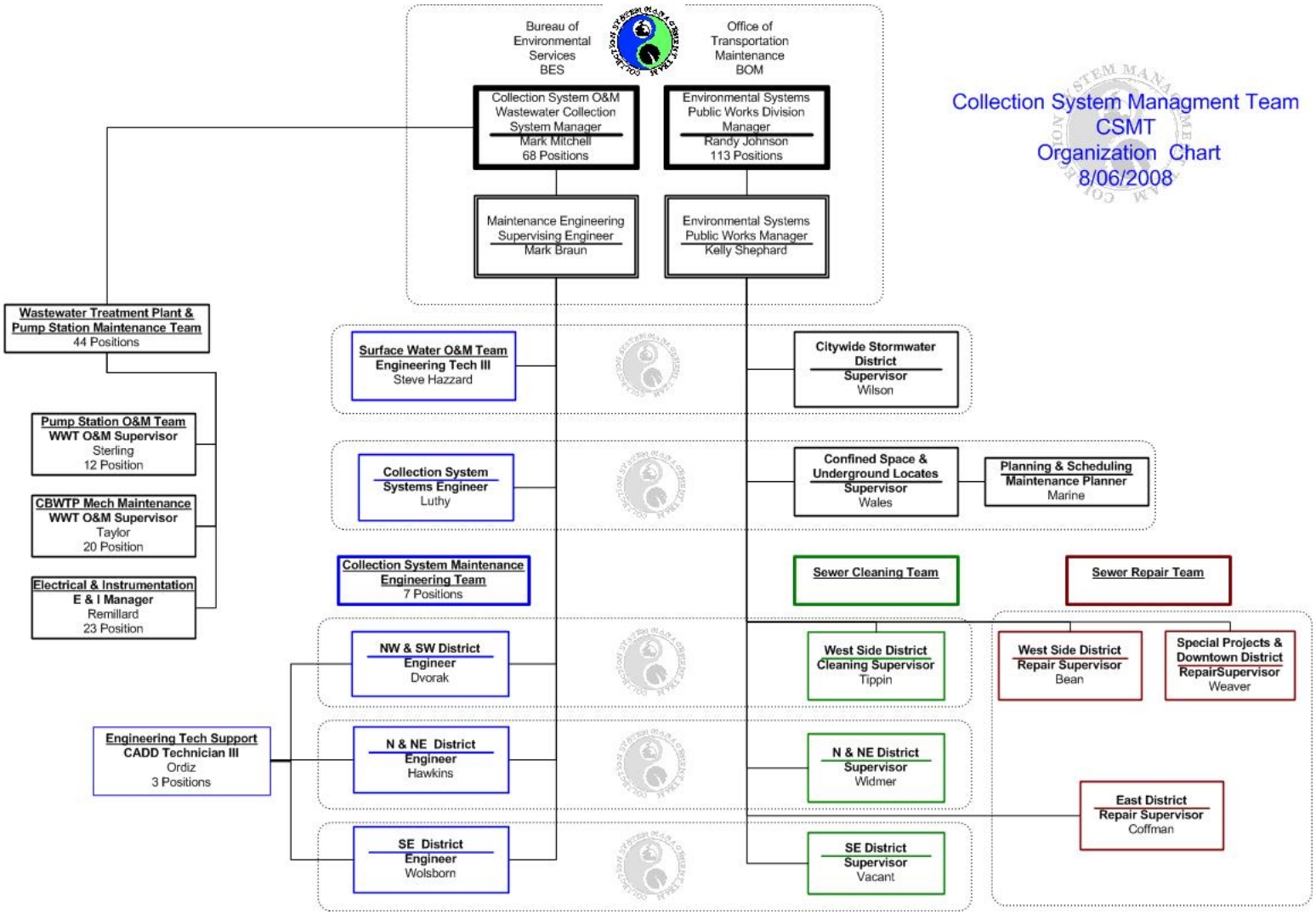
The CSMT includes two staff members from each bureau, as shown in Figure 3-5. Major supporting staff to the CSMT are also shown.

Higher level quarterly meetings are held between the CSMT and a designated representative from BES and PDOTMO that include repair and cleaning supervisors, a planner/scheduler, the BES Collection System Maintenance Engineering Section, and the BES Stormwater Operations Section.

Another inter-bureau communication mechanism is the Sanitary Sewer Overflow Reduction Team (SSORT). SSORT is a group of BES and PDOTMO employees who collect and document all relevant information associated with each SSO and attempts to determine if there are common causes or recurring locations. The SSORT meets quarterly and is composed of the following:

- Collection System Maintenance Engineering Supervisor
- Collection System Maintenance Engineering System Engineer
- Asset Systems Management Manager
- Asset Systems Management Data Mapping Technician
- Environmental Compliance Officer
- Spill Control and Citizen Response Supervisor
- PDOTMO Senior Public Works Supervisor
- PDOTMO CSO/Program Specialist

Figure 3-5. Collection System Management Team



SSORT oversees implementation of routine measures to prevent SSOs. In addition, they develop policy and budget recommendations to be presented to the Sanitary Sewer Overflow Oversight Team (SSOOT). The SSORT uses the CMOM guidelines as guidance for implementing SSO reduction measures. The SSORT reports annually to the SSOOT and gives input to the Annual CSO Report.

Management Information Systems

BES has a robust suite of data and work management systems for the wastewater collection systems and the treatment plants and pump stations.

Synergen®

Facility locations and plant/pump station components are recorded in the Synergen database. Synergen is used to track planned (predictive and preventive) and corrective maintenance on components. Also, Synergen is used to manage the spare equipment and parts inventory for the pump stations.

Maximo®

Maximo is used by PDOTMO to track spare parts and equipment for the operation and maintenance of the wastewater collection system.

Hansen MMS

Detailed attributes of the collection system are recorded in the Hansen MMS database. Hansen is also used to manage work orders, to record work completed (planned and corrective), to store inspections (providing condition assessment information) and to store additional information used for maintenance planning, permit application analysis and system planning.

ArcGIS

The sanitary sewer collection system has been mapped and is viewable through the City's GIS tools. BES is currently using MapInfo® as the primary GIS tool; however, changes are being implemented to shift the bureau to an ESRI based GIS. The GIS is linked to the Hansen database.

GIS has substantially replaced paper maps. Asset data is displayed graphically in layers that draw upon available data from the Hansen database. GIS map features are associated with database information, thus keeping map data as current as the asset database.

Information Included in Maps

The GIS maps include the following data classes associated with the Hansen database: asset type, asset physical characteristics, location, ownership (maintenance responsibility), installation information including project information and installation date, connectivity, safety information, work order history, and inspection information. All but the work order history and inspection information is available to City staff through GIS. All data including work order history and inspection information is available to City staff and the public through PortlandMaps.com.

Map Updating Process and Frequency

The assets that comprise the BES sewer and stormwater collection system are mapped in a custom GIS application known as the Data Maintenance Environment (DME). DME consists of a tool set that operators use with GIS software, a structured query language (SQL) Server database holding the spatial data, and a set of SQL stored procedures that synchronize the attribution with the separate Hansen database.

The core set of attributes for the assets such as pipe size, type, length, and material are entered into the system inside of the Hansen interface. To eliminate the need for duplicate data entry and avoid discrepancies between Hansen and the GIS data, all inserts, updates, and deletion trigger SQL stored procedures to move new values to the GIS database using transactional replication within a few seconds. The spatial data are protected using structures that prevent direct editing of the attributes in the GIS software, so all attribute changes can only be made within the Hansen application.

The toolset provided to the operators adds specific functionality for integrating the records replicated from Hansen with geometry drafted from as-built records provided by engineers and construction crews. These tools add searching functionality, the ability to delete records once they are deleted in Hansen, and to associate geometry to replicated records. Once this association is made, all future updates in Hansen are then reflected automatically within the common attributes on the spatial data.

BES's asset data and GIS map layers are kept current by the inclusion of construction information (rehabilitation projects and new construction) and permit records as soon as they are available. Asset information is also updated on field inspections, investigations, and survey information. Construction documents are submitted to the Mapping, Data and Applications Group when projects go to bid. The Hansen database and GIS are updated to indicate changes/additions to the collection system (including current service status). The asset changes/additions are finalized in both the database and GIS after the construction is complete. Updated information in Hansen is available immediately. The GIS map layers are refreshed weekly.

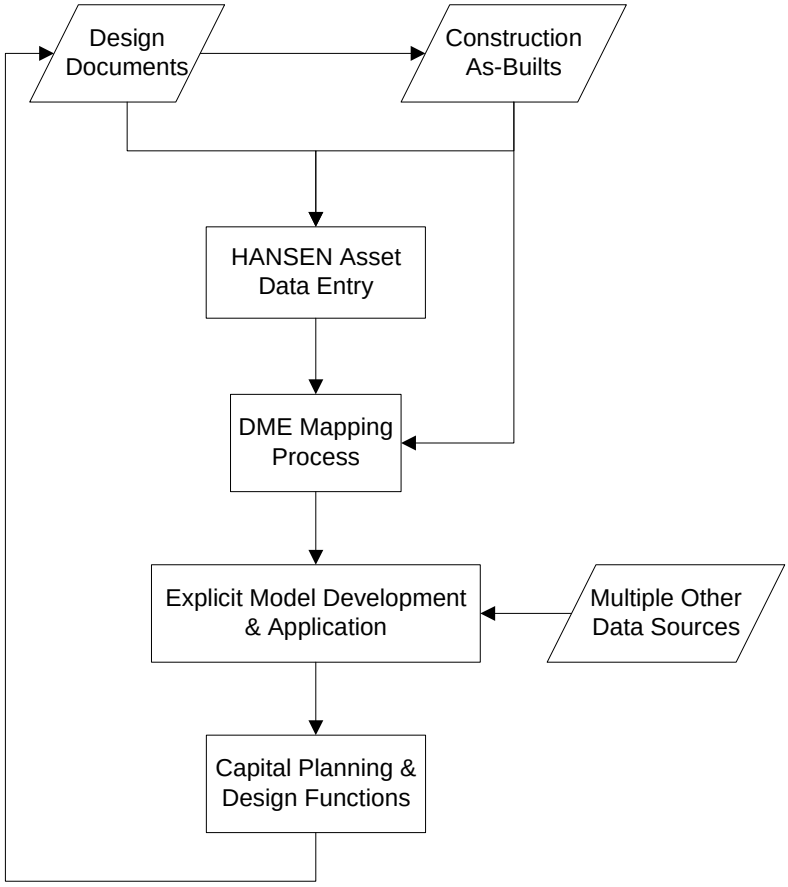
In addition to the GIS maps, as-built documents are stored electronically and are available for viewing to employees through BES's website and to the public through PortlandMaps.com.

Hydraulic Modeling/GIS/Hansen MMS Integration

For the purpose of computer modeling and analysis, the asset spatial and attribute data is copied from the linked GIS coverages, SQL geo-database, and Hansen attribute database and placed into the Explicit Modeling system. The Explicit Model is used for all of BES's planning and design activities that impact any part of the combined or sanitary system. The term "explicit" is used because it incorporates all of the manholes and pipes in the two systems, as well as the detailed stormwater catchments and inflow reduction facilities. The "modeling engine" relies on commonly used urban storm and sewer modeling software (EPA SWMM, XP-SWMM, DHI-MOUSE). Using both the GIS and the Hansen data helps ensure realistic simulations that closely mimic the actual response of the system as measured in the field.

The flow path for the asset data from the point of design, through the Hansen data entry, DME Mapping, and the Explicit Modeling process is shown schematically in Figure 3-6.

Figure 3-6. Data Flow Path for Assets in the Management Information Systems



Training Requirements and Programs

Because BES and PDOTMO are two separate City bureaus, they do not have the same training requirements and programs. The training programs for each bureau are described in the following sections.

BES Training

BES is committed to provide appropriate training to all staff in order to ensure successful implementation of all its programs. Specific to CMOM, training is provided in the following areas:

- Technical
- Safety
- Emergency Response
- Customer Service

The BES Safety Officer maintains safety training records for all BES employees in the training database.

Technical

Training for District Engineers is through conferences and internal training from experienced individuals within BES. The District Engineers attend the annual No-Dig Conference on trenchless technology or the annual Underground Construction Technology Conference each year and are involved in the Municipal Forum on Trenchless Technology. These conferences have papers that are presented on specific projects. The forum includes a session for sharing information about processes, procedures, technologies and products and their individual applications, successes and failures.

The System Engineer attends the appropriate conferences for working with the Hansen MMS (asset database) and classes on database management.

Technicians attend classes that enhance their capabilities at CADD work and database management.

Safety

BES recognizes that employees are the organization's most important asset. Therefore, BES is committed to minimizing risks and promoting health, wellness, and safety for all its employees and the community. This is accomplished through employee involvement, engineering controls, and management practices.

A training guide has been developed that identifies the type and frequency of training required for each employee classification. For example, employees who work in construction are required to have training in at least the following categories: blood borne pathogens, boat safety, confined space entry, driver safety, electrical safety, fall protection, fire safety, first aid/CPR, hazard communication, hearing conservation, lockout/tagout, initial safety orientation, personal protective equipment, strain and sprain prevention, traffic control, and trench safety. Training can be provided by in-house staff and/or outside vendors depending on the need.

For pump-station related activities, safety-related activities and awareness are incorporated in the daily workings of the Wastewater Group's PUMA. PUMA staff successfully work together to promote a safety culture which encourages employee participation and instills a positive safety awareness. Activities incorporated in PUMA's safety program include but are not limited to:

- *Safety Tailgate Meetings*–PUMA staff conduct twice-monthly tailgate safety meetings that provide employees with reviews of safety policies/procedures, allow for input on new policies/procedures, provide for training opportunities, and serve as a forum to discuss safety deficiencies. The meetings are recorded in writing outlining the content of discussions and issues to be forwarded to the Wastewater Group Loss Control Officer and Safety Committee Chair.

- *Personal Protective Equipment (PPE) and Other Equipment*–Adequate safety equipment are provided to all employees. Employees wear PPE as dictated by safety policies and material safety data sheets. Hoists, cranes, tripods, atmospheric monitors, harnesses, etc., are used whenever a hazard can be reduced. Employees are trained regularly on the use of PPE and safety equipment.

- *Safety Policies and Procedures*–Employees comply with all safety policies and procedures. Should an employee deem an activity unsafe, he/she communicates that situation to the lead/supervisor immediately. All accidents and near misses (near hits) are reported appropriately and consistently with adopted policies or practices in a timely manner.

- *Safety Committee Representation*–Each work group in the O&M Division has a representative (not necessarily from the same group) in the Wastewater Group Safety Committee. Employees representing these groups serve as advocates and liaisons for their constituencies in Safety Committee activities. Representatives report back to their constituencies on the activities of the Safety Committee.

- *Accident Reporting and Investigation*–All accidents that result in injuries at PUMA sites are reported to management immediately. If the accident requires professional medical care, the employee fills out an appropriate form. If possible, the employee takes an injured worker packet to give to the doctor at the time of the initial visit. If professional medical care is not anticipated, the employee submits a completed non-medical injury form to his/her immediate supervisor. For any injury accident, the management representative conducts an accident investigation and submits findings to the Safety and Loss Control Manager.
- *Inspections and Problem Remediation*–PUMA staff conduct quarterly safety inspections. Records of the inspection and subsequent actions are submitted to the Safety and Loss Control Manager. These inspections are in addition to quarterly inspections conducted by the Safety Committee.
- *Safety Training*–PUMA staff participate in periodic training that targets the hazards associated with performing pumping station O&M. This training includes:
  - Confined space entry
  - Smart driver training
  - Lockout/tagout procedure
  - Blood-borne pathogens
  - Ergonomics
  - CPR/first aid

Emergency Response

Training for the Emergency Coordination Center and the Emergency Operations Center positions are through the National Incident Management System online training courses and courses given at local emergency response centers.

Customer Service

The following training is provided to customer service staff and front-line field crews with direct public contact:

- All BES staff are provided with a copy of the BES media policy.
- Select staff are trained so that they can conduct tours for the public at the wastewater treatment plants.
- Public Involvement/Community Relations staff use a variety of training methods, such as on-the-job (OTJ) training, shadowing peers, and following the procedure manual.

PDOTMO Training

All PDOTMO employees receive a full orientation when they begin work in the ESD. The orientation covers an introduction to personnel policies and bureau-wide safety practices. PDOTMO spends approximately $460,000 or 2.6 percent of the collection system maintenance budget on its safety and training program.

Technical

Employees receive a wide range of OTJ mentoring from experienced field personnel. For example, CCTV operators and cleaning personnel meet monthly and quarterly, respectively, to review current practices and standard operating procedures. OTJ mentoring is an important component for the career development of newer employees, wherein the employee is provided training in technical skills and in equipment operation

he/she has identified as a career goal. When proficient, the employee is evaluated by experienced operators using a defined format to determine areas for improvement or qualifying him/her to perform the work during operator absences.

Vendor training is provided in numerous areas, including installation of cured-in-place pipe, use of sewer cleaning equipment (particularly for new equipment and demonstrations on how to achieve more effective cleaning), and use of CCTV equipment.

Additional technical training is provided through Clackamas Community College and the American Public Works Association Fall Street Maintenance and Collection Systems Conference.

All training sessions are documented with records managed by the Maintenance Operations Safety and Training Work Group.

Safety

ESD has a Safety Committee that represents all of PDOTMO and also four additional safety committees representing each work division. The safety committees perform quarterly jobsite safety inspections and post the safety findings and problem resolutions. Monthly accident reviews are conducted, involving management and field employees with a focus on team-developed solutions toward future accident prevention.

PDOTMO has a number of written safety policies in place. The Confined Space Entry Policy was initially established in 1986 and is currently under revision. Copies are available upon request from the Maintenance Operations Confined Space Coordinator. The Trenching and Excavation policy was developed in 1985, and was included in the Employee Safety Handbook in 1998 and revised in 2006. The Employee Safety Handbook is issued to new employees during orientation and is available at any time upon request. The Accident Prevention program and policy was developed in 1998 and revised in 2005. The Hazard Communication program was implemented in 1998.

Collection system maintenance consists of cleaning miles of sewer pipe, repair of existing pipe, and maintenance of structures, valves, gates, etc. To ensure that it is done in a safe manner, PDOTMO provides training in the following areas:

- Medic first aid
- Work zone traffic control
- Lockout/tagout
- Hazard communication
- Blood-borne pathogens
- Confined space entry and competent person training

Confined space entry and competent person training is given to all employees who work on jobsites where deep excavation is done. Competent person training instruction covers soil analysis, the use of protective systems, and the requirements of the Excavation Standard. Some employees receive a higher level of confined space training in the use of self-contained breathing apparatus or supplied air when their position requires certain special inspection and repair activities.

Safety policies are available electronically from the Outlook public folders, which is the main depository for all PDOTMO policies, as listed in Table 3-1.

Table 3-1. PDOTMO Safety Policies

Subject	Location	Name
Confined space entry	Outlook/BES Public Folders/BES Safety Policies & Procedures	Confined Space Entry.doc
Crane policy	Outlook/BES Public Folders/BES Safety Policies & Procedures	Crane Policy.doc
Lockout/tagout	Outlook/BES Public Folders/BES Safety Policies & Procedures	Lockout Tagout-Rev_June 2005.pdf
Personal protective equipment	Outlook/BES Public Folders/BES Safety Policies & Procedures	PPE Policy.doc
Hot work	Outlook/BES Public Folders/BES Safety Policies & Procedures	Hot Work Revised 2007.doc

Emergency Response

Crews designated for SSO/CSO response meet quarterly with management staff for informal training on various sewer-related response and investigation activities. Each crew member is issued a sewer emergency response notebook detailing processes and procedures for responding to all types of sewer-related emergencies. Topics included response, investigation, spill mitigation, and public exposure protection.

Customer Service

Crews meet quarterly with management staff for informal training related to customer service/notification.

4: LEGAL AUTHORITY

The City of Portland (City) has the legal authority to enforce all aspects of wastewater collection system management, including prohibitions or restrictions on the quality and quantity of wastewater discharges, standards for new construction and rehabilitation, and prohibitions on stormwater connections. The legal authority is provided through Portland City Code (Code), ordinances, and intergovernmental agreements (IGAs).

This section summarizes the provisions of the Code that authorize the City to effectively manage, operate, and maintain all aspects of the wastewater collection and treatment systems.

Codes and Ordinances

Dischargers of wastewater are regulated by "Title 17, Public Improvements" of the Code and associated administrative rules. Provisions of Chapter 17 include those governing sewer user charges (Chapter 17.36), general discharge prohibitions (Chapter 17.34.030), and stormwater connections to the sanitary sewer (Chapter 17.32.080).

Chapter 17.34 of the Code applies to sanitary discharges and provides that it is the City's policy to "develop and manage sewer facilities that are adequate for the transportation and disposal of waste water within the City and to operate the sewer system in such a manner which protects public health and the environment."

Through the authority derived from the City Charter and Code Sections, the City may:

> …construct, reconstruct, enlarge, alter, modify, equip, operate and maintain, a sewage disposal or sewage purification system within…the corporate limits… including all methods of collection, transport, treatment and disposal of sewage (Charter of the City of Portland, Chapter 11 Special Services).

The Bureau of Environmental Services' (BES) Chief Engineer has Code authority (Code Chapter 17.04.037 Responsible Engineer) to approve the design of all sewers constructed for ownership and maintenance by the City. Title 3 of the City Code, Section 3.13.020, states:

> The Bureau of Environmental Services is responsible for design, construction, operation and maintenance of the sanitary and stormwater collection and transport systems, and watershed management.

Pretreatment Program

The Pollution Prevention Services Group manages programs that regulate discharges to the sanitary system. As part of the group, the Industrial Source Control Division (ISCD) manages the Pretreatment Program, a federally mandated program under the Clean Water Act. The ISCD issues wastewater discharge permits with permit limits to facilities that discharge to the wastewater collection system. The ISCD also initiates surveys, performs inspections, determines compliance and conducts enforcement. In support of the program, the Field Operations Program collects samples and the samples are analyzed by the City's laboratory. An industrial pretreatment annual report is prepared and submitted to the Oregon Department of Environmental Quality as required by Schedule E of the National Pollutant Discharge Elimination System permit.

Fats, Oils, and Grease (FOG) Program

The City has regulatory authority governing discharges to the sewer system in City Code 17.34.030 which includes the following prohibitions:

> **B.1.** Wastewater containing substances in such concentrations that they inhibit or interfere with the operation or performance of the sewer system…
>
> **B.3.** Any solid or viscous substances capable of obstructing wastewater which will or may cause obstruction to the flow of wastewater or other interference with the operation of the sewer system;
>
> **B.18.** Petroleum oil, non-biodegradeable cutting oil, or products of mineral oil origin in amounts that will cause interference or pass through

The above prohibitions apply to the discharge of oil and grease to the City sewer system which includes the "entire sewage collection and treatment system, including but not limited to all conduits, pumps, treatment equipment" [Code 17.34.020 (12)] and all components involved in the collection and transportation of wastewater. Additional prohibitions are defined by the City's Pretreatment Program which includes an oil/grease limit at 110 milligrams per liter for non-polar discharges. As part of the Update of Local Discharge Standards conducted by Black and Veatch in 1996, the standard was reviewed and recommended to be continued. At the same time, the existing local limit for polar FOG was also reviewed and recommended for elimination in favor of more effective alternative control strategies.

The City has taken a multi-faceted approach to the reduction of oils and grease that includes programs targeted at both residential and commercial customers. Elements of the FOG Program include:

- *Educational activities*—Informational mailings to almost 300,000 sewer customers, distribution of informational materials at neighborhood associations and community events as well as the development, introduction and use of best management practices (BMPs) for both the residential and commercial sector.
- *"Hot-Spot" Program*—Similar to those conducted by other municipalities around the country. The program includes a collaborative approach between City maintenance, engineering, public involvement and compliance representatives to identify areas of the City where there have been repeated grease issues including obstructions. Grease Management Areas (GMAs) are identified during maintenance activities, preventive closed-circuit television (CCTV) inspection, and sanitary sewer overflow (SSO) response activities. GMAs are inspected on an accelerated (more frequent) cycle until an appropriate cleaning cycle can be determined to prevent future stoppages or SSOs. Cleaning cycles for GMAs are entered into the Hansen® computerized maintenance management system database and become a part of the routine preventive maintenance scheduling. Currently, there are four GMAs. All accelerated cleaning and inspection cycles are based solely upon grease accumulation rates in each problem area or line segment.
- *Survey of existing conditions*—Includes dischargers (both residential and commercial), system conditions, frequencies of cleaning and other unique aspects of the area. The goals are the elimination of obstructions, improved system performance, and continued implementation of BMPs to prevent future problems.
- *Extra Strength Program*—This is a new program currently under development that will provide additional financial incentives to encourage even greater use of BMPs for grease management by the commercial sector.

- *Multi-jurisdictional approach*—The City is currently establishing a collaborative effort with Multnomah County (which conducts inspections at food service establishments, including restaurants) to provide certain inspection services relating to the management of grease in these facilities. These inspections will benefit the county in insuring the health and safety of these food service establishments and the City by the identification and referral of problems to the City for follow-up, investigation, and corrective actions. These techniques are considered both efficient and cost-effective.

- *Enforcement*—In addition to the pollution prevention approaches described above and in the current version of the *Grease Management Program Manual* (2003), the City retains and continues to use its regulatory enforcement authority. Under city Code 17.34.030 and Administrative Rules, the City has enforcement authorization to deal with those who cause blockages in the system. The enforcement portfolio for grease blockage includes civil penalties and cost recovery for the investigation, CCTV inspection of the line or problem area, and Portland Bureau of Transportation Maintenance Operation costs in clearing the blockage and cleaning the line or effected area of the system. While there is no city-wide requirement for grease interceptors or traps, the City has and uses its authority to require the installation of these facilities when required. The requirements are generally used as part of a compliance action or where such installation is determined to be necessary to reduce the discharge of grease.

The City is aware of the nature and extent of grease problems throughout the country and the significant problems that they present. The incidence of grease problems or blockages in Portland is much lower than the national average. A recent review of sewage release causes places grease-related problems at 14 percent of the total. This is the fifth-ranked cause of system releases. Studies of the City's sewer system show that there is a greater contribution of FOG from residential sources than from the commercial or industrial sector. Local limits studies performed in the last 15 years have not shown grease to be a problem at the wastewater treatment plants.

The City is interested in both addressing collection system issues as well as being cost effective in its approach. In both instances, there is an obligation to the public to use the numerous tools available. The City has analyzed the effectiveness of the current grease management program and the benefits and costs to address grease management through a mandatory commercial grease trap ordinance. The cost of implementing a mandatory ordinance with inspection and maintenance requirements and the benefit derived by such an ordinance, made this option substantially less desirable than the current program. Through the Extra Strength Program, additional financial incentives will be available to encourage even greater use of BMPs for grease management by the commercial sector.

As part of a continuous improvement approach to managing the sewer system, the City has extensively reviewed a number of grease management programs throughout the country. There has been direct communication with representatives of a number of urban jurisdictions through conversation and survey. BES staff have attended seminars sponsored by the Water Environment Federation, Association of Metropolitan Sewerage Agencies and the Oregon Association of Clean Water Agencies. These seminars have featured speakers from around the country who have described their programs. Most programs have identified a number of building blocks that can be used in designing a customized local program. As described above, the City is currently using many of the same strategies as those employed elsewhere.

The Grease Management Program is managed within the Pollution Prevention Services Group. The Spill Protection and Citizen Response section of the Pollution Prevention Services Group responds to sewer collection complaints, blockages and overflows, including those caused by FOG.

Design and Construction Specifications

The City has numerous documents that provide guidance on minimum design and construction standards for its sanitary sewer projects. Some of the more important documents include the following:

- *Standard Construction Specifications*—standards and details for the development engineering community commonly referred to as the Gray Book
- *Sewer Design Manual*—defines requirements for new or replacement sanitary sewers
- *CADD Manual*—defines format for construction drawing files
- *Stormwater Management Manual*—defines requirements for stormwater management (quality and quantity)
- *Engineering Services QA/QC Manual*—used by consultants working for the City

Section 8 of this report describes the development review process to ensure that new designs and construction meet all City standards and specifications.

IGAs for Satellite Systems

IGAs in place between the City and satellite communities are legally binding documents that regulate the quantity and quality of wastewater. IGAs establish minimum levels of operation with regard to the design of new and rehabilitated sewers and service laterals, pretreatment program requirements, grease prohibitions, standards that minimize the amount of infiltration and inflow, and prohibitions on stormwater connections to the sanitary sewer, including, roof drains, footing drains and all other stormwater and groundwater connections. A summary of the agreements between the City and the satellite communities is listed below:

- *Clackamas County Service District #1 (CCSD#1)*–The City and CCSD#1 both transport and treat sewage from each other in areas along the common border which drain from one entity to the other. The City treats the flow from approximately 1,000 CCSD #1 equivalent drainage units (EDUs), and CCSD#1 treats the flow from approximately 30 City EDUs with differences netted and paid on a prorated share of operating costs based on flow. CCSD#1 pre-purchased 2,000 EDUs of transportation and treatment capacity and has the right to connect up to that amount, given appropriate line capacity. The agreement, effective as of October 17, 1990, has 5-year terms that are automatically renewed, and termination is available with a minimum of 6 months notice.
- *City of Gresham*–The City and Gresham both transport and treat sewage from each other in areas along the common border which drain from one city to the other. The City treats the flow from approximately 800 Gresham EDUs, and Gresham treats the flow from approximately 80 City EDUs, with difference netted and paid on a percent retail EDU basis (currently 80 percent). The terms of the agreement, effective as of July 1, 2002, are perpetually renewed and may be terminated with a minimum of 18 months notice.
- *Dunthorpe-Riverdale Service District*–The City provides transportation and treatment of Dunthorpe-Riverdale Service District (DRSD) sewage, as well as all maintenance and engineering of DRSD facilities. The District pays the City on a percent retail EDU basis, currently 80 percent, as well as all direct capital repairs and improvements. The agreement, effective as of February 15, 1995, consists of 3-year terms that are automatically renewed and may be terminated with a minimum of 6 months notice.

- *City of Lake Oswego*–The City owns the Tryon Creek Wastewater Treatment Plant, which is located within Lake Oswego city limits and treats sewage 8.3 million gallons per day from both cities. Lake Oswego pays BES for a prorated share of the plant's operating expenses, depreciation, and return on investment. Terms for the agreement, effective as of January 23, 1983, are for a minimum of 50 years, perpetually renewed thereafter and terminated with a minimum 5 years' notice.

- *City of Milwaukie*–The City and Milwaukie both transport and treat sewage from each other in areas along the common border which drain from one city to the other. Milwaukie treats the flow from 79 City EDUs, and the City treats mostly commercial/industrial flows. Each pays the other separately for flows on 100 percent of retail basis. The agreement, effective as of October 25, 1978, has a 10-year term that is automatically renewed for 5 years, and may be terminated with a minimum of 5 years' notice.

- *Clean Water Services*–The City sends sewage to facilities owned and operated by Clean Water Services in Washington County and pumps a portion of Clean Water Services' flow back to City-owned facilities as an offset to what the City sends there. During times when the pump station is down for maintenance or repairs, all flow is diverted to Clean Water Services facilities for treatment. The City pays Clean Water Services on a percent retail EDU basis, currently approximately 82.5 percent of average residential rate. The terms of the agreement, effective as of July 1, 1999, are perpetually renewed and may be terminated with a minimum of 18 months notice.

- *Multnomah County Drainage Districts*–The City has an agreement with the three drainage districts in the Columbia Slough area (Multnomah County Drainage District, and Peninsula Drainage Districts #1 and #2) for cost sharing of stormwater management and riparian improvements by the City within the districts' boundaries. The agreement has an effective date of July 1, 2000, with a perpetual term to be reevaluated every 5 years, and termination by either party with 5 years' notice.

- *Private Pump Stations*–In addition to the public agency agreements described above, the City has operating agreements to maintain private pump stations for the Port of Portland (two stations), and the Portland Motorcycle Co.

Legal Representation

The Office of the City Attorney provides legal advice and representation to BES and other City entities. The City Attorney offers services on all topics including expertise in the development of rates and charges and implementation of the Clean Water Act and associated federal, state, and local environmental laws.

5: FINANCIAL MANAGEMENT

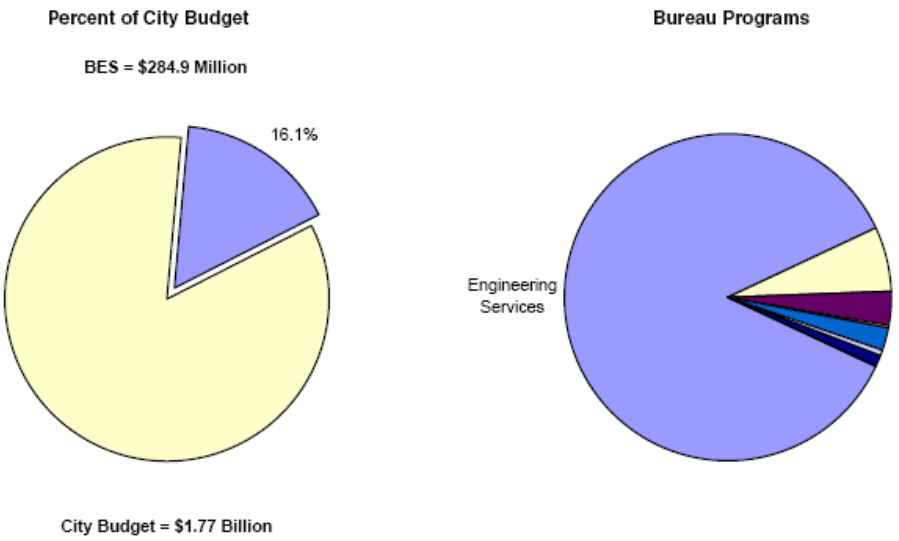
This section defines the budget and financial aspects of managing the City of Portland's (City) wastewater collection and treatment system. It includes a description of how revenues are raised to finance the various City programs and describes the major financial elements of the capital improvement and operating programs.

Financial Management Overview

The Bureau of Environmental Services' (BES) activities are supported with retail sewer and stormwater charges, wholesale contract revenues from surrounding jurisdictions, and reimbursements for services provided to other bureaus.

An overview of the fiscal year (FY) 2008-09 adopted budget is shown in Figure 5-1. The FY 2008-09 adopted budget for operating and capital expenditures is $284.9 million. This budget represents a decrease from the previous year due to carrying forward nearly $40 million of Capital Improvement Program (CIP) budget authority to continue and accelerate the combined sewer overflow (CSO) abatement projects. Seventy-three percent of the FY 2008-09 CIP budget is attributable to the Eastside Tunnel project.

Figure 5-1. BES Budget Overview



Bureau Overview

Expenditures	Revised FY 2007–08	Adopted FY 2008–09	Change from Prior Year	Percent Change
Operating	100,962,577	96,932,927	-4,029,650	-4.0%
Capital	195,080,274	187,972,000	-7,108,274	-3.6%
Total Expenditures	**$ 296,042,851**	**$ 284,904,927**	**$ -11,137,924**	**-3.8%**
Authorized Positions	504	524	20.00	4.0%

The City's strategic direction for managing the sewer system is based upon complying with environmental regulations and providing a level of service that is acceptable to the community. The major activities and programs comprising the strategic direction are described in the following paragraphs.

CSO Program

The City is subject to Oregon Department of Environmental Quality (DEQ) administrative orders regarding overflows from BES's combined sewer collection system. The City has agreed to eliminate CSO discharges that violate applicable water quality standards by December 1, 2011. The FY 2008-09 adopted budget includes $139.1 million of CSO capital costs.

Portland Harbor Superfund

BES represents the City's interests on the Portland Harbor Superfund site by working with DEQ to identify and reduce sources of contamination conveyed to the Willamette River via stormwater outfalls, and with other stakeholders to assess current and past land use practices within the lower-Willamette River drainage basin. This information will be used in the Superfund process over the next several years to assess the City's potential liability for cleanup activities. The FY 2008-09 adopted budget includes $5.4 million of expenditures related to the Portland Harbor Superfund.

Water Quality Compliance

Compliance with the City's National Pollutant Discharge Elimination System (NPDES) stormwater permit requires modeling and evaluation of city-wide pollutant loads, stormwater runoff volumes, and the effectiveness of stormwater management program implementation. In addition to complying with NPDES requirements regarding stormwater-related total maximum daily load (TMDL) allocations, BES also engages in a comprehensive program of in-stream water quality and flow testing to comply with TMDL regulations issued by DEQ. BES is also required to comply with underground injection control (UIC) regulations issued by DEQ for the City's approximately 8,500 stormwater sumps. The City's Water Pollution Control Facility permit regulates the construction, operation, and maintenance of UICs. Compliance requires that BES implement a comprehensive evaluation of all City-owned UICs to determine if they comply with the Federal Safe Drinking Water Act. The adopted budget contains water quality compliance-related funding across a variety of program areas including Watershed Services, Pollution Prevention Services, and Engineering Services.

Endangered Species Act (ESA) Requirements

BES continues to develop and implement a comprehensive watershed framework for the protection of Lower Columbia Steelhead and Lower Columbia Chinook salmon per the requirements of the ESA. In addition, BES has also begun implementing procedures to comply with requirements related to the designation of the City's streams as critical habitat by the National Marine Fisheries Service. The FY 2008-09 adopted budget contains nearly $1 million in ESA-related funding in program areas including Watershed Services, Pollution Prevention Services, and Engineering Services.

Restoration and Remediation

The adopted budget includes funding for continued flood management and watershed restoration activities in the Johnson Creek watershed and pursuant to a consent order between the City and DEQ, funding for the identification and characterization of contaminated sediment sites in the Columbia Slough.

Operational Issues

BES's adopted budget includes $46.2 million to support the operation and maintenance (O&M) of 1,435 miles of separated sanitary and stormwater sewers, 860 miles of combined sewer lines that carry both sanitary waste and stormwater runoff, 96 pump stations, two wastewater treatment plants with a combined secondary treatment capacity of 108 million gallons per day, 160 pollution reduction facilities, and 120 stormwater detention facilities. The adopted budget includes costs associated with the operation of new CSO control facilities on the west side of the Willamette River.

Infrastructure

Also included in the adopted budget is $25.2 million to support capital repair and replacement of sewer system assets to prevent catastrophic failures. More than 30 percent of the collection system is over 80 years old and maintenance needs are anticipated to increase significantly in the near future. BES has committed to providing funds for repair of structurally deficient portions of the sewer collection system, and the long-term financial forecast anticipates significant increases in the capital maintenance budget beyond completion of the CSO program.

Watershed Opportunities

The adopted budget includes $1.5 million for each year of the 5-year CIP to fund innovative watershed enhancements. Priority will be given to projects that leverage other funding sources, demonstrate new technologies, and/or address multiple watershed health goals. Additionally, BES is investing $40 million over the next 5 years to ensure that the City continues to grow in a way that protects and enhances watershed health. This new 5-year initiative will add 43 acres of ecoroofs, construct 920 Green Street facilities, plant 33,000 yard trees and 50,000 street trees, set up the fight against invasive weeds, replace eight culverts that block fish passage, and purchase 419 acres of high priority natural areas.

Financial Plan Overview

The 5-year financial forecast presents BES's revenue and expenditure plan for the operation, maintenance, expansion, and reconstruction of the City's wastewater collection and treatment system. The operations, maintenance, and capital construction programs represented in the plan must provide for operation of the system in a safe, sound, and efficient manner as well as compliance with all applicable health, safety, and environmental laws, regulatory body rules, regulatory body orders, and court orders.

Revenues from rates and other sources must be sufficient to fund the necessary operations and capital programs. To this end, BES forecasts annual rate increases of 5.7 percent over each of the next 5 years. These increases are due to growth in annual debt service costs resulting from the CIP, partially offset by transfers from the Rate Stabilization Fund and increases in non-rated revenues. All CIP expenditures in the financial forecast include an estimate for inflation.

Program Revenues

The major sources of funding for operating, maintaining, expanding, and reconstructing the City's sewer collection and treatment systems are shown in Figure 5-2. These sources are described as follows:

- *Revenues from Rates*–Charges to retail sanitary and stormwater customers, represented by approximately 164,000 residential accounts and 13,400 commercial industrial accounts. Charges are assessed based on the prior winter's average water use, or actual water use, whichever is lower. For FY 2008-09, revenue from rates is projected to be $206.0 million.

- *CIP Transfers*–Cash transfers from the Construction Fund to reimburse for CIP expenditures made out of the Operating Fund, as well as an allocated share of BES overhead. For FY 2008-09, these transfers are projected to be $201.6 million, and consist of sewer revenue bond proceeds (approximately 90 percent), permit fees and charges, line and branch charges (in lieu of assessment), construction grants and state loans, investment income, and current income contributed from the Net Operating Income.

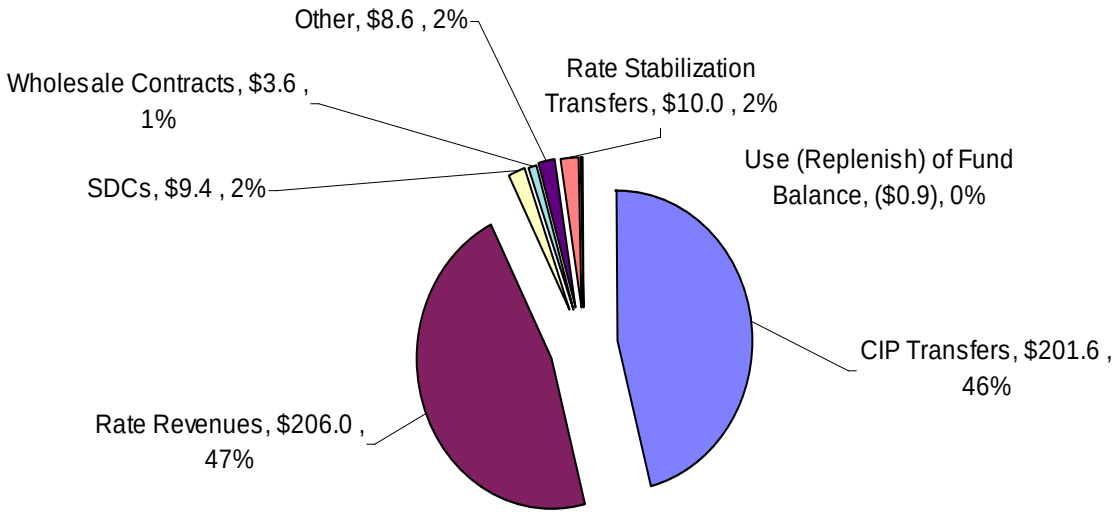
- *System Development Charges (SDCs)*–These are equity charges applied to properties at the time they connect to the sewer collection system for recovering the previous investment made by rate payers for treatment plant, pump stations, major trunks, and interceptors. SDCs are projected to be $9.4 million in FY 2008-09.

- *Rate Stabilization Transfers*–Cash from the Rate Stabilization Fund accumulated over prior years meant to smooth the peaks and valleys of annual expenditures. The FY 2008-09 transfers of $10.0 million represent the beginning of the planned drawdown of funds accumulated in anticipation of the increased debt associated with the completion of the CSO project.

- *Wholesale Contracts*–Charges from neighboring jurisdictions for the transportation and treatment of wastewater flow as per intergovernmental agreements (as discussed in Section 4). Wholesale contracts are projected to be at $3.6 million in FY 2008-09.

- *Other Reven*ues–$8.6 million in revenues include service reimbursements from other bureaus within the City, miscellaneous service charges, licenses and permits, rents, other product sales and investment earnings.

Figure 5-2. FY 09 Projected BES Revenue Overview



BES's finances are reported within several Enterprise Funds. The revenues are dedicated to sanitary and stormwater uses. All costs, operating and capital, are paid from the Sewer System Operating Fund. All of the funds are tracked separately from the City's General Fund and other City funds.

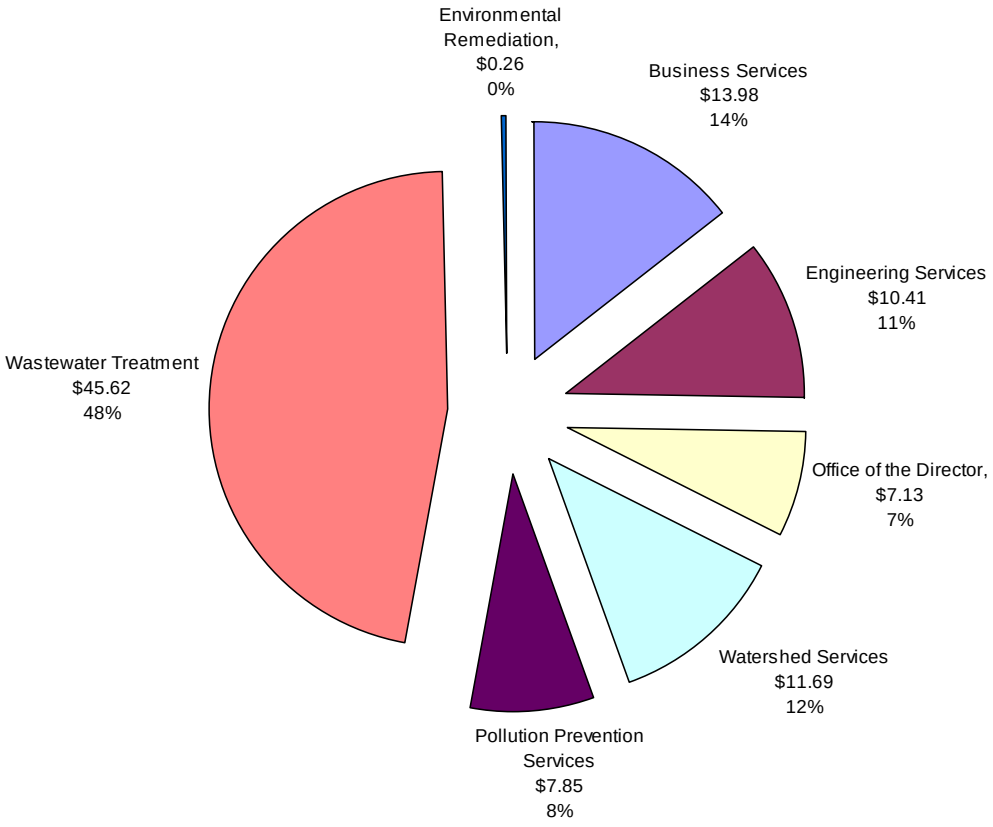
BES's financial reporting system is organized into the five funds described below.

