Thea Foss and Wheeler-Osgood Waterways 2023 Source Control and Water Year 2023 Stormwater Monitoring Report

March 2024

Prepared for
Washington State Department of Ecology and
U.S. Environmental Protection Agency

Prepared by
City of Tacoma

ACKNOWLEDGEMENT

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Special consideration to the following support staff:

- Data Management and Analysis Application Development and Support from Karen Bartlett and Bonnie McLeod, Asset Management, Analytics & Engineering and Bob Saucier, Peter Van Pelt and Michael Sparkman, Asset Management, Technology & Business Operations, Application Development, GIS
- Rainfall, Stormwater and Stormwater Sediment Sampling and Data Management from Steve Shortencarrier, Ryan Gore, Chad Atkinson, and Steve George with support from Haley Abbruscato and Michael Blanchette, Laboratory Services, Quality Assurance and Laboratory Data Management: Environmental Services Laboratory Services with special consideration to support from Monica Herbert, Tiffany Ryan, and Eric Bitten, Environmental Services Laboratory.

Special thanks to all others in Environmental Services whose hard work has resulted in the statistically significant improvements in stormwater quality and the success of this Superfund cleanup and source control program.

- Business Operations Environmental Compliance, business inspections and spill response
- Science and Engineering, Environmental Programs, NPDES with Stormwater Municipal NPDES Permit Compliance
- Operations Maintenance, Transmission Maintenance, sweeping, line cleaning and other stormwater system cleaning and maintenance.

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LIST OF ABBREVIATIONS

ANOVA	Analysis of Variance
BEL	Biological Effects Level
BMPs	Best Management Practices
BNSF	Burlington Northern Santa Fe
CD	Consent Decree
CDF	Controlled Density Fill
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CHB	Community for a Healthy Bay
City	City of Tacoma
CIPP	Cured-In-Place Pipe
COCs	Contaminants of Concern
CRM	Certified Reference Material
DEHP	Di(2-ethylhexyl) phthalate or Bis(2-ethylhexyl) phthalate
DMMP	Dredged Material Management Program
Ecology	Washington State Department of Ecology
EC	Environmental Compliance
EPA	Environmental Protection Agency
ER	Exceedance Ratio
Foss Waterway	Thea Foss and Wheeler-Osgood Waterways
FWDA	Foss Waterway Development Authority
GOF	Goodness-of-fit
HPAHs	High Molecular Weight PAHs
IDDE	Illicit Discharge Detection and Elimination
ISWGP	Industrial General Stormwater Permit issued by Ecology
LCS	Laboratory Control Sample
LID	Low Impact Development
LPAHs	Low Molecular Weight PAHs
LTMP	Long Term Monitoring Plan
LUST	Leaking Underground Storage Tank
MLLW	Mean Lower Low Water
MS4	Municipal Separate Storm Sewer System
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NPDES Phase I Permit	NPDES Phase I Municipal Stormwater Permit dated August 1, 2012
NWDC	Northwest Detention Center
OF	Outfall
OMMP	Operations, Maintenance, and Monitoring Plan
PAHs	Polycyclic Aromatic Hydrocarbons

LIST OF ABBREVIATIONS - CONTINUED

PCBs	Polychlorinated biphenyls
Permit	State Waste Discharge General Permit for Discharges from Large and Medium Municipal Separate Storm Sewer Systems
PIC	Pierce County Code Enforcement Officers Group
PSD	Particulate Size Distribution
QAPP	Quality Assurance Project Plan
QA/QC	Quality Assurance/Quality Control
ROW	Right-of-way
SSPM	Stormwater Suspended Particulate Matter
SAP	Sampling and Analysis Plan
SQOs	Sediment Quality Objectives
SQS	State Sediment Quality Standards
SR	State Route
STRAP	Stormwater Rapid Assessment Program
SWMP	Stormwater Management Program
SWPPP	Stormwater Pollution Prevention Plan
TNT	The News Tribune
TPCHD	Tacoma Pierce County Health Department
TSS	Total Suspended Solids
Twin 96ers	Outfall 237A and 237B
UCL	Upper Control Limit
USGS	United States Geological Survey
LUST	Leaking Underground Storage Tank
UST	Underground Storage Tank
Utilities	Group of Private Utilities who performed cleanup in the Head of the Thea Foss Waterway
WASP	Water Quality Analysis Simulation Program
WRDA	Water Resources Development Act
WSDOT	Washington State Department of Transportation
WY	Water Year

EXECUTIVE SUMMARY

Under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), also referred to as Superfund, contaminated bottom sediments were remediated in the Thea Foss and Wheeler-Osgood Waterways in Tacoma, Washington, under the oversight of the Environmental Protection Agency (EPA) at a cost of $105 million. In 2022, EPA initiated the process of deleting the waterway from the National Priorities List as part of the Commencement Bay Superfund site. It is unknown at this time when this process will be completed.

The waterways are located in a highly urbanized basin with residential, commercial, and industrial land uses and transportation corridors. Sources of contaminants of concern (COCs) continue to exist in the drainage basins and are conveyed to the waterway via stormwater (municipal and private), aerial deposition, marinas, and groundwater discharges. The contaminants identified as having the greatest potential to affect sediment quality following the cleanup action include polycyclic aromatic hydrocarbons (PAHs) and phthalates.

Since stormwater is one of the potential sources of these contaminants, the City of Tacoma (City) has been implementing a comprehensive monitoring and source control strategy in the Foss Waterway Watershed since 2001. Stormwater monitoring is required under a Stormwater Work Plan Addendum to the Thea Foss Waterway Consent Decree (CD) with EPA and currently by Section S8.C of the Phase I National Pollutant Discharge Elimination System (NPDES) and State Waste Discharge General Permit for Discharges from Large and Medium Municipal Separate Storm Sewer Systems (Permit) issued by the Washington State Department of Ecology (Ecology), which supersedes previous NPDES requirements.

The Thea Foss Post-Remediation Source Control Strategy implemented under the CD used a multifaceted approach consisting of aggressive source control efforts, continuation of the comprehensive monitoring program, a computer model (used during the first ten years) to predict impacts, and a decision matrix to identify the need for additional source controls. This monitoring information was used to guide control of contaminant sources in the drainage basins. The intent of this program is to help provide long-term protection of sediment quality in the waterways and to fulfill NPDES requirements. Implementation of the requirements of the CD remain in effect until performance standards in the waterway are met.

Under the comprehensive monitoring program, annual baseflow[1], stormwater, and stormwater suspended particulate matter (SSPM) monitoring of the stormwater discharges from seven outfalls to the Thea Foss Waterway are used to evaluate effectiveness of the City's source control efforts, and to provide early warning of any new problems which arise in the drainages. The requirements of the monitoring program and the approach to the evaluation of results were originally outlined in the 2001 Sampling and Analysis Plan (SAP) for the Thea Foss and Wheeler-Osgood Waterways dated September 2001 (Tacoma 2001) and approved by EPA on September 13, 2001. A revised Thea Foss and Wheeler-Osgood Waterways Stormwater Monitoring Quality Assurance Project Plan (2020 QAPP) for monitoring was completed and

[1] After 10 years of baseflow monitoring were completed at the end of WY2011, baseflow monitoring was discontinued (approval granted by EPA and Ecology on February 7 and February 9, 2012, respectively). Baseflow quantity and quality were determined to be well characterized by the 10-year monitoring record. Some additional baseflow monitoring was performed in WY2016 and in WY2019 to determine whether there had been changes in recent years.

approved by EPA and Ecology in August 2020 and went into effect starting with Water Year 2021 (WY2021) monitoring.

Prior to December 2022, the primary municipal outfalls to the Foss Waterway monitored under the Foss Waterway Monitoring Program were Outfall 237A (OF237A) and OF237B (the twin 96ers), OF230, OF235, OF243, OF245, and OF254. These seven outfalls covered 98 percent of the watershed. The City began construction in 2021 on a new stormwater pipeline and its new 60-inch stormwater outfall discharging to the Thea Foss Waterway (OF230A). The existing stormwater system discharging to OF230 and OF235 did not have sufficient capacity to convey runoff generated during significant storm events occurring in the downtown area. The new OF230A was under construction during WY2022 and a portion of WY2023. Stormwater runoff from the upstream drainage area was connected to the new pipeline and thus discharged to the waterway through the new outfall in mid-December 2022. OF230A drains approximately 98 percent of the stormwater previously discharging to OF230 and approximately 26 percent of the stormwater previously discharging to OF235 (see Section 1.4.2).

This annual report outlines the City's existing programs completed in WY2023 and includes a status update on ongoing source control investigations, as well as an evaluation of the need for any new stormwater management actions. Annual source control evaluations are completed for the seven major outfalls discharging to the waterways: Outfalls (OF) 230(Historic) and 230A (Current), 235, 237A, 237B, 243, 245, and 254. The evaluations include a drain-by-drain assessment incorporating the review of ongoing studies, source control investigations, water quality data, and SSPM data for that outfall/basin. A summary of this evaluation is included in Section 5 of this report.

As part of the WY2023 evaluation, this report reviews results from 22 years (August 2001-September 2023) of outfall monitoring conducted under the Foss Monitoring Program and source control actions completed in the Thea Foss drainage basins. In addition, since the City completed additional waterway sediment monitoring in 2023, this report also includes an analysis of this data relative to stormwater concentrations to evaluate the impact of known ongoing urban and marine sources on waterway sediments. At this time the waterway appears to have equilibrated with known sources generally at concentrations below levels of concern. The City and others will be monitoring waterway sediments next in 2028 and the WY2028 report will include a qualitative analysis of this data.

Based on results of the WY2018 monitoring and subsequent reporting, EPA determined that the requirements of the Record of Decision had been met, and the remedial action in the waterway is complete. With this determination, EPA initiated the process of deletion of the Thea Foss Waterway from the National Priorities List as part of the Commencement Bay/Nearshore Tideflats Superfund site. There was no further progress on this deletion process in 2023, and the timing on any further action is uncertain.

WY2023 STORMWATER QUALITY STATISTICAL ANALYSIS

Stormwater and stormwater sediments have been sampled at the seven major outfalls that discharge into the Thea Foss and Wheeler-Osgood Waterways since 2001. In addition, baseflow was sampled at the same seven outfalls for the first ten years of the program and confirmed with additional sampling in 2016 and 2019. Over the last 22 years, 2,390 samples have been collected, with 366 baseflow and 1,514 stormwater samples collected at the outfalls, and 134 outfall and 376 upline SSPM samples collected in pipeline sediment traps deployed throughout the watershed. This long and rich data record provides the basis for meaningful statistical evaluation of the trends over the program period.

Stormwater Time Trend Analysis[2] Forty-eight statistically significant time trends (48 out of 49 tests or approximately 98 percent of the tests) were shown in Year 22 using simple linear regression. All trends were in the direction of decreasing concentrations. This is the same number of trends and constituents with trends as were observed since WY2021. In Years 19 through 22, 48 trends have been observed, but the constituents were different in Year 19. Between Years 15 and 18, 47 significant trends were observed; in Years 13 and 14, 46 significant trends were observed; in Year 12, 44 significant trends were detected; in Year 11, 41 significant trends were detected; in Year 10, 37 significant trends were detected; in Year 9, 26 significant trends were observed; in Year 8, 10 significant trends were observed; and in Year 7, only 4 significant trends were observed.

In addition to the 49 time trend tests that have been evaluated in past years, the 2014 QAPP requires the City to analyze and evaluate total copper. For three outfalls, OF235, OF237B, and OF245, the data collected since WY2015 has been added to data previously collected under the NPDES program between WY2010 and WY2012. With more data available, an evaluation of time trends has been performed for these outfalls for the last several years. As of WY2019, sufficient data is available for all seven outfalls to perform an evaluation of time trends, although with less data available, the statistical results will not be fully comparable to data for the remaining constituents. With these seven tests added, there are 51 statistically significant time trends (51 out of 56 tests, or approximately 91 percent of the tests) shown in Year 22, with all trends in the direction of decreasing concentrations. As additional data becomes available, time trends for copper will become more comparable to remaining tests.

The time trends were modeled with best-fit regression equations to estimate percent reductions over the 22-year monitoring period for these constituents and outfalls:

- **Total Suspended Solids (TSS)**: Approximately 40-75 percent reduction all seven outfalls
- **Copper:** Approximately 33-47 percent reduction in OF235, OF237B, and OF245
- **Lead**: Approximately 69-83 percent reduction in all seven outfalls
- **Zinc**: Approximately 51-71 percent reduction in all seven outfalls
- **PAHs**: Approximately 62-89 percent in all seven outfalls with the exception of indeno(1,2,3-c,d)pyrene at OF237A

  Bis(2-ethylhexyl)phthalate (DEHP): Approximately 42-80 percent reduction in all seven outfalls.

ONGOING EFFORTS TO AFFECT CHANGE

The cumulative effect of municipal, state, and federal source control efforts has likely caused the observed improvements in stormwater quality. The City has directed numerous source

[2] It should be noted that some new statistical approaches were implemented beginning in WY2012 and for this reason, the results since then are not fully comparable to results from previous years. However, these changes have improved the statistical approach to the trend analysis, and the City's ability to discern trends.

control efforts in this watershed focused on these COCs. Refer to Sections 2.0 and 5.0 for more detail regarding specific efforts.

The City implements aggressive source control activities that comply with or exceed the requirements of the NPDES permit requirements. Many of these activities have been developed specifically to respond to sources of contaminants found during various investigations.

Stormwater Management Program The 2019 Permit, effective August 1, 2019, through July 31, 2024, requires the City to implement a Stormwater Management Program (SWMP) which is divided into 11 components, including stormwater outfall sampling, stormwater planning, source control, maintenance, inspections, capital projects, and program development and implementation for the municipal separate storm sewer system (MS4). The City integrates these NPDES program elements with the ongoing Thea Foss Program.

The City's stormwater ordinance, through the 2021 Stormwater Management Manual, requires stormwater treatment and control systems on new and redeveloped sites when certain thresholds are met, and provides a mechanism for enforcement of the stormwater management regulations. Through new development and redevelopment, stormwater runoff from industrial and commercial sites throughout the Thea Foss Basin is being converted over time from untreated to treated runoff (i.e., removal of solids from stormwater runoff).

In 2023, City staff performed numerous field activities within the Foss Waterway Watershed, including the following:

- Responded to 217 spills/complaints including conducting investigations
- Provided technical assistance on source control and best management practices (BMPs)
- Conducted 177 business inspections and follow-ups

All the business inspections, complaints and spills, and various source control field activities are documented and tracked using a web-based database. The web-based database is an effective tool for retrieving historical information and examining trends.

Enhanced Maintenance The City has conducted several special studies over time to better understand the distribution of DEHP and PAHs in the urban environment and how those and other COCs might best be controlled with enhanced maintenance. The following enhanced maintenance elements are currently being implemented in the City:

- Basin-wide sewer line cleaning program to remove residual sediments in the storm drains and sediment-bound contaminants. Contaminants in sediments present in the system may not solely be from new sources but may in part be from legacy contamination in the pipe that could be continuing to impact stormwater or baseflow quality through resuspension and/or dissolution. Based on the effectiveness seen in this program since it was implemented in the Foss Waterway in 2006, the City has expanded this program to include the drainage system throughout the City. Currently, the City is anticipating a 20-year cycle for cleaning of the storm system throughout the City as a part of routine maintenance. The City is continuing to evaluate the need to increase the frequency in this sensitive area.
- An enhanced street sweeping program has been implemented in an attempt to reduce sediment buildup in the storm sewer system. Under the enhanced program, the sweeping frequency was increased, air regenerative sweepers replaced mechanical

sweepers, and the City has also increased communications with residents, which helped raise awareness of the importance of the street sweeping program.

- Finally, in industrial areas, the City is currently conducting a pilot program to evaluate the effectiveness of further increasing the frequency of street sweeping in the industrial areas around the Thea Foss Waterway in reducing the levels of metals in stormwater.

Results of statistical analyses using WY2023 data are included in Section 2 of this report.

THEA FOSS WATERWAY SEDIMENT QUALITY

When the waterway sediment remediation projects were completed, the majority of the sediment surface had no, or very low, concentrations of contaminants present since the surface was either dredged to clean sediments or covered with new, clean capping materials. It was anticipated that ongoing source contributions to the waterway would cause concentrations of contaminants to increase gradually. Over time, the goal is to have the contaminant concentrations equilibrate at a level below the sediment cleanup standards set by the EPA.

The sediments in the waterway are the true barometer of whether additional source controls are needed for compliance with regulatory requirements. Sediment monitoring was performed by the City in 2023. An analysis of the results shows that the data were generally consistent with, or better than, previous monitoring results indicating that the risk of wide-scale recontamination in the waterway remains low. At this time, it appears that waterway sediment concentrations have largely equilibrated with modern sources since the completion of the remedial action in 2006. As a result, the risk of recontamination is not expected to be substantially higher in the future unless there is a change in the nature, strength, or distribution of waterway sources. The next scheduled sediment monitoring event will occur in 2028.

STATUS OF SOURCE CONTROL EFFORTS

In December 2020, EPA determined that the City had fully performed the sediment remedial action in the Thea Foss and Wheeler-Osgood Waterways. As such, and because the waterway sediments have reached equilibrium with modern sources at levels generally below EPA's required cleanup levels for the Superfund site, there is not currently a need for new source control actions. Several source control investigations and actions are underway at this time and will be carried out to completion. The status of these activities is described in Sections 2 and 5 and Appendix A. In addition, if future monitoring identifies the potential of a new source that may be affecting sediment quality in the waterway, additional source control actions will be undertaken.

In addition, the City believes some minor additional improvements in stormwater quality may be realized in the future with ongoing NPDES Permit programs and continuing improvements in source control implementation. Sediment trap results are valuable in that they provide an early warning of potential stormwater sources to the waterway sediments that can be investigated and addressed before Sediment Quality Objective (SQO) exceedances requiring action are identified in the waterways.

2024 Source Control Work Plan A considerable amount of source control work has taken place in the Foss Waterway Watershed over the last 22 years. With the significant improvements realized, fewer source control issues remain and as described above, no new investigations are needed at this time. The Source Control Work Plan for 2024 is included in

Section 6 of this report that identifies specific activities for the watershed and for each basin that are currently underway.

CONCLUSION

Through the City's implementation of its SWMP, as well as through the control of other sources, reduction of contaminant loads to the Thea Foss and Wheeler-Osgood Waterways over the years has been substantial. The improvement in stormwater quality since the mid-1990s indicates that source control efforts by the City and others in the Foss Waterway Watershed have been effective in reducing chemical concentrations in stormwater. Tests performed over the entire project period show 98 percent statistically significant time trends, all in the direction of decreasing concentrations. This result is significant and a testament to the City's ongoing comprehensive source control program[3].

Source control activities currently being implemented by the City include business inspections, response to spills and illicit discharges, mapping/maintenance/cleaning of the stormwater system, source tracing pollutants of concern, and implementation of the City's Surface Water Management Manual through the stormwater ordinance. The City will continue with ongoing source tracing investigations. Ongoing control of sources that are outside the City's jurisdiction must also continue to be coordinated by other federal, state, and local authorities.

It should be noted that while considerable improvements to stormwater quality have been made, the largest changes were realized in the earlier years of the program when major sources were identified and eliminated. Because the source control program has been so effective through the years, fewer major sources or maintenance actions are needed and the program has attained equilibrium or maintenance mode. In other words, the concentrations of COCs in the stormwater discharges to the Foss Waterway Watershed have generally levelled out, meaning few of the more highly contaminated sources are likely connected to these outfalls, thus opportunities for large reductions are limited. The concentrations are low and likely now reflect the ubiquitous nature for some of these COCs in the airshed and general human activities in urban areas. This may over time lead to the appearance of fewer additional decreasing trends in contaminant concentrations, lower percentages of reduction, and potentially even a few minor increasing trends, particularly if looking only at results from more recent years. Overall, the data show that the City's stormwater source control and monitoring program reduced contaminant levels in stormwater and SSPM and that the risk of recontamination of sediments over biological effects thresholds in the Thea Foss Waterway from stormwater is low.

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[3] Copper was added as an analyte in WY2015. As of WY2019, it was determined that sufficient data was available for all seven outfalls to perform an evaluation of time trends, although with less data available, the statistical results will not be fully comparable to data for the remaining constituents. With these seven tests added, there are 51 statistically significant time trends (51 out of 56 tests, or approximately 91 percent of the tests) shown in Year 22. As additional data becomes available, time trends for copper will become more comparable to remaining tests.

1.0 INTRODUCTION

Stormwater monitoring is required under the Thea Foss Waterway Consent Decree (CD) with the Environmental Protection Agency (EPA) and elected by the City to perform under Section S8.B of the Phase I National Pollutant Discharge Elimination System (NPDES) and State Waste Discharge General Permit for Discharges from Large and Medium Municipal Separate Storm Sewer Systems (Permit) issued by the Washington State Department of Ecology (Ecology). To address these monitoring requirements, stormwater monitoring is conducted at seven outfalls in the Thea Foss Waterway and includes collection of event-based composite and grab samples for chemical analysis as well as annual sediment samples for chemical analysis.

1.1 THEA FOSS CONSENT DECREE OVERVIEW AND MONITORING REQUIREMENTS

Under the Foss CD with EPA dated May 9, 2003, the City completed remediation of marine sediments in the majority of the Thea Foss and Wheeler-Osgood Waterways in Tacoma, Washington in March 2006. Remediation of the southernmost 1,000 feet of the Thea Foss Waterway was completed in 2004 by a group of private utilities (Utilities) under a separate CD with EPA. These waterways are narrow estuarine water bodies on the southeastern margin of Commencement Bay, with 13 municipal outfalls that discharge stormwater to the waterways as well as numerous private outfalls. Based on the success of the cleanup, EPA has initiated the process of delisting the Thea Foss and Wheeler-Osgood Waterways from the National Priorities List as part of the Commencement Bay Superfund Site. It is unknown at this time when the delisting will be completed.

With the completion of the cleanup action in the Thea Foss and Wheeler-Osgood Waterways and pending delisting of the site, it remains necessary to continue monitoring and source control activities as required by the CD to ensure sediment quality is protected in dredged, capped, and natural recovery areas. Included as part of the CD Statement of Work, a letter addendum dated November 1, 2001 (identified as Attachment 1 to the CD), provides a detailed schedule and work plan for the City's stormwater source control efforts for the Thea Foss and Wheeler-Osgood Waterways. This addendum, herein referred to as the Stormwater Work Plan Addendum, includes a description of stormwater monitoring efforts, studies, source control efforts, and BMP assessments for municipal stormwater sources.

