FY 2020

CITY OF PORTLAND | BUREAU OF ENVIRONMENTAL SERVICES

Annual CSO and CMOM Report

Environmental Services
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Annual CSO and CMOM Report - FY 2020

September 2020

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Portland, Oregon

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CERTIFICATION

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Amanda Haney
NPDES Duly Authorized Representative
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Glossary

AGCA. Accelerated Grease Cleaning Area

BOD. Biochemical Oxygen Demand

CBWTP. Columbia Boulevard Wastewater Treatment Plant

CCTV. Closed-circuit Television

CEPT. Chemically Enhanced Primary Treatment

CIP. Capital Improvement Program

CMMS. Computerized Maintenance Management System

CMOM. Capacity, Management, Operation, and Maintenance

COOP. Continuity of Operations Plan

CSCC. Columbia Slough Consolidation Conduit

CSO. Combined Sewer Overflow, especially as it pertains to discharge events. Note that during the CSO Program's implementation, "CSO's" were being captured into the new facilities such as the Willamette CSO Tunnels and the CSCC. Technically, CSOs are no longer being "captured" after the implementation completed—rather, the water that used to produce those events is now controlled within the augmented combined sewer system, and the term *CSO* is limited once again to discharges from the combined system to receiving waters.

CSS. Combined Sewer System

DEQ. Oregon's Department of Environmental Quality

DMR. Discharge Monitoring Report

DO. Dissolved Oxygen

EPA. Environmental Protection Agency

EMC. Event Mean Concentration

EWWPT. Enhanced Wet Weather Primary Treatment

FM. Force Main

FOG. Fats, Oils, and Grease

FY. Fiscal Year (FY 2020 is July 1, 2019, through June 30, 2020)

I&I. Inflow and Infiltration

IPS. Influent Pump Station

MAO. Mutual Agreement and Order

MGD. Million Gallons per Day

MG. Million Gallons

NFAA. No Feasible Alternatives Analysis

NMC. Nine Minimum Controls

NPDES. National Pollution Discharge Elimination System. This report addresses NPDES permit #101505.

PIO. Public Information Officer

RDII. Rainfall Derived (also, Dependent) Inflow and Infiltration

SICSO. Swan Island CSO Pump Station

SPCR. Spill Protection and Citizen Response

SRRP. Sewer Release Response Plan

SSO. Sanitary Sewer Overflow

Summer Season. Defined in NPDES permit #101505 as May 1 to October 31.

SWMM. Stormwater Management Manual

TCWTP. Tryon Creek Wastewater Treatment Plant

TSS. Total Suspended Solids

Winter Season. Defined in NPDES permit #101505 as November 1 to April 30

Section 1 Introduction

The Annual CSO and CMOM Report for fiscal year 2020 (FY 2020: July 1, 2019, through June 30, 2020) provides a comprehensive review of Portland's integrated combined sewer overflow (CSO) system and the Capacity, Management, Operation, and Maintenance (CMOM) Program during FY 2020. This report provides updates to the previous report submitted for FY 2019.

1.1 Major Changes from FY 2019 Report

Reflecting the updated Columbia Boulevard Wastewater Treatment Plant (CBWTP) National Pollution Discharge Elimination System (NPDES) permit #101505, effective July 1, 2020, Schedule D, Condition 1, this report now includes the City's Annual Inflow and Infiltration Report in Section 7.

1.2 Programs

CSO Program. The City of Portland (City) completed its CSO long-term control plan implementation in 2011. The City is currently proceeding with implementing its *Post-2011 Combined Sewer Overflow Facilities Plan*, published in 2010. This plan looked at ways to cost-effectively exceed the level of control specified in the 1994 Amended Stipulation and Final Order agreement with Oregon's Environmental Quality Commission. This additional work is necessary to handle the pressure on the combined sewer system (CSS) facilities' capabilities to control CSOs due to increased population and development.

CMOM Program. Over several years, the City of Portland has implemented a CMOM program to reduce the likelihood of sewer releases by improving the overall reliability of the sanitary and combined sewer collection systems. The *CMOM Program Report* that was submitted to DEQ on June 28, 2013, explains BES's strategies and activities for the development, reinvestment, operation, and maintenance of the system. The report was developed to comply with Condition NPDES permit #101505, Schedule D, Condition 3.b.

The CMOM program specifically addresses proper operation and regular maintenance of the collection system (Nine Minimum Controls, or NMC, #1). The City's wastewater collection system includes main lines, trunk lines, interceptors, pump stations, and force mains. The City is generally responsible for service laterals from the sewer main up to the curb line, while the building or private sewer laterals extending behind the curb are the responsibility of the property owner. Portland's sewer collection system consists of a network of 2,640 miles of collection system piping (1,006 miles of sanitary sewer including force mains, 913 miles of combined sewer, and 721 miles of sewer laterals) and 41,155 sewer manholes.

The system also maintains two wastewater treatment plants and 98 pump stations. There are 95 City-owned and operated pump stations, 3 pump stations owned by other public agencies that are operated and maintained by the City under satellite or easement agreements, and 10 privately-owned septic tank effluent pumping systems that are maintained by the City under agreements with the property owners.

This annual update for FY 2020 provides a review of CMOM program actions and key performance indicators, and an evaluation of the effectiveness of BES's risk-based asset management approach to collection system operation and maintenance.

1.3 Summary of CSO and CMOM Performance

1.3.1 CSO Program Achievements

FY 2020 was a year with below average total rainfall depth, with very few intense periods of rainfall. An average of 33.2 inches fell over the combined service area. Normally, 36-43 inches falls over the city in any given year. Only one CSO was recorded, which met the permit's requirements for storm return periods during CSO events.

There was no exceedance for either of the maximum 7-day effluent limits for the plant for the CBWTP. For FY 2020, maximum 7-day concentrations were 24 mg/L for BOD and 25 mg/L for TSS; 45 mg/L is the permitted effluent limitation. There was also no exceedance for either of the maximum 30-day limits: 20 mg/L for BOD and 22 mg/L for TSS were calculated, and 30 mg/L is the permitted limitation.

The Wet Weather Treatment Facility (WWTF) with Chemically Enhanced Primary Treatment (CEPT) continues to operate well, contributing to the plant meeting the minimum average monthly percent removal efficiencies indicated in the permit (85% efficiency during the summer—May 1 to October 31—and 65% efficiency during the winter—November 1 to April 30—for both BOD and TSS).

Low rainfall led to the second lowest volume of flow captured by the Willamette and Columbia Slough storage facilities since the facilities became fully operable: 3.9

billion gallons. Operators managed the integrated collection system to treat 65% of this volume through the secondary system, with 35% treated through the WWTF. There were 37 events in which flows were sent through the WWTF. The average WWTF event lasted 9 hours and discharged 37 million gallons from the WWTF. During the events, the average flow rate treated by the dry weather/secondary system was 111 MGD, slightly exceeding the 110 MGD minimum required in the NPDES permit.

1.3.2 CMOM Program Achievements

Portland's CMOM program was designed to ensure that components of the collection system are cleaned and inspected at the right frequency and that preventive maintenance and repairs are performed to cost-effectively reduce the number of sewer releases, extend the useful life of the City's sewer infrastructure, and properly manage collection system operations. CMOM program accomplishments in FY 2020 include:

- Inspection of 0.85 million feet (160 miles) of sewer pipe, or about 8% of the mainline sewer system
- Cleaning of 1.2 million feet (229 miles) of sewer pipe, or about 12% of the mainline sewer system
- Completion of mainline sewer maintenance repairs on 8,092 feet of pipe; 36% of the repairs were in response to collection system problems
- Repair of 670 service laterals totaling about 8,566 feet of pipe; 35% of those repairs were in response to discovered problems
- Treatment of nearly 232,946 feet (44 miles) of sewer pipe for roots using chemical root foaming
- Completion of 444 inspections of manholes considered to be at greatest risk of failure (Tier 2—see Section 3.1.5).
- Completion of 17 Capital Improvement Program (CIP) projects repairing and rehabilitating portions of the sanitary and combined collection system during the 2019 calendar year, resulting in an estimated risk reduction of $31.4

million. Maintenance activity on mainlines and service laterals also resulted in an estimated risk reduction of $5.4 million.[1]

The number of sewer releases from the City-maintained sanitary and combined sewers decreased slightly in FY 2020. The number of sewer releases per 100 miles of sewer was 6.6 in FY 2020, which fell short of BES's target of 5.0 or fewer releases per 100 miles.

Sewer emergency response crews arrived on site within the City's 2-hour response time target 98% of the time during FY 2020.

[1] These numbers are reported on a calendar year basis due to reporting lag times.

Section 2 Integrated CSO System Performance for FY 2020

The integrated CSO system consists of the combined sewer collection system; the CSO collection, storage, and pumping system; and the CBWTP treatment system. This section reports on the performance of the overall integrated CSO system during FY 2020.

2.1 Rainfall Patterns for the Past Fiscal Year

FY 2020 was a below average rainfall year for the City of Portland. The area-weighted average rainfall for the Willamette CSO area measured 33.2 inches over the year, 90% of the average annual rainfall of 37 inches for Portland.

During this period, one summer storm generated a CSO discharge after exceeding the 3-year summer design storm:

- August 10, 2019 – Summer CSO event

No winter storms generated a CSO discharge. Three winter storms were large enough to have caused a permitted CSO, although no CSO occurred. CSOs were avoided for the following events:

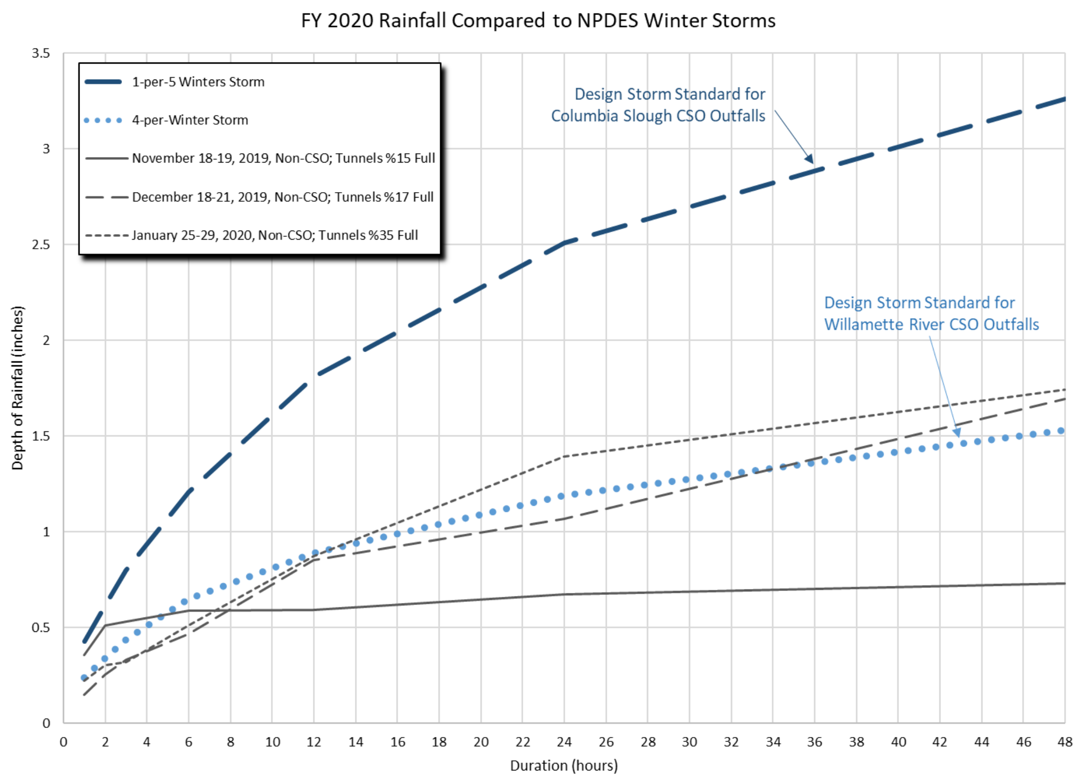
- November 18-19, 2019 – Winter storm event
- December 18-21, 2019 – Winter storm event
- January 25-29, 2020 – Winter storm event

The summer storm of August 10, 2019, consisted of an extremely heavy thunderstorm that passed over the northern parts of the city. The rainfall event lasted for about 1.5 hours and resulted in a CSO discharge only from OF24. Rainfall at the nearby Shipyard Pump Station #82 exceeded the 10-year design storm for all durations between 15 minutes and 12 hours, and the 3-year design storm for the 24-hour duration. The rainfall intensity also exceeded the 100-year storm for durations between 5 minutes and 3 hours. In the Willamette CSO area, the average rainfall did not exceed the 3-year design storm for any duration.

2.1.1 Winter Storm Review

The three storms that exceeded the 4-per-winter NPDES Permit design depths are shown graphically in Figure 1 below. This graph is a “Depth-Duration” chart that displays the maximum depth of rainfall that occurred for the range of storm durations, from 1-hour to 48- hours. The observed rainfall events are compared to the two NPDES Winter Design Storms (4-per-winter and 5-year winter) shown with blue-tinted dashed lines. The three storms that exceeded the 4-per-winter design storm but did not result in CSOs are shown in grey. Details for the rainfall for the winter rainfall events is provided in Table 1 below.

Figure 1 CSO winter storms compared to NPDES winter storms



Details for the winter rainfall events are provided in Table 1 below.

Table 1 Winter storm comparisons

Storm	Duration (hours)						Notes
	1	3	6	12	24	48	
Willamette River Winter Design Storm (inches)							
4-per-Winter Design Storm	0.24	0.44	0.65	0.89	1.19	1.53	
Columbia Slough Winter Design Storm (inches)							
5 Year Winter Design Storm	0.43	0.80	1.21	1.81	2.51	3.26	
FY 2020 Winter Storms - Average Rainfall over Willamette CSO Basin (inches)							
November 18-19, 2019	0.36	0.53	0.59	0.59	0.67	0.73	Exceeds 4-per-winter design storm for 1 and 3 hour durations. No CSO event.
December 18-21, 2019	0.15	0.33	0.47	0.85	1.07	1.70	Exceeds 4-per-winter design storm for 48 hour duration. No CSO event.
January 25-29, 2020	0.22	0.32	0.51	0.88	1.39	1.74	Exceeds 4-per-winter design storm for 24 and 48 hour durations. No CSO event.

2.1.2 Summer Storms Review

One storm exceeded the NPDES Permit 3-year Summer Storm and resulted in a CSO discharge. The storm is shown graphically in Figure 2 below. This graph is a “Depth-Duration” chart that displays the maximum depth of rainfall that occurred for the range of storm duration, from 1-hour to 24-hours. The rainfall event is shown as a solid red line. The two comparison Summer Design Storms (3-year summer and 10-year summer) are shown with blue-tinted dashed lines. Table 2 provides rainfall details for this event. The storm of August 10, 2019, was locally intense but did not exceed the design storm when averaged over the entire Willamette CSO area.