- *Sewer System Operating Fund*–The Sewer System Operating Fund (Fund 151) provides for the day-to-day operation, maintenance, and management of BES programs. All payments for sewer system personnel, materials, and services are made within the Sewer System Operating Fund, with reimbursement from the Sewer System Construction Fund for capital improvements.
- *Sewer System Construction Fund*–The Sewer System Construction Fund (Fund 552) provides for the funding of sewer system capital improvements and reimburses the Sewer System Operating Fund for these capital related expenditures.
- *Sewer System Debt Redemption Fund*–The Sewer System Debt Redemption Fund (Fund 351) provides for the payment of principal and interest on revenue bonds, notes and state loans issued to finance Sewer System improvements.
- *Sewer System Rate Stabilization Fund*–The Rate Stabilization Fund (Fund 632) provides BES with the ability to smooth rate increases by forecasting and offsetting fluctuations in sewer system revenues over several years.
- *Environmental Remediation Fund*–The Environmental Remediation Fund (Fund 161) has in the past supported the City's solid waste disposal site remediation activities. Beginning in FY 2005-06, BES moved the budget for the Portland Harbor Superfund project to this fund. Expenditures for the Portland Harbor Superfund project are financed through earnings within this fund and supplemented by cash transfers from the Sewer System Operating Fund. This allows BES to distinguish the Portland Harbor Superfund project from routine sewer system operations, which are budgeted for and funded within the Sewer System Operating Fund.

Program Expenditures

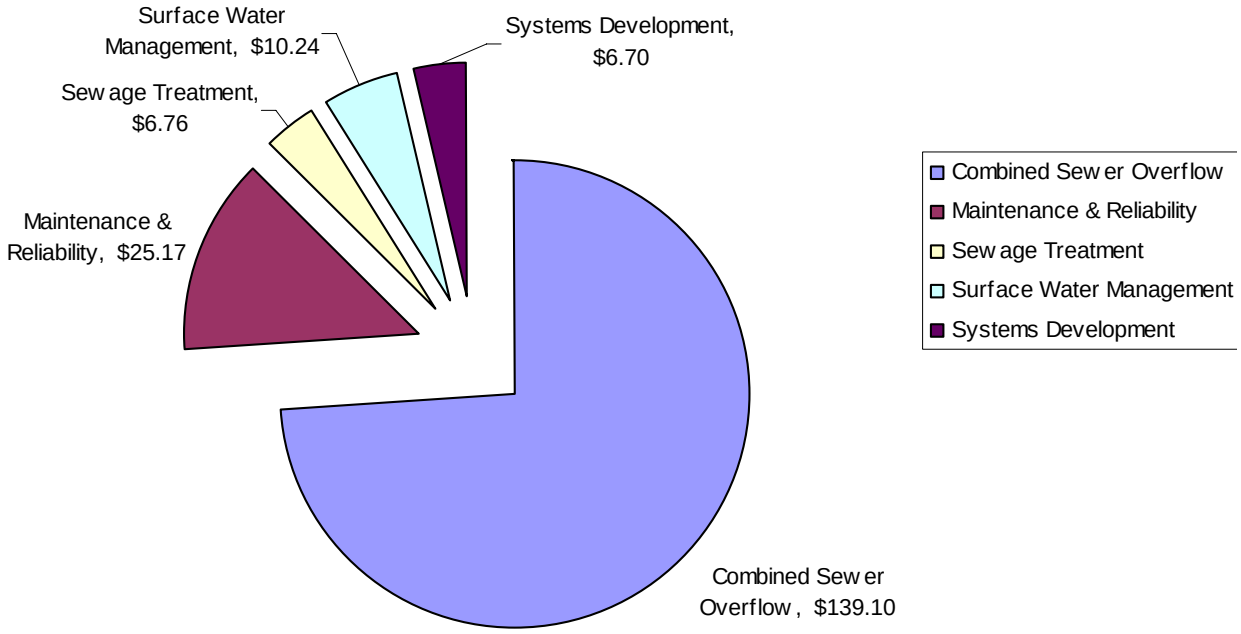
The FY 2008-09 budget is approximately $285 million with approximately $97 million allocated to Operations and $188 million allocated to the CIP. The operating budget supports the activities and programs of its seven business units as shown in Figure 5-3. Wastewater Treatment comprises about 48 percent of BES's FY 2008-09 operating budget, or $45.6 million.

Figure 5-3. FY09 Program Operating Expenditures



The CIP is divided into five program areas: CSOs, Maintenance and Reliability, Sewage Treatment, Surface Water Management, and Systems Development. The distribution of funds to these five areas is shown in Figure 5-4. Nearly 99 percent of BES's capital budget of $187.97 million goes to Engineering Services.

Figure 5-4. CIP Expenditures



Process for Developing the CIP Budget

The CIP budget is developed using a multi-step process to identify, develop, review, score, and rank projects for funding and scheduling priority. This process ensures that the core needs of the sewerage, drainage, and surface water systems and the community they serve are appropriately funded and scheduled. A bureau-wide stakeholder review team investigates, scores, and ranks all CIP projects in accordance with identified CIP criteria. CIP weighted criteria, scoring instructions, scheduling guidelines, estimating procedures, and project request forms are used to ensure that each project is developed, reviewed, and scored based on detailed and consistent information. A CIP development strategy guides project selection and scheduling. Projects are reviewed by managers in finance, program areas, operations, and engineering to ensure financial resources are expending effectively and appropriately. The CIP management team evaluates all the information from the process, meets with selected project and program managers to refine cost and schedule data, and submits a recommendation to the BES Director. The Director reviews the findings and approves the CIP plan.

Process for Developing an Operating Budget

In developing the 5-year financial forecast for the operating budget, managers develop projected costs for the operation and maintenance (O&M) expenditures necessary for existing sanitary and stormwater collection, transportation and treatment facilities. In addition, new capital projects must include cost estimates for maintaining these facilities. The first year of the 5-year financial forecasts becomes the basis for BES's operating budget.

Cost Tracking

BES monitors the CIP and operating budgets for cost control and budgetary status. The CIP is monitored by project life-to-date and fiscal year budget to actual. The operating budget is monitored at detailed levels that consolidate to larger programs. Budgets may be adjusted three times per year, if they are minor, or two times per year if it is a major initiative (supplemental budgets).

Operating projects are tracked if they require a distinct breakdown of the costs through the phases of the project. Collection system O&M activities are tracked by cost centers with computerized maintenance information management systems, including Hansen® and Maximo®. Synergen® is used for the pump stations. The Portland Bureau of Transportation, Maintenance Operations provides BES with labor, vehicle, and equipment use statistics, together with production summaries for evaluating the cost of doing business.

Within BES's CIP project tracking system, projects can be maintained through the life of a project. Project narration, type of work costs, and phase costs are all monitored within BES's CIP Project Controls Division.

BES's cost structure reflects activity-based costing or program accounting, in that expenditure tracking is identified by the type of work/nature of the costs. These costs are then consolidated into divisions which are also organized by type of work. Divisions are then grouped into operating programs or groups that reflect BES's organizational structure.

Program Performance

Each of the six BES primary program areas has its own budget and metrics for evaluating program performance. The targets and actual performances are shown in the FY 2008-09 budget included in Appendix A.

User Rates and Connection Charges

Section 11-302 of the City Charter authorizes the City Council to fix fees and charges for connection to and use of the sewer system. Sewer user fees and connection charges are formally reviewed every year by BES. Rates required to support proposed activities and meet all obligations to bondholders under the ordinance are submitted annually to the City Council for review and approval. No governmental approval, other than the City Council's, is required.

User rates are projected forward for a minimum of 5 years as listed in Table 5-1. The City Council approved an average increase of approximately 5.70 percent to fees and charges for FY 2008-09 in May 2008. Based on the most recent financial forecast, rate increases over the next 5 years are expected to be 5.75 percent annually, compared to an average increase of 9.2 percent annually over the last 20 years. The increases are due to growth in annual debt service costs resulting from the CIP, partially offset by transfers from the Rate Stabilization Fund and increases in non-rated revenues.

Table 5-1. User Rate Forecast

Customer class	Fiscal year					
	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14
Residential						
Sanitary volume, dollars per 100 cubic feet [1]	6.17	6.57	7.00	7.46	7.94	8.45
Impervious area charge, dollars per 1,000 square feet [1]	8.07	8.65	9.27	9.94	10.66	11.42
Average single-family monthly bill, dollars per account [2,3]	50.17	53.05	56.10	59.33	62.74	66.35
Commercial						
Sanitary volume, dollars per 100 cubic feet [1]	6.347	6.737	7.179	7.634	8.115	8.626
Cooling (clean) water to storm sewer, dollars per 100 cubic feet	0.651	0.688	0.728	0.770	0.814	0.861
Impervious surface charge, dollars per 1,000 square feet [1]	8.77	9.40	10.08	10.80	11.58	12.42
Extra strength, biochemical oxygen demand (BOD), dollars per pound [2]	0.505	0.534	0.565	0.597	0.632	0.668
Suspended solids, dollars per pound	0.603	0.638	0.674	0.713	0.754	0.797
Capital charges, sanitary sewer SDCs, (dollars per equivalent dwelling unit) [4]	3,520	3,731	3,995	4,192	4,444	4,711
Forecast year-to-year increase of average single-family monthly bill, percent	5.70	5.75	5.75	5.75	5.75	5.75

[1] Residential and commercial volume and impervious area charges are gross, including the Willamette River/Portland Harbor Superfund Charge, which was split out separately on sewer bills beginning in FY 2007-08.

[2] Beginning in FY 2007-08, BES will no longer collect any account service charges associated with the sewer system billings. These charges will be consolidated with the Water Bureau account service charges. The Water Bureau will set the rates for all sewer system and water system account service charges, collect these revenues, and pay related expenses.

[3] Average bills reflect average annual billed sewer use, which is lower than winter average water consumption.

[4] Capital charges for FY 2009-10 and beyond are estimated; state law requires that these fees to be based on actual capital projects completed, thus they are computed annually.

BES uses the following five-step process to calculate rates. This process is common to most sanitary sewer and stormwater drainage utilities throughout the U.S.

Step 1: Determine the Gross Revenue Requirement. Revenues are required to fund two broad categories of costs operating and capital, which sum to form BES's overall gross revenue requirement. Operating revenue requirements include the recurring cost of providing service plus overhead charges and contingency reserves. The BES adopted budget provides a detailed description of these operating costs for the upcoming fiscal year. Capital expenditures are funded via bond debt and rate revenues from customers (so-called cash financed CIP). The capital revenue requirement includes debt service payments to bondholders and the value of cash-financed capital improvements. The 5-year financial plan describes planned CIP expenditures for the upcoming fiscal year and also provides a discussion of BES debt management policies.

Step 2: Calculate the Revenue Required from Rates (Net Revenue Requirement). Funding to meet the gross revenue requirement is provided from multiple sources, including rate revenues, SDCs, wholesale contract revenues, and interest earnings. To determine the amount of rate revenue required from customers, all sources of non-rate revenue must be identified and used as an offset to the gross revenue requirement. The remaining net revenue requirement is recovered from recurring sanitary sewer and stormwater drainage rates.

Step 3: Allocate the Revenue Requirement to Individual Service Parameters. Under cost-of-service ratemaking, the revenue requirement is allocated to individual service components, commonly called service parameters. This process translates the overall gross revenue requirement into a specific revenue requirement for each individual service parameter. BES uses the service parameters that best represent the services provided to customers. These service parameters fall into one of the following four broad categories:

Sanitary Sewage Flow includes the costs of managing the volume of sanitary sewer and stormwater drainage flow, beginning in the collection system and ending with treatment and discharge into the Willamette and Columbia Rivers.

Sanitary Sewage Strength captures the costs of purification at the treatment plant. Sanitary sewage strength is measured according to two characteristics, BOD and total suspended solids.

Stormwater Drainage Service includes all of the costs of managing the volume and quality of urban stormwater runoff.

Account Service costs are included with Water Bureau service costs. In lieu of separately stated account service charges for both Water Bureau and BES, the customer bill shows one charge. BES no longer has an interagency agreement with the Water Bureau to reimburse it for providing these services.

There are a variety of approaches for allocating revenue requirements (costs) to service parameters. Some allocations are self-evident. For example, pump station maintenance costs are appropriately allocated to sanitary sewage flow because a pump station's function is to transport wastewater—not purify it. Other allocations are less obvious. The cost of maintenance functions within a combined sanitary sewer and stormwater drainage system should be allocated to both sanitary sewage flow and stormwater drainage. However, it is less apparent how costs should be divided between these two service parameters. Allocations of this type are based on the best professional judgment of BES personnel responsible for performing these activities.

To ensure that revenue requirements are allocated to individual service parameters in the most accurate and equitable manner, BES periodically employs consultants to review the cost allocations used in the rate model. In 1998, the consulting firm Black & Veatch reviewed BES's capital cost allocations and offered specific recommendations that continue to be utilized. In 2005, Black & Veatch completed a comprehensive review of BES's sanitary sewer and stormwater drainage rate model. This review included an evaluation of the following areas:

- Methodologies used by BES to allocate O&M and capital costs to individual service parameters
- Whether sanitary sewer and stormwater drainage rates are properly calculated to match revenue requirements
- How BES's ratemaking methodologies compare to those used by other sewer and stormwater utilities

As a result of this review, Black & Veatch concluded that BES is allocating O&M and capital costs in a "reasonable manner consistent with industry practices."

Step 4: Assign Units of Measure to Each Service Parameter. The fourth step in the rate setting process is to quantify each of the service parameters by a unit of measure, which then allows individual unit rates be calculated. The units of service for sanitary sewage flow and strength are a direct measure of a customer's wastewater discharge and, therefore, a direct measure of the level of service.

Impervious area is currently the only stormwater drainage service unit of measure used by BES. The precise level of stormwater drainage service provided to individual customers is also a function of property slope, soil type, semi-impervious area, and access to and use of public rights of way. However, adding these additional factors would result in high customer billing analysis and transaction costs relative to the size of the stormwater drainage rate. For this reason, impervious area is used as the only unit of service measure.

How the Budget Is Externally Communicated

BES's financial plans and budgets are reviewed by several groups. Each year, BES convenes an external budget advisory committee to review its 5-year financial plan and budget. After review, the advisory committee makes budget recommendations to the Commissioner-in-Charge. In addition, the Public Utility Review Board (PURB), a group of citizens representing neighborhoods, businesses, and advocacy groups reviews financial plans, budgets and proposed rates for BES (as well as for the City's Water Bureau and Office of Sustainable Development). The PURB makes its comments and recommendations directly to City Council.

BES's budget also receives public review during the City's budget process. After the requested budgets from all bureaus are submitted, there are several City budget forums held, during which the public has a chance to ask questions and to comment on requested budgets. During budget deliberations, Council is assisted by several citizen budget advisors. Finally, the adopted budget is available for public review on the City's website at: http://www.portlandonline.com.

6: CUSTOMER SERVICE AND PUBLIC RELATIONS

Since the City of Portland's (City) mission and vision statements focus, in part, on providing an acceptable level of service to the community, a variety of programs have been developed and implemented to improve customer service. Citizens who request service have multiple communication tools available for their use. In addition, the public relations program helps to educate and inform the public on important matters relating to the management, operation, and maintenance of the wastewater collection and treatment systems. Public education is provided through a variety of media on how the wastewater collection system is operated and managed, and information is distributed on best management practices (BMPs) for improving performance. In addition, "front-line" customer service responders and field maintenance staff are trained in how to deal with the public, whether they are responding to customer service requests, providing educational information, or performing field maintenance activities.

This section presents the formal procedures for processing customer service requests as they relate to the management of the wastewater collection treatment system.

Customer Service

The Bureau of Environmental Services (BES) has developed effective customer service procedures to ensure that all incoming inquiries, requests, and complaints are addressed in a timely fashion. Procedures are currently in place for reporting the following:

- Spills and signs of pollution
- Combined sewer overflows (CSOs)
- Sanitary sewer overflows (SSOs)
- Odors
- Sewer back-ups (basement flooding)

Spills and Signs of Pollution

The Spill Protection and Citizen Response (SPCR) section of BES's Pollution Prevention Services Group investigates pollution going to, threatening, or leaving Portland's sewer system. Examples of incidents SPCR investigates include paint washing down a storm drain, a strange looking discharge coming from a pipe on the river, or sewage coming out of a manhole. Reports can be made to a spill hotline or by e-mail. BES staff monitor the hotline 24 hours a day, 365 days a year, answering the hotline during business hours. After hours and on weekends, callers leave a voice mail and the on-call duty officer monitoring the hotline will respond within half an hour.

Spill Reporting Hotline:	(503) 823-7180 website via http://www.portlandonline.com (Go to POL/Government/Bureaus/BES/What We Do/Pollution Prevention/Spill Protection and Citizen Response)

Odors

The website provides e-mail access for reporting odors. In addition, BES posts notices on the City's website and sends e-mails to odor notification subscribers about any maintenance projects that may result in odors outside treatment plants' boundaries. Odor complaints can also be called in to the hotline that is monitored 24 hours a day and 365 days a year by the Bureau of Transportation/Maintenance Operations (PDOTMO) (see Sewer Backups).

Odor Reporting Hotline:	Information available (503) 823-7374 website via http://www.portlandonline.com (Go to POL/Services/Service Requests/Portland Odor Monitoring Report)

Sewer Backups

PDOTMO has field crews dedicated to sewer-related investigations 16 hours a day Monday through Friday and 10 hours a day on weekends and holidays along with a sewer maintenance supervisor on call 24 hours a day, 365 days a year. Sewer-related calls received in the communications center are dispatched to field crews for investigation and notification is sent to BES that an investigation is in process. BES is notified of the results of the investigation immediately. If the call is received after hours, the on-call PDOTMO supervisor and a BES technician are notified of the complaint. Depending on the type of complaint, field crews may be called back to work to investigate or the BES technician will respond.

Sewer Backup Reporting Hot Line:	(503) 823-1700

Public Education

The City uses the following procedures and activities to educate the public on the mission and goals of wastewater collection system management:

- Newsletters, fact sheets, and other printed materials, many with mail-back surveys to gather public input.
- The BES website provides a broad range of information on collection system management ranging from design manuals, planning documents, design standards, program descriptions (e.g., CSO Program, Pollution Prevention, etc.), and fact sheets. The fact sheets on sewer management include:
  - Food Service Industry Stormwater BMPs
  - Help Keep Portland Sewers Fat Free (available in English, Spanish, Chinese, and Vietnamese)
  - Industrial and Commercial Customer Submeter Program
  - Installing Your Private Sewer Line
  - Portland's Sewer System - Guidelines for Homeowners and Homebuyers
  - Construction Projects and Sewer Charges
- Community presentations, open house meetings, and visits to organized neighborhood and business associations.

- News releases to the local media are used to provide information regarding CSOs, SSOs, sewer rates, pollution prevention, construction projects, major programs, and other pertinent information about the system.
- For specific projects or issues, talking points may be developed that address issues or questions raised by the media, council, or the community. The talking points can be used by communications staff, the Public Involvement Outreach contact, the Bureau Director, or other staff as needed. Project fact sheets provide succinct, consistent information that can be used as a reference by anyone involved in a project.
- Utility bill inserts are used to provide detailed information on accessing the BES website.
- The annual report to City Council provides information about BES.
- Information is provided to the Public Utility Review Board and the BES Budget Advisory Committee.
- Information on rates is provided when ratepayers are involved in the Clean River Rewards Program, Downspout Disconnection Program, party line sewer, and sewer connection programs.
- Project site visits.
- Public advisory committees, task groups, and focus groups are used to help make key project or policy decisions.

BES provides the following environmental education activities:

- Environmental educators teach students and adults about BES's Clean River programs, i.e., water quality issues, watershed health, stormwater management, endangered species issues, CSOs, macro invertebrates, wastewater, riparian restoration, and water science. Educators actively engage students and adults in watershed restoration efforts and encourage watershed stewardship. Educators teach school teachers about water quality issues and provide them with materials they can use in the classroom to continue water quality education.
- The environmental education team provides classroom presentations. They develop and organize school assembly programs, field trips for school groups, tours of Columbia Boulevard Wastewater Treatment Plant, watersheds, pollution reduction facilities, and river boat science education trips.
- The program includes development and management of curriculum kits for teachers to check out and use in the classroom, and trains teachers during city-wide teacher in-service days.
- Permanent curb markers are made available to community groups.
- Field education programs are established for key projects and specific issues.
- BES staff attend community events to provide information.

BES has established notification procedures to be used prior to major construction or maintenance activities. All sewer construction projects are assigned a public involvement/community outreach contact who works with the local community/affected area to build awareness and provide information to the public about the project. Sometimes a local construction office will be opened to provide more direct contact with the community. For citizens who have signed up for the service, regular e-mail updates are issued to keep people in a project area informed. Staff may use newspapers, door hangers, fliers, signs, public meetings, presentations, and other measures as appropriate, to notify the public before and during construction. In addition, staff attend neighborhood and business association meetings both in advance of and during

construction to provide project updates and solicit public feedback. Surveys are sent out after selected construction projects are completed. The responses are evaluated and used to improve and modify outreach activities.

Statistics for Recent Years' Customer Service Metrics

BES has commissioned formal public opinion polls/surveys periodically to assess the public's knowledge and awareness. The last survey was conducted in 2005.

The City Auditor's office conducts an annual Service Efforts and Accomplishments Report which assesses City residents' satisfaction with services provided by the City including transportation, parks, and utilities.

2005 BES Customer Survey

Davis, Hibbitts & Midghall, Inc. (DHM) was contracted by BES to conduct a telephone survey of 500 Portland residents during September 14-17, 2005. Respondents were selected using random digit dialing to include households with unlisted phone numbers. In gathering the survey responses, DHM employed quality control measures which included questionnaire pretesting, callbacks, and verification.

Summary of Survey Results

The results of the 2005 customer survey are summarized below.

- *Changes in Public Perceptions.* Since 1989, residents have consistently said that sewage overflow and industrial discharges/spills are the top two contributors to water quality problems in the Willamette River. The biggest change over the last 15 years is the perceived contribution of stormwater/runoff from industrial and commercial sites. Residents' priority for fish and wildlife protection appears to have increased over the last ten years, especially among younger residents.

  Residents use strong imagery about pollution in the Willamette River–dirty, filthy, nasty–and their overall perception of water quality in the Willamette River seems to have deteriorated over the last 6 years (since the last survey).

- *Subgroup Variations.* There were very few subgroup variations by neighborhood. Variations were more commonly found between age and length of residence, and sometimes gender.

- *Awareness.* A good percent of Portland residents (62 percent) are aware of The Big Pipe project. Fewer than a majority are aware of The River Alert notification program. The survey findings on The Big Pipe project demonstrate the potential to increase the public's awareness over time.

- *Public Support.* Public support is very strong for BES services. This support does not translate directly into support for the highest additional fees presented in the survey, but there is majority support for a $10 per month increase.

- *Information Sources.* Television and newspapers continue to be the main sources of information about Portland's rivers and streams.

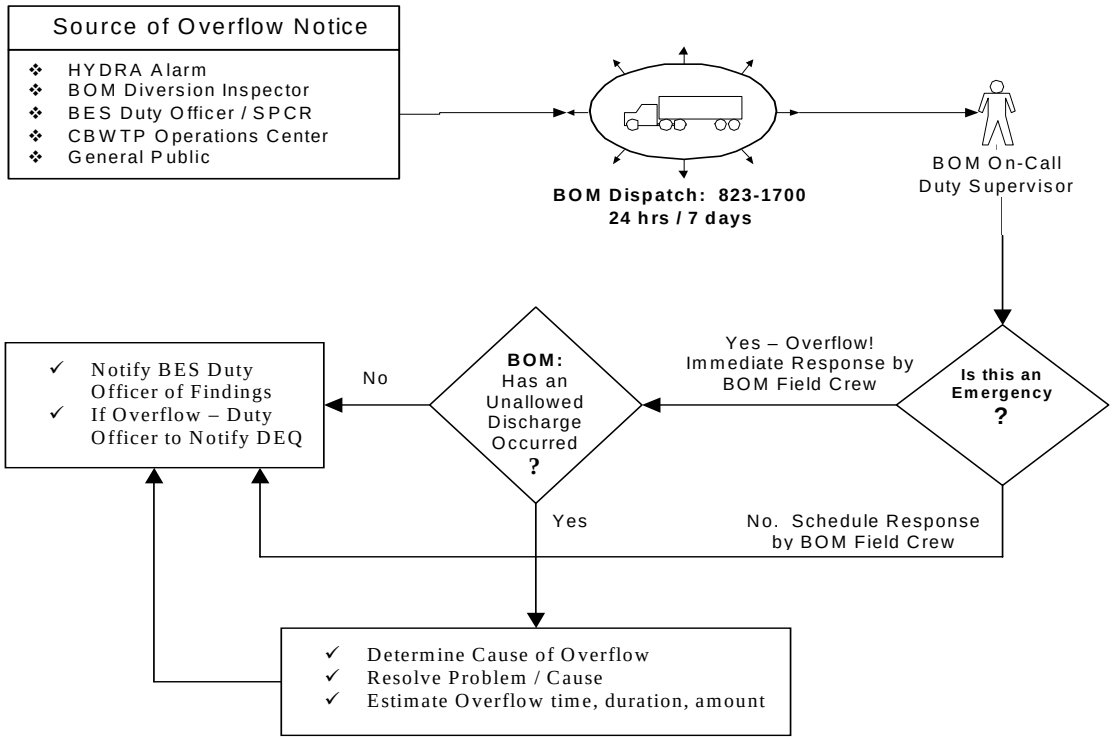
7: CSO/SSO NOTIFICATION AND EMERGENCY RESPONSE PROGRAMS

This section presents procedures that the City of Portland (City) has developed for responding to combined sewer overflows (CSOs) and sanitary sewer overflows (SSOs) and describes highlights of existing emergency response planning.

Overflow Notification Response Procedures

The Portland Department of Transportation/Maintenance Operations (PDOTMO) dispatch center acts as the initial point of contact for all overflow notifications. When an overflow notification is received, the PDOTMO Duty Supervisor determines if an emergency crew should be sent out immediately (typical for all unapproved overflows), or if it is an allowed discharge that can be investigated on a scheduled basis. Unapproved overflows are resolved as quickly as possible by the emergency crew dispatched to the site. Overflows allowed under the Amended Stipulation and Final Order (ASFO), (i.e., during heavy rains in the Willamette River system or an extreme event on the Columbia Slough), are reported to the CSO Program Manager by the Bureau of Environmental Services' (BES) Duty Officer for a system performance review. The CSO Program Manager reviews rainfall and overflow monitoring data to examine CSO regulatory compliance and verify system performance. Figure 7-1 provides an overview of the notification procedures.

Figure 7-1. Overflow Notification Response Procedures



The following notification procedures were developed for responding to SSOs:

- Spill Protection and Citizen Response (SPCR) Unit conducts immediate telephone reporting of SSOs 24 hours per day to the Oregon Emergency Response System (OERS). OERS is the after-hours contact for sewage releases required by the Oregon Department of Environmental Quality (DEQ) as stated in the National Pollution Discharge Elimination System (NPDES) permit.
  - Normal working hours—immediate telephone notification is conducted by SPCR staff.
  - After-hours—immediate telephone reporting is conducted by the BES Duty Officer. The City has developed the following guidance for Duty Officers specific to after-hours reporting:
    - Notify OERS (800-452-0311), the after-hours contact for DEQ-required reporting, regarding surface water impacts. An example of surface water impact would be visible sheen from petroleum material.
    - SPCR reports visible dye test coloration of surface water to OERS. This dye test notification is a pre-emptive measure to provide notification of the known source of coloration and prevent a hazardous materials response (see description below).
    - Specific event criteria for Duty Officer notification to OERS:
      1. Sewage release from City system/facility on weekends
      2. Verified visible impact to surface water (such as oily sheen)
      3. Dye testing and other impacts
      4. Hazardous materials event
    - Event criteria not to be notified to OERS:
      1. Private sewage event not impacting City system (storm or sanitary sewer system)
      2. Discharge to City that is not confirmed to be visible at surface water
      3. Discharge, or suspected discharge, to a sump/underground injection control facility
- SPCR facilitates submittal of written reports to DEQ within the 5-day time requirement of the NPDES permit. Written reports are produced by SPCR for BES management review and submittal.
- SPCR maintains annual SSO data tracking in Excel® spreadsheets.

Upon notification of an SSO or backup, SPCR notifies the Environmental Services Communications Division of the following:

- When the event occurred
- Where the discharge occurred
- Why the discharge occurred
- The estimated volume of the discharge

In addition to public reporting and staff observation, CSOs are reported through the City's HYDRA system. The HYDRA system monitors water surface elevation at key overflow and diversion points. When certain pre-specified levels are reached, the HYDRA system notifies staff via an alarm system.

Additional Information on Calls to OERS

SPCR staff and BES Duty Officers call OERS to report sewage releases that impact surface water. These events may be the responsibility of private parties as well as City responsible releases.

SPCR staff will also call OERS to report dye tests that have the potential to impact surface waters. PDOTMO uses a green dye to test quickly for inappropriate connections to either the sewer system or the storm system. These dye test reporting-calls are placed to notify federal (U.S. Coast Guard), state (DEQ) and local (Fire Departments) of the green coloration in surface waters such as ditches, creeks, streams, and rivers. In addition, dye test notification calls are made to inform downstream authorities that have responsibility for surface water or stormwater management. Local agencies frequently contacted for dye testing include Clean Water Services in Washington County, Water Environment Services in Clackamas County, and the City of Milwaukie. SPCR staff developed these dye test notification procedures from interagency coordination for communicating spill response and notification efforts.

Reporting on Resolutions of Spill Issues

PDOTMO notifies BES when a sewage release has been identified as well as when the problem has been corrected and the release stopped. If after the initial analysis it appears that a solution will take a substantial period of time to implement, PDOTMO notifies SPCR and then provides updated information as it becomes available. This information includes any steps taken to mitigate the release prior to full completion of the specific resolution.

The SPCR unit provides the formal reporting to DEQ regarding sewage releases. This report includes a description of the resolution of the problem to ensure that it does not recur and any future plans for additional action (if known at the time of the letter submission). Additionally, follow-up letters are provided when the initial report indicates there will be continuing activities, i.e., system investigations including closed-circuit television investigative work, major replacement work, or requirements for an outside contractor. BES obtains this information from PDOTMO through use of standardized documentation as well as frequent contact by phone and in person.

Daily Duty Officer Reports are distributed to BES and PDOTMO staff via e-mail to inform them of the activities and findings regarding calls received. In addition, monthly reports on the actual spills (public and private) are provided to various units within BES as well as to PDOTMO. This information is used for a variety of purposes including identifying trends or problem areas that may need additional attention such as increased cleaning or hot-spot designation. Long-term trends and system deficiencies are analyzed and incorporated into the Public Facilities Planning efforts.

CSO and SSO Record-Keeping

CSOs are tracked at outfalls that are controlled according to the ASFO via the CSO monitoring system and IFIX, the supervisory control and data acquisition interface. Because CSO discharges are due to extreme wet weather and are released at specific control structures, their tracking is fairly simple.

Sewage releases (or SSOs) occur unexpectedly at uncontrolled locations throughout the city. Therefore, it is necessary to track the incident, location, cause, impacts, and response. The first level of tracking is performed by the SPCR Section. As part of the spill response procedures, SPCR staff log the sewage release incident from the first initial call to the conclusion or ending of the event. Staff enter the critical information into the Sewage Release Log (an Excel spreadsheet). Information included in the log includes date of event, location, causation, and notification information. This system has been in use since approximately 2002 and is maintained on a daily basis. BES has had an SSO reporting policy and records retention system in place since 1995. An example of the data tracked in the Sewage Release Log is provided in Figure 7-2.

PDOTMO dispatch uses the following reporting documents to record an event:

- Field Crew Sewage Spill Form
- Dispatch Sewage Spill/Dye Test Form

These documents are completed to the extent possible at the time of the sewage release. The information that is gathered is used by BES to complete a Sewage Release Form for each event. This form is then placed in a file that documents each event. Information from the Sewage Release Form is also used to prepare the required letter to DEQ.

On a monthly basis, SPCR prepares a report that lists all sewage releases during that month. This report is sent to the BES Collections Division Manager, the CSO Program Manager/Asset Systems Management (ASM) Division, and the PDOTMO Sewer System Manager. This report is designed to keep key management staff aware of sewage releases and identify activity trends.

A second level of tracking is performed by ASM as part of the long-term planning and analysis necessary for addressing the system causes of the sewage releases. ASM staff have created a Sewage Release Database linked to the geographic information system (GIS) that contains all of the SPCR Sewage Release Logs for public and privately-caused events. The address for each sewage release record is linked to the GIS in order to support spatial analyses of the sewage releases for any given time period. The GIS database is used to help track and identify spatial and temporal trends that can be used to guide analyses of system deficiencies and support facilities planning efforts. An example map showing the sewage release event locations and causes for the 2003 to 2007 period is shown in Figure 7-3.

The Wastewater Group conducts reporting as required by the NPDES permit for the two wastewater treatment plants.

DEQ LTR (Y,P,N)	SP/CR #	DATE 2008	AREA	ADDRESS	BOM Notified	BOM at SITE	RELEASE Stopped	SPCR Notified	REPORT TO DEQ (Date/Time)	OERS # 2008	FLOW GPM	TOTAL G	BASIN	DESTINATION (B,G, P,I,R,S)	BASEMENT (Y/N)	CAUSE (W,G,R,S,B,M ,F,3,0)	SYSTEM COMPONENT (M,C,P,S, 0,L)	RAINFALL INCHES	CAUSATION DETAIL	IMPACT	HANSEN SEGMENT NODES	DISCHARGE NODE # or OUTFALL #	PREVIOUS OVERFLOW? (date)	Notes	Followup	RISK CLAIM FILED ?	ORG #
P	**187**	8/13	N	2711 N Killingsworth	8/13;10:00	8/13;10:30	Unk	8/13;13:25	N/A	N/A	Unk	15	Columbia Slough	B	N	Unk	L	0	Unk	Commercial							37199
P	**188**	8/13	SW	234 SW Broadway St	8/13;16:10	8/13;16:25	8/13;16:25	8/13;18:15	N/A	N/A	2	10	Willamette	B	N	Unk	Unk	0	Unk	Commercial							37205
P	**189**	8/13	SW	4815 SW Beaverton Hillsdale Hwy	8/13;16:30	8/13;18:30	8/13;19:40	8/13;19:40	N/A	N/A	3	25	Fanno	G	N	D	L	0	Poor connection	Commercial				Poor design of lateral connection to MH			37204
N	**190**	8/13	NW	9914 NW Engleman St	8/13;16:42	Unk	N/A	8/20:00	N/A	N/A	0	0	Cedar Mill	N/A	N	Unk	L	0	Sluggish flow	Residentail							37236
P	**191**	8/18	NE	4100 NE Fremont St	8/18;13:48	8/18;14:15	Unk	8/18;14:48	N/A	N/A	Unk	10	Willamette	B	Y	Unk	Unk	0.24	Unk	Commercial				Apartments over storefront; lateral attaches to dead-end MH			4143
N	**192**	8/18	NE	3581 NE Alberta Ct	8/18	8/18	N/A	8/20	N/A	N/A	0	0	Willamette	B	N	R	L	0.24	Sluggish flow	Residential							37227
P	**193**	8/20	SW	9928 SW 53rd Ave	8/20;01:40	8/20;11:20	Unk	8/20;13:50	N/A	N/A	Unk	3	Fanno	B	N	Unk	Unk	0.26	Unk	Residential							37224
P	**194**	8/20	NW	2901 NW Front Ave	8/20;08:20	8/20;08:30	Unk	8/20;10:27	N/A	N/A	Unk	1	Willamette	B	N	Unk	Unk	0.22	Unk	Commercial							4452
N	**195**	8/20	NW	618 NW Glisan St	8/20	8/20	Unk	8/21	N/A	N/A	Unk	Unk	Willamette	B	Y	Unk	Unk	0.22	Unk	Commercial				Rain water			24597
P	**196**	8/20	SW	9228 SW 53rd Ave	8/20;01:40	8/20;11:20	Unk	8/20;13:50	N/A	N/A	Unk	3	Fanno	B	N	Unk	Unk	0.26	Unk	Residentail							37224
P	**197**	8/20	NW	2901 NW Front Ave	8/20;08:20	8/20;08:30	Unk	8/20;10;27	N/A	N/A	Unk	1	Willamette	B	N	Unk	Unk	0.22	Unk	Commercial							4452
P	**198**	8/20	SE	10611 SE Francis St	8/20;20:45	8/20;21:09	Unk	8/20;21:29	N/A	N/A	Unk	Unk	Johnson	B	N	Unk	Unk	0.33	Unk	Residentail							37225
P	**199**	8/21	SW	110 SW Yamhill St	8/21;13:30	Unk	Unk	8/21;13:15	N/A	N/A	Unk	30	Willamette	B	Y	Unk	Unk	0.17	Unk	Commercial				Also backed up 8/16/08			13825
P	**200**	8/21	SW	6524 SW Locust St	8/21;08;20	8/21;08:45	Unk	8/21;09:35	N/A	N/A	Unk	1	Ash	G	N	Unk	Unk	0.24	Unk	Residentail							37226
P	**201**	8/25	SW	110 SW Yamhill St	8/25;11:31	8/25;11:50	Unk	8/25;12:50	N/A	N/A	Unk	4	Willamette	B	Y	Unk	Unk	0	Unk	Commercial			P 8/25/08	Referred to BDS Plumbing			13825
P	**202**	8/25	SE	5314 SE Milwaukie Ave	8/25;16:35	8/25;17:50	Unk	8/25;21:00	N/A	N/A	Unk	2	Willamette	B	Y	Unk	L	0.7	Unk	Commercial							29887
Y	**208**	8/28	SE	2633 SE 23rd Ave	8/28;15:54	8/28;16:10	8/29	8/28;16:25	8/29;08:09	N/A	Unk	10	Willamette	B	Y	R	L	0	Roots in lateral	Residentail							37240
P		8/29	SW	5939 SW Texas St	8/29;15:00	8/29;16:10	Unk	8/29;20:03	N/A	N/A	Unk	1	Fanno	B	Y	Unk	Unk	0	Unk	Residential							37242
P		8/31	SE	14002 SE Fircrest St	8/31;10:03	8/31;12:45	Unk	8/31;20:18	N/A	N/A	Unk	Unk	Johnson	B	Y	Unk	Unk	0.13	Unk	Residential							37243
Y		9/1	SW	2153 SW Main St	9/1;14:16	9/1;14:30	9/1;16:00	9/1;16:27	9/1;16:47	2155	5	600	Willamette	B	Y	R	O	0	Roots	Commercial							37245
P		9/3	SW	3611 SW Humphrey Blvd	9/3;10:31	9/3;12:30	Unk	9/3;13:55	N/A	N/A	0.5	50	Willamette	B	N	Unk	L	0	Unk	Residential				Four properties share lift station.			37249
P		9/3	SE	2436 SE Ash St	9/3;08:59	9/3;09:00	Unk	9/10:20	N/A	N/A	Unk	40	Willamette	B	Y	Unk	Unk	0	Unk	Residential							34283
P		9/4	NE	84 NE Saratoga St	9/			9/4;15:15	9/4;15:50		Unk	10								Residential				Blockage 27' behind curb			29475
P		9/4	NE	5310 NE Cully Blvd	9/4;09:45	9/4;10:05	Unk	9/4;10:40	N/A	N/A	Unk	1	Columbia Slough	B	N	Unk	Unk	0	Unk	Apartments							37250

White = City release
Blue = private release
Grey = not a release
Red = information pending
Unk = unknown
Tan = MOU area
Pink = numbers intention. out of order

N/A = Not applicable
Unk = Unknown
* = information not provided

FOOTNOTES:

Destination of Overflow: **B**=basement or building; **G**=ground; **I**=sump system; **R**=returned to combined sewer; **S**=storm sewer to stream or directly to stream, i.e., reached water of the U.S.

Category of Cause: B=other blockages; **F**=equipment failure; **G**=grease problems; **M**=line deterioration due to aging; **O**=other; **R**=roots; **S**=sediment; **W** = extreme weather; 3=3rd party action inc. vandalism

Sewer System Component: C=constructed overflow; **M**=manhole; **O**=other; **P**=pipe crack; **S**=pump station, **L**=lateral

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Sewer System Component: C=constructed overflow; **M**=manhole; **O**=other; **P**=pipe crack; **S**=pump station, **L**=lateral

Figure 7-2. 2008 Sewage Release Log Example

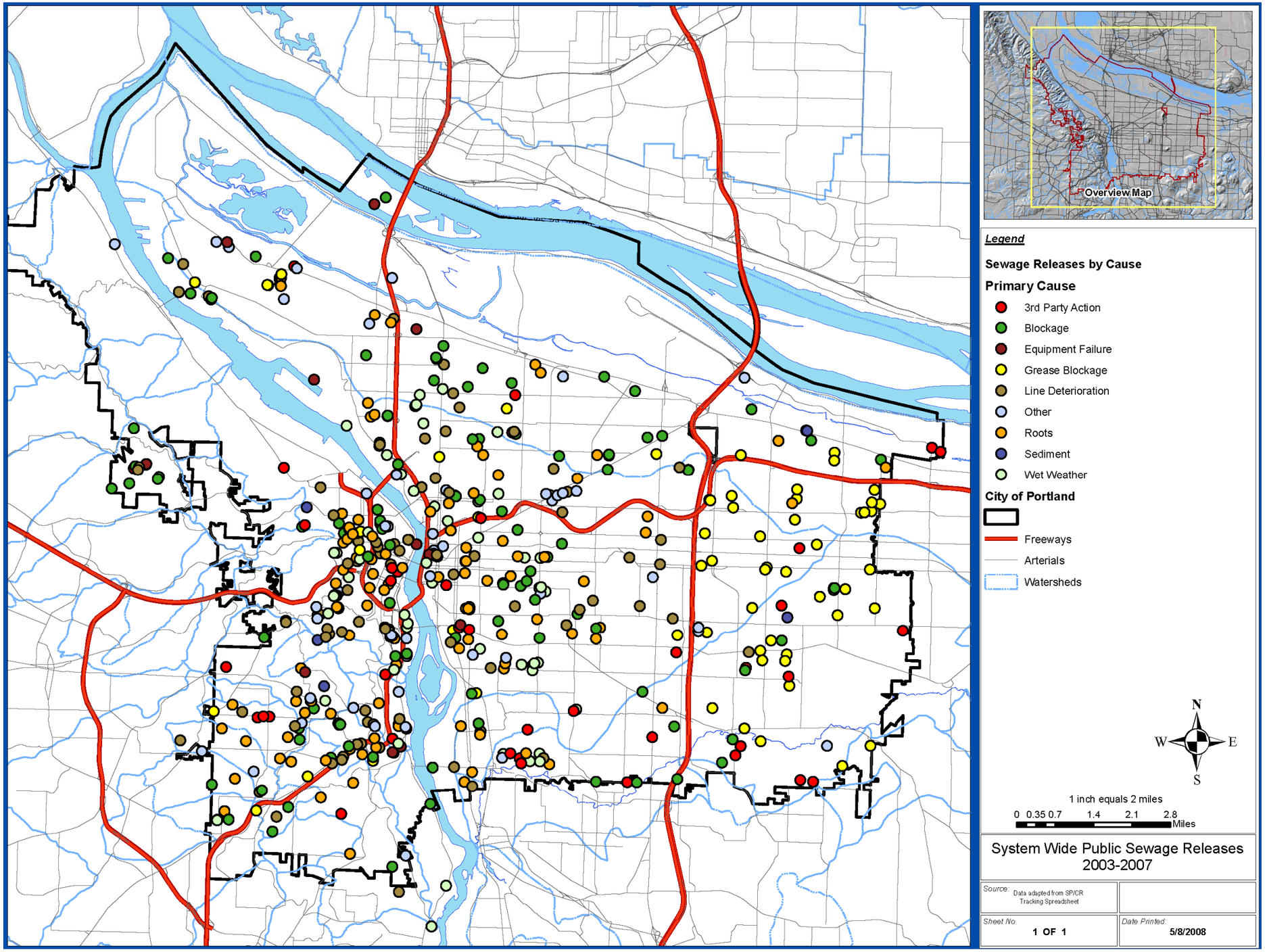


Figure 7-3. SRDB Releases by Cause (2003 through 2007)

Procedures for Notifying the Public

The procedures used to notify the public are somewhat different for SSOs than for CSOs. Each procedure is described below.

Notifying the Public of SSOs

City uses the following procedures to alert the public to an SSO:

- *Buoys*–If the discharge is to the Willamette River, a contractor deploys three Warning Sewage buoys to mark the outfall location where the verified SSO enters the river. The buoys are marked with a message similar to that shown below:

  Buoys are placed:

  - 100 feet in front of the outfall pipe that is overflowing
  - 300 feet downstream of the overflowing outfall pipe
  - 150 feet upstream of the overflowing outfall pipe

- *Signage*–PDOTMO responds to a verified dry weather overflow to the Willamette River by posting Dry Weather Overflow signs at potentially impacted public recreation areas near the discharging outfall. Placement locations are based on the Dry Weather Overflow Signage Chart for Public Areas that identifies locations for signs. The signs remain in place for 48 hours after the overflow is stopped.

- *Media outlets*–BES issues facsimile and e-mail advisories to local newspapers, radio and television stations, and to the City's Office of Neighborhood Involvement when SSOs occur. The advisory information includes:

  - Nature and time of the release
  - Amount of release (estimated gallons per minute)
  - Location of release (local landmarks identified)
  - Notification procedure used to inform the public of the overflow event
  - Who the media should call for additional information

  The Office of Neighborhood Involvement's notification system sends out an e-mail advisory to City residents, neighborhoods, and civic and business associations who have subscribed. Anyone can subscribe to the system. Subscribers can select from a list of topics about which they wish to receive information, including CSO alerts.