1.1.1 Representativeness of WY2023 Laboratory Analyses

The WY2024 laboratory quality assurance/quality control (QA/QC) review included 51 stormwater samples and 14 SSPM samples; detection limit performance samples; laboratory and field blanks; laboratory, matrix, and field duplicates; spiked surrogates; laboratory control and matrix samples; and certified reference materials (CRM). Overall, 10,361 sample and QA/QC results were analyzed in WY2204. Data was reviewed, verified, and validated using a Tier II data review level or higher.

This type of analysis is helpful in identifying issues to be addressed when the majority of data quality is acceptable yet may still be improved. In WY2024, 98 percent of stormwater and 99 percent of SSPM data met measurement quality objectives. Only 0.2 percent of the data was classified as censored or rejected. Stormwater and SSPM samples are therefore considered representative. This review is provided in Appendix B.

1.2 PHASE I PERMIT OVERVIEW AND MONITORING REQUIREMENTS

Monitoring is also performed to meet the requirements of the NPDES Phase I Permit (Permit). Ecology issued the most recent Permit on July 1, 2019, with an effective date of August 1, 2019, and an expiration date of July 31, 2024. This Permit required the City to develop an updated QAPP and submit the final plan before August 2020. The 2020 QAPP (Tacoma 2020b) was approved in August 2020 and went into effect beginning October 1, 2021, and remained in effect for WY2023 monitoring. The 2020 QAPP, developed in accordance with Section S8.C and Appendix 9 of the Permit, provides details on the stormwater discharge monitoring component in place for stormwater monitoring beginning in WY2021.

In WY2023 an updated QAPP was prepared to address several changes in the sampling program. This updated QAPP was approved by EPA and Ecology in December 2023 and is in effect for WY2024 monitoring (Tacoma 2023).

The Permit applies to all entities in Washington State that are required to have stormwater permit coverage under current (Phase I) EPA stormwater regulations. Section S8 – Monitoring and Assessment of the Phase I Permit includes two separate components with multiple compliance options for municipalities. The City has chosen the following activities to meet the obligations outlined in this section:

- **S8.A Regional Status and Trends Monitoring** –The City has elected to make the annual payments into a collective fund for Section S8.A to implement regional receiving water status and trends monitoring of small streams and marine nearshore areas in Puget Sound.
- **S8.B Stormwater Management Program Effectiveness Monitoring and Source Identification Studies** – The City has selected Option #2 to meet the requirements under S8.B. Section S8.C.2.a encourages the City to continue monitoring the same five locations that were monitored under Section S8.C of the Phase I Municipal Stormwater Permit August 1, 2013 – July 31, 2018.

1.3 GOALS AND OBJECTIVES

The goal of the stormwater characterization monitoring is to meet the requirements of the Foss CD and Section S8.B of the Permit. The goals of both programs generally involve:

- Measuring the effectiveness of stormwater source control actions, confirming that reductions in concentrations of target analytes have been realized, and confirming that recontamination from stormwater sources is not occurring. This is achieved by gathering data to identify trends in the quality of the water.
- Providing an early indication of any new water or sediment quality problems associated with the storm drains.
- Informing decision-making regarding additional source controls.
- Tracing sources of contamination to outfalls using sediment traps.

The objectives are accomplished through performance of the following:

- Provide Ecology and EPA with data characterizing the quality of the water and sediments discharging into the Thea Foss and Wheeler-Osgood Waterways.

- Collect and submit for analysis representative composite and grab stormwater samples during stormflow events from all seven outfalls.
- Collect and submit for analysis representative annual sediment samples at specified locations.
- Produce an annual report documenting activities associated with the sampling and analysis effort, a quality assurance review of field and laboratory data, and an evaluation data relative to continuing source control efforts and report to Ecology and EPA.

1.4 BACKGROUND

1.4.1 Remedial Action Description

In 2006, the City completed remediation of marine sediments in the Thea Foss and Wheeler-Osgood Waterways. The remedy for the waterway included a combination of natural recovery, dredging, and capping. The dredged material was disposed of in a nearshore confined disposal facility in the nearby St. Paul Waterway.

In general, the remedy included the following elements:

- No action at the mouth of the waterway, an area of clean sediments.
- Natural recovery north of East 11th Street, an area where low-level contamination was expected to recover to below the sediment quality objectives (SQOs) within the first 10 years following remediation, and which is currently below required navigational depths.
- Some combination of dredging (complete or partial) followed by capping over any residual contaminated sediment in the area from the East 11th Street Bridge to just north of the State Route (SR) 509 Bridge. Note that the authorized channel depth requirements are generally maintained in this area.
- Capping (by others, referred to herein as the Utilities) from just north of the SR509 Bridge to the head of the waterway to maintain a depth of 10 feet Mean Lower Low Water (MLLW). Deauthorization of the federal navigation channel in this area was required to eliminate the need to maintain authorized channel depths and was approved as part of the Water Resources Development Act (WRDA) Bill of 2007.

Other remedy features included:

- Construction of intertidal habitat as mitigation for construction impacts;
- Dredging to maintain authorized depths in the active navigation channel;
- Capping of about 20 acres of sediments in channel and harbor areas;
- New slopes and erosion protection on about 10,000 feet of shoreline.

In December 2019, EPA determined that the remedial action work that the City was required to perform under the Consent Decree with EPA had been officially completed and they have initiated the process to delist the waterway from the Commencement Bay Superfund Site. Long-term monitoring and maintenance work for containment and mitigation areas will continue under the Long-Term Monitoring Plan, along with stormwater monitoring under the Stormwater Work Plan Addendum as the only remaining work under the Consent Decree.

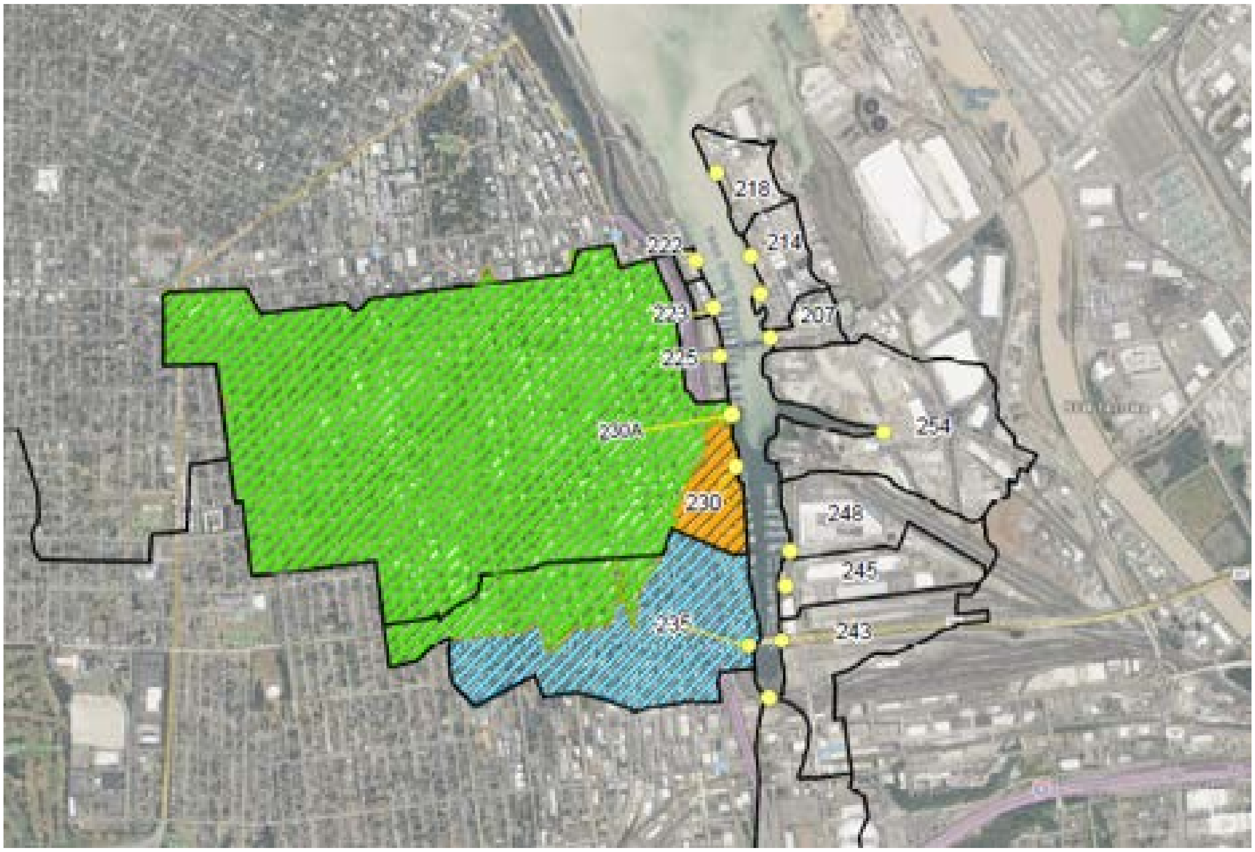
1.4.2 Drainage Basin Description

The Thea Foss and Wheeler-Osgood Waterways are estuarine waterways on the southeastern margin of Commencement Bay. In Commencement Bay and the waterways, average tidal fluctuations vary from 0 feet MLLW to 11 feet MLLW. Extreme tides, which generally occur in June and December, range from approximately –4.0 feet MLLW to 14.5 feet MLLW. The Thea Foss Waterway lies generally north-south along the City's downtown corridor. The Wheeler-Osgood Waterway lies west-east and connects to the east side of the Thea Foss Waterway just south of the Murray Morgan (11th Street) Bridge. The Thea Foss and Wheeler-Osgood Waterways are commonly referred to as the Thea Foss or Foss Waterway and are referred to herein as the Foss Waterway. The drainage area tributary to the Foss Waterway is referred to herein as the Foss Waterway Watershed.

The Foss Waterway Watershed is one of nine watersheds in the City (see Figure 1-2). This watershed covers approximately 5,864 acres and is comprised of drainage basins located in the south-central portion of Tacoma. The area borders the North Tacoma Watershed on the north, Lawrence Street on the west, and East "F" to East "K" Streets on the east. The area extends as far south as South 86th Street and includes portions of the Tideflats on the east side of the Foss Waterway.

Prior to December 2022, the primary municipal outfalls to the Foss Waterway monitored under the Foss Waterway Monitoring program were OF237A and OF237B (the twin 96ers), OF230, OF235, OF243, OF245, and OF254. These seven outfalls covered 5,750 acres (98%) of the watershed. There are also several other smaller outfalls that discharge to the waterway. The City began construction in 2021 on a new stormwater pipeline and its new 60-inch stormwater outfall discharging to the Thea Foss Waterway (OF230A). The existing stormwater system discharging to OF230 and OF235 did not have sufficient capacity to convey runoff generated during significant storm events occurring in the downtown area. OF230A was under construction during WY2022 and a portion of WY2023. Stormwater runoff and any baseflow from upstream drainage areas and the associated conveyance system (catch basin inlets and pipes) was connected to the new pipeline at several locations and thus discharged to the waterway through the new outfall in mid-December 2022.

OF230A drains approximately 98 percent of the stormwater previously discharging to OF230 and approximately 26 percent of the stormwater previously discharging to OF235 as shown in the Figure below.



Due to the re-routing of stormwater from OF230 to OF230A, there was insufficient stormwater flow at OF230 to collect monitoring samples at this location. The City began monitoring the new OF230A on April 12, 2023. Flow and stormwater monitoring continued at OF235 as stated in the amended QAPP although the discharge area changed during the water year.

The City is evaluating the existing flow data at all three monitoring locations and will evaluate sampling data from the OF230A monitoring location as it becomes available. This data will be used to: 1) determine changes in flow/chemistry in the existing OF235 2) establish flow/chemistry metrics at the new outfall (OF230A) 3) continue to evaluate the flow regime at OF230, and 4) evaluate data to assess if past conditions are representative of the newly changed conditions. Any changes to the statistical analysis, rainfall to runoff relationships and flow regime changes will be discussed in the City's annual report update. Primary land uses in the basins draining to each of the major outfalls and the changes with this new outfall configuration are reflected in the table below.

Outfall	Historic Area (Ac)	Current Area (Ac)	Land Use
230	558	24.2	Commercial
230A	-	583	Residential and Commercial
235	166	109	Commercial
237A	2,813	2813	Residential and Commercial
237B	1979	1,979	Residential and Commercial
243	59	59	Industrial and Commercial
245	39	39	Industrial
254	127	127	Industrial

Additional details describing the drainage area changes and the new OF230A drainage area details are discussed in Appendix B, Section B.2.2 Monitoring Locations. Overall, land use in the watershed is predominately residential, although most of the City's commercial businesses are also located in this watershed (see Figure 1-3). There are some industrial uses, which are concentrated mainly in the eastern Tideflats areas and Nalley Valley portions of the watershed.

Several of the outfalls discharging to Foss Waterway are tidally influenced, and portions of the pipe are inundated with marine water twice a day depending on the pipe elevations and the tide height. Continuous or tidal baseflow is also present in some of the outfalls. Baseflow in OF230A, OF235, OF237A, and OF237B is continuous. In OF237A and OF237B, this baseflow is derived from old creeks and seeps that were piped and/or infiltrating groundwater. In OF230A and OF235, this baseflow consists of groundwater and/or noncontact cooling water. Baseflow in eastside outfalls OF243, OF245, and OF254 is seasonal (i.e., higher in the winter and lower in the summer) and is believed to be due to groundwater infiltration due to the high-water tables in the Tideflats area.

Since 2001, the City has performed a significant amount of sampling and analysis of the storm drains entering the Foss Waterway. Over the last 22 years, 2,390 samples have been collected, with 366 baseflow and 1,514 stormwater samples collected at the outfalls, and 134 outfall and 376 upline SSPM samples (128 outfall and 368 upline). The purpose of the sampling efforts is to evaluate the quality of stormwater discharges to the Foss Waterway and the effect of those discharges on sediment quality. Early in the program, the results of these efforts were used in an overall evaluation of source loadings to the waterway to predict whether municipal stormwater discharges would be protective of sediment quality following remediation. Prior to beginning remedial action projects, EPA determined that sufficient source control was in place to complete the work. Now the results of stormwater monitoring are used to evaluate the effectiveness of source control efforts, and to provide early warning of any new problems which may arise in the drainages. In addition, the results are used to track changes in stormwater quality and to document the improvements that have been realized over time due to source control and other efforts.

1.4.3 Contaminants of Concern

COCs are those contaminants that were identified through sediment monitoring and model predictions to have the greatest potential to compromise sediment quality in the waterways following remediation. They were, therefore, the primary target for source control activities for the municipal storm drains as well as for other potential sources that are largely not in the City’s control. DEHP and various PAHs are the primary COCs for the Foss Waterway and have therefore been the primary focus of source control activities to date. In addition, residual concentrations of other legacy COCs for which sources have largely been controlled through regulatory bans or restrictions are continuing to be monitored. These legacy COCs include mercury and polychlorinated biphenyls (PCBs). Source control activities have also been conducted for these COCs.

1.5 Thea Foss Post-Remediation Source Control Strategy

For ongoing evaluation of the municipal stormwater discharges and their relation to future sediment conditions in the waterway, the City established a source control strategy. This strategy is set forth in Figure 1-1.

The City is continuing to implement a comprehensive stormwater monitoring program in the Foss Waterway Watershed. The results of these efforts have been used over time to focus source control efforts and to assess the source control program's effectiveness. The various components of the post-remediation source control strategy are described in more detail throughout this report.

The City is committed to an ongoing program of stormwater source control to maintain and enhance stormwater quality in the Foss Waterway Watershed. The City will implement all "reasonable and practicable" controls necessary to improve stormwater quality and comply with regulatory standards. "Reasonable and practicable" shall take into consideration maintenance requirements, flood control, and cost in comparison to the effectiveness achieved or expected in reducing contaminant loads to the Foss Waterway.

The remainder of this report is as follows:

- Section 2.0 provides a summary of the source control activities performed during 2022 in the Foss Waterway Watershed.
- Section 3.0 presents the results of the Water Year 2001-2022 stormwater and storm sediment monitoring.
- Section 4.0 presents the results of the Foss Waterway sediment monitoring, when new data are available.
- Section 5.0 provides an update on the evaluation of program effectiveness for the Thea Foss Source Control Strategy.
- Section 6.0 presents a summary of the conclusions, pollutant loading analysis, and recommendations.

2.0 SUMMARY OF SOURCE CONTROL ACTIVITIES

The NDPES Phase I Permit, effective August 1, 2019, through July 31, 2024, requires a SWMP, which is divided into 11 components. One of these components is source control. The City integrates this NPDES program element with the ongoing Thea Foss Program to protect the sediment remedy in place in the waterway.

The source control activities performed in 2023 are summarized in Section 2.1, including those associated with the 2023 Source Control Work Plan and those associated with the City's Permit as part of the City's SWMP. Section 2.2 discusses overall requirements of the NPDES Phase 1 Permit, and finally, Section 2.3 presents a summary of the special studies that have been conducted under the Thea Foss Program relevant to source control within the Foss Waterway Watershed.

2.1 SOURCE CONTROL ACTIVITIES COMPLETED IN WY2023

This section provides a summary of source control activities performed in 2023 in the Foss Waterway Watershed. These activities are further detailed in Appendix A, and where relevant, in the specific outfall work plan sections.

Results from WY2023 sediment trap monitoring used in source control investigations is described below in Section 2.1.1 and a status update on source control activities performed under the 2023 Source Control Work Plan is provided in Section 2.2.2.

2.1.1 Stormwater Suspended Particulate Matter (SSPM) Monitoring

SSPM monitoring has been used over time in identifying potential problem areas in sub-drainage systems. Multi-year sampling is used to confirm an ongoing problem area or to confirm control/resolution of an issue. Between WY2002 and WY2023, upstream monitoring has been performed in most of the Foss drainage basins. Table 2-1 lists the upstream monitoring locations as well as the end of pipe sediment trap locations for each of these years.

The drainage basins and SSPM data are shown graphically in Figures 2-1.1 through 2-1.4 for four of the key COCs (i.e., mercury, total PAHs, total phthalates, and total PCBs). These figures show each outfall and upline sediment trap location and the relative level of concentration for that location for that year. The levels of concentrations are color-coded as low, medium, and high concentration ranges with each additional year stacked on the previous year. These levels are set without regulatory basis, but rather were set at the beginning of the sampling program at concentrations based on the data collected to allow for meaningful comparison between monitoring locations and identify areas that were different from others, requiring follow up action.

Low concentration ranges (green) represent concentrations that are similar to other locations with no need for additional source control efforts currently. Medium concentration ranges (yellow) represent concentration levels that are slightly higher than other locations. For locations with medium levels, additional source control actions were initiated in some areas but were at a lower priority in comparison to other locations with higher levels that were determined to be of greater impact. High concentration ranges (red) represent concentration levels above and beyond other locations in the Foss Waterway Watershed, and the need for additional source control was greater in comparison to other locations.

In WY2023, SSPM data for the most part remained the same. However, a few locations increased and a few decreased in concentration as summarized below:

- **Mercury**: Consistent with the past several years, no locations were measured in the high-level range during this monitoring year. One location, FD3A/FD3C[4] (OF230A), was in the moderate range in WY2023 (see Figure 2-1.1). No sample was obtained from FD23 in WY2023 due to low sample volume. Locations with current or recent concentrations in the moderate range are described further below:
  - At FD3A/FD3C (OF230A), concentrations were in the low range since WY2015. The WY2021 concentration was 0.232 mg/kg, just above the 0.20 mg/kg level that was established to evaluate relative concentrations on Figure 2-1.1. No sample was obtained in WY2022 due to ongoing construction activities in the area. This location will continue to be monitored to determine whether these moderate level detections resolve and during 2024 staff will evaluate the need for additional mercury investigations in this area.
  - At MH390 (OF245), concentrations were in the low range since the beginning of the monitoring period in WY2002. The WY2022 concentration of 0.211 mg/kg was just above the 0.20 mg/kg level established to evaluate relative concentrations on Figure 2-1.1. In WY2023 mercury concentrations were back in the low range at 0.0683 mg/kg. WY2024 sediment trap results will be reviewed to confirm the WY2022 result was an anomaly.
  - At location FD23 (OF243), levels were consistently in the moderate range between WY2007 and WY2022. Concentrations during this period ranged from 0.206 mg/kg to 0.661 mg/kg with the highest concentration observed in WY2018 and the lowest concentration in this range observed in WY2021. The WY2022 concentration was 0.2140 mg/kg, remaining in the low end of the range. No analysis was performed at this location in WY2023 due to low sample volume. Considerable source control activities for mercury have been performed in this basin and follow up work is continuing at this time. A new potential source was identified in 2019 and source control is ongoing. Resampling of the catch basin source occurred in 2022, and the concentration remained elevated although lower than previously detected. In 2023 staff met with the business owner and reviewed system cleaning work in the area. Due to insufficient sediment in the FD23 sediment trap there was no mercury analysis for WY2023. Staff will continue to review sediment trap results and work with property owners for on-going investigations in WY2024.
- **PAHs**: In WY2023, there were no locations with PAH concentration above the level established for medium or high-level relative concentrations as shown on Figure 2-1.2. Until 2021, PAH concentrations in sediment trap FD13B New (OF237A) had fluctuated between the medium and the high range since it was installed in WY2013. The WY2021 concentration of total PAHs detected at this location dropped to the low range with a concentration of 159,944 µg/kg, down from a concentration of 282,110 µg/kg detected

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[4] Due to the construction of OF230A and the re-routing of the drainage area, FD3A was removed in WY2022 and replaced in March 2023 in an upstream manhole after construction was completed. FD3C represents a similar drainage area to the historic FD3A.

in WY2020. Levels reduced further in WY2022 with a measured concentration of 142,919 µg/kg, and in WY2023 with a concentration of 58,296 µg/kg. A source control investigation was initiated in this area in WY2014 and continued as additional sources were identified and at this time there are no active investigations for PAHs in this basin The City will continue to monitor sediment trap results in FD13B-new to determine if there are any additional sources of PAHs in this drainage area. Additional discussion of this work is included in Section 5.3.