Figure 2 Rainfall compared to NPDES summer storms

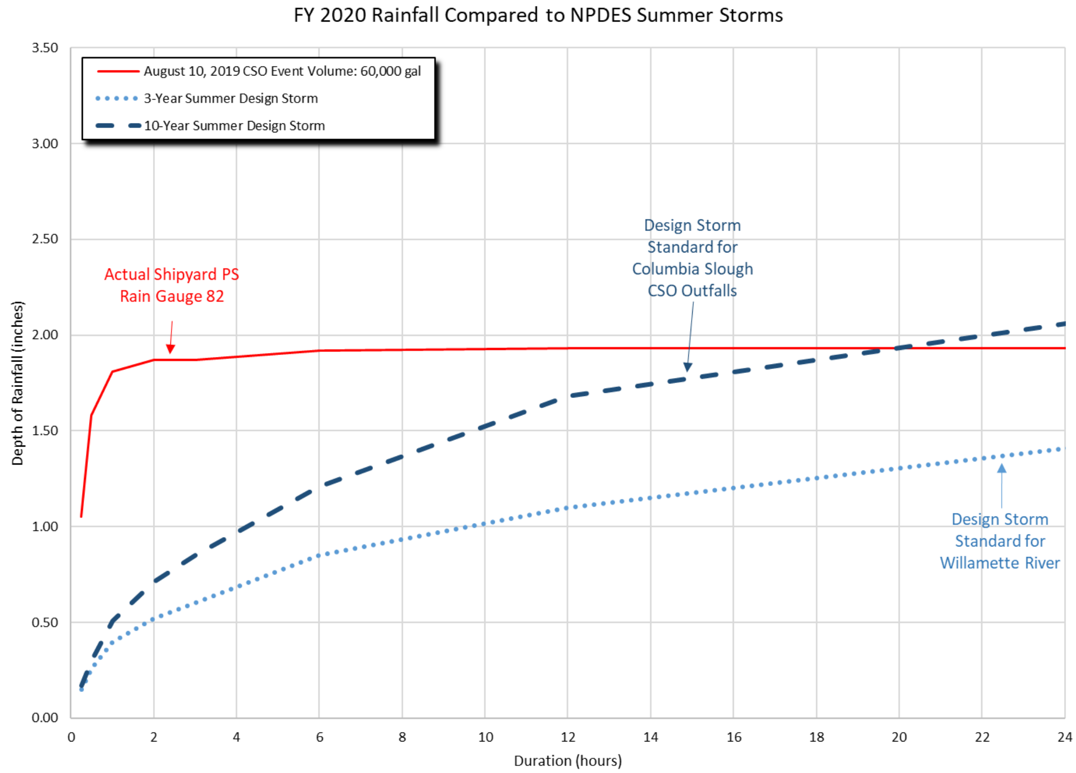


Table 2 Summer storm comparisons

Storm	Duration (min)		Duration (hours)						Notes
	15	30	1	3	6	12	24	48	
Willamette River Summer Design Storm (inches)									
3-Year Summer Design Storm	0.15	0.26	0.40	0.60	0.85	1.10	1.41	2.12	
Columbia Slough Summer Design Storm (inches)									
10-Year Summer Design Storm	0.17	0.30	0.48	0.85	1.25	1.68	2.06	3.15	
FY 2020 Summer Storms - Average Rainfall over Willamette CSO Basin (inches)									
August 9-10, 2019	0.03	0.04	0.06	0.08	0.11	0.12	0.13	0.19	
FY 2020 Summer Storms - Rainfall at Shipyard Pump Station Rain Gauge #82 (inches)									
August 10, 2019	1.05	1.58	1.81	1.87	1.92	1.93	1.93	1.93	Exceeds 10-year summer design storm for durations from 15 minutes to 12 hours, and 3-year summer design storm for 24 hour duration.

2.2 CSO Discharges into the Willamette River and Columbia Slough

2.2.1 Discharge Events

In FY 2020, there was one summer CSO discharge event to the Willamette River and none to the Columbia Slough. Please consult the compliance letter submitted to DEQ for details on the circumstances and validation of this event as allowed by the NPDES permit for CBWTP.

- **August 10, 2019.** 0.060 MG (60,000 gallons) discharged over a total of 23 minutes from the Linnton OF24 outfall. The storm that led to the overflow was caused primarily by extremely heavy rainfall from thunderstorms that developed across the northern tier of the city. Rainfall at the nearest gauge reached 100-year design storm levels for durations from 5 minutes to 3 hours.

The entire historical record of CSOs discharged from the City's CSO facilities is provided in Appendix A.

2.2.1.1 How Well Were CSO Events Controlled?

System rainfall was below average during the reporting period. The system only experienced one summer overflow out of a total 59 distinct storm events. Approximately 1,895 MG were stored in the CSO tunnels during these events.

Total CSO discharge for the year was only 0.060 MG from the Willamette CSO system, which was less than 0.002% of the wet weather volume handled by the combined and sanitary collection systems. This equates to more than 99.9% volume control, exceeding the 94% level of control expected from the Willamette CSO system.

2.2.1.2 Were Wet Weather Flows Maximized to the Plant?

There was only one very small overflow from a single outfall at the periphery of the combined area. The rest of the wet weather flow captured by the collection system was delivered to the treatment plant.

2.2.1.3 Was System Storage Maximized?

All flows leading to the CSO storage tunnels were captured and delivered to the plant during FY 2020. The only overflow that occurred was due to rainfall that overwhelmed a local system. Tunnel storage levels peaked at 35% of their capacity during all events. For non-CSO sized storms, tunnel storage levels did not exceed more than 16% of their capacity.

2.2.2 Dry Weather Overflow Events

No dry weather overflow events from the combined system outfalls were recorded in FY 2020.

2.2.3 Control of Floatables and Debris

Most outfalls have floatables controlled by the storage tunnels and overflow structure configurations. City maintenance crews inspect and clean bar screens for the remaining overflow structures. Other bar screens are cleaned when CSOs are discharged through them, but no such discharges occurred in FY 2020.

Linnton (OF24), the only CSO discharge that occurred in FY 2020, is not hydraulically connected to the tunnel system nor does it have a bar screen for floatables. Linnton has a siphon trap similar to catch basins that retain floatables in the overflow structure manhole. When the water level subsides, trapped debris is transported by gravity flow back to the Linnton Pump Station and then to the treatment plant.

2.3 Wet Weather Treatment Performance and Effluent Quality

2.3.1 CSO Facilities Operations

The CSO System configuration experienced no major changes in FY 2020. The system experienced a below average year in terms of total rainfall, having received about 33.2 inches. Influent volumes to CBWTP were reduced by 5% from FY 2019, and the percentage treated by the secondary system increased slightly to 94%. The percentage of captured CSO treated via secondary increased from 57% in FY 2019 to 65% in FY 2020. For FY 2020, Overall BOD and TSS removal efficiencies continue to exceed 90% at the plant's two outfalls, OF001 and OF003. Both BOD and TSS removal efficiencies dropped marginally from last year's 95%, reaching a high of 94%. These numbers indicate that the plant reliably exhibits satisfactory performance year over year.

Table 3 shows the total volume pumped from the two major CSO pump stations in the system, Swan Island CSO pump station (SICSO), which drains the Willamette River system, and the Influent Pump Station (IPS), which drains the Columbia Slough system. About 3,900 MG of captured CSO reached the plant (see Table 5). About 3,287 MG of tunnel flow was pumped, representing 84% of that captured volume.

Table 3 Volume pumped from CSO tunnels

CSO Tunnel Pumping	Total Pumped Volume (MG)
Swan Island CSO Pump Station	
Force main 1 (Peninsular Dry Weather)	1,568
Force main 2 (Peninsular Wet Weather)	156
Force main 3 (Portsmouth Wet Weather)	870
Swan Island CSO Pump Station Subtotal	2,594
Influent Pump Station Total	693
Total Volume Pumped to CBWTP from Tunnels	3,287

2.3.2 Annual Treatment Performance for CBWTP

2.3.2.1 Annual CSO Treatment Characteristics

Key parameters for the treatment system's annual performance are derived from the NPDES permit for the CBWTP, which specifies seasonal percent removal efficiencies at the plant[2]. Table 4 summarizes this aspect, and the minimum efficiency limits for BOD and TSS were met for both seasons. Annual percent removal efficiencies for the wet weather system were based on Portland's No Feasible Alternative Analysis (NFAA) report, submitted to DEQ in 2009.

Table 4 Combined OF001/003 minimum average 30-day removal efficiency

System	Season	Efficiency Target	BOD Removal Efficiency	TSS Removal Efficiency
Combined OF001/OF003	Summer	85% or more	92%	93%
	Winter	65% or more	87%	88%

[2] NPDES Permit #101505 Schedule A, Condition 1.a.i (Table A1)

Table 5 summarizes the main annual treatment performance measures for the CBWTP systems. This table provides a comparison of the performance against the average year model and permit values. Key parameters are in blue text. For FY 2020:

- Secondary treatment achieved 111 MGD, 1% higher than the 110 MGD minimum required by the permit after FY 2014. Secondary flows were lowered significantly at times during FY 2020 to protect the plant's treatment capacity due to the following conditions:
    - Outbreak of filamentous bacteria in January 2020
    - Record-setting January 2020 rain amounts and treatment with hypochlorite considered too risky after the outbreak; protection of the biomass was prioritized while chlorinating the return activated sludge (RAS). Secondary flows were reduced as part of these measures. This happened through March 2020.
- Percent of wet weather volume treated through secondary exceeded the model target level (65% compared to 54%).

When evaluating wet weather treatment, BES asks three questions:

- **Were wet weather flows treated to a high quality?** Yes. This is according to the observed numbers in comparison with permit requirements. See Section 2.3.2.2.
- **Were flows to secondary treatment maximized?** Yes. See Section 2.2.1.2. Flows were maximized cautiously to protect treatment capacity, given the filamentous bacteria outbreak that occurred in January 2020.
- **Were effluent limits achieved at OF001 and OF003?** Yes. Table 4, Table 6, and Table 7 indicate that the system is producing the proper annual treatment results.

Examination of the annual results indicates that the CSO system operations strategy continues to sustain desired performance and can handle various conditions throughout the year, even with large changes in rainfall amounts year over year. Portland's use of CEPT continues to keep BOD and TSS discharges from the Wet Weather Treatment Facility at consistently reduced levels.

Table 5 CBWTP annual treatment performance data[3]

CBWTP Annual Treatment Performance											
Annual Treatment Characteristics	**Avg Yr Model/ Permit**	*No CEPT* **FY 2012**	*With CEPT* **FY 2013**	*With CEPT* **FY 2014**	*With CEPT* **FY 2015**	*With CEPT* **FY 2016**	*With CEPT* **FY 2017**	*With CEPT* **FY 2018**	*With CEPT* **FY 2019**	*With CEPT* **FY 2020**	**Trend**
Annual Rainfall Depth (inches/year)	37	46.8	40.2	40.0	33.9	53.4	59.5	37.6	30.5	33.2	
Flows to CBWTP											
Influent Volume (MG/Year)	28,300	28,800	26,625	26,549	25,760	30,665	33,544	26,844	23,763	22,528	
Dry Weather Sanitary Volume (MG/Year)	22,100	20,200	19,496	19,471	19,609	20,179	22,358	21,635	20,037	18,624	
Captured CSO Flow - Volume (MG/Year)	6,200	8,600	7,129	7,078	6,151	10,485	11,187	5,209	3,726	3,904	
Total Volume Treated Thru Secondary (MG)	25,443	25,662	24,197	24,002	23,221	26,301	28,765	24,947	22,173	21,176	
% of Plant Flow Treated Through Secondary System	90%	89%	91%	90%	90%	86%	86%	93%	93%	94%	
WWTF (EWWPT) Events											
Rate to DW / Secondary During EWWPT (MGD)	110*	120	126	112	112	117	119	117	118	111	
Number of Events / Year	32	29	22	27	27	39	41	37	35	37	
WWTF Volume / Year	2,857	3,138	2,429	2,546	2,540	4,363	4,779	1,897	1,590	1,352	
Amount of Captured CSO Treated via Secondary (%)	54%	64%	66%	64%	59%	58%	57%	64%	57%	65%	
Duration of WWTF Events (hours)	919	706	668	904	591	1241	1333	602	387	338	
Calendar Days of WWTF Discharges (days)	---	66	50	65	51	92	99	65	52	53	
Blended Effluent (OF001 & 003) Treatment											
BOD Loading (pounds / year)	2,510,000	4,000,000	2,957,783	3,472,307	4,176,834	3,871,106	4,554,872	3,046,966	2,786,772	2,925,285	
BOD Average Concentration (mg/l)	27	16.6	13.3	15.7	19.4	15.1	16.3	13.6	14.1	15.6	
Total Plant BOD Removal Efficiency (%)	---	93%	95%	94%	93%	93%	92%	95%	95%	94%	
TSS Loading (pounds / year)	2,440,000	5,050,000	3,585,748	4,055,479	4,413,412	4,910,264	5,248,619	3,738,873	3,237,714	2,962,541	
TSS Average Concentration (mg/l)	27	21.0	16.1	18.3	20.5	19.2	18.8	16.7	16.3	15.8	
Total Plant TSS Removal Efficiency (%)	---	92%	94%	93%	92%	92%	92%	94%	95%	94%	

3* The permit average for "Rate to DW/Secondary During EWWPT (MGD)" rose to 110 MGD from 100 MGD in 2014 (applicable for FY 2015 and onwards).

2.3.2.2 CBWTP Max-Month and Peak-Week Treatment Performance

Table 6 provides maximum 30-day treatment results for BOD and TSS for the fiscal year. While the permit requires reporting of maximums on a calendar month basis, this evaluation uses a more stringent moving 30-day window analysis. Maximum 30-day concentrations and loadings for both BOD and TSS at the outfalls for the maximum 30-day period year-round (ending February 2, 2020, for BOD5 and January 29, 2020, for TSS) were below the permit's maximum monthly limits.

Table 6 Wet weather max-month (30-days maximum solids loading) treatment performance

Parameters	Maximum Monthly (30-Day)						
	Avg Concentration During Maximum Month for Mass Loading			Mass Loading			
	Permit Monthly (mg/l)	Max 30-Day (mg/l)	30-Day Avg Flow (MGD)	Permit Monthly (lbs/day)	Max 30-Day (lbs/day)	Date of 30th Day	Notes
Columbia Boulevard WWTP - Outfalls 001 and 003 Effluent Quality							
BOD5	30	20	114	45,000	19,372	2-Feb-20	9.2 inches of rain in 30d
TSS	30	22	110	45,000	19,956	29-Jan-20	

Table 7 provides peak 7-day treatment results for BOD and TSS for the fiscal year. Similar to the previous discussion for the 30-day analysis, the permit requires reporting of peaks on a calendar week (Sunday to Saturday) basis. However, this analysis uses a more stringent moving 7-day window. Concentrations and loading for both 7-day BOD and TSS for the maximum period year-round (ending January 20, 2020) were below the permit's maximum weekly limits.

Table 7 Wet weather peak-week (7-days maximum solids loading) treatment performance – winter season

Parameters	Peak Week (7-Day)						
	Avg Concentration During Peak Mass Loading Week			Mass Loading			
	Permit Weekly (mg/l)	Max 7-Day (mg/l)	7-Day Avg Flow (MG)	Permit Weekly (lbs/day)	Max 7-Day (lbs/day)	Date of 7th Day	Notes
Columbia Boulevard WWTP - Outfalls 001 and 003 Effluent Quality							
BOD5	45	24	165	118,800	33,048	29-Jan-20	3.7 inches of rain in 7d
TSS	45	25	165	118,800	34,875	29-Jan-20	

2.4 Wet Weather Treatment Performance for Enhanced Wet Weather Primary Treatment (EWWPT) Events

Wet weather treatment performance is best evaluated by examining the events in which the WWTF discharged treated effluent. These events are called Enhanced Wet Weather Primary Treatment (EWWPT) events to underscore that the wet weather flow diverted from the secondary system receives CEPT.

An EWWPT event begins when the WWTF starts discharging effluent, and ends after either of the following:

- WWTF discharge has ended AND the plant inflow remains below 80 MGD for 6 hours OR
- WWTF discharge has ended and no subsequent WWTF discharge occurs for 48 hours. This condition may occur when low level rainfall keeps plant inflows up, but Operations is able to send all inflows through secondary treatment.

Table 8 summarizes the WWTF events for FY 2020 (required by the permit, Schedule A, Condition 2.f). The full, detailed list of the events is in Table 9.