Notifying the Public of CSOs

The following procedures are used to alert the public to CSOs:

- *Phone*–A recorded telephone message gives callers CSO information 24 hours a day. Callers have the option of hearing a recorded message to learn if a CSO has occurred, or to hear a detailed message about CSOs and CSO projects. The River Alert phone number is 503-823-2479.
- *Media outlets*–From May through October, BES issues facsimile and e-mail advisories to local newspapers, radio and television stations and to the City's Office of Neighborhood Involvement each time a CSO occurs. The advisories recommend that people avoid contact with the Willamette River for 48 hours following the end of a CSO event.
    - *The Oregonian*–the state's largest daily newspaper publishes a CSO icon and explanatory text at the top of its weather page each time a CSO occurs between May and October warning people to avoid contact with the Willamette River for 48 hours following rainfall.
    - *Internet*–Internet users can log on to the BES website at www.portlandonline.com/bes to see if a CSO alert is in effect. In addition, the Office of Neighborhood Involvement's notification system sends out an e-mail advisory to those who have subscribed to this service.
- *River Alert Signage*–River Alert warning signs are posted at ten public access points along the Willamette River. The signs are hinged in the middle and can be locked open or folded and locked close. The signs use graphic illustrations and lettering to convey to both English speaking and non-English speaking people that they should avoid contact with the water after rainfall because of the presence of sewage. The signs also list the River Alert telephone number.

  From May 15 through October 15, River Alert warning signs are locked closed during dry weather conditions. When rainfall causes an overflow, a contractor travels the Willamette River by boat to lock open each sign. Forty-eight hours after rain has ended, the contractor locks the signs closed.

  The signs are locked open or closed within 4 hours of notification during daylight. If notification comes after sundown, signs are changed at first light the following day.

  From October 15 through May 15, the signs are locked in the open position.

  Warning signs are visible from these recreation areas on the river.

    - Cathedral Park boat ramp
    - Cathedral Park swim dock
    - Swan Island boat ramp
    - Eastbank Esplanade
    - Riverplace public dock
    - Riverplace rowing club
    - Willamette Park boat ramp
    - Sellwood Riverfront Park dock
    - Staff Jennings boat ramp, west end of the Sellwood Bridge
    - Milwaukie boat ramp
- *CSO Identification Signs*, posted at each combined sewer outfall on the Willamette River, alert water users to the presence of an outfall and advise against water contact in those areas during rainy weather.

Emergency Preparedness and Response

The City's Emergency Response Plan describes how it will respond to emergencies. It also establishes the procedures and processes for the Emergency Coordination Center (ECC) and whether it is activated either partially or fully. Personnel who are familiar with the operation of the collection system are attached to the operations and planning functions of the ECC. The City's plan is summarized below.

BES has an Emergency Operations Plan that delineates how it will operate during emergencies and how to interact with the ECC during an emergency. BES also has a Continuity of Operations Plan.

BES's Emergency Operations Center (EOC) is located at the Columbia Boulevard Wastewater Treatment Plant. The City's Emergency Response Plan is kept by the Portland Office of Emergency Management. Both documents are housed at the EOC.

The Emergency Response Plan outlines the appropriate responses for different types of emergencies. Responding to a deleterious material in the system that may overflow into a receiving stream has an entirely different response than an earthquake that causes damage to the system or a collapsed or plugged pipe that causes an overflow. These guidelines are documented and located in the Environmental Systems Division office.

BES has identified the critical elements of the wastewater collection system and attached rating scores to each element. The elements are mapped according to the criticality rating assigned to them. The collection system is vulnerable to failure in some of the old monolithic concrete, brick and mortar pipe and concrete pipe depending on date of manufacture. There is also some old vitrified clay pipe that is subject to failure due to methods used to backfill the trench.

Emergency situations are tracked at the ECC and EOC unless the emergency is an isolated collapse or failure in the collection system. Then the emergency is tracked by a District Engineer who oversees the response. An on-call maintenance supervisor will perform an assessment, assign a maintenance crew to stabilize the area, and make the area safe for the public. The District Engineer will then assess the situation and recommend an appropriate permanent repair.

8: ENGINEERING DESIGN AND NEW CONSTRUCTION

The City of Portland (City) has engineering design and construction standards that must be met before new sewer facilities can be accepted into the City's wastewater collection system. These standards help to ensure that new facilities satisfy current and future hydraulic capacity requirements, provide long-term service life, and minimize the operations and maintenance (O&M) effort.

This section describes elements of engineering design activities and parameters for new construction within the City's sewer collection system.

Engineering Design/Capital Improvement Program Elements

Engineering activities are performed in support of sewer collection system management, O&M, and ensuring that adequate capacity is provided. A number of these activities can influence the effectiveness of the collection system in conveying flow and the effort required for performing O&M activities. The most relevant engineering activities are described below.

Design Standards and Guidance Documents

The City has numerous documents that provide guidance on minimum design and construction quality assurance/quality control (QA/QC) standards for its wastewater sewer projects. Some of the more important documents include the following:

- *Standard Construction Specifications*—standards and details for the development engineering community commonly referred to as the Gray Book
- *Sewer and Drainage Facilities Design Manual*—defines requirements for new or replacement sanitary sewers
- *CADD Manual*—defines format for drawing files
- *Stormwater Management Manual*—defines requirements for stormwater management (quantity and quality)
- *Engineering Services QA/QC Manual*—provides requirements for consultants working for the City

Collection System Plans

The Bureau of Environmental Services (BES) updates its city-wide facilities plan approximately every 10 to 15 years. The last city-wide collection system facilities plan was completed in 1999. An update to that plan is currently under way, with completion set for 2009.

The 1999 Public Facilities Plan (PFP) identified 268 projects, valued at $780 million, as necessary to improve the collection and treatment systems. Approximately 163 short-term projects are projected to be needed within the next 10 years at an estimated cost of $675 million. Seventy-seven percent of these costs are for combined system improvements, with only 4 percent allocated to the separated sanitary system. Other allocations are to the stormwater collection and treatment systems. Approximately 105 long-term projects were identified at an estimated cost of $106 million. Fifty-nine percent of the costs were for the combined system and 26 percent for the sanitary collection system.

The PFP concluded that a greater investment will be needed in the future to address the problems of the existing, aging portions of the system. Additional rehabilitation and replacement funds will be required to maintain these sewers at an acceptable level of service.

Pump Station Plans

BES has developed and is implementing a Pump Station Improvement Plan, which includes an inventory and assessment of all of the City's 94 pump stations. The condition assessment considers the following conditions: pump age, inflow rating, pump rating, variable frequency drive rating, parts and supplies availability, onsite emergency power, control system rating, electrical system rating, unscheduled maintenance rating, and other special problems rating. This information is used to establish a system-wide preventive maintenance program for the pump stations that includes maintenance schedules and equipment replacement schedules. In addition, BES is evaluating how to provide back-up power to all of its pump stations.

New Construction

New sewer construction projects must provide adequate capacity for current and planned future conditions and be constructed in accordance to all city design and construction standards. The overall process for ensuring that adequate capacity is provided prior to accepting new construction flows includes three major steps:

- Land-use process
- Building plan review process
- Public works permitting

The processes are described below.

Land-Use Process

In the state of Oregon and as reinforced in Portland City Code (Code) Title 33, there is a prescribed land-use process that reflects the public facility plans for the entire region's infrastructure. Land-use designations in the City dictate the land uses allowed on each parcel of urban land and the allowed density of development. The sanitary system assessments and all capital improvements are designed reflecting this Comprehensive Plan and on the more updated 2040 Plan. Because of this, the City is able to assume that new sanitary flows from private development can be conveyed by the existing system as long as the new construction is consistent with the zoning. There are a few exceptions, however, due to known local conveyance issues or the timing of the development occurring before needed capacity expansion in local conveyance sections. With this base level of understanding and deference to the continuously updated PFP and ongoing system assessments, it is still necessary for BES staff to review all land-use plans.

Land-use staff review all proposed developments as required through the land-use process as defined in Code Title 33 to ensure that proposals "meet the maximum flow rate or volume a sewer facility (e.g., pipe, channel, storage facility, inlet, culvert, flow control device, etc.) is designed to safely convey, receive, or contain to meet a specific performance standard depending on the facility location within the sewer system" (definition of sewer capacity in the *Sewer and Drainage Facilities Design Manual*).

Specifically, the land-use review is performed by staff to ensure the following:

- Densities being proposed are appropriate for the zoning designations by evaluating against the Comprehensive Plan and 2040 Plan.
- There is no anticipated use of the property that may generate additional flow from what would be considered normal for this land-use.

- Stormwater is hydraulically separated and discharged to an approved stormwater discharge point and not sent to the sanitary system.
- Maintenance records are checked to see if there are reports of basement flooding in suspected areas.
- Modeling is done on proposed commercial developments by assessing the existing system at build-out with the proposed new flow.
- Engineering calculations submitted by the civil engineer of the proposed development are evaluated by review staff against the requirements of the *Sewer and Drainage Facilities Design Manual*. The following internet link contains more information on the design criteria required of all proposals and reviewed by BES Engineering Development staff for compliance with technical assumptions.

  http://www.portlandonline.com/shared/cfm/image.cfm?id=135901

  If there are reasons that capacity is in doubt, staff will:

  - Recommend denial of the development, or
  - Require permit applicant to furnish an alternative development proposal that can adequately address the capacity constraint, or
  - Require permit applicant to modify the receiving system to accommodate the need for additional capacity using a public works permitting process

For additional information on related administrative rules guiding land division-related decisions for sanitary and stormwater reviews see the internet link below:

http://www.portlandonline.com/auditor/index.cfm?a=5856&c=26906

All new submitted modified proposals will be reviewed to ensure they meet capacity of the receiving system.

Building Plan Review Process

All new construction, tenant improvements, or alterations requiring a building or site development permit are reviewed by BES staff to ensure compliance with the *Stormwater Management Manual* and the needs of the receiving sanitary and stormwater systems. The administrative rules for the building plan reviews are described in two documents. Following is the link for the Sewer Development Administrative Reviews:

http://www.portlandonline.com/auditor/index.cfm?a=73483&c=28044

Following is the link for the *Stormwater Management Manual*:

http://www.portlandonline.com/auditor/index.cfm?a=12548&c=28044#PDF

The review conducted at the time of application for a building permit is more detailed and based on the actual engineering calculations and the final construction plans for the building being proposed. The administrative rules cited above describe a similar, but more detailed review than was conducted at the time of land-use review. If no land-use review was conducted because it was a proposed use that is allowed by right without a review, the same analysis is done as would have been performed at the time of land-use. If a land-use review was done, the results from the land-use review are used to assist in the more detailed analysis using the engineered plans to ensure that they meet the standards defined in the *Sewer and Drainage Facilities Design Manual* and the *Stormwater Management Manual*. These documents are designed to ensure that all new development appropriately either meets the constraints of the receiving system or is designed to address any impacts it will have on the receiving systems. All development is charged system development charges in

advance of development to reimburse the City for costs associated with meeting the anticipated demands of new development on the sanitary and stormwater infrastructures, as was anticipated in the Comprehensive Plan and 2040 Plan for the Metropolitan area.

Public Works Permitting

A public works permit is required prior to constructing or altering any public sanitary or storm facilities or sewers in Portland. The authority for sewer connection and public works permits and the code relevant to them is Portland City Code 17. 32. See also the *Sewer and Drainage Facilities Design Manual*, the *Stormwater Management Manual*, BES CADD Standards, and Sewer Connection Administrative Rules for related and more detailed information about decision-making processes and procedures.

When a public works permit is taken out to build what will become City infrastructure for new development, or to modify existing infrastructure to meet needs of a development, it is designed and paid for by the developer and representatives under the BES public works permit. The plans are reviewed by City staff through the permit process. The City's Development Engineering Division processes and reviews new construction plans. The process includes O&M staff review of the construction plans.

In addition to constructability and compliance with maintenance and reliability standards, the facility is confirmed as addressing all capacity needs.

Once the final plans have been approved and the Chief Engineer has signed them, the developer picks up the permit and hires a contractor to construct the building under BES inspection.

Acceptance of New Construction

Once a new construction project is completed and a final testing and inspection have been approved, the developer is responsible for ensuring against defect in workmanship. The following tests, as defined in the Standard Construction Specifications, are completed on all sanitary pipes:

- Electronic sewer locating test
- Air test to ensure the integrity of the system
- Video inspection (results are compared against the pipe's 2-year warranty check)
- Mandrel test
- The Standard Construction Specifications include standard forms to be used for documenting inspections and testing. Construction inspection is performed using the criteria defined in the adopted *Inspector's Manual* (currently being revised). City inspectors are used on all new public construction projects. Registered professional engineers provide inspection supervision on City capital construction projects.

Formal O&M Acceptance Procedure

The permit applicant is expected to ensure that facilities remain in working order for 2 years after construction completion, even if the properties (or lots within a subdivision) are sold in those 2 years. The facilities are then conveyed to the City for ongoing maintenance and ownership responsibility. Maintenance Engineering staff (sanitary) and a Condition Assessment Team visit the facilities and ensure that the assigned Hansen® computerized maintenance management system number is in the system, and adequately describes the facility and its maintenance schedule.

9: SYSTEM EVALUATION AND CAPACITY ASSURANCE

The City of Portland (City) has an extensive flow monitoring program for the combined sewer (CSO) and separated sewer (SSO) systems that provides detailed information on the capacities of these systems. This information is used to calibrate detailed hydrologic and hydraulic models for assessing the capacity of the wastewater collection system under current and future planning scenarios, including local sewer capacity assessments and system-wide master planning. Water quality monitoring is performed to detect and monitor potential impacts of spills and sewer overflows to local water bodies, as well as to comply with regulatory permitting requirements.

A variety of techniques are used to assess the structural and operational condition of sewers and manholes. The primary tool is closed-circuit television (CCTV) inspection. The prioritization of CCTV inspection activities, as well as sewer cleaning (See Section 11), is based on Asset Management (AM) principles that consider the risk and consequence of sewer failure.

The City has taken an AM approach to developing and implementing the sewer and manhole rehabilitation programs. The rehabilitation programs include use of the concept of Remaining Useful Life (RUL) which provides for an economic evaluation of rehabilitation project alternatives. The City has been in the forefront of developing an AM approach to sewer management and rehabilitation since the mid-1990s.

This section describes the specific methods and activities used to evaluate the performance and assure capacity of the sewer systems managed by the City.

Flow Monitoring for Combined and Sanitary Systems

The Bureau of Environmental Services (BES) employs a flow monitoring program for the CSO system and a somewhat different program for the SSO system. Both monitoring programs utilize permanent flow monitoring, temporary flow monitoring, and pump station flow/cycle data. Due to their similarities, both programs are discussed together.

Purpose of Flow Monitoring Programs

The CSO flow monitoring program is intended to provide the data necessary to:

- Determine if CSO facilities are effectively controlling CSOs in compliance with the return frequency of storms required to be controlled under the National Pollutant Discharge Elimination System (NPDES) permit.
- Determine when CSO discharges occur (broadcast alarms) and measure discharges for start/stop time, peak discharge rates, and total volume released at each location.
- Determine that CSO facilities operate and perform according to design expectations.
- Calibrate combined sewer models for predicting stormwater runoff and effectiveness of stormwater controls.
- Detect when future CSO loads have increased above the system capacity.

The SSO flow monitoring program focuses on issues that impact the sanitary system. The purpose of this monitoring program is to:

- Identify areas with high rainfall dependent infiltration/inflow (RDII).
- Provide flow rate and rainfall data to generate RDII hydrographs for historical storms using time-series linear regression.
- Provide calibration and verification data to be used as the basis for developing collection system models.

Permanent and Temporary Flow Monitoring Activities

Portland employs both permanent (fixed location) and temporary (mobile) monitoring systems that measure rainfall, depth and flow rate of combined, sanitary, and stormwater flows.

Permanent Monitoring Activities

The permanent monitoring activities are organized into two major systems that provide rainfall, water level and flow rate, pump station, overflow, and treatment performance data. The HYDRA system has been in use by the City since 1976 and provides rainfall measurements, sewer level and flow monitoring, and pump station alarms and cycle data. The CSO Communications and Controls System was created as part of the 2006 Willamette CSO Facilities, and provides real-time data to the operators for tracking and controlling flows and levels across the sanitary and combined sewer collection systems. This is essentially a large supervisory control and data acquisition (SCADA) system with a graphical interface called iFIX.

HYDRA Monitoring System. The City owns, operates, and maintains HYDRA, a large monitoring system for collecting rainfall, water level and flow, and pump station data. HYDRA stands for Hydrologic Data Retrieval and Alarms. Data collected by HYDRA are stored on a separate server and shared with users via the NEPTUNE data management system. HYDRA uses a radio telemetry system to collect data from over 40 rainfall gauges, 100 sewer level monitors, and 90 pump station alarm/monitors. Data from the monitoring system are stored in 1-minute increments. Figure 9-1 shows the locations of the HYDRA monitors.

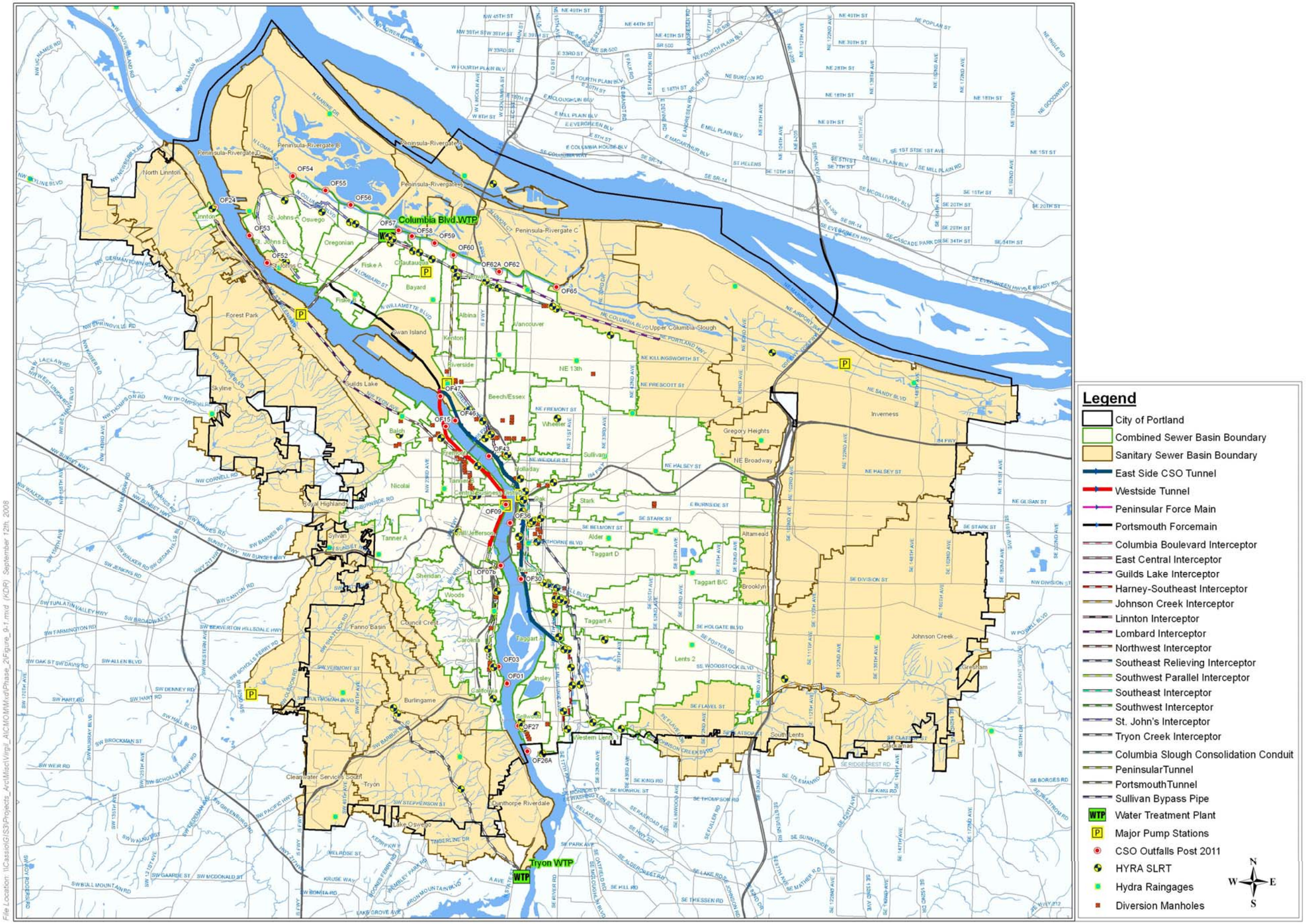
CSO Communications and Control System. Columbia Boulevard Wastewater Treatment Plant (CBWTP) operators use the CSO Communications and Control System via the SCADA program called iFIX to receive alarms, to view and record performance data, and to operate the CSO facilities, major pump stations, and treatment plants as an integrated system. Data from the monitoring devices are relayed by each facility's programmable logic controller to the iFIX servers using a fiber-optic loop that connects the major facilities to the CBWTP Operations Center. The iFIX data are stored on servers in 5-second increments and are available for historical trend analysis and extraction. Operators can also access HYDRA data via the iFIX system.

Figure 9-1 shows the location of the major facilities (pump stations, overflow structures, treatment plants) that are connected via the communications and control system.

Temporary Monitoring Activities

Temporary monitoring activities in the combined and sanitary system are conducted by the BES Field Operations Section (Field Ops) which provides environmental sampling and monitoring services for a wide range of projects. For capacity, management, operation, and maintenance (CMOM)-related activities, Field Ops provides:

- Level and flow rate monitors for the sanitary and combined system for periods of 1 to 12 months
- Data analysis and quality control
- Field inspections for unusual conditions that impact the monitoring data



File Location: \\Cassiot\GIS\Projects_Arc\Misc\Virgil_AltCMOM\Mxd\Phase_2\Figure_9-1.mxd (KDP) September 12th, 2008

Figure 9-1.
Permanent Monitoring Locations

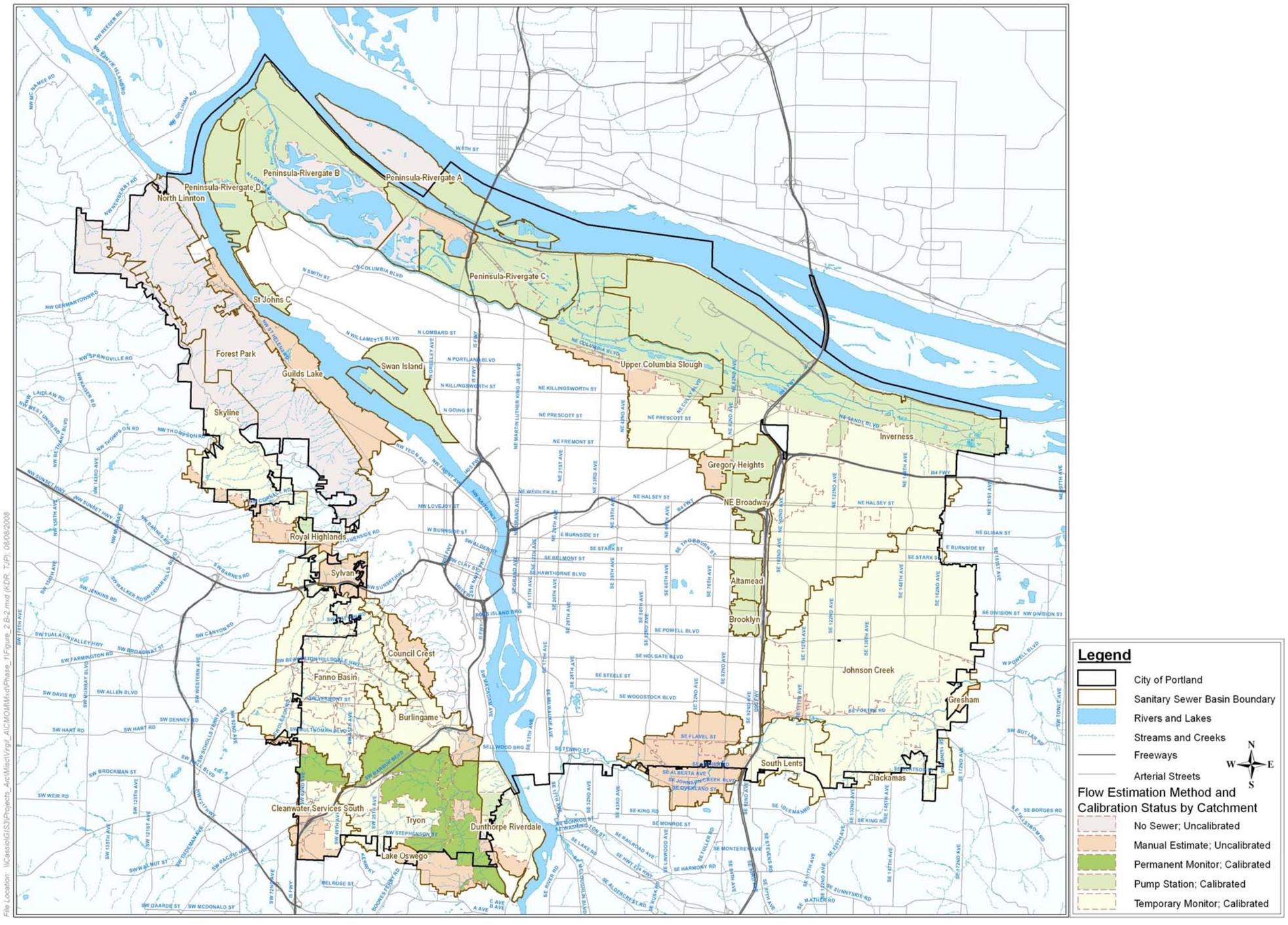


Figure 9-2.

Flow Estimation Method and Calibration Status–Summer 2008

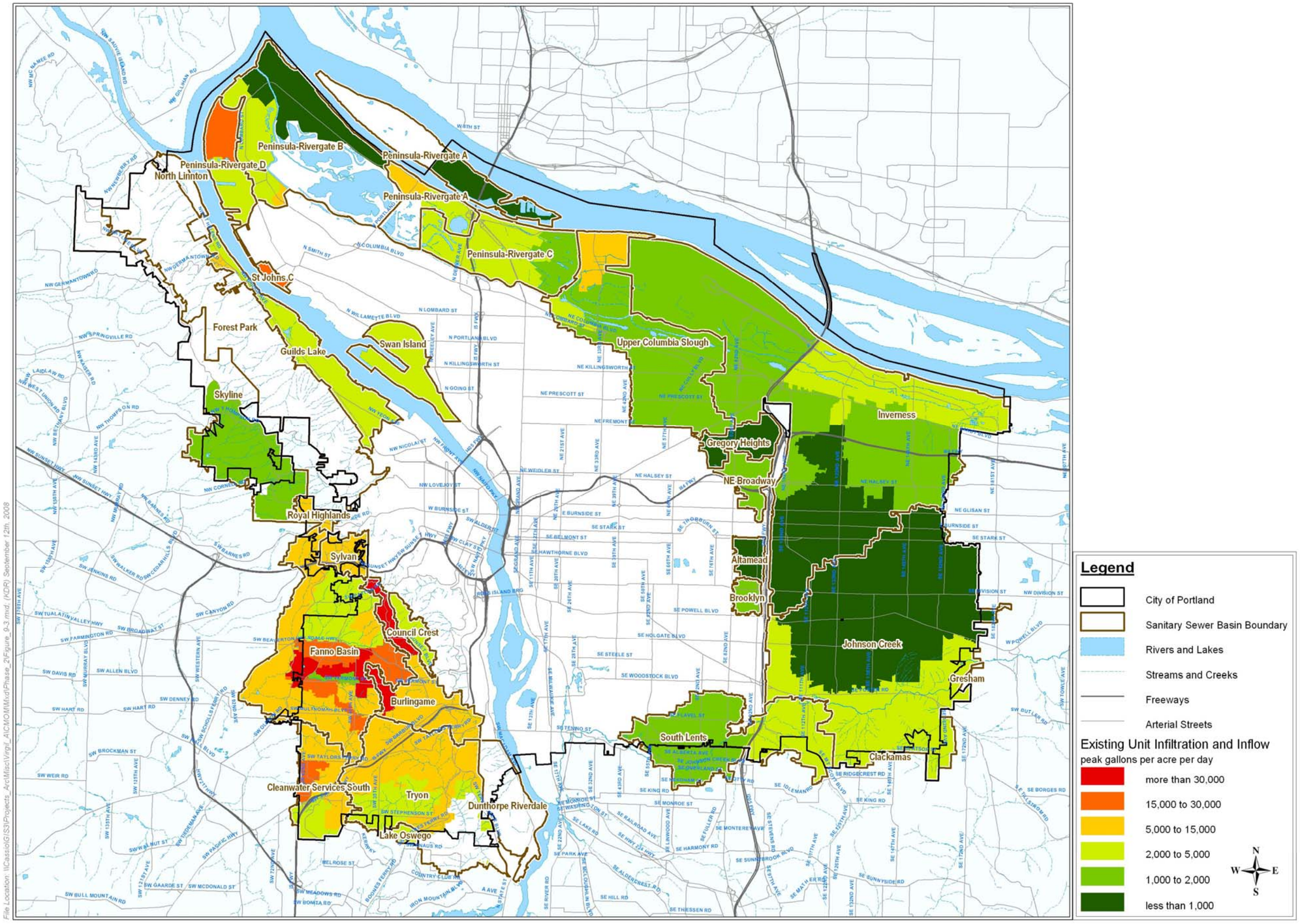


Figure 9-3.
System-Wide I/I Rates

Program for Identifying Excessive Infiltration/Inflow (I/I).

- *Flow Monitoring for Characterizing and Identifying Excessive I/I.* The specific monitoring program developed for the sanitary system was the key tool for characterizing sanitary base flow as well as the RDII for each sanitary sewer basin. The flow monitor data were used to calibrate predictive models of RDII response to rainfall.

  Flow estimation (FE) catchments, defined as distinct areas for which a unique base flow and RDII response function can be generated, were defined from the sanitary collection system network. An FE catchment is the area delimited by a model trace that originates at a downstream boundary condition and continues up the sewer network until all sewers have been accounted for or the downstream boundary condition of another FE catchment is reached. The downstream boundary of an FE catchment is typically a location for which flow measurement data are available. Measurements may be from a temporary flow monitor, a permanent flow monitor, or pump cycle data.

  Based on a review of the initial monitoring data, additional monitors were placed to further subdivide FE catchments with high RDII. Flow monitor locations were generally selected to help characterize areas with known hydraulic capacity issues that result from excessive RDII. Figure 9-2 shows each FE catchment and the method used to monitor the catchment.

- *Ongoing Flow Monitoring for RDII.* Future flow monitoring locations will be selected based on accomplishing the following:

  1. Confirm results of the initial characterization phase in locations within a basin where hydraulic deficiencies are suspected but the flow monitoring data are suspect.
  2. Characterize areas experiencing level of service failures where none were predicted through the initial characterization phase.
  3. Further subdivide FE catchments with known RDII issues into viable constructible project areas. Subdivision of an FE catchment with a high RDII rate will allow further isolation of RDII hot spots and support initializing the Capital Improvement Program (CIP) process.
  4. Determine the effectiveness of RDII reduction activities.

Summary of Areas with Excessive I/I. The results of the characterization and RDII analysis are shown in Figure 9-3, which provides a view of the system-wide I/I rates. The map and I/I rates were developed as part of the Sanitary System Plan which is analyzing the capacity needs for the sanitary system as well as the structural rehabilitation needs for the pipes in the system. One major component of the Sanitary System Plan will be a new I/I Reduction Program designed to address the major sources of I/I as they are identified through monitoring and modeling.

Water Quality Monitoring

The City's water quality monitoring is carried out by BES's Pollution Prevention Services Group. The group's organizational chart appears in Section 3 of this report. This group performs the key functions necessary for detecting and monitoring potential impacts of sewage to Portland's water bodies:

- Investigates spills, slicks, and suspicious discharges. The Spill Control and Citizen Response (SPCR) section of the Pollution Prevention Services Group is available 24 hours a day, 7 days a week.
- Conducts long-term sampling and monitoring of surface water and groundwater; monitors stormwater and municipal and industrial wastewater for regulatory compliance; provides short-term flow monitoring for the City's sewer systems and surface waters; and samples soils, sediments, and gases.

- Performs laboratory analyses of samples from treatment plant effluent, industrial waste discharges, stormwater, rivers, streams, and soil excavated during construction projects.
- Monitors and controls stormwater runoff from industrial and commercial properties. Implements Best Management Practices to reduce stormwater pollution and protect rivers and streams.
- Works to minimize the use of pollutants in the manufacturing process, encouraging businesses to reuse potential pollutants or treat them before releasing them to the environment.
- Uses HYDRA system to collect and store historical data concerning sewer levels and flows, pump station wet well levels and operational alarms, wastewater pH and conductivity, and rainfall.
- Provides public notification of CSOs to the Willamette River.

Ongoing Water Quality Monitoring Activities

The Pollution Prevention Services Group carries out the various sampling and monitoring requirements specified in the NPDES permit for the City's treatment plants. The group monitors stormwater, SSO, and CSO discharges to ensure that water quality meets permit requirements and that the internal program concerning such discharges are followed. Specific monitoring activities related to the CMOM are presented below.

The Pollution Prevention Services Group performs random sampling and analyzes the effluent from industrial users at frequencies appropriate for the character, consistency, and volume of the industrial users' discharge. This analysis helps confirm the information supplied by industrial users and tests for compliance with NPDES pretreatment standards. These data, along with almost all of the water quality sampling data taken by BES staff, are stored in the Aquarius Database. A sample page of the annual pretreatment sampling summarizing the sampling performed for significant industrial users is provided in Figure 9-4. It was generated as a report from the Aquarius Database. Sampling required for sewer discharges from industrial sources is specified in Section 7 of Schedule E in the NPDES permit.

Figure 9-4. SIU Sampling Report Excerpt (Form 7)

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Organization Name	Permit #	Expire Date	Num. Doc. Inspections	Number of City Sample Visits All POCs/Total	Number of Self Monitoring Events All POCs/Total	SNC for Quarter 1 2 3 4
AJINOMOTO USA INC	400.169	08/01/2009	2	2/ 12	12/ 11	
ALPENROSE DAIRY	405.001	05/01/2009	1	4/ 15	11/ 12	
AMERICAN INDUSTRIAL SERVICE	400.174	06/15/2011	1	4/ 5	4/ 12	
AMERICAN LINEN	400.167	12/01/2010	1	5/ 17	5/ 25	
ANODIZING SPECIALTIES	333.009	01/01/2013	1	0/ 0	0/ 0	
APEX ANODIZING	433.039	01/15/2009	1	0/ 2	4/ 5	
ARAMARK UNIFORM SERVICES INC	400.153	11/15/2008	1	2/ 12	2/ 365	
BAY VALLEY FOODS LLC	407.003	07/30/2010	2	4/ 12	11/ 13	
BELTSERVICE CORPORATION	428.001	08/13/2012	1	2/ 2	2/ 2	
BLACKLINE INC	433.023	05/10/2009	1	0/ 15	2/ 53	
BOEING COMPANY	433.043	05/15/2012	2	0/ 4	3/ 9	
CHEVRON USA-WILLBRIDGE DISTRIBUTION	400.0 14	07/06/20 12	2	2/ 2	44/	
CINTAS CORP	400.155	01/31/2009	1	2/ 4	4/ 13	
COCA COLA USA SYRUP DIV	400.075	06/01/2010	1	2/ 8	12/ 66	
CONOCOPHILLIPS-CHEVRON REMEDIATION SITE	500.015	08/15/2012	1	2/ 2	6/ 11	
CONTAINER MANAGEMENT SERVICES	400.028	07/01/2008	1	2/ 5	4/ 14	
CONTINENTAL BRASS	433.007	02/27/2012	2	0/ 4	5/ 84	
CRAFT BREWERS ALLIANCE INC	400.080	02/01/2011	1	4/ 15	12/ 12	
DACON INDUSTRIES	428.002	05/09/2010	1	2/ 3	3/ 4	
DARIGOLD	405.002	07/31/2009	1	13/ 15	107/ 313	
DEL MONTE FRESH PRODUCE	400.171	01/05/2011	2	4/ 13	6/ 6	
DREW PAINTS INC	446.003	02/17/2009	2	0/ 0	0/ 0	
DURA INDUSTRIES	433.038	01/15/2013	2	0/ 2	1/ 11	
EAST SIDE CSO TUNNEL PROJECT	400.193	05/18/2011	18	0/ 46	0/ 0	
EAST SIDE PLATING 1, 2, & 3	433.019	04/30/2008	2	0/ 4	6/ 126	
EAST SIDE PLATING 4	413.002	11/15/2008	2	0/ 8	7/ 124	

Note: A = SNC with Applicable Pretreatment Standards B = SNC with Self Monitoring Requirements C = SNC with Reporting Requirements
D = SNC with Compliance Schedule E = SNC - Imminent Endangerment F = SNC - Falsification of Reports

Effects of CSOs and SSOs on Receiving Waters

The CSO Program performs an extensive amount of water quality monitoring and sampling to determine the impacts of CSOs on the receiving streams and the improvements achieved by the CSO control facilities. Historically, the CSO Program has implemented large sampling projects to characterize the contents of CSO discharges and their in-stream impacts. This information was fundamental to establishing the required level of CSO control and the ultimate sizing of the facilities during the early stages of the 20-year program. Because there are only 3 years remaining before the 20-year program is complete, the City is now focusing on the Post-Construction Monitoring Program to ensure that the CSO system meets event-based requirements and long-term performance criteria. The criteria include the following:

- Event-Based Performance Compliance Monitoring—
  - Rainfall measurements over service area for comparison against the storm event frequency criteria for compliance.
  - CSO discharge measurements to determine overflow occurrence (with alarms), start/stop time, peak discharge rates, and total volume released.
  - CSO facilities operations monitoring to confirm the integrated system operates according to design expectations.
  - Water quality sampling of CSO discharges at overflow structures to confirm that water quality standards will be achieved outside of intermittent mixing zones.
- Long-Term Performance Monitoring—
  - Collection system monitoring for operations and analysis to provide calibration and future detection of increased loads to CSO system.
  - In-stream river sampling for long-term trends in water quality.

In essence, there are two types of water quality sampling performed for CSO discharges:

- *Event-Based Sampling for CSO*—The City plans and is prepared to execute a sampling program to measure the water quality of CSO discharged to the receiving stream as identified in the current draft of the NPDES permit.
- *Fixed-Day Monthly Sampling*—The City obtains water quality samples from the Willamette River for three sections (west, middle, and east) across the river at four transects along the river:
  - River Mile 17.9: Near Waverley Country Club
  - River Mile 12.7: Morrison Bridge
  - River Mile 6.8: St. Johns Railroad Bridge
  - River Mile 1.1: Kelley Point

On a fixed day each month, City staff collect grab and composite samples at these locations and analyzes them for multiple constituents, including the following:

- Dissolved oxygen
- *E. coli* and fecal coliform bacteria
- Copper (total and dissolved)
- Lead (total and dissolved)

- Zinc (total and dissolved)
- Hardness
- pH
- Temperature
- Total dissolved solids
- Total solids
- Total Suspended Solids

- *Unplanned Event-Based Sampling for SSO*—In the case of sewage releases from manholes or SSOs to a receiving stream, water quality samples are typically taken by SPCR section staff as part of their investigation to identify the source location, cause, and impact of a sewage release. The water quality sampling is unplanned in that it is done when appropriate and is simply a part of the overall response procedure. Water quality samples for SSOs are typically focused on bacteria and are performed to:

  - Verify that the reported overflow was sanitary sewage (often it is another source)
  - Determine the magnitude of the sewage release on the water quality of the receiving stream
  - Confirm that clean-up activities have adequately reduced the bacteria levels

NPDES Permit and Amended Stipulation and Final Order Requirements

NPDES permits for the City's treatment plants dictate specific effluent water quality monitoring and pretreatment program sampling. Schedule B of the NPDES permit specifies the monitoring required for the pretreatment program's tracking of pollutants in flows to CBWTP and the Columbia Boulevard Wet Weather Treatment Facility (CBWWTF). Figure 9-5 provides an example of the monitoring requirements for CBWTP and was taken from the Schedule B of the current draft permit.

Figure 9-5. CBWTP NPDES Permit Example: Schedule B Minimum Monitoring and Reporting Requirements

b. CBWTP and/or CBWWTF Treated Effluent from Outfall 001 and/or 003, as applicable.

The facility effluent sampling locations are the following:

Effluent grab samples, measurements and composite samples are taken from discharge lines. The composite sampler is to be located at a point following clarification to assure representative sampling for the discharge. Bacteria, total residual chlorine and bioassay samples shall be taken after dechlorination mix box and just before the outfalls.

Item or Parameter	Minimum Frequency	Type of Sample
Total Flow (MGD)	Daily	Measurement
Flow Meter Calibration	Quarterly	Verification
pH	Daily	Grab
Biochemical Oxygen Demand (BOD_5)	Daily	24-hr Composite*
Total Suspended Solids (TSS)	Daily	24-hr Composite*
Pounds Discharged (BOD_5 and TSS)	Daily	Calculation
Average Percent Removed (BOD_5 and TSS)	Monthly	Calculation
E. coli	Daily	Grab (See Note 1)
Quantity Chlorine Used	Daily	Measurement
Total Residual Chlorine	Daily	Continuous**
Bioassay (See Note 2)	Annually	Acute & chronic
Nutrients:		
NH_3-N, NO_2+NO_3-N, TKN and Total Phosphate-P	Weekly (May – Oct)	24-hr Composite*

*CBWWTF composite samples are dependent on the day's wet weather diversion and may be less than 24 hours.

**Continuous monitoring results shall be evaluated on an average hourly basis for compliance determination.

c. Pretreatment Program

Item or Parameter	Minimum Frequency	Type of Sample
Metals (Ag, As, Cd, Cr, Cu, Hg, Mo, Ni, Pb, Se, Zn) and Cyanide (CN)		
• Influent	Weekly	24-hr Composite
• Effluent	Monthly	24-hr Composite
• Biosolids	Monthly	Representative of the Primary Digested Biosolids
Priority Pollutant Organics:		
• Influent	Quarterly	24-hr Composite
• Effluent	Quarterly	24-hr Composite
• Biosolids	Quarterly	Grab
Toxics Removal Rate:		
• Metals, cyanide and priority pollutant organics	Annually	Calculation

Sampling Quality Assurance/Quality Control (QA/QC) Procedures

The sampling procedures are fairly structured and written in the form of either NPDES permit requirements (as presented above), in the Monitoring/Sampling Request Forms submitted by the customer, and in formal Standard Operating Procedures (SOPs) developed by the Field Investigations Section to ensure that QA/QC protocols are followed.

To obtain monitoring or sampling services, a customer must fill out a Sampling Request Form and a budget worksheet to fully identify the locations, types of samples, and constituents to be sampled. The worksheet identifies the specific sampling method to be used for each constituent. Table 9-1 is an example part of a worksheet.

Table 9-1. Sampling Request Form Example

I. General Chemistry			Fiscal Year (FY) 2008-09 rate, dollars	No. of tests	FY 2008-09 cost, dollars
Analysis	Matrix	Method			
Alkalinity	Water	SM 2320B	27.00		-
Ammonia-nitrogen	Water	EPA 350.1	32.00		-
BOD, 5-day	Water	SM 5210B	60.00		-
Chloride/bromide	Water	EPA 300.0	26.00		-
Chlorine, residual[1]	Water	SM 4500-CL D	26.00		-
Chlorophyll a	Water	SM 10200 H	60.00		-
COD	Water	SM 5220 D	47.00		-
Color	Water	SM 2120 B	29.00		-
Conductivity	Water	SM 2510B	25.00		-
Cyanide, amenable	Water	SM 4500CN-HK	78.00		-
Cyanide, total	Water	SM 4500-CN C	62.00		-
Flash point, closed cup	Water	ASTM D93-66	48.00		-
Fluoride	Water	EPA 300.0	26.00		-
Grain size	Solid	ASTM D422	120.00		
Hardness	Water	SM 2340 B	28.00		-
Nitrate-nitrogen	Water	EPA 300.0	26.00		-
Nitrite-nitrogen	Water	EPA 353.2	32.00		-
Oil and grease, total[1]	Water	EPA 1664	73.00		-
Oil and grease, non-polar[1]	Water	EPA 1664	80.00		-

As part of its QA/QC Program, a series of SOPs has been developed for the different field activities performed to collect environmental samples. Figure 9-6 shows these procedures and their status.