- **Total Phthalates**: All sediment trap concentrations have been in the low range since WY2014 (see Figure 2-1.3).
- **Total PCBs**: One location, FD3A/FD3C (OF230A) was in the high-level range during WY2023 sampling (see Figure 2-1.4). Locations with current or recent concentrations in the moderate range are described further below:
    - Concentrations at FD3A/FD3C (OF230A) have been in the high-level range since WY2013. Detected concentrations between WY2017 and WY2021 ranged from 550 µg/kg to 3,600 µg/kg. No sample was obtained from FD3A in WY2022 due to ongoing construction activities. The sediment trap was installed at a slightly different location in March 2023, and sample collected in August 2023 had a high-level concentration of 485 µg/kg. A source control investigation has been underway in this area for the last several years. Several sources have been identified and some are in the process of being removed. The City is continuing to work with the property owners and regulatory agencies to complete source control actions at these properties (see Section 5.1).
    - Concentrations in FD16 (OF230) fluctuated between low and medium levels from WY2007 to WY2021. The WY2022 concentration of 663 µg/kg was more than double the WY2021 concentration of 170 µg/kg. A source control investigation was conducted in this area between 2017 and 2019, leading to the cleaning of public and private storm systems in the vicinity. With the increasing concentrations in WY2022, additional source control actions were initiated in 2023 and will continued to be investigated during 2024. See Section 5.1. PCBs were not detected in the sediment trap at this location in WY2023.
    - FD10C (OF237A) fluctuated between medium and high levels from WY2013 to WY2022. Concentrations during this time period have ranged from 130 µg/Kg to 1300 µg/kg. The WY2022 concentration of 165 µg/kg was the third year of a decreasing trend at this location following source control efforts, and PCBs were not detected at this location in WY2023. The source control investigation for this basin has been completed and sediment trap data will continue to be reviewed and additional investigations will be conducted if concentrations increase. Additional information can be found in Section 5.3.
    - FD18 (OF230) varied between moderate and high concentrations since WY2011. The lines in this area were cleaned in 2015, and subsequently concentrations climbed to 790 µg/kg in WY2018, 2,200 µg/kg in WY2019, and 5,300 µg/kg in WY2020. A source control investigation was conducted and identified a source which was removed in WY2020. The WY2021 concentration dropped to 780 µg/kg, a significant drop, but still in the high

range. WY2022 results dropped further to a moderate level concentration of 225 µg/kg, and PCBs were not detected at this location in WY2023. There are no further investigations planned for this basin. Sediment trap data will continue to be reviewed and additional investigations will be conducted if concentrations increase. (see Section 5.1).

- WY2020 concentrations in FD2 (OF237A) were measured in the medium range (390 µg/kg) for the first time since WY2015. In WY2021, results decreased to 180 µg/Kg, still in the medium range. PCBs were not detected in FD2 in WY2022 or WY2023.There is no known cause for the intermittent increases in concentration.
- Concentrations at FD3-New (OF230) were at medium levels between WY2015 and WY2017 but were not detected at this location in WY2018. In WY2019, concentrations returned to medium levels (350 µg/kg) and in WY2020, more than doubled to an elevated level of 910 µg/kg. In WY2021, concentrations returned once again to medium levels at 300 µg/kg, in WY2022 were at the low level concentration of 64 µg/kg, and were not detected in WY2023. FD3-New previously had relatively high levels measured between WY2004 and WY2007, but those decreased to low levels between WY2008 and WY2013 following cleaning of the lines in the drainage basin. The lines were cleaned again in early 2015.
- Due to rerouting of the drainage area for the new OF230A, the FD3-New Sediment trap no longer receives discharges from the FD18, FD3A/FD3C, and FD16 drainage areas. These areas discharge to the new OF230A and the new FD7 sediment trap. The City will evaluate the FD7 sediment trap data to determine if there are any ongoing issues in this basin.

Over the 22-year monitoring period, the number of sites with concentrations at the medium and high levels has decreased significantly. This is a good indicator of the effectiveness of the source control program. A few sediment traps results show medium and high level fluctuation as compared to the other sites in the Foss Waterway Watershed and are therefore still have ongoing source control work.

Detailed data results by basin are discussed in Section 5.0 of this report. The City will continue to conduct SSPM monitoring using sediment traps at the outfalls and at selected upstream locations in several drainage basins where needed for ongoing source control investigations.

2.1.2 2023 Source Control Work Plan Status

Tacoma submitted the 2022 Stormwater Source Control Report and Water Year 2022 Stormwater Monitoring Report on March 31, 2023 (Tacoma 2023b). In this report, the City recommended several source control activities in the 2023 Source Control Work Plan (referred to herein as the 2023 Work Plan).

A majority of the recommended tasks from the 2023 Work Plan were completed or are ongoing at this time. Activities from the 2023 Work Plan and their status are as follows:

- **OF230:** Continue follow-up on private property cleanups performed, and complete ongoing system cleaning and monitoring for PCBs and PAHs as appropriate in the areas draining to FD3A, FD3A New, FD18 and FD16.

  Status: Significant work has been underway in this area since 2012, and several Mercury, PCB, phthalate, and PAH sources have been identified and controlled. Several areas of concern have been the subject of ongoing work:

  - South 12th Street and Pacific Avenue (PCBs): Due to construction in the area, the FD3A sediment trap was removed in WY2022 and has been permanently replaced with the FD3C sediment trap. While FD3C is in a slightly upstream location, it is considered representative of the same drainage area as FD3A. WY2021 sediment trap results for FD3A had continued to show elevated PCB concentrations (550 µg/kg). Source control actions are continuing in this area and additional catch basin sampling performed in the area indicated either a continued source, or insufficient cleaning performed post source control actions previously performed. The City cleaned the catch basins in this area at the end of 2022. During 2023, staff attempted to sample the catch basins surrounding the Wells Fargo complex and 1123 Pacific Avenue and found there was insufficient sediment available for sample collection. Staff will attempt to sample the targeted catch basins surrounding the entire Wells Fargo Complex and in front of 1123 Pacific Avenue early in 2024 to determine if the sources of PCBs are ongoing or if the remediation at these locations were successful.

  - South 9th Street and Fawcett Avenue (PCBs): Following completion of building remediation in 2020, the storm system was cleaned. In September 2021, sediment samples were taken from adjacent catch basins, and elevated PCB concentrations were detected. At the City's request, the property owner pressure washed the sidewalks to remove residual materials. In 2022, a construction project began at this location, which involved the removal and replacement of all of the curb/gutter and sidewalk at this intersection. The project also removed one of the catch basins sampled during this investigation. Sediment trap PCB concentrations in FD18 have continued to decrease since remediation work was completed in 2020. PCB concentrations dropped to from high to medium levels for the first time since 2017 in this basin and were below detection limits in the 2023 FD18 sediment trap sample (see Figure 2-1.4). There are no further investigations planned for 2024. Sediment trap data will continue to be reviewed and additional investigations will be conducted if concentrations increase.

- South 13th Street and Commerce Street (PCBs): The catch basins in this area will be cleaned in 2024 and resampled when sufficient sediment is present. Based on the findings of this next round of sampling site inspections will be scheduled if necessary to look for the sources of contaminants in the adjacent structures.

- South 10th Street and Pacific Avenue (PCBs): The City is continuing to work with the EPA to develop a remediation plan for the Park Plaza North parking structure. There was no movement towards remediation for this site during 2023.

- South 14th Street and "A" Street (PAHs): Throughout 2022, the City continued to work with the property owner to fix a damaged drainage pipe that was allowing sediments to enter the system. The property owner obtained a permit from Ecology in 2022 and the repair was completed in October 2022. Both the municipal and private systems were cleaned in November 2022. Public catch basins will be resampled in 2024 when sufficient sediment has accumulated.

Reports describing the investigations performed to date in this area and the status of each are included in Appendix A.

- **OF230/OF235:** Continue to evaluate potential sources of spring/summer outliers for copper to stormwater.

  Status: No copper outliers were observed during WY2020 sampling; however, one moderate outlier was detected in OF230 and two extreme outliers in OF235 in WY2021 sampling. All the WY2021 outliers were detected in the spring. No outliers were detected in WY2022 or WY2023.The City will continue to watch for these outliers and is investigating potential sources. One potential source was identified as discussed in Appendix A.
  The City worked with the property manager at the Union Station to clean their private drainage system and will resample these catch basins when sufficient sediment has accumulated.

- **OF235:** Evaluate the need for additional source control work for lead, copper, and DEHP in stormwater following completion of construction activities in this area. These construction activities are expected to have a positive impact on controlling the flow of potentially contaminated groundwater into the storm drainage system.

  Status: During 2023, the City continued to monitor the sites in this area with active construction to ensure proper BMPs were maintained. Upon completion, it will be determined whether construction in this area will eliminate runoff from possible contaminated groundwater in this drainage basin. This project was on hold until the new Foss Waterway outfall construction I and the rerouting of the stormwater system was completed in December 2022.It is anticipated that construction for the Tacoma Town Center Jefferson Street Project will continue in 2024. In December 2022, a stormwater collection pond at the construction site was connected to the City's stormwater system and will be in place through the end of the project.

- **OF237A:** Continue to work in the area at and around The News Tribune to eliminate source(s) of PAHs to the municipal drainage system. Monitor upcoming SSPM results and catch basin sample results near FD13B-New to evaluate whether source control work done to date in this area has been successful in eliminating this source.

  Status: This investigation has been ongoing for several years, with medium range PAH concentrations present in FD13B-New through WY2020, before dropping to the low range in WY2021 where they remained in WY2022. In 2021, staff discovered an additional property that has stormwater discharge to this system. Catch basins from that property showed high concentrations of PAHs, and the property owner was asked to clean their entire system. In 2023, EC staff received confirmation that all parking lot repairs were completed, and that the private stormwater system had been cleaned post-construction. WY2023 Sediment trap results exhibited a significant decrease in PAH concentrations with a concentration of 58,330 ug/Kg, which is significantly lower than what is classified as relative low levels of contamination (<164,000 ug/Kg) (see Figure 2-1.2). Based on these results, no investigations are planned in this basin for 2024. The City will continue to monitor the sediment trap results to determine if there are any additional sources of PAHs in this drainage area.

  A report on the status of this investigation is included in Appendix A.

- **OF237A:** Continue evaluation of possible sources of PCBs to FD10C.

  Status: During 2021, additional sampling showed no apparent sources of PCBs. In 2022, an additional investigation was performed to confirm that there were no errors in the mapping that might lead to identification of a potential source. With that mapping information confirmed, the City continued the investigation with installation of short-term sediment traps at two new locations in attempt to isolate the source. Results from these short-term traps exhibited non-detectable levels of PCBs. Additionally, the FD10C sediment trap had non-detectable levels of PCBs for WY2023. It is possible that the source of PCBs was historical contamination, and the system cleaning removed this contamination. No investigations are planned in this basin for 2024. The City will continue to monitor the sediment trap results to determine if there are any additional sources of PCBs in this drainage area.

  A report describing the investigation completed to date is included in Appendix A.

- **OF237A:** Evaluate potential sources and seasonality of occasional outliers of indeno(1,2,3-cd)pyrene and other PAHs in stormwater.

  Status: Periodic high outlier concentrations of indeno(1,2,3-cd)pyrene have been detected in this basin over time, including some higher concentrations in WY2021 and an extreme outlier in WY2022 (see Figure G-6). Overall concentrations are significantly reduced over concentrations identified early in the 22-year monitoring record. However, because of these occasional elevated concentrations, the City will initiate review of potential unidentified sources of indeno(1,2,3-c,d)pyrene and other PAHs in this drainage basin.

- **OF243:** Perform follow-up work with the business owner and system cleaning work in the area where elevated mercury concentrations were identified in catch basins in the FD23 drainage area.

  Status: During 2023 staff resampled the identified catch basin to determine if there is an ongoing mercury issue at that location. The catch basin was sampled on June 21, 2022, and the results were 1.38 mg/kg. Catch basin concentrations continue to trend downward and there are no other probable sources to investigate at this location. During 2023, EC staff requested to have the catch basin re-cleaned and will re-sample after sediment accumulates to determine if there is a continued source or residual contamination from the previously remediated source. During 2023 there was insufficient sediment to analyze for mercury. The analyte priority list has been updated to mercury as the highest priority.

- **OF243/OF245/OF254:** Continue evaluation of the effectiveness of the street sweeping pilot project on lead and zinc concentrations in the industrial area as additional data becomes available.

  Status: The City initiated a pilot program in WY2014 that continued through WY2023 to determine whether an increased frequency of street sweeping in this area would influence elevated lead and zinc concentrations in stormwater and baseflow in this area. Starting on October 1, 2013, the City began sweeping the right-of-way (ROW) within the OF243 and OF245 drainage basins at a frequency of once every two weeks rather than the usual frequency of once per month for industrial areas. An evaluation of the effectiveness of this increased sweeping frequency on metals reductions has been performed since WY2017 and is discussed in more detail in Section 2.3.2. Note that while initial results appear promising, the statistical analysis will be more robust in future monitoring years as more data becomes available. The pilot project is continuing in WY2024.

Other tasks conducted under the Source Control Program are:

- Continue Foss Stormwater Monitoring for WY2024.

  Status: WY2023 stormwater monitoring was completed on September 30, 2023, and WY2024 stormwater monitoring is currently underway.

- Review WY2023 SSPM data in all areas when available to evaluate the effectiveness of treatment systems installed and confirm the effectiveness of source control actions that have been taken over time.

  Status: Data review completed. An evaluation of these results is included in Sections 3.0 and 5.0 and summarized above. Generally, stormwater facilities are inspected once per year and maintenance performed as indicated by inspection results. The City has a twenty-year cleaning cycle for drainage systems throughout the City. Determination of whether a more frequent maintenance schedule is needed in the Foss Basins will continue to be statistically evaluated as additional data become available.

- Monitor the major construction activities throughout the watershed including the Washington State Department of Transportation (WSDOT) Nalley Valley Viaduct/SR-16 rebuild.

  Status: Ongoing. Major construction projects occurring in each basin are discussed in Section 5.0 as applicable.

- Monitor and conduct inspections at new developments as completed to review appropriate BMPs for each site.

  Status: Inspections at new developments continue, including the inspection/approval of new BMP treatment devices.

- Implement the City's Stormwater Management Manual, 2021 Edition.

  Status: The 2021 Stormwater Management Manual is currently being implemented for projects with applications submitted on or after July 1, 2021.

- Continue NPDES business inspections program and document the inspections using the business inspections database. Respond and track all complaints/spills in the complaints database.

  Status: Business inspections and spill/complaint response is continuing, and activities are tracked in the database. A summary is provided in Appendix A.

- Monitor Tacoma-Pierce County Health Department (TPCHD) and Ecology underground storage tank/leaking underground storage tank (UST/LUST) removal projects along with any other remediation projects in the watershed.

  Status: Ongoing. A summary of UST/LUST work performed under TPCHD oversight in 2023 is included in Appendix A.

2.2 CITY OF TACOMA PHASE I MUNICIPAL STORMWATER PERMIT

The Phase I Permit regulates the discharge of stormwater to surface waters and groundwaters of the state from the City's MS4. The Permit is designed to protect and improve the water quality of receiving waters by implementing stormwater management activities. Tacoma's SWMP describes the City of Tacoma's plan for meeting goals and managing stormwater in compliance with the Permit.

The 2019-2024 Permit included a requirement that a new Stormwater QAPP be developed for this sampling program. Data reported in this monitoring report was performed in compliance with the 2020 QAPP developed under the 2019-2024 permit.

The City's SWMP progress are summarized in an NPDES Annual Report. The NPDES Annual Report is used as a tool to assess the City's progress and to determine whether any changes to the SWMP procedures or priorities are needed to fulfill the permit obligations. The SWMP is evaluated annually, and updated when necessary, based on the annual report and program assessment.

2.2.1 City of Tacoma Stormwater Management Program

The City is considered a leader in responding to water quality issues related to urban runoff. The City's activities have included pioneering efforts in water quality testing to identify pollutants in stormwater runoff as early as 1980. Other efforts have included investigating source control and treatment of stormwater pollutants like phthalates. The Tacoma City Council and Tacoma's Surface Water Utility ratepayers have supported substantial rate increases in recognition of the importance of protecting and enhancing the water quality in Commencement Bay and our freshwater lakes, wetlands, and streams in the face of increasing stormwater runoff and pollutant loads from urban development, increased traffic, and population pressure.

The City's established goals further emphasize its commitment to meeting the water quality goals under the Permit. These priorities include the following:

- Manage stormwater to minimize flooding, erosion, and contamination
- Mitigate the impacts of increased runoff from urbanization
- Manage runoff from developed properties and those under development
- Protect the health, safety, and welfare of the public
- Correct or mitigate existing water quality problems
- Restore and maintain the chemical, physical, and biological integrity of waters in the City for the protection of beneficial uses
- Develop and put into place a cost-effective, affordable SWMP
- Educate the public about what they can do to help keep our waters clean

The Science and Engineering Division, Operations and Maintenance Division, and Environmental Compliance Section of the Environmental Services Department administer Tacoma's SWMP. Staffing and budget are designed to meet the program goals and challenges described above. Current work includes:

- Inspecting business activities and educating businesses about BMPs to reduce stormwater impacts
- Collecting and evaluating stormwater and sediment quality monitoring data
- Implementing a source control and illicit discharge screening program throughout the City's nine watersheds
- Mapping, maintaining, and cleaning the City's stormwater system that includes approximately 500 miles of storm pipe, 10,000 manholes, 19,000 catch basins,

450 outfalls, four pump stations, and over 130 stormwater ponds and other treatment and flow control facilities

- Managing the City's tree canopy cover and open spaces to maximize stormwater benefits
- Rehabilitating and replacing aging infrastructure and improving the storm system with capital projects to address identified flow control and water quantity issues; infrastructure assessment of areas in need of attention is done using crawler cameras
- Providing public education about the impacts of polluted runoff and practices to reduce those impacts to create behavior change in target audiences ranging from school-age children and homeowners to property managers and builders
- Coordinating our activities regionally through watershed councils, NPDES permit-holder committees, and others
- Permitting and inspecting new and redevelopment construction projects to help them comply with stormwater requirements including erosion control, maximizing onsite management, use of Local Improvement Districts (LID), stormwater treatment, flow control, wetlands protection, and ongoing maintenance
- Provide staff training to ensure the City activities and operations minimize impacts to stormwater and receiving waters

City-wide activities are expected to benefit the quantity and quality of stormwater discharges to the Foss Waterway as well as discharges to other receiving waters throughout the City. The SWMP is evaluated annually and updated, when necessary, based on the annual report and program assessment that will continue to supplement and enhance the City's existing program activities.

2.2.2 2023 Business Inspections/Spills/Complaints

The City began conducting stormwater business inspections prior to 1984 as part of its delegated responsibility to implement Ecology's NPDES sanitary sewer pretreatment program. Subsequently, the inspection program was intensified in the Foss Waterway Watershed in response to EPA's identification of municipal outfalls as a potential source of contaminants to the Foss Waterway, which had been identified as a problem area within the Commencement Bay Superfund Site. In 2002, under the CD with the EPA for the Foss Waterway Superfund Cleanup, the City further expanded its comprehensive source control program in the Foss Waterway Watershed. The City expanded its Source Control Program city-wide to fulfill the 2007 Phase I NPDES Permit requirements.

The current source control program is managed by the Environmental Services Department and includes the following:

- Inspecting multi-family units (i.e., those that include four or more residential units) in addition to businesses and industries. Inspections address both stormwater and sanitary compliance.
- Providing information on BMPs and program literature directly to businesses during site visits (which are available in the City's Stormwater Management Manual).
- Educating the general public and businesses on BMPs and City environmental programs.

- Inspecting and signing off on commercial drainage facilities. This inspection also provides an educational opportunity for Environmental Compliance (EC) inspectors to review operation and maintenance requirements with the builder or owner.
- Continuing to implement the City's Illicit Discharge Detection and Elimination (IDDE) Program that includes investigation and termination of illicit connections. The IDDE Program uses the City's database to track the complete process of screening, investigation, referral to responsible agencies (if other than the City), and enforcement.
- Use of a SQL database, the Environmental Services Spills and Complaints Database, to track spills, complaints, business inspections and flooding claims since 2003. Regular updates and refinements have been made to facilitate advanced data management for tracking inspections.
- Investigating potential illicit or historic contamination discharges based on complaints, business inspection reports and stormwater monitoring information and responding to potential and confirmed illicit discharges using the same procedures applied to potential illicit connections.

Out of all the 2023 business inspections/spill and complaints responses (475 business inspections,790 spill/complaint responses, and 1,138 treatment device inspections), only 27 formal enforcement action letters (14 Warning letters, 10 surfacing Effluent letters, and two notices of violation) were sent City-wide. Eleven of these were in the Foss Waterway Watershed. City-wide, only a small percentage of all inspections led to formal warnings or enforcement which shows that the City's education-based source control program continues to be very successful and that the business community and City's residents are very supportive and engaged in protecting stormwater quality.

Thus far, since the first NPDES Permit was issued in 2007, Tacoma has canvassed/inspected 100 percent of the City, inspecting both sanitary and stormwater compliance. The vast majority of the inspections found catch basins that had never been cleaned. These inspection efforts have resulted in tons of catch basin sediment removal, drainage repair, sewer protection, and customer education.

2.3 BMP Effectiveness Studies

The primary COCs in waterway sediments are DEHP and PAHs. Both of these contaminants are ubiquitous in urban runoff and are present in many consumer products. Over the years, high sources of these contaminants have been managed and the City's source control goal is to reduce the high concentrations. Phthalates, in particular, are widespread in the urban environment. Because of challenges faced by the City and others in addressing phthalate contamination, a Phthalate Work Group comprised of the City, EPA, Ecology, King County/Metro, and Seattle Public Utilities was formed in 2006 to research the sources, pathways, and treatment options for phthalates and other ubiquitous compounds in stormwater. The group developed a Summary of Findings and Recommendations document[5] which is currently in the process of being implemented by the regulatory agencies. Ecology worked with the Washington State Department of Health, along with industry and environmental stakeholders including the City, to develop a Phthalate Action Plan that identifies sources of

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[5] Document is available on the Washington State Department of Ecology's website. To view the document copy and paste this link into your web browser: http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.592.1779&rep=rep1&type=pdf

phthalates, and recommends actions to reduce the use, release, and exposure to phthalates in Washington (Ecology 2023).

In addition, the City is continuing to employ enhanced maintenance in the municipal stormwater conveyance system as described further below. Maintenance area sub-basins are shown on Figure 2-2.

2.3.1 Storm Line Cleaning

The City evaluated the effectiveness of a thorough and systematic maintenance practice for aging pipe systems. Between 2006 and 2008, the City completed basin-wide sewer line cleaning of three entire drainage basins (OF254, OF235, and OF230) and part of a fourth basin (OF237A). In 2010 to 2011, a fifth basin (OF237B) was cleaned and in 2021 a first cleaning occurred in OF243 and OF245. The objective of the sewer line cleaning program was to remove residual sediments in the storm drains, some of which may contain legacy contamination from past years that may continue to contaminate stormwater or baseflow through resuspension and/or dissolution. Second cleanings have been performed in portions of OF237A and OF254.