Table 8 Enhanced wet weather primary treatment events summary

		CBWTP Flows			WWTF Flows				WWTF Effluent			
	Events	Avg Influent During EWWPT (MGD)	Influent at Onset of EWWPT (MGD)	Avg Secondary Flow During EWWPT (MGD)	Avg WWTF Flow (MGD)	WWTF Discharge Volume (MG)	Duration of WWTF Discharge (hrs)	Calendar Days WWTF Discharge Occurred	Event BOD Load Discharged (lbs)	Event TSS Load Discharged (lbs)	EMC BOD (mg/L)	EMC TSS (mg/L)
Total	**37**					**1,352**	**338**	**53**	**554,304**	**455,651**		
Over all events		**202**	**135**	**111**	**80**	**37**	**9.1**	**1.4**	**14,981**	**12,315**	**59**	**48**
Statistic type		Avg	Min	Avg	Avg	Avg	Avg	Avg	Avg	Avg	Avg	Avg

Key aspects for this year's WWTF performance include:

- Volume of EWWPT events was 1.4 billion gallons. This is only about 6% of the total volume received at the CBWTP for the year (22.5 billion gallons; see Table 5).
- An EWWPT event was in progress during the year for about 338 hours (4% of the year) and 53 calendar days (about 1 day per week). Treatment through the WWTF continues to be highly intermittent.
- The minimum flow to the CBWTP at the onset of any EWWPT event throughout the year was 135 MGD, above the minimum 110 MGD required

in the permit (Schedule A, Condition 2.d). Usage of the WWTF was always under conditions when flows to the plant exceeded 110 MGD (Schedule A, Condition 2.g).

- The average mean concentrations (EMC) for BOD of 59 mg/L and 48 mg/L for TSS is a decrease in performance over FY 2019 but is comparable to other dry years and with expected values for the CEPT system.
- Operators maintained an average of 111 MGD of flow through secondary treatment during EWWPT events, compared to the permit requirement of 110 MGD. This rate is 55% of the average flow rate reaching the plant during an EWWPT event (202 MGD).
- EWWPT events lasted just over 9 hours on average and typically occurred across 1.4 days. This is representative of a similar dry year experienced in FY 2019.

Table 9 Enhanced wet weather treatment events - detailed information

		CBWTP Flows			WWTF Flows				WWTF Effluent			
Date & Time Bypass Event Started	Event #	Avg Influent During EWWPT (MGD)	Influent at Onset of EWWPT (MGD)	Avg Secondary Flow During EWWPT (MGD)	Avg WWTF Flow (MGD)	WWTF Discharge Volume (MG)	Duration of WWTF Discharge (hrs)	Calendar Days WWTF Discharge Occurred	Event BOD Load Discharged (lbs)	Event TSS Load Discharged (lbs)	EMC BOD (mg/L)	EMC TSS (mg/L)
9/10/19 0:15	1	170	218	109	54	7	3.3	1	4,607	3,256	75	53
9/15/19 10:30	2	223	239	110	106	42	9.5	1	24,437	21,134	70	61
9/16/19 21:15	3	168	192	111	36	3	1.8	1	1,889	667	86	30
9/17/19 22:15	4	190	250	108	73	56	18.3	2	26,336	16,733	57	36
9/29/19 10:15	5	183	214	110	62	8	3.3	1	2,357	1,456	34	21
10/16/19 15:30	6	137	197	106	25	8	8.0	1	6,389	4,878	92	70
10/17/19 21:00	7	226	285	118	96	11	2.8	1	5,159	2,623	56	29
10/19/19 5:30	8	239	304	113	109	18	4.0	1	3,603	2,350	24	15
11/19/19 6:15	9	242	289	121	114	44	9.3	1	18,417	20,522	50	56
12/7/19 4:45	10	177	135	107	62	40	15.5	1	15,347	13,679	46	41
12/10/19 17:15	11	193	257	112	71	19	6.5	2	14,508	9,512	91	60
12/11/19 22:45	12	207	232	110	89	32	8.5	1	12,697	8,393	48	32
12/19/19 13:00	13	266	281	114	139	48	8.3	1	28,755	21,566	72	54
12/20/19 10:00	14	249	231	116	123	141	27.5	2	46,997	40,355	40	34
12/22/19 21:45	15	159	178	109	37	2	1.5	1	1,146	1,052	59	54
12/31/19 21:45	16	214	246	109	97	15	3.8	2	8,515	4,220	68	33
1/4/20 3:15	17	166	230	106	50	7	3.5	1	1,946	1,632	32	27
1/6/20 8:15	18	178	235	109	62	26	10.0	1	7,008	4,818	32	22
1/7/20 21:30	19	222	283	110	103	30	7.0	3	10,522	7,412	42	29
1/10/20 17:45	20	194	185	110	75	103	33.0	3	39,046	27,104	45	32
1/13/20 15:15	21	146	171	108	30	3	2.3	1	2,843	3,652	121	156
1/15/20 20:00	22	172	232	110	46	16	8.5	2	8,925	4,713	65	35
1/18/20 7:00	23	245	280	110	127	45	8.5	1	12,156	12,156	32	32
1/21/20 16:30	24	199	250	108	82	9	2.8	1	5,153	2,335	66	30
1/23/20 13:30	25	275	255	114	152	112	17.8	2	26,138	24,922	28	27
1/26/20 2:45	26	276	253	117	150	308	49.3	4	114,272	101,024	44	39
1/30/20 21:30	27	216	249	110	87	9	2.5	2	5,563	5,965	73	79
2/1/20 11:15	28	193	169	110	49	8	4.0	1	2,257	1,461	33	21
2/15/20 12:15	29	222	240	111	100	56	13.5	2	23,293	14,530	50	31
3/6/20 19:45	30	146	148	110	28	2	1.5	1	986	1,571	69	110
3/14/20 6:00	31	161	236	108	45	27	14.8	1	19,135	10,703	84	47
3/30/20 7:45	32	207	248	119	77	18	5.5	2	5,634	4,799	38	33
4/25/20 11:45	33	208	249	109	91	7	1.8	1	3,084	2,748	55	49
5/2/20 15:30	34	175	219	109	57	12	5.3	1	6,160	3,901	60	38
5/30/20 19:45	35	131	157	110	11	2	3.8	1	962	987	68	70
6/6/20 16:45	36	248	266	113	127	27	5.0	1	25,578	29,276	115	132
6/9/20 3:45	37	239	279	113	118	29	6.0	1	12,485	17,547	51	72
Total	**37**					**1,352**	**338**	**53**	**554,304**	**455,651**		
Over all events		**202**	**135**	**111**	**80**	**37**	**9**	**1.4**	**14,981**	**12,315**	**59**	**48**
Statistic type		Avg	Min	Avg	Avg	Avg	Avg	Avg	Avg	Avg	Avg	Avg

BOD and TSS removal efficiencies compared to event volume are shown in Figure 3 (BOD) and Figure 4 (TSS). Small events tend to have higher BOD and TSS concentrations, and larger volume events have lower concentrations. The CEPT system achieves better than 50% BOD and 70% TSS removal efficiencies on an overall basis. Most wet weather events this fiscal year placed above the target efficiencies, as seen on the charts. These sporadic events with lower efficiencies tend to happen during drier years.

Figure 3 WWTF BOD removal efficiency vs. event volume

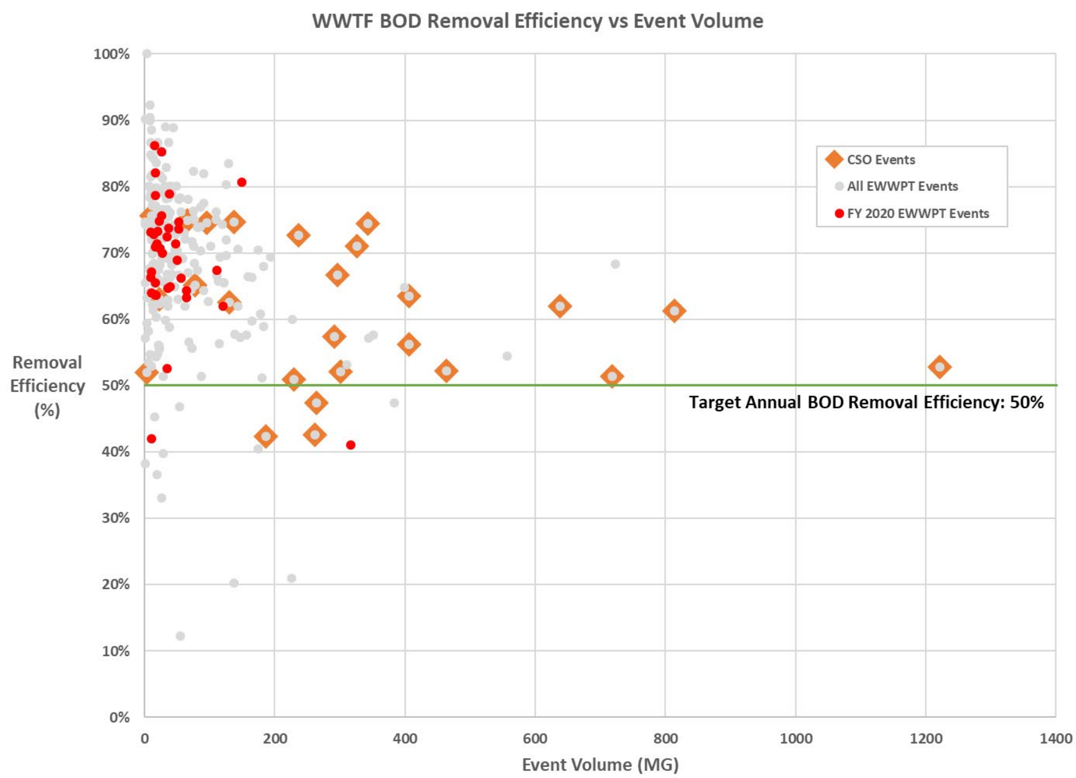
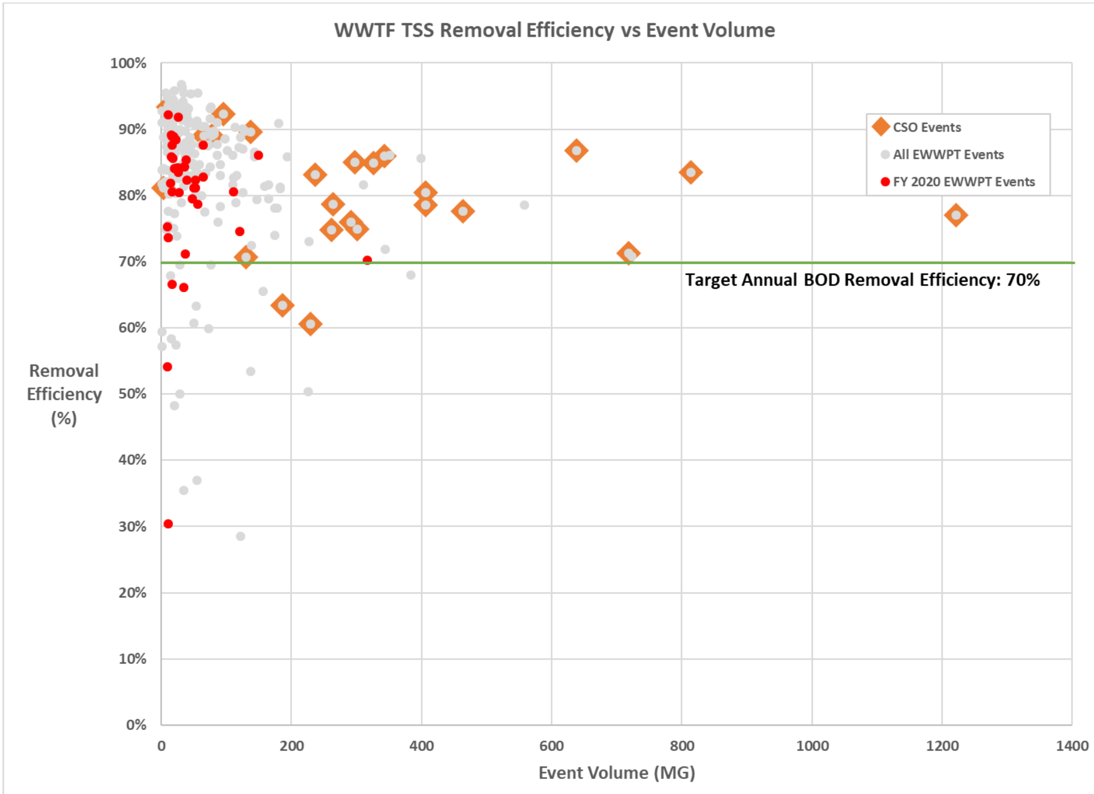


Figure 4 WWTF TSS removal efficiency vs. event volume



2.5 CSO System and Water Quality Monitoring

2.5.1 CSO Discharge Sampling

Portland completed the permit requirements of obtaining 5 event samples for the 2011-2016 permit cycle (8 total were retrieved: 2 near Outfall 46, and the remaining near Outfall 36). Portland had elected to continue to retrieve one sample per year as part of its Post-Construction Monitoring Program while the permit was in administrative extension. For FY 2020, like FY 2019, there were no large-scale Willamette River CSO system overflows, and therefore no event samples were obtained. For details about this sampling program, please see Section 8.2 of the *FY 2015 Annual CSO and CMOM Program Report*. Portland will collect five additional samples in the next five years as part of its Post-Construction Monitoring Program, required by the current permit effective July 1, 2020.

2.5.2 Willamette River Instream Water Quality Sampling

Figure 5 through Figure 9 show the water quality trends along the Portland stretch of the Willamette River for five parameters: zinc, lead, copper, TSS, and *E. coli*. These metals and bacteria parameters are the pollutants of concern for Portland CSO discharges. The sampling results indicate continued similar performance as FY 2019.