Figure 9-6. Standard Field Operating Procedures

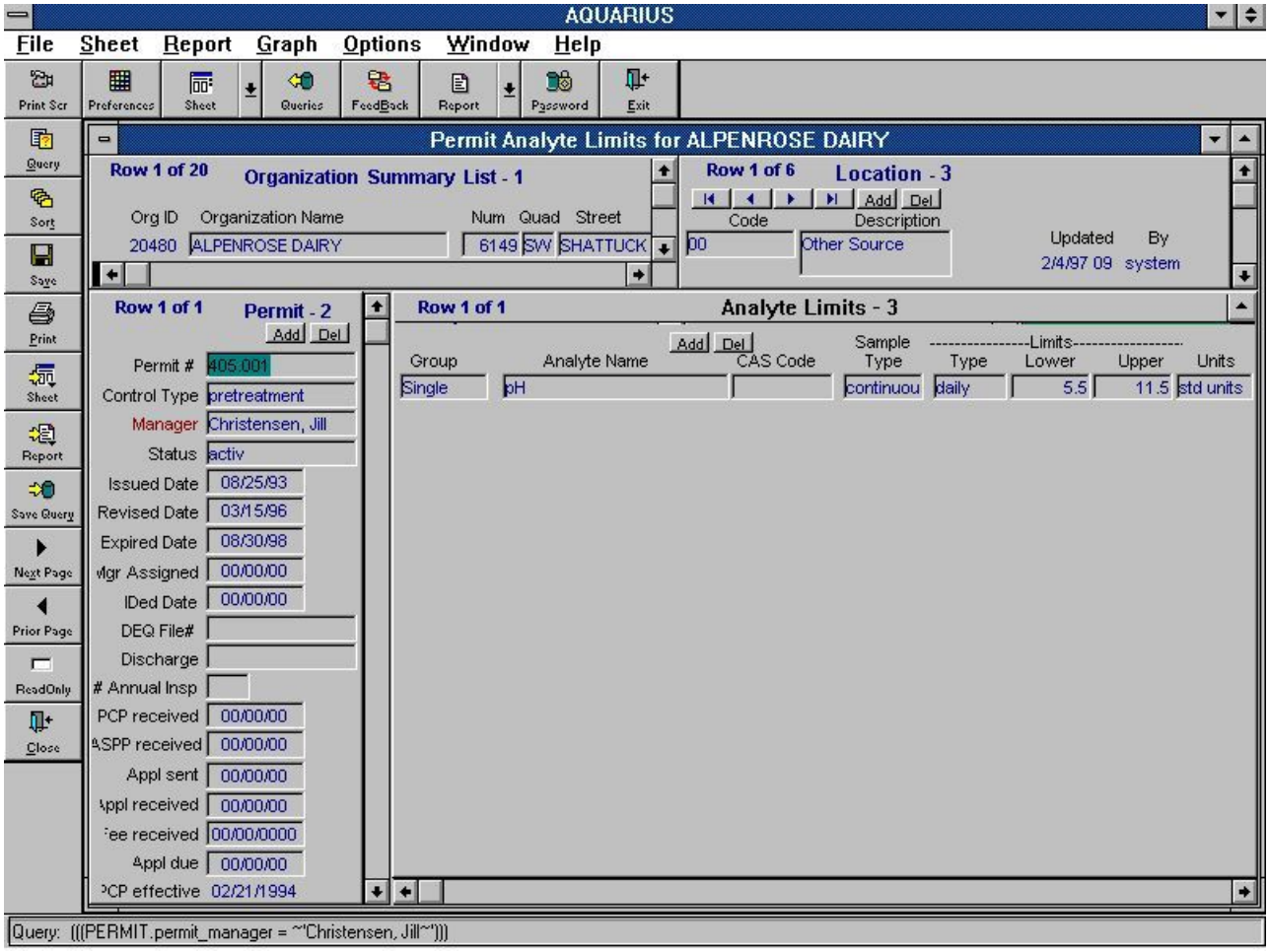
Sop #	Category	Subcategory	Sop Working Title	Author	Written	Reviewed	Completed
1.01a	Field Measurement	pH	Field pH Measurement of Water Samples	CJE	●	●	●
1.01b			Field pH Measurement of Wastewater Samples	MKS	●	●	●
1.01c			Field pH Measurement of Sediment Samples	LAP	●	●	●
1.02a		D.O.	Field Dissolved Oxygen Measurement of Water Samples	MKS	●	●	●
1.03a		Conductivity	Field Conductivity Measurement of Water Samples	MKS	●	●	●
1.04a		Turbidity	Field Turbidity Measurement of Water Samples Using a Turbidimeter	CJE	●	●	●
1.04b			Field Turbidity Measurement of Surface Water Using a Secchi Disc	AMM	●	●	●
1.05a		Temperature	Field Temperature Measurement of Water Samples	MJS	●	●	●
1.05b			Continuous Field Temperature Measurement	AMM	●	●	●
1.06a		Multi-parameter	Field Measurement of Multiple Parameters	MJS	●	●	●
1.06b			Continuous Field Measurement of Multiple Parameters	ECH	●	●	●
1.07a		Gas	Field Measurement of Methane	MJS	●	●	●
1.08a		Redox	Field Redox Measurement of Sediment Samples	LAP	●	●	●
2.01a	Surface/Stormwater	Composite	Time-Paced Composite Sampling of Stormwater	MJS	●	●	●
2.01b			Flow-Paced Composite Sampling of Stormwater	MJS	●	●	●
2.02a		Grab	Grab Sample Collection with Sample Bottle	JBB	●	●	●
2.02b			Grab Sample Collection with Stainless Steel Beaker	MJS	●	●	●
2.02c			Grab Sample Collection with Peristaltic Pump	CJE	●	●	●
2.02d			Grab Sample Collection with Column Sampler	MJS	●	●	●
2.02e			Grab Sample Collection for Chlorophyll a	MKS	●	●	●
2.03a		Ultraclean	Ultraclean Surface Water Sampling with Peristaltic Pump	CJH	●	●	●
2.04a		Level Measurement	Surface Water Elevation Measurement				
2.05a		SPMD	Sampling Selected Organics using Semi-Permeable Membrane Device	MJS			
3.01a	Groundwater	Level Measurement	Groundwater Level Measurement	MJH	●	●	●
3.02a		Sampling	Groundwater Sampling with Disposable Bailer	MJH	●	●	●
4.01a	Wastewater	Composite	Time-Paced Composite Sampling of Wastewater	MKS	●	●	●
4.01b		Grab	Grab Sample Collection of Wastewater	MKS	●	●	●
4.01c			Grab Sample Collection of Wastewater for Cyanide Analysis	WCR			
5.01a	Solids	Soil/Sediment	Sampling of Soil and Sediment	MJH/LAP	●	●	●
5.01b			Sampling Stormwater Solids Using Inline Sediment Traps	JXB	●		
5.01c			Sampling Wastepiles	JXB			
5.01d			Sampling Sediment Beneath an Aqueous Layer	LAP			
5.01e			Inline Sampling of Stormwater Solids	DJH			
5.01f			Sampling of Stormwater Solids from Sedimentation Chambers	RCB			
5.02a		Biosolids	Grab and Composite Sampling of Biosolids	WCR	●	●	●
6.01a	Flow Monitoring		Open Channel Flow Monitoring - Equipment Installation	MJH	●	●	●
6.01b			Open Channel Flow Monitoring - Routine Site Visit	MJH	●	●	●
6.01c			Open Channel Flow Monitoring - Data Management and QA Review	MJH	●	●	●
7.01a	Miscellaneous		Decontamination of Sampling Equipment	MJH	●	●	●
7.01b			Field Filtering of Water Samples	MJS	●	●	●
7.01c			Field QC Sample Collection	JBB	●	●	●
7.01d			Sample Chain-of-Custody, Transport and Delivery	BCL	●	●	●
7.01e			Compositing Samples Using a Churn Splitter	MJS	●	●	●
ADMIN1	Administrative	Billing	Billing for Sampling and Monitoring Services	DJH	●	●	●

Note - SOPs listed above indicate activity is a routine task of the Field Operations section.

Sampling Records Maintenance

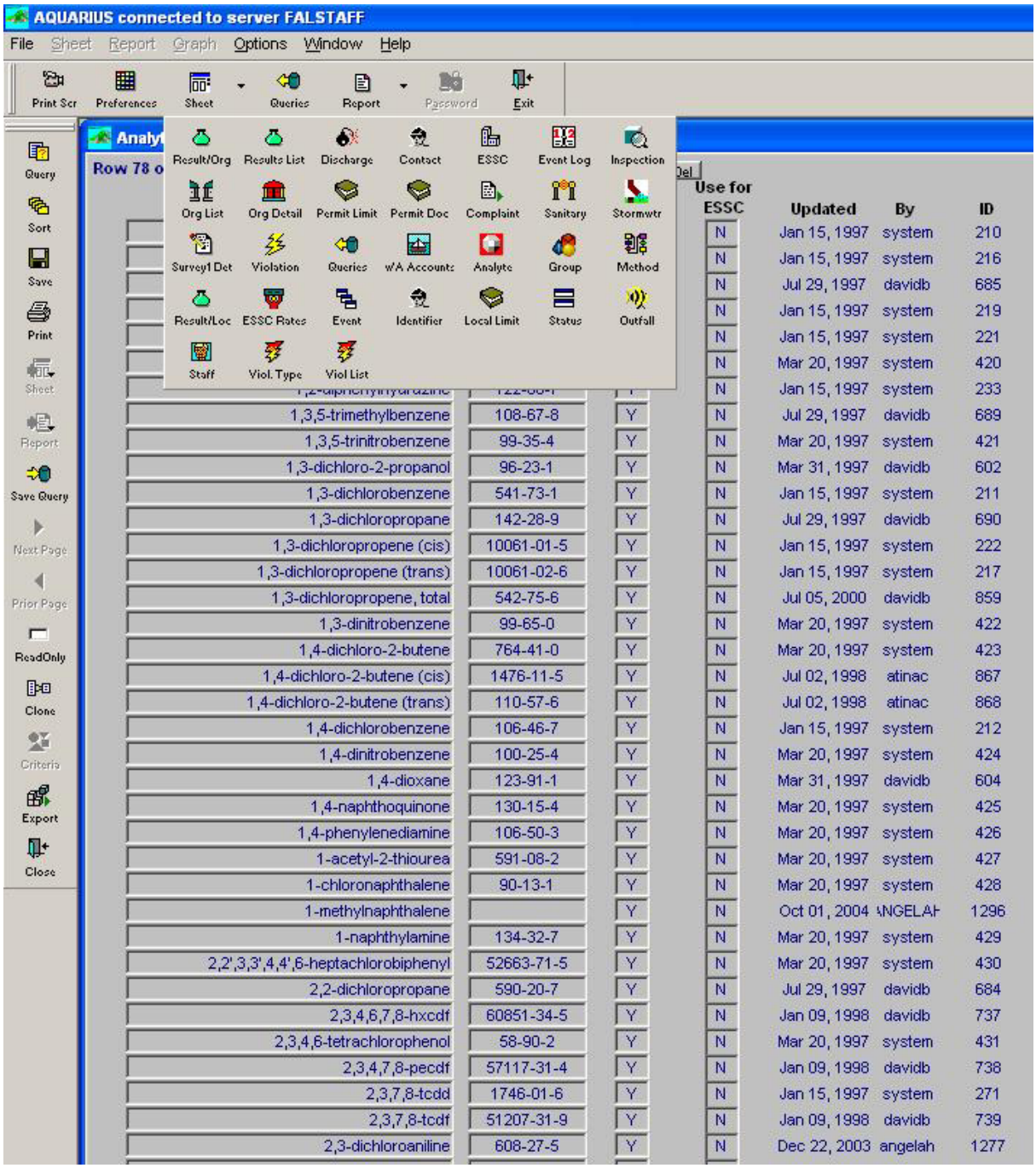
All environmental sample results (for water quality and others samples) are stored in the Aquarius Database, which is a structured query language-based data management system developed by the City. This data management system provides tools and automation for input, analysis, reporting, and background data management for the City's water quality samples. A screen image of Aquarius system being used to evaluate an industrial site sample is shown in Figure 9-7.

Figure 9-7. Aquarius Screen-Shot for Industrial Site Sample



The Aquarius system serves several BES programs, including source control, industrial stormwater, and pollution prevention. Figure 9-8 provides an example view of the many types of reports that can be generated to support these programs.

Figure 9-8. Aquarius Screen-Shot for Various Reports Available



Hydraulic Modeling and Capacity Assessments

This section describes the modeling tools used to characterize flows in the wastewater collection system and provides an overview of where and how collection system hydraulic limitations are reported.

Types of Modeling Tools Currently Used

BES employs a set of robust modeling tools to simulate stormwater runoff, sanitary flow, combined sewage flow, and CSO flow management across the collection system, as listed below:

- *XP-SWMM RUNOFF* for simulating stormwater runoff into the combined sewer or separated stormwater systems
- *RDII Regression Tool* to generate expected RDII hydrographs into the sanitary system using historical rainfall and flow monitoring data
- *XP-SWMM Extran* for simulating the hydraulics of flow through the combined and sanitary networks, including pipes, manholes, pump stations, and overflow structures.
- *DHI-MOUSE* for simulating large diameter interceptors and CSO tunnels, large CSO pump stations, and real-time controls for delivering captured dry and wet weather flow to the CBWTP.

The combined and sanitary models follow an Explicit Model approach that allows simulation of every pipe, manhole, property, street drainage area, and each specialty structure (diversion, overflow, pump station) in the collection system. This highly detailed set of models has given BES the ability to calibrate the model for both local (small scale) and regional (large scale) areas. The models are used to accurately determine the following:

- Location of basement and street flooding
- Source of stormwater and sanitary flows in the combined and sanitary system
- Impacts of improvements to reduce stormwater, provide additional capacity, or provide a new route for hydraulic relief

The Explicit Model requires tens of thousands of laterals, pipes, and manholes to be simulated. Due to the amount of data required to carry out Explicit Modeling, BES employs extensive data management tools to store modeling data and results. Both the original data and the modeling results are further analyzed and displayed using geographic information system (GIS) tools.

Summary of System Hydraulic Limitations

As part of the System Planning effort (updated Public Facilities Plan), BES has developed extensive documentation of the hydraulic capacity limitations in the combined and sanitary sewer systems for both existing and future conditions. The *Combined System Plan Characterization Repo*rt includes a large atlas of maps that show the following:

- Basement flooding risk under a 2-year, 5-year, and 25-year storm
- Basement flooding risk for existing and future 25-year storms
- Pipes with hydraulic capacity problems under the 25-year storm
- Pipes with structural condition problems

An example of one of the many maps from the *Combined System Plan Characterization Report* is provided as Figure 9-9.

The *Sanitary System Plan Characterization Report* has created similar maps to characterize the hydraulic capacity and performance of the sanitary system. Figure 9-10 shows a sample map from the report, and shows properties at risk of basement backup as well as specific pipes that experience capacity problems. The map also indicates the status of capacity problems for the local sanitary pump stations. In general, there are much fewer capacity problems in the sanitary system compared to the capacity problems identified in the combined sewer system.

Capacity Assessment Facility/Master Planning

In general, periodic capacity assessments are performed for two reasons—first, as part of a regularly scheduled update of BES's public infrastructure plan, and second, on an as-needed basis to support design and construction of new connections to the system. For both situations, the procedure used to carry out the capacity assessment is similar, and is described below.

System-wide and local capacity assessments are conducted by the Systems Analysis section within BES. To conduct these assessments, Systems Analysis staff calibrate their hydraulic models using data from the City's permanent flow monitoring system—HYDRA. In addition, temporary flow monitors are installed at specific locations where increased data resolution is needed. Systems Analysis staff create XP-SWMM models for hydrologic and hydraulic analyses. The assumptions used in the development of these models include population and land use projections for future conditions derived from the Planning Bureau's Comprehensive Plan. This provides a source for projected information (20 and 50 years into the future or longer) such as impervious area, population changes, and new transportation configurations. As part of building the future-based models, the new information on impervious coverages, infrastructure changes, and reported problems are routinely incorporated. A series of design storms are then simulated to generate various flow conditions to determine potential capacity problems.

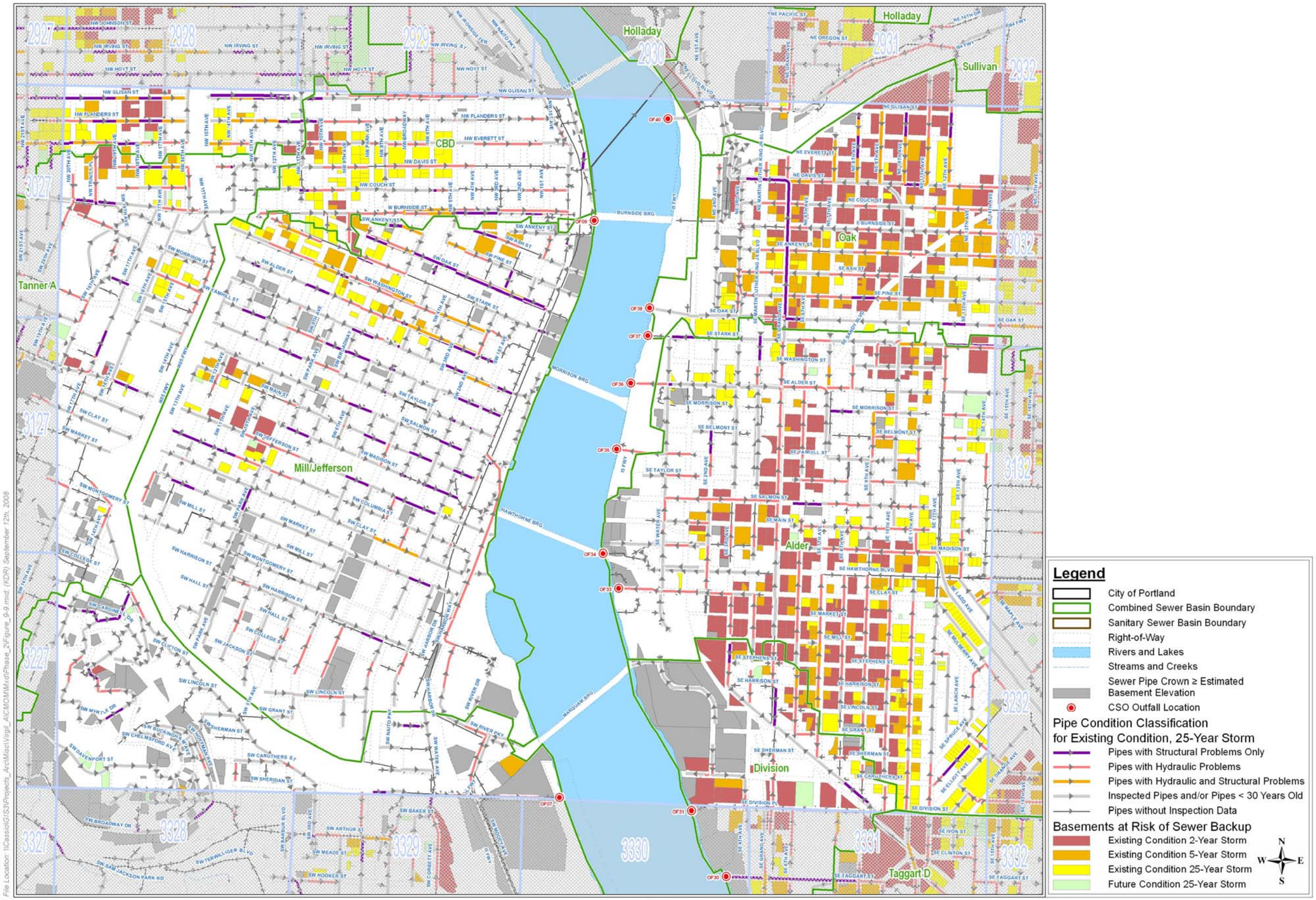
Identification of pipe capacity issues includes detection of lines with excessive surcharge, lines that are in danger of causing street flooding or basement sewer backups, and structurally defective lines that may become vulnerable when surcharged. For instances in which a capacity problem is found in the existing collection system, new connections may be restricted until the capacity relief has been implemented.

Local capacity problems, determined from the model and field experience, are analyzed to develop potential solutions as part of regular System Planning updates. This planning effort includes capacity analyses of pump stations and wastewater treatment plants. These regularly scheduled updates prioritize and integrate solutions for capacity problems with solutions for structural problems to optimize the maintenance and replacement of sewer infrastructure. Solutions for capacity problems include pipe replacement, capacity augmentation, and low-impact development schemes (including curb extensions, street planters, infiltration galleries, and downspout disconnections).

Sewer Assessment Methods

BES has long used standard industry practices for assessing the condition of the wastewater collection system. BES is in the process of expanding its sewer assessments methods to support and implement AM practices. Sewer inspections, assessments and the resulting data are being used to identify the risks (likelihood and consequence) of failure for the three major failure modes:

- *Capacity failures*: Driven by wet weather inflows, including I/I
- *Mortality failures*: Driven by structural condition
- *Operation & Maintenance (O&M) failures*: Driven by blockages due to grease, roots, and debris



File Location: \\Cassiopia\GIS3\Projects_Arc\Misc\Virgil_ACMOM\Mxd\Phase_2\Figure_9-9.mxd; (KDP) September 12th, 2008

Figure 9-9.

Example Map of Combined System Characterization for Basement Sewer Backup Risk

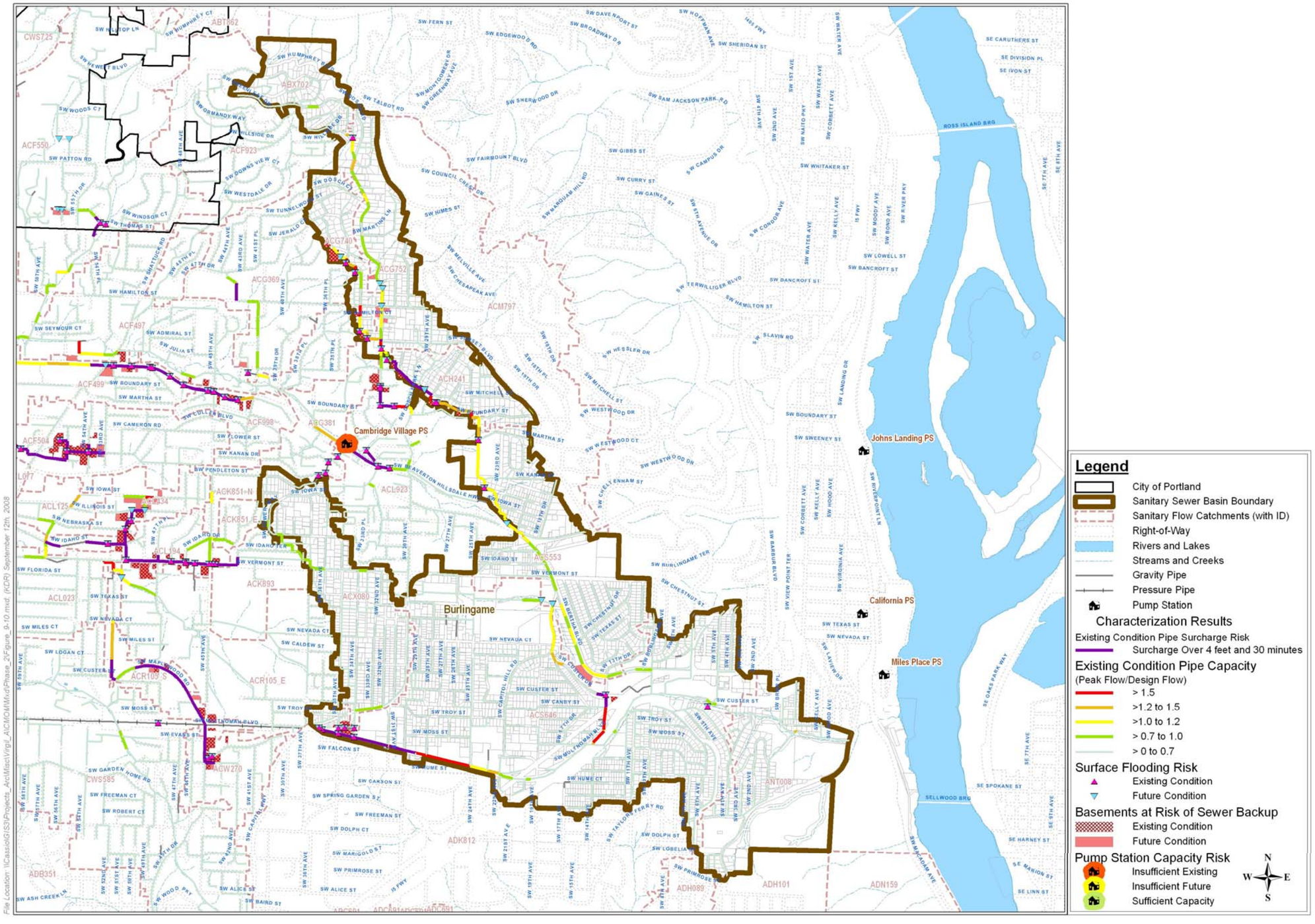


Figure 9-10.

Example Map of Sanitary System Characterization for Hydraulic Performance Indicators

In order to determine the likelihood (or probability) of these failures, BES performs sewer assessments using flow monitoring, hydraulic modeling, CCTV inspection, dye testing, smoke testing, and detailed tracking of reported blockages.

Identification of Risk of Capacity Failures

Capacity failures in combined and sanitary pipes are typically caused by excess stormwater entering the collection system. In the combined sewer system, BES's Explicit Model (a detailed hydrologic model) along with extensive flow monitoring is used to identify and quantify the sources of wet weather inflows. In contrast, the sanitary system typically does not have direct stormwater connections; therefore, BES identifies and quantifies I/I through a series of efforts:

- Detailed flow monitoring of specific local areas
- Dye testing of suspected individual connections, including rat holes, surface drains, foundation drains, and roof drains
- Smoke testing of neighborhoods with a large number suspected rat holes and surface drains (Smoke testing is not a reliable detection method for sanitary connections of roof drains or foundation drains.)

Results from these assessments are incorporated into one or two types of responses. Sources of I/I that can be addressed by maintenance staff are identified in a work order with the repair scheduled to occur soon after. Large sources of I/I that require a major capital improvement project or the efforts of a large I/I reduction program are identified in the Sanitary System Plan and recommended for funding in the CIP or the Operating budget, as appropriate.

Identification of Risk of Mortality (Structural) Failures

Sewer assessments are performed as a way of determining the risk of mortality or structural failure. The likelihood or probability of structural failure is determined through the cleaning and inspection program. Currently, cleaning and inspection are performed on both the combined and sanitary sewers according to three major maintenance efforts:

- Preventive Maintenance Program
- Basin Relief and Reconstruction Predesign Project Inspections
- Special Projects and Risk-Based Accelerated Inspection Program

Preventive Maintenance Program

Preventive cleaning and inspection are performed on a basin-by-basin basis that rotates geographically throughout the city. BES's Maintenance Engineering staff assign specific areas to the Department of Transportation/Maintenance Operations (PDOTMO) for cleaning and inspection based on:

1. Date of last inspection
2. Potential pipe condition concerns
3. Basin relief and reconstruction predesign timing

Basin Relief and Reconstruction Predesign Projects

In this category, cleaning and inspection activities are initiated to resolve basement flooding problems caused by capacity and structural condition deficiencies. These projects require a considerable amount of CCTV inspection in order to identify potential existing, and near-future condition problems. Currently, City staff are working to identify the basin relief and reconstruction project areas that will be performed over the next 5 years.

Special Projects and Risk-Based Accelerated Inspections

This category of cleaning and inspection ensures that pipes and manholes identified as having a potential high-risk of failure are inspected more frequently. Also, BES and PDOTMO perform special inspections on an as-needed basis to ensure that the entire wastewater collection system is being properly maintained. For example, within the past 10 years, BES completed the Large Sewer Diameter Inspection Project, which entailed cleaning and inspecting the majority of the combined sewer pipes sized 48 inches or more in diameter. Recently, BES has expanded this inspection program to be more directly prioritized according to AM principles to reduce the total base risk of the combined and sanitary sewer systems. Pipes that are designated as having a high structural failure risk (calculated as consequence of failure times likelihood of failure) are evaluated to determine if the last inspection has occurred within the greater period of (a) the past 5 years or (b) one-half of the remaining expected service life. Once pipes needing accelerated inspection are identified, those pipes and the nearby pipes are grouped in order to create a list of pipes large enough in the specific local areas to justify and ensure a cost-effective inspection effort.

Identification of Risk of Operating Failures

The third type of sewer assessment performed by BES is performed to identify the likelihood of operational failures in the sewer system caused by roots, grease, debris, and other blockages. BES performs these assessments by examining the historical record of SSOs that is kept and maintained by BES staff. The Sewage Release Database (SRB) is created from the daily records kept by the SPCR staff for all sewage releases reported to BES or PDOTMO. The SRB contains data that identifies:

- Times of event start, stop and BES/PDOTMO responses
- Identified cause of the event (roots, grease, construction debris, vandalism, etc.)
- Release location (to ground, stream, street/inlet) and volume released

This information is geo-coded and reviewed via GIS maps to help determine:

- Hot-spot areas
- Frequency of repeated areas
- Spatial and temporal patterns, if any

Using the SRB, a basis Likelihood of Failure is determined, not necessarily for a specific pipe as much as for specific areas that are susceptible to repeated events. BES uses these assessments and data to help guide programs that perform the O&M work in order to reduce the potential for a repetition of releases.

CCTV Inspection Program

The previous sections described the reasons for implementing the CCTV Inspection Program. This section describes the equipment and resources used to implement the inspection program. This section defines the overall goals of the program and provides an explanation as to how the condition assessment information is used to make operation, maintenance, and capital decisions. The CCTV Inspection Program includes the inspection and assessment of pipes and manholes.

Inspection Program Goals

The goals of the overall CCTV Inspection Program are detailed below:

1. Collect current information to maintain accuracy of the system inventory.
2. Assess the condition of the sewer system to:
   - set maintenance priorities for cleaning and root control
   - support development, funding, and implementation of sewer rehabilitation plans
   - identify causes of system failure
   - identify facilities in need of immediate repair
3. Provide data to project managers for modeling, predesign, design, and construction for the following:
   - identification of I/I
   - lateral locations
   - acceptance inspections
   - 2-year warranty checks
4. Operate and maintain the sewer collection system in a manner that:
   - meets established standards
   - is at a value that equals or exceeds that of other municipalities and private operators
   - provides an equivalent level of service
5. O&M Manuals used by BES include:
   - *Sewer Collection Facilities Maintenance Management Manual* (April 1997)
   - *Surface Stormwater Facilities Maintenance Management Manual* (April 1997)

Condition Assessment Methodology

As part of the CCTV inspection and review process, trained staff assign pipe defect codes to identify the type and severity of the defects, including cracks, fractures, holes, corrosion, erosion, joint problems, sediment and debris, grease, and other structural and operational problems observed during the inspections. These defect codes, stored in the Hansen maintenance management system (MMS), identify the number and severity of the defects as well as their location. The MMS also contains information on the age of the pipe, the pipe material, and the depth of the pipe.

Pipe condition grades are determined from the structural defect codes identified during the CCTV inspection. Condition grades range from 1 to 5, in which a 1 is a good condition pipe and a 5 is a very poor condition pipe. A pipe can also be assigned a Grade 6 to indicate that it requires a special spot-repair to restore it to an acceptable condition grade (2 or 3). The pipe grading methodology is documented in Technical Memorandum 3.1.A.2 Structural Grading for the System Plan Update project.

The assessment of manholes is included as part of the sewer inspection. The defect identification codes used to define the types and severities of the observed defects are based upon EPA guidelines for manhole inspections. The results of the inspections are stored in the Hansen MMS.

A final step in the process of evaluating pipe structural condition is to calculate the RUL of the pipe based on the structural grade. The RUL effectively serves as the likelihood or probability of mortality failure based on the risk calculation.

Currently the City of Portland is establishing the estimated remaining useful life per Technical Memorandum (TM) 3.1.B.1A Remaining Useful Life Assignment for the System Plan Update project and Brown and Caldwell's RUL TM 3-1.

Setting Inspection Priorities

Sewer inspections are prioritized within the specific program according to the program objectives:

1. Preventive Maintenance Inspection Program–Priority of pipes assigned to be inspected in this program is determined from:
    - Date of last inspection
    - Potential pipe condition concerns in the general area
    - Basin relief and reconstruction predesign project timing
2. Basin Relief and Reconstruction Predesign Projects–Pipes to be inspected are prioritized according to the following:
    - Pipes are within the specific CIP project boundary
    - Date since last inspection
    - Potential concern due to last inspection or nearby a problem area
3. Special Projects/Accelerated Inspection Program:
    - Pipes that have a high risk of mortality failure–High consequence of failure times high likelihood of failure
    - When business risk exposure justifies cost of inspection but no later than one-half the RUL estimate

Frequency of Inspections

BES had a history of inspecting pipes and manholes at a rate that would have approximated inspection every 25 years. About 10 years ago, the goal was changed to inspect the system on a 12-year cycle. Over the past 5 years, BES has been inspecting an average of about 160 miles of sewer pipe in the wastewater system per year. At this rate all pipes (on average) will be inspected in the desired 12-year inspection cycle.

BES is in the process of establishing the priority and frequency for inspections based on an AM approach. This approach is based upon three main drivers:

- Driver 1: Prevent high-risk pipe failures
    - Addressed by the Special Project/Accelerated Inspection program
    - Expected frequency of high-risk pipes is approximately once every 5 to 10 years
- Driver 2: Collect ongoing data to determine condition and rate of decay of the collection system for long-term planning
    - Addressed by Preventive Maintenance Inspection Program
    - Expected frequency for pipes are average is to be a 12-year cycle (internal goal)
- Driver 3: Capture potential structural problems in nearby pipes during basin improvement projects
    - Addressed by Basin Relief and Reconstruction Projects
    - Expected frequency of pipes is once per nearby basin project (less than 10 years until pipes are ensured to have a grade of 3 or better).

Manhole Inspection Program

PDOTMO staff inspect manholes as part of the overall CCTV Inspection Program. The manhole inspections are performed to identify defects and to determine appropriate rehabilitation actions that should be taken to prolong structural integrity and to reduce infiltration.

Manhole inspections are performed in accordance with industry standards. Currently, the City uses the manhole defect codes from the Hansen MMS for identifying the type and severity of the defects. A copy of the Manhole Inspection Work Process is provided in Appendix B. The Manhole Inspection Form is provided in Appendix C.

Corrosion and Odor Monitoring and Control

Wastewater collection systems may be vulnerable to two common problems—odor and corrosion. Both result from hydrogen sulfide production caused by the decomposition of organic matter in wastewater without adequate dissolved oxygen.

The City's collection system was developed in the late 1800s and early 1900s. Maintenance, retrofits, and rehabilitations since then have resulted in a system comprised of a patchwork of materials from different eras. The sewers in some areas of the city consist mostly of vitrified clay and plastic pipes which are very resistant to hydrogen sulfide corrosion. Other areas of the city are constructed with concrete, steel, and iron pipes which are more susceptible.

Corrosion that leads to hydrogen sulfide production and resultant odors tends to occur in collection systems that are in warm climates and have a flat grade or do not have the flow-through velocities to prevent stagnation of fluid, allow the septic conditions to occur. This is not typically the case with Portland's sewers. There are few areas of the City's system, however, that may be subjected to the effects of hydrogen sulfide production and the potential for related corrosion. Areas thought to be subject to generation of hydrogen sulfide include the following: sewer segments that have a flat grade and low velocity conditions and/or long detention times; sewers subject to solids deposition; pump stations; turbulent areas, such as drop manholes or force main discharge points; and inverted siphon discharges. Overall, the system's vulnerability for hydrogen sulfide corrosion is fairly low, limited to a few isolated areas.

Odors are an infrequent source of complaints considering the size of the system. A moderate climate and frequent rainfall most of the year combine to reduce the potential for septic conditions to develop in the collection system.

Methods Used to Identify Corrosion and Odor Problem Areas

Odor and corrosion problems can be mitigated or corrected by using a planned approach to identify the area and conditions in which hydrogen sulfide production occurs.

Inspection

The City inspects manholes for odor and signs of corrosion. Inspectors use gas detectors to monitor the atmosphere in the manhole and record the readings as part of the inspection. Observations are compiled onto a paper form and subsequently entered into the Hansen® database in appropriate asset inspection fields.

Instrumentation

The City is using Odalog® instruments to identify areas where hydrogen sulfide is present and which strategy or technique(s) will mitigate its harm and prevent damaging effects. The instruments log levels of hydrogen sulfide in the range of 0 to 200 parts per million for later data downloading in tabular or graphical form to highlight significant variations in levels over time. High hydrogen sulfide levels are noted in the Hansen®

system under safety messages so that crews working in the area in the future will be alerted to take special care. The recorded high hydrogen sulfide levels are provided to a committee dedicated to analyzing odors and corrosion potential.

Methods Used to Prevent and Control Corrosion and Odor

Chemical injection into the sewer is used on a limited basis. For example, the Fanno Basin force main is set up for chemical injection to decrease odors. Chemical dosages are recorded and tracked. The Portsmouth force main is being designed for chemical injection as well when it is completed in 2011.

The large force mains in the system contain air valves at high points. The valves allow air to exit, thus avoiding air space at the crown of the force main system. The valves are inspected on a regular basis.

Design Considerations

The City takes hydrogen sulfide corrosion into consideration when designing new sewers. The *Sewer Design Manual* has adopted U.S. Environmental Protection Agency guidance called *Designing to Avoid Odor and Corrosion in New Wastewater Collection Systems*. The City's Design Manual includes this document as an appendix to ensure that the City's design standards are consistent with the recommendations.

Designers are aware of hydrogen sulfide considerations and also rely on the supervising engineers to continue to raise awareness and identify potential areas of concern. Newer force mains have liners and/or are constructed with materials less likely to be subject to the effects of hydrogen sulfide.

Odor Control and Corrosion Protection Committee

The City has established an Odor Control and Corrosion Protection Committee. The committee meets monthly to share information and address concerns regarding collection system odor generation and corrosion issues. Members include staff from collection system operations, maintenance, engineering, source control, and public involvement. The committee addresses corrosion issues that have been identified by the various corrosion and odor detection and monitoring activities.

Following are the objectives of the Odor Control and Corrosion Protection Committee:

- Identify odor sources, new and old
  - Relate to mapping tool or GIS
  - Document in a database
  - Establish an odor complaint and reporting system
  - Develop and maintain an odor monitoring program, including responses to complaints
  - Issue an annual report that includes identified odor sources and complaints
- Research and implement odor control technologies and recommend standard approaches
  - Resolve existing problems within the purview of the committee members (reactive mode)
  - Recommend standard approaches for new systems (proactive mode)
  - Issue progress reports
  - Develop and recommend design standards where applicable

- Research and apply corrosion protection and control techniques, and recommend standard materials and systems
  - Resolve existing problems within the purview of the committee members (reactive mode)
  - Recommend standard materials for new systems (proactive mode)
  - Issue progress reports

Rehabilitation Program

BES performs rehabilitation on sewer mains, service laterals, and manholes to extend their service life in a cost-effective manner that is based on AM principles.

Sewer Main Rehabilitation Program

The Rehabilitation Program includes small diameter (less than or equal to 36 inches) and large diameter (greater than 36 inches) gravity sewers, and force mains.

Background

BES has completed numerous basin-wide projects that addressed sewers in poor condition in conjunction with pipes with capacity limitations. In addition to these basin projects, in FY 1997-98 BES performed a comprehensive large diameter sewer inspection project that led to several rehabilitation projects. In 2006, BES began the Phase I Rehabilitation Program to focus rehabilitation activities on the sewers with the greatest need. This program identified the rehabilitation needs of highly critical, small diameter sewers with a high likelihood of failure. The resulting rehabilitation projects have been included in BES's CIP. The rehabilitation of these sewers is expected to be completed by 2012. The Phase II Rehabilitation project is nearing completion as a part of the City's Public Facility Plan Update to provide a 20-year plan to address long-term rehabilitation needs.

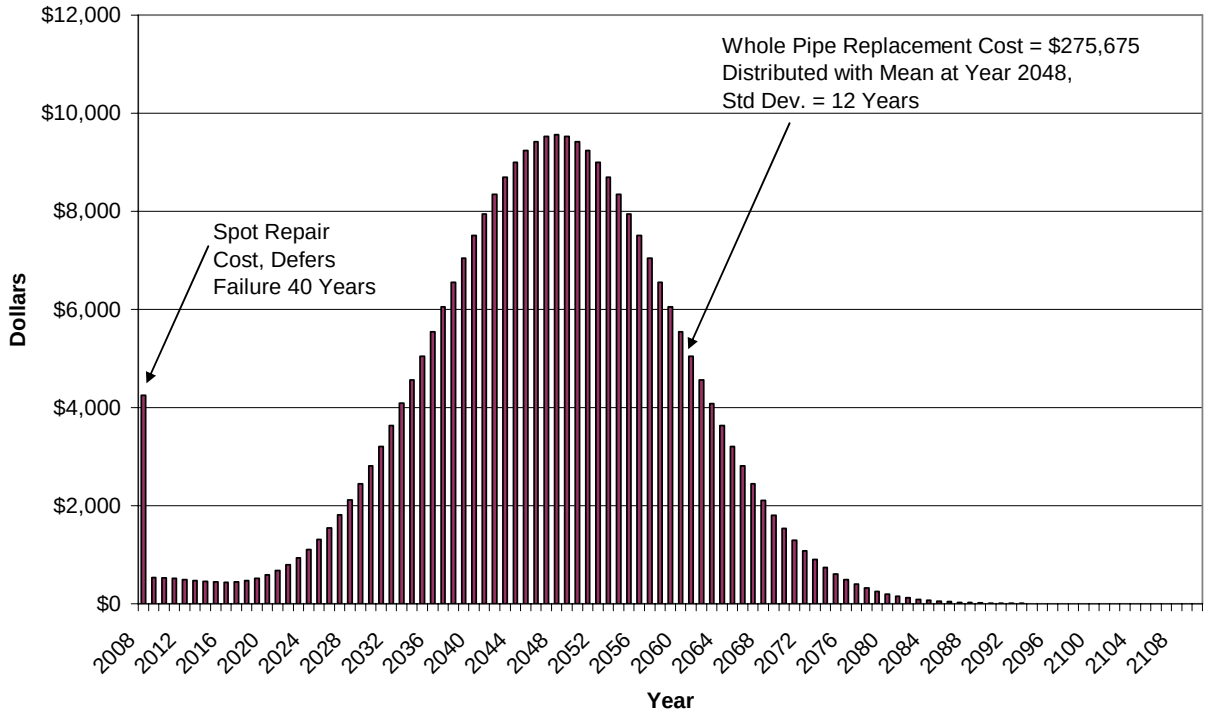
Future Rehabilitation Requirements

AM principles guide the identification and scheduling of rehabilitation projects. For example, future rehabilitation needs are projected by using the estimated failure date (the theoretical end of service life) and replacement cost for each asset.

The estimated failure date can be estimated by assessing the RUL of each asset. RUL is primarily determined using pipe condition grades when such information is available. Alternatively, several other assumptions, including age of pipe, are used when a condition grade is not available. This process is described in three TMs: 3.1.A.2 Structural Grading for the System Plan Update Project, TM 3.1.B.1A Remaining Useful Life Assignment for the System Plan Update project and Brown and Caldwell's TM RUL TM 3-1.

The replacement cost of the pipe is a function of its physical characteristics and location. The replacement cost is assumed to be normally distributed about the estimated failure date with a standard deviation dependent upon the confidence interval of the RUL. Figure 9-11 shows the cost of a spot repair as well as the cost of pipe replacement. In this example, the spot repair defers the replacement of the pipe by 40 years.

Figure 9-11. Example Distribution of Spot Repair and Replacement Costs



Small Diameter Pipes

To date, the City has focused rehabilitation activities on highly critical sewers with a high likelihood of failure. These activities are defined by the Phase I Rehabilitation Program, Maintenance Capital Projects, and the Basin Relief and Reconstruction Program. Completion of the projects defined by these activities, especially the Phase I Rehabilitation Program, is expected by 2012.

There are a number of small diameter sewers (less than 36 inches) with low to moderate consequence of failure but a high likelihood of failure. These pipes are the focus of the City's next phase of rehabilitation planning. The rehabilitation of these sewers will be prioritized on the ability to cost-effectively lower the business risk of structural failure. The resulting rehabilitation activities will be packaged into projects consistent with their location, rehabilitation method, and project size. The rehabilitation of these pipes will be added to the CIP as appropriate, which is likely to occur over a 10-year period beginning no later than 2014.

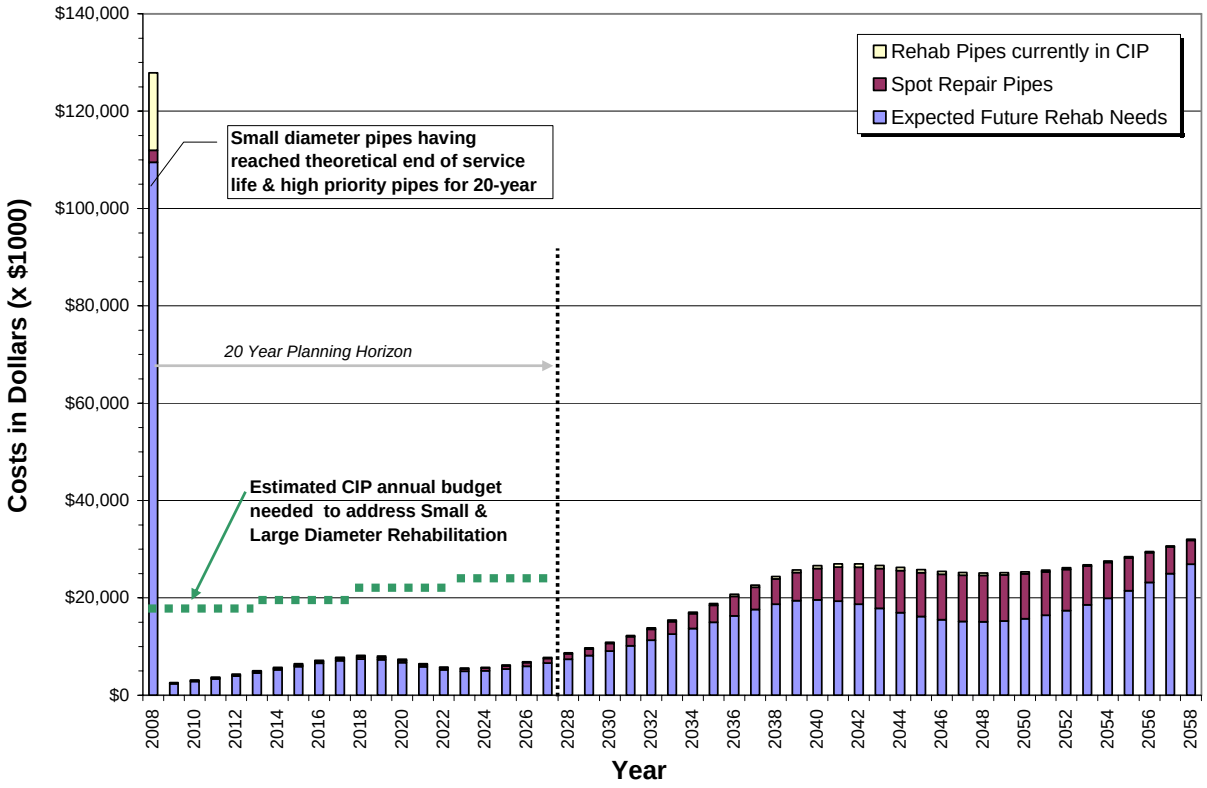
A summary of the City's small diameter sewer rehabilitation needs is shown in Figure 9-12. The rehabilitation costs shown in the figure include those for repairs and projects already identified, and estimated costs for repairs and projects that are expected to be identified in the ensuing years.

The values shown in the figure are based on the end-of-service-life methodology discussed above. Spot repairs were assumed for condition grade 4 and 5 (i.e., poor and failed condition) pipes when the repair was determined to significantly extend the service life of a pipe (approximately 40 years). Spot repairs were identified for approximately 1,022 pipes at an estimated total cost of $9.5 million. Most of the spot repair work will be performed by maintenance crews funded by the operating budget.