This effectiveness evaluation was included in past annual reports and results are updated here with the WY2023 data. Results of the analysis are presented in Table 2-2 and shown graphically on Figures 2-3.1 through 2-3.7. A summary of significant reductions observed for each outfall is discussed in Section 5.0. The City's Asset Management group has established a City-wide schedule of line cleaning approximately every twenty years. The Foss data will be evaluated statistically to determine whether more frequent cleaning is needed due to the sensitivity of the receiving water body. As additional wide-scale cleaning in the Foss Basin is performed, the statistical approach will be reviewed and modified, if applicable, to provide the most meaningful analysis of effectiveness of this enhanced maintenance practice over time.

2.3.2 Enhanced Street Sweeping

In January 2007, the City's street sweeping program was transferred from the Streets and Grounds division to the Sewer Transmission Maintenance section for continued implementation. The program schedule was increased at that time in an attempt to reduce sediment buildup in the storm sewer system. The schedule was set to sweep all areas of the City twice per year, with more frequent sweeping in the business districts and on major arterials. Each of the 12 primary business districts in the City are swept at night twice per month on average and arterials are swept on a 9-week rotation. The City also increased communications with residents and business owners, which helped raise awareness of the importance of the street sweeping program.

In 2008, the City started the transition from mechanical sweepers to regenerative air machines. In mid-2018, due to the end of usable life of one of the City's regenerative air sweepers and a staff retirement, Tacoma temporarily reduced its street sweeping program. This resulted in Tacoma reducing the frequency of arterial sweeping to quarterly and residential streets to annually.

The City received a grant from the Washington State Department of Ecology (Ecology) in 2021 to purchase an additional street sweeper which will allow staff to return to the higher sweeping frequency. The new schedule increases the frequency of sweeping at arterials from every 12 weeks to every six weeks and increases residential sweeping to twice per year City-wide. The sweeper was purchased during 2021, however there were delivery delays, and the sweeper was not delivered until November 2022. After set-up and the addition of a water tank, operations of the new sweeper began in March 2023. Global Positioning System (GPS) is used to track the number of miles swept and the amount of material removed is recorded.

Similar to line cleaning, the effectiveness of the program was evaluated, and results are presented in Table 2-3.1. The results are discussed in more detail in Section 5.0 and Appendix A. This effectiveness evaluation will continue to be updated as more post-enhanced sweeping data becomes available.

In addition, in response to relatively elevated concentrations of lead and zinc in both stormwater and baseflow in the industrial basins OF243 and OF245, the City initiated a pilot program in WY2014 to determine whether an increased frequency of street sweeping in this area would have an effect on these results. Starting on October 1, 2013, the City began sweeping the ROW within these drainage basins at a frequency of once every two weeks rather than the usual frequency of once per month for industrial areas. The pilot project continued in WY2023 and is ongoing at this time.

With several years of data available, statistical analysis of the effectiveness of this enhanced sweeping schedule was done, although results will be more statistically robust as additional data becomes available. Evaluation of the change in concentrations before and after implementation of the pilot project in these basins is presented in Table 2-3.2. The results are discussed in more detail in Section 5.0. This effectiveness evaluation will continue to be updated as more data becomes available.

With the promising results shown from the pilot project in the basins for OF243 and OF245, a portion of the OF254 drainage basin was added to the pilot project starting in January 2019. As staff and equipment capacity becomes available the City hopes to increase street sweeping in the entire OF254 drainage basin. It is expected this will occur in 2023.

2.3.3 CIPP Lining

Approximately 41,921 linear feet of existing storm sewer has been rehabilitated in the Foss Waterway Watershed using CIPP construction technologies. This approach fixes pipe defects (e.g., cracks, holes) that could have allowed potentially contaminated groundwater and soil from historic “hot spots” to enter the storm sewer system. Similar to line cleaning and street sweeping, the effectiveness of this approach was evaluated through WY2020, and results showing the effectiveness of this maintenance activity are presented in past reports. Since this is not a maintenance activity that will recur in these pipes over time, the statistical comparison of pre- and post-lining was discontinued in WY2020.

3.0 STORMWATER AND STORM SEDIMENT MONITORING RESULTS

A major component of the Thea Foss Post-Remediation Source Control Strategy is the stormwater monitoring program. To address these monitoring requirements, stormwater monitoring is conducted at seven outfalls in the Foss Waterway and includes collection of event-based composite and grab stormwater samples as well as annual sediment trap samples for chemical analysis.

The goals and objectives of the stormwater characterization monitoring done to meet the requirements of the Foss CD and the Permit are provided in this section. The goals in common for both programs generally involve:

- Measuring the effectiveness of stormwater source control actions, confirming that reductions in concentrations of target analytes have been realized, and confirming that recontamination from stormwater sources is not occurring; this is achieved by gathering data to identify trends in the quality of the water
- Providing an early indication of any new water or sediment quality problems associated with the storm drains
- Informing decision-making regarding additional source controls
- Tracing sources of contamination in outfalls as needed using sediment traps

The objectives will be accomplished through performance of the following:

- Provide Ecology and EPA with data characterizing the quality of the water and sediments discharging into the Thea Foss and Wheeler-Osgood Waterways
- Collect and submit for analysis representative composite and grab stormwater samples during stormflow events from all seven outfalls
- Collect and submit for analysis representative annual sediment samples at specified manholes
- Produce an annual report documenting activities associated with the sampling and analysis effort, a quality assurance review of field and laboratory data, and an evaluation of the data relative to continuing source control efforts and deliver the report to Ecology and EPA

The whole-water and SSPM concentrations discharged to the waterway are affected by a number of factors. Some of these factors include:

- Weather conditions and rainfall amounts and distributions which cannot be controlled by the City
- Inherent variability of chemical concentrations in stormwater runoff which are addressed using statistically based sampling designs
- Source activities and land use within the basin
- Illicit discharges

Section 3.1, Sample Representativeness, is a summary of the Data Validation Report that is presented in Appendix B. WY2023 analytical data for stormwater and SSPM are presented in Appendix D.

3.1 SAMPLE REPRESENTATIVENESS

Representativeness evaluates field sampling approximation of actual (true) stormwater and SSPM water quality and quantity of the Foss Waterway Watershed. Representative sampling results are used to identify trends in stormwater quality, provide an early indication of new contaminant sources, and trace sources of contamination within the municipal outfalls (Tacoma 2020b).

3.1.1 Monitoring Design

Stormwater comprises the majority of freshwater discharge from municipal outfalls and is a direct result of precipitation that produces stormwater runoff and is not a direct result of tidal fluctuations. Baseflow represents the continuous daily discharge from the municipal outfalls that is not a direct result of precipitation and is not a direct result of tidal fluctuations. Sources of baseflow may originate from seeps, creeks, groundwater infiltration, and illicit connections (see Appendix B).

Baseflow monitoring was discontinued after WY2011 because after ten years of monitoring it was determined that the baseflow component was well characterized. Some additional baseflow monitoring was performed in WY2016 and again in WY2019 to determine whether there were any changes in baseflow conditions since WY2011. In general, baseflow concentrations in both WY2016 and WY2019 were similar to or less than the 2001-2011 baseflow concentrations.

Annual sampling goals for WY2023 include (from each monitoring outfall):[6]

- To meet NPDES Permit Section S8.C requirements:
  - A total of 55 composite stormwater samples combined from the seven outfalls.
  - Sediment trap sampling at six of the outfalls (all but OF254). Five of these locations are collected using in-line sediment traps placed to collect SSPM from stormwater only. The other SSPM location, MH390 (OF245), is a sump manhole and the sediment it collects represents a combination of stormwater and baseflow.
- To meet the Foss CD:
  - A minimum of eight stormwater samples from OF230, OF235, OF237A, and OF237B
  - A minimum of three stormwater samples from OF243, OF245[7], and OF254
  - One SSPM sample from each outfall, except for OF254, as described above

Stormwater monitoring was conducted at seven of the 14 City outfalls discharging to the Foss Waterway. These eight outfalls comprise approximately 5,733 acres, or 98 percent of the total

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[6] Prior to WY2013, the annual sampling goal was to collect ten samples from each of the seven monitored outfalls. In October 2012, EPA and Ecology approved a reduction in sampling frequency beginning in WY2013.

[7] Note that to achieve the target of 55 samples per year required under the NPDES permit, OF245 is included in the list of outfalls with a target of eight samples per year.

Foss Waterway Watershed drainage (5,864 acres, see Section 1.2.2). Monitored outfalls for WY2023 include OF230, OF230A, OF235, OF237A, OF237B, OF243, OF245, and OF254. Primary land uses within the Foss Waterway Watershed include residential, commercial, and industrial.

Contaminant source tracing is further executed through sampling of SSPM (see Section 2.1.1). One station is located within the stormwater distribution system, near each outfall that represents the entire basin. It was not possible to locate an SSPM station within OF254 because of tidal influence. Additional upstream stations have been established throughout the Foss Waterway Watershed to evaluate and isolate contaminant sources. Over the years of the program, up to 34 SSPM locations have been sampled annually strictly for source tracing purposes. Sites are removed when it is determined that further source tracing in that area are not needed. In WY2023, eight upline sediment traps were sampled for source tracing purposes in addition to the six outfall sites. A sediment trap (FD7) was added for the new OF230A and the City will continue to monitor the OF230 sediment trap for WY2024.

3.1.2 Rainfall Summary for WY2023

For each Water Year, 2002 through 2023, monthly and annual rainfall totals are presented in Table 3-1. The total rainfall for WY2023 was 29.05 inches, almost ten inches less than the recent historic average of 38.95 inches (Tacoma No. 1 National Oceanic and Atmospheric Administration (NOAA) site) and is now the driest year since monitoring began in 2002 as illustrated Table 3-1. Wet season rainfall was 25.25 inches, which was 7.0 inches below the historical average. The dry season was 2.90 inches less than normal rainfall totals. There was below-average precipitation seen from May through August, returning to close to normal conditions by September, which experienced higher than normal monthly rainfall by 1.07 inches. The increased September rainfall minimized the overall dry conditions during the WY2023 dry season. Table 3-1 shows that the average monthly rainfall for each month during the monitoring period.

3.1.3 Baseflow

In OF230, OF235, OF237A, and OF237B, the baseflow is continuous and derived from old creeks that were piped, seeps or groundwater infiltration, and some amount of non-contact cooling water. Tides have minimal effect on baseflow in these drainages. A summary of baseflow sources to these outfalls is provided in Appendix B.

OF243, OF245, and OF254 do not have any creeks or other sources that provide constant baseflow. These drains do, however, have tidal backflushing year-round and during the wet season there is evidence of groundwater infiltration due to the high-water table in the Tideflats area. The groundwater table is comprised of a bottom layer, which is influenced by tides, and an upper fresher water lens. In the wet season, the upper lens is freshened by rain recharge and salinity effects (e.g., conductivity) are less.

As indicated above, baseflow sampling was conducted during the first ten years of the monitoring program but was discontinued after WY2011 when it was determined that the baseflow had been well characterized. Additional baseflow monitoring was performed in WY2016 and WY2019 to determine whether there had been changes in recent years. Based on the results of the samples taken, it can be concluded that baseflow concentrations have remained fairly consistent or have decreased over time. The City is planning to sample baseflow in WY2024 to characterize the baseflow discharging from the new OF230A and the baseflow representing the new drainage area of OF235. It is anticipated that the OF230A baseflow will be representative of the historic OF230 baseflow and that the OF235 baseflow will be characteristic of the historic baseflow in that drainage area.

3.1.4 Stormwater

The intent of stormwater sampling is to identify trends in stormwater quality, to measure the effectiveness of source control actions, and to provide early warning of any new problems that arise in the watershed. Stormwater representativeness is a function of seasonal and individual storm characteristics.

Individual storms, historic averages, and seasonal effects Storm events are variable in nature by runoff volume, flow rate, antecedent rainfall, and season. Each year, this variability is evaluated by comparing the magnitude and intensity of the runoff hydrographs (see Figures 3-2.1 and 3-2.2), where samples were collected on the hydrographs, time between storm events, and time of year the samples were collected, to determine whether a representative range of storm types were included in the monitoring program.

The distribution of WY2023 storm depths sampled varied somewhat from what is typically seen in both the historical average and the monitoring record. As shown in Figure 3-3, the majority of the storms accepted in WY2023 were 0.4-0.49 inch (17.6 percent) and 0.5-0.59 inch (23.5 percent). The variations are discussed in detail in Appendix B, Section 4.4.4. In comparing the historical trends, there are a greater number of storms sampled in WY2023 with 0.5-0.59 inches in depth range when compared to historic storm magnitudes (see Figure 3-3). Approximately 10 to 11 percent of both 1948-2009 storms and WY2002-WY2023 storms deposited approximately 0.5-0.59 inch of rainfall compared to 23.5 percent for WY2023. Despite these differences, the growing overall monitoring record completed under this program generally continues to reflect storm patterns similar to the historical record (Figure 3-1) except for an ongoing trend toward larger storms seen in more recent years.

Based on the historical record (1982-2009), 84 percent of annual precipitation occurs during the wet season and 16 percent during the dry season (see Figure 3-4). Stormwater sampling under this monitoring program remains slightly biased toward the dry season, with 23 percent (WY2002-WY2023) of sampled storms occurring during the dry season and 77 percent during the wet season. This is likely due to the fact that antecedent periods are easier to meet in the dry season as compared to the wet season, which provides more opportunities for sampling. WY2023 sampling was distributed with 12 percent of sampled storms from the dry season and 88 percent from the wet season.

Numeric goals Stormwater sampling representativeness criteria is summarized as follows:

- To meet the requirements of the NPDES Permit, a total of 55 composite samples were collected from the seven monitored outfalls as identified in the 2020 QAPP,
- Targets to meet the requirements of the Foss CD:
  - Eight samples collected annually at four sites (OF230/230A, OF235, OF237A, and OF237B).
  - Three samples collected annually from three sites (OF243, OF245[8], and OF254).

[8] As indicated above, to achieve the target of 55 samples per year under the NPDES permit, OF245 is included in the list of outfalls with a target of eight samples per year.

- Precipitation:
  - Proportional to storm seasonality.
  - During storm flow conditions, defined as:
    - Total precipitation of at least 0.2 inches and,
    - Antecedent periods of less than or equal to 0.05 inch of precipitation in the previous 24 hours during the wet season and less than or equal to 0.02 inch of precipitation in the previous 48 hours during the dry season.
- Storm, sampling, and tidal influence including:
  - Flow composite samples representing 75 percent of the total storm volume (OF237A[9] and OF237B) or,
  - Conductivity (tidal influence) of ≤ 2,000 µS/cm (≤ 5,000 µS/cm at OF243 and OF254), and
  - A minimum of 10 aliquots composited at all sites.
- A dry period of six hours provides delineation between individual storms.

In WY2023, composite samplers were deployed during 20 different events at the various outfalls, resulting in 112 sample deployments at all monitoring locations (see Appendix B, Table B4-2). Fifty-one stormwater samples were submitted for analysis during WY2023, of which all were accepted. Five out of seven outfalls met the annual sampling goal of eight storms per year for OF235, OF237A, OF237B, and OF245 and three storms per year for OF243. Only three samples were collected at OF230 due to several factors; few samples were collected at OF254 due to equipment issues, and no successful samples collected at the new OF230A. See Appendix B Section B.4 for additional details.

As a result, the sampling goal of 55 samples was not met in WY2023 with 51 composite samples accepted, a 93 percent success rate. This was largely due to the lack of sampling opportunity at OF230/OF230A as the City transitioned to monitoring at the new location. The drainage area for OF230 was rerouted to the new OF230A from October to December 2022. During that time there was limited flow discharging to OF230 and monitoring for this outfall ceased in December 2022 after discussions with Ecology. Eight of the eleven sampling deployments at this location from October to December were unsuccessful due to insufficient flow and low rainfall. Additionally, OF230A had limited opportunity for sampling during WY2023. The City anticipates increased sampling success during WY2024 at this new monitoring location. The additional equipment issues experienced at OF254 limited deployments and sampling success at this site. These issues have been resolved.

The minimum number of samples was met at the remaining outfalls A minimum of two qualifying events were sampled at OF235, OF237A and OF245 during the dry season. There was one successful dry season sample at both OF237B and 243. The remainder of the samples were collected in the wet season.

For each sampling event during WY2023, the City reviewed the flow hydrograph, the discrete sampling times relative to tidal stage, rainfall, and the conductivity (salinity) of the discrete

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[9] OF237A, which is now monitored at the 237A New manhole, has some tidal influence so this criterion does not strictly apply.

samples to determine which of these samples should be composited to best represent the runoff event. The level, velocity, and flow data for every storm event was evaluated and determined to be representative of stormwater runoff conditions. Most of the stormwater criteria were met for conductivity, tidal window, rainfall, and required number of aliquots, and if not, were evaluated and the samples determined to be representative. Field and analytical data for all the samples collected and analyzed are included in Appendices C and D of the WY2023 Report. Rejected data were not included in any of the statistical analyses. Additional details regarding data validation and sample representativeness are included in Appendix B, Section 4.0.

Stormwater Representativeness Over the course of the City's 22-year monitoring record, a representative range of storm events has been characterized considering the following hydrological variables (see Figures 3-2.1 and 3-2.2):

- Total rainfall
- Runoff hydrograph
- Intensity
- Antecedent period
- Season

3.1.5 Stormwater Suspended Particulate Matter Monitoring – Sediment Traps and MH390 Sump

SSPM monitoring is considered successful if samples obtained from each monitoring outfall have laboratory results that are verifiable. Sample volumes available at each site vary with weather and insufficient volumes may be available to perform all analyses. In WY2023, six samples from the six outfalls[10] locations (FD1, FD2, FD3 New, FD6, FD23, and MH390) were submitted to the City laboratory for analysis. Eight additional upline sediment traps were also placed for source tracing purposes. In all, samples were collected from a total of 14 SSPM locations in WY2023, including the outfall and upline locations.

3.1.6 Representativeness of WY2023 Laboratory Analyses

The WY2023 laboratory quality assurance/quality control (QA/QC) review included 51 stormwater samples and 14 SSPM samples; detection limit performance samples; laboratory and field blanks; laboratory, matrix, and field duplicates; spiked surrogates; laboratory control and matrix samples; and certified reference materials (CRM). Overall, 10,361 sample and QA/QC results were analyzed in WY2023. Data was reviewed, verified, and validated using a Tier II data review level or higher.

This type of analysis is helpful in identifying issues to be addressed when the majority of data quality is acceptable yet may still be improved. In WY2023, 98 percent of stormwater and 99 percent of SSPM data met measurement quality objectives. Quality Assurance review censored or rejected only 0.2 percent of WY 2023 data; therefore it is considered representative and useable for the purposes of this report. WY2023 sediment samples have not yet been analyzed for PBDEs due to a contracting issue with the laboratory. The City froze the samples which are

[10] OF254 does not have a sediment trap because of tidal influences.

still within their holding time, and analysis will occur once the contract is finalized. The review of laboratory data is provided in Appendix B.

3.2 Monitoring Results: WY2002-WY2023 (Years 1 Through 22)

This section presents a qualitative and quantitative description of spatial and temporal patterns in stormwater and storm sediment quality in Monitoring Years 1 through 21 which occurred in WY2002 through WY2023. The qualitative analysis is derived from visual inspection of summary tables and box plots appended to this report (see Appendices E through H). The quantitative analysis includes statistical test procedures described in Section 14.3 of the Thea Foss Stormwater QAPP.

The objective of the statistical evaluation is to test the magnitude and significance of spatial and temporal trends in the monitoring data. Spatial trend analysis includes identification of particular municipal storm drains that may be significantly higher or lower in concentration compared to other storm drains in the Foss Waterway Watershed. Temporal trend analysis includes identification of increases or decreases in stormwater concentrations over time that may be caused by source control actions, construction activities, changes in source strength, land use, or other characteristics of the drainage basins over time.

In the past, temporal trend analysis has also included an evaluation of seasonality and whether significantly higher stormwater concentrations were observed during certain parts of the year. Conventional wisdom suggests higher concentrations might be expected during dry season conditions because there is more time for contaminants to accumulate on drainage basin surfaces between runoff events. There are two seasons in a water year, as defined in the NPDES Phase I Permit; the wet season runs from October 1 through April 30, and the dry season runs from May 1 through September 30.

3.2.1 Summary Statistics

For each detected chemical at each outfall, the following summary statistics are calculated for baseflow, stormwater, and sediment trap data sets (see Appendix E):

- Number of samples analyzed
- Number and percentage of samples with detected chemical concentrations
- Arithmetic mean concentration
- Median concentration (50th percentile)
- Minimum and maximum concentrations
- 10th and 90th percentile concentrations
- Standard deviation of the arithmetic mean concentration
- Coefficient of variation
- Standard error of the arithmetic mean concentration
- 95th percentile upper and lower confidence limits on the arithmetic mean and median concentrations

Global summary statistics averaged over all municipal outfalls in the Foss Waterway drainage basin and all available monitoring years (WY2002-WY2023: Years 1 through 22) are provided in Tables 3-2.1, 3-2.2, 3-3.1, and 3-3.2 for baseflow[11], stormwater and sediment trap data, respectively. The global summary statistics include:

- Total number of samples
- Percentage of samples with detected concentrations
- Minimum and maximum detected concentrations for each outfall
- Mean and median concentrations for each outfall
- Global weighted-mean concentrations for the entire Thea Foss basin (weighted by number of samples per outfall)
- Overall maximum concentration for all outfalls, and sampling date of maximum concentration

Summary statistics are generated using the R and Python programming languages. When computing statistics that characterize the distribution of pollutant concentrations (e.g., mean, standard deviation), non-detected concentrations were imputed via Monte Carlo Imputation as described in stormwater statistical recommendations report provided to the City by Herrera & MacStat (Herrera 2022). In instances where the value of individual observations were being considered (e.g., time series analysis), 1/2 reporting limit values were used as specified in the 2020 QAPP (Tacoma 2020b).

3.2.2 Contaminants of Concern

COCs are those contaminants that were identified through sediment monitoring and model predictions to have the greatest potential to compromise sediment quality in the waterways following remediation. They are, therefore, the primary target for source control activities for the municipal storm drains as well as for other potential sources that are largely not in the City's control. DEHP and various PAHs are the primary COCs for the Foss Waterway and have therefore been the primary focus of source control activities to date. In addition, residual concentrations of other legacy COCs for which sources have largely been controlled through regulatory bans or restrictions are continuing to be monitored. These legacy COCs include mercury and PCBs. Source control activities have also been conducted for these COCs.

The NPDES permit identifies stormwater quality analytes as parameters of concern based on the analytes that have a history of association with stormwater discharges and are expected to be found in urban environments. These analytes include conventional parameters, nutrients, metals, selected organics (including PAHs and DEHP), fecal coliforms, and total petroleum hydrocarbons.