Figure 5 Willamette River monitoring results for zinc

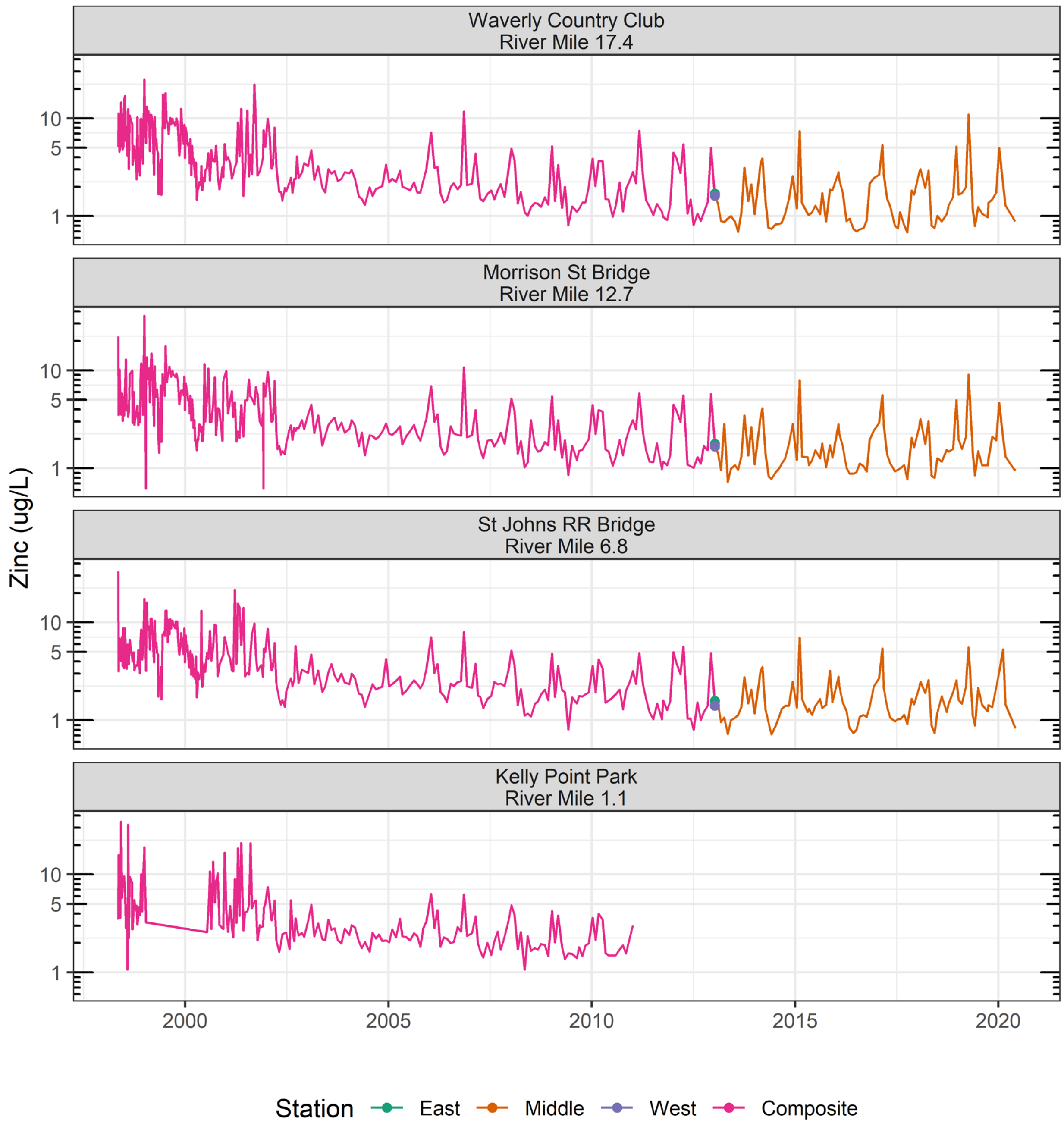


Figure 6 Willamette River monitoring results for lead

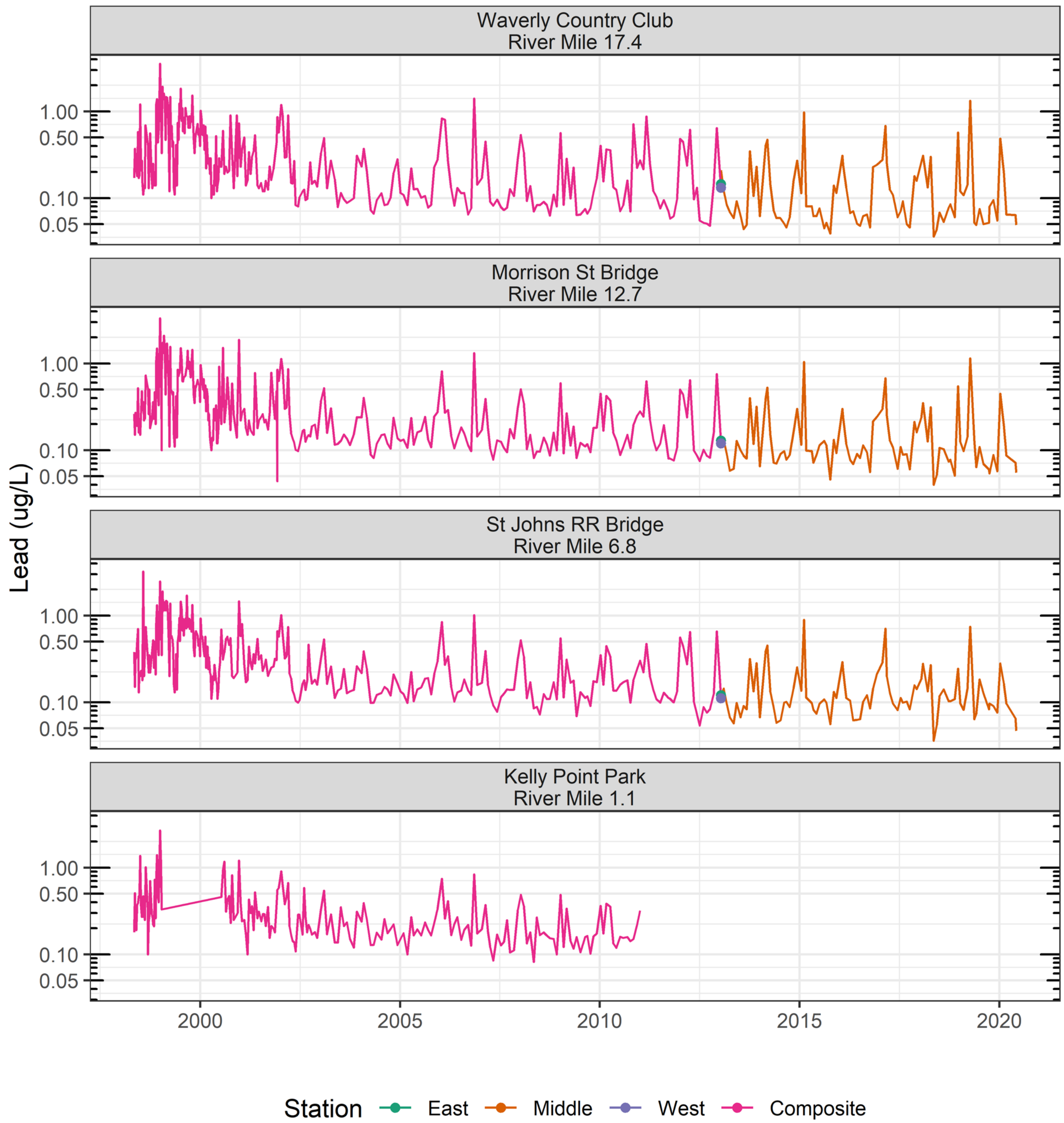


Figure 7 Willamette River monitoring results for copper

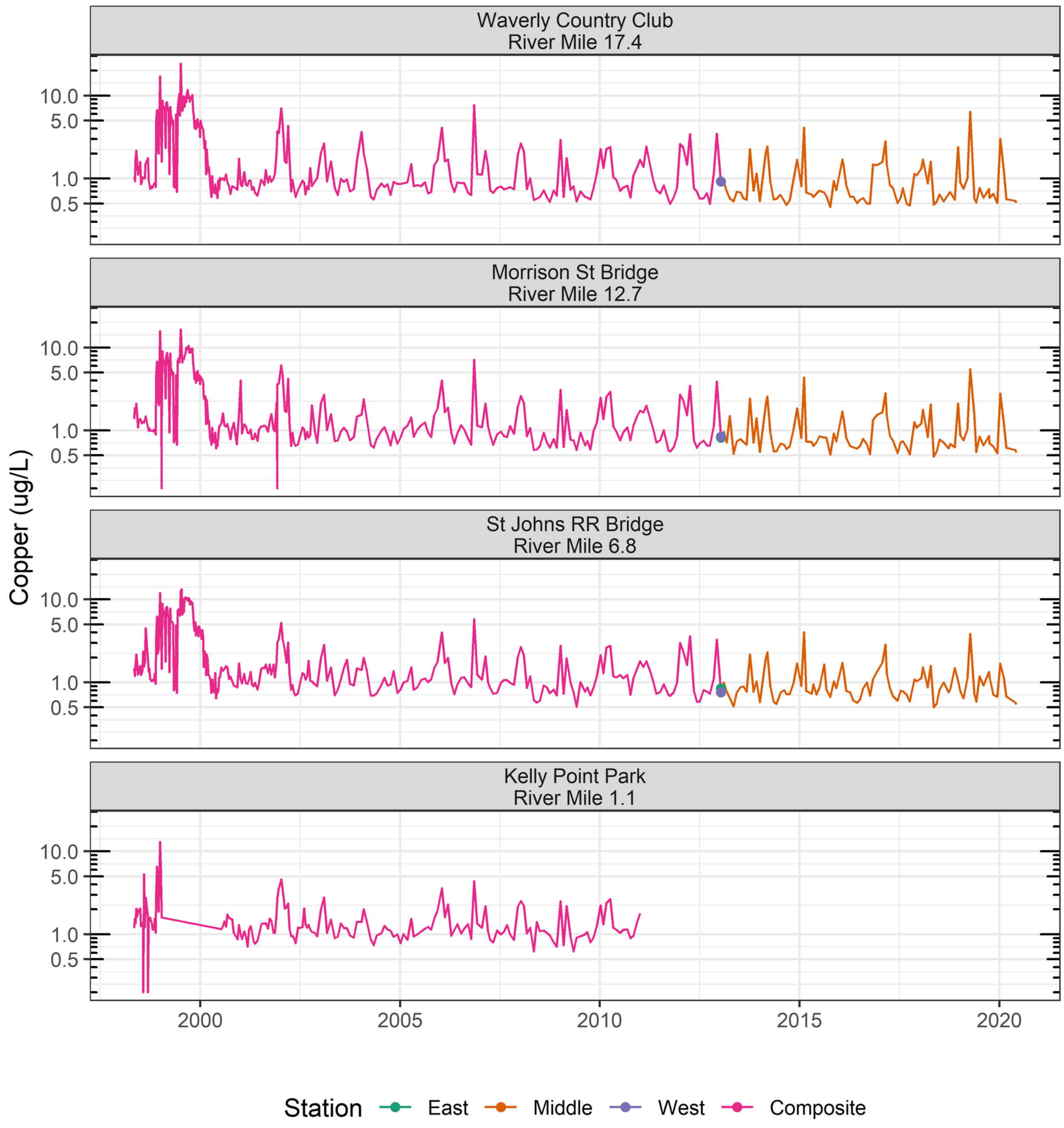


Figure 8 Willamette River monitoring results for TSS

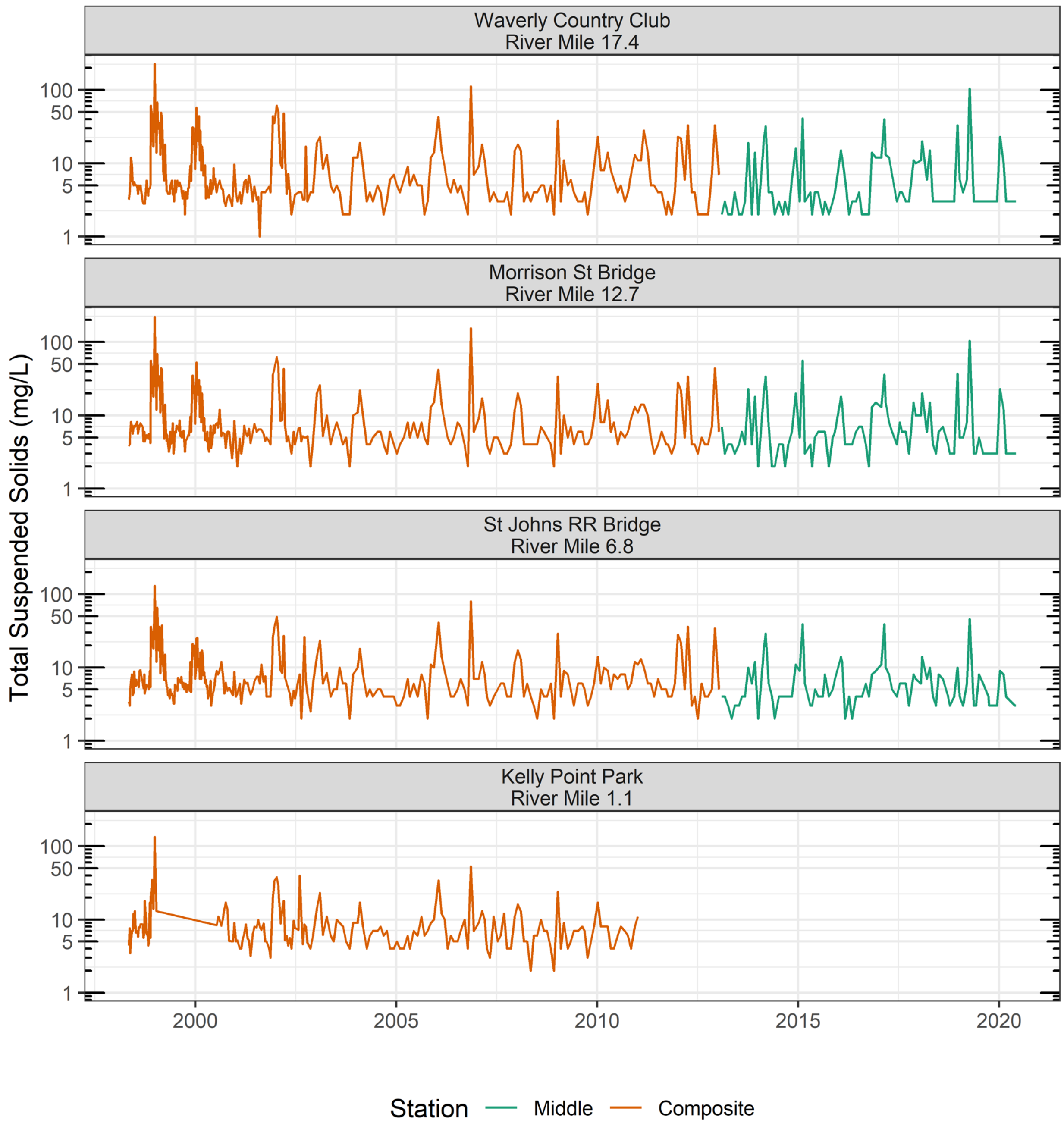
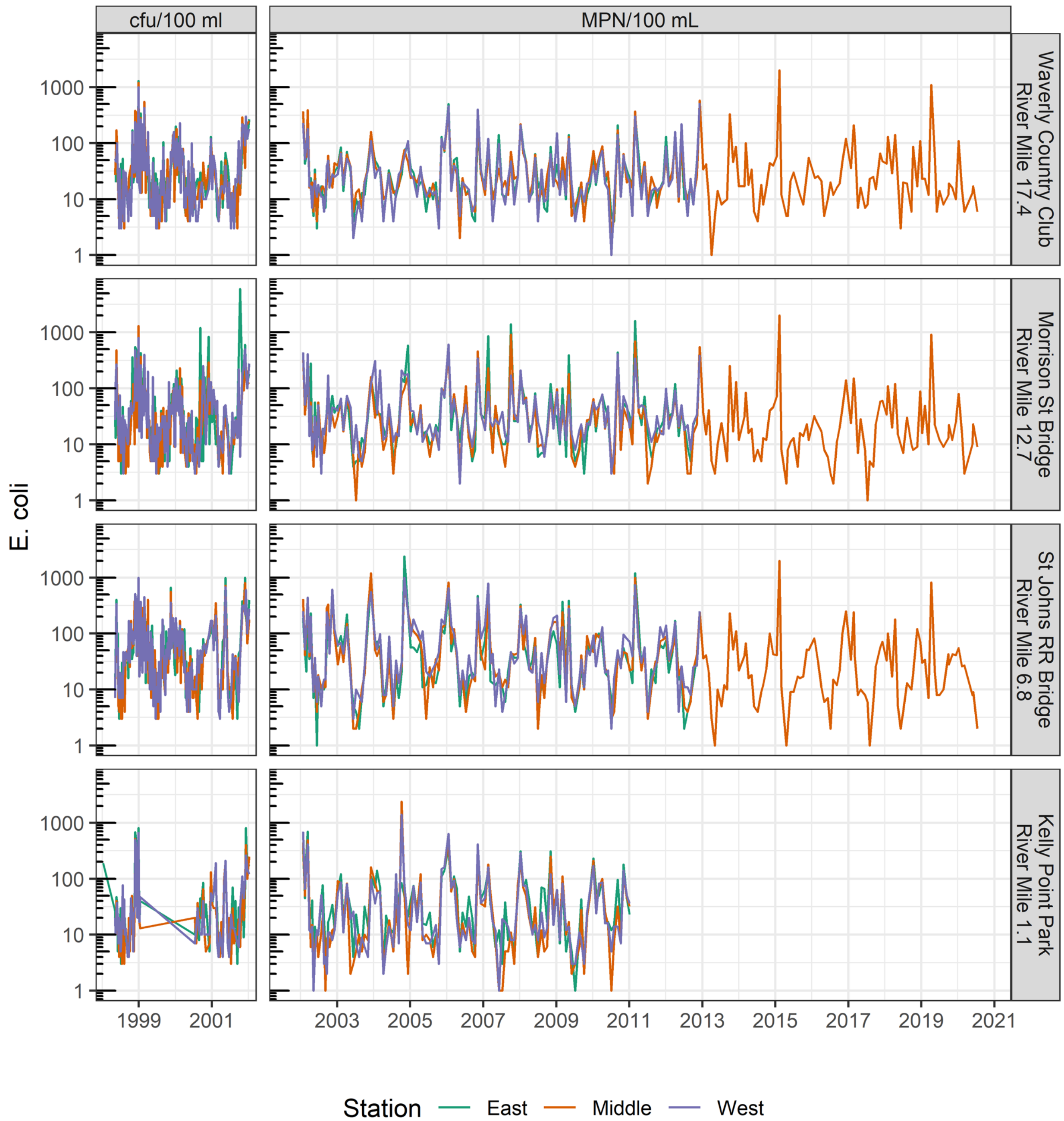


Figure 9 Willamette river monitoring results for *E. coli*



2.5.3 Columbia River Instream Water Quality Sampling

Columbia River water quality sampling for CSO pollutants of concern was suspended in 2019-2020 pending new permit conditions. Columbia River water quality will be assessed through effluent toxics characterization, including copper biotic ligand model sampling of OF003 and reasonable potential analysis process during the next permit cycle.