A stack of rehabilitation needs is shown for the year 2008. The stack includes three major categories of rehabilitation needs:

- Spot repair projects for pipes that are at or near the end of their theoretical service life
- Pipes that are already funded for repair in the current CIP budget (including the high risk pipes from the Phase 1 Rehabilitation Plan and the Basin Relief and Reconstruction Projects)
- Pipes that are anticipated to require whole pipe replacement within the next 20 years

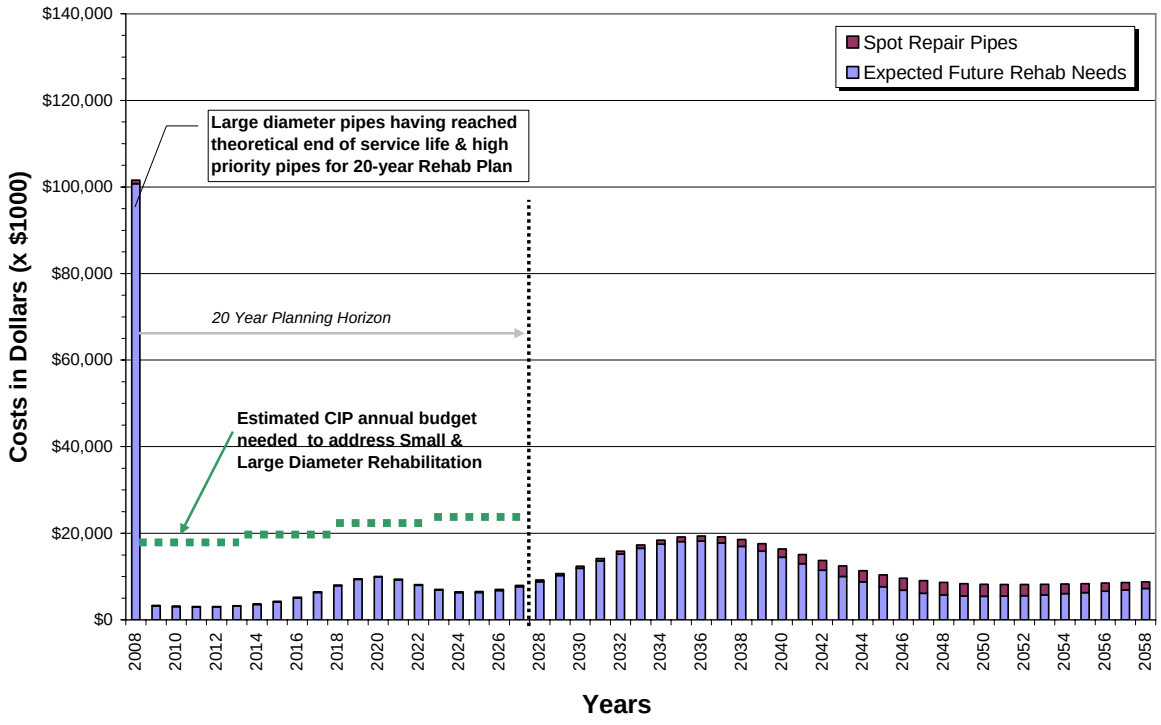
Figure 9-12. Estimated Future Rehabilitation Costs for Small Diameter Pipes (<36 inches)



Large Diameter Pipes

Figure 9-13 shows the estimated rehabilitation requirements of the large diameter sewer pipes (greater than 36 inches). Similar to the small diameter graph, this figure also shows a large amount of pipe at or near the end of its theoretical service life in the year 2008. However, a large portion of these sewers may be readily repaired by spot liners and will likely not require the full replacement costs assumed in this analysis. These large diameter pipes will be inspected over the next 5 years. Predesign and design projects will begin when rehabilitation needs are identified. Spot repairs will be performed as needed to preserve infrastructure and lower total business risk. As large diameter sewer rehabilitation requires special methods and may require substantial bypass pumping, it is anticipated that any major rehabilitation will begin sometime after 2012 (when the CSO system can provide bypass capacity). The large diameter sewers with the most likelihood of failure (as identified in 1998) have already been rehabilitated.

Figure 9-13. Estimated Future Rehabilitation Costs for Large Diameter Pipes



Force Mains

A number of force mains are anticipated to require rehabilitation in the foreseeable future. BES assumes the life expectancy of force mains to be between 70 and 100 years. Because this estimate is based on industry literature without actual condition assessment data, a large standard deviation is assumed. BES will perform condition assessments to identify specific rehabilitation needs as part of long-term rehabilitation activities.

The current Rehabilitation Program budget is $18 million per year through FY 2013-14 with the budget anticipated to increase to $20 million for the following 5 years and to increase again to $22 million for the subsequent 5 years. This funding level will address the sewer main needs as currently estimated.

Service Lateral Rehabilitation

The current estimate of publicly maintained service laterals is approximately 400 miles. BES is responsible for the maintenance of service laterals in the public right-of-way to the face of curb (unless specifically identified as private). The current service lateral repair budget $2.7 million. In addition, service laterals are replaced as part of mainline rehabilitation projects. BES is proposing an increase in the lateral repair program that will increase the number of laterals inspected and repaired each year. This program may include installation of cleanouts at the curb line allowing for enhanced inspection and maintenance of service laterals.

Manhole Rehabilitation

Manhole rehabilitation is currently performed on as-needed basis or as part of sewer main rehabilitation projects. BES has undertaken a condition assessment inventory of sewer manholes in conjunction with sewer inspections. BES has reviewed and piloted several rehabilitation methodologies. From the condition inventory and available rehabilitation methodologies, BES will develop a manhole rehabilitation program that best matches its needs.

10: WASTEWATER COLLECTION AND TREATMENT SYSTEM (WCTS) OPERATION

This section describes the various operating plans used within the City of Portland's (City) WCTS to achieve the Bureau of Environmental Services' mission, vision, and goals for protecting human health and the environment in a cost-effective manner.

Overview

The operation of both the wastewater treatment and collection systems, including pump stations, is supported by a real-time control system centered at the Columbia Boulevard Wastewater Treatment Plant (CBWTP) Operations Center. The control system is connected by a fiber optic network throughout CBWTP and Tryon Creek Wastewater Treatment Plant and a full loop across the city that reliably provides high-speed data communications between the facilities.

The CBWTP Operations Center is the brain trust of the real-time control system for both the plant and the collection system. From this central point, the operators use the supervisory control and data acquisition and monitoring system to review and control the facilities and processes required for collecting and treating dry weather and wet weather flows. The collection and treatment systems are sufficiently complex that specific operations manuals (plans) have been developed to guide the operations of the collection system and the treatment system:

- *Combined Sewer Overflow (CSO) System Operating Plan*: Describes the major collection system facilities and the operations strategy for controlling them together as a system.
- *CBWTP Operations Plan*: Describes the major systems on the CBWTP site, their specific capacity and operational considerations, and strategies for operating under different weather conditions.

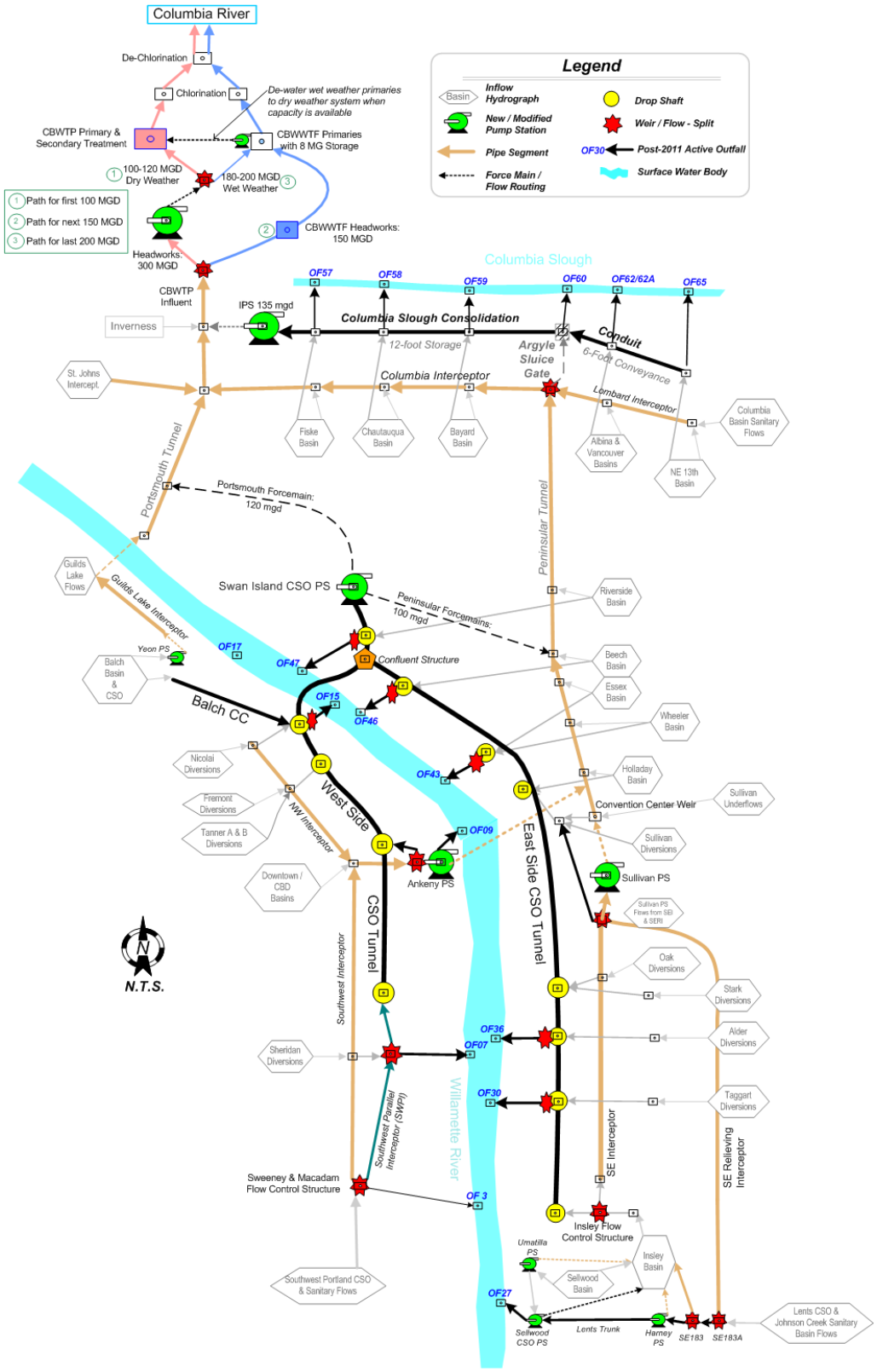
Each of these plans is summarized below.

CSO System Operating Plan

The purpose of the CSO System Operating Plan is to outline the operating and monitoring strategy for the entire CSO control system, which includes both the existing combined sewer and Columbia Slough CSO system and the West Side and East Side CSO facilities to be completed in the near future. Figure 10-1 shows a schematic of this expanded system.

The infrastructure that requires this operational control includes CSO storage facilities, pump stations, and flow control structures in the Willamette River and Columbia Slough conveyance systems. The CSO System Operating Plan does not contain detailed operations and maintenance (O&M) information for each individual facility listed in this document; that information is provided in the O&M manuals developed during the construction of each facility. Instead, this document focuses on the system-wide view and shows how the operations of the individual facilities can be orchestrated to achieve the benefits of CSO control and management of flows to the CBWTP site.

Figure 10-1. Schematic of Expanded CSO System



This plan was developed to meet specific, prioritized objectives for operating the combined sewer collection system in a manner that is practical and consistent with the regulatory requirements driving these new facilities. The State of Oregon's Amended Stipulation and Final Order with the City, the National Pollutant Discharge Elimination System permit for CBWTP, and the U.S. Environmental Protection Agency's national Nine Minimum Controls policy all provide the regulatory foundation for this work. The prioritized list of objectives for the CSO System Operating Plan are listed in Table 10-1.

Table 10-1. CSO System Operating Plan List of Objectives

Objective	Approach
1. Protect and maintain biological system and meet effluent discharge limits	• Maintain 100 million gallons per day through secondary system • CBWTP secondary effluent: less than 30 milligrams per liter suspended solids and biochemical oxygen demand
2. Capture and convey all dry weather flow to CBWTP	Treat all dry weather flow through primary and secondary system
3. Prevent releases to street/basement	Limit pumping to prevent excessive surcharging in downstream interceptors; Lower pump station overflow weirs to relieve excessive upstream backwater.
4. Capture and convey maximum amount of wet weather flow	Treat all via primary and disinfection at a minimum
5. Treat as much CSO through secondary as possible	Store CSO in wet weather primary clarifiers and tunnels until secondary system is available
6. Protect Columbia Slough (sensitive area)	Higher level of CSO control required for Columbia Slough compared to Willamette River (ten times difference)
7. Minimize energy usage and pumping costs	• Keep flows to tunnel at a minimum if possible • Pump during low-cost periods of the day
8. Keep flows at high rate through interceptors and tunnels	Too low of flow rates/velocities in pipes will cause sediments to fall out and harden. Capture and convey maximum amount of wet weather flow.

The CSO System Operating Plan is organized to provide two views into system operations. The first is a facility-by-facility view in which the focus is on individual facilities, their configuration and capacity, and how they are operated under four specific and comprehensive conditions:

- Dry weather conditions
- Transition to wet weather conditions (start of a storm)
- Wet weather conditions (storm and possibly overflows occurring)
- Transition to dry weather conditions (dewatering the tunnels)

The second view is a system-wide approach in which the operations across the system are described for the four weather conditions. The information provided is the same in both views, but together they provide a better understanding of how the facilities are operated together as a system to achieve the eight prioritized objectives.

Because there will be a change in 2011 when the East Side CSO system comes online, the CSO System Operating Plan is divided into a 2006 system (Pre-2011 System) and a 2011 system (Post-2011 System). Having them both together in the CSO System Operating Plan provides a way to view how the operations of the various facilities and the overall system will change when the full CSO system is completed.

The original CSO System Operating Plan was completed in 2005 and was used as a guide to develop the communication and controls system and programming logic needed for the 2006 system. Since that time, improvements have been made to the operating procedures for several facilities to address problems and to provide higher levels of CSO control. Therefore, the CSO System Operating Plan is being updated in 2008 for both the 2006 System and the 2011 System.

CBWTP Operations Plan

The intent of the CBWTP Operations Plan is to outline the Standard Operating Procedures (SOPs) for the operation of the Class IV Wastewater Treatment Facility during dry and wet weather conditions. This document provides guidance to the operations staff during normal flow conditions, when wet weather is anticipated, and during actual wet weather conditions (high flows). The operational strategy of this plant is to maximize secondary treatment and to minimize pollutant discharge.

The document serves as a general guidance document only. Given the complexity of CBWTP's operation and the number of unpredictable variables involved with wet weather conditions, it is not feasible to establish detailed procedures applicable to every operating scenario. The procedures in the document are intended to guide and assist operators under typical dry and wet weather events. Operators are also expected to use their best professional judgment in light of circumstances, which may require deviation from the SOPs in order to achieve the operational goals of the plant. The plant operational goals are consistent with the NPDES permit and the CSO System Operating objectives described above.

The CBWTP Operations Plan is divided into two main parts:

- *Part I: Description of Plant Systems*–Describes each major system at CBWTP, identifying its configuration, capacity, and control identification.
- *Part II: Specific Operational Strategies*–Provides comprehensive operational strategies to address key issues or conditions at the plant, especially wet weather related conditions.

Figure 10-2 shows a sample table of contents for the current version of the CBWTP Operations Plan. This plan is reviewed annually and updated as needed. A copy of the CBWTP Operations Plan is available upon request.

Figure 10-2. Sample CBWTP Operations Plan Table of Contents

Section		Page(s)
PART I:	DESCRIPTION OF PLANT SYSTEMS	
1.0	Introduction	3
2.0	Support Systems	4
3.0	Influent Sources	5-6
4.0	Liquid Stream Overview	7
5.0	Influent Pump Station	8-9
6.0	Headworks	10-12
7.0	Primary Treatment	13-17
8.0	Secondary Treatment	18-19
9.0	Effluent/Hayden Island	20-21
10.0	Disinfection	22-23
11.0	Dechlorination	24-25
12.0	Water Reuse	26-27
13.0	Digesters	28-30
14.0	Sludge Processing	31-34
PART II:	SPECIFIC OPERATIONAL STRATEGIES	
15.0	CSO & Weather-Related Operations	35-40
16.0	Selector / SVI Control Operations	40-41

11: OPERATIONS AND MAINTENANCE ACTIVITIES

The City of Portland (City) performs operations and maintenance (O&M) activities on the wastewater collection system to achieve three major goals: prevent and/or reduce the number and quantity of combined sewer overflows (CSOs) and separated sanitary sewer overflows (SSOs), minimize life-cycle costs while providing an acceptable level of service, and sustain the public's investment in the sewer infrastructure by ensuring that service lives are extended as long as economically feasible. The City's strategic approach to the planning and implementation of O&M activities is based on asset management principles consistent with the Bureau of Environmental Services' (BES) Asset Management Program.

The Portland Department of Transportation/Maintenance Operations (PDOTMO) performs most of the maintenance activities on the wastewater collection system in accordance with the Collaborative Work Agreement (CWA) with BES. The Pump Station Maintenance Operations (PUMA) section of BES's Wastewater Group performs the maintenance at the City's wastewater pump stations.

Overview of Collaborative Work Agreement

Required maintenance activities are defined in the CWA between BES and PDOTMO. The following excerpts are taken from the fiscal year 2005-06 Collection System CWA.

Section 2.1.2 Preventive Maintenance--CCTV Inspection of Sewers. BOM will provide at least 750,000 lineal feet of CCTV inspection of sanitary and combined sewers in accordance with priorities established by BES.

- *Scope of Work. Inspection includes detailed inspection of the mainline, inspection of the laterals to the extent possible from inside the mainline, and cursory inspection of manholes. BOM will record the inspection on videotape, enter defects into the database, and on a weekly basis, upload and download data and work orders to and from Hansen®.*
- *Planned CCTV Inspection Schedule. Scheduling of planned CCTV inspections will be based on a system-wide 12-year cycle. Planned CCTV inspection schedules will be based on asset groups, prioritized by date last inspected. BOM has the discretion to follow the schedule on a citywide basis or on a geographic (maintenance district) basis.*
- *Review of videotapes. BOM will review videotapes to identify sewers in need of repair. Depending on the problem, BOM will either fix the problem, coordinate with BES Source Control, or refer the problem to BES Maintenance Engineering (see 3.4.1).*

Section 2.2. Unscheduled Maintenance. Unscheduled maintenance includes response to system, problems, capital project planning and design, 2-year warranty checks, and verification of the effectiveness of cleaning and repairs. BOM will make every effort to meet requested timelines. If BOM cannot meet a timeline, BOM will notify the requester as soon as possible so that other resources can be used to complete the work in a timely manner.

Section 2.2.1 Investigations. When notified of a problem, BOM will investigate system problems, including sewer blockages, street cavities, street flooding, and other operational and structural problems. BOM will use its judgment in determining the appropriate response time. Results of the investigation will be documented in Hansen and/or daily crew reports.

- *Notification. If a sewage release is identified or suspected, BOM will contact the BES Duty Officer (503) 823-7180) immediately, so that BES can meet the permit requirement to report any non-compliance to DEQ within 24-hours of the City becoming aware of the release.*

- *Sewerage system. At its discretion, BOM may use visual inspection, video camera, smoke testing, dye testing, and other appropriate techniques to investigate and diagnose system problems. Depending on the problem, BOM will either fix the problem, coordinate with BES Source Control, or refer the problem to BES Maintenance Engineering (see 3.4.1).*

- *Surface Stormwater Facilities. At its discretion, BOM may use visual inspection, video camera, smoke testing, dye testing, and other appropriate techniques to investigate and diagnose facility problems. Depending on the problem, BOM will repair the problem, contact the BES Stormwater O&M Manager to obtain permits and coordinate repairs, or refer the issue to the responsible party.*

Section 2.2.2 Unscheduled CCTV Inspection of Sewers.

- *Inspections for collection of data for capital project planning and design, 2-year warranty checks, and verification of the effectiveness of cleaning and repairs will be scheduled as appropriate. BOM will coordinate scheduling with BES for time-sensitive inspections.*

- *BOM will provide unplanned CCTV inspection of sewers as needed to investigate reported system failures and as requested by BES. BOM will make every effort to meet timelines requested by BES*

Please note that the BOM referenced above is now referred to as PDOTMO.

Fleet, Materials, Equipment, and Spare Parts Management

BES and PDOTMO recognize that maintenance crews require a broad range of vehicles, equipment, materials, and spare parts to perform O&M activities efficiently and effectively. This section presents the approach that BES and PDOTMO have adopted for ensuring minimum down-time and productive field activities.

Fleet Management

BES owns a fleet of cars and trucks that are used by a variety of staff in support of City programs. In addition, BES owns the vehicles and equipment used by PDOTMO, which includes various types of utility trucks, dump trucks, backhoes, and other miscellaneous equipment and vehicles. Fleet Management maintains and manages the rolling stock. Some of the major vehicles/equipment used by PDOTMO to maintain the collection system are listed in Table 11-1.

Table 11-1. Major Categories of Vehicles	
Type of equipment	Number of pieces
CCTV[1] trucks	6
Jet trucks	3
Vactors	8
Backhoes	10
Trackhoes	2
Dump trucks	17
Liner systems	2
Crew Leader trucks	10
Emergency response trucks	4
Detail Investigation trucks	3

[1]closed-curcuit television

BES maintains an annual operating budget to improve, add, or replace fleet equipment. A replacement schedule has been developed to identify when resources are to be replaced and the projected costs. The annual budget includes money for providing O&M services on the fleet. Specialized equipment needed for repairs or other activities is leased from vendors on an as-needed basis. Minor maintenance is performed in-house and typically results in vehicles or equipment being out of service for only one day. Major repairs may take longer and may be contracted out to specialized vendors.

Vehicles and equipment used in maintaining the wastewater collection system are stored at the following two maintenance yard locations:

- 5645 Northwest Willbridge Avenue—pump station maintenance trucks
- 2835 North Kerby Avenue (Stanton Yard)—gravity sewer maintenance equipment is stored at the Bureau of Transportation Maintenance and Operations Facility

Materials, Equipment and Spare Parts Management

PDOTMO has spare parts for major elements of the collection system. Parts such as smaller pipe sizes, manhole sections, manhole covers, and repair kits are available from City Stores located at PDOTMO shops. Other items not in stock are available from local supply houses from which staff can purchase directly. PDOTMO staff are authorized to purchase from these stores. Refueling is primarily performed at the centralized City Stores. Crews have gas cards for remote purchase if required.

BES owns the CCTV inspection equipment used by PDOTMO for routine inspection of the sewer system.

In addition, for BES-related activities, BES Stores performs a variety of procurement and inventory maintenance duties as it pertains to spare parts, equipment, and supplies. These duties include inventory and non-stock acquisition, receiving, stocking, disbursing, spare parts maintenance, payment processing and surplus disposal. BES Stores maintains two secured warehouse locations for inventory as well as one non-staffed, secured warehouse primarily for non-stock, spare parts storage. Warehouse locations are adequately and properly maintained to ensure convenient access and accessibility. Total inventory value is about $974,000. In total, Stores staff procure about $5 million annually in support of BES functions.

A diverse range of goods and services are procured following City purchasing rules and processes. Inventory and spare parts are under the custody and responsibility of BES Stores staff until they are released to end users. Purchase order history and inventory data for pump station-related parts and equipment are stored and maintained in Synergen, the Wastewater Group's asset management (AM) system. A description of inventory items, including quantity, cost, lead time, and available vendors is available electronically in Synergen for

review by BES wastewater staff. The inventory and inventory tracking are maintained solely by BES Stores staff. Each item is assigned a unique stock number, bar code and designated bin location. Items are set up with appropriate minimum-maximum stocking levels to ensure that optimal quantities are available for disbursement. Inventory stock disbursals involve issuing items and applying costs to appropriate program areas via Synergen. In addition, an annual physical inventory is conducted to compare accuracy of cost and inventory quantities.

PDOTMO maintains the inventory of spare parts and equipment for the sewer collection system. MAXIMO software is used to manage the inventory. It tracks the inventory similar to Synergen as described above.

Routine Preventive O&M Activities—Gravity Sewers and Manholes

Routine preventive O&M activities for gravity sewers and manholes in the City's wastewater treatment collection system include the following:

- CCTV inspection (sewers and manholes)
- Main line sewer cleaning
- Root management
- Minor repairs

CCTV Inspection

Section 9 describes in detail the CCTV Inspection Program. The program includes the inspection of both sewers and manholes. Results of the sewer and manhole inspections are recorded in the Hansen maintenance management system software. The defect guidelines (i.e., defect type and level of severity) are based on EPA requirements for sewer and manhole inspections. Routine preventive maintenance inspections and investigative inspections are performed by PDOTMO. BES may contract out the inspections required to support basin relief and reconstruction predesign projects.

BES identifies the areas of the city due for inspection based on the procedure outlined in Section 9. PDOTMO schedules and performs the inspections.

Main Line Sewer Cleaning

Sewer cleaning includes the removal of sediment; fats, oils, and grease (FOG); and debris from the sewer using vacuum and/or jet cleaning equipment. In addition, sewer cleaning includes the activities required to remove roots from sewers and manholes. Routine main line sewer cleaning activities are discussed in the following paragraphs. Sewer cleaning for FOG removal is addressed in Section 4 as part of the FOG Program. Root management is presented later in this section.

The City's sewer cleaning program is set up similar to that of the CCTV inspection program. The program goal is to clean each sewer on a 6-year cycle. Pipes are cleaned prior to inspection, but not all pipes that are cleaned are inspected. BES establishes the areas or basins to be cleaned. Sewerage basins to be cleaned are identified based on the age of the last cleaning. Selected basins to be cleaned are assigned to crews by basin location. A standing work order is issued that directs the crew to keep working in the basin until all the pipes have been cleaned. No time limit for performing the work is established. The cleaning schedule is prepared by a planner at PDOTMO.

As presented in Section 4, five or six areas of the city have been designated as hot spots. These are areas with chronic cleaning needs, primarily due to FOG buildup. Historically, these areas have been cleaned before problems occur mainly because they are cleaned based on need, which is more frequently than the standard 6-year cycle. Some of these areas are cleaned as frequently as every 3 months.

Cleaning equipment includes eight combination machines and three jet trucks, each with a two-person crew and one bucket machine. The jet trucks are used on pipes 15 inches or less in diameter and the combination trucks are used on larger diameter pipe. Typical cleaning production is between 1,100 to 1,500 feet per day. Material is not washed downstream, but removed from the pipes.

Root Management

The Root Control Program focuses on minimizing the potential for backups and SSOs due to blockages created by roots. The program's root abatement techniques include chemical treatment and mechanical removal of roots, and in severe cases, sewer rehabilitation. Roots in sewers are identified through routine cleaning and CCTV inspection, and from repair activities. In addition, roots may be found in sewers through customer service investigations.

Main Line Sewer Root Priority Definition

A priority ranking system has been developed so that sewers with the greatest need for root treatment are addressed first. The Root Priority assigned to a line segment is based on its CCTV inspection ROOTRATE and any subsequent information that may amend that rating. Table 11-2 lists Root Priority assignments.

Table 11-2. Major Categories of Vehicles

Rank	Priority	Rating
V	Very low	1 to 5
L	Low	6 to 25
M	Moderate	26 to 75
H	High	76+
R	Unknown	No ROOTRATE[1]

[1]Roots indicated as present but not quantified.

For some pipes without a CCTV root rating, a comment may be placed in the work order indicating that roots are present. In this case, the rating provided by the maintenance worker who completes the work order is accepted until a CCTV inspection can be performed.

The Root Priority rating and treatment cycles can vary somewhat based on diameter and length. Subsequent repair and construction activities are reviewed and the Root Priority rating may be modified based on that additional information.

Treatment of Main Line Sewers Based on Root Prioritization

The goal of the Root Control Program is to have all sewers that are rated as H on a 2-year chemical root control cycle. The 2-year treatment cycle is repeated for at least three treatments. If after three treatment cycles, limited root re-growth has occurred, then a longer treatment cycle will be introduced. If funds are available, sewers with a rating of M are also on a 2-year treatment cycle. If funds are not available, M-rated will be treated on a 3- or 4- year cycle depending upon funding.

The City has found that sewers with L or V rankings do not require chemical treatment. In these sewers, the thickness and frequency of roots does not typically lead to plugged sewers. They have roots that are light and fragile enough to be removed by conventional cleaning methods. Consequently, roots in these sewers can be managed through more frequent regular sewer cleaning. If any significant increase in root infestation is observed, the treatment and frequency of treatment is modified accordingly.

In some sewers with significant root intrusions, chemical root control treatment is ineffective. These sewers require mechanical treatment or they may require rehabilitation to eliminate the root intrusions. The material and condition of the host pipe and the severity of the root intrusion are evaluated to determine the most appropriate mechanical removal method. Mechanical removal methods include hydraulic cutting jet nozzle, root saw, or chain flail. Some pipes with mass root intrusions may have mechanical treatment performed prior to chemical treatment.

Sewers remain in the Root Control Program until they are repaired or Capital Improvement Program project eliminates the need for future root treatment. Queries of the maintenance management database are performed routinely (no less than monthly) to determine if sewers:

- Need to be added to the Root Control Program based on CCTV inspection information.
- Need to have root priority modified based on CCTV inspection information. Note: sewers generally do not have root priority lowered, however treatment frequencies may be modified.
- Need to be removed from the Root Control Program.

Roots in Service Lines

Roots in service lines that are visible from the sewer main are recorded during the CCTV inspection of the sewer main. Visible roots in service lines are often an indication of a similar or more severe problem on the private property portion of the line. Some degree of treatment of service line roots may occur during application of root control agents in sewer main line; however, the amount of treatment varies and is not a reliable treatment for service lines. Generally, very severe service line roots indicate the need to dig and repair the public portion of a service line.

Minor Repairs

PDOTMO has 11 repair crews to perform all sewer repairs within the City. Seven crews do standard sewer repairs, one crew does spot lining, and three crews fix manholes and storm inlets. Sewers that need repair are identified through the inspection and condition assessment program, and from customer complaints. In general, if a sewer has three or more significant defects, a Specific Work Order is generated.

Current funding levels are adequate for addressing the A and B sewers, but not the C and D sewers. (See O&M Work Management later in this section for a description of the ranking process.) Historically, all repairs were made, but because of current funding of CSO projects, the C and D work is not being per performed. (See Backlog Management later in this section.) Consequently, staff are seeing more of the C defects deteriorating further to become B and A rated sewers. Staff consider the repair program to be more reactive than preventive, but measures are being implemented to turn that around, particularly upon completion of the CSO projects.

For pipes that require more repair effort than is provided by several spot repairs, the PDOTMO Repair Group can install a cured-in-place-pipe (CIPP) liner system. CIPP liner systems can be installed on the main line and on service laterals. PDOTMO decides which pipes are to receive the liner system. Currently, the Allan Kay Pipeline product is being used. Liners are used most often in the downtown central business district due to the cost and disruption associated with open-trench repairs in this area. Approximately 6,000 feet of CIPP liner were installed in a recent year.

Anecdotal information suggested that nearly half of the repair time effort was spent on service laterals. Approximately 70 percent of all dig-ups are done on service laterals. In a recent year, PDOTMO production records document that 5,878 feet of laterals were repaired compared to repair of 4,765 feet of main line. The same year, 9,000 feet of sewer was lined. Labor for each of these is as follows:

- Laterals = 26,000 hours
- Main Lines = 17,000 hours
- Sewer Liners = 9,000 hours.

Planning Standards/Standard Maintenance Procedures

Planning standards were prepared in the mid-1990s for all major PDOTMO collection system work activities. They have been updated since that time because methods, materials, and needs have changed. The standards define the activity, the cost code, the purpose of the activity, required personnel, and required equipment and material; provide an overview of what is to be done; and provide an average production rate. The original planning standards were developed based on how the City performed each activity, but have been updated to address new equipment and procedures.

O&M Contract Services

Although PDOTMO is the primary provider of wastewater collection system maintenance services, BES contracts out to private vendors several specialized activities, including the following:

- *Root foaming*— All chemical treatment of sewers is contracted out to a private vendor. The contractor uses diquat dibromide as the active chemical used in the treatment. All mechanical root treatment is performed by PDOTMO staff.

- *Vector control*—An agreement with Multnomah County is in place for rat and mosquito abatement services. Vector Control services required on capital projects are contracted out to private vendors.

- *CCTV inspection*—BES contracts out CCTV inspection services to augment the services provided by PDOTMO, particularly in support of basin relief and reconstruction predesign projects.

Routine Preventive O&M Activities—Pump Stations and Force Mains

This section describes routine preventative O&M activities for pump stations and force mains in the City's wastewater treatment collection system.

Overview of O&M Program for Pump Stations

Historically, PUMA staff have been a self-motivated and responsible work group who are committed to the growing involvement with environmental stewardship, permit compliance, effective AM, and customer service. PUMA staff provide maintenance for all pump stations in the system in accordance with the BES's Clean River Guide. PUMA uses various methods to track and implement the O&M requirements for its facilities. These methods are described in the following paragraphs.

Major Predictive, Preventive, and Corrective Maintenance Activities

PUMA maintains all pumping systems, force mains, structures, and grounds not handled by another agency. Its aim is to ensure that the general condition of the facilities remains equal to, or better than, its condition as of July 1, 2001. PUMA is responsible for the following activities:

- *Preventive Maintenance*—This encompasses routinely planned activities that help to lengthen equipment and facility life. Examples include periodic cleaning and inspection, lubrication and filter changes, calibration and adjustments, replacement of questionable parts, and painting. The outcome desired from preventive maintenance is an increase in equipment life-cycle and reductions in downtime and overall O&M costs. Preventive maintenance activities and schedules are recorded and tracked by means of a computerized maintenance management system (MMS) in coordination with maintenance planners and Wastewater Group objectives.

- *Predictive Maintenance*—This includes use of the following advanced troubleshooting tools: vibration analysis, thermography, ultrasonic wall thickness testing, ultrasonic leak detection, and data analysis and trending.

  The use of these methods allows PUMA staff to develop a maintenance schedule based on the life span of equipment and systems and provides for planned refurbishing before the equipment and systems fail.

- *Routine Maintenance*—The routine maintenance associated with PUMA includes:

  - *Regular Station Checks*—Remotely located pumping stations' performance is monitored via a combination of radio communication (HYDRA and DMAX) and routine inspection by PUMA staff. Most of the 95 pump stations are checked on a weekly or bi-weekly basis, with the exception of the most critical stations, which are checked daily. Tasks performed during station checks include, but are not limited to, the following:

    - Running idle equipment to ensure readiness
    - Making minor adjustments to ensure peak performance and safety standards
    - Ensuring proper operation of level sensing devices and controls
    - Flushing wet wells to reduce odors and grease build-up
    - Performing preventive maintenance
    - Checking fuel in standby generators
    - Making minor repairs (defined as those that can be completed in 15 minutes or less)
    - Maintaining records of activities performed
    - Identifying maintenance needs for buildings, grounds, etc.
    - Establishing community relations
    - Reporting permit violations
    - Ensuring facility security

  - *Four-Year, 30,000-Hour Overhauls*—PUMA staff have instituted a 4-year or 30,000-hour pump rebuild schedule within which all the sewage pumps in the various stations located throughout Portland are overhauled and/or rebuilt. This program is now well into its fifth year of execution, and the practice has greatly influenced the reduction of machinery down-time and has helped PUMA staff to identify potential points of failure. PUMA is now adjusting the rebuild intervals on the basis on its findings at individual pump stations to reflect the specific machinery and operating conditions at each pump station.

- *Standby Equipment*—PUMA staff maintain portable standby equipment, such as generators, pumps, and various other equipment and tooling needed for emergency response.
- *Other Collection System-Related Facilities*—In addition to the pumping stations and PUMA shop, responsibilities of the PUMA staff extend to maintaining functionality and operation of the combined sewer overflow tide gates, various ventilation and odor control facilities, and valves and structures associated with other BES-owned water quality containment, storage, and conveyance systems throughout Portland.
- *Housekeeping*—PUMA staff perform all housekeeping duties associated with pump stations.
- *Grounds Maintenance*—PUMA staff perform basic yard maintenance and upkeep not covered by the interagency agreement with the Portland Department of Parks and Recreation.

- *Corrective Maintenance*—Performed after problems have been identified, PUMA staff prioritize and perform corrective maintenance. The current structure at PUMA divides the pump stations into five runs. Two partners are assigned to each run. The prioritization of corrective maintenance is primarily the decision of the partners assigned to the run. This decision-making ability lends itself to a sense of ownership that is elevated by responsibility and accountability to the team.
- *Emergency Maintenance*—PUMA staff are greatly reducing the amount of emergency maintenance by focusing on a preventive and predictive maintenance schedule. Since the institution of the 4-year, 30,000-hour rebuild schedule, pump-related mechanical failures have been virtually eliminated from the emergency maintenance list. An on-call coordinator assigns any necessary after-hours and weekend emergency response.
- *Capital Project Support*—PUMA staff support engineering and construction teams in the planning and design of pumping stations. They are directly involved with the contractors and inspection teams who perform construction. They provide technical and logistical support and perform tasks that are more cost-effective to accomplish with City staff and resources.
- *Installations and Improvements*—Working closely with other agencies and departments within BES, the PUMA crew have developed and applied cost-effective solutions in the following scenarios:
  - *Pump Retrofits*—PUMA staff have replaced problematic pump designs with lower-maintenance and/or more efficient alternatives.
  - *Equipment modifications*—Working closely with the plant machinist, PUMA staff modify details of machinery to improve equipment longevity and performance. Most modifications reduce the frequency and ease the process of removing and replacing machinery. Examples include the following:
    - Addition of ceramic coatings to reduce wear
    - Installation of sealed bearings where applicable
    - Upgrade of wear rings with more wear-resistant materials
    - Retrofit of couplings to reduce removal and replacement time
  - *Altering System Configuration*—Working with the other work groups, both within City staff and contracted services, PUMA provides solutions for temporary pumping that allow installation of new sewer gravity and force mains. These alterations of the system enable projects to avert hundreds of thousands of dollars in sewage hauling expenses.

- *Piping Modifications*—PUMA staff modify piping configurations to remedy design difficulties that reduce pumping abilities or cause undue wear to equipment.
- *Motor Replacement*—Assisting the Electrical Department, PUMA staff are retrofitting electric motors with high-efficiency alternatives at select pump stations.
- *Support System Modifications*—PUMA crews have installed such items as seal water systems, odor reduction systems, structural improvements, and lifting device upgrades.
- *Mechanical Equipment Maintenance Tracking*—Mechanical equipment in the collection system includes manual and automatic gates and valves, flapper valves, air/vacuum release valves and drains on force mains, and the combined sewer overflow weirs. The air/vacuum release valves and force mains are being added to the Hansen MMS. Once the Hansen inventory of these items is complete, the City will implement routine inspections to ensure they equipment is in good working order. After the maintenance requirements are identified, each item will be put on a maintenance schedule.

Work Management

This section presents how work is planned, scheduled, managed, and tracked.

Planning and Scheduling

The CWA between BES and PDTOMO defines the type and quantity of work that is to be provided by PDOTMO. PDOTMO sets the priorities for daily work activities in accordance with meeting the terms of the agreement. For example, the FY 2005-06 agreement calls for the inspection of 750,000 linear feet of sewer and cleaning of 1.1 million linear feet. Work planners at PDOTMO monitor the age of the inspections and cleaning as recorded in the Hansen database and make assignments based on this information. Typically, inspection and cleaning activities are scheduled on a basin-by-basin basis.

The scheduling of repairs is based on observations made in the field (via CCTV inspections), primarily the severity of the problem. PDOTMO staff use their judgment to prioritize repair activities. Specific Work Orders are generated for repair activities, as opposed to the basin approach used for inspection and cleaning. If the repair requires engineered shoring, then PDOTMO staff will confer with Maintenance Engineering at BES to decide upon the best course of action.

Information developed through the weekly pump station inspections and maintenance activities is used to assess the condition of pumps and equipment. Consequently, a preventive maintenance program is developed for each pump station and its components that includes maintenance and replacement schedules. Stations in need of more detailed and extensive improvements are identified and the work prioritized. Each work order that is generated is identified with a priority code, as indicated in Table 11-3.

Table 11-3. Work Order Prioritization

Priority Code	Completion Priority
A	<24 hours
B	1 to 30 days
C	1 to 6 months
D	6 to 12 months
E	In accordance with preventive maintenance schedule

The intent of the priority rating is to focus repair activities on sewers and defects that have the highest potential for SSOs.

Preventive Maintenance versus Corrective Maintenance

O&M staff estimate that 75 to 80 percent of all collection system maintenance is preventive maintenance, with the balance being customer service/emergency maintenance. The estimate is similar to PDOTMO records for the sewer cleaning activity. For example, in 2005 approximately 188,000 feet of sewer were cleaned in response to customer complaints, while 821,000 feet were cleaned as part of the planned maintenance program.

Backlog Management

The activities with the most significant backlog are the repair and rehabilitation of main line and service lateral activities.

As noted earlier in this section, funding is not available for repairing many of the C and D category sewers. Table 11-4 lists the number of open work orders for repair activities as of January 2006. Staff estimate that this backlog represents about 2 to 3 years of work.

Table 11-4. Open Work Orders—Repair

Activity	Category				
	A	B	C	D	Total
Repair Laterals	5	149	182	12	356
Main Sewers	3	248	724	60	1047
Liner	3	206	257	108	580

Limited funding has delayed the implementation of several basin-wide rehabilitation programs. It is anticipated that funding will be available for these activities once the CSO projects are completed.

Labor Tracking and Utilization

BES and PDOTMO staff have access to the Hansen database. From it, any number of queries can be made to track work completed, facility maintenance history, number and type of customer response activities, work order generation and backlog, and labor, equipment, and material usage. The Maximo® software is used to track labor effort and costs.

When vehicles or equipment are in the shop, staff have other duties to perform. Work hours are typically from 7 a.m. to 3:30 p.m. Most crews leave the yard between 7:30 to 8 a.m. and return around 3 p.m. Refueling, material pickup, training, and other miscellaneous activities are performed while crews are in the yard.

The pump station O&M staff work four 10-hour shifts with a half crew available on Mondays and Fridays.

Competitive Services

PDOTMO is the contractor of choice for performing many of the City's required collection system O&M services. However, BES retains the right to contract out to the private sector or to other public agencies, services currently provided by PDOTMO. BES evaluates the services provided by PDOTMO against those that could be provided by private contractors to ensure that the cost and quality of work are competitive. In addition, BES continues to work with other agencies to determine how Portland's costs compare with other agencies and to identify best management practices that may help the City be more competitive. According to staff, the City's inspection, cleaning, pipe liner, and repair activities are cost-competitive with private vendors.

O&M activities such as root foaming, vector control, and special assignment CCTV inspection are contracted out to the private sector.

Analysis of O&M Activities against Sewage Release Data

One of the challenges facing agencies with CMOM Programs is to determine how effective current O&M activities are in preventing sewage releases to streets, basements, or streams. Using the Hansen database records for pipe cleaning, inspection, and root control activities, and combining that with the reported sewage releases recorded in the sewage release database, the City created a unique graphical analysis tool that highlights the causes of releases and the relative effectiveness of cleaning, inspection, and root control.

This analysis was done by dividing the O&M activity records and the sewage release events into 2-year event windows as follows: January 1, 2002 through December 31, 2003; January 12004 through December 31, 2005; and January 1 2006 through December 31, 2008. This data was then thematically mapped for color for each 2-year window. This helps indicate whether a sewage release happened long before or after the most recent O&M activity was performed in that area.

The sewage release data was divided into O&M-related causes, consisting of the following:

- *Grease and sediment:* Any sewage release in which grease, sediment, or debris caused a blockage.
- *Roots:* Any sewage release in which roots were mentioned as a contributing cause.

Finally, the sewage release events in these categories were identified by the system component that was affected by the blockage—for example, the main sewer line, the lateral, a constructed overflow, a pipe-crack or joint, a pump station, or a miscellaneous structure. Figure 11-1 present a graphical analysis of the grease and sediment cleaning activities. The results of the analysis include the following characteristics:

- Frequent cleaning is performed throughout the combined sewer area.
- Grease and sediment blockages in the combined sewer area do not typically occur in the mainline pipes.
- Sewage releases from grease and sediment blockages occur frequently in laterals and from pipe cracks.
- Sewage releases in the combined area are not affected by or correlated with pipe cleaning since the source is most often lateral failure or structural pipe cracks.
- Reduced frequency of releases can be seen in Forest Heights due to new control practices for construction debris, and in mid-county due to improved cleaning practices.
- Grease and sediment blockages in the separated sanitary sewer area occur in existing hot spots as well as in areas not yet under a preventive maintenance program for cleaning and inspection.

These findings indicate that the City should maintain or reduce cleaning in the combined sewer area and shift available resources to the separated sanitary sewer areas. In addition, the City should focus on addressing lateral failures in a manner similar to the inspection program focused on pipe rehabilitation.

The root cleaning program was evaluated using a similar graphical analysis as shown in Figure 11-2. This analysis indicates similar strong characteristics for the City's Root Control Program:

- The City serves a significant area of the combined sewer area and the west side separated area with frequent root control and treatment efforts.
- Laterals with root blockages are the dominant cause of sewage releases due to roots.
- Most mainline blockages occurred in areas known for root problems and recently received root treatment.

These findings reinforce the need for a focused lateral inspection and repair program to address the most frequent location of sewage releases. In addition, pipe cracks as an indicator of root problems can be addressed by an increased cleaning and inspection effort. Finally, these results may be indicating that some small increases in root control may be helpful in areas experiencing recent mainline blockages.