Tables B2-7 and B2-9 contain lists of all parameters that have been analyzed under either the Thea Foss CD or the Permit. If either the Permit or the Foss CD requirements are discontinued

[11] Baseflow results for WY2002 to WY2011 are presented in Table 3-2.1. Some additional baseflow monitoring was performed in WY2016 and WY2019 to determine whether there have been changes in recent years. WY2016 and WY2019 baseflow results are included in Table 3-2.2. Additional discussion about baseflow monitoring and a comparison of results is included in Appendix B.

for any of the monitoring activities at some point in the future, these tables will be used to determine which analyses are required under the remaining regulations.

The Table 3-2.1 and 3-2.2 summary charts for baseflow were prepared and statistical tests performed on the following parameters:

- Total Suspended Solids (TSS) (initial baseflow and WY2016/WY2019)
- Conventionals (MBAS, BOD and Turbidity) (WY2016/WY2019)
- Nutrients (Nitrate+Nitrite as N, Orthophosphate, Total Phosphorus, and Total Nitrogen) (WY2016/WY2019)
- Total and Dissolved Metals (lead, mercury, and zinc) (initial baseflow and WY2016/WY2019)
- Total and Dissolved Metals (cadmium and copper) (WY2016/WY2019)
- Chlorpyrifos (WY2016/WY2019)
- PAHs (initial baseflow and WY2016/WY2019)
- Phthalates (initial baseflow and WY2016/WY2019)
- Herbicides (2,4-D and Dichlobenil) (WY2016/WY2019)
- TPH (NWTPH-Diesel, NWTPH-Gasoline and NWTPH-Heavy Oil) (WY2016/WY2019)
- Fecal Coliform (WY2016/WY2019)
- BTEX (WY2016/WY2019)

The Table 3-3.1 summary chart for stormwater was prepared and statistical tests performed on the following indicator parameters:

- TSS
- Conventional parameters (MBAs, BOD, Chloride, Conductivity, Hardness, pH, and Turbidity)
- Fecal Coliform, E.Coli, and Enterococci
- Nutrients (Nitrate+Nitrite as N, Orthophosphate, Total Phosphorus, and Total Nitrogen)
- Insecticides (2,4-D, Carbaryl, Chlorpyrifos and Bifenthrin)
- Herbicides (Dichlorobenil)
- Total and Dissolved Metals (copper[12], cadmium, lead, mercury, and zinc)
- PAHs
- Phthalates
- Total Petroleum Hydrocarbons (TPH-Oil, TPH-Gasoline, and TPH-Diesel)

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[12] Copper was added as a key constituent for stormwater and SSPM in the 2014 QAPP. Analysis for copper in stormwater began for OF235, OF237B, and OF245 in WY2010 under the NPDES program, and continued through WY2012. Under the 2014 QAPP, copper was added as a key constituent for stormwater and SSPM and therefore analysis for copper began for all of the outfalls in WY2015. Statistical analyses for this constituent are being performed, although results will become more robust over time as additional data becomes available.

- BTEX

The Table 3-3.2 summary chart for SSPM was prepared and statistical tests performed on the following indicator parameters:

- Conventional parameters (Grain Size, TOC, Total Solids, and Total Volatile Solids)
- Nutrients (Total Phosphorus)
- Metals (cadmium, copper, lead, mercury, and zinc)
- Total Petroleum Hydrocarbons (TPH-Oil and TPH-Diesel)
- PAHs
- Phthalates
- Bifenthrin
- PCBs
- Phenolics
- Dichlobenil

Graphical presentations and trending statistics are performed for key constituents of interest. For whole-water, key constituents include the following analytes:

- TSS
- Metals (total copper, total lead, and total zinc)
- Phenanthrene (a low-molecular weight PAH)
- Pyrene and Indeno(1,2,3-c,d)pyrene (high-molecular weight PAHs)
- Bis(2-ethylhexyl)phthalate DEHP

For sediment, key constituents include the following analytes:

- Metals (total copper, total lead, total mercury, and total zinc)
- TPH-Oil
- Bifenthrin
- Phenanthrene (a low-molecular weight PAH)
- Pyrene and Indeno(1,2,3-c,d)pyrene (high-molecular weight PAHs)
- Total PCBs
- Butylbenzylphthalate, DEHP, and total phthalates

3.2.3 Statistical Test Methods

The stormwater monitoring data were subjected to the following statistical tests as further discussed in the 2023 QAPP and in the MacStat & Herrera Report (Herrera 2022):

- Qualitative Assessment of Spatial and Temporal Trends
- Statistical Distribution Testing

- Analysis of Variance (ANOVA) and Post-Hoc Comparison Tests:
  - Parametric ANOVA and Tukey HSD Test (Stormwater Data) (Table 3-4)
  - Nonparametric ANOVA (Kruskal-Wallis Test) and Dunn Test (Baseflow and SSPM Data); and (Table 3-5)
- Time Trend Analysis (Lognormal Linear Regression) (Table 3-6)

The ANOVA, Kruskal-Wallis, Tukey, and t-tests, and lognormal regression analyses are performed using SYSTAT Python version 3.11 Version 13 or equivalent with SciPy version 1.11. The lognormal regressions and nonparametric post-hoc tests (Dunn Test) are performed in Microsoft Excel and the same version of Python using the equations in Zar (1999). Graphical data presentations were prepared for key constituents. Box and whisker plots provide a graphical representation of spatial and temporal trends in stormwater quality and include:

- Outfall-to-outfall comparison – stormwater (land use differences, Appendix F of the WY2023 Report)
- Year-by-year comparisons within a given outfall (long-term trends, Appendix G of the WY2023 Report)
- Wet season versus dry season comparison (seasonal differences, Appendix H of the WY2023 Report)

Box and whisker plots are generated using Python version 3.11 and wqio version 0.6[13] from the International Stormwater BMP Performance Database. The wqio library is a python library that uses SciPy (version 1.11) and other statistical libraries to analyze and visualizing water and sediment quality data. These plots display the following characteristics of the data distributions:

- Interquartile range, or IQR (data between the 25th and 75th percentile)
- Median and arithmetic mean
- Moderate outliers (more than 1.5 x IQR above the 75th percentile, or below the 25th percentile)
- Extreme outliers (more than 3 x IQR above the 75th percentile, or below the 25th percentile)

In addition, time-series scatter plots of the key constituents (Figures 3-5.1 through 3-5.8) in stormwater are prepared with annotation to delineate the different monitoring years. Time-series plots, as well as box plots, include comparable data collected back to August 2001.

3.3 SPATIAL ANALYSIS

This section presents a qualitative and quantitative spatial analysis of differences in stormwater and SSPM quality between municipal storm drains. It should be noted that there are similarities as well as differences in the spatial patterns of exceedances observed in stormwater and SSPM, as discussed in the following sections and as shown on Tables 3-4 and 3-5.

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[13] https://github.com/International-BMP-Database/wqio

Qualitative analysis includes inspection of drain-by-drain summary statistics and box plots. Quantitative analysis includes lognormal parametric ANOVA and post-hoc comparison (Tukey HSD Test) for stormwater data, and nonparametric ANOVA (Kruskal-Wallis test) and post-hoc comparison (Dunn Test) for SSPM data. Note that this information is used to guide stormwater source control activities that are discussed further in Section 5.0.

3.3.1 Baseflow Quality

Baseflow sampling was discontinued at the end of Year 10 since baseflow quality was well characterized. Refer to the WY2012 report (Tacoma 2013) for a detailed description of the baseflow characteristics in each of the outfalls.

Since 2011, detection limits for some analytes have changed and are lower than those in the 2001 SAP. The WY2011 baseflow concentrations, many of which were not detected, biased the baseflow pollutant loadings and overestimated the resulting loads. To more accurately estimate the baseflow loadings, baseflow samples were collected in WY2016 and WY2019 and analyzed for the stormwater analytes listed in the QAPP.

Most of the WY2016/WY2019 data results are similar or less than the 2001-2011 data results. In a few instances the WY2016/2019 arithmetic mean or median results were slightly higher than the 2001-2011 data results; however, in the majority of cases, the maximum WY2016/2019 results for that analyte were within the 2001-2011 data range for that analyte. The WY2016/2019 results further support the conclusion that baseflow concentrations in the Foss outfalls have remained fairly consistent or are improving over time.

3.3.2 Stormwater Quality

Qualitative Outfall Comparisons Inspection of summary tables and box plots of stormwater quality among the various Foss Waterway storm drains suggests the following generalized conclusions (see Table 3-3.1 and Appendices D, E, F, and G):

- **TSS** Overall, comparatively higher TSS concentrations are observed in OF254 (see Figures F-1). OF235 and OF237A had elevated maximum concentrations (441 and 668 mg/L), while OF254 had the highest mean (90.4 mg/L) and median (68.9 mg/L) concentrations, with OF243 next highest with a mean concentration of 62mg/L. OF230, OF237B, and OF237A had the lowest means (48.7, 48.1, and 48.7 mg/L, respectively) and median (30.8, 35.0, and 33.3mg/L, respectively) TSS concentrations.

- **Metals** Comparatively higher mean and median lead concentrations were observed in OF235 (53.80 µg/L and 41.20, respectively); while OF243 also showed some evidence of elevated lead concentrations, including the highest overall lead concentration (379 µg/L) in September 2009, as well as the second highest mean and median lead concentrations (32.6 µg/L and 15.40µg/L). The highest mean mercury concentrations were observed at OF254 (0.0260 µg/L), while the maximum mercury concentration (0.8700 µg/L) was observed in OF245 in 2008. The highest mean (131.0 µg/L) and median (103.0 µg/L) zinc concentrations were found at OF245 while the maximum zinc concentration (1,170 µg/L) was observed in OF243, with the maximum concentration detected in 2004.[14] The highest mean, median, and maximum copper concentrations were observed at OF235 (28.10 µg /L, 22.70 µg/L, and 162 µg /L, respectively) with the maximum concentration occurring in 2015.

- **Phthalates** DEHP is the phthalate compound with most frequent detections (86 percent detection) and the highest mean and median concentrations. The highest mean, median and maximum concentrations of DEHP were observed in OF235 (3.95 µg/L, 1.96 µg/L, and 97.0 µg/L respectively). The second highest mean and maximum concentrations were observed in OF230 (3.23 µg/L and 44.1 µg/L). Unusually elevated DEHP concentrations were also found in OF245 in Year 2 (October 2002 through April 2003), and in OF230 and OF243 in Year 7, but these appear to be isolated occurrences (see Appendices F and G). Certain other phthalates, though less frequently detected, peaked at higher concentrations. Elevated diethylphthalate concentrations were measured in 2002 in OF237A (230 µg/L), OF235 (590 µg/L), OF245 (430 µg/L), and OF254 (120 µg/L). The peak butylbenzylphthalate concentration was measured in OF245 (290 µg/L) in 2003. However, diethylphthalate and butylbenzylphthalate have been detected in less than half the samples (29 percent and 28 percent detections, respectively). Peak concentrations of dimethyl phthalate, di-n-butyl phthalate, and di-n-octyl phthalate occurred at OF230, OF237A, and OF254, respectively, although these concentrations were one to two orders of magnitude lower than the peak concentrations of the other phthalates. The fact that the peak concentrations of various phthalates occur in different outfalls indicates that the phthalate composition is somewhat variable across the Foss Waterway drainage basins. All peak concentrations occurred in 2005 or earlier, indicating improvement over time.

- **PAHs** OF245 contains the highest maximum concentrations of several of the lighter-weight PAH compounds including acenaphthene, acenaphthylene, fluorene, and phenanthrene, while OF235 contained the highest maximum concentrations of several other the lighter-weight PAH compounds including naphthalene, 2-methylnaphthalene, and total Low Molecular Weight PAHs (LPAHs). Comparatively higher mean and median concentrations of a number of LPAHs and the maximum concentration of anthracene were observed in OF254. The maximum concentrations observed in OF245 occurred in 2004, while the maximum concentrations observed in OF235 were in 2002. Comparatively higher mean, median, and maximum concentrations of HPAHs were generally observed in OF237A and OF254. The only exception is that the maximum concentration for dibenz(a,h)anthracene of 0.684 µg/L occurred in OF243 in 2016. The elevated concentrations in OF237A occurred in 2007, while the elevated concentrations in OF254 occurred in 2002. In general, PAH concentrations over the last fifteen years (Years 8 through 22) were relatively low compared to previous monitoring years.

Parametric ANOVA Results ANOVA was performed to determine whether there are statistically significant differences between outfalls. The ANOVA test helps to determine whether stormwater quality in the Foss Waterway Watershed is relatively uniform across drainages (i.e., all outfalls are drawn from a single statistical population), or whether there is reason to believe that certain drainages are unique (i.e., characterized by unusually high or low concentrations).

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[14] While elevated zinc values of 4570 ug/l total and 4430 ug/l dissolved were measured on February 1, 2018, these values were nearly 4 times higher than the previously identified extreme outliers with no apparent cause, so these values were not included in the summary statistics

Goodness of fit tests show that practically all stormwater analytes in all outfalls may be characterized by lognormal or nearly lognormal statistical distributions (Tacoma 2009a, Tacoma 2012). Therefore, lognormal parametric ANOVA tests were conducted. The ANOVA test statistic is the F statistic with 6 (n-1) degrees of freedom (n = 7 outfalls in the monitoring program).

ANOVA and post-hoc comparison tests were performed using: (1) all 22 years of monitoring data, and (2) only the last two years of monitoring data[15]. ANOVA tests using the entire 22-year monitoring record have significantly more power to discriminate between drains due to a much larger sample size. ANOVA tests using only the most recent monitoring data have lower statistical power but provide information on the most current conditions in the storm drains, to better determine whether the City's source control actions have resulted in recent improvements in stormwater quality and to guide future source control activity prioritization.

Following are the results of the parametric ANOVA test using all 22 years of stormwater[16] monitoring data:

Parameter	F Statistic	Probability	Significant?
TSS	13.0	<0.001	Yes
Total Copper	40.4	<0.001	Yes
Total Lead	85.3	<0.001	Yes
Total Zinc	18.7	<0.001	Yes
Phenanthrene	3.95	<0.001	Yes
Pyrene	9.73	<0.001	Yes
Indeno(1,2,3-c,d)pyrene	18.9	<0.001	Yes
DEHP	8.53	<0.001	Yes

Following are the results of the parametric ANOVA test using only the last two years of monitoring data:

Parameter	F Statistic	Probability	Significant?
TSS	4.22	<0.001	Yes
Total Copper	19.0	<0.001	Yes
Total Lead	28.1	<0.001	Yes
Total Zinc	5.9	<0.001	Yes
Phenanthrene	7.38	<0.001	Yes
Pyrene	8.96	<0.001	Yes
Indeno(1,2,3-c,d)pyrene	17.3	<0.001	Yes
DEHP	6.76	<0.001	Yes

[15] Earlier annual reports presented only the last year of monitoring data. However, due to the reduction in sampling numbers starting with WY2013, the ANOVA analysis was changed to include the last two years of data. Without this change, very few statistically significant differences would be observed.

[16] Stormwater analysis for copper found in OF235, OF237B, and OF245 was performed between WY2010 and WY2012, discontinued, and then began for all outfalls in WY2015. Therefore, with less data available, statistics performed for copper are not fully comparable to those performed for other parameters.

The parametric ANOVA test results indicate there is greater than or equal to 99.9 percent probability ($p \leq 0.001$) that one or more outfalls are significantly different from the norm, either higher or lower, for every one of the index constituents. The ANOVA test results indicate it is possible in all cases to differentiate stormwater quality between outfalls in the Foss Waterway Watershed for the index constituents using the entire data set, or only the last two years of data. As a result, post-hoc tests were performed to identify which specific outfalls contain unusually high or low stormwater concentrations.

Parametric Post-Hoc Comparison (Tukey Test) Because the ANOVA test showed statistically significant differences ($p < 0.05$) between stormwater quality in the various municipal drainages, post-hoc tests were performed to determine which specific drains are higher or lower than normal. The Tukey Test is an appropriate post-hoc test for parametric ANOVA. The results of the parametric post-hoc tests are summarized in Table 3-4. On this table, the top portion provides the results for the evaluation of the 22-year data set, while the bottom portion provides the results when looking at only the last two years of data. Since this data set is smaller, there is somewhat less confidence in the results, however, it does provide some indication of the current source control status and priorities.

Drainages and constituents exhibiting significant differences in stormwater quality, based on the entire 22-year monitoring record, include the following (see Table 3-4):

- **TSS** When looking at the 22-year monitoring data, TSS concentrations are significantly higher in OF254 (+6) with other outfalls exhibiting relatively similar concentrations (-1). When looking at the last two years of data, TSS concentrations are moderately higher in OF254, and generally neutral to slightly lower in the other outfalls.
- **Total Copper**[17] When looking at all of the monitoring data, copper concentrations are significantly higher in OF235 (+6) and moderately higher in OF243 (+3). Concentrations are slightly lower in OF230 and OF237A (-2) and significantly lower in OF237B (-4). When looking at only the last two years of data for copper, concentrations are significantly higher at OF235 (+5), moderately higher at OF254 (+2), while the concentration at OF237B and OF230 is moderately lower (-3).
- **Total Lead** OF237B (-4), OF237A (-2), and OF230 (-2) contain lead concentrations that are moderately below average when looking at the entire monitoring period while OF243 (+4) and OF235 (+6) are moderately to significantly elevated compared to other outfalls during this same time period. When looking at only the last two years of data, concentrations are generally more neutral, with the exception of OF235, which remains significantly elevated relative to other outfalls (+6). Concentrations at OF243 went from moderately higher (+4) when looking at the overall dataset, to slightly below average (-1) when looking at data from only the last two years.
- **Total Zinc** Zinc concentrations in OF237B are significantly lower (-6) and concentrations in OF243 and OF237A are slightly lower (-1) than all other outfalls during the full monitoring period. OF254 (+3) and OF245 (+4) are moderately elevated in zinc when looking at the 22-year monitoring period. When looking at only the last two years of data,

[17] Outfalls OF235, OF237B, and OF245 have more data available for evaluation with a total of ten years of monitoring completed. OF230, OF237A, OF243, and OF254 have seven years of data available. In general, the statistical evaluation for copper is not fully comparable to outfalls with different amounts of data available.

zinc concentrations are generally more neutral but remain significantly lower than other outfalls (-5) in OF237B.

- **DEHP** When looking at data from the entire monitoring period, OF235 (+5) exhibits significantly elevated DEHP concentrations relative to other outfalls while OF23A, OF237B and OF243 has exhibited relatively lower concentrations (-2). DEHP concentrations in OF245 and 254 are relatively low and largely indistinguishable from one another. The significantly higher concentrations are less apparent at OF230 (+2) and OF235 (+3) when looking at only the last two years of data when compared other outfalls. DEHP concentrations are moderately lower (-3) at OF243 and OF237B based on the last two years of data.
- **PAHs** OF237B, OF243 and OF245 has slightly lower concentrations of pyrene (-2) and OF237B has moderately lower levels of phenanthrene (-3) when looking at the 22-year monitoring record. Additionally, OF245 has significantly lower indeno(1,2,3-c,d)pyrene (-4). Conversely, OF254 has moderately higher concentrations of pyrene (+4) and slightly higher concentrations of phenanthrene (+1) and OF237A has moderately higher concentrations of pyrene (+3) and significantly higher concentrations of indeno(1,2,3-c,d)pyrene (+6) during this same 22-year period. When looking at only the last two years of data, OF237A contains significantly higher indeno(1,2,3-c,d)pyrene (+6), pyrene (+6) phenanthrene (+6) relative to other outfalls. All other PAHs are relatively neutral and largely indistinguishable from one another over the last two years at all other outfalls.

In summary, when looking at the entire monitoring period, results indicate that OF235 (copper, lead, DEHP), OF230 (DEHP), OF237A (indeno(1,2,3-c,d)pyrene and pyrene), OF243 (copper and lead), OF245 (zinc), and OF254 (TSS, zinc, phenanthrene, and pyrene), have the highest number or most extreme positive pair comparisons; therefore, source control activities, as needed, are best focused for these constituents in these drainages. OF237B, and to a lesser extent OF245, OF237A, and OF243 have the highest number of negative pair comparisons relative to other drains, and therefore exhibit the best overall stormwater quality. With 22 years of monitoring data, very good statistical power has been achieved (with exception for copper), and the spatial patterns in Foss stormwater are relatively stable and generally consistent from one monitoring year to the next.

When looking at only the last two years of monitoring data, results generally show more neutral conditions in all the outfalls, although the statistical power of this analysis is lower. The only exceptions are PAHs in OF237A, which become more elevated when looking at only the last two years, and lead and copper in OF235, which remains significantly elevated. A few samples with relatively higher concentrations of indeno(1,2,3-c,d)pyrene detected in since WY2021 in OF237A are likely causing the higher relative level shown in Table 3-4 (see also Figure G-6).

3.3.3 Baseflow Versus Stormwater Quality

Summary statistics for baseflow[18] for WY2002-2011 and WY2016/2019 are provided in Table 3-2.1 and Table 3-2.2, respectively. Summary statistics for stormwater quality are provided in Table 3-3.1. These tables include mean concentrations averaged across all seven

[18] Baseflow results are presented for WY2002 to WY2011 since baseflow monitoring was discontinued after WY2011. Some additional baseflow monitoring was performed in WY2016 and WY2019 to determine whether significant differences had been realized since initial comprehensive baseflow monitoring was discontinued.

outfalls in the Foss Waterway Watershed. The arithmetic mean concentrations in baseflow and stormwater are summarized below for the Thea Foss index chemicals.

Constituent	**Units**	**Mean Baseflow** WY01-11/WY16 &19	**Mean Stormwater**	**Ratio** WY01-11/WY16 &19 to WY2023
TSS	mg/L	12 / 4.8	57.9	20% / 8%
Lead	µg/L	5.5 / 1.7	21.8	25% / 8 %
Zinc	µg/L	47 / 11	101.2	46% / 11%
Phenanthrene	µg/L	0.013 / 0.009	0.066	20% / 14%
Pyrene	µg/L	0.026 / 0.008	0.138	19% / 6%
Indeno(1,2,3-c,d)pyrene	µg/L	0.006 / 0.005	0.036	17% / 14%
DEHP	µg/L	1.1 / 0.536	2.53	43% / 21%

Inspection of these summary statistics indicates the following:

- Baseflow concentrations are consistently lower than stormwater concentrations. WY2001-11 average baseflow concentrations range from approximately 1/5 to 2/5 (17 - 46%) of stormwater concentrations. WY2016 & 2019 average baseflow concentrations range from approximately 1/20 to 1/5 (6 - 21%) of stormwater concentrations.
- In addition to lower mean concentrations, baseflow samples are generally characterized by lower maximum values and less frequent detections.
- Because the TSS content is approximately five (2001-11) to 12 (2016 & 19) times higher in stormwater, the increased chemical concentrations that are observed during storm events is likely caused in part by suspended sediments entrained in the runoff.