Section 3 CMOM Program Implementation

The City of Portland's CMOM program is designed to ensure that components of the collection system are cleaned and inspected at the right frequency and that preventive maintenance and repairs are performed to cost-effectively reduce the number of sewer releases, extend the useful life of the City's sewer infrastructure, and properly manage collection system operations. This annual summary for FY 2020 provides a brief overview of collection system operation and maintenance programs and practices as context for evaluation of the effectiveness of CMOM activities. Section 4 of this report includes sewer release analysis and performance.

3.1 Collection System – Gravity Sewers Operation and Maintenance

BES has programs in place to ensure that gravity sewers and manholes are properly inspected, cleaned, and repaired. Closed-circuit television (CCTV) inspection activities are key for an accurate determination of the structural and operational condition of collection system assets. Cleaning helps maintain asset condition and hydraulic capacity, enhances the effectiveness of inspections, and helps to control odors. Repairing structural deterioration protects the community's infrastructure investment, can extend an asset's useful life, and reduces the potential for catastrophic failures.

3.1.1 Sewer Inspections and Cleaning

The *Collection System Inspection and Cleaning Plan* submitted to DEQ in December 2012 provides detailed information about the City's "needs-based" maintenance strategy for prioritizing maintenance, inspection and cleaning activities and expenditures. The inspection and cleaning programs contain both preventive maintenance and unplanned work.

In FY 2020, the sewer inspection program inspected 847,159 lineal feet (160 miles) of mainline sewer pipe, which corresponds to approximately 8.5% of the mainline sewer system. Sewer mainlines are inspected for general preventive maintenance, special investigations in support of the chemical root and grease management programs, in response to sewer problems, and to support asset reinvestment projects through the Capital Improvement Program (CIP). In FY 2020, approximately 95% of the work orders in the mainline inspection program were considered planned work, including general preventive maintenance and support of the City's CIP Sewer Rehabilitation Program. The CCTV inspection program provides the pipeline condition assessment information that is instrumental to the risk prioritization process used to drive the CIP Rehabilitation Program work. In addition to mainline sewer inspections, the City completed 538service lateral inspections in FY 2020.

In FY 2020, the sewer cleaning program cleaned 1,207,224 (229 miles) of sewer pipe, which corresponds to approximately 12% of the mainline sewer system. The sewer cleaning program includes preventive maintenance, accelerated cleaning in grease management areas, support for the root treatment program, special investigations related to collection system problems, and support of CIP projects.

In FY 2020, 95% of mainline cleaning work orders were considered planned maintenance; that is, the cleaning was performed for general preventive maintenance, to support a planned CCTV inspection, cleaning of grease management areas, and cleaning to support root treatment activities.

In support of BES's integrated approach towards overall watershed health, Maintenance Engineering and Watershed Services staff conducted stream walks and data analysis to assess external factors that might affect sewer pipes near streams. The Tryon Creek stream walks, conducted in July and August of 2019, were at the southern end of Tryon Creek State Park, and in and around Marshall Park in the Tryon Creek watershed. The walks followed approximately 4,990 lineal feet of sanitary sewer mainline and twenty-three manholes. One additional walk was conducted in June 2020, between SW Fairmount Blvd. and SW Washougal Ave. in the Fanno watershed. This walk followed approximately 400 lineal feet of sanitary sewer mainline and three manholes. In total, 5,391 lineal feet of sanitary sewer mainline and twenty-six manholes were inspected on these stream walks.

BES is continuing to evaluate all the stream walk data collected to assess the usefulness of external visual inspection and observations of site conditions in conjunction with other preventive maintenance activities and to develop a standardized, repeatable condition assessment approach for this type of inspection moving forward.

3.1.2 Sewer Assessment and Repairs

Maintaining the wastewater collection system in good repair is a core service BES provides to its ratepayers. The City has a well-established sewer and manhole repair program. Priority codes in Hansen[4] are assigned when work orders are created. The priority codes are used when scheduling and assigning work and to help manage the backlog of open work orders to ensure that repairs are completed according to their relative risk and consequence of failure (e.g., top priority is given to Sanitary Sewer Overflow (SSO) and hazard-related repairs). The *CMOM Program Report* includes descriptions of sewer repair maintenance activities and equipment.

During FY 2020, for minor urgent or emergency repairs BES relied preferentially on services from City crews for sewer cleaning, investigation, inspection, and repair. However, for larger urgent or emergency projects BES Maintenance Engineering coordinated closely with BES Engineering Services to conduct work under the Maintenance Capital Contract Program or emergency CIP projects.

City maintenance crews completed mainline sewer repairs totaling 8,092 lineal feet. Approximately 36% of these repairs were considered unplanned. Repairs are considered unplanned if the work is in direct response to a collection system problem, such as a sewer release or surface cavity, or if the severity of the problem is significant enough to warrant the deployment of repairs within a week. The majority of planned repairs occur either from defects identified by the preventive maintenance CCTV inspection program or when additional repairs on a line are made in conjunction with an unplanned repair. Repairs on mainline sewers are typically localized spot repairs where pipe sections are excavated and replaced or renewed using cured-in-place pipe (CIPP) liners.

City crews completed over 670 service lateral repairs totaling approximately 8,566 lineal feet. Approximately 35% of these repairs were unplanned. Unplanned service lateral repairs are typically in response to a sewer system problem such as a sewer backup or a positive dye test from a sewer investigation. Planned service lateral repairs generally occur in conjunction with adjacent repairs on mainline sewers. Service lateral repairs typically involve the complete replacement or renewal of the lateral and the addition of a cleanout at the curb for improved future maintenance.

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[4] *Hansen* refers to Infor Public Sector, © 2017 Infor. All rights reserved. www. infor.com

3.1.3 Root Management and Control Actions

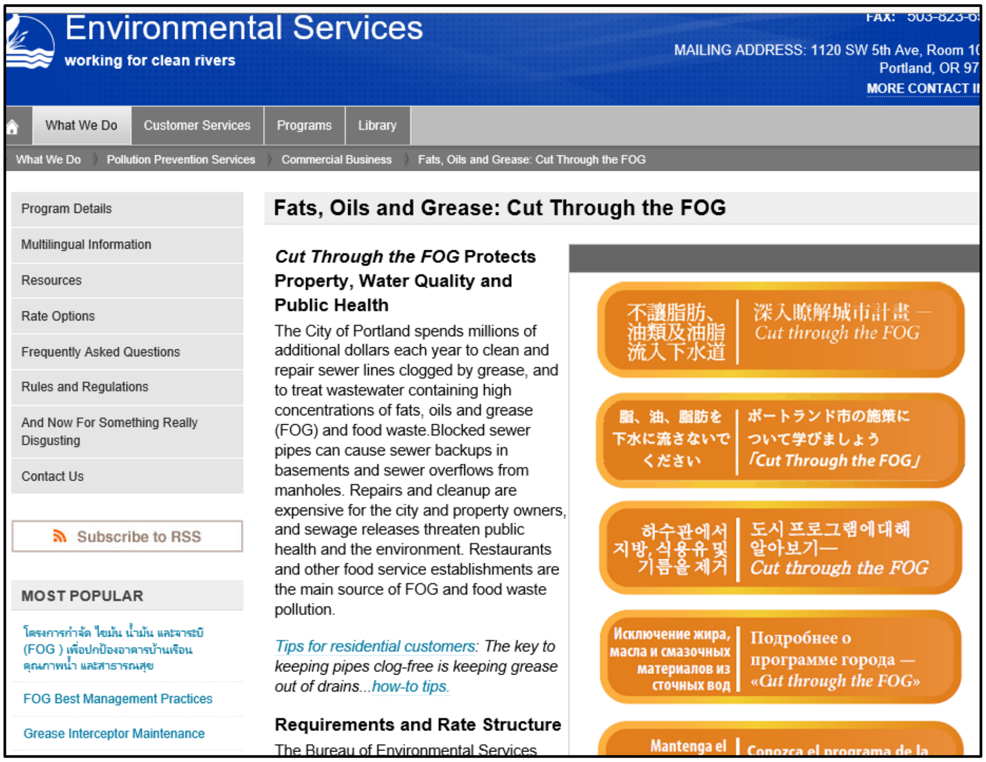
Portland is renowned for its urban forest and must balance the need to protect both trees and sewer infrastructure. During FY 2020, BES Maintenance Engineering continued to manage the chemical root control program using third-party service providers who apply dense herbicidal foam that kills roots on contact without harming trees or surface vegetation. The City's Root Control Program uses a priority ranking system so that sewers with the greatest need for chemical root treatment are addressed first. During FY 2020, 232,496 lineal feet (44 miles) of mainline sewer were chemically treated for roots. In addition to chemical root foaming, City crews cleaned approximately 21,000 lineal feet of sewer to locally remove roots using root saws and conventional cleaning in support of sewer inspection activities as well as in response to sewer system problems.

3.1.4 Grease Management and Control Actions

In FY 2020, four sewer releases from the City-maintained sewer system were attributable to grease. This low number emphasizes the effectiveness of the Portland's program to control fats, oils, and grease (FOG), which was described in the *City of Portland Grease Management and Control Program* document that was included in the *CMOM Program Report*.

The *Cut Through the FOG Program* has developed and maintains outreach and educational materials to more equitably and effectively inform food service customers impacted by our program. The *Cut Through the FOG* web page (https://www.portlandoregon.gov/bes/54538, Figure 10) has program fact sheets and three multilingual educational videos in seven languages in addition to English. The videos are intended to educate food service employees on the proper way to clean a grease trap, kitchen best management practices, and how to manage their sewer costs. They also contain information on how FOG can negatively impact the sewer system and what food service customers need to do to prevent its discharge and stay in compliance.

Figure 10 Cut Through the FOG website



Areas of the collection system vulnerable to FOG buildup and blockages are managed on a more frequent preventive maintenance and cleaning cycle (AGCA – Accelerated Grease Cleaning Area). In FY 2020, there was 34,668 lineal feet (6.5 miles) of Accelerated FOG-related sewer lines. During FY 2020, 30,854 lineal feet of cleaning was completed (some AGCAs are cleaned more than once a year), and 20,000 lineal feet of mainline sewer received FOG-related CCTV inspections.

The FOG management program has continued to proactively inspect food service establishments in the City of Portland and the City of Lake Oswego, to ensure that grease interceptors are installed correctly, in a proper state of repair, and are cleaned at the proper frequency. FOG staff completed 218 program educational outreach inspections at food service establishments and 622 grease interceptor cleaning inspections in FY 2020. FOG enforcement actions in FY 2020 are summarized in Table 10.

Table 10 FOG Enforcement Activities in FY 2020

Description	Number	Requirement
Warning Notice	199	Increase grease removal device cleaning frequency
	28	Repair or replace grease removal devices
Notice of Violation with Civil Penalties/ Cost Recovery	5	Plumb all fixtures to a grease interceptor
	4	Service grease interceptor at prescribed cleaning frequency
	2	Make required grease interceptor repairs
	1	Escalated enforcement for failing to meet compliance dates for original NOV

The FOG Coordination Team continues to meet three times a year to improve FOG-related activities performed by work groups responsible for FOG inspection and compliance, maintenance engineering, sewer cleaning and maintenance, pump station operations and maintenance, and asset management and data management. Based on CCTV inspection results and similar information, the FOG Coordination Team determines areas that are cleaned at an accelerated frequency.

The BES Plan Review Section is an important component of BES's control of FOG. In FY 2020, the work of the Plan Review Section resulted in the FOG program adding 111 food service establishments with grease interceptors installed to current Oregon Plumbing Specialty Code due to new development, redevelopment, or enforcement requirements.

3.1.5 Manhole Inspection

BES continued the second tier of the risk-based manhole inspection in FY 2020. As described in the *Collection System Inspection and Cleaning Plan* submitted to DEQ in December 2012, Tier 2 manhole inspections are more detailed in nature than the routine Tier 1 manhole inspections performed during inspection of associated mainline sewers. The Tier 2 manhole inspections focus on the manholes considered to be at the greatest risk of failure, prioritized by age and material. The Tier 2 manholes are primarily those constructed of brick and monolithic concrete. In FY 2020, 444 manhole inspections were completed. Inspections identified the need for some minor repairs but in general the manhole inspections have shown that the manholes are predominantly in good condition. The majority of defects found have been manhole cover/frame damage and light to medium deterioration of the bench/channel. Two manholes were found to have missing bricks and needed total replacement. Of the Tier 2 manholes inspected in FY 2020, seven were identified for repair and one for total replacement; work orders have been completed for the majority of those repairs.

Section 4 Sewer Release Analysis and Performance

The City of Portland's *Sewer Release Response Plan* (SRRP), submitted to the Oregon Department of Environmental Quality (DEQ) in December 2011 and adopted on January 1, 2012, establishes the process for responding to sewer releases from the City's combined and sanitary sewer system and reporting to DEQ as required by the National Pollutant Discharge Elimination System (NPDES) permit. The *CMOM Program Report* further describes the organizational structure for implementing the SRRP.

BES has a long history of implementing best management practices for collection system operation and maintenance to reduce the number and severity of sewer releases. Under the CMOM program, additional emphasis is placed on understanding why releases have occurred and how to prevent future releases.

4.1 Sewer Release Tracking and Reporting

The BES Spill Protection and Citizen Response (SPCR) Section is responsible for coordination of the overall response to sewer release events, maintaining official City sewer release records, and reporting releases to DEQ. BES SPCR routinely provides SRRP training to ensure that every report of a sewer release is dispatched for immediate response and investigation, reported as required by the NPDES permit, and documented completely and accurately. Each month, SPCR prepares the report of sewer releases that is submitted to DEQ with the monthly discharge monitoring report for the Columbia Boulevard Wastewater Treatment Plant.

BES maintains sewer release data within the Hansen computerized maintenance management system (CMMS), allowing service call information to be connected with follow-up actions and work history of assets. Better data controls have been added to help manage work orders, such as more specific problem codes and standardization of planned and unplanned maintenance work types. Well-defined work order priority codes are used to ensure that work related to sewer releases receives top priority. The resources the City uses for operation and maintenance planning are explained in the *CMOM Program Report*.

BES has developed a standardized list of causes to facilitate tracking and analysis of sewer releases, as shown in Table 11. BES further categorizes weather-related sewer releases, as shown in Table 12, to more directly associate these releases with the City's levels of service established through the BES Asset Management Improvement Program.