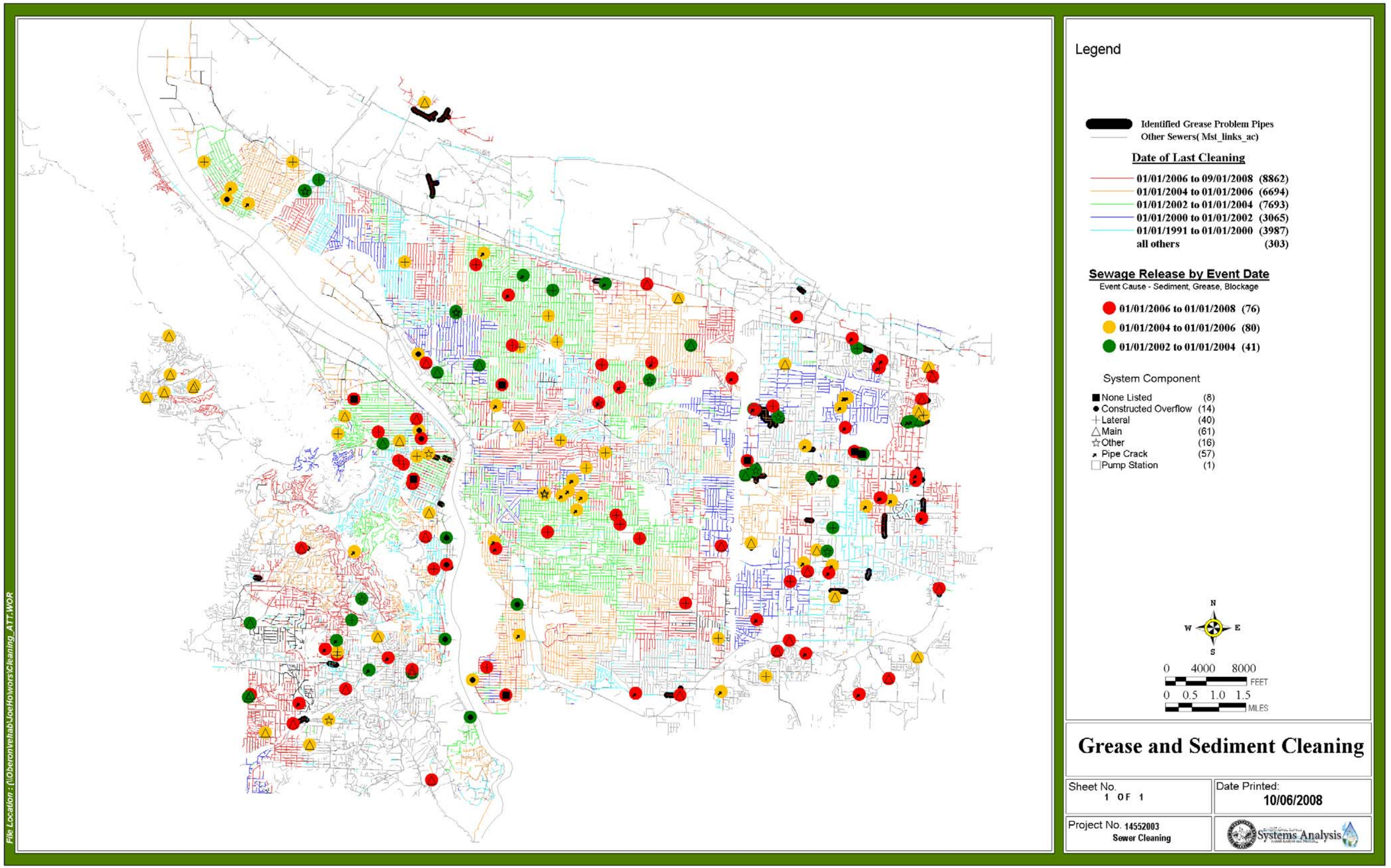


Figure 11-1. Grease and Sediment Cleaning

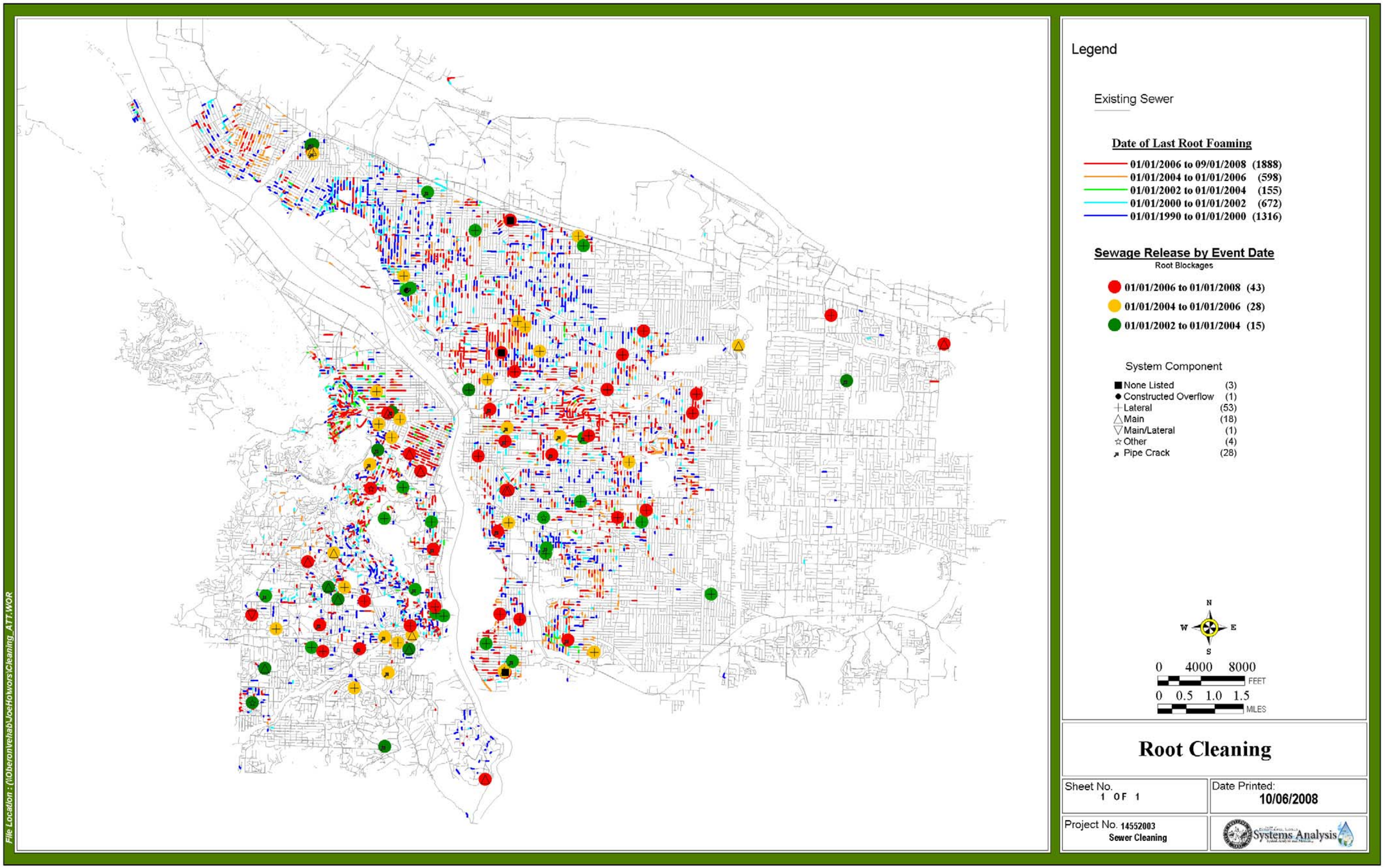


Figure 11-2.
Root Cleaning

12: MONITORING, MEASUREMENT, AND PROGRAM MODIFICATION

This section describes the process the City of Portland (City) uses to monitor, measure, and modify elements of the Capacity, Management, Operation, and Maintenance (CMOM) Program.

Monitoring and Measuring Effectiveness of Program Elements

All elements of the CMOM Program will be assigned to a manager/supervisor who will be responsible for monitoring each element and reporting the results on an annual basis. Accomplishments will be measured against the goals for each element to determine their effectiveness. Table 12-1 lists program elements and their respective group managers.

Table 12-1. Responsibility Matrix

Element	Responsibility of
Purpose and goals	Collection System Manager
Service area and System Description	Wastewater Group Manager
Organizational structure	Collection System Manager
Internal communication	Collection System Manager
Training	Training Coordinator(s)
Customer service	Public Involvement Manager
Management information systems	Data Management Manager
Combined sewer overflow (CSO) and sanitary sewer overflow (SSO) notification and Response Programs	Pollution Prevention Services Manager
Legal authority	Regulatory Manager
Budgeting	Business Services Group Manager
Mapping	Data Management Manager
Flow monitoring	Asset System Manager
Hydraulic modeling and capacity assessments	Asset System Manager
Sewer assessment methods	Maintenance Engineering Supervisor
Corrosion monitoring and control	Maintenance Engineering Supervisor
Rehabilitation Program	Design Services Manager
Wastewater collection system and treatment	Wastewater Group Manager
Water quality monitoring	Asset System Manager
Safety	Risk Services Manager(s)
Emergency preparedness and response	Emergency Management Coordinator
New construction	Development Services Manager
Pump station reliability	Collection System Manager
Maintenance facilities, equipment, and spare parts	Collection System Manager
Mapping and data management activities	Data Management Manager

Table 12-1. Responsibility Matrix	
Routine preventive operations and maintenance (O&M) activities–gravity sewers and manholes	Maintenance Engineering Supervisor
Routine preventive O&M activities–pump stations and force mains	Pump Station O&M Supervisor
Monitoring, measurement, and program modification	CMOM Administrator

CMOM Program Improvements

Over the next 5-year cycle of the renewed National Pollution Discharge Elimination System (NPDES) Permit, the City will expand its programs to reach an optimal level of cleaning and inspection and small system repairs (laterals and manholes). The increased effort is targeted to reduce SSOs and increase the data capture required for condition assessment and maintenance planning. Based on asset management principles, this additional information will help to determine the optimal level for sewer pipe reinvestment and rehabilitation that will reduce overall business risk in a cost-effective manner.

To develop the CMOM Program improvements, the City used field experience, historical inspection and condition data, sewer cleaning data, sewage release data, and business risk exposure (BRE) based on mortality (condition) failure. The specific recommended program improvements for addressing sewage releases consists of increased sewer cleaning and inspection, as well as increased manhole inspection for a 5-year period.

Increased Sewer Closed-Circuit Television (CCTV) Inspection

Bureau of Environmental Services (BES) staff calculated the BRE for each pipe based on its remaining useful life, and used that information to determine the priority for pipes to be inspected during the next 5 years. Those pipes were then divided into three groups:

- Large diameter (greater than 36 inches) pipes to be inspected by specialty contractor
- Small diameter pipes in Inspection Work Plan
- Small diameter pipes not in Inspection Work Plan

Based on the results of this analysis, there are about 4,000 small diameter pipe segments outside of the current inspection program plans that need to be inspected in the next 5 years. Therefore, BES is recommending a one-time 5-year increased inspection effort to inspect an additional 1,000 pipes or 250,000 feet of pipe per year using contractor support. BES currently inspects an average of 800,000 feet of sewer pipe per year. Once this new program is in place, in excess of 1 million feet of pipe will be inspected per year over the 5-year period.

Figure 12-1 shows the location of the small diameter pipes that need to be inspected over the next 5 years. This figure displays the basins where Portland Bureau of Transportation's Maintenance Operations staff will be assigned to carry out the Preventative Maintenance Program inspections. The map also shows the areas the contractor will begin as part of the inspection and analysis effort.

This represents a $500,000 per year addition to the financial planning process.

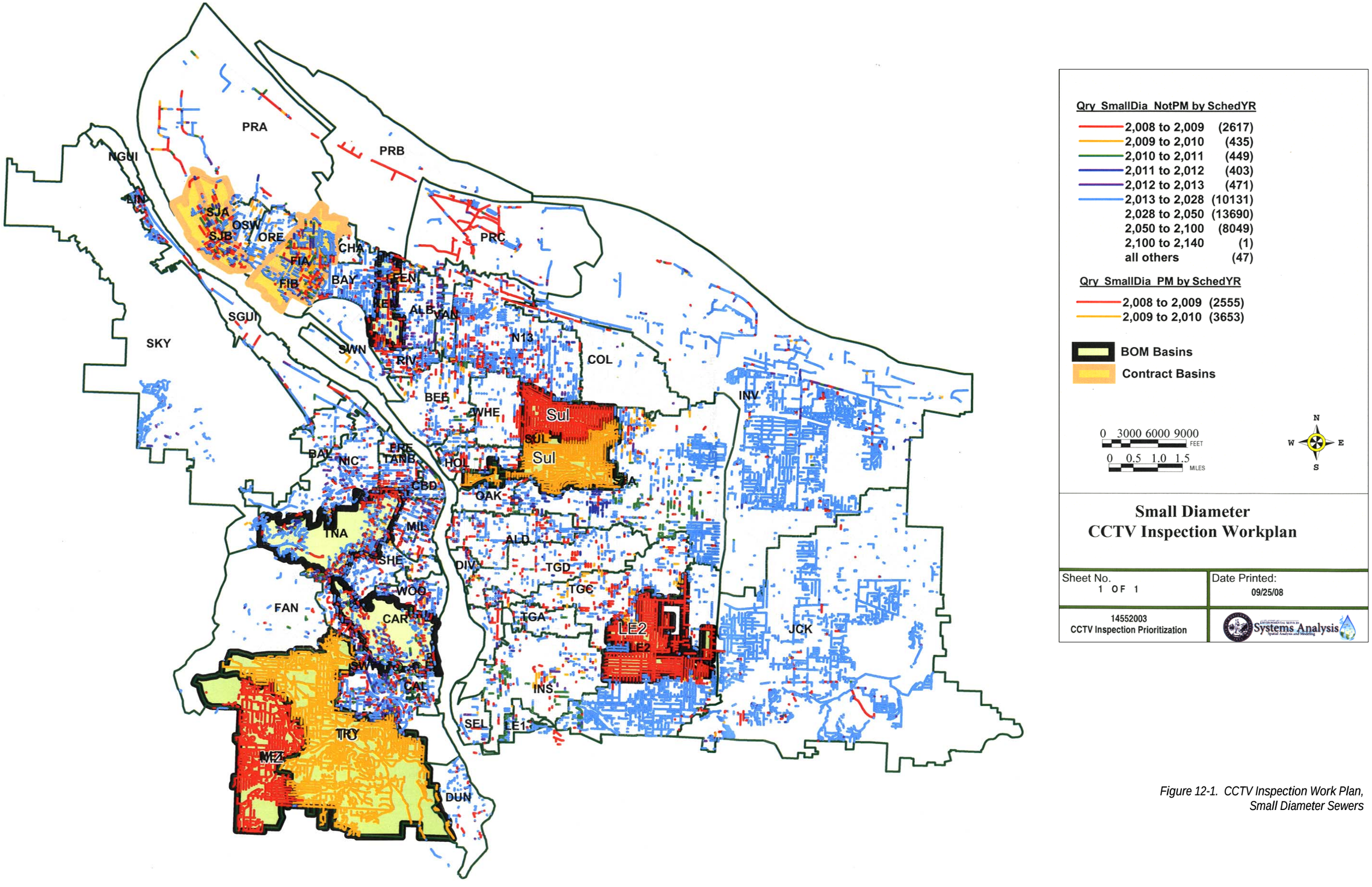


Figure 12-1. CCTV Inspection Work Plan, Small Diameter Sewers

Increased Manhole Inspection

BES currently inspects manholes on a routine basis in conjunction with sewer main CCTV inspection. Sewer manhole inspections are performed and the results are recorded in the Hansen® database using defect codes based on U.S. Environmental Protection Agency (EPA) requirements for a manhole inspection.

Due to the increased sewer inspection by 1,000 pipe segments per year, the City will increase manhole inspection by approximately 1,000 manholes per year as well. In addition, the City will increase manhole inspections in high risk areas consisting of older brick sewers with high groundwater. This tends to include manholes in the southeast quadrant of the combined system, and is an area not scheduled for sewer inspection in the near future. Therefore, BES will inspection an additional 1,000 manholes per year, starting first in the southeast quadrant of the combined system.

This represents a $200,000 per year addition to the financial planning process.

Proactive Lateral and Manhole Repair – Find and Fix

Laterals are the pipes that connect homes, businesses, and multiple dwelling or industrial customers to the City's sewer main lines. Portland City Code identifies the curb line as the delineation between public and private responsibility for maintenance and repair. The City is responsible for the portion of the branch connection within the public right-of-way from the mainline sewer to the curb. The property owner is responsible for the portion of the branch connection from behind the curb to the house.

In Portland, one third of the total reported SSOs resulting from failures in the public sewer system can be attributed to lateral failures. Root infestation and structural decay are the two main causes for this type of failure. Common problems in older sewers include cracking, joint separation, and root infestation at the curb or on property. Although these problems are not readily accessible for routine inspection using standard techniques, there are advances in lateral launch video equipment that allow the user to inspect the lateral to asses these types of problems. Another common problem is settling and breakage at the wye head or mainline tap (the interface between mainline and lateral). As the lateral settles over time, it can shift and break away from the sewer main. Infiltration/inflow at these locations can cause further problems, creating voids, sink holes, and robbing capacity in the system. Many problems can be identified easily through routine mainline inspection; however, many are out of view of the camera during mainline inspection.

Using state-of-the-art geographic information system mapping tools to identify hot spots and a combination of trenchless and traditional repair methods, the City will embark on a find and fix repair program specifically designed to identify and repair lateral problems before they have failed completely. Many are in good enough condition to be repaired through the use of trenchless technology. Tee Lining is a process by which the City will be able to dramatically reduce SSOs attributable to lateral failure at the connection to the main sewer. An epoxy resin impregnated liner can be installed to seal the joint and provide a structural repair. This technique restricts further settling at the branch connection and provides a high-strength repair that extends from the mainline to a newly installed cleanout at the curb. Once the liner and cleanout have been installed, the City will have an inspection port that provides for a clear control point between public and private sewers. This will improve the ability to quickly determine if a future blockage is in the City-maintained portion of the lateral, improving customer service and enhancing the maintainability and reliability of the system.

Increasing manhole inspection will require additional resources for manhole repair. This too will be part of the find and fix program, so that inspection and analysis within an asset management framework is what drives the program.

In addition, the City will continue to analyze the business case for requiring cleanouts at the curb on all future permit taps for public and private developers.

This represents a $500,000 per year addition to the financial planning process.

CMOM Program Manager

The increased workload for planning, scheduling, contracting, reviewing, analyzing, and reporting on the full CMOM Program activities will be assigned to a new staff position in Maintenance Engineering. Current responsibilities carried by others would be centralized in this new position to better balance workload and ensure that CMOM Program performance review and reporting is a priority.

This represents a $100,000 per year addition in the financial planning process.

CMOM Program Annual Report

The CMOM Program Annual Report will be submitted each year to the Wastewater Group Manager. The CMOM Program Manager will be directly responsible for the development, review, and submittal of the annual report, with assistance from Collection Systems Maintenance and Asset Systems Management staff. The report will contain results from the key program elements that impact the performance of the system, along with any improvements/adjustments for those key elements. The managers and staff involved in developing the report will gather the data and track the performance measures for the final report and will determine a basis for change in the procedures for the report.

Table 12-2 provides a sample of the type of data tracking form to be used to aid the reporting process.

Table 12-2. CMOM Program Element Performance Tracking Criteria

Program Area	Program Goals	Measurement Metric	Process for Continuous Improvement
System Evaluation and Capacity Assurance	• 1,000,000 feet of pipe CCTV inspected per year • 5,000 manholes inspected per year	• Feet of pipe per year inspected via CCTV • Number of manholes inspected and recorded	• Evaluate cost-effectiveness of crews and contractors • Update BRE-based map for prioritizing next year's inspections
System Evaluation and Capacity Assurance	Create tables and maps of locations and causes of public sewer releases	• Number and type of source for sewage release event	• Determine number of years since last inspection and cleaning if caused by blockage • Compare against current hot spot areas and determine if new areas need to be defined
WWTS Operations	Meet NPDES permit performance standard	• Number of CSO events and Volume of CSO from controlled outfalls • Percent of volume to Columbia Boulevard Wastewater Treatment Plant site that was treated through secondary system	Provide summary evaluation of system performance, including strengths and challenges
O&M Activities	1,400,000 feet of pipe cleaned per year	Feet of pipe cleaned per year	Compare against current hot spot areas and determine if new areas need to be prioritized for cleaning apart from inspections
O&M Activities	Meet EPA-Rehab Agreement	Dollars invested in pipe rehabilitation and replacement	Update prioritized list of pipes for rehab in kidney fund and Capital Improvement Program #8400

APPENDIX A

Bureau of Environmental Services
FY 2008 - 2009 Budget

Bureau of Environmental Services

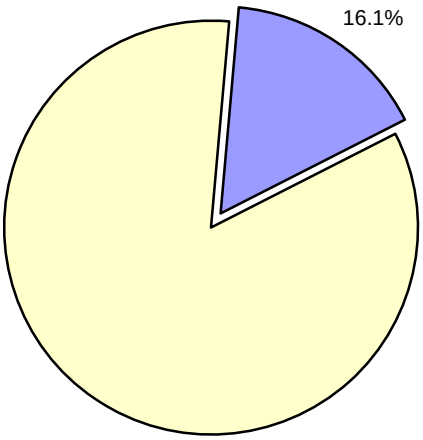
Public Utilities Service Area

Sam Adams, Commissioner-in-Charge

Dean Marriott, Director

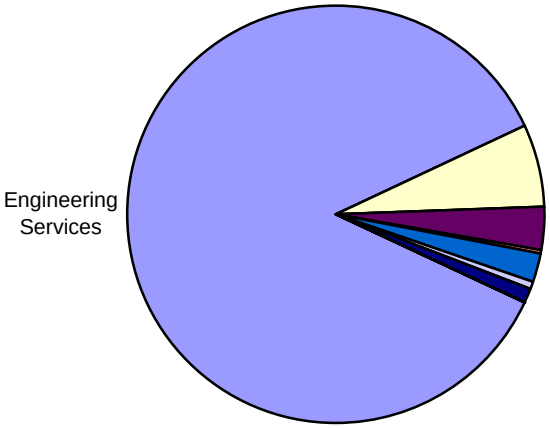
Percent of City Budget

BES = $284.9 Million



City Budget = $1.77 Billion

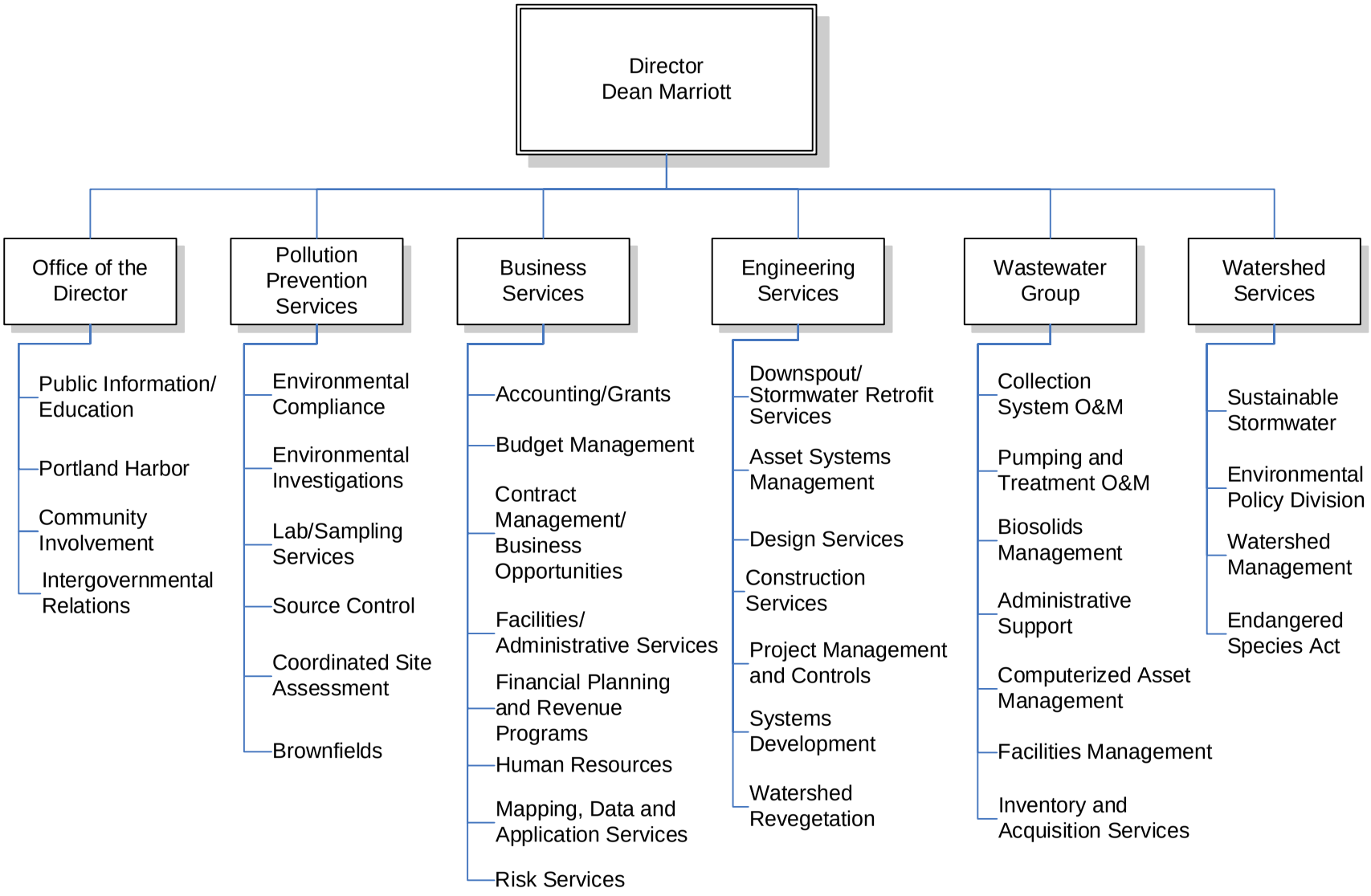
Bureau Programs



Bureau Overview

Expenditures	Revised FY 2007–08	Adopted FY 2008–09	Change from Prior Year	Percent Change
Operating	100,962,577	96,932,927	-4,029,650	-4.0%
Capital	195,080,274	187,972,000	-7,108,274	-3.6%
Total Expenditures	**$ 296,042,851**	**$ 284,904,927**	**$ -11,137,924**	**-3.8%**
Authorized Positions	504	524	20.00	4.0%

Bureau of Environmental Services



Bureau Summary

Bureau Mission

The Bureau of Environmental Services, Portland's clean river agency, serves the Portland community by protecting public health, water quality, and the environment.

We protect the quality of surface and ground waters and conduct activities that promote healthy ecosystems in our watersheds.

We provide sewage and stormwater collection and treatment services to accommodate Portland's current and future needs.

Bureau Overview

Six major program areas serve over 560,000 people.

The bureau operates and maintains sanitary sewer and stormwater collection systems serving over 560,000 people. The bureau's activities are supported with retail sewer and stormwater charges, wholesale contract revenues from surrounding jurisdictions, and reimbursements for services provided to other bureaus. This budget includes 523.6 full-time equivalent positions and is organized into six primary program areas: Engineering Services, Pollution Prevention Services, Watershed Services, Wastewater Group, Business Services, and the Office of the Director.

The Adopted Budget reflects a 3.8% decrease in operating and capital expenditures from the FY 2007-08 Revised Budget level.

The FY 2008-09 Adopted Budget for operating and capital expenditures is $284.9 million, $11.1 million or 3.8% lower than the Revised Budget for FY 2007-08. The decrease is due to the carrying forward of nearly $40 million of Capital Improvement Program (CIP) budget authority from the prior fiscal year to continue and accelerate Combined Sewer Overflow (CSO) abatement projects. A better comparison would be against the FY 2007-08 Adopted Budget which shows an overall increase of 12.2% with a 20.9% increase in CIP expenditures as the bureau continues construction of the Eastside Tunnel portion of the CSO program. Seventy-three percent of the FY 2008-09 CIP budget is attributable to the Eastside Tunnel project. The operating portion of the Adopted Budget is 1.6% lower than the FY 2007-08 Adopted Budget.

Strategic Direction

Environmental Issues

Combined Sewer Overflows

The City is subject to Oregon Department of Environmental Quality (DEQ) administrative orders regarding overflows from the bureau's combined sewer and stormwater collection system. The City has agreed to eliminate CSO discharges that violate applicable water quality standards by December 1, 2011. The FY 2008-09 Adopted Budget includes $139.1 million of CSO capital costs.

Portland Harbor Superfund

The bureau represents the City's interests on the Portland Harbor Superfund site by working with DEQ to identify and reduce sources of contamination conveyed to the Willamette River via stormwater outfalls, and with other stakeholders to assess current and past land use practices within the lower-Willamette drainage basin. This information will be used in the Superfund process over the next several years to assess the City's potential liability for cleanup activities. The FY 2008-09 Adopted Budget includes $5.4 million of expenditures related to the Portland Harbor Superfund.

Water Quality Compliance

Compliance with the City's National Pollution Discharge Elimination System (NPDES) stormwater permit requires modeling and evaluation of citywide pollutant loads, stormwater runoff volumes, and the effectiveness of stormwater management program implementation. In addition to complying with NPDES requirements regarding stormwater-related total maximum daily load (TMDL) allocations, the bureau also engages in a comprehensive program of in-stream water quality and flow testing to comply with TMDL regulations issued by DEQ. The bureau is also required to comply with underground injection control (UIC) regulations issued by DEQ for the City's approximately 8,500 stormwater sumps. The City's Water Pollution Control Facility permit regulates the construction, operation, and maintenance of UICs. Compliance requires that the bureau implement a comprehensive evaluation of all City-owned UICs to determine if they comply with the Federal Safe Drinking Water Act. The Adopted Budget contains water quality compliance-related funding across a variety of bureau program areas including Watershed Services, Pollution Prevention Services, and Engineering Services.

Endangered Species Act Requirements

The bureau continues to develop and implement a comprehensive watershed framework for the protection of the Lower Columbia Steelhead and the Lower Columbia Chinook Salmon per the requirements of the Endangered Species Act. In addition, the bureau has also begun implementing procedures to comply with requirements related to the designation of the city's streams as critical habitat by the National Marine Fisheries Service. The FY 2008-09 Adopted Budget contains nearly $1.0 million in Endangered Species Act-related funding in program areas including Watershed Services, Pollution Prevention Services, and Engineering Services.

Restoration and Remediation

The Adopted Budget includes funding for continued flood management and watershed restoration activities in the Johnson Creek watershed and pursuant to a consent order between the City and DEQ, funding for the identification and characterization of contaminated sediment sites in the Columbia Slough.

Operational Issues

The bureau's Adopted Budget includes $46.2 million to support the operation and maintenance of 1,435 miles of separated sanitary and stormwater sewers, 860 miles of combined sewer lines that carry both sanitary waste and stormwater runoff, 95 pump stations, two wastewater treatment plants with a combined secondary treatment capacity of 108 million gallons per day, 160 pollution reduction facilities, and 120 stormwater detention facilities. The Adopted Budget includes costs associated with the operation of new CSO control facilities on the westside of the Willamette River.

Infrastructure

Also included in the Adopted Budget is $25.2 million to support capital repair and replacement of sewer system assets to prevent catastrophic failures. More than 30% of the collection system is over 80 years old and maintenance needs are anticipated to increase significantly in the near future. The bureau has committed to providing funds for repair of structurally deficient portions of the sewer collection system, and the long-term financial forecast anticipates significant increases in the capital maintenance budget beyond completion of the CSO program.

Watershed Opportunities

The Adopted Budget includes $1.5 million for each year of the five-year CIP to fund innovative watershed enhancements. Priority will be given to projects that leverage other funding sources, demonstrate new technologies, and/or address multiple watershed health goals. Additionally, the bureau is investing $40 million over the next five years to ensure Portland continues to grow in a way that protects and enhances watershed health. This new five-year initiative will add 43 acres of ecoroofs, construct 920 Green Street facilities, plant 33,000 yard trees and 50,000 street trees, set up the fight against invasive weeds, replace eight culverts that block fish passage, and purchase 419 acres of high priority natural areas.

SUMMARY OF BUDGET DECISIONS

The Adopted Budget, including the following decision packages, will require a 5.7% average rate increase.

System Operations - Combined Sewer Overflow

Flows from Westside CSO control facilities and other system operation and maintenance needs are driving the following additions:

- $64,200 for an additional operations position at the Columbia Boulevard treatment plant for handling increased wastewater flows
- $400,000 for an additional sewer spot liner crew and equipment to enhance system maintenance
- $120,000 for additional large pipe inspection services, to improve system information and help prioritize system maintenance needs
- $100,000 for a one-year test of a system that eliminates the need to dewater waste from vactor trucks. If successful, this system could enhance operating efficiency by reducing the number of trips necessary to off-load wastes
- $250,000 to replace one of the two lagoon dredges at the Columbia Boulevard treatment plant as the dredge has reached the end of its useful life
- $54,000 for an industrial stormwater facility maintenance inspector

Asset Management - System Maintenance

Continued improvement of asset data in support of bureau asset management, improved service in land use reviews, improved service to internal customers in project design, and improved response time for failing private sewers require the following additions. This $521,300 increase in services is primarily paid from CIP funding.

- $81,300 for a database management position in support of bureau asset management efforts
- $145,000 for 1.5 positions for additional design services to support increasing workloads
- $69,000 for an additional position to work on land use reviews to support increasing workloads and reduce turnaround times
- $317,000 for four positions to implement the Non-Conforming (Party Line Sewer) program

Portland Harbor Program

To improve the City's understanding of potential liability and cost allocation issues in advance of Portland Harbor Record of Decision, one position is added. Payments to the Lower Willamette Group are reduced.

- Reduce the transfer from the Sewer System Operating Fund to the Environmental Remediation Fund by $1,050,000 to reflect reduced City payments to the Lower Willamette Group
- $87,000 for an outfall inspection position to support the City's Remedial Investigation and Feasibility Study activities

Grey to Green Watershed Initiative

This is a new initiative to protect and restore Portland's rivers and watersheds reflecting City Council's vision of how Portland should reduce its stormwater footprint. The Grey to Green (G2G) initiative invests an additional $40 million over the next five years to ensure Portland continues to grow in a way that protects and enhances watershed health. The city will invest an additional $5.2 million in FY 2008-09 to begin implementing the five-year G2G effort.

G2G Operating Budget

The Operating Budget portion of this initiative is $1,776,000 in FY 2008-09 and includes seven new bureau FTEs:

Ecoroofs: $548,000 for two positions

- One position to manage the Ecoroof Challenge and early action projects
- One position for development and administration of the ecoroofs grant and loan program. This effort will add three acres of ecoroofs.

Trees: $702,000 for three positions

- Two positions to support the administration and implementation of the street tree and yard tree programs
- The third position will spend the majority of time in coordinating overall G2G operations, but will also provide some of the Trees element project management
- A position ($75,000) for a Portland Parks, Arborist Tree Inspector will be provided through an interagency agreement
- $100,000 for Yard tree implementation (2,750 trees)
- $151,000 for Street tree implementation (1,800 trees)
- $150,000 for two staff positions at Non-Governmental Organizations, such as Friends of Trees, Audubon, or others

Invasive Species Removal and Revegetation: $476,000 to revise city code to accelerate invasive species removal

- Develop enforcement code and policy
- Determine future invasives regulation and enforcement
- Support for invasives programs of other city bureaus
- Two positions are added for $151,000 to support the Early Detection and Rapid Response (EDRR) program
- Another position ($75,000) will be funded through a FY 2008-09 interagency with the Bureau of Planning to develop enforcement code and policy. That position will be converted in later years to a Bureau of Development Services interagency position for invasives regulation and enforcement

- Support for Parks “Protect the Best" program includes $250,000 for five seasonal Botanical Specialists within the Parks Bureau

Ecosystem Services: $50,000 to evaluate the effects of investments on ecosystem functions and watershed health. Ecosystem services provide useful performance and valuation indicators to inform investment decisions.

G2G Capital Budget:

The CIP budget portion of this initiative is $3,466,000, including 1 bureau FTE:

Greenstreet/Swales: $436,000 for Sustainable Stormwater Team Projects ($161,000) and Fanno-Tryon SW 19th Greenstreet ($275,000). Future years will include another $604,000 totaling $1,015,000 of annual resources for this effort. In FY 2008-09, the bureau will construct eight Green Street Facilities in the first year; 920 Green Street Facilities within the five-year CIP horizon.

Land Acquisition: $3,030,000 for one position to seek lands for purchase, establish partnerships for funding and purchase arrangements, negotiate purchases, and manage properties acquired. The expected results are to purchase 46 acres of natural areas and restore native vegetation to 70 acres of natural area

Development on forested areas, steep slopes, and drainage ways can cause landslides and erosion, increase flooding problems, and harm water quality and habitat. Public acquisition of natural areas protects them from development and preserves watershed and floodplain functions.

A significant portion of the purchase of these lands will be through partnerships and funding by others. Intergovernmental Agreements with the State of Oregon, Oregon Parks, and Federal agencies may also be necessary for their involvement. Agreements with Portland Parks and Metro will be necessary for potential grant funding or use of Metro bond funding.

Other Budget Decisions Affecting the Bureau

In addition to the budget additions brought forward by the bureau, the Adopted Budget includes decisions that affect BES. Various payments for other bureaus total over $94,000; the payments fund e-government, an Americans with Disabilities Act coordinator, a fleet fuel tank replacement, and Portland Building major maintenance. The major infrastructure bureaus will also contribute $130,000 each toward updating the City’s Disparity Study originally completed in 1996. This study gives agencies policy-setting direction to improve opportunities for minority and women business owners and workers in the construction industry.

Capital Budget

CAPITAL PLANNING & BUDGETING

Capital Planning Process

The CIP is developed utilizing a multi-step process to identify, develop, review, score, and rank projects for funding and scheduling priority. This process insures that the core needs of the sewerage, drainage, and surface water systems and the community they serve are appropriately funded and scheduled. A Bureauwide stakeholder review team investigates, scores, and ranks all CIP projects in accordance with identified CIP criteria. CIP weighted criteria, scoring instructions, scheduling guidelines, estimating procedures, and project

request forms are used so that each project is developed, reviewed, and scored based on detailed and consistent information. A CIP development strategy guides project selection and scheduling. Projects are reviewed by managers in finance, program areas, operations, and engineering to ascertain that financial resources are expending effectively and appropriately. The CIP management team evaluates all the information from the process, meets with selected bureau project and program managers to refine cost and schedule data, and submits a recommendation to the bureau director. The bureau director reviews the findings and approves the CIP plan.

Financial Plan Overview

The five-year financial forecast presents the bureau's revenue and expenditure plan for the operation, maintenance, expansion, and reconstruction of the City's sanitary sewer and stormwater drainage system. The operations, maintenance, and capital construction programs represented in the plan must provide for operation of the system in a safe, sound, and efficient manner as well as compliance with all applicable health, safety, and environmental laws, regulatory body rules, regulatory body orders, and court orders. Revenues from rates and other sources must be sufficient to fund the necessary operations and capital programs. The Bureau forecasts annual rate increases of 5.7% over each of the next five years. These increases are due to growth in annual debt service costs resulting from the CIP, partially offset by transfers from the Rate Stabilization Fund and increases in non-rate revenues. This five-year forecast assumes some amount of financial risk, and in particular no funds are included for sewer work that may be associated with the construction of the Eastside Streetcar, for a possible facility for additional chemical treatment at the CBWTP, or any significant shifts in the cash flow of the Eastside CSO project. As mentioned previously, all CIP expenditures in the financial forecast include an estimate for inflation.

System Costs

Annual system costs fluctuate between $370 million and $450 million over the five-year financial forecast, largely dependent on the amount of CIP expenditures in any year.

- CIP expenditures decrease by $116 million over the forecast interval with the completion of the Eastside CSO in the fourth year. Cash transfers from the Operating Fund to the Construction Fund increase by nearly $18 million over the forecast interval.
- Costs other than CIP and cash transfers to the Construction Fund increase by $57 million over the forecast interval, of which 62% or $36 million, is new debt service from issuance of sewer system revenue bonds to finance capital construction activity. The financial forecast includes $460 million in additional bonded indebtedness through the five-year forecast interval. Bond sales are planned for FY 2009-10, and FY 2011-12.
- Total operations and maintenance expenditures increase by nearly $17 million over the forecast interval, an average annual increase of 4.2%.
- Utility License Fees (ULF) are projected to remain constant at $12.8 million annually over the first four years of the forecast interval due to the freeze instituted by City Council in FY 2004-05. This freeze will be in effect until such time as the effective ULF rate reaches 5% (compared to the 7.5% charged prior to the freeze), currently estimated to occur in FY 2012-13 when payments would equal $12.9 million.
- Transfers from the Operating Fund to the Rate Stabilization Fund (RSF) total only $125,000 during the forecast interval, while use of RSF balances for smoothing rate increases total $66 million.

- CIP expenditures are projected to total $677.9 million over the forecast interval (in FY 2008-09 dollars). The pattern of expenditures is influenced primarily by the timing of CSO projects. These expenditures are funded by sewer system revenue bonds as well as substantial cash contributions ($55 million over the five-year forecast interval) made possible by coverage requirements on sewer system revenue bonds.

System Resources

Forecast annual system revenues from sources other than rates (excluding changes in Operating Fund balances) decrease by $104 million over the five-year forecast interval. This is primarily due to the following:

- Reimbursements from the Construction Fund to the Operating Fund decrease by $116 million over the forecast interval, reflecting the completion of the CSO program during the forecast interval.
- Revenues from system development charges are forecast to increase by $2.5 million over the forecast interval.
- Transfers from the RSF to the Operating Fund increase by $7.9 million during the five-year forecast interval, smoothing rate increases needed as the debt service from capital financing increases.
- Other cash transfers such as federal and state grants, remain at zero, as no projection is made for future grants that have not been awarded as of this date.
- Annual revenue requirements from rates increase by $65.2 million from FY 2007-08 to FY 2012-13, an annual average increase of 5.9%.

Public Facilities Plan Overview

The Bureau's 1999 Public Facilities Plan (PFP) identified major public sewage infrastructure needs for the City of Portland through the year 2015. Projects are based on an analysis of the capacity of the existing system as compared to the densities in the Comprehensive Plan. Capacity is determined from hydraulic analysis and a review of existing structural conditions. The Bureau is developing a methodology to more comprehensively predict pipe rehabilitation needs which will lead to a program to systematically replace the most critical and deficient pipeline segments.

The current PFP addresses significant or major facilities for the bureau's four types of infrastructure systems:

- The combined sewer system includes the network of pipelines and pump stations that collect and convey combined stormwater and wastewater. The PFP addresses combined sewer pipes 15 inches in diameter or larger. Its emphasis is on system improvements needed to prevent sewer backups and basement flooding.
- The sanitary sewer system includes the network of pipelines and pump stations that collect and convey wastewater. The current PFP addresses sanitary sewer pipes 10 inches in diameter or larger.
- The stormwater system includes the swales, ponds, channels, creeks, sloughs, ditches, culverts, sumps, and pipe systems that convey and/or treat stormwater runoff from the land. The current PFP addresses stormwater facilities in basins draining 160 acres or more, corresponding to a typical minimum pipe diameter of 12 inches or larger.
- The wastewater treatment system includes two secondary treatment plants, the Columbia Boulevard and the Tryon Creek Wastewater Treatment Plants.

The PFP uses an integrated watershed approach to assess facilities needs. In this approach, an entire watershed is analyzed as a unit to identify interrelated problems and coordinate all plans, activities, and programs. This avoids solving a problem in one area while creating another problem elsewhere. It also leverages limited funds to solve multiple problems with a single integrated solution. There are five major watersheds within the City of Portland:

- Fanno and Tryon Creeks
- West Willamette River
- Columbia Slough/Columbia River
- East Willamette River
- Johnson Creek

There are 268 projects recommended in the 1999 PFP including construction, design, predesign, and multiphase projects. Predesign is recommended when preliminary analysis indicated a need for more comprehensive and detailed planning prior to the development of construction specifications. Recommendations from the PFP are implemented primarily through the CIP.

System Plan Update

The Bureau is currently updating the 1999 PFP with a new Systems Plan. The new Plan will have an asset management context to ensure that infrastructure investments are made at the right time and at the right budget. The Plan will include plans for all four infrastructure systems: the combined sewer system, the sanitary sewer system, the stormwater system, and the wastewater treatment system. The Plan will provide for enhanced integration of traditional pipe solutions with non-pipe solutions. It is scheduled for completion in July 2008.

The new Systems Plan also results in the development of new planning processes, software tools, and data management systems that will significantly benefit the future work of the bureau. The asset management context will be based on a “triple bottom line" ranking of projects (that considers the financial, social, and environmental benefits of projects), the risk associated with non-performance, and a life-cycle cost analysis that considers both capital and operating costs. It will identify the investment required for maintaining a sustainable system.

In actuality, the Systems Plan will be a “virtual plan," an extensive database that has the ability to evolve and be updated continuously. The virtual plan will be viewable from the desktop. Customized hardcopy documents will be created to meet specific needs.

Asset Management and Replacement Plans

A Rehabilitation Plan is currently being developed. This plan will systematically predict collection system rehabilitation needs for sewer pipelines, pump stations, and drainage facilities. Phase One of the plan is complete. The full plan will be complete in the next year.

Pipeline Element: The first phase focuses on sewer pipelines. Automated tools will use physical attributes to predict the future performance of individual facilities. The tools will rely heavily on data currently maintained within the Maintenance Management System. The new tools may require the collection of additional data or require existing data to be collected and stored in a different way.

Pump Station Element: The second phase of the project focuses on the development of a more comprehensive plan to provide baseline information for each pump station, establish evaluation criteria for rating station performance, prioritize pump station improvements, and develop an implementation plan for improvements.

CAPITAL PROGRAMS & PROJECTS

Program Description

The Capital Improvement Program is divided into five program areas: Combined Sewer Overflow, Maintenance and Reliability, Sewage Treatment Systems, Surface Water Management, and Systems Development.

Combined Sewer Overflow

Approximately 60% of Portland's population is served by a combined sewer system which carries both domestic sewage and stormwater runoff. When it rains stormwater runoff has historically exceeded the carrying capacity of the combined sewers, causing overflows through outfalls to both the Willamette River and the Columbia Slough. These outfalls have been deemed a significant source of pollution in these two waterways. Prior to the start of the CSO program, the City's combined sewers discharged an average of six billion gallons annually in to the Willamette River. With the completion of the Cornerstone projects and the Westside CSO Tunnel in December 2006, this was reduced to an annual average of 2.7 billion gallons of which an estimated 20% is untreated sewage. Combined sewage overflows represent only 8% of the entire sewer system flows; 92% receives treatment.

In September 1990, the bureau initiated an engineering study to characterize the CSO problem and to evaluate alternative methods for abating pollution attributable to CSOs. In August 1991, the City signed a Stipulation and Final Order (SFO) with the State Environmental Quality Commission. The SFO was a compliance order for the City to control its 55 CSO outfalls by 2011 and included interim milestones. It mandated a 99.6% reduction in CSO volume, but included language to allow revisiting the level of control.

In November 1993, the City undertook a collaborative process with extensive public involvement to determine the desirable level of CSO control. As a result of this process, it was decided to maintain the 99.6% CSO reduction for the Columbia Slough, but to lower the level of control for the Willamette River to 94% reduction. This resulted in an Amended SFO (ASFO) in August 1994.