3.3.4 Storm Sediment Quality

SSPM samples were collected in pipeline sediment traps and in the MH390 sump (representing OF245). These samples include suspended particulate matter in transport through the storm drains. OF254 does not have a sediment trap because of tidal influences. SSPM data helps to provide information on hydrophobic constituents such as mercury, HPAHs, DDT, and PCBs, which have a strong affinity for sediments but are poorly soluble and often undetected in whole-water samples. In conjunction with baseflow and stormwater data, SSPM data is used to help the City, EPA, and Ecology identify and trace unusually elevated sources of contaminants in the municipal drainages.

Summary statistics for SSPM for WY2002-WY2023 are provided in Table 3-3.2. This table includes weighted mean concentrations averaged across the six outfall sediment traps in the Foss Waterway Watershed (weighted by sample size for each location). The weighted mean concentrations are summarized below for the Thea Foss index chemicals.

Due to the limited dataset available for review (only one sample per year), the assumption was made in early reports that the SSPM data would follow a lognormal distribution similar to the stormwater data. This assumption was tested in WY2011 and it was determined that the sediment traps were generally not well described by a lognormal distribution. Therefore, nonparametric statistical tests were used.

ANOVA was performed to identify storm drains with significantly higher or lower sediment concentrations compared to other drains in the Foss Waterway Watershed. A nonparametric ANOVA (Kruskal-Wallis Test) was performed, with 5 (n-1) degrees of freedom (n = 6 outfalls in the sediment trap monitoring program).

Following are the results of the nonparametric ANOVA test using all 22 years of storm sediment data:

Parameter[1]	F Statistic	Probability	Significant?
Copper	45.6	<0.001	Yes
Lead	97.8	<0.001	Yes
Zinc	66.7	<0.001	Yes
Mercury	72.4	<0.001	Yes
TPH-Heavy Oil	43.5	<0.001	Yes
Phenanthrene	23.8	<0.001	Yes
Pyrene	62.6	<0.001	Yes
Indeno(1,2,3-c,d)pyrene	77.6	<0.001	Yes
Bifenthrin	58.2	<0.001	Yes
Total PCBs	25.6	<0.001	Yes
DEHP	38.9	<0.001	Yes
BBP	78.1	<0.001	Yes
Total Phthalates	36.5	<0.001	Yes

[1] Note that analysis for DDT was discontinued in WY2013 and analysis for Bifenthrin and copper began in WY2015

The nonparametric ANOVA test results indicate there is a high probability (equal or greater than 99 percent confidence; $p \leq 0.01$) that storm sediment concentrations in one or more outfalls are significantly different from the norm, either higher or lower, for all analytes.

Following are the results of the nonparametric ANOVA test using only the last five years of monitoring data:

Parameter[1]	F Statistic	Probability	Significant?
Copper	21.9	<0.001	Yes
Lead	22.9	<0.001	Yes
Zinc	18.1	0.003	Yes
Mercury	15.6	0.008	Yes
TPH-Heavy Oil	12.4	0.029	Yes
Phenanthrene	14.3	0.014	Yes
Pyrene	18.4	0.002	Yes
Indeno(1,2,3-c,d)pyrene	20.7	<0.001	Yes
Bifenthrin	18.9	0.002	Yes
Total PCBs	9.5	0.089	Yes
DEHP	18.9	0.002	Yes
BBP	18.0	0.003	Yes
Total Phthalates	17.1	0.004	Yes

[1] Note that analysis for DDT was discontinued in WY2013. Analysis for Bifenthrin and copper began in WY2015.

The nonparametric ANOVA test results indicate it is possible to differentiate SSPM quality for most of these analytes between outfalls in the Foss Waterway Watershed using only the last five years of data. Only Total PCBs and TPH-Oil show no significant differences between the outfalls as shown on Table 3-5.

Pair-comparison tests were performed using the Dunn method, as summarized in Table 3-5. Each outfall is compared to a maximum of five other outfalls in the storm sediment monitoring program (six outfalls total). Outfalls and constituents that exhibit a higher number of significant pair comparisons help to identify drainages that are increasingly unique (either higher or lower concentrations) compared to the other drains in the Foss Waterway Watershed. On Table 3-5, the top portion provides the results for the evaluation of the 22-year data set, while the bottom portion provides the results when looking at only the last five years of data. Since this data set is smaller, there is somewhat less confidence in the results, however, it does provide some indication of the current source control status and priorities.

Following is a summary of observations regarding spatial patterns in SSPM quality based on the 22-year monitoring record. The spatial patterns observed in the SSPM data are sometimes but not always consistent with the patterns observed in stormwater data (compare Table 3-5 and Table 3-4). Discrepancies between these two data sets are included below and may be caused by differential transport of pollutants in dissolved and particulate phases.

- **Metals** SSPM in OF243 is moderately elevated in copper (+3), lead (+3), mercury (+4), and zinc (+4). OF230 and OF235 are slightly elevated in some metals, but to a lesser degree than OF243. OF237B has moderately lower copper, lead, and mercury concentrations (all at -3), and significantly lower zinc (-5) relative to other outfalls, while OF245 contains moderately lower lead concentrations (-3).

  Some of these patterns found in SSPM are contrary to those observed in stormwater. For example, lead and copper concentrations in OF235 are significantly elevated in stormwater (both at +6), but at most only slightly elevated in SSPM (+2 and +1, respectively); zinc concentrations in OF243 are moderately elevated in SSPM (+4) but not in stormwater (-1). Conversely, zinc concentrations in OF245 are moderately elevated in stormwater (+4) but are neutral (0) in SSPM.

- **Total Petroleum Hydrocarbons (TPH-Oil)** SSPM in OF237B is significantly lower in TPH-Oil (-5) relative to the other outfalls while levels at other outfalls are generally similar throughout the drainage basin.

- **Pesticides** No significant differences in DDT concentrations were observed among the six outfalls during the time it was monitored. It is no longer analyzed under the 2014 QAPP. Bifenthrin was added as a constituent in the 2014 QAPP, and in general all outfalls appear to be generally similar throughout the basin based on available data, although it is slightly elevated in OF237A.

- **PAHs** Storm sediment in OF245 contains moderately to significantly lower concentrations of PAHs (-4 to -5) relative to all other outfalls. SSPM in OF230 and OF237A are slightly to moderately enriched in all three PAHs (+2 to +4). The remaining outfalls are generally neutral for PAHs (+1 to -2). These patterns are generally consistent with those observed in stormwater except for OF230 where, as indicated above, the SSPM is slightly to moderately enriched (+2 to +3) in all three indicator PAHs while the stormwater is generally more neutral (0 to +2).

- **Total PCBs** Storm sediment in OF230 exhibits slightly higher concentrations of PCB (+2) relative to all other outfalls. SSPM concentrations at all other locations are relatively neutral (-1 to +1). Storm sediment shows no significant differences for PCBs between the outfalls when looking at the last five years of data.

- **Phthalates** DEHP is fairly consistent in concentrations in storm sediment throughout the various drainages; only OF237B (-3) shows a moderately lower concentration in DEHP. This pattern is not altogether consistent with that observed in stormwater. DEHP in OF230 and OF235 was significantly elevated in stormwater (at+3 and+5, respectively), but not in SSPM (at +2 and +1). OF243 and OF245 continue to exhibit notably different phthalate compositions that are dominated by butylbenzylphthalate (+1 and +4, respectively). In particular, OF243 and OF245 have the majority of the highest butylbenzylphthalate concentrations in the monitoring program (see Figure F-20).

When looking at only the last five years of monitoring data, fewer spatial patterns are observed, and the patterns are generally consistent with the 22-year monitoring record results (Table 3-5). The differences between outfalls are less pronounced when looking at only the more recent data when compared with the 22-year monitoring record.

3.4 Seasonal Analysis

This section presents a qualitative evaluation of seasonality in baseflow and stormwater quality by inspection of seasonal box plots (see Appendix H). As per the City's NPDES Phase I Permit, the wet season is defined as October 1st through April 30th, and the dry season is defined as May 1st through September 30th.

It might be expected that dry season conditions would generate higher contaminant concentrations in both baseflow and stormwater. This might be caused by more isolated storms and longer antecedent dry periods between storms, resulting in longer periods of contaminant accumulation on the surfaces of the drainage basin. The seasonal effect on runoff quality found through the City's monitoring program is evaluated below.

3.4.1 Seasonal Analysis of Stormwater Quality

Inspection of box plots comparing stormwater quality between the wet and dry seasons for the 22-year monitoring record suggests the following (see Appendix H):

- Evidence of seasonal effects in TSS concentrations is weak in all outfalls.
- Metals (lead and zinc) in stormwater showed occasional evidence of seasonality (i.e., higher median, mean, and/or peak concentrations during dry season months).
- Evidence of seasonal effects was generally not observed in organics data.
- Similar patterns were observed in baseflow data (i.e., inorganic constituents exhibit stronger evidence of seasonality), whereas evidence of seasonality for organic constituents is weak or absent. This analysis was performed based on the first 10 years of baseflow monitoring performed from WY2002-WY2011 and presented in the WY2011 report (Tacoma 2012).

3.5 Time Trend Analysis

This section presents a qualitative and quantitative analysis of time trends in stormwater quality. The objective of time trend analysis is to identify specific drains and constituents that show evidence of significant improvement or degradation in stormwater quality over time. The changes can be a result of source control actions in the drainage basins that help to curtail pollutant concentrations, or alternatively, changes or disturbances in the watersheds that may cause concentrations to increase, (e.g., temporary construction activities or increased urban density and traffic).

3.5.1 Stormwater Time Trends

Qualitative Analysis of Time Trends Inspection of box plots comparing stormwater quality from one monitoring year to the next suggests the following (see Appendix G):

- Time trends can be difficult to discern by visual inspection of the year-to-year box plots due to the generally high degree of variability in stormwater data. Time trends are evaluated using more quantitative statistical tests later in this section.
- Despite the inherent variability of the data, there nevertheless appears to be across-the-board reductions in most metals, PAH compounds, and DEHP in most drains since about Year 10 of the monitoring program. Having generally stabilized at low levels for several consecutive years, these trends may be indicative of the effectiveness of the City's source control and enhanced maintenance programs, and additional reductions will be difficult to achieve. Note that apparent higher organics concentrations are present in the last eight years, however, because this increase in concentrations was seen consistently in all the outfalls, additional investigation was performed to evaluate this issue. A summary of the investigation is provided below in Section 3.5.2.
- Unusually dry (Year 2 and Year 4) and unusually wet (Year 6, Year 12, Year 15, and Year 16) monitoring years are summarized in Table 3-1. WY2017 was the wettest year in the monitoring record, while WY2023 is now the driest year of the 22-year monitoring record. Despite the variability over time, there has been no discernible relationship between these unusual water years and stormwater quality. Reliable correlations between stormwater quality and other hydrologic parameters (i.e., rain depth, rainfall intensity, and antecedent period; see Figures 3-2.1 and 3-2.2) are not discernible either.

Simple Linear Regression Analysis of Time Trends The simple linear regression is performed using the logarithms (base 10) of the stormwater concentrations. This is equivalent to an exponential decay model, which is a typical decay profile for environmental data. No seasonal effects were modeled with the regression given that such effects are not consistently observed and are especially weak for organic compounds.

The relevant regression statistics are summarized in Table 3-6. Scatterplots of the time-series data and best-fit lognormal regression models are presented on Figures 3-5.1 (TSS), 3-5.2 (copper), 3-5.3 (lead), 3-5.4 (zinc), 3-5.5 (phenanthrene), 3-5.6 (pyrene), 3-5.7 (indeno(1,2,3-c,d)pyrene), and 3-5.8 (DEHP). These plots show all significant cases of the simple linear regression test.

The regression analysis confirms that reducing trends are statistically significant in 48 of 49 cases at or greater than 95 percent confidence for the seven original key constituents (i.e., all but copper). This is the same number of trends that was observed in WY2022. A decreasing trend for TSS in OF254 was observed for the first time in WY2021. While a significant decreasing trend for indeno(1,2,3-c,d)pyrene in OF237A has been present for many years, it was not observed in WY2021 through WY2023. All other trends were for the same locations and constituents previously observed.

In addition to the 49 temporal trend tests that have been evaluated in past years, the 2014 QAPP required the City to analyze and evaluate total copper. For three outfalls, OF235, OF237B, and OF245, the data collected since WY2015 has been added to data previously collected under the NPDES program between WY2010 and WY2012. With more data available, an evaluation of time trends has been performed for these outfalls for the last several years. In WY2019, it was determined that sufficient data was available for all seven outfalls to perform an evaluation of time trends, although with less data available, the statistical results will not be fully comparable to data for the remaining constituents. With these seven tests added, there are 51 statistically significant time trends (51 out of 56 tests, or approximately 91 percent of the tests) shown in Year 22, with all trends in the direction of decreasing concentrations. As additional data becomes available, time trends for copper will become more comparable to remaining tests.

The best fit regression equations are used to estimate percent reductions over the 22-year monitoring period for these constituents and outfalls:

- TSS: Approximately 40-75 percent reduction in all seven outfalls
- Copper: Approximately 33-47 percent reduction in OF235, OF237B, and OF245
- Lead: Approximately 69-83 percent reduction in all seven outfalls
- Zinc: Approximately 51-71 percent reduction in all seven outfalls
- PAHs: Approximately 62-89 percent reduction in phenanthrene and pyrene in all seven outfalls, and approximately 63-83 percent reduction in indeno(1,2,3-c,d)pyrene in all outfalls except OF237A
- DEHP: Approximately 42-80 percent reduction in all seven outfalls

3.5.2 Analytical Results Follow Up

In review of the analytical results and trends over time, two anomalies were identified which the City evaluated on a comprehensive basis. The first is the organics uptick that was identified in WY2014 and has been discussed in past reports. The second is the frequent and dispersed higher levels of PCBs in sediment traps that were identified during WY2020. A discussion of each of these issues and a summary of the completed evaluations is provided below.

Organics Uptick Review of the scatterplots (Figures 3-5.1 through 3-5.8) showed that while results for TSS and metals generally appear to fall within the range of expected concentrations, there has been an apparent slight uptick in concentrations of organics realized at all outfalls in recent years, coinciding with the start of sampling under the 2014 QAPP. This was first reported in the WY2016 report (Tacoma 2017). While it was expected that there will be a leveling off result over time as the effects of source control actions reach an equilibrium, the across-the-board uptick at all outfalls appeared unusual and led to significant investigation of potential causes for this apparent uptick.

A number of different lines of inquiry were pursued focused on laboratory reporting and performance (see Tacoma 2021 for a complete summary of these efforts). At this time, organics data appears to be leveling out at the recently observed concentrations, leading to the conclusion that these concentrations are representative of the stormwater quality. It appears that rather than these concentrations being higher, past concentrations may have been biased low. While this observed slight increase in organic concentrations is present, concentrations remain substantially lower than the concentrations present early in the monitoring program (see boxplots in Appendix G).

Investigations are completed at this time; however, the City will continue to monitor this as additional data becomes available to identify any ongoing anomalies.

Increased PCB levels in Sediment Traps Review of WY2020 SSPM results showed consistently higher levels of PCBs wherever they were detected. Because these higher concentrations were dispersed across several locations and drainage basins, it did not appear to be caused by a specific event or source. Sampling methods remained the same as prior years. Based on this observation of elevated levels, significant investigation into potential causes was initiated as described in the WY2020 report (Tacoma 2021). Following a thorough analysis, no cause for the increased PCB levels was identified. WY2021 and WY2022 SSPM concentrations returned to expected levels. Therefore, it was determined that WY2020 results were not accurate and will not be used to determine steps forward in source tracing investigations.

3.6 CONCLUSIONS

The City has been performing outfall monitoring in the Thea Foss Basin for 22 years. Most of the COCs have undergone significant reductions in concentrations and loads compared to past monitoring efforts in the late 1980s through mid-1990s. The cumulative effect of federal, state, and municipal source control efforts has likely caused the observed improvements in stormwater quality. The City has directed numerous source control efforts in this watershed, including control of potential TSS, metals, PAH, and DEHP sources. In particular, PAH and DEHP concentrations in the last 13 years have decreased significantly in all the outfalls. Having generally stabilized now for several consecutive monitoring years, the observed concentration reductions are likely an indication of source control effectiveness. The City will continue to evaluate remaining known source(s) of the COCs in the Foss Waterway Watershed. The COCs for each basin and source control priorities are discussed in Section 5.0.

Many significant reductions have been observed in the City's 22-year monitoring record. Forty-eight time trends were shown to be statistically significant in Year 21 (48 out of 49 tests, or approximately 98 percent of the tests) using simple linear regression. All trends were in the direction of decreasing concentrations. As shown below, this is the same number of trends observed WY2020. While the overall number of trends was the same, it should be noted that a new statistically significant decreasing trend for TSS in OF254 was identified for the first time in WY2021, while the ongoing decreasing trend for indeno(1,2,3-c,d)pyrene in OF237A fell below the level of significance in WY2021 where it remained through WY2023.

Year	No. of Significant time trends	Percent of 49 tests
22	48	98%
21	48	98%
20	48	98%
19	48	98%
18	47	96%
17	47	96%
16	47	96%

15	47	96%
14	46	94%
13	46	94%
12	44	90%
11	41	84%
10	37	76%
9	26	53%
8	10	20%
7	4	8%

With sufficient copper data available, an overall evaluation of the source control program including trends for copper for three of the outfalls (OF235, OF237B, and OF245) began in WY2015, and for the other four outfalls (OF230, OF237A, OF243, and OF254) began in WY2019. It should be noted that the results are not as statistically robust, so are not directly comparable to analyses performed for the other constituents. Based on this analysis, the number of statistically significant trends becomes 51 of 56, or 91 percent of tests, showing statistically significant improvement. The three trends are for the three outfalls with the most data, OF235, OF237B, and OF245. As more data becomes available, the data is expected to become more comparable to other constituents.

Year	No. of Significant time trends	Percent of tests
22	51	91%
21	51	91%
20	50	89%
19	51	91%
18[19]	50	89%
17[20]	49	94%
16	49	94%
15	48	92%
14	47	90%
1-13	Not applicable	

With a comprehensive monitoring record – including a 2-year record of sampling of storm events along with ten full years of sampling baseflow events[21] – the drainages in the Foss Waterway Watershed have been well characterized. Significant reducing trends have been observed in a majority of cases, including statistically significant reductions in PAHs, TSS, lead,

[19] Beginning of trend analysis for all seven outfalls for a total of 56 tests going forward.

[20] Includes trend analysis for three outfalls (OF235, OF237B, and OF245) for a total of 52 tests.

[21] Comprehensive baseflow sampling was discontinued at the end of WY2011, so there is a ten-year record for baseflow. Stormwater sampling has continued and currently has 20 years of monitoring data. Some additional baseflow monitoring was completed in WY2016 and WY2019.

zinc, copper, and DEHP concentrations in all or a majority of the drains where sufficient data is available, attesting to the effectiveness of the City's stormwater management program.

4.0 THEA FOSS WATERWAY SEDIMENT MONITORING

The purpose of this section is to evaluate trends in sediment quality in the Thea Foss Waterway over the post-remediation monitoring period. When new sediment analytical results are available, they are compared to cleanup standards to determine if sediment quality in the waterway is being protected from ongoing sources. In addition, the sediment results are evaluated to determine whether any new source issues are present with the potential to impact future integrity of the remedy.

4.1 OVERVIEW OF THEA FOSS SEDIMENT MONITORING PROGRAM

4.1.1 Background

When the waterway sediment remediation projects were completed, the majority of the sediment surface had no, or very low concentrations of contaminants present since the surface was either dredged to clean sediments or covered with new, clean capping materials. It was anticipated that ongoing source contributions to the waterway would cause concentrations of contaminants to increase gradually. Over time, the goal is to have the contaminant concentrations equilibrate at a level below the sediment cleanup standards set by the EPA. The City developed a predictive model so that actual sediment monitoring results could be compared to model predictions during the first ten years post-cleanup to determine areas where additional source controls may be needed to remain in compliance. When comparisons were made at Year 10 (2016), the waterway sediments were found to be generally in equilibrium with the current sources, so it was determined that further comparisons to computer model predictions were no longer needed.

4.1.2 Sediment Monitoring Under Long Term Monitoring Plans

Consistent with past reporting, the City is responsible for collecting post-construction sediment quality data in the middle and outer portions of the Thea Foss Waterway and in the Wheeler-Osgood Waterway. In addition, in accordance with the 2022 addendum to the Long-Term Monitoring Plan (2022 LTMP Addendum), the City also collected, post-construction surface sediment quality data in the Head of Thea Foss Waterway. During WY2023, monitoring of the sediments was performed by the City in accordance with the 2022 LTMP Addendum.

Sediment analytical results are generally compared to Commencement Bay SQOs to determine if the waterway is being protected from recontamination, whether any trends of concern are being observed, or if additional source controls may need to be implemented. In the case of DEHP throughout the water, and HPAHs in the head of the waterway, sediment concentrations are also compared to the State Sediment Quality Standards (SQS) per EPA’s request.

Sampling Locations. Surface sediment sampling locations for long-term monitoring in the waterway are shown on Figure 4-1. These locations were established in coordination with EPA based on proximity to potential sources of contamination.

Sampling Depth. Surface sediment samples in the City’s work area were collected from the top ten centimeters of the sediments. This is the point of compliance for Commencement Bay SQOs.

Sample Types. Surface sediment samples collected from the City’s work area in the mouth and central portion of the waterway are designated as Waterway Source Samples, designated with the prefix WS-x as the sample location identification. In 2022, the City completed construction of Outfall 230A. A waterway source monitoring sample station was added waterward of this outfall starting with the Year 17 (2023) waterway source monitoring event. In addition, in accordance with the 2022 LTMP Addendum, four sample locations within the Head of the Thea Foss Waterway were added to the LTMP waterway source monitoring program. These four sample stations are referred to as the Head of the Thea Foss Waterway Monitoring Sample Stations, with the prefix WC-x as the sample location identification.

Additional LTMP Monitoring Activities. Along with the surface sediment sampling work described above, both the City and Utilities do additional monitoring work in the waterway to ensure that the remedy in place remains protective. During the Year 17 (2023) LTMP monitoring event in both the City's and Utilities' work areas, this included cap integrity monitoring through low tide slope cap inspections and a subtidal hydrographic survey to ensure that the sediment caps remain intact. These activities are completed by the City and Utilities every five years. In addition, every 10 years, the Utilities perform core sampling in the head of the waterway to watch for migration of buried contamination through the sediment cap, as well as a diver inspection of the sheet pile wall that separates the City and Utilities work areas. These activities will be performed next in 2028.