Table 11 Sewer Release Cause Descriptions

Sewer Release Cause	Description
Structural Defect	Release caused by a physical failure of the pipeline
Equipment Failure	Release directly resulting from equipment failure typically either at a pump station or during a bypass pump around
Maintenance	Release caused by a City-related maintenance activity
Weather Event	Release caused by hydraulic capacity issues associated with weather (there are three subcategories described in Table 12)
Grease	Release caused by a blockage due primarily to grease
Debris	Release caused by a soft blockage due to sediment or other material
Roots	Release caused by a blockage due primarily to roots
Surcharge	BES collection system surcharging but not weather event related
Cause Unknown	A release where the investigation does not identify a specific cause

Table 12 Weather-related Sewer Release Terminology

Term	BES Definition
Hydraulically overloaded system	Rainfall less than or equal to the 5-year, 24-hour storm (the BES level of service is to prevent sewer releases to surface waters for all storm events up to a 5-year frequency)
Extreme weather	Rainfall in excess of the 5-year, 24-hour storm but less than or equal to the 25 year, 6-hour storm
Force majeure	Rainfall exceeds 25-year storm (the BES level of service is to convey sewer to prevent releases to buildings or streets up to a 25-year storm frequency)

4.2 Sewer Release Key Performance Indicators

Striving for continuous improvement is a cyclical process of evaluating current practices, identifying needed improvements, and measuring performance. BES has developed a set of key performance indicators to gauge the effectiveness of the CMOM program.

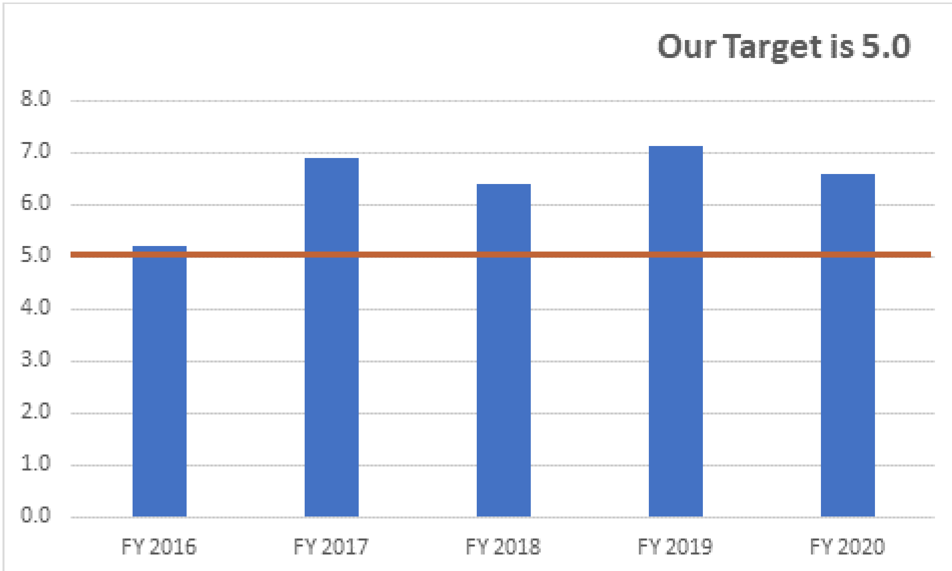
4.2.1 SSOs per Hundred Miles of Pipe

SSOs provide a good measure of the overall effectiveness of maintenance programs for controlling roots, fats, oils, and grease, structural failures, and pump station performance. By tracking SSOs per 100 miles of sewer, BES has a succinct metric for gauging overall success toward minimizing SSOs.

The City is typically responsible for maintaining the portion of the service lateral extending from the main sewer to the curb. During FY 2020, the City experienced 174 sewer releases over the 2,640 miles of collection system, which is approximately 6.6 releases per 100 miles of sewer.

Sewer release data is updated by BES SPCR as more complete information becomes available and investigations are conducted, and thus totals in this report reflect current records and may not match previous years' reports and/or monthly discharge monitoring report submittals. A comparison with previous fiscal years is shown in Figure 11.

Figure 11 SSOs per 100 miles of sewer (lower numbers are better)



4.2.2 Response to Urgent Health and Safety-Related Service Requests

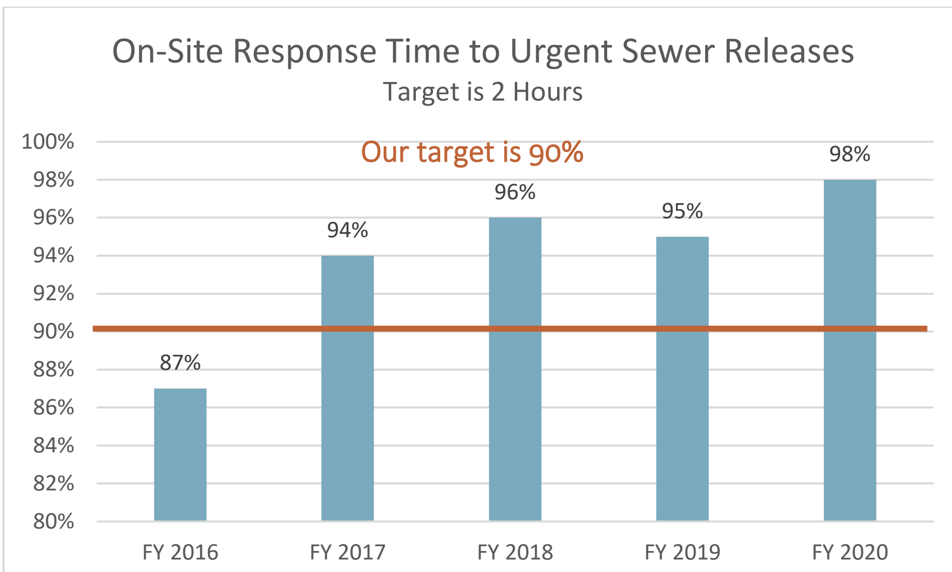
The City's goal is for a sewer emergency crew to be on site within 2 hours of receiving the initial call reporting an urgent sewer release. BES SPCR is responsible for maintaining electronic records of sewer releases, and their records are used to assess the response time of the on-site emergency crew. Under certain circumstances, such as when the caller is reporting a release that occurred in the past or is requesting to meet the City crew at a prearranged time, a sewer release is considered non-urgent, and the 2-hour on-site response goal does not apply.

Response time performance for FY 2020 is shown in Table 13. A comparison with previous fiscal years is shown in Figure 12. Sewer emergency response crews arrived on site within the City's 2-hour response time target 98% of the time during FY 2020.

Table 13 SSO Response Time and Counts for FY 2020

FY 2020 Total Urgent Calls Sewer Release Calls	Number of Calls	Percent of Total
Urgent Calls with Response Time Less Than 2 Hours	441	98%
Urgent Calls with Response Time 2 Hours or More	9	2%
Total	450	100%

Figure 12 SSO response time comparison (higher numbers are better)



4.3 Analysis of Causes and Locations of Sewer Releases

During FY 2020, the City experienced 174 releases from the sanitary and combined sewer systems. There were no weather-related release events in FY 2020 that exceeded the design capacity of the collection system (referred to as *force majeure*).

A chart comparing the causes of releases in FY 2016 through FY 2020 is shown in Figure 13. The release data shown are for releases due to problems in the City-maintained portion of the collection system (excluding releases due to causes resulting from problems in privately-owned sewers or laterals). The locations of the sewer releases in FY 2020 are shown on the map in Figure 14.

In addition to the rigorous investigatory research conducted by BES SPCR to determine the cause of sewer releases, improvements have been made to facilitate the use of the Hansen CMMS to track initial and actual problem codes on work orders. This enhanced capability provides a clearer understanding of the underlying reasons why a problem occurred or why work on (or near) an asset was required. For example, a work order may have an initial problem code "REL" for a release, or "SBU" for a sewer backup such as a plugged line. An actual problem code such as "GRS" (for grease) or "ROOTS" is also recorded on the work order and is typically based on the findings of the field crew, supervisor, or engineer.

These problem codes supplement the City's customized coding system used to characterize CCTV operators' observations and the degrees of severity (for structural defect, debris, roots, grease, etc.), as explained in the *CMOM Program Report* and the *Collection System Inspection and Cleaning Plan*. This broader array of information sources will become more useful over time as asset histories can be more closely aligned with system performance.

Structural Defects. There were 43 releases caused by structural defects in FY 2020. There were 34 releases from structurally defective laterals, five from mainline sewers, three from manholes, and one with a septic system maintained by the City. As part of the City's CIP sewer rehabilitation program, poor condition mainline sewers are identified for repair. The laterals connecting to those pipes are inspected during the design process and included for replacement or rehabilitation if structurally deficient. The risk of releases associated with structural defects should decrease as the large number of sewer repair, rehabilitation, and replacement CIP projects currently in design or under construction are completed.

Roots. During FY 2020, of the 61 releases caused by roots, 10 were in sewer mainlines and 50 were in service laterals, and one from a manhole. To reduce the risk of future root intrusion, City crews installed CIPP liners or excavated and replaced the majority of laterals where releases occurred in FY 2020.

Figure 13 Comparison of causes of sewer releases in FY 2016 through FY 2020

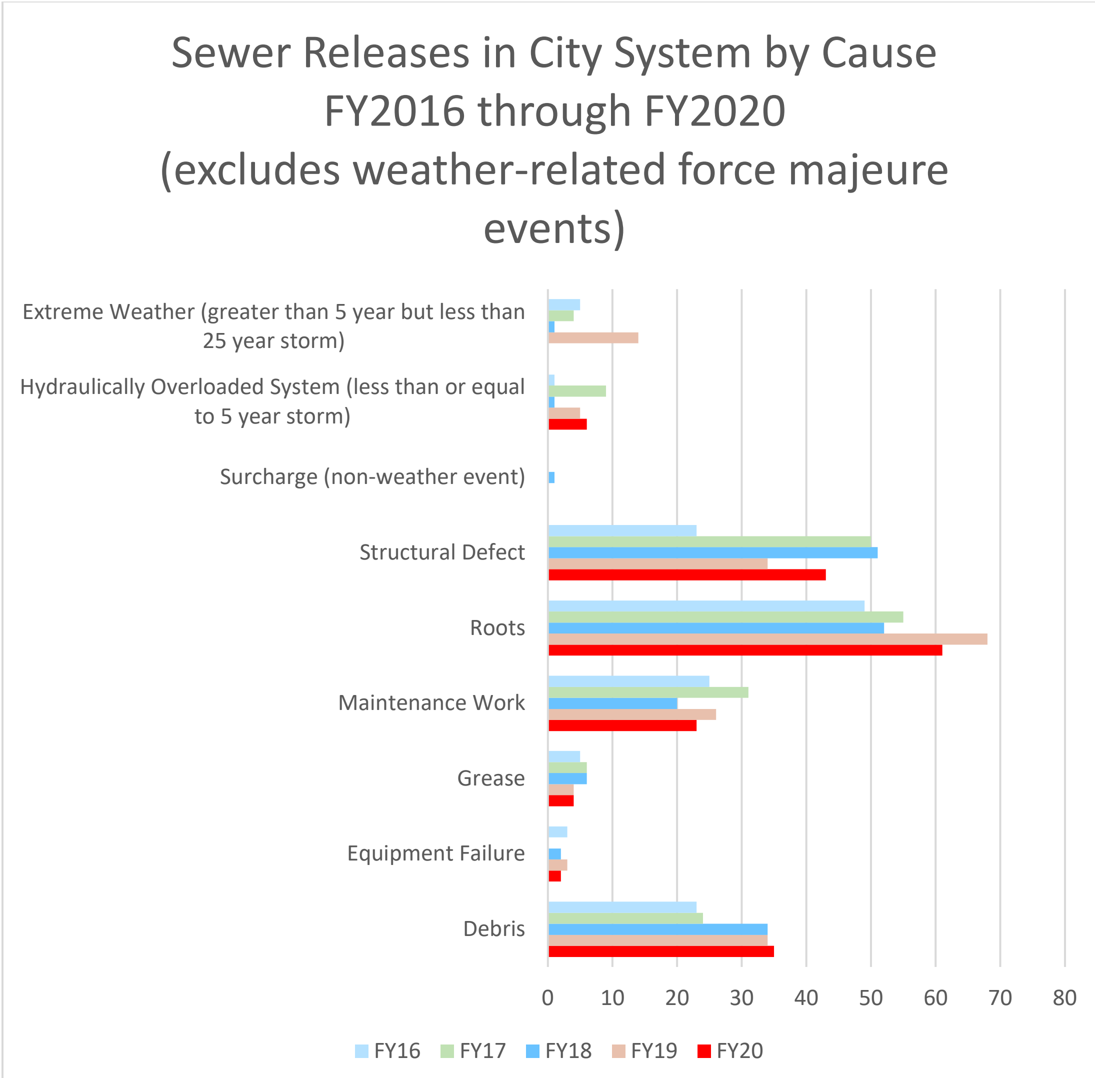
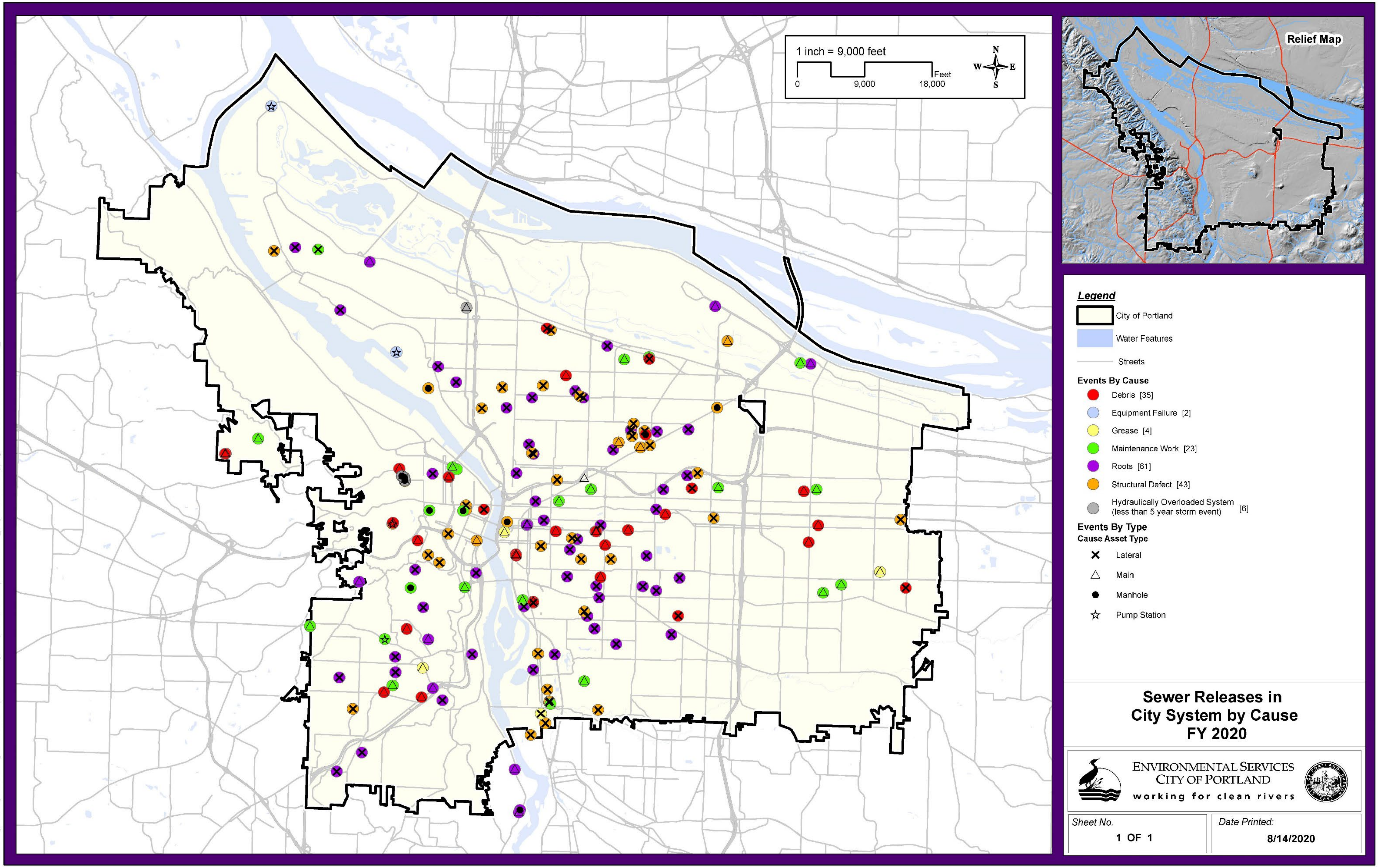


Figure 14 FY 2020 sewer release map



Produced by Asset Systems Management: Work Request 9566 August 14, 2020 (bfreeman) \\Besfile1\Asm_Projects\CMOMMapping\Mxd\FY2020\SanSewerOverflows_FY2020.mxd

Maintenance. In FY 2020, there were 23 releases associated with maintenance activities, compared to 25 in FY 2016, 31 in FY 2017, 20 in FY 2018, and 26 in FY 2019. Seventeen releases were associated with sewer cleaning operations; many of these releases were “bowl water” from toilets and the volume was less than 10 gallons (three of these releases were attributed to BES contractors). While precautions are taken to prevent these “blow back” occurrences, some private plumbing systems lack adequate venting and the configuration of some City sewers makes it very challenging for cleaning equipment operators to work in some locations. Special precautions, such as using cleaning nozzles with steeper jet angles and running lower pressures, are taken in areas prone to blow back.