Since that time, a number of CIP projects to address CSO issues have been completed, most significantly the series of projects to address the Columbia Slough outfalls and the Tanner Creek and West Side CSO tunnel, shafts, pump station, and pipelines projects for the west side of the Willamette River. Several major projects in various stages of design and construction are in the five-year CIP.

Combined Sewer Overflow Major Projects

Eastside CSO Tunnel: This project includes 29,000 linear feet of 22-foot diameter tunnel extending from the Insley combined sewer basin to the south to the Riverside Basin in the north (Swan Island). This project is a significant component of the Eastside CSO (ESCSO) control program. The tunnel will collect, store, and convey overflows from thirteen combined sewer basins on the east side of the Willamette River. It will connect to the new CSO pump station at Swan Island at its northern downstream end. The depth of the tunnel will vary along its length with depths in excess of 120 feet in some places.

Portsmouth Force Main: This project includes approximately 17,000 linear feet of 66-inch diameter force main. It will connect the Swan Island CSO Pump Station to the existing Portsmouth Tunnel in order to transport Eastside CSO Tunnel flows to the Columbia Boulevard Wastewater Treatment Plant.

Swan Island CSO Pump Station Phase 2: This project will provide three additional wet weather pumps with associated mechanical, electrical, instrumentation, and control systems to expand the pump station capacity from 100 million gallons per day (MGD) to 220 MGD in preparation for connection of the Eastside CSO tunnel.

Balch Consolidation Conduit: This project will connect and convey CSO flow from the Balch Outfall and an adjacent stormwater outfall to the Westside CSO Tunnel. It includes construction of 4,900 feet of 72- to 84-inch pipe at an average depth of 40 feet. It will replace the failing Balch Trunk Sewer.

Southeast CSO System Improvements: These projects address CSOs in the area south of the Eastside Tunnel. They will replace sewers in the 313-acre Sellwood Combined Sewer Basin and in the 1,090-acre Lents 1 and 2 Basins to reduce combined sewer overflows and relieve basement flooding. The predominately residential Sellwood Basin is located on the east bank of the Willamette River at the southern city limits. The Lents basins are east of the Sellwood Basin. Additional storage capacity and a new pump station will be constructed. These projects will control the discharges from three outfalls, as recommended by the 2001 Update to Portland's Combined Sewer Overflow Management Plan.

Sellwood CSO System Improvements: This project will design and construct replacement sewers in the Sellwood Combined Sewer Basin to reduce combined sewer overflows and basement flooding. Installation of sumps and an analysis of roof drain disconnections have been completed within this basin. This basin is a 313 acre, predominantly residential basin located on the eastern bank of the Willamette River at the southern limits of the City. The sewer facilities serving this area consist of the Umatilla pump station, approximately 62,600 lineal feet of combined sewer lines, 11 diversion structures, and three outfalls. This project and the Harney Pump Station and Separation project will control the discharges from three outfalls as recommended by the 2001 Update to Portland's Combined Sewer Overflow Management Plan.

CBWTP Primary Treatment Expansion: This project is adding a fourth dry weather primary clarifier to the existing complex. The project includes integration with existing systems such as scum removal, sludge pumping, and odor control. When complete, the peak treatment capacity of the dry weather primary clarifiers will be adequate to optimize treatment for both the east and west side Willamette River CSO facilities.

CBWTP Wet Weather Headworks: This project will construct a 150 million-gallon per day wet weather screening facility at the Columbia Boulevard Wastewater Treatment Plant to accommodate projected increased influent flows from the implementation of the Willamette River CSO program.

Maintenance and Reliability

Projects in this program area address major maintenance requirements of the sewerage collection system including collector sewers, trunk sewers, and interceptor sewers. The City's sewerage collection and transportation system includes over 2,315 miles of sewer line ranging in diameter from four inches to 14 feet. Much of the largest pipe in the City's older neighborhoods is more than 100 years old.

In some areas of the City, recurrent basement flooding is a major problem creating health and environmental hazards as well as property damage. This program addresses those problems using a multi-objective approach which includes onsite drainage controls, street inflow controls, and upsizing undersized public facilities that are causing backup of sewage into basements.

Funding in this program area is focused on rehabilitation/reconstruction of the most structurally deficient portions of the collection system. When the Systems Plan is completed, a more accurate schedule and expenditure forecast will be developed.

Maintenance and Reliability Major Projects

Maintenance Capital Contract: This project supports contracted maintenance repair and reconstruction throughout the collection system. This work is distinguished from routine maintenance because the solutions require private contracting as spot repair techniques used by City maintenance crews are insufficient. Due to the age of the system, structural failures, localized flooding, and/or hydraulic capacity problems are discovered with some frequency and need to be addressed quickly. In any given fiscal year, 10 to 15 maintenance projects are identified which require a designed solution and a rehabilitation contract.

Balch Consolidated Conduit (BCC) Support 1 and 2: These two projects are identified in the NW Neighborhoods Predesign Report as projects with ASFO/CSO impacts. The Balch Consolidation Conduit, part of the CSO program, will alleviate combined sewer overflows from the Balch and Nicolai drainage basins. The BCC Support 1 and 2 projects send combined sewage to the BCC. Support 1 redirects combined sewage from an existing 54-inch sewer that is in poor structural condition and segments of this pipe will be abandoned. These projects also rehabilitate deficient pipe and reduce the risk of basement flooding.

Transit Mall Rehabilitation: Construction of the downtown transit mall has affected the condition of the sewer pipes in a number of streets that cross the new mall. The project will rehabilitate/replace 38 segments of pipe in the vicinity of 5th and 6th Avenues.

Sewer Structural Rehabilitation: This project is focused on the highest priority pipes for rehabilitation based on risk and criticality in the Phase I Rehabilitation Plan. The project will rehabilitate 172 sanitary and combined sewer pipe segments.

Taggart D Basin Separation: This multi-year, multi-project program will address system deficiencies and eliminate basement flooding through the 25-year storm in the 1,432 acre Taggart D Basin. The design of the projects will include both traditional pipe solutions and alternative surface-based stormwater management systems.

Oak Basin CP-B: This project is for repair and upgrading of sewers in the Oak B drainage basin. The basin area affected by the project is approximately 80 acres in size. Sewers in the basin are aging and deteriorating and some basement flooding has been reported. This project will replace sewers that are damaged or undersized. Also, it will provide permanent repairs to the sewer at SE 16th & Oak, where a large sinkhole recently formed.

Fanno Basin Force Main projects: These projects address deficiencies in the Fanno Basin Pump Station Pressure Line system identified after two recent point failures occurred. The two projects will repair or replace pipe in the Multnomah and Garden Home sections.

Sewage Treatment Systems

This program funds projects located at the Columbia Boulevard Wastewater Treatment Plant (CBWTP) and the Tryon Creek Wastewater Treatment Plant (TCWTP) as well as maintenance and repair/rehabilitation of the 97 active pump stations located systemwide.

Both treatment plants operate within the framework of the Federal Clean Water Act. Specific requirements for removal of pollutants from wastewater before the treated effluent is discharged into the Columbia or Willamette Rivers are contained in the National Pollution Discharge Elimination System (NPDES) permit for each plant.

High priority is given to projects that provide operating efficiency, reliability, and longevity of the facilities. Most of these improvements include replacement and reconstruction of aging and unreliable plant or pump station components. Projects that mitigate odor from the CBWTP are also part of this program in accordance with a citizen supported City Council resolution.

The Bureau continues to support the implementation of the CBWTP and TCWTP Facility Plans. Projects identified for both plants will be completed in time to meet the increased demand due to growth and the completion of the CSO Program.

Sewage Treatment Systems Major Projects

Pump Station Improvement Program: This is an ongoing program to refurbish and upgrade pump stations to meet current codes, to operate more reliably, to upgrade facilities to meet increased demand, and to replace out dated equipment. The Bureau operates 97 pump stations.

Treatment Facilities - Rehabilitation and Modification: Both the CBWTP and TCWTP are major capital assets that require ongoing investment for repair, rehabilitation, and maintenance work to protect the capital investment and enhance system reliability. This program is key to preventing violations of the Bureau's NPDES permit and it facilitates replacement of capital equipment and upgrading of aging facilities.

CBWTP Digester Expansion Project: This project will construct two additional primary digesters at the CBWTP. Two conditions are driving the need to expand the anaerobic digesters. One, the solid loading has increased to the point where the existing system is nearing capacity, and two, additional wet weather loading from the Westside CSO will be further augmented when the Eastside CSO is complete in 2011.

Ankeny Pump Station Upgrade: This project will modernize the aging Ankeny Pump Station and replace four sewerage pumps and associated systems, add upgraded instrumentation, control, and communication to operate with the Willamette River CSO Control System during storm events, and make exterior improvements to be more compatible with the Waterfront Park including access and security control and odor treatment.

Surface Water Management

The primary objective of this program is to protect the quality of surface and ground waters by addressing watershed health and public safety concerns associated with flooding, stream erosion, and urban pollution. Water quality and flood control projects are located in the Columbia Slough, Fanno Creek, Johnson Creek, Tryon Creek, and along the main stem of the Willamette River. Projects are developed to meet the provisions of the Watershed

Management Plan adopted by City Council in 2005. The Watershed Management Plan promotes techniques that incorporate natural systems into the built environment. By protecting and restoring natural functions, the City can provide a stormwater management system more resilient to impacts and more responsive to federal and state regulatory mandates related to surface and groundwater protection. This program is also guided by the Endangered Species Act Resolution adopted in 1998, the Clean River Plan finalized in 2000, and the River Renaissance Vision adopted in 2001.

This program is also responsible for meeting certain conditions of the Water Pollution Control Facilities Permit issued by the Oregon Department of Environmental Quality (DEQ) in June 2005. The specific areas covered by the Surface Water Management Program are the conditions placed on the City associated with owning and operating about 8,500 active Underground Injection Control Systems (UICs). As part of this permit, the City is required to identify any UIC that will not meet conditions of the permit and retrofit or decommission them.

Projects proposed under this program include construction of Pollution Reduction Facilities (PRF), sump retrofits, stream restorations, and the installation of surface water filtering systems. By addressing water quality and flooding issues, these projects aim to protect fish, enhance wildlife habitat, and enhance community livability through the greening of urban areas.

Surface Water Management Major Projects

Johnson Creek Restoration Program: This program is implementing the recommendations of the Johnson Creek Restoration Plan, 2001. The plan identifies a number of projects to mitigate flooding, improve water quality, and improve fish and wildlife habitat. This program includes willing seller land acquisition in four target areas. It also includes predesigns for projects identified in the plan.

East Lents/South of Foster: This project, the first of two phases, will restore floodplain areas along Johnson Creek and create approximately 60 acre feet of flood storage in 18 acres of Bureau owned property south of SE Foster Road between SE 106th Avenue and SE 110th Drive. The project is 75% funded from the Federal Emergency Management Agency (FEMA). Project goals include increased flood storage, increased habitat for fish and other wildlife, and improved water quality.

UIC Improvements Category 2 (CAT2): In June 2005, DEQ issued a permit pursuant to ORS 468B.050 to implement the Federal Safe Drinking Water Act requirements. The permit covers the city's approximately 8,500 active UICs. UICs (sumps) provide drainage for many rights of way on the east side of the Willamette River. This project will correct compliance issues for approximately 400 UICs that are estimated to have less than ten feet separation between the bottom of the UIC and groundwater, or otherwise be determined to be "non-compliant" by DEQ. More assessment work will define compliance status of, and the required corrective actions for, the remaining UICs. Non-compliant UICs must be corrected within three years unless an alternative timeline is negotiated under the permit.

Grey to Green: This is a new initiative to protect and restore Portland's rivers and watersheds reflecting City Council's vision of how Portland should reduce its stormwater footprint. This initiative invests an additional $40 million over the next five years to ensure Portland continues to manage its infrastructure in a way that protects and enhances watershed health.

In the first year, the city will begin implementing the five-year Grey to Green effort by investing a $5 million to construct an additional 3 acres of ecoroof, 8 green streets, 5,000 trees, 750 acres of invasive species management, and purchase 46 acres of high value habitat to preserve watershed and floodplain functions. First year work will also identify funding partnerships for culverts that do not allow fish passage where retrofitting will improve fish habitat and reduce flooding and erosion. By the fifth year and including other leveraged dollars, projects will result in 43 acres of ecoroof, 920 green streets, 83,000 trees, more than 2,700 acres of invasive species control, 419 acres purchased, and 8 replaced culverts.

Watershed Investment: In the past two years, Council funded several high priority projects to "jump-start" the city's work towards the goals of the Portland Watershed Management Plan. This program, now within the CIP, will continue to fund watershed enhancements that achieve the greatest benefit to watershed health while also seizing partnership and other leveraging opportunities. Projects are intended to provide the natural system components necessary to reduce long term capacity and water quality impacts related to managing pipe infrastructure.

Systems Development

The primary focus of this program area is to expand the city's sewer collection system in support of the implementation of the 2040 Plan. This program carries out the bureau's commitment to provide an efficient sewerage system to residents and businesses within our service area, to support new development, and to protect public health and the environment. This program also includes other capital projects that do not fall under the scope of other CIP program areas relating to sewer system expansion and privately funded development.

Systems Development Major Projects

South Airport Sanitary Trunk Sewer: This project will construct new sanitary trunk sewers to serve the basin. The project basin area is approximately 1,300 acres in NE Portland near Columbia Boulevard between 42nd Avenue and Colwood Way, including a large area at the airport.

Lents Sanitary Sewer Extension: Construct 8,600 linear feet of sewer to connect 120 residences and several vacant lots not currently sewered to the Lents Trunk Sewer.

Capital Funding Sources

Planned CIP outlays total $677.9 million (including inflation) over the five-year forecast of FY 2008-09 through FY 2012-13. Based on current planning assumptions, the bureau's five-year CIP request will require $460 million (nominal dollars) in additional borrowings over the next five fiscal years. A brief description of the resources needed to finance this requirement follows:

- Fees, Charges, and Permits. This source of funding includes an estimate of reimbursements for engineering, administration, and construction management services charged to local improvement districts and for permit sewer construction. Also included are anticipated revenues from construction and/or engineering services for projects initiated by other local government agencies such as the City's Department of Transportation and the Port of Portland.
- Line and Branch Charges. Charges in lieu of assessment will be used to support CIP outlays. Line and branch charges are received in the form of cash and in the form of proceeds from special assessment bonds issued for property owners who elect to finance their line and branch charges. Total revenues from these charges are projected to be approximately $14.2 million over the five-year forecast.
- Cash Transfers from the Sewer System Operating Fund. Current Sewer System net income from service fees and charges will also be used to fund CIP outlays. The availability of current income to fund CIP expenditures is the result of meeting debt service coverage requirements on outstanding bonds. For planning purposes, the bureau maintains coverage ratios of 1.50 on first lien debt, 1.30 on combined first and second lien debt, and an ongoing reserve of ten percent of operating expenses for unforeseen financial needs. After making debt service payments, funds in excess of those required for the ten percent operating reserve are available to fund capital improvements. Cash transfers from the Operating Fund to the Construction Fund are projected to total $55 million over the five-year forecast.
- Bond Proceeds. Proceeds from the sale of sewer system revenue bonds will support the CIP. Debt service requirements for future bond sales have been calculated assuming level debt service. Interim short-term financing may be used in lieu of, or in combination with, long-term financings. The forecast assumes an average annualized coupon rate of 6.0% for the bonds sold in FY 2009-10, and 6.5% for the bonds sold in FY 2011-12, with the bureau's planning standard debt service coverage ratios of 1.50 and 1.30, as mentioned previously.

Operating And Maintenance Costs

Each project includes estimated Operating and Maintenance (O&M) costs (or savings) to be included in the operating budget once the facility comes online. The O&M estimates for costs or savings are prepared by the Wastewater Group. The basis for the estimates depend upon the type of expected impact. The four major components for treatment plant O&M are labor, energy, chemicals, and materials. Energy and chemicals O&M costs are more easily predicted while labor and materials O&M costs are not. Labor and material costs are more commonly based on experienced estimates with similar projects and facilities from either the City of Portland or others.

Business Services

Description

Business Services develops and recommends bureau-wide policies and practices related to all aspects of financial operations and administrative services. Services provided by the group include:

- Payroll, accounts payable, accounts receivable, grants, project tracking, and year-end financial reporting
- Bureau-wide coordination for the annual budget development process
- Maximizing the utilization of minority, women, and emerging small businesses in bureau contracting
- Procurement-related services including assistance with solicitation, selection, disputes and protests, and administration of contracts
- Coordination and management of bureau-wide administrative services, including training, human resources administrative support, clerical support, property management and administration, and management of interagency agreements
- Financial planning and forecasting, wholesale service contract development and administration, debt management, and user fee and system development charge ratemaking, and management of the Clean River Rewards stormwater discount program
- Development and provision of spatial data through electronic maps and GIS, maintenance and provision of collection system asset data, and management of the service level agreement with the Bureau of Technology Services
- Administering loss control and safety for the bureau and owner-controlled insurance programs for the capital program

Goals

Business Services supports the City goal of protecting and enhancing the natural and built environment by facing funding limitations and ensuring that ratepayer dollars are spent wisely. Business Services plays a key role in prioritizing programs to limit rate increases and reflect those choices in the bureau's financial plan, works to maintain a strong bond rating on the bureau's revenue debt, works to improve employees' understanding of the financial impact their work and expenditures have on sewer and stormwater rates, and seeks funding sources to support programs and reduce impacts to ratepayers.

Performance

The bureau's debt service coverage ratio for first-lien revenue bonds was 2.08 for FY 2006-07 and is expected to be 1.86 for FY 2007-08. The goal is to reduce this to the Financial Planning standard of 1.50 over the next five years.

The bureau's current bond rating is Aa3/AA-, which is a strong rating for sewer revenue credit. The goal is to maintain this rating.

Hours lost to injuries were 4.02 for FY 2006-07, down from 4.6 for the previous year. The goal for FY 2008-09 is to keep time lost to injuries at a level at or below 4.5 hours.

Changes to Services and Activities

New work on City document retention policy compliance and administration of the Non-Conforming (Party Line) Sewer program require the extension of a limited term position and the addition of a Program Coordinator in the Revenue Programs area of Business Services. One current position, a Principal Financial Analyst, has transferred to the Office of the Director to staff the new Intergovernmental Relations Division.

FTE & Financials	Actual FY 2005–06	Actual FY 2006–07	Revised FY 2007–08	Proposed FY 2008–09	Adopted FY 2008–09
FTE	33	45	47	48	48
Expenditures					
Personal Services	2,867,339	3,922,299	4,440,035	4,573,252	4,537,696
External Materials & Services	1,260,162	911,457	2,435,134	2,251,390	2,290,190
Internal Materials & Services	14,017,415	15,651,695	7,698,308	7,363,932	7,363,932
Capital Outlay	595,422	142,296	110,000	85,000	85,000
Total Expenditures	18,740,338	20,627,747	14,683,477	14,273,574	14,276,818

Performance	Actual FY 2005–06	Actual FY 2006–07	Yr End Est. FY 2007–08	Target FY 2008–09
Effectiveness				
Maintain the bureau's debt service coverage ratio at 1.5 or greater	1.80	2.08	1.86	1.50
Maintain bureau's combined 1st & 2nd debt service coverage ratio at 1.3 or greater	1.46	1.46	1.30	1.30
Efficiency				
Time loss hours (due to injuries)	4.60	4.02	4.50	4.50

Engineering Services

Description

Engineering Services is responsible for developing the bureau's capital improvement plan, system planning, managing implementation of capital projects, providing engineering services to all bureau programs, and managing the bureau's Systems Development program.

Program Management & Controls develops the bureau's annual capital budget and five-year capital improvement plan. Project schedules and budgets are monitored to ensure timely and cost effective progress towards completion of capital projects.

Asset Systems Management is responsible for bureau-wide system planning and Combined Sewer Overflow program management, to ensure the requirements of the Amended Stipulation and Final Order are met in a timely, cost effective, and functional manner.

Design Services provides project management and engineering design services, and is responsible for ensuring each assigned project accomplishes its intended purpose on schedule, within budget, at best value, and in a manner consistent with City and bureau missions and values.

Construction Services provides construction management and inspection services for bureau projects and provides materials testing services for both bureau projects and projects managed by other City bureaus.

Systems Development assists developers and other customers and supports City development goals by reviewing and approving plans and issuing permits. This division also has primary responsibility to develop and revise the City's Stormwater Manual and to implement policies that protect water resources and stream integrity.

Administrative/Stormwater Retrofit Services is responsible for managing group operations, operating budget, personnel, and contract services, and provides support to all group programs. The Downspout Disconnect program and technical assistance for the Clean River Rewards program is also managed within this division.

Goals

Engineering Services supports the City goal of protecting and enhancing the natural and built environment by preserving, protecting, and enhancing infrastructure. Engineering Services manages wastewater and stormwater assets to preserve and enhance the value of the community's investment; aggressively controls sewer overflows and basement flooding; explores and evaluates innovative technologies and solutions; and integrates natural system concepts into design, construction, and maintenance of systems that retain or improve the current service level.

Performance

An estimated 65% of combined sewer overflow volumes have been diverted from the rivers and receive treatment. This will increase to a minimum of 94% when the Eastside CSO abatement facilities come online at the completion of the 20-year program in 2011.

An additional 2,000 roof drains will be disconnected from the combined sewer in the coming fiscal year in accordance with the CSO program schedule, increasing the number of disconnected roof drains to 53,000.

Construction management costs are forecast to remain at 12% of total construction costs.

More than 75% of pipe identified as highest priority for repair or replacement is incorporated into funded CIP or operating projects.

Changes to Services and Activities

In continuing efforts to respond to the Bureau Improvement Project #19, Cross-Bureau Permitting, one Engineering Technician II is requested to decrease plan review turnaround times and improve service to the development community. The cost for this position will be recovered through permit fees.

Three positions, two Engineering Technician IIs (one limited term) and one Senior Engineering Associate are requested for management of the Non-Conforming (Party Line) Sewer Program.

An Engineering Technician III is requested for database management in support of the BES System Plan. A Supervising Engineer position and a permanent part-time Senior Engineering Associate are added for CIP project management.

Of the 6.5 FTE positions requested, 5.3 FTEs are funded by the CIP or permit fees.

FTE & Financials	Actual FY 2005–06	Actual FY 2006–07	Revised FY 2007–08	Proposed FY 2008–09	Adopted FY 2008–09
FTE	163	168	174	181	183
Expenditures					
Personal Services	14,001,029	15,165,734	16,593,310	16,742,534	16,880,714
External Materials & Services	28,016,287	26,230,611	22,441,398	21,077,147	21,182,147
Internal Materials & Services	3,496,909	4,113,918	5,484,710	4,765,687	5,133,587
Capital Outlay	106,733,683	135,357,662	162,388,803	150,125,173	152,947,263
Total Expenditures	152,247,908	180,867,925	206,908,221	192,710,541	196,143,711

Performance	Actual FY 2005–06	Actual FY 2006–07	Yr End Est. FY 2007–08	Target FY 2008–09
Effectiveness				
Percent of pipe identified as highest priority for repair or replacement incorporated into funded CIP or Op. proj.	NA	99%	50%	75%
Efficiency				
Construction management costs as a percentage of total construction costs	12%	13%	12%	12%
Workload				
Cumulative disconnected roof drains	48,231	50,237	53,000	53,000

Office of the Director

Description

The Office of the Director manages the Bureau of Environmental Services, coordinates the activities of the bureau's five operating groups, and ensures timely and appropriate response to the public, ratepayers, and regulatory agencies. Coordination includes overseeing the development of the bureau budget and managing review of programs, projects, and services offered by the bureau.

The Director's Office develops and manages bureau and environmental policy recommendations for City Council consideration. The office works closely with other City bureaus, regulatory agencies, the Natural Resource Trustees, and tribal governments on local, state, and national environmental issues. The Director provides supervision of the newly formed Regulatory and Public Affairs Group, the Portland Harbor Superfund program, and the Combined Sewer Overflow program.

Regulatory and Public Affairs Group

The Regulatory and Public Affairs Group is comprised of the following divisions in the Office of the Director: Intergovernmental Relations, Public Information and Community Outreach and Involvement, and Portland Harbor Superfund.

Intergovernmental Relations

The Intergovernmental Relations Division builds relationships and partnerships with federal, state, local and tribal governments, and other city bureaus. The division works with the different BES work groups to develop policies, programs, and code changes that implement new environmental programs or respond to new regulatory requirements.

Public Information and Community Outreach and Involvement

The Public Information and Community Outreach and Involvement Division provides public information, communication planning, public involvement, environmental education, and internal communication services to keep the public, ratepayers, and bureau employees informed about the work of the bureau. Such services are required to meet the mandates of several state and federal requirements.

- Public involvement services ensure there is a process for shared decision-making with the community regarding the $650 million capital improvement program that will impact a number of neighborhoods in Portland
- Public information services include graphic design, publications, signage, public notification, media relations, and public service announcements and campaigns
- Environmental education services include classroom presentation, fieldwork with students, assembly programs, and teacher workshops

Portland Harbor Superfund

The Portland Harbor Superfund program is funded within the Environmental Remediation Fund. The existence of the bureau's Superfund program is recognition by Council that a strong City presence in the Superfund cleanup is critical. The program manager represents the City at a management level in the Lower Willamette Group, and with the Tribal governments and federal and state agencies.

The City is a member of the Lower Willamette Group, a group of private and public entities who have signed an agreement with the Environmental Protection Agency to fund a contaminated sediment investigation. The City also has a role as a party potentially responsible for cleaning up contaminated sediments. The City's involvement includes assessing the potential of the City's stormwater conveyance system to carry contamination from upland sources to the river sediments.

Program staff work with trustee agencies and tribal governments on natural resource restoration efforts, and are developing government-to-government relationships with several Tribal governments involved in the project. Program staff are working with other City staff to spearhead a Lower Willamette Ecosystem Restoration project with the Corps of Engineers under the authority of the Water Resources Development Act (WRDA). This work coordinates the efforts of Bureau of Planning and the watershed management of BES.

The Bureau is continuing to pursue and maintain a strong, direct government-to-government role with EPA, DEQ, and the six Tribal governments on all of these issues in addition to its work as a member of the LWG PRP group.

Combined Sewer Overflow Program

The CSO abatement program is entering the final phase of major projects to reduce overflows to the Willamette River. The last phase is construction of the Eastside Big Pipe and related projects. This final set of projects will be constructed from 2008 to 2011. The Office of the Director administers the program and ensures that the program is responsive to all federal and state mandates regarding CSO control. Expenditures for the CSO program are recorded in Engineering Services.

Goals

The Public Information and Community Outreach and Involvement Division supports the City goal to protect and enhance the natural and built environment through communicating the importance of these goals to city residents and ratepayers. One method of attaining that help is through public information, education, and involvement in bureau programs and projects. The Office of the Director formally establishes customer service standards contained in the employee manual and the strategic plan.

The Superfund program supports the City goal of protecting and enhancing the natural and built environment by actively participating in the Superfund cleanup. This involvement will also ultimately promote economic vitality and opportunities as Superfund cleanup issues are resolved. The City is helping to fund and coordinate the investigation and potential cleanup activities to ensure that the Lower Willamette River is fully evaluated in a timely and cost-effective manner, the Lower Willamette is restored to protect human health and the environment, and liability is fairly allocated among all responsible parties.

Performance

During FY 2008-09 the Public Information and Community Outreach and Involvement Division plans to conduct customer satisfaction surveys to test effectiveness of program outreach and involvement. As an example a project that will be evaluated is the Eastside Big Pipe project.

The Public Information and Community Outreach and Involvement Division will survey more than 40,000 residences and businesses that receive the quarterly Big Pipe Update newsletter. This survey will include questions to determine if this newsletter update approach has been useful and effective for recipients.

The quarterly mass mailings will be considered effective and continued if at least 50% of the respondents rank the update as moderately to highly useful for:

- Staying in touch with project activities
- Understanding project objectives
- Knowing how to contact the bureau if there were questions or concerns

Other communication performance measures include:

- Increasing community awareness of BES programs and services evaluated through a public awareness survey. The goal is to have 75% of those surveyed aware of BES programs and services.
- Developing publications about BES that support informational, educational, and community involvement efforts
- Providing clean river education opportunities for grades K-12. The goal is to reach 18,000 students annually.

Change to Services and Activities

The Portland Harbor Superfund Program will reduce the level of payments to the Lower Willamette Group. A Water Resources Program Manager has been added to determine the City's potential liability and cost allocation issues in advance of Portland Harbor Record of Decision.

Two positions from current bureau programs (Portland Harbor Superfund and Business Services) have been transferred to the Office of the Director to form the new Regulatory and Public Affairs Group.

FTE & Financials	Actual FY 2005–06	Actual FY 2006–07	Revised FY 2007–08	Proposed FY 2008–09	Adopted FY 2008–09
FTE	16	16	19	20	21
Expenditures					
Personal Services	1,501,328	1,598,994	1,861,739	2,018,869	2,145,889
External Materials & Services	3,622,836	7,153,703	5,443,757	4,741,501	4,642,024
Internal Materials & Services	322,819	529,820	664,180	680,873	795,350
Total Expenditures	5,456,983	9,282,517	7,969,676	7,441,243	7,583,263

Performance	Actual FY 2005–06	Actual FY 2006–07	Yr End Est. FY 2007–08	Target FY 2008–09
Workload				
No. of students provided with bureau education programs	19,711	24,801	18,000	18,000

Pollution Prevention Services

Description

The Pollution Prevention Services Group includes four functional divisions: Source Control, Environmental Investigations, Environmental Compliance and Enforcement, and Special Waste.

Source Control

The Source Control division provides environmental oversight and technical services to industrial and commercial customers to control or eliminate pollutants to wastewater or stormwater discharges. Services include permitting and enforcement activities, industrial and commercial development plan reviews, best management plans, education, and alternative discharge control strategies as well as development and support of voluntary partnerships with regional organizations and business associations.

Environmental Investigations

The Environmental Investigations division provides sampling and monitoring services, data collection and analysis, environmental process management, consultation and report development and preparation services for the bureau. Services include management of the bureau's hydrological data retrieval and alarm system, which provides remote telemetry sensing of sewer flows, rainfall, and pump station operations throughout the city; field water quality sampling and flow monitoring, and laboratory analysis and reporting; and sampling plan and protocol development and data interpretation.

Environmental Compliance and Enforcement

The Environmental Compliance division manages the bureau's regulatory enforcement process, which includes industrial pretreatment, stormwater, and other environmental regulations under the bureau's authority. The division also ensures bureau compliance with state and federal regulatory obligations including permits governing wastewater collection and treatment. The division also includes the Spill Protection and Citizen Response section which provides 24-hour a day complaint response

Special Waste

The Special Waste division is responsible for environmental assessment and clean-up of contamination on property in which the bureau has an interest. The division also provides this service on a cost-reimbursement basis to a large number of City bureaus, as well as designated Brownfield properties.

This Division also includes the Brownfield program. This program involves contaminated site assessment, cleanup, and redevelopment activities through use of federal Brownfield grants, matching funds from the City and other public agencies, and investment by private sector partners. The focus of the program is to return previously contaminated property to productive economic and community use through partnership with neighborhoods and businesses.

Goals

Pollution Prevention Services supports the City goal of protecting and enhancing the natural and built environment by increasing innovative pollution prevention strategies. Pollution Prevention Services provides technical assistance to City staff and to citizens to help others prevent pollution through effective permit management, best management practices and education, and partnerships with customers to prevent or control pollution at the source.

Performance

Performance Measurements include:

- This year we expect to meet our goal of 99% of industrial enforcement tests to be in full compliance, which is the same level of performance as last year.
- Site investigations and remediations will each require an average expenditure of $2,750, which is a slight increase over the average cost of $2,500 for FY 2007-08. This increase is driven by increases in labor costs.
- Our Water Pollution Control Laboratory estimates it will perform 50,000 lab analyses in FY 2008-09, up slightly from 46,000 in FY 2007-08.

Changes to Services and Activities

Within Pollution Prevention Services Group, increase Personal Services by $54,036 for an Environmental Technician I to perform industrial stormwater facility maintenance inspections. This will ensure proper maintenance of private stormwater facilities.

FTE & Financials	Actual FY 2005–06	Actual FY 2006–07	Revised FY 2007–08	Proposed FY 2008–09	Adopted FY 2008–09
FTE	71	72	74	75	75
Expenditures					
Personal Services	5,340,307	5,669,828	6,245,377	6,636,290	6,636,290
External Materials & Services	2,086,554	1,656,241	2,796,323	2,013,904	2,013,904
Internal Materials & Services	505,416	519,362	1,218,496	(917,619)	(917,619)
Capital Outlay	109,390	18,042	300,000	252000	252,000
Total Expenditures	8,041,667	7,863,473	10,557,196	7,984,575	7,984,575

Performance	Actual FY 2005–06	Actual FY 2006–07	Yr End Est. FY 2007–08	Target FY 2008–09
Effectiveness				
Percent of industrial enforcement tests in full compliance	99.3%	99.0%	99.0%	99.0%
Efficiency				
Average resources spent in site investigations and cleanup, per site investigated or remediated	$1,937	$0	$2,500	$2,750
Workload				
No. of lab analyses performed each year	38,442	0	46,000	50,000

Wastewater Treatment

Description

The Wastewater Group (WG) protects public health, water quality, and the environment by operating and maintaining wastewater and stormwater collection and treatment facilities and managing programs in a manner that ensures compliance with applicable permits, regulations, and contracts.

WG operates and maintains wastewater and stormwater conveyance and treatment systems. In addition to two wastewater treatment plants, the system includes 97 active pump stations, approximately 2,300 miles of pipeline, 61,000 manholes, 8,500 stormwater sumps, 122 miles of ditches, 20 miles of culverts, 54,000 stormwater inlets and catch basins, 573 trash racks, 250 pollution reduction facilities, and 161 stormwater detention facilities.

Inspection, cleaning, maintenance, and repair for most sewer and stormwater facilities are provided through an interagency agreement with the City's Bureau of Maintenance. The Bureau of Maintenance also provides collection system customer response and utility locating services.

Services provided by WG also include stormwater residuals management, vector control contract management, emergency capital repair, and response to customer inquiries. WG manages support services including administrative services, computerized asset management, facilities management, and inventory management as well as acquisition to support wastewater and stormwater collection and treatment operations.

Goals

The WG supports the City goal of protecting and enhancing the natural and built environment by meeting regulatory requirements.

Performance

The treatment process continues to achieve removal of approximately 96% of total suspended solids and biochemical oxygen demand from the wastewater, compared with the 85% regulatory performance required in the NPDES permits. The Wastewater Group plans to sustain this level of performance in FY 2008-09.

Collection and treatment facilities delivered and processed over 29 billion gallons of wastewater during FY 2007-08. Factors affecting total volume include the degree of water conservation by customers, how much stormwater and groundwater are kept out of the system, the volume of captured CSO from the Columbia Slough and Westside CSO facilities now in place, and rainfall in the service area. It is expected that wastewater conveyed and treated will increase to about 30 billion gallons in FY 2008-09.

The operating and maintenance cost of wastewater treatment was approximately $537/mg treated for FY 2006-07 and is projected to be reduced in FY 2007-08 to about $531/mg due mostly to energy savings from the combined heat and power facility but increase again slightly in FY 2008-09 to about $534/mg due to inflation, increased flows and rising chemical usage and costs.

Changes to Services and Activities

WG continues to invest in collection system programs to address the myriad of system infrastructure demands. Reliable system operation requires us to effectively inspect, assess, clean, and repair the sanitary and stormwater systems in a manner that meets established local and national standards. In FY 2008-09 the treatment plant will realize a net annual energy cost savings of about $400,000 with the utilization of a new combined heat and power cogeneration facility.

Within the WG, a Columbia Boulevard Wastewater Treatment Plant (CBWTP) Wastewater Operator II position will be added corresponding to the increase in facilities related to CSO treatment. Other FY 2008-09 additions to internal services include $200,000 for a sewer spot liner crew at Bureau of Maintenance, $200,000 for equipment for the spot liner crew, and $120,000 for additional large pipe inspection services. Increases to Capital Equipment are $100,000 for a one-year test of a system that eliminates the need to dewater waste from vactor trucks and $250,000 to replace one of the two dredges at the CBWTP sludge lagoon.

FTE & Financials	Actual FY 2005–06	Actual FY 2006–07	Revised FY 2007–08	Proposed FY 2008–09	Adopted FY 2008–09
FTE	149	136	140	141	141
Expenditures					
Personal Services	11,933,870	11,754,537	11,932,916	12,635,851	12,635,851
External Materials & Services	11,070,716	11,515,100	11,257,265	11,281,912	11,281,912
Internal Materials & Services	15,747,496	14,912,071	19,089,560	20,214,035	20,214,035
Capital Outlay	673,339	1,235,405	739,560	2,383,000	2,383,000
Total Expenditures	39,425,421	39,417,113	43,019,301	46,514,798	46,514,798

Performance	Actual FY 2005–06	Actual FY 2006–07	Yr End Est. FY 2007–08	Target FY 2008–09
Effectiveness				
Percent of biochemical oxygen demand (BOD) removed	94.9%	96.1%	95.0%	96.0%
Efficiency				
Millions of gallons per day wastewater processed per operating and maintenance employees, including Bureau of Maintenance staff.	136	133	134	135
Cost to operate and maintain the treatment plants reflected in costs per million gallons per day (mgd)	$491	$537	$531	$534
Workload				
Wastewater processed in million gallons per day	29,402	29,556	30,100	30,000

Watershed Services

Description

The Watershed Services Group (WSG) FY 2008-09 budget covers the third full year of integrated watershed management under the Portland Watershed Management Plan (PWMP). The PWMP provides coordination of, and consistent direction for, the goals and priorities of all bureau activities in conjunction with the bureau's Strategic Plan and the City's River Renaissance objectives for a "Clean and Healthy River."

The WSG is responsible for maintenance of the watershed management plan covering all of the City's urban watersheds, policies, and programs needed to protect and improve watershed health and meet federal and state regulations in the most effective and coordinated manner possible. WSG conducts watershed assessments and comprehensive watershed planning under the PWMP, monitors and evaluates the effectiveness of stormwater management practices, promotes and implements sustainable site development projects and practices, develops new policies, interprets and implements state and federal surface water and groundwater policies and regulations, and implements projects to protect and restore watershed functions.

Watershed Services Group Responsibilities and Programs

Watershed Management Plans

The WSG coordinates implementation of the PWMP in a manner supporting the integration of watershed health goals within the work of all the City Bureaus and consistent with the River Renaissance Strategy. Further, the PWMP is designed to integrate the City's response to regulatory requirements of the Clean Water Act, the Safe Drinking Water Act, the Endangered Species Act, and other laws and programs. The PWMP approach is based in ecological principles and watershed conditions, rather than relying on regulatory requirements to define City actions.

WSG applies engineering, economic, and scientific principles and restoration guidelines to select or recommend actions meeting watershed specific needs and objectives. The PWMP was reviewed by the public, the City's Watershed Science Advisory Group, by watershed councils, and is the basis for future budgeting and regulatory compliance. BES will periodically update or refine PWMP elements based on effectiveness of actions taken.

Coordination and Policy Development

The WSG is responsible for developing environmental policies and coordinating with other bureaus, interest groups, and federal, state, and local agencies involved in environmental planning affecting the City.

WSG also prepares BES' responses to federal and state regulations and facilitates BES' participation in development of policies made elsewhere in the City. Through partnerships and collaboration, WSG works to not only comply with regulations, but also influence environmental legislation and codes for consistency with the bureau's mission and goals.

Stormwater Management

The WSG is responsible for program development and coordination of activities related to the City's Municipal Separate Storm Sewer System (MS4) Discharge permit, and its State Water Pollution Control Facility (WPCF) permit for the City's stormwater sumps. WSG coordinates permit implementation actions within BES and with other bureaus, as well as with the City's MS4 permit co-permittees, the Port of Portland and Multnomah County.

In late 2001, the Environmental Protection Agency (EPA) classified subsurface stormwater infiltration facilities as Class V Underground Injection Control (UIC) wells. As a result of this classification, the City's stormwater sumps fall under Safe Drinking Water Act regulations. WSG has developed a UIC and groundwater protection program as required by the WPCF permit in coordination with other bureaus and jurisdictions.

The WSG also provides policy and technical assistance, education and outreach, and project design and implementation to demonstrate and create incentives for projects related to sustainable stormwater practices. Those efforts assist the City in meeting resource protection and environmental compliance goals by integrating sustainable stormwater management practices into the urban environment. Sustainable practices reduce the volume of stormwater entering the combined system, mitigate impacts to sensitive habitats, and reduce stormwater pollutants. Projects that accomplish these goals include eco-roofs, rain gardens, green streets and parking lots, and downspout disconnections. Monitoring, testing, and reporting on these facilities is an integral part of WSG’s work.

The EPA Innovative Wet Weather Grant is another example of sustainable stormwater efforts. Since the start of the grant in FY 2001-02, $2,658,200 has been awarded by the EPA for these on-going innovative wet weather projects.

Science, Fish and Wildlife

The Science, Fish, and Wildlife Division, previously known as the Endangered Species Act Program, has programmatic responsibilities for the integration of its planning and analysis work into the bureau's overall watershed programs, and provides ecological expertise to other bureaus. The Science, Fish, and Wildlife Division provides the scientific foundation and technical expertise needed to respond to the City's obligations under the Endangered Species Act, and provides other services vital to implementation of a variety of City projects and programs in multiple bureaus.

The division has had a number of successes including the completion of the comprehensive "Framework for Integrated Management of Watershed Health," which is guiding the development and implementation of the PWMP. The division also has spearheaded the successful permit streamlining agreement and team. The streamlining work has proved invaluable for many of BES and other bureaus' projects. Other services provided to City bureaus include research, site assessment, pre- and post-project monitoring, permit development, strategy and negotiation, project design, and grant preparation and reporting. The division is responsible for managing in-water construction permits for all City bureaus. In addition, the division fosters and maintains coordination with a variety of federal, state, and regional watershed management programs. The division's budget is comprised of money from a collaboration of the Water Bureau, Portland Development Commission, Office of Transportation, BES and the General Fund.

Goals

WSG supports the City goal of protecting and enhancing the natural and built environment by improving watershed health within the urban community. WSG promotes the advantages of incorporating watershed health into developing and implementing City programs and projects; develops methods for assessing the impacts that implementation has on watershed health goals of water quality, water quantity, habitat and biological communities; and provides technical assistance and training for BES and other City staff on reducing negative impacts on watershed health.

Performance

Watershed Services restored 3,400 feet of streambank during FY 2006-07, and with the additional 5,000 feet of streambank restored in FY 2007-08, brings the bureau's cumulative total restored to 298,400 feet. The goal for FY 2008-09 will be an additional 5,000 feet. Also, in FY 2006-07 16,406 people participated in projects organized or catalyzed by the Stewardship Program. The level of participation goal for FY 2007-08 was 15,000, and the goal for FY 2008-09 is 18,000.

The number of trees planted was added as a performance measure in FY 2006-07 and 15,446 trees were planted in FY 2006-07. For FY 2008-09, the first year a projection has been established in advance, the goal is 18,000 trees planted.

Changes to Services and Activities

A new initiative, Grey to Green (G2G), is established in FY 2008-09 to protect and restore Portland's rivers and watersheds reflecting City Council's vision reducing the city's stormwater footprint. This initiative invests an additional $50 million over the next five years to ensure Portland continues to grow in a way that protects and enhances watershed health. Eight positions are added, seven in the operating budget and one in the capital budget.

In the first year the city will begin implementing the five-year G2G effort by investing $5 million to construct an additional three acres of ecoroof, eight green streets, 5,000 trees, 750 acres of invasive species management, and purchase 46 acres of high value habitat to preserve watershed and floodplain functions. First year work will also identify funding partnerships for culverts that do not allow fish passage where retrofitting will improve fish habitat and reduce flooding and erosion. By the fifth year, and with other leveraged dollars, projects will result in 43 acres of ecoroof, 920 green streets, 83,000 trees, more than 2,700 acres of invasive species control, 419 acres purchased, and eight replaced culverts.

The CIP Adopted Budget also includes $1.5 million for each year of the five-year CIP to fund watershed enhancements. Priority will be given to projects that leverage other funding sources and/or address multiple watershed health goals.

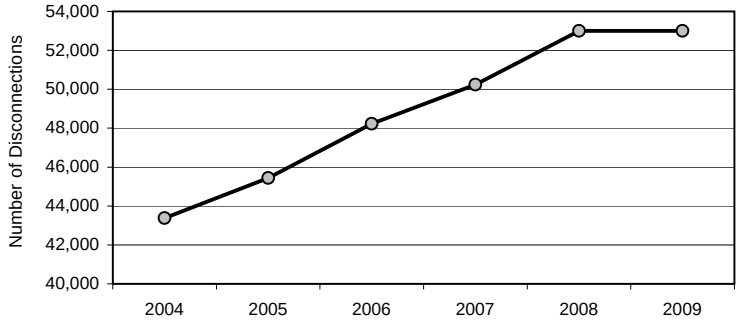
FTE & Financials	Actual FY 2005–06	Actual FY 2006–07	Revised FY 2007–08	Proposed FY 2008–09	Adopted FY 2008–09
FTE	46	47	50	50	56
Expenditures					
Personal Services	3,836,039	4,058,859	4,770,802	5,002,762	5,523,326
External Materials & Services	2,248,063	2,055,899	5,219,825	2,888,360	3,824,375
Internal Materials & Services	540,502	642,543	2,666,825	2,383,834	2,783,834
Capital Outlay	0	0	0	15,000	15,000
Total Expenditures	6,624,604	6,757,301	12,657,452	10,289,956	12,146,535

Performance	Actual FY 2005–06	Actual FY 2006–07	Yr End Est. FY 2007–08	Target FY 2008–09
Workload				
Feet of streambank restored (cumulative)	290,000	293,400	298,400	303,000
Number of individual participants in projects catalyzed or hosted by the Stewardship Program	13,430	16,406	15,000	18,000
Number of trees planted	0	15,446	NA	18,000

Performance Measures

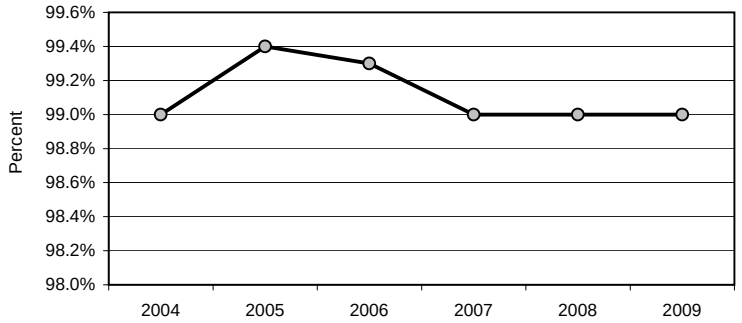
Roof Drain Disconnections

Roof drain disconnections will proceed in accordance with CSO program schedules.