4.2 2023 Sediment Sampling Results

This section includes a summary of current sediment quality conditions throughout the waterway based on data collected during WY2023, Year 17 of the monitoring program. Figure 4-2 summarizes the SQO or DEHP SQS exceedances in waterway source monitoring surface sediment samples. Exceedance ratios (ER) shown are the ratio of the sediment concentration to the corresponding sediment quality criterion (i.e., Concentration/SQO or Concentration/SQS), analogous to a hazard quotient in ecological risk assessment.

Findings from 2023 waterway source monitoring include the following:

- There were no SQO exceedances for metals in any of the Year 17 waterway source monitoring samples.
- During the 2023 event, eight of the 13 Waterway Source Monitoring Sample Stations had no SQO or DEHP SQS exceedances. These samples were collected from Stations WS-1, WS-2, and WS-3, toward the mouth of the waterway; Stations WS-4 and WS-5 in the Wheeler-Osgood Waterway; Station WS-6 located within RA 5, Station WS-7B located in the vicinity of new City Outfall 230A, and Station WS-11 located in the RA 19A channel sand cap area.

  During previous monitoring events, Station WS-3 has had no samples with metals HPAHs, or phthalate SQO exceedances. Stations WS-1, WS-4, and WS-6 have only had samples with DEHP SQO exceedances since baseline sampling (Year 0) began, with DEHP only detected greater than the SQO in the Year 10 sample from Station WS-1 and in the Year 7 sample from Station WS-4. At Station WS-6, DEHP exceeded the SQO in all the previous samples collected since Year 4. Stations WS-2, WS-5, and WS-11 previously had samples with both HPAHs and DEHP SQO exceedances. The HPAH SQO exceedances in the previous samples from these stations were generally not consistent from year to year. DEHP SQO exceedances at Station WS-2 occurred in the samples collected between Year 4 and Year 10, while at both Stations WS-5 and WS-11, DEHP exceeded the SQO in all the previous samples collected since Year 2.

- Two of the Waterway Source Monitoring Sample Stations had no SQO exceedances in the Year 17 samples but did have low level DEHP SQS exceedances when the concentrations were OC-normalized. These samples were collected from Stations WS-10 and WS-12. At Station WS-10, the Year 17 OC-normalized DEHP concentration just exceeded the DEHP SQS criterion by approximately 1.2 times. In previous samples collected at this station, DEHP exceeded the SQO in the Year 7, Year 10, and Year 12 samples, but did not exceed the SQO in Year 17 sampling. At Station WS-12, the Year 17 OC-normalized DEHP concentration exceeded the DEHP SQS criterion by approximately 1.6 times. In previous samples collected at this station, DEHP exceeded the SQO in the Year 4, Year 7, Year 10, and Year 12 samples, but did not exceed the SQO in Year 17 sampling. There were also a couple of HPAHs that exceeded their SQOs in the Year 12 sample from Station WS-10 and in the Year 10 sample from Station WS-12, but no HPAHs were detected in Year 12 or Year 17.
- Samples from two of the Waterway Source Monitoring Sample Stations (Stations WS-7A and WS-9) had only SQO exceedances for DEHP in Year 17, with ratios of approximately 2.7 and 1.04 times the SQO, respectively. The DEHP OC-normalized result for the Year 17 sample from Station WS-9 did not exceed the DEHP SQS. For Station WS-7A, an OC-normalized result was not calculated for the Year 17 sample because the TOC was greater than the normal range for OC-normalization. DEHP sample results from previous monitoring years at these stations also showed DEHP SQO exceedances. In previous samples from Station WS-7A, DEHP has been detected greater than its SQO since Year 2 and there have also been SQO exceedances of individual HPAHs and butyl benzyl phthalate previously detected in some samples, including the Year 12 sample. At Station WS-9, DEHP exceeded its SQO in the Year 2 and Year 12 samples, at similar concentrations to the Year 17 sample.
- The Year 17 sample from Station WS-8 had SQO exceedances of one HPAH only, for pyrene. The Year 17 pyrene result, at approximately 1.4 times the SQO, was similar to pyrene concentrations in previous samples collected at this station. However, in all previous samples collected at Station WS-8 (except for the Year 10 sample that had no SQO exceedances), SQO exceedances for other HPAHs and phthalates were also detected.
- There were no SQO exceedances for HPAHs or SQS exceedances for total HPAHs in the 2023 samples collected from the Head of the Thea Foss Waterway Monitoring Sample Stations. Previous samples collected at Station WC-02, between 2007 and 2014, consistently had SQO exceedances for HPAHs. For the previous samples from Station WC-03, only the sample collected in 2011 had HPAH SQO exceedances. Previous samples from Station WC-09 had multiple HPAH SQO exceedances in the 2009 sample and in one of the samples collected in 2014. Previous samples from Station WC-11 showed only two individual HPAH exceedances in one of the samples collected in 2014.
- For DEHP, three of the Year 17 samples from the Head of the Thea Foss Waterway Monitoring Sample Stations (Stations WC-02, WC-03, and WC-09) had SQO exceedances ranging from approximately 1.1 to 3.8 times the SQO. The Year 17 DEHP OC-normalized concentration for Station WC-03 also exceeded the SQS criterion. DEHP OC-normalized concentrations for Stations WC-02 and WC-09 were not calculated for the Year 17 samples because the TOC was outside the normal range for OC-normalization. DEHP usually exceeded its SQO in the previous

samples collected from these three stations. At Station WC-11, while the DEHP concentration in the Year 17 sample did not exceed the SQO, it did exceed the DEHP SQS criterion when OC-normalized. In previous samples collected from Station WC-11, the DEHP SQO was exceeded in the 2008, 2009, 2011, and 2014 samples.

No cap integrity concerns were identified in either the City or Utility work areas.

4.3 Conclusions

Based on the results of the Year 17 (2023) waterway source monitoring, no response actions are proposed at this time. No metals exceeded the SQOs at the 13 Waterway Source Monitoring Sample Stations. One HPAH (pyrene) was detected just exceeding its SQO at one of the Waterway Source Monitoring Sample Stations (Station WC-8), but no HPAHs exceeded the SQOs or the total HPAH SQS at the Head of the Thea Foss Waterway Monitoring Sample Stations. There were DEHP SQO and/or SQS exceedances at four of the Waterway Source Monitoring Sample Stations and at three of the Head of the Thea Foss Waterway Monitoring Sample Stations, but these results were generally consistent with or lower than the DEHP results from the previous monitoring samples collected at these stations. DEHP is a known ongoing urban and waterway operational contaminant and will continue to be monitored at these stations during the next LTMP monitoring event.

Waterway source monitoring will continue to occur at the 17 monitoring stations during the next LTMP monitoring event, occurring in Year 22 (2028).

5.0 THEA FOSS PROGRAM EFFECTIVENESS: WATER YEARS 2001 TO 2023

In this section, program effectiveness of the Thea Foss Source Control Strategy is evaluated by linking source control activities, long-term outfall monitoring results, and post-construction sediment monitoring, as applicable (see Figure 1-1).

Long-term outfall monitoring is used to measure the effectiveness of Tacoma's SWMP and on-the-ground source control activities. Monitoring also provides information for evaluation of the need for any new source control activities. Monitoring tools used to achieve this are temporal trend analysis and spatial trend analysis. Temporal trend analysis provides a measure of changes in the characteristics of the drainage basins over time by identifying increases or decreases of contaminant concentrations. These changes can be the result of source control activities, construction activities, or other impacts in the basin that alter land use. Spatial trend analysis identifies particular municipal storm drains that may be significantly higher or lower in contaminant concentrations compared to other storm drains in the Foss Waterway Watershed and guides source control prioritization. Table 3-4 summarizes this analysis for stormwater, while Table 3-5 summarizes the analysis for SSPM. On each of these tables, the top portion provides the results for the evaluation of the 22-year data set, while the bottom portion provides the results when looking at only the more recent data. For stormwater the last two years of data are evaluated, while for SSPM the last five years are evaluated since there is only one data point for each year. Since the two- or five-year data sets are smaller, there is somewhat less confidence in the results, however, it does provide some indication of the current source control status and priorities.

Each subsection below includes a presentation of stormwater and SSPM data. SSPM data helps to provide information on extremely hydrophobic constituents such as mercury, HPAHs, pesticides, and PCBs, which have a strong affinity for sediments but are poorly soluble and often not detectable in whole-water samples. In conjunction with baseflow and stormwater data, SSPM data is used to help the City, EPA, and Ecology identify areas of unusually elevated contaminants in the municipal drainages and to determine the need for focused source control work.

It should be noted that the spatial patterns observed in stormwater are not always consistent with those observed in SSPM. Discrepancies between these data sets may be caused by differential transport of pollutants in dissolved and particulate phases or how the source is introduced into the system (e.g., below ground leak, illicit connection, contact with stormwater).

Post-construction surface sediment data from the waterway is used as another tool to evaluate the effectiveness of existing source controls in the Foss Waterway Watershed, whether additional source controls and BMPs for municipal stormwater discharges or other sources are necessary and appropriate, and if so, where and how they might best be implemented. As discussed in Section 4.0, there were no recontamination issues requiring follow-up identified the most recent in-waterway monitoring performed in 2023. The next sediment monitoring event will be performed in summer 2028 and a summary of results will be presented in the WY2028 report.

Although the recommendations presented in this section are intended specifically for municipal outfalls and activities within their respective drainage basins, stormwater discharges must also be evaluated in the context of other source loads to the waterway. It is anticipated that chemical loads from other sources will be appropriately monitored and managed under other federal, state, and local regulatory programs.

5.1 OUTFALL 230

Many activities have occurred in the OF230 drainage basin, some of which have contributed to improvements in the quality of baseflow, stormwater, and SSPM. Statistically significant improvements in all index COCs (TSS, lead, zinc, PAHs, and DEHP) have been observed in stormwater in OF235 (Table 3-6). Figure 5-1.1 shows the annual average concentrations for stormwater, baseflow, and SSPM.

This section provides a summary of water/sediment quality results within the OF230 drainage basin and compares the water/sediment data results with the major source control and other activities that have occurred within the basin. A more comprehensive description of source control activities performed to date is provided in Appendix A.

As indicated in Section 3, a new outfall, OF230A, was under construction throughout 2022. Upon completion, this new outfall is designed to carry approximately 98 percent of the stormwater previously discharging to OF230 and approximately 26 percent of the stormwater previously discharging to OF235. The City will be proposing a modification to the monitoring program in 2023.

Stormwater runoff and any baseflow from upstream drainage areas and the associated conveyance system (catch basin inlets and pipes) was connected to the new pipeline at several locations and thus discharged to the waterway through the new outfall in mid-December 2022. The transition period was October through December of 2022 and sampling of OF230A was started after the transition period and once a new sampling location was established. WY2023 data represents only a portion of the year and will be discussed in further detail in the WY2023 report.

Also due to construction of OF230A, FD3A was removed in December 2021 and was not reinstalled until January 2023 (now FD3C) after construction was complete. Therefore, there are no results for this sediment trap in WY2022. Since the sediment trap was not reinstalled until after the start of WY2023, the WY2023 results that are reported reflect deployment for a partial year.

5.1.1 Water and SSPM Quality

Annual and seasonal data for stormwater and SSPM for the COCs and other parameters is used to identify ongoing areas of concern. The following paragraphs summarize the WY2001-WY2023 monitoring results for OF230, where COCs in this outfall are different from other Foss drainage basins, and where source control activities may be focused.

5.1.1.a TSS and Metals

Stormwater TSS concentrations in OF230 stormwater remain among the lowest mean and median observed in all the drainages (see Table 3-3.1 and Figures F-1). Stormwater TSS concentrations in OF230 are slightly below average (-3) during the 22-year monitoring period but neutral or average (0) when looking at only the last two years (see Table 3-4). As shown in Figure 3-5.1 and Table 3-6, TSS has shown a statistically significant improvement in stormwater quality from 2001 to present. The best-fit regression equations result in an estimated 47 percent reduction in TSS concentrations in OF230 in the 22-year monitoring period.

As shown in Figure G-2 and G-3, lead and zinc concentrations in stormwater have remained fairly consistent over the last 22 years, although decreasing somewhat in the last eleven to twelve years. Stormwater quality in OF230 for the 22-year data set is roughly the same as other outfalls (0). The last two years is moderately (-3) and slightly (-1) decreased in lead and zinc, respectively, as compared to the other outfalls (see Table 3-4).

Analysis for copper at this outfall began in WY2015 so more limited data is currently available for complete and comparable statistical analysis. When looking at the eight years of data available, OF230 is slightly lower in copper as compared to other outfalls (-2), while it is only moderately lower (-3) when looking at the last two years of data. While the regression analysis showed a statistically significant increase in WY2020, in WY2021 and WY2022 this increasing trend was not apparent in WY2023. It should be noted that only three samples were collected from this monitoring location during WY2023, and the historic drainage area now largely discharges to the new OF230A. When looking at the entire monitoring record, copper levels are generally relatively low compared to other outfalls, and this apparent increasing trend may have been a result of several outliers measured in the spring or summer of WY2017, WY2018, and WY2019 (see Figures G-5 and G-15). These outliers have more influence in the smaller data set. No outliers were identified in WY2022 or WY2023.

<u>SSPM</u> Storm sediment in OF230 is slightly elevated in lead, mercury, and zinc (+2, +1, and +1, respectively) as compared to most other outfalls when looking at the 22-year monitoring record (see Table 3-5 and Figures F-11-F-13. When looking at only the last five years of data, SSPM quality in OF230 is generally similar to the other basins for lead, mercury, and zinc (all at 0). Copper also appears to be slightly lower (-1) based on all available data, and neutral (0) over the last five years compared to other outfalls.

In WY2015, mercury concentrations at FD3A increased from low levels back to medium levels, and then returned to low levels in WY2016, where they remained through WY2020 (see Figure 2-1.1). In WY2021, mercury concentrations increased back to medium levels at 0.232 mg/kg, just above the threshold used on the figure to define medium level concentrations. There was no sample available for FD3A in WY2022 due to construction of the new outfall in this area. The sediment trap was removed in December 2021 and was installed in January 2023 after construction was complete. This sediment trap was moved to an upstream manhole due to the construction (now FD3C) and is considered representative of the FD3A drainage area. Mercury concentrations during WY2023 remained at medium levels with a slight increase from WY2021 concentrations at 0.355 mg/kg. There were no active mercury investigations in this drainage basin during WY2023. The City will evaluate additional source control investigations in this basin during 2024.

As shown in Figures 2-1.1 and 5-2.1, mercury concentrations at all these locations generally decreased somewhat from WY2004 to WY2009, which is believed to be a result of the storm line cleaning project and removal of a point source (see Section 5.1.2 below). Due to increasing or variable contamination levels in sediment traps in recent years (after point source removal and storm line cleaning), source(s) of mercury were determined to still be present, and this led to additional investigation and removal of additional sources. The general stabilization of concentrations at lower levels indicates that sources have likely been controlled at this time. In WY2020, FD18B was removed, and based on results from WY2021, mercury was removed from the analyte list for FD18.

5.1.1.b PAHs

Stormwater OF230 had similar to slightly higher levels of phenanthrene, pyrene, and indeno(1,2,3-c,d)pyrene in stormwater as compared to other outfalls (+1, 0, and +2) when looking at the 22-year monitoring record (see Table 3-4 and figures in Appendix F). When looking at only the most recent two-year monitoring record, OF230 is slightly lower (-1) relative to other outfalls for indeno(1,2,3-c,d)pyrene, pyrene, and phenanthrene.

Most PAH concentrations in stormwater appear to have decreased following line cleaning (see Section 5.1.2) and stayed fairly constant from WY2009 (Year 8) to WY2014 (see Figure 5-1.1 and figures in Appendix G). The apparent uptick in organics concentrations observed in recent years of monitoring was further evaluated and as discussed in Section 3.5.2, it was concluded that the earlier data was likely biased low. As shown in Table 3-6 and Figures 3-5.5, 3-5.6, and 3-5.7, PAHs (phenanthrene, pyrene and indeno(1,2,3-c,d)pyrene) show a statistically significant improvement in stormwater quality from 2001 to present. The best-fit regression equations result in an estimated 81 to 85 percent reduction in PAHs in OF230 in the 22-year monitoring period.

SSPM Compared to the other outfalls, SSPM quality in OF230 is slightly enriched in phenanthrene and pyrene (both at +2) and moderately enriched in indeno(1,2,3-c,d)pyrene (+3) when looking at the 22-year monitoring period (see Table 3-5 and figures in Appendix F). When looking at just the last five years, all three indicator PAHs are neutral to slightly enriched relative to other outfalls. As shown in Figure 5-1.1, SSPM PAH concentrations increased slightly between WY2005 to WY2009. SSPM PAH concentrations remained fairly consistent with a slight increase in 2014 but generally decreasing concentrations since that time, with an increase observed in WY2020 and a decrease in concentrations in WY2021. Earlier data had indicated a possible ongoing source(s) of PAHs in the FD3A area that was present in the stormwater sediments but wasn't seen in stormwater concentrations. Source control investigations identified a potential source in this area and cleanup was completed and post-cleanup monitoring is underway. Additional investigation identified another possible source in this area and has been addressed by the property owner. As stated above, there was no sample from FD3A available in WY2022 due to construction in the areas, but the WY2023 sediment trap sample from the new FD3C location exhibited a further decreased in PAH concentrations in this basin. Ongoing monitoring will confirm whether control of the identified sources has been successful (see Section 5.1.2 below).

As shown in Figure 5-2.1, all the OF230 sub-basins appear to have also remained relatively consistent over the last 22 years. Overall, PAH concentrations throughout this basin are considered to be relatively low level (see Figure 2-1.2); however, because PAHs have been an ongoing priority for sediment recontamination throughout the waterway, they have been a priority for source control in this basin and others since the beginning of the monitoring program.

5.1.1.c Phthalates

Stormwater The second highest mean and maximum as well as the highest median concentrations of DEHP in stormwater were observed in OF230 (3.21, 44.1, and 1.95 µg/L, respectively) (see Table 3.3.1 and Figures F-8). An unusually high peak concentration of DEHP was observed in Year 7 (WY2008) in OF230, but this appears to be an isolated occurrence (see Figures G-8). OF230 contains moderately elevated DEHP concentrations (+3) in stormwater when reviewing the 22-year monitoring record (see Table 3-4). Concentrations of DEHP in OF230 slightly decreased (+2) when only the last two years of monitoring data are evaluated.

As shown in Table 3-6 and on Figure 3-5.8, DEHP shows a statistically significant improvement in stormwater quality from 2001 to present. The best-fit regression equations result in an estimated 69 percent reduction in DEHP in OF230 in the 22-year period. In particular, there was a consistent decrease in total phthalate concentrations from WY2008 to WY2014 (see Figures 5-1.1, G-8) that occurred following cleaning of the storm lines (see Section 5.1.2). The apparent uptick in organics concentrations observed in the last eight years of monitoring was evaluated by the City and as discussed in Section 3.5.2, recent results were determined to be representative while earlier results were likely biased low. While this slight increase in organic concentrations is observed, concentrations remain substantially lower than the concentrations present early in the monitoring program (see boxplots in Appendix G).

SSPM OF230 SSPM quality is slightly enriched in DEHP and total phthalates (+2 and +1, respectively), and slightly lower in butylbenzylphthalate (-1) relative to other outfalls when looking at the entire 22-year monitoring record (see Table 3-5 and figures in Appendix F). Concentrations of DEHP and total phthalates are neutral (0) and butylbenzylphthalate is slightly lower (-1) relative to other outfalls when looking at the last five years of data.

Within the OF230 basin, some of the higher concentrations of total phthalates were found early in the monitoring program in FD3A (max of 161,500 µg/kg in WY2004), in FD3B (max of 130,590 µg/kg in WY2005), in FD16 (max of 161,860 µg/kg in WY2010), and in FD18 (max of 100,520 µg/kg in WY2004) (see Figures 2-1.3 and 5-2.1). Concentrations have generally been much lower since cleaning of the storm drainage system, although intermittent medium level concentrations were noted in FD18 and FD18B in WY2010 and WY2012. Concentrations have been in the low range since WY2012 throughout this basin.

5.1.1.d Pesticides

Stormwater Analysis for bifenthrin in stormwater began in WY2021 under the 2020 QAPP. Statistical analysis will be performed when sufficient data is available.

SSPM Analysis for bifenthrin in SSPM began in WY2015 under the 2014 QAPP. Although there are fewer data points available for statistical analysis, the results are significant ($p<0.05$) and there are only slight discernible differences between outfalls. OF230 is neutral (0) relative to other outfalls based on available data. The highest maximum concentration of bifenthrin was found in OF230 (142 µg/kg) with the maximum concentration detected in 2015 (Table 3-3.2).

5.1.1.e PCBs

Stormwater PCBs are not a COC tested for in stormwater under the 2020 QAPP.

SSPM Many of the highest concentrations in SSPM PCBs during the monitoring period have been found in the OF230 drainage basin (see Figure F-21). WY2017 concentrations at FD3A were less than half the concentration measured in WY2016, however they increased each year between WY2018 and WY2020. Following a thorough analysis, no cause for the across-the-board elevated PCB levels in WY2020 was identified. Therefore, as discussed in Section 3.5.2, it was determined that the WY2020 results were not accurate, and they will not be used to determine steps forward in source tracing investigations. The WY2021 concentration at FD3A was the lowest observed since 2005, however it remained in the high range relative to other outfalls (Figure 2-1.4). There is no data available for WY2022 due to the construction project in the area, but sampling resumed in WY2023 (FD3C) and remained in the relatively higher range when compared to other drainage areas. Concentrations at FD3-New have fluctuated between low and high levels since WY2014, with WY2022 concentrations returning to the low range relative to other outfalls (Figure 2-1.4).

Concentrations at FD18 decreased from high levels to moderate levels in WY2014, where they remained through WY2017. In WY2018, concentrations increased back to the high range, nearly double the WY2017 concentration, where they remained through WY2021 (Figure 2-1.4). Source control activities have taken place in this area as further described in Section 5.1.2 below. The WY2022 concentration at FD18 returned to the medium range and were below detection limits in the WY2023 FD18 sediment trap sample.

PCB concentrations at FD16 fluctuated between low and medium levels relative to other outfalls since WY2013. The WY2022 concentration was in the high range, however, the WY2023 sediment PCB concentrations were back down below detection limits. Total PCBs in SSPM in OF230 were slightly elevated (+2) relative to other outfalls when looking at the entire 22-year monitoring record, but there are no significant differences between outfalls when looking at the last five years of data (see Table 3-5).