Six maintenance-related releases were associated with either sewer repairs or sewer construction projects. Two releases involved installation of CIPP liners, one by a City crew and one by a BES contractor. Two releases occurred during construction projects when bypass hoses were damaged by contractors. One release was related to maintenance work at a city pump station and one release was due to debris left in the sewer system by contractor working on a BES project.

Debris. There were 35 releases caused by debris in FY 2020, compared to 23 in FY 2016, 24 in FY 2017, 34 in FY 2018, and 34 in FY 2019. In addition to accumulation of debris during normal system operation, introduction of foreign objects and debris into the system by third parties resulted in sewer releases in FY 2020. While the source of debris and vandalism is difficult to trace, enforcement action is being pursued in response to utility contractors who bored through public sewers at several locations. BES continues to conduct “what not to flush” public outreach, disposable wipes were a significant contributor to the increase in debris-related sewer releases in FY 2020.

4.3.1 Sewer Releases to Surface Water in FY 2020

Sewer releases to surface water occurred at five locations in FY 2020. The circumstances of these release events are described below. Although volume estimates are not always available, they are included in each event below when possible. Public notifications were made following each release, as required by the permit and the City’s SRRP.

8599 NE Alderwood (release to the Columbia Slough). On September 24, 2019, a city employee observed sewage coming out of the ground at the PDX-E Business Park pump station at 8599 NE Alderwood Road. The pump station maintenance crew arrived quickly to assess the situation.

The crew observed sewage coming out of the ground near the location of the force main on pump station property. The sewage ran over ground until it reached a catch basin on property that leads to the nearby Columbia Slough.

The crew immediately initiated actions to mitigate the release. Two tanker trucks were dispatched to the site to capture the flow from the pump station wet well and stop the release from the damaged force main. The tanker trucks hauled the captured flow to the nearby Holman pump station for re-entry into the sewer system. Subsequently, a mobile pump was brought to the site to establish a pump-around so that the on-site wet well pumps could be deactivated, allowing for inspection of the force main. Crews cleaned the affected surface area and storm sewer system.

The release was discovered at noon that day, and the pump around was established at 15:30, thereby ending the release at that time. The volume of the release was estimated at 10,500 gallons.

An inspection of the nearby Columbia Slough indicated that there had been impact to surface water from the release. *E. coli* samples were collected at the site of the impact, and from downstream, on September 24, 2019. The results indicated that the impact was localized to the area near the outfall.

Follow-up samples were collected on October 1, 2019. The samples collected near the outfall indicated that e. coli levels had returned to baseline conditions. The cause of the release was a structural defect in the force main leaving the pump station. The force main has since been replaced.

203 SE Alder (release to the Willamette River). On November 5, 2019, a city employee was conducting a stormwater outfall inspection at SE 2nd Avenue and SE Alder Street. The inspection identified what appeared to be sewage in the combined sewer outfall line at node ABQ755 that leads to outfall 36.

An investigation was conducted and a nearby sanitary sewer manhole ABQ752 appeared to have a defect in the bottom of the manhole shaft that was allowing sewage to leave the system. A dye test confirmed that the flow leaving sanitary manhole ABQ752 had found a preferential pathway subsurface and was reaching the combined storm outfall line at manhole ABQ755.

A repair crew responded to the site immediately. The hole in the sanitary node was plugged and the release was stopped at 1:30pm that day. The volume of the release was estimated at 3,000 gallons.

Sanitary flow had reached Outfall 36 to the Willamette River. This outfall is located on the east side of the Willamette River approximately 220 feet south of the Morrison Bridge. Water quality samples were collected from the Willamette River near Outfall 36. Results indicated 160 MPN/mL just 50 ft. downstream of the outfall. Due to the low levels of *E. coli* in the samples, no follow-up samples were collected.

Sanitary sewer manhole ABQ752 has since been rehabilitated and the nearby 24" storm main that carried flow to the river has also been CIPP-lined to prevent any further potential subsurface migration of sanitary sewer flows to the storm sewer system and then the river.

5050 SW 26th Place (release to a tributary of Fanno Creek). On January 24, 2020, a sewage release was reported at this address. Sewage was observed coming out of a cleanout on private property. Sewage was observed running down the steeply sloped driveway to the neighbor's driveway, where it entered a private storm drain leading to a nearby unnamed tributary of Fanno Creek.

A City of Portland sewage release response crew responded quickly. A CCTV investigation identified a debris blockage in the connection between the private lateral sewer line and the city main sewer. Initial attempts to clear the blockage were unsuccessful. But, the blockage was finally cleared on January 27.

The resident living at 5050 SW 26th Place was made aware of the situation and was asked to limit the use of sanitary facilities until the blockage could be cleared. After the release was stopped, the surface area and storm line impacted by the release was cleaned.

E. coli samples were collected from the unnamed tributary upstream and downstream of the release location at the time the release was occurring on January 24. Due to the low levels of e. coli in those samples, no follow-up samples were collected.

6735 SW Capitol Hill Road (release to Stephens Creek). On April 2, 2020, a sewage release was reported at this address. A resident observed sewage coming out of a manhole in the street.

A City of Portland sewage release response crew responded immediately to this location. The response crew identified the overflowing manhole as ACS161. Flow was observed bubbling from the manhole and running down the street for approximately 20 meters until it entered inlet AQN315. That inlet leads to Stephens Creek.

The crew dispatched a vactor truck to the site and removed a grease blockage from the downstream main sewer line. The release was stopped at 8:50 PM that evening. The crew then cleaned the affected surface street and inlet.

E. coli samples were collected from Stephens Creek the next day, on April 3, and then again four days later on April 7. The sample results indicated elevated E. coli in the creek after the release and then a return to baseline conditions four days later.

3495 SW Beaverton-Hillsdale Highway (release to Fanno Creek). On April 9, 2020, a pump station maintenance crew was performing maintenance activities at the Cambridge Village Pump Station. The crew was pumping down the wet well in order to clean it. They observed sewage coming out of the ground at the base of the Cambridge Village pump station, outside the building.

The crew immediately shut off the pump station. A vactor truck was dispatched to completely pump out the wet well. The crew investigated and determined that the force main leading from the pump station had failed, releasing sewage into the ground. Sewage flowed from the broken force main at the pump station building until it reached nearby Fanno Creek. The volume of the release from the force main was estimated at 3,000 gallons. A majority of the sewage release soaked into the ground near the pump station.

E. coli samples were collected from Fanno Creek on April 9th and then again on April 14th, from both upstream and downstream of the release location. The samples documented an increase in e. coli levels on the day of the release and then a return to baseline conditions five days later.

The cause of the sewage release was a structural defect in the force main immediately adjacent to the pump station building. A coupling between two sections of ductile iron pipe had deteriorated to the point where it failed. The force main appeared to be in good condition beyond this location. After structural engineering review, the failed section of force main pipe was replaced and the pump station was returned to service on April 15.

4.4 Conclusions and Follow-Up Actions for Sewer Release Reduction

The City of Portland's CMOM program is now being fully implemented. Shifting toward risk-based operation and maintenance of the collection system should, over time, result in a positive trend toward planned, proactive maintenance and fewer sewer releases. The City is also implementing a force main condition assessment program to create a framework by which the force main network assets can be assessed and managed. The intent is to develop a long-term systematic maintenance plan for preventative activities such as inspection, cleaning and repairs. BES continues to develop and improve the Hansen CMMS to facilitate work prioritization and asset management in the gravity collection system. BES's CMOM program effectively incorporates the essential elements and best management practices for proper operation and maintenance of the collection system.

BES is currently evaluating ways to improve the overall effectiveness of the sewer main line cleaning program, focusing on ways to reduce sewer releases related to operational problems such as roots and debris. As part of this work BES will reassess the thresholds for placing pipes into the chemical root treatment program and/or the mid cycle cleaning program.

The City continues to install cleanouts whenever our maintenance crews replace a sewer lateral. The addition of the cleanout, routinely installed at the curb, provides crews with an ability to perform future maintenance activities such as cleaning and chemical root treatment.

The majority of structurally defective laterals where releases occurred in FY 2020 have been repaired by City crews using CIPP liners or were excavated and replaced. Additionally, to proactively prevent sewer releases from laterals, CIP projects for replacement, repair, and rehabilitation of sewer mainlines also include inspection and repair/replacement of service laterals based on the risk of structural or operational failure. The City will continue to utilize opportunities for making cost-effective improvements to laterals.

BES continues to make significant reinvestments within the Capital Improvement Program to renew and replace structurally deteriorated sewers. Each year, the Bureau has a number of active projects in design and construction. These projects to replace, repair, and rehabilitate collection system assets that pose the highest risk and consequence of failure will position the City to better provide proactive rather than reactive maintenance. The methodology used for risk-based prioritization of CIP projects was presented in the *Collection System Assessment and Rehabilitation Plan* that was submitted to DEQ in December 2012.

Also, BES has a series of CIP projects which were created for the purpose of reducing rainfall-derived inflow and infiltration (RDII) into the sewer system. In recent years, BES has completed multiple projects which have CIPP-lined sewer mains and both the public and private portions of sewer laterals in order to reach this goal.

As an example, the Hillsdale Crest RDII Project is scheduled to begin construction in late summer 2020. That project will line approximately 18,000 linear feet of sewer mains and 128 sewer laterals. The reduction in RDII may help reduce sewer releases in the future. BES has similar projects in design now which also have the goal of reducing inflow and infiltration and subsequently reducing sewer releases as a result.

Overall, continued implementation of the *BES System Plan—Combined and Sanitary Sewer Elements*, dated March 2012, will address condition and capacity risks in both the combined and separated sanitary sewer systems. The System Plan's consolidated system-wide approach for prioritizing reinvestment and business risk reduction through CIP projects should also reduce the potential for sewer releases.

Section 5 Maximization of Storage in the Collection Systems

One of the Nine Minimum Controls, *Maximization of Storage in the Collection Systems,* ensures that combined sewage is kept within the sewer system using existing in-system storage. This optimizes the volume sent to enhanced wet weather treatment, increasing the volume treated by the biological secondary processes and reducing the number and volume of CSO events. While this control originally focused on keeping sewers free of blockages, removing relatively clean stormwater from the collection system also contributes to maximizing available storage and conveyance capacity. The programs documented here also have the added benefits of increased visibility of these efforts and public education opportunities.

5.1 Private Development and Redevelopment

BES's Stormwater Management Manual (SWMM) applies to all development and redevelopment proposals that create or redevelop over 500 square feet of impervious area.

In FY 2020, implementation of the SWMM in combined sewer basins led to construction of stormwater facilities at 704 properties, managing 85 acres of private impervious area onsite, thereby reducing stormwater volume into the combined system.

City staff are implementing a newly revised SWMM that went into effect August 2016.

5.2 Private Property Retrofit Program

Installation of stormwater facilities on private property continues in the Private Property Retrofit Program (PPRP). Guided by BES's 2012 System Plan—Executive Report: Combined and Sanitary Sewer Elements and its Capital Improvement Program, this program researches opportunities with private property owners to voluntarily retrofit or install on-site stormwater infiltration facilities such as rain gardens, drywells and pervious pavers to keep runoff out the combined sewers.

Eliminating runoff helps reduce local sewer capacity problems and CSO volumes. For more information, see previous Annual CSO and CMOM reports (FYs 2014 and 2015).

Installation season typically lasts from mid-October through June. Due to Covid restrictions for FY20, the season was closed in early March, losing a significant portion of the construction season. This resulted in reduced output for FY20. For FY20, 1.4 acres of impervious surfaces were managed through 54 private property stormwater retrofit projects. Examples of retrofits are shown in Figure 15-Figure 18.

Figure 15 Example retrofit #1, Buckman area rain garden

Figure 16 Example retrofit #2, SE Ladd's Right-of-way Rain Garden

Figure 17 Example retrofit #3, drywell installation

Figure 18 Example retrofit #4, established FY 2019 rain garden in action

5.3 Ecoroofs

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

The City of Portland strongly supports the installation of ecoroofs through Central City requirements, the City's Green Building Policy, SWMM, and developer floor area ratio bonuses in specific portions of the city.

As of June 2020, Portland has 515 ecoroofs installed throughout the city, managing over 34.4 acres of roof. Approximately 406 of those ecoroofs are in the combined sewer area. During FY 2020, 4 new ecoroofs were installed in the combined sewer area, managing approximately 13,000 square feet of roof. This roof area represents 300,000 gallons of rainfall to the combined system annually, and Portland's monitoring data indicate that approximately 150,000 gallons are retained by the roofs and returned to the atmosphere through evapotranspiration.

5.4 Public Right-of-Way Development and Redevelopment

As of June 2020, Portland has implemented over 2,400 green streets in the right-of-way, with approximately 1,100 in the combined sewer area. The *Post-2011 Combined Sewer Overflow Facilities Plan* identifies specifically how Portland will continue to implement both public and private stormwater controls to further reduce stormwater entering the combined sewer system and thereby increase the storage available for capturing CSO discharges.

During FY 2020, 17 new green street facilities were installed in the combined sewer area. The facilities were implemented by BES CIP, PBOT interagency, and private development projects. Collectively, these facilities manage approximately 2.8 acres of impervious area that generate 2.8 million gallons of stormwater to the combined sewer system annually. Based on the City's performance monitoring of green street facilities, these facilities will remove approximately 2.0 million gallons of runoff annually from the combined sewer system through infiltration and evapotranspiration.

Section 6 System Reinvestment and Risk Reduction

The City of Portland, Bureau of Environmental Services' asset management program is founded on strategically reducing risk through cost effective investments. The City has improved its methods for calculating risk and making cost effective decisions to reduce risk through investment activities. This section discusses how the City is valuing existing risk in the collection system and how its investments reduce risk to meet levels of service.

6.1 FY 2020 Reporting Methodology, Changes, and Improvements

Risk in mainline pipes and pump stations are generally determined by inspections and hydraulic modeling.

Pipe inspections provide the condition data used to determine the risk of structural failure. The inspections include routine maintenance inspections to determine the structural condition of the pipes, and post-repair acceptance inspections to ensure that repairs meet designated standards and/or contract specifications. Structural risk of laterals is assumed based on quantity of lateral repaired.

Hydraulic modeling is done to determine the risk of capacity failure, specifically to determine the likelihood of basement and surface flooding with respect to the Bureau's adopted levels of service.