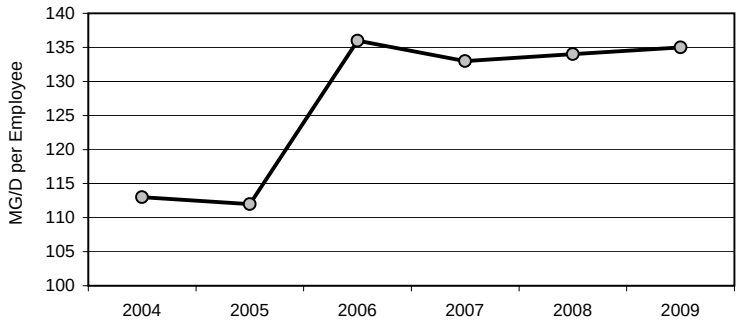
Enforcement Tests

Percent of industrial enforcement tests in full compliance.



Wastewater Processed

Higher rainfall in 2006 caused a significant increase in wastewater processed for the year. Higher ongoing flows are a result of the completion of the Westside CSO Tunnel project. As millions of gallons per day of wastewater processed increases, employees find operating efficiencies.



Bureau of Environmental Services

SUMMARY OF BUREAU BUDGET

	Actual FY 2005–06	Actual FY 2006–07	Revised FY 2007–08	Proposed FY 2008–09	Adopted FY 2008–09
RESOURCES					
External Revenues					
Licenses and Permits	733,870	1,041,882	1,476,562	1,528,784	1,460,000
Service Charges and Fees	198,687,024	225,147,868	206,506,436	221,991,285	223,929,012
State Sources	302,390	103,123	0	0	0
Local Sources	599,033	274,282	1,089,240	753,516	753,516
Bond & Note Sales	1,826,528	6,662,483	581,348	500,000	500,000
Miscellaneous Revenues	2,236,141	2,450,984	1,679,813	1,677,168	1,715,968
Total External Revenues	204,384,986	235,680,622	211,333,399	226,450,753	228,358,496
Internal Revenues					
Other Cash Transfers	154,952,203	190,064,188	210,385,542	203,814,333	207,165,451
Federal Grants Transfers	1,874,419	441,212	2,422,029	997,897	997,897
Interagency Reimbursements	1,793,740	1,687,597	5,960,690	2,286,388	2,646,388
Total Internal Revenues	158,620,362	192,192,997	218,768,261	207,098,618	210,809,736
Beginning Fund Balance	36,799,399	24,485,480	32,602,272	27,900,000	27,900,000
TOTAL RESOURCES	**$ 399,804,747**	**$ 452,359,099**	**$ 462,703,932**	**$ 461,449,371**	**$ 467,068,232**

Note: Discretionary General Fund revenues are those which may be used by City Council for any public purpose. Nondiscretionary revenues are restricted by policy or contractual agreement to the bureaus that generate the revenue.

EXPENDITURES					
Bureau Requirements					
Personal Services	39,479,912	42,170,353	45,844,179	48,541,659	49,291,867
External Materials & Services	48,305,678	49,532,583	49,630,702	44,657,801	45,638,139
Internal Materials & Services	34,750,735	36,466,441	37,029,607	33,410,281	34,292,658
Capital Outlay	108,111,834	136,753,405	163,538,363	152,860,173	155,682,263
Total Bureau Requirements	230,648,159	264,922,782	296,042,851	279,469,914	284,904,927
Fund Requirements					
General Operating Contingency	0	0	21,897,827	32,917,097	32,041,217
General Fund Overhead	2,691,316	3,877,023	4,712,604	5,184,925	5,184,925
Other Cash Transfers	136,321,833	134,212,351	136,102,837	143,722,790	144,782,518
Debt Retirement	5,657,959	2,253,744	3,947,813	154,645	154,645
Ending Fund Balance	24,485,480	47,093,199	0	0	0
Total Fund Requirements	169,156,588	187,436,317	166,661,081	181,979,457	182,163,305
TOTAL EXPENDITURES	**$ 399,804,747**	**$ 452,359,099**	**$ 462,703,932**	**$ 461,449,371**	**$ 467,068,232**
PROGRAMS					
Business Services	18,740,338	20,627,747	14,683,477	14,273,574	14,276,818
Positions	*33.23*	*44.93*	*47.08*	*48.30*	*48.30*
Engineering Services	152,247,908	180,867,925	206,908,221	192,710,541	196,143,711
Positions	*163.48*	*167.57*	*174.05*	*180.80*	*182.80*
Office of the Director	5,568,221	9,389,223	8,217,204	7,696,470	7,838,490
Positions	*15.80*	*16.00*	*19.00*	*20.00*	*21.00*
Pollution Prevention Services	8,041,667	7,863,473	10,557,196	7,984,575	7,984,575
Positions	*70.92*	*72.00*	*74.00*	*74.70*	*74.70*
Wastewater Treatment	39,425,421	39,417,113	43,019,301	46,514,798	46,514,798
Positions	*149.25*	*136.25*	*139.75*	*140.75*	*140.75*
Watershed Services	6,624,604	6,757,301	12,657,452	10,289,956	12,146,535
Positions	*46.30*	*46.75*	*49.75*	*50.00*	*56.00*
TOTAL PROGRAMS	**$ 230,648,159**	**$ 264,922,782**	**$ 296,042,851**	**$ 279,469,914**	**$ 284,904,927**
Positions	***478.98***	***483.50***	***503.63***	***514.55***	***523.55***

This table summarizes Capital Improvement Plan project costs by capital programs.

Bureau Capital Program		Revised	Adopted	Capital Plan				
Project	**Prior Years**	**FY 2007–08**	**FY 2008–09**	**FY 2009–10**	**FY 2010–11**	**FY 2011–12**	**FY 2012–13**	**5–Year Total**
Bureau of Environmental Services								
Combined Sewer Overflow								
Balch Consolidation Conduit	22,469	1,500,000	1,899,000	25,357,000	5,488,000	0	0	32,744,000
CBWTP Primary Treatment Expansion	302,054	4,196,000	3,370,000	50,000	0	0	0	3,420,000
CBWTP WW Headworks	0	0	663,000	4,193,000	4,268,000	1,168,000	0	10,292,000
East Tunnel	30,537,979	97,320,000	12,310,000	12,510,000	10,820,000	3,530,000	0	39,170,000
Eastside CSO System Startup	0	0	0	0	522,000	173,000	0	695,000
ESCSO Construction Contract	0	0	88,690,000	53,890,000	50,580,000	11,970,000	0	205,130,000
ESCSO OCIP Program	922	4,000,000	3,400,000	1,800,000	1,500,000	100,000	0	6,800,000
Lents 1&2 CSO Control	0	860,000	1,423,000	4,894,000	2,508,000	0	0	8,825,000
Portsmouth Force Main	34,837	2,600,000	25,000,000	35,000,000	3,000,000	100,000	0	63,100,000
Sellwood Interceptor Upgrade	139,122	0	238,000	1,804,000	0	0	0	2,042,000
Sellwood Reliever Sewer	285,679	2,317,340	1,409,000	0	0	0	0	1,409,000
Swan Island PS Phase 2	0	0	700,000	4,500,000	2,500,000	0	0	7,700,000
Total Combined Sewer Overflow	31,323,062	112,793,340	139,102,000	143,998,000	81,186,000	17,041,000	0	381,327,000
Maintenance & Reliability								
Ash Creek Sewer Rehab	0	0	1,032,000	0	0	0	0	1,032,000
Beech Essex CP-K	0	0	0	0	0	122,000	647,000	769,000
Bybee Subbasin Relief & Recon	0	0	0	0	0	0	853,000	853,000
Central Balch B	0	0	0	0	0	0	98,000	98,000
East Nicolai	0	0	0	0	0	420,000	2,625,000	3,045,000
Elk Rock Bypass @ RD Sch	0	0	3,000	0	0	0	0	3,000
FABA PS FM: Garden Home	13,679	735,770	250,000	0	0	0	0	250,000
FABA PS FM: Multnomah	13,604	159,677	3,696,000	3,700,000	0	0	0	7,396,000
Fanno/Tryon Maintenance	0	0	0	0	146,000	1,354,000	0	1,500,000
Far North Nicolai	0	0	0	0	391,000	1,691,000	1,419,000	3,501,000
Forest Park Separation	0	0	0	0	0	574,000	3,423,000	3,997,000
Fremont	0	0	0	0	0	0	649,000	649,000
H/S/S Inflow Control	0	435,000	324,000	530,000	588,000	6,000	0	1,448,000
H/S/S Inflow Controls 2	0	0	0	0	97,000	97,000	386,000	580,000
Han/Sch/Gr to 16 HO6	0	0	0	0	0	0	51,000	51,000
Insley Basin Phase III	0	0	0	0	0	0	98,000	98,000
Lents 1&2 Relief & Recon	0	0	0	0	0	0	1,511,000	1,511,000
Lents Xing Plant Estb & Maint	0	0	13,000	13,000	13,000	0	0	39,000
Linnton Residential Sewer Rehab	0	0	0	0	0	0	52,000	52,000
Maintenance Capital-Construction	123,285	207,000	213,000	213,000	213,000	213,000	213,000	1,065,000
Maintenance Capital-Contract	568,249	5,000,000	2,063,000	2,063,000	2,063,000	2,063,000	2,063,000	10,315,000
Mall Transit Rehab	0	0	1,600,000	0	0	0	0	1,600,000
MCC Emergency Projects	0	250,000	258,000	258,000	258,000	258,000	258,000	1,290,000
Nicolai Greenstreets & Pipe Rpl	0	0	0	0	0	476,000	1,013,000	1,489,000
North Tanner	0	0	0	0	0	0	878,000	878,000
NW Neighborhoods BCC #1	0	0	658,000	1,561,000	2,681,000	0	3,000,000	7,900,000
NW Neighborhoods BCC #2	0	0	242,000	417,000	1,796,000	29,000	3,000,000	5,484,000
Oak Basin CP-B	0	3,108,000	10,000,000	2,010,000	0	0	0	12,010,000
Oak Basin CP-C	0	0	0	0	0	85,000	163,000	248,000
Oak Basin CP-C/1	0	183,855	206,000	0	0	0	0	206,000
Oak Basin CP-D	0	0	0	0	0	70,000	110,000	180,000
Oak Basin CP-E	0	0	0	0	52,000	326,000	567,000	945,000
Oak Basin CP-F	0	0	0	10,000	66,000	0	0	76,000
Sandy Storace (SU6)	0	0	0	0	0	0	206,000	206,000
SE 12th & Gideon Recon (04)	0	0	0	0	1,231,000	3,633,000	2,000	4,866,000
SE 26th & Tibbetts Grst (12)	0	0	0	156,000	417,000	86,000	33,000	692,000
SE 28th & Harrison Grst (14)	0	0	0	145,000	567,000	396,000	82,000	1,190,000
SE 34th & Grant Recon	0	0	0	0	7,000	930,000	1,015,000	1,952,000
SE 41st Recon & Grst	0	0	0	0	0	0	39,000	39,000
SE 52nd & Salmon Grst	0	0	160,000	870,000	747,000	93,000	40,000	1,910,000
SE 9th Grst (TGD-02)	0	0	0	0	0	0	105,000	105,000
SE Division Recon & Grst	0	0	0	0	685,000	735,000	6,999,000	8,419,000
SE Division Recon & Grst	0	0	0	75,000	280,000	190,000	60,000	605,000
SE Harrison Grst	0	0	1,177,000	743,000	81,000	30,000	0	2,031,000

This table summarizes Capital Improvement Plan project costs by capital programs.

Bureau Capital Program		Revised	Adopted	Capital Plan				
Project	**Prior Years**	**FY 2007–08**	**FY 2008–09**	**FY 2009–10**	**FY 2010–11**	**FY 2011–12**	**FY 2012–13**	**5–Year Total**
SE Hawthorne Recon Grst	0	0	0	0	0	96,000	1,033,000	1,129,000
SE Powell Recon & Grst	0	0	0	525,000	576,000	5,850,000	41,000	6,992,000
SE Salmon Recon & Grst (26)	0	0	0	0	0	0	30,000	30,000
Sewer Structural Rehab	0	388,920	3,275,000	3,275,000	3,275,000	2,874,000	0	12,699,000
Taggart BCD-TG 3	0	160,000	0	230,000	2,393,000	6,000	0	2,629,000
Taggart D Phase 2	0	0	0	0	0	0	2,000,000	2,000,000
Tryon Sanitary Sewer Project	0	0	0	0	231,000	1,234,000	1,207,000	2,672,000
Total Maintenance & Reliability	718,817	10,628,222	25,170,000	16,794,000	18,854,000	23,937,000	35,969,000	120,724,000
Sewage Treatment Systems								
Ankeny PS Upgrade	0	0	200,000	200,000	1,623,000	2,612,000	5,121,000	9,756,000
CBWTP Digester Expansion	0	1,300,000	3,300,000	11,000,000	9,750,000	2,250,000	0	26,300,000
Pump Station Improvement Program	2,176,311	1,350,000	1,579,000	1,477,000	1,651,000	2,000,000	2,000,000	8,707,000
TCWTP Thickeners & Wet Well Odor	0	0	0	0	0	0	63,000	63,000
Treatment Facilities-Rehab & Modification	2,573,030	1,800,000	1,679,000	1,679,000	1,679,000	1,800,000	1,805,000	8,642,000
Total Sewage Treatment Systems	4,749,341	4,450,000	6,758,000	14,356,000	14,703,000	8,662,000	8,989,000	53,468,000
Surface Water Management								
Boones Ferry Culvert	0	0	0	0	0	0	224,000	224,000
Brownwood	282,360	5,815,000	29,000	29,000	29,000	29,000	29,000	145,000
Columbia Slough Outfalls Predesign	0	0	0	0	0	0	644,000	644,000
Crystal Sprg Culvert Rpl: PH1	0	0	827,000	0	0	0	0	827,000
Fanno Beaverton Hillsdale Hwy	0	0	0	0	0	73,000	514,000	587,000
Fanno/Tryon Ditch to Swale	0	0	0	0	0	25,000	216,000	241,000
Fanno/Tryon Land Acquisition	0	0	100,000	100,000	0	58,000	0	258,000
Fanno/Tryon Outfall	0	0	0	0	0	123,000	554,000	677,000
Fanno/Tryon Stormwater Retro	0	0	0	0	0	67,000	95,000	162,000
Fanno/Tryon WQF 2	0	0	0	0	0	0	31,000	31,000
Freeway Land Co FP Restor	0	0	0	0	0	258,000	937,000	1,195,000
Grey to Green	0	0	3,466,000	5,555,000	6,345,000	6,705,000	7,425,000	29,496,000
Johnson Creek Restoration Prog	4,135,351	600,000	619,000	619,000	619,000	619,000	619,000	3,095,000
Kelley Crk Plant & Monitor	90,964	6,600	7,000	7,000	0	0	0	14,000
Lents Interceptor Crossing	0	0	0	210,000	373,000	1,106,000	10,000	1,699,000
NE 148th WQF	9,254	127,000	48,000	4,282,000	0	0	0	4,330,000
PH1: Oaks B. Culvert Replc	0	0	0	52,000	550,000	2,209,000	3,000	2,814,000
PH2: Oaks B. WCS & Weirs	0	0	0	235,000	547,000	0	0	782,000
PH3: Oaks B. Resrvr & Islan	0	0	0	0	203,000	880,000	2,061,000	3,144,000
S Foster East Lents	0	870,000	870,000	1,737,000	1,603,000	0	0	4,210,000
S Foster- E Lents Phase 2	0	0	0	0	0	0	849,000	849,000
Spring Garden Stream	0	0	0	0	0	50,000	200,000	250,000
Springwater Wetland	0	0	0	0	0	0	413,000	413,000
Stephens Creek Confluence	0	0	104,000	130,000	443,000	27,000	27,000	731,000
Sunderland WQF	0	0	23,000	0	0	0	0	23,000
UIC CAT2 Non-Compliant	0	0	733,000	0	0	0	0	733,000
UIC Improvements CAT2	0	261,000	1,531,000	1,531,000	1,531,000	1,531,000	3,888,000	10,012,000
Watershed Investment Fund	0	0	1,500,000	1,500,000	1,500,000	1,500,000	1,500,000	7,500,000
Wellhead Sump Retrofit	13,015	457,200	385,000	0	0	0	0	385,000
West Lents Flooding	0	0	0	0	0	0	258,000	258,000
Total Surface Water Management	4,530,944	8,136,800	10,242,000	15,987,000	13,743,000	15,260,000	20,497,000	75,729,000
Systems Development								
Bureau of Transportation Interagency	255,692	250,000	258,000	258,000	258,000	258,000	258,000	1,290,000
Drainage Improvement	987,046	25,000	26,000	26,000	26,000	26,000	26,000	130,000
I-205 Light Rail Extension	0	2,845	15,000	8,000	0	0	0	23,000
Lents Sanitary Sewer Extension	187,940	783,000	2,318,000	520,000	0	0	0	2,838,000
Mall Light Rail Extension	15,024	263,741	3,000	2,000	0	0	0	5,000
Party Sewers	0	0	250,000	500,000	750,000	1,000,000	1,000,000	3,500,000
Permit Reimbursement	702,359	40,000	40,000	40,000	40,000	40,000	40,000	200,000
Permits	0	670,000	670,000	670,000	670,000	670,000	670,000	3,350,000
Pleasant Valley Stormwater	0	0	0	0	0	0	500,000	500,000
S Airport Phase IV	674,816	1,502,000	1,769,000	0	0	0	0	1,769,000

This table summarizes Capital Improvement Plan project costs by capital programs.

Bureau Capital Program		Revised	Adopted	Capital Plan				
Project	**Prior Years**	**FY 2007–08**	**FY 2008–09**	**FY 2009–10**	**FY 2010–11**	**FY 2011–12**	**FY 2012–13**	**5–Year Total**
S Airport Phase V	120,989	1,510,000	1,205,000	0	0	0	0	1,205,000
SE 83rd Pump Station	0	947,790	101,000	0	0	0	0	101,000
SE Claybourne & 134th	0	0	0	275,000	142,000	2,085,000	0	2,502,000
SE Foster & 122nd	0	0	45,000	349,000	0	0	0	394,000
Total Systems Development	2,943,866	5,994,376	6,700,000	2,648,000	1,886,000	4,079,000	2,494,000	17,807,000
Total Bureau of Environmental Services	**$ 44,266,030**	**$142,002,738**	**$187,972,000**	**$193,783,000**	**$130,372,000**	**$ 68,979,000**	**$ 67,949,000**	**$649,055,000**

Class	Title	Salary Range		Revised FY 2007–08		Proposed FY 2008–09		Adopted FY 2008–09	
		Minimum	Maximum	No.	Amount	No.	Amount	No.	Amount
0514	Accountant I	35,392	49,381	1.00	49,380	1.00	49,380	1.00	49,380
0515	Accountant II	46,270	56,501	3.00	159,264	3.00	159,264	3.00	159,264
7103	Administrative Assistant	41,906	64,561	4.00	243,758	4.00	248,134	4.00	248,134
7106	Administrative Supervisor I	50,864	67,797	2.00	131,628	2.00	134,277	2.00	134,277
7152	Assistant Program Specialist	41,906	64,561	1.00	63,528	1.00	64,302	1.00	64,302
7140	Assistant to Bureau Director	69,823	93,020	1.00	69,828	1.00	69,828	1.00	69,828
1314	Auto Equip Oper II-Tractor Trailer	40,298	48,525	1.00	48,528	1.00	48,528	1.00	48,528
7628	Biosolids/Reuse Pgm Manager	64,916	87,237	1.00	86,904	1.00	87,128	1.00	87,128
6011	Botanic Specialist I	47,732	60,907	0.00	0	0.00	0	2.00	95,472
6012	Botanic Specialist II	50,237	64,081	6.00	356,784	6.00	359,904	7.00	410,136
7112	Business Operations Manager	69,823	93,020	1.00	92,664	1.00	92,964	1.00	92,964
7110	Business Operations Supervisor	61,909	82,831	2.00	165,024	2.00	165,672	2.00	165,672
7121	Business Systems Analyst	53,411	71,180	1.00	64,252	1.00	66,886	1.00	66,886
6034	CAD Analyst	57,232	73,101	1.00	73,104	1.00	73,104	1.00	73,104
6032	CAD Technician II	47,105	60,114	14.00	785,084	14.00	801,712	14.00	801,712
6033	CAD Technician III	57,232	73,101	5.00	334,960	5.00	348,073	5.00	348,073
7660	Capital Pgm Mgmt & Cntrls Mgr	80,722	107,469	1.00	81,787	1.00	85,142	1.00	85,142
6141	Capital Projects Manager I	57,232	73,101	3.00	172,166	2.00	116,143	2.00	116,143
7656	Capital Projects Manager II	61,909	82,831	1.00	82,593	2.00	143,464	2.00	143,464
7165	CDD Program Coordinator	58,923	78,676	0.50	39,240	0.50	39,336	0.50	39,336
3285	Chemist	46,521	60,114	5.00	280,221	5.00	288,120	5.00	288,120
7653	City Engineer	95,401	136,597	2.00	256,622	2.00	266,681	2.00	266,681
7685	Communications Engineer	61,909	82,831	1.00	79,284	1.00	82,536	1.00	82,536
7202	Community Outreach & Info Asst	41,906	64,561	2.00	108,204	2.00	112,244	2.00	112,244
7203	Community Outreach & Info Rep	50,864	67,797	1.00	65,640	1.00	67,800	1.00	67,800
7135	Contracts Dev & Rev Admin	61,909	82,831	1.00	81,720	1.00	82,557	1.00	82,557
7116	Customer Service Supervisor	58,923	78,676	1.00	71,760	1.00	74,700	1.00	74,700
7630	Data Acquisition & Mgmt Supr	64,916	87,237	1.00	86,988	1.00	87,240	1.00	87,240
7768	Development Services Manager	75,084	99,994	1.00	99,612	1.00	99,996	1.00	99,996
7767	Development Supervisor	58,923	78,676	1.00	65,460	1.00	67,467	1.00	67,467
7564	Electrical/Instrumentation Spvr	64,916	87,237	1.00	76,569	1.00	79,710	1.00	79,710
1453	Electrician	59,842	64,582	6.00	387,504	6.00	387,504	6.00	387,504
1459	Electrician/Instrument Tech	61,659	66,545	6.00	394,356	6.00	394,356	6.00	394,356
6160	Electronic Systems Tech	47,105	60,114	3.00	168,310	3.00	170,708	3.00	170,708
6112	Engineer	73,101	80,534	32.50	2,560,465	34.00	2,691,542	33.00	2,618,438
6110	Engineering Associate	49,423	66,252	6.00	300,312	6.00	310,024	7.00	357,124
6111	Engineering Associate Senior	63,162	73,101	10.50	723,871	12.00	838,759	12.00	838,759
6021	Engineering Technician I	35,162	47,105	1.00	35,890	1.00	37,687	1.00	37,687
6022	Engineering Technician II	47,105	60,114	24.00	1,324,749	26.00	1,436,286	26.00	1,436,286
6023	Engineering Technician III	57,232	73,101	8.00	540,773	9.00	610,310	9.00	610,310
7605	Enviro Svcs Planning Group Mgr	86,715	115,571	1.00	115,128	1.00	115,461	1.00	115,461
7604	Enviro Svcs Planning Mgr	75,084	99,994	1.00	98,316	1.00	99,716	1.00	99,716
7622	Environ Monitor Svcs Group Mgr	86,715	115,571	1.00	101,292	1.00	104,060	1.00	104,060
7608	Environmental Program Coord	56,105	74,813	4.00	274,766	4.00	280,210	5.00	336,310
7609	Environmental Program Manager	61,909	82,831	10.00	822,528	10.00	828,360	11.00	890,268
7607	Environmental Program Spec	50,864	67,797	3.00	186,428	3.00	189,064	3.00	189,064
7040	Environmental Services Dir	120,686	172,949	1.00	153,270	1.00	159,552	1.00	159,552
6053	Environmental Specialist	57,232	73,101	23.50	1,575,243	24.50	1,674,748	28.00	1,878,784
6051	Environmental Technician I	35,162	47,105	3.00	110,808	4.00	151,548	4.00	151,548
6052	Environmental Technician II	47,105	60,114	34.00	1,819,344	34.00	1,873,809	33.00	1,826,709
7614	ESA Program Coord	58,923	78,676	1.00	78,422	1.00	78,672	1.00	78,672
6061	GIS Technician I	35,162	47,105	1.00	47,100	1.00	47,100	1.00	47,100
6062	GIS Technician II	47,105	60,114	3.00	154,746	3.00	162,494	3.00	162,494
6063	GIS Technician III	57,232	73,101	2.00	141,912	2.00	145,347	2.00	145,347
6123	Graphics Designer III	57,232	73,101	1.00	73,104	1.00	73,104	1.00	73,104
6055	Hydrogeologist	63,162	80,534	1.00	82,476	1.00	82,476	1.00	82,476
1803	Indust Main Millwright	48,316	52,492	29.00	1,520,064	29.00	1,522,152	29.00	1,522,152
1520	Industrial Machinist	48,316	52,492	1.00	52,488	1.00	52,488	1.00	52,488
1445	Industrial Painter	47,815	51,949	1.00	51,948	1.00	51,948	1.00	51,948
2543	Info System Analyst III	58,923	78,676	1.00	78,672	1.00	78,672	1.00	78,672
7509	Information Systems Manager	75,084	99,994	1.00	99,612	1.00	99,996	1.00	99,996
3260	Instrument Technician	59,842	64,582	8.00	511,932	8.00	511,932	8.00	511,932
3261	Instrument Technician Lead	62,849	67,818	1.00	67,824	1.00	67,824	1.00	67,824
7176	Insurance Specialist	50,864	67,797	1.00	52,296	1.00	53,720	1.00	53,720
3280	Laboratory Assistant	39,609	50,028	7.00	345,583	7.00	348,966	7.00	348,966
7624	Laboratory Manager	69,823	93,020	1.00	92,694	1.00	93,024	1.00	93,024
3288	Laboratory Production Spec	48,817	63,120	1.00	63,120	1.00	63,120	1.00	63,120
3286	Laboratory Quality Assurance Spl	48,817	63,120	1.00	58,456	1.00	61,944	1.00	61,944
7580	Maintenance Planner/Scheduler	50,864	67,797	4.00	254,116	4.00	259,148	4.00	259,148

Class	Title	Salary Range Minimum	Salary Range Maximum	Revised FY 2007–08 No.	Revised FY 2007–08 Amount	Proposed FY 2008–09 No.	Proposed FY 2008–09 Amount	Adopted FY 2008–09 No.	Adopted FY 2008–09 Amount
7130	Management Assistant	41,906	64,561	2.00	121,020	2.00	125,076	2.00	125,076
6072	Materials Testing Tech II	47,105	60,114	4.00	216,768	4.00	221,592	4.00	221,592
6073	Materials Testing Tech IV	57,232	73,101	1.00	73,104	1.00	73,104	1.00	73,104
3284	Microbiologist	46,521	60,114	1.00	60,120	1.00	60,120	1.00	60,120
0102	Office Support Spec II	29,295	40,862	8.00	308,747	8.00	312,364	8.00	312,364
0104	Office Support Spec III	37,480	48,233	3.00	139,297	3.00	141,479	3.00	141,479
7641	Portland Harbor Superfund Adm	80,722	107,469	1.00	107,192	1.00	107,472	1.00	107,472
7652	Principal Engineer	80,722	107,469	4.00	408,504	4.00	415,629	4.00	415,629
7378	Principal Financial Analyst	69,823	93,020	4.00	356,484	4.00	359,856	4.00	359,856
2545	Principal Info System Analyst	69,823	93,020	4.00	372,096	4.00	372,096	4.00	372,096
7133	Principal Management Analyst	69,823	93,020	1.00	83,400	1.00	85,965	1.00	85,965
7154	Program Coordinator	56,105	74,813	4.00	239,656	4.00	246,336	5.00	311,796
7156	Program Manager	58,923	78,676	4.00	293,808	4.00	296,719	4.00	296,719
7153	Program Specialist	50,864	67,797	2.00	120,492	2.00	123,788	2.00	123,788
7678	Prop Acquisition & Svcs Mgr	58,923	78,676	1.00	78,372	1.00	78,672	1.00	78,672
7640	Prtlnd Harbor Sprfund Tech Mgr	69,823	93,020	1.00	92,664	1.00	92,904	1.00	92,904
7208	Public Information Manager	64,916	87,237	1.00	72,072	1.00	75,030	1.00	75,030
7206	Public Information Officer	58,923	78,676	1.00	78,372	1.00	78,672	1.00	78,672
3151	Public Works Insp Senior	57,357	67,589	11.00	743,424	11.00	743,424	11.00	743,424
7663	Public Works Inspection Mgr	61,909	82,831	1.00	82,512	1.00	82,782	1.00	82,782
3150	Public Works Inspector	52,889	60,427	15.00	902,481	15.00	906,480	15.00	906,480
7553	Public Works Supervisor II	53,411	71,180	2.00	115,320	2.00	118,866	2.00	118,866
0112	Records Specialist	29,295	40,862	1.00	32,388	1.00	35,574	1.00	35,574
7185	Risk Specialist	50,864	67,797	1.00	67,536	1.00	67,756	1.00	67,756
7193	Safety & Risk Officer II	64,916	87,237	1.00	86,904	1.00	87,240	1.00	87,240
7102	Senior Admin Specialist	39,025	60,072	4.00	193,631	4.00	200,984	4.00	200,984
7113	Senior Business Operations Mgr	86,715	115,571	1.00	113,364	1.00	115,572	1.00	115,572
7122	Senior Business Sys Analyst	58,923	78,676	1.00	70,194	1.00	73,072	1.00	73,072
7386	Senior Economist	61,909	82,831	1.00	67,536	1.00	70,077	1.00	70,077
7650	Senior Engineer	64,916	87,237	12.00	1,024,579	11.00	951,028	11.00	951,028
7610	Senior Environmental Prgm Mgr	69,823	93,020	4.00	340,455	4.00	344,672	4.00	344,672
7132	Senior Management Analyst	58,923	78,676	1.00	78,447	1.00	78,672	1.00	78,672
7158	Senior Progam Manager	69,823	93,020	2.00	173,784	2.00	177,071	2.00	177,071
7186	Senior Risk Specialist	56,105	74,813	2.00	149,317	2.00	149,616	2.00	149,616
7620	Source Reduction & Control Mgr	75,084	99,994	1.00	99,612	1.00	99,932	1.00	99,932
7204	Sr Comm Outreach & Info Rep	56,105	74,813	2.00	130,701	2.00	130,908	2.00	130,908
0406	Storekeeper/Acq Specialist II	40,090	49,026	3.00	145,350	3.00	147,096	3.00	147,096
0408	Storekeeper/Acq Specialist III	45,289	56,313	1.00	50,166	1.00	54,956	1.00	54,956
7161	Stores System Supervisor II	53,411	71,180	1.00	58,569	1.00	60,972	1.00	60,972
7651	Supervising Engineer	69,823	93,020	9.00	831,438	10.00	924,012	11.00	993,840
7270	Training & Development Analyst	53,411	71,180	1.00	61,608	1.00	64,140	1.00	64,140
7635	Wastewater Collections Sys Mgr	80,722	107,469	1.00	98,098	1.00	102,119	1.00	102,119
7637	Wastewater Operations Grp Mgr	86,715	115,571	1.00	115,276	1.00	115,572	1.00	115,572
1815	Wastewater Operations Spec	49,841	56,397	5.00	275,026	5.00	282,000	5.00	282,000
1811	Wastewater Operator II	43,410	52,492	39.00	2,009,462	40.00	2,065,242	40.00	2,065,242
7633	Wastewater Treatment Manager	80,722	107,469	1.00	107,052	1.00	107,402	1.00	107,402
7632	Wastewater Treatment O&M Supr	61,909	82,831	4.00	297,153	4.00	301,977	4.00	301,977
7600	Water Resource Program Manager	61,909	82,831	4.00	309,991	5.00	378,411	5.00	378,411
7617	Watershed Reveg Pgm Mngr	61,909	82,831	1.00	67,020	1.00	69,768	1.00	69,768
7616	Watershed Reveg Prog Supr	56,105	74,813	1.00	74,532	1.00	74,739	1.00	74,739
TOTAL FULL-TIME POSITIONS				**493.00**	**$ 32,087,568**	**503.00**	**$ 33,119,129**	**512.50**	**$ 33,649,061**
7103	Administrative Assistant	41,906	64,561	0.50	32,200	0.50	32,280	0.50	32,280
7120	Asst Business Systems Analyst	41,906	64,561	0.75	48,240	0.75	48,405	0.75	48,405
6012	Botanic Specialist II	50,237	64,081	0.80	51,264	0.80	51,264	0.80	51,264
6111	Engineering Associate Senior	63,162	73,101	0.00	0	0.50	31,584	0.50	31,584
6022	Engineering Technician II	47,105	60,114	0.50	24,813	0.50	26,076	0.50	26,076
6052	Environmental Technician II	47,105	60,114	1.00	47,100	1.00	47,100	0.50	23,556
7154	Program Coordinator	56,105	74,813	0.50	37,069	0.50	37,404	0.50	37,404
TOTAL PART-TIME POSITIONS				**4.05**	**$ 240,686**	**4.55**	**$ 274,113**	**4.05**	**$ 250,569**
0514	Accountant I	35,392	49,381	1.50	58,719	2.00	89,535	2.00	89,535
7202	Community Outreach & Info Asst	41,906	64,561	1.00	52,690	1.00	54,852	1.00	54,852
6110	Engineering Associate	49,423	66,252	0.75	37,071	1.00	51,092	1.00	51,092
6053	Environmental Specialist	57,232	73,101	1.00	63,168	1.00	66,252	1.00	66,252
0104	Office Support Spec III	37,480	48,233	1.00	39,571	1.00	43,213	1.00	43,213

Class	Title	Salary Range Minimum	Salary Range Maximum	Revised FY 2007–08 No.	Revised FY 2007–08 Amount	Proposed FY 2008–09 No.	Proposed FY 2008–09 Amount	Adopted FY 2008–09 No.	Adopted FY 2008–09 Amount
7122	Senior Business Sys Analyst	58,923	78,676	0.58	34,370	1.00	58,920	1.00	58,920
6134	Senior City Planner	57,232	73,101	0.75	42,921	0.00	0	0.00	0
TOTAL LIMITED TERM POSITIONS				**6.58**	**$ 328,510**	**7.00**	**$ 363,864**	**7.00**	**$ 363,864**

BUDGET DECISIONS

This chart shows decisions and adjustments made during the budget process. The chart begins with an estimate of the bureau's Current Appropriation Level (CAL) requirements.

ACTION	AMOUNT Ongoing	AMOUNT One-Time	AMOUNT Total Package	FTE	DECISION
FY 2008-09	279,048,286	0	279,048,286	505.05	FY 2008-09 Current Appropriation Level
CAL Adjustments					
	0	224,096	224,096	0.00	OMF IA adjustments
Mayor's Proposed Budget Decisions					
	638,272	350,000	988,272	2.00	Systems Operations/CSO
	85,044	0	85,044	6.50	Development assistance & asset mgmt
	87,108	0	87,108	1.00	Superfund Program - Fund 161
	(962,892)	0	(962,892)	0.00	Superfund Program - Fund 151
Approved Budget Additions and Reductions					
	5,241,751	0	5,241,751	8.00	Grey to Green
	91,464	0	91,464	1.00	Nonconforming (party-line) sewers
	(114,882)	0	(114,882)	(1.00)	Fund 161 - Move 1.0 FTE from Superfund program
	114,882	0	114,882	1.00	Fund 151 - Add 1.0 FTE to Superfund program
Adopted Budget Additions and Reductions					
	0	38,800	38,800	0.00	Trustee account technical adjustment
	(114,477)	0	(114,477)	0.00	Reduce outside legal services
	114,477	0	114,477	0.00	Increase City Attorney interagency
	15,000	0	15,000	0.00	Fund BES Diversity Committee
	0	100,000	100,000	0.00	Portland Comprehensive Plan professional svcs
	9,918	0	9,918	0.00	Reclass two positions
	(61,920)	0	(61,920)	0.00	Reclass & move one position from Ops to CIP
	5,143,745	712,896	5,856,641	18.50	Total FY 2008-09 Decision Packages
			$ 284,904,927	**523.55**	Total Adopted Budget


CITY OF PORTLAND, OREGON
1851

APPENDIX B

Manhole Inspection Work Process

Manhole Inspection Process Summary

All Manholes (MHs) Need To Be Inspected

Type of Inspection

Routine CCTV Inspection (TVI) -- inspect the upstream manhole (UPS) MH on the line segment.
Special TVI -- inspect both the UPS and downstream (DWN) MHs.
Investigations -- inspect all MH's you enter or are investigating

Data Verification

Every MH requires an inspection. Paved over or buried MHs need to be turned in for raising and a follow-up inspection. This is to be noted on the inspection W/O and turned in for follow-up activities. You will be provided MH inspection work orders (W/Os) so that you can verify that the inventory information is correct. You will mark up the W/O as required for inventory corrections. Verify the address, location, MH type, surface cover, depth, and wall material. Until Hansen is working for the MH inspections, staple the W/O to the MH Inspection sheet and turn in at the end of the day. *(Once Hansen is working, the W/O will be closed by the crew in Fieldworks. Enter only the date and crew information, no time will be charged to the W/O. If the information is complete and correct the W/O can be discarded, if corrections are needed the W/O will be turned in at the end of the day.)*

The Inspection

After existing data verification, use a bright spotlight to visually inspect all components of every MH.

MHs that are inspected from (Tved from) -- look down the MH from the street with the camera and videotape the MH as the camera is lowered into the MH that you are Tving from. The gas tester needs to be used to monitor the atmosphere in the MH you are Tving from or making an entry into and the readings recorded as part of the inspection.

MH's that are inspected through (Tved through) -- stop and do a thorough inspection of the MH using the main line camera, also use a spotlight and visually inspect all components of the MH and the gas tester to monitor the atmosphere in the MH. If the MH has no defects this will complete the inspection. If defects are noted a clear videotape picture of the defect is required from either inside of the MH while Tving through or use a top roller and video tape as the camera is lowered into the MH.

You will complete a paper report to record your observations at each inspection. The report will include each component of the MH and the defect codes that pertain to each component. The cone and wall observations used are to record information differently for concrete or for brick MHs. (*Once Hansen is working, the inspection data will be entered into Hansen into the Nodal Asset Inspection. Components are" Observation" and Clock position is "Observation Position" in Hansen).*

Defect Code Definitions

- Observation Codes (these are the physical components of the MH)
  CVR - Cover, the MH cover
  RSR – Riser Ring, the MH riser ring between the cover and casting
  CST - Casting, the MH casting or frame
  RNG - Rings, the grade rings between the casting and cone
  CCO – Cone - Concrete, the cone section or flattop
  CBR – Cone – Brick, the cone section or flattop
  WLC – Wall - Concrete, the wall section of the MH
  WLB – Wall – Brick, the wall section of the MH
  BCH – Bench, the bench section of the MH
  INV – Invert, the MH invert
  PI – Pipe In, pipe into the MH
  PO – Pipe Out, pipe out of the MH
  SUR – Surcharge, include the depth from top of the MH down to the surcharge line in comments
  GTR – Gas Tester, record any readings other than normal in comments

- Observation Degree/Severity (these are the MH defect codes for the cover, riser ring, and casting)
  A – Satisfactory
  C – Cracked
  B – Broken
  W – Worn need to replace

- Debris (use comments to record amount or additional information as needed)
  A – No debris
  G – Grease
  D – Dirt
  V – Vandalism
  C – Concrete
  O – Other

- Defect codes (defect codes for ring, cone, wall, bench, invert, Pipe IN, and Pipe OUT)
  A – Satisfactory
  DA – Deterioration Light
  DB – Deterioration Medium
  DC - Deterioration Heavy
  HA – Hole Small
  HB- Hole Medium
  HC – Hole Large
  CA – Cracks Light
  CB – Cracks Medium
  CC – Cracks Severe
  IA – I & I Light
  IB – I & I Medium
  IC – I & I Heavy
  RA – Roots Light
  RB – Roots Medium
  RC – Roots Heavy

- Defect codes for Brick MHs
  BRA – Missing Mortar
  BRB – Loose Bricks
  BRC – Missing Bricks

APPENDIX C

Manhole Inspection Form

MH Inspection

rev 2/08/06

MH number | Date | Crew | Weather

Check the overall condition of all components of the MH and circle the condition / defect code letter. The clock position is to be used to record the position of the pipe and / or defect, 12:00 is true North. The pipe inspection is used to record the condition of the tap, the patchwork around the tap and the pipe at the tap. Use the comments box to further describe the problem, problem location, pipe type, pipe size, etc.

Components	**Condition / Defect codes for the components below**				**Comments**
Cover **CVR**	**A** -satisfactory	**C** -cracked	**B** –broken	**W** –worn needs replacing	
Riser Ring **RSR**	**A** -satisfactory	**C** -cracked	**B** –broken	**W** –worn needs replacing	
Casting **CST**	**A** -satisfactory	**C** -cracked	**B** –broken	**W** –worn needs replacing	
Grade Ring **RNG**	**A** -satisfactory	**C** -cracked	**B** –broken	**W** –worn needs replacing	
Surcharge **SUR**	**A** - satisfactory	**SUR –**signs of surcharge, note measurement in comments			

Debris Record amount & additional information about Debris in comments **Comments**

DEB **N** – no deb. **G** - grease **D** - dirt **V** - vandalism **CO -** concrete **O** - other

Gas tester readings Normal readings are A, Any other readings are U - If Not Normal record actual Readings

GTR **A -** satisfactory **U** - unsatisfactory **LEL** **O2** **H2S** **CO**

Condition / Defect codes for the components below

Deterioration Concrete MH's – C / CO

Good Cond.	Det Concrete	Hole	Cracks	I/I	Roots
A –satisfactory	**DA** –light	**HA** –small	**CA** –light	**IA** –light	**RA** –light
	DB –medium	**HB** –medium	**CB** –medium	**IB** –medium	**RB** –medium
	DC –heavy	**HC** –large	**CC** –severe	**IC** –heavy	**RC** –heavy

Deterioration Brick MH's –B / BR

Det Brick
BRA – Missing Mortar
BRB – Loose Brick
BRC – Missing Brick

Components	**Clock**	**Condition / Defect codes**														**Comments**
Cone concrete **CCO**		A	DA	DB	DC	HA	HB	HC	CA	CB	CC	IA	IB	IC	RA	RB	RC	
Cone brick **CBR**		A	BRA	BRB	BRC	HA	HB	HC	CA	CB	CC	IA	IB	IC	RA	RB	RC	
Wall concrete **WLC**		A	DA	DB	DC	HA	HB	HC	CA	CB	CC	IA	IB	IC	RA	RB	RC	
Wall brick **WLB**		A	BRA	BRB	BRC	HA	HB	HC	CA	CB	CC	IA	IB	IC	RA	RB	RC	
Bench **BCH**		A	DA	DB	DC	HA	HB	HC	CA	CB	CC	IA	IB	IC	RA	RB	RC	
Invert **INV**		A	DA	DB	DC	HA	HB	HC	CA	CB	CC	IA	IB	IC	RA	RB	RC	
Pipe out **PO**		A	DA	DB	DC	HA	HB	HC	CA	CB	CC	IA	IB	IC	RA	RB	RC	
Pipe out **PO**		A	DA	DB	DC	HA	HB	HC	CA	CB	CC	IA	IB	IC	RA	RB	RC	
Pipe out **PO**		A	DA	DB	DC	HA	HB	HC	CA	CB	CC	IA	IB	IC	RA	RB	RC	

Pipe In on back

Condition / Defect codes for the component below

Good Cond.	Deterioration	Hole	Cracks	I/I	Roots
A –satisfactory	**DA** –light	**HA** –small	**CA** –light	**IA** –light	**RA** –light
	DB –medium	**HB** –medium	**CB** –medium	**IB** –medium	**RB** –medium
	DC –heavy	**HC** –large	**CC** –severe	**IC** –heavy	**RC** –heavy

Components	**Clock**	**Condition / Defect codes**																		**Comments**
Pipe In **PI**		A	DA	DB	DC	HA	HB	HC	CA	CB	CC	IA	IB	IC	RA	RB	RC			
Pipe In **PI**		A	DA	DB	DC	HA	HB	HC	CA	CB	CC	IA	IB	IC	RA	RB	RC			
Pipe In **PI**		A	DA	DB	DC	HA	HB	HC	CA	CB	CC	IA	IB	IC	RA	RB	RC			
Pipe In **PI**		A	DA	DB	DC	HA	HB	HC	CA	CB	CC	IA	IB	IC	RA	RB	RC			
Pipe In **PI**		A	DA	DB	DC	HA	HB	HC	CA	CB	CC	IA	IB	IC	RA	RB	RC			
Pipe In **PI**		A	DA	DB	DC	HA	HB	HC	CA	CB	CC	IA	IB	IC	RA	RB	RC			
Pipe In **PI**		A	DA	DB	DC	HA	HB	HC	CA	CB	CC	IA	IB	IC	RA	RB	RC			
Pipe In **PI**		A	DA	DB	DC	HA	HB	HC	CA	CB	CC	IA	IB	IC	RA	RB	RC			
Pipe In **PI**		A	DA	DB	DC	HA	HB	HC	CA	CB	CC	IA	IB	IC	RA	RB	RC			
Pipe In **PI**		A	DA	DB	DC	HA	HB	HC	CA	CB	CC	IA	IB	IC	RA	RB	RC			
Pipe In **PI**		A	DA	DB	DC	HA	HB	HC	CA	CB	CC	IA	IB	IC	RA	RB	RC			
Pipe In **PI**		A	DA	DB	DC	HA	HB	HC	CA	CB	CC	IA	IB	IC	RA	RB	RC			
Pipe In **PI**		A	DA	DB	DC	HA	HB	HC	CA	CB	CC	IA	IB	IC	RA	RB	RC			