As shown on Figure 2-1.4, PCBs concentrations at FD3A, FD3 New, FD18, and FD16 were intermittently at high levels before the 2007 cleaning project and were at low levels immediately following the cleaning (also see Figure 5-2.1 and Section 5.1.2). However, PCB concentrations at all these locations have been fluctuating between low, medium, and high levels since pipe cleaning, with moderate to high levels detected since WY2012. Over the last several years, additional sources of PCBs in the OF230 drainage basin have been identified and are in various stages of source control actions. The status of this work is further described below.

5.1.2 Source Control Program Activities

Mercury Source Tracing Investigation Several source control investigations for mercury have been performed, and actions taken to eliminate identified sources. Additional information can be found in Appendix A.

Due to the likely presence of a remaining source or sources in this drainage basin, specifically the FD18 and FD3A areas, a source tracing investigation was launched to further investigate potential sources of mercury in this area.

Results from the mercury investigation and business inspections of the surrounding area indicated that sources of mercury were likely present in two primary areas: one in the sidewalk roof drains draining to a catch basin at the corner of South 12th and Court A, and one found at a lower concentration level at South 11th and Broadway. The South 12th and Court A area was subsequently resolved as described in the WY2020 report. At the South 11th and Broadway location, mercury concentrations continued to trend downward but remained higher than normal catch basin concentrations. The basins were cleaned in November 2018 and resampled in June 2020. While mercury concentrations continue to trend downward at this location, higher than normal basin concentrations remained present in 2021.

There were no sediment trap results for WY2022 at FD3A due to construction activities in the area. Due to construction of the new outfall (OF230A) this sediment trap was removed in December 2021 and was replaced in a slightly upstream location with the FD3C sediment trap in January 2023, after construction was complete. The FD3C drainage area is considered representative of the FD3A drainage area. WY2021 sediment trap sampling results had increased slightly to medium levels, however the measured concentration of 0.023 mg/kg was just over the 0.20 mg/kg used in Figure 2-1.1 to differentiate low and medium levels. WY2023 sediment trap results continued to exhibit medium concentrations with an increase to 0.355 mg/kg. There were no active mercury investigations during 2023. The City will evaluate additional source control investigations in this based during 2024.

More detailed information regarding this investigation can be found in Appendix A.

PCBs Source Tracing Investigation Since the inception of the sediment trap monitoring program, intermittently high levels of PCBs have been identified in some of the OF230 sediment traps (see Figure 2-1.4). After the lines were cleaned in 2007, concentrations decreased, but over time increased back to moderate to high levels. Because of the likely presence of a remaining intermittent source or sources, a source tracing investigation was launched in 2012 in conjunction with the mercury source tracing work described above, to further investigate potential sources of PCBs in this drainage basin.

In 2013, the investigation indicated that elevated levels of PCBs were present in the caulking materials from two properties: the Wells Fargo and Sound Physicians (now known as 1123 Pacific Partners) properties located in the vicinity of South 12th and South 13th Streets, between Pacific Avenue and Court A in downtown Tacoma. It was determined likely that these materials were the source of PCB contamination found in the nearby catch basins in the targeted drainage areas. To ensure that the contamination did not reach the waterway, the system was cleaned in early 2015.

Significant remediation work has been performed at both properties. The catch basins in the area were cleaned and during 2022, the City resampled the catch basins adjacent to the Wells Fargo building and found that there appears to be a continuing source of contamination at the southeast corner of the property. The catch basin in the southeast corner of the site showed a concentration of 0.9 mg/Kg in 2016 and 1.8 mg/Kg in 2017, and as a result the system was cleaned in 2017. Following this cleaning, this same catch basin continued to exhibit elevated PCB concentrations.

At the 1123 Pacific Partners site during 2022, the City attempted to resample three adjacent catch basins. One of the locations did not have enough sediment to sample and the two other catch basin samples exhibited concentrations that were reduced from 2020 levels but were still considered elevated concentrations. It was discovered that the property was purchased by new owners in 2022 and they were unaware of the PCB remediation at this location. During discussions with the property owners/managers of the Wells Fargo and 1123 Pacific Partners sites, it was agreed that the City would clean and resample the surrounding catch basins in 2023 to determine if this was an ongoing issue. Once the results are received, the City will meet with the property owners to discuss any required remediation moving forward. All of the catch basins surrounding this complex were cleaned in October 2022 however, there was insufficient sediment in the catch basins and no samples were collected during 2023. During 2024, staff will attempt to collect samples in the catch basin surrounding this property.

As indicated above, WY2022 SSPM results were not available for FD3A due to construction activities. The new sediment trap at this location (FD3C) was replaced in January 2023, so WY2023 results only represents a partial year. These partial year results, and future SSPM monitoring results, will be reviewed in conjunction with source control catch basin results to identify next steps at these properties.

SSPM PCB concentrations during WY2023 in the FD3C sediment trap remained at high levels with a slight decrease from WY2021 concentrations at 485 µg/kg. Concentrations during WY2023 were the lowest seen since the investigation begin in this basin. During 2024 the City will continue to follow-up on private property cleanups performed, and complete ongoing system cleaning and monitoring for PCBs in this drainage basin.

While the areas discussed above were identified as the highest priority, several other areas with lower levels of PCB contamination were also identified through the initial investigation. These areas were initially assigned lower priority ratings since contaminant levels were lower. Storm drains throughout this area were cleaned in February 2015, and the area resampled in March/April 2016. Results indicated ongoing lower-level sources of PCBs in several areas, leading to additional investigation. Updates on each of these PCB investigations are provided below, and more information can be found in Appendix A.

- One of these areas is located at South 9th and Fawcett St. in the FD18 area. Investigation led to the identification of the CenturyLink building as the likely source of PCB contamination found in the nearby catch basins and the City worked with the business and regulatory agencies to work towards a remediation solution at this site. The property owner completed the encapsulation project for the building in 2020. Following completion of building remediation in 2020, the storm system was cleaned. In September 2021, sediment samples were taken from adjacent catch basins, and elevated PCB concentrations were detected. At the City's request, the property owner pressure washed the sidewalks to remove residual materials. In 2022, a construction project began at this location, which involved the removal and replacement of all of the curb/gutter and sidewalk at this intersection. The project also removed one of the catch basins sampled during this investigation. Sediment trap PCB concentrations in FD18 have continued to decrease since remediation work was completed in 2020. PCB concentrations dropped to from high to medium levels for the first time since 2017 in this basin and were below detection limits in the 2023 FD18 sediment trap sample (see Figure 2-1.4). There are no further investigations planned for 2024. Sediment trap data will continue to be reviewed and additional investigations will be conducted if concentrations increase.

- Another area of concern is located at South 13th and Commerce. Initial source tracing efforts did not turn up a likely source. Cleaning of the system will be completed performed in this area during 2024 the basins will be resampled when sufficient sediment has accumulated to determine if an issue is persisting at this site.

- Finally, the Park Plaza parking garage located at South 10th and Pacific Avenue was identified in 2016 as having exposed caulking, sealant, and sediment materials that are likely the source of PCBs in the storm system. The City, as property owner, is continuing to work with EPA to assess the extent of contamination and develop a remediation plan.

The City is continuing to coordinate efforts to keep contaminants out of the municipal stormwater collection system. Sediment trap results for WY2024 will be assessed to monitor the ongoing conditions in this basin as additional sources are controlled. More detailed information regarding these investigations can be found in Appendix A.

PAH Source Tracing Investigation Based on sediment monitoring in OF230, the FD3A drainage area was identified as having ongoing issues with PAH sediment contamination. A source control investigation identified elevated levels of PAHs in a specific segment of the FD3A drainage area leading to identification of a parking area at the corner of Court A and South 14th Street as having the presence of elevated PAH concentrations.

Since the source was identified, the City has been working cooperatively with the property owner as they clean and repair their private onsite storm system. Repair of the private system was completed in October 2022, and the municipal catch basins that the private systems connect to were cleaned in November 2022. Public catch basins will be resampled in 2024 when sufficient sediment has accumulated.

PAH concentrations in FD3A decreased over time from 111,295 µg/kg in WY2016 to 63,830 µg/kg in WY2023. This overall decrease in concentrations indicates that efforts to date have been successful. There are no new PAH investigations are planned in this basin for 2024. Staff will review the 2024 sediment trap data for FD3C (Formerly FD3A) when it becomes available to see if the PAH contamination has returned or remains at reduced levels. More detailed information regarding this investigation can be found in Appendix A.

FD16 PCB Source Tracing Investigation Composite catch basin samples were taken in the FD16 drainage basin during 2017 to investigate the ongoing presence of PCBs is this area. Through this sampling, the City discovered elevated PCBs in catch basin sediments from three segments in the FD16 drainage basin. Following continued investigation in 2018, five discrete catch basin locations were cleaned, and resampling suggested that the relatively low-level concentrations of PCBs were emanating from building materials located at 1301 and 1331 Tacoma Avenue South. PCBs were not detected in FD16 in WY2019, WY2020 or WY2021. However, PCB concentrations then rebounded to higher levels in 2022 with a concentration of 430 µg/kg, and then in WY2023 sediment PCB concentrations were back down below detection limits.

During 2023, short term sediment traps were installed in multiple locations within the FD16 sub basin to try and narrow down the source of PCB contamination within the basin. The traps were deployed during October 2023 in drainage areas that had previously exhibited elevated concentrations of PCBs. These sediment traps are currently scheduled to be removed in early 2024. The city will continue to monitor the sediment trap results to determine if this is an ongoing issue requiring further investigation.

More detailed information regarding this investigation can be found in Appendix A.

Storm System Cleaning In 2007, the municipal storm system in OF230 was cleaned and video inspected. The objective of this project was to remove residual sediments in the storm drains that may contain legacy contaminants. As discussed in detail in the WY2011 report, storm system cleaning contributed to significant reductions in stormwater concentrations. Storm line cleaning is an important component of the City's source control program, and the City is currently on a schedule of cleaning each storm system area on a 20-year cycle. Additional cleaning is performed on an as-needed basis to address specific maintenance needs. In combination with other source control activities, storm system cleaning appears to have been effective at removing all seven of the compounds tested. The City is statistically evaluating the results to determine whether a maintenance schedule different from the City-wide schedule for pipe cleaning projects is needed within this sensitive basin.

Statistically significant reductions were evident for TSS, lead, zinc, PAHs, and DEHP (see Table 2-2). Line cleaning, along with other source control activities, resulted in reductions of TSS at 28 percent, lead at 51 percent, zinc at 28 percent, DEHP at 58 percent, and PAHs (phenanthrene, pyrene, and indeno(1,2,3-c,d)pyrene) at 77-82 percent.

Enhanced Street Sweeping Program In January 2007, the City's street sweeping program was enhanced in an attempt to reduce sediment buildup in the storm sewer system. Under the enhanced program, the sweeping frequency was increased, air regenerative sweepers replaced mechanical sweepers, and the City also increased communications with residents, which helped raise awareness of the importance of the street sweeping program.

Statistically significant reductions were evident for TSS, lead, zinc, PAHs, and DEHP (see Table 2-3.1). Street sweeping, along with other source control activities, resulted in reductions of TSS at 31 percent, lead at 51 percent, zinc at 30 percent, DEHP at 56 percent, and PAHs (phenanthrene, pyrene, and indeno(1,2,3-c,d)pyrene) at 75-81 percent. PAH concentrations shown in Figure 5-1.1 show a fairly consistent decrease and then leveling off between WY2007 and WY2015 that occurred following the start of street sweeping and the cleaning of the storm lines. An apparent uptick in organics concentrations observed in the last eight years of monitoring was evaluated by the City, as discussed in Section 3.5.2. Recent results were determined to be representative, while earlier results were likely biased low. While this slight increase in organic concentrations is observed, concentrations remain substantially lower than the concentrations present early in the monitoring program (see boxplots in Appendix G).

General Source Control Activities In addition to the ongoing investigation and maintenance activities described above, the City has been and is continuing to implement other source control program elements in the OF230 drainage basin, which are described in more detail in Appendix A. Several other source control actions have been completed or are currently underway in this basin, including the Sauro's Cleanerama site remediation and the removal of USTs at various locations under TPCHD oversight. In addition, one new private treatment device was installed in this basin in 2023 and one warning letter was issued (see Appendix A).

5.1.3 Outfall 230 2024 Work Plan

As shown in Table 3-6 and Figures 3-5.1 to 3-5.8, TSS, lead, zinc, PAHs (phenanthrene, pyrene, and indeno(1,2,3-c,d)pyrene), and DEHP all show statistically significant improvement in OF230 stormwater quality from 2001 to present with an estimated 47 percent reduction for TSS, 82 percent for total lead, 51 percent for total zinc, 79-84 percent reduction for the three index PAHs (phenanthrene, pyrene, and indeno(1,2,3-c,d)pyrene), and 69 percent for DEHP in the 22-year period. While there is not a statistically significant trend for copper in WY2023, mean copper concentrations in OF230 are among the lowest relative to the other Foss outfalls (Figure F-5). In looking at box plots for individual years, there are several outliers identified six outliers dating back to WY2017 (Figure G-5). However, when looking at the entire monitoring record (Figure F-5), there are four outliers identified: two in WY2017, one in WY2018 and one in

WY2019. There were no copper outliers identified during WY2023 based on this year's data or the entire monitoring record.

As described in detail above, OF230 monitoring results generally show:

- Stormwater – Slightly lower TSS (-1) and moderately higher DEHP and indeno(1,2,3-cd)Pyrene (+3 and +2, respectively) concentrations compared to other outfalls when evaluating the 22-year monitoring record (see Table 3-4). DEHP is moderately higher (+2) when looking at only the last two years of data. Copper (-2) is moderately lower in concentration compared to other outfalls based on the last eight years of data that are available. Concentrations of other COCs are generally similar to concentrations found in other outfalls.

- SSPM – Outfall results show moderately higher indeno(1,2,3-c,d)pyrene (+3) compared to other sediment trap locations (see Table 3-5) when evaluating the entire 22-year monitoring record. When looking only at more recent data, indeno(1,2,3,cd)pyrene has relatively neutral concentrations when compared to other outfalls (0). Over time, upline sediment traps have shown possible areas of concern primarily for mercury and PCBs, and to a lesser extent PAHs and phthalates. Source control efforts have either been completed or are ongoing as described above and in Appendix A.

Therefore, the following recommendations are included in the 2024 Work Plan for OF230:

- Continue follow-up on private property cleanups performed, and complete ongoing system cleaning and monitoring for mercury, PCBs, and PAHs as appropriate in the areas draining to FD3C and FD16
- Continue evaluation of potential sources of spring/summer outliers for copper to stormwater
- Review the WY2024 SSPM data to evaluate the potential for ongoing sources in the various investigation areas

5.2 OUTFALL 235

Many activities have occurred in the OF235 drainage basin during the monitoring period, some of which are contributing to improvements in stormwater and SSPM quality. Statistically significant improvements in all index COCs (TSS, lead, zinc, PAHs, and DEHP) have been observed in stormwater in OF235 (Table 3-6). In addition, copper has shown significant improvement in stormwater based on a more limited data set. It is, therefore, likely that the City's source control efforts have helped to reduce these constituents in OF235. Figure 5-1.2 shows the annual average concentrations for stormwater, baseflow, and SSPM.

This section provides a summary of water/sediment quality results within the OF235 drainage basin and compares the water/sediment data results with the major source control and other activities that have occurred within the basin. A more comprehensive description of source control activities performed to date is provided in Appendix A.

As indicated in Section 3, due to the construction of the stormwater interceptor along Jefferson Street, a portion of the historic OF235 drainage area now drains to the new OF230A and the final rerouting of the drainage system was completed on December 15, 2022. OF230A receives approximately 98 percent of the stormwater previously discharging to OF230 and approximately 26 percent of the stormwater previously discharging to OF235.

Transition of flow from the drainage area to the new outfall did not begin until after the end of the water year, so all stormwater data from WY2022 was evaluated consistent with data from the entire reporting period. Because the transition of flow took place on December 15th, 2023, WY2023 data represents data from two different drainage areas. This is discussed further in Section 6 and Appendix B.

5.2.1 Water and SSPM Quality

Annual and seasonal data for stormwater and SSPM for the COCs and other parameters is used to identify ongoing areas of concern. The following paragraphs summarize the WY2001-WY2023 monitoring results for OF235, where COCs in this outfall are different from other Foss drainage basins, and where any subsequent source control activities may be focused.

5.2.1.a TSS and Metals

Stormwater Moderate TSS concentrations have been observed in stormwater from OF235 with mean and median TSS concentrations of 55.7 and 40.8 mg/L, respectively. The second highest maximum TSS concentration (441 mg/L) during the monitoring program was observed at OF235 in WY2001 (see Table 3-3.1 and Figure F-1).

TSS in OF235 is slightly lower (-1) compared to other outfalls when looking at the entire 22-year monitoring record in the Foss Watershed (see Table 3-4). As shown in Table 3-6 and Figure 3-5.1, TSS shows a statistically significant improvement in stormwater quality from 2001 to present with an estimated 75 percent reduction of TSS in 22 years. The trend is gradual over time and does not lend itself to be a direct result of any one action. Figures 5-1.2 and G-1 also show the gradual downward trend of TSS over the last 22 years.

The highest mean and median concentrations of lead (53.77 and 41.20 µg/L, respectively) were observed in OF235 stormwater. In addition, the highest overall copper concentration (162 µg/L) occurred in OF235 in 2015 (Table 3-3.1). This outlier appears to be relatively isolated, although one other high outlier occurred in 2012 and high and moderate outliers are present throughout available data. Two outliers were present in WY2021, but no outliers were present in WY2022. While there were no outliers present in WY2023, the overall concentrations for this monitoring year are elevated compared to other years (see Figure G-5). OF235 is significantly elevated in lead (+6) and copper (+6), and slightly elevated in zinc (+1) compared to all other outfalls when looking at the 22-year monitoring record (see Table 3-4). It should be noted that the data set for copper is smaller and the statistical analysis less robust than for other constituents. When only the last two years of monitoring data for OF235 is evaluated, lead (+6) and copper (+5) are still significantly. Zinc remains slightly elevated relative to other drains for the full monitoring record (+1) and the past two years (+2).

As shown in Table 3-6 and Figures 3-5.3 and 3-5.4, lead and zinc show a statistically significant improvement in stormwater quality from 2001 to present, with an estimated 70 percent and 60 percent reduction respectively in 22 years. OF235 also shows a statistically significant improvement in stormwater quality for copper based on available data, with an estimated 37 percent reduction in concentrations. The trends are gradual over time and do not lend themselves to be a direct result of any one action. Figure 5-1.2

shows the gradual decreasing trend of zinc over the last 22 years, and the boxplots in Appendix G also show this decreasing trend for both lead and zinc. It is, therefore, possible that the City's source control efforts have helped to reduce lead and zinc in OF235. However, the continuing relatively higher stormwater concentrations indicate that there may be a source(s) of lead and copper in OF235 since levels are greater than those found throughout the Foss Waterway Watershed. Source control investigations are continuing at this time as described further below.

SSPM Consistent with stormwater results, total lead in SSPM is slightly elevated in OF235 (+2) during the last 22 years (see Table 3-5). Results for all other metals are the same or only slightly different relative to other outfalls with copper, mercury, and zinc at +1, 0, and 0, respectively. When looking at only the last five years, all metals are neutral or slightly elevated (copper, lead, and zinc all at +1, and mercury at 0) in OF235 SSPM compared to other outfalls.

5.2.1.b PAHs

Stormwater OF235 stormwater contained the highest mean and maximum concentrations of the very light end compounds naphthalene and 2-methylnaphthalene, with the maximum concentrations detected early in the monitoring program (see Table 3-3.1). ANOVA results show that OF235 is neutral to slightly lower than average for PAHs (phenanthrene and indeno(1,2,3-c,d)pyrene at 0, and pyrene at +1) when looking at the entire 22-year monitoring record (see Table 3-4 and boxplots in Appendix F).

As shown in Figure 5-1.2 and in the boxplots in Appendix G, LPAH and HPAH concentrations in stormwater generally decreased between 2007 and 2009-2010 and remained fairly consistent until WY2014. These decreases are believed to be due in large part to the storm line cleaning project (see Section 5.2.2). Concentrations have remained fairly consistent over the last eight years. When only the last two years of monitoring data are evaluated, phenanthrene, indeno(1,2,3-c,d)pyrene, and pyrene concentrations are slightly lower (-1) compared to other outfalls.

As shown in Table 3.6 and Figures 3-5.5, 3-5.6, and 3-5.7, PAHs (phenanthrene, pyrene and indeno(1,2,3-c,d)pyrene) show statistically significant improvement in stormwater quality from 2001 to present. The best-fit regression equations result in an estimated 74-86 percent reduction in each of these PAHs in OF235 in the 22-year monitoring period. The apparent uptick in organics concentrations observed in the last eight years of monitoring was evaluated by the City, as discussed in Section 3.5.2, and recent results were determined to be representative while earlier results were likely biased low. While this observed slight increase in organic concentrations is observed, concentrations remain substantially lower than the concentrations present early in the monitoring program (see boxplots in Appendix G).

SSPM PAH concentrations are relatively neutral for SSPM at OF235 compared to the other outfalls during both the 22-year monitoring period (-1 to +1) and the last five years (all at 0). As shown in Figure 2-1.2, PAH concentrations in storm sediment are considered low level and are similar to other outfall and upland locations. In fact, LPAH and HPAH concentrations in storm sediment have remained fairly consistent in this basin over the last 22years (see Figure 5-1.2).

5.2.1.c Phthalates

Stormwater The highest mean and maximum stormwater concentrations of DEHP during the 22-year monitoring period were observed in OF235 (3.95 and 97 µg/L). Unusually high peak concentrations of DEHP were observed in WY2003 (Year 2) in OF235, but these appear to be isolated occurrences (October 2002 and December 2002) and are not evident in recent years (see Table 3-3.1, Figure 5-1.2 and boxplots in Appendices F and G). The cause of the outliers during WY2003 is unknown.

DEHP is usually the phthalate compound with the most frequent detections and the highest median concentrations. However, the maximum concentration of diethylphthalate was also detected in OF235 stormwater (590 µg/L) in December 2002. The cause of this occurrence is also unknown and may be related to the high concentrations of DEHP in October and December 2002. OF235 contains significantly elevated DEHP concentrations (+5) relative to other outfalls when looking at the entire 22-year monitoring period (see Table 3-4). When only the last two years of monitoring data are evaluated, DEHP concentrations in OF235 are only moderately elevated (+3) compared to other outfalls. The relatively elevated level of DEHP in the entire 22-year monitoring period is likely a result of several high outliers observed in this basin over time (see Figure G-8).

As shown in Table 3-6 and Figure 3-5.8, DEHP shows a statistically significant improvement in stormwater quality from 2001 to present. The best-fit regression equations result in an estimated 80 percent reduction in