Likewise, pump station inspections also provide condition data used to determine the risk associated with operational failure of the critical assets within a pump station. Hydraulic modeling is done to determine the risk of capacity failure, specifically to determine the likelihood of overflows.

System risks change over time as a result of the following:

1. **Capital Improvement Program:** Capital projects repair or rehabilitate existing assets or introduce new ones to reduce capacity (level of service) risk and structural (mortality) risk in the system.
2. **Maintenance:** Maintenance work orders seek to reduce structural risk in the system by applying targeted repairs and rehabilitation on high-risk assets.

3. **Change in pipe condition due to aging:** Inspections provide more accurate information about pipe condition than simple age-based assumptions. Changes in risk can be due to actual aging as indicated by consecutive inspections, or due to the inspection-based condition of pipes varying from the age-based assumed condition. Since actual pipe condition can be better than the age-based assumed condition, risks can decrease for a particular pipe when it is first inspected.
4. **Unexpected changes to hydrologic conditions:** In general, future development conditions are modeled to allow BES to provide sufficient capacity to meet anticipated hydrologic conditions in the future. Future conditions are largely defined by the City's currently adopted Comprehensive Plan. In some instances, development may occur that is different than was set in the Comprehensive Plan. These changes may have a positive or negative effect on capacity risk.

Items 1 and 2, above, are the focus of this section.

The City of Portland has been working diligently over the past fiscal year on developing a risk reporting methodology for pipe rehabilitation. The methodology relies on existing internally developed asset management and project tracking systems. These systems underwent significant changes and upgrades over the past year, but they need to be further adjusted to enhance risk reduction reporting.

The City is in the process of improving risk calculations for large diameter (36-inch or larger vertical and/or horizontal dimension) pipe assets. The risks for large diameter assets assume different failure scenarios and rehabilitation methods, compared to smaller diameter pipes. Results presented in this report apply to smaller diameter pipes (less than 36-inch diameter).

The City also completed its *Pump Station System Plan* in 2020. The plan developed a process to implement a data-driven risk analysis process for determining necessary pump station investment. To promote consistency in decision-making, the asset management approach developed for the pipe collection system was tailored for use in evaluating pump station assets. Characterization to identify condition, capacity, and level of service deficiencies among pump station assets is used to quantify risk with the goal of identifying corrective actions. These actions meet the BES core mission by protecting public health, water quality, and the environment in a manner that optimizes the return on investment for the rate paying customer.

6.2 FY 2020 Activity for Risk Reduction

Risk reduction is the present value of the cost of repairing or replacing infrastructure, thereby deferring failure, and its related consequences, to the expected life of the repair or replacement.

Risk reduction for capital work is now reported on a calendar year basis as fiscal year reporting is delayed due to construction during the summer and end of the fiscal year. Risk is not reported for investments in correcting non-conforming sewers (e.g. sewers not constructed to current standards).

6.2.1 Risk Change Due to Capital Improvements and Inspections

Capital improvement projects are designed and installed to resolve capacity and structural risk. Resolution of both types of risk are included in the risk reduction calculations. The changes in capacity and structural risk due to rehabilitation is summarized in Table 14. This data is currently incomplete, and the actual risk reduction is likely much higher. BES is continuing to work on improving the data systems required to develop these risk reductions more accurately.

Table 14 Risk change due to capital improvement projects with available data

Type	Value
Total Risk Reduction Due to CIP Investment in Repaired/Replaced Gravity and Pressurized Assets	$31,445,000

The Capital Improvement Program completed 17 projects in the sanitary and combined collection system during the 2019 calendar year. These projects repaired and rehabilitated 308 sanitary and combined sewer gravity mains and two pump stations.

6.2.2 Risk Change Due to Maintenance Activity

Maintenance repairs reduce risk in the collection system and involve localized repairs on sewers and the replacement of service laterals. The Hansen system showed that planned maintenance activities included approximately 6,228 lineal feet of repair and lining work on sewer main assets and 443 laterals which were replaced or lined.

Table 15 Risk change due to maintenance activity with available data

Type	Value
Total risk reduction due to maintenance activity	$5,446,000

Section 7 Inflow and Infiltration

Inflow and Infiltration (I&I) activities for the City of Portland are now limited to planned local capacity improvements. In the past, the City made concerted efforts to study and mitigate problems caused by I&I. Significant historical improvements to the collection system and CBWTP, as well as the City's execution of its Nine Minimum Controls, means the City no longer needs a widespread I&I program to improve the CBWTP's ability to treat all the wastewater and stormwater reaching it.

7.1 FY 2020 Activities

Flow monitoring for three sanitary basins, Burlingame, Council Crest, and Fanno, have been in progress since FY 2019. Data from these monitoring efforts will inform pre-construction modeling work and design requirements, as well as provide the basis for evaluating project effectiveness after construction.

Council Crest is currently undergoing a wider, integrated planning effort that includes addressing I&I issues. Solving I&I issues in West Hills areas where there is currently no dedicated storm or combined system requires more comprehensive stormwater planning to strategically handle the flows that used to enter the sanitary system.

7.2 Planned FY 2021 Activities

The City will continue with its integrated planning effort for Council Crest.

Local I&I projects in the Burlingame and Fanno basins have been recommended to be delayed to FY 2025 (Burlingame) and FY 2026 (Fanno) to address CBWTP Secondary Treatment Expansion budget requirements.

7.3 SSOs Summary

See Section 4.3.1, Sewer Releases to Surface Water in FY 2020.

Appendix A CSO Event History

When reporting on *how the Portland CSO system has performed*, the City of Portland usually refers to the number of events and the size of overflows that have occurred since the system became fully operational in December 2011. From that standpoint, BES has validated and reported 29 permitted events from the Willamette River and Columbia Slough facilities.

Prior to December 2011, the Amended Stipulation and Final Order from DEQ required the City of Portland to eliminate most overflows to the Columbia Slough by December 1, 2000. Another 16 outfalls (represented by a mix of outfalls from the West Side and East Side of the Willamette River) were controlled by December 1, 2006.

Columbia Slough CSO Events since October 2000

This table presents the CSO events to the Columbia Slough since the Columbia Slough CSO system became fully operational in October 2000. There were no CSO events to the Columbia Slough in FY 2020. Winter events are shaded in green, and summer events are shaded in yellow. All events were valid under the NPDES permit at the time.

Table 16 Columbia Slough CSO events since October 2000

CSO Discharge Events			Storm Characteristics			System Totals		West Side Totals	
Event #	Dates of Storm / Overflow Events	Description	6-Hour Rainfall (inches)	12-Hour Rainfall (inches)	24-Hour Rainfall (inches)	Overflow (MG)	Duration (hours)	Overflow (MG)	Duration (hours)
1	May 26, 2012	> 100-year, 30-minute storm	-	-	-	0.022	0.20	0.022	0.20
2	December 5-13, 2015	25-year, 3-6 hour storm	2.04	2.61	3.19	0.01	0.15	0.01	0.15

Willamette River CSO Events from December 2006 to December 2011

This table presents the CSO events to the Willamette River since the West Side Willamette River CSO Tunnel became fully operational in December 2006 until the full Willamette system became operational in December 2011. Winter events are shaded in green, and summer events are shaded in yellow. All events complied with the requirements of the NPDES permit and the 1994 Amended Stipulation and Final Order in effect at the time.

Table 17 Willamette River CSO events, December 2006-December 2011

CSO Discharge Events*			Storm Characteristics			System Totals		West Side Totals	
Event #	Dates of Storm / Overflow Events	Description	6-Hour Rainfall (inches)	12-Hour Rainfall (inches)	24-Hour Rainfall (inches)	Overflow (MG)	Duration (hours)	Overflow (MG)	Duration (hours)
1	Dec 14, 2006	4-per-Winter Storm	0.82	1.17	1.60	66.85	18.37	66.85	18.37
2	Jan 3, 2007	4-per-Winter Storm	0.69	1.04	1.54	5.15	4.35	5.15	4.35
3	Dec 2-3, 2007	> 5-year 24-hour Winter Storm	0.97	1.76	3.09	154.5	26.85	154.5	26.85
4	Nov 12, 2008	4-per-Winter Storm	0.76	1.02	1.38	8.1	4.1	8.1	4.1
5	Jan 1-2, 2009	5-year Winter Storm	1.12	1.52	2.73	122.60	21.58	122.60	21.58
6	May 4, 2009	3-year Summer Storm (3-6 hr duration)	0.94	1.02	1.18	5.26	1.05	5.26	1.05
7	Nov 7, 2009	2-per-Winter Storm	0.93	1.22	1.51	9.60	2.92	9.60	2.92
8	June 6, 2010	3-year Summer Storm	1.07	1.25	1.43	26.02	3.08	26.02	3.08
9	Nov 17, 2010	1-per-Winter Storm	1.03	1.56	1.77	11.48	5.58	11.48	5.58
10	Dec 8-12, 2010	5-year Winter Storm	1.43	1.52	2.34	41.82	8.92	41.82	8.92
11	Dec 28, 2010	2-per-Winter Storm	0.57	0.89	1.58	6.85	5.50	6.85	5.50
12	Jan 15-16, 2011	1-per-Winter Storm	0.94	1.21	2.13	26.27	8.92	26.27	8.92
13	Feb 27-Mar 4, 2011	1-per-Winter Storm	1.15	1.70	2.41	75.98	28.25	75.98	28.25
14	Nov 21-23, 2011	5-year Winter Storm	1.44	1.66	2.24	115.96	6.25	115.96	6.25

Willamette River CSO Events since December 2011

This table presents the CSO events to the Willamette River since the Willamette River CSO Tunnel system became fully operational in December 2011. FY 2020's events are listed in the bold box below. Winter events are shaded in green, and summer events are shaded in yellow. All events were valid under the NPDES permit at the time.

Table 18 Willamette River CSO events, December 2011 to June 2019

CSO Discharge Events			Storm Characteristics			System Totals		West Side Totals		East Side Totals	
Event #	Dates of Storm / Overflow Events	Description	6-Hour Rainfall (inches)	12-Hour Rainfall (inches)	24-Hour Rainfall (inches)	Overflow (MG)	Duration (hours)	Overflow (MG)	Duration (hours)	Overflow (MG)	Duration (hours)
1	January 17-21, 2012	> 5-year 12-hour Winter Storm	1.48	2.15	2.32	304.90	10.30	86.40	10.30	218.50	10.30
2	May 26, 2012	> 100-year, 30-minute Storm	-	-	-	0.17	0.42	-	-	0.17	0.42
3	November 17-21, 2012	5-year, 24-hour Winter Storm	1.22	1.65	2.44	176.40	9.50	44.00	9.50	132.40	9.30
4	November 24, 2012	3-per Winter, 24-hour Storm	0.61	1.09	1.49	0.50	0.80	0.50	0.80	-	-
5	May 23, 2013	3-year, 12-hour Summer Storm	0.90	1.22	1.50	26.30	2.30	11.90	2.30	14.40	1.80
6	September 27-30, 2013	10-year, 24-hour Summer Storm	1.20	1.41	2.08	88.50	7.00	27.00	7.00	61.50	5.40
7	March 25-30, 2014	2-per Winter, 12-hour Storm	0.89	1.26	1.53	43.10	3.00	14.30	3.00	28.70	3.00
8	June 15-16, 2014	3-year, 30-minute Summer Storm	-	-	-	0.03	0.20	-	-	0.03	0.20
9	October 22-23, 2014	10-year, 24-hour Summer Storm	1.42	1.68	2.11	69.4	3.92	13.41	3.50	56.00	3.92

CSO Discharge Events			Storm Characteristics			System Totals		West Side Totals		East Side Totals	
Event #	Dates of Storm / Overflow Events	Description	6-Hour Rainfall (inches)	12-Hour Rainfall (inches)	24-Hour Rainfall (inches)	Overflow (MG)	Duration (hours)	Overflow (MG)	Duration (hours)	Overflow (MG)	Duration (hours)
10	December 4-6, 2014	5-year, 3-hour Winter Storm	0.95	1.37	1.56	1.6	1.57	0.05	0.27	1.52	1.57
11	January 17-18, 2015	1-per Winter, 24-hour Storm	0.97	1.50	2.04	91.6	7.98	15.15	6.75	76.43	7.98
12	March 14-15, 2015	1-per Winter, 48-hour Storm	1.05	1.80	2.41	78.9	6.48	16.61	5.92	62.31	6.48
13	October 30-November 2, 2015	50-year, 2-hour storm	1.94	1.98	2.55	190.5	6.35	30.24	4.88	160.05	6.35
14	November 16-17, 2015	1-per Winter, 1-hour storm	0.80	0.85	1.37	0.03	0.17	-	-	0.03	0.17
15	December 5-13, 2015	25-year, 3-6 hour storm	2.04	2.61	3.19	638.7	15.60	134.86	13.33	503.83	15.60
16	December 16-19, 2015	1-per Winter, 3-48 hour storm	1.11	1.56	2.37	145.8	11.00	26.79	9.70	118.99	10.30
17	May 19, 2016	3-year, 30-minute Summer Storm	-	-	-	0.02	0.18	-	-	0.02	0.18
18	October 13-17, 2016	> 100-year, 1-2 hour storm	1.56	1.81	2.09	0.92	0.63	0.89	0.63	0.03	0.33
19	November 22-25, 2016	5-year winter, 3-hour storm	1.20	1.81	2.47	210.5	17.00	49.36	16.10	161.15	16.60
20	January 17-18, 2017	2-per-winter, 1-day storm	0.61	1.03	1.78	93.5	8.90	20.82	7.50	72.70	8.90
21	February 3-6, 2017	5-year winter, 1-day storm	0.81	1.48	2.53	206.0	12.10	53.07	11.5	152.95	12.1
22	February 7-10, 2017	4-per-winter, 1-day storm	0.51	0.82	1.36	0.0035	0.17	0.0035	0.17	-	-
23	February 15-16, 2017	1-per-winter, 1-2 day storm	0.80	1.25	1.98	89.6	6.4	25.61	5.8	63.98	5.8

CSO Discharge Events			Storm Characteristics			System Totals		West Side Totals		East Side Totals	
Event #	Dates of Storm / Overflow Events	Description	6-Hour Rainfall (inches)	12-Hour Rainfall (inches)	24-Hour Rainfall (inches)	Overflow (MG)	Duration (hours)	Overflow (MG)	Duration (hours)	Overflow (MG)	Duration (hours)
24	May 12-14, 2017	>10-year summer, 15 minute storm	0.43	0.68	0.75	0.0051	0.20	0.0051	0.20	-	-
25	September 17-20, 2017	10-year summer, 15-minute - 2-hour storm	0.76	1.18	1.58	0.097	0.63	-	-	0.097	0.063
26	October 19-22, 2017	10-year summer, 24-hour storm	0.96	1.64	2.29	70.5	6.17	19.82	4.92	50.68	6.00
27	April 6-8, 2018	1-per-winter, 12-48 hour storm	0.74	1.29	1.94	24.7	2.55	4.71	2.32	19.95	2.52
28	October 25-29, 2018	25-year, 10-minute - 2-hour storm	1.46	2.06	2.12	0.0037	0.17	-	-	0.0037	0.17
29	August 10, 2019	100-year: 5-minute - 3-hour storm	1.93	1.93	1.93	0.060	0.38	0.060	0.38	-	-

The City of Portland ensures meaningful access to City programs, services, and activities to comply with Civil Rights Title VI and ADA Title II laws and reasonably provides: translation, interpretation, modifications, accommodations, alternative formats, auxiliary aids, and services. To request these services, call 503-823-7740, City TTY 503-823-6868, Relay Service: 711.

Traducción e Interpretación | Biên Dịch và Thông Dịch | अनुवादन तथा व्याख्या | 口笔译服务 | Устный и письменный перевод | Turjumaad iyo Fasiraad | Письмовий і усний переклад | Traducere și interpretariat | Chiaku me Awewen Kapas **503-823-7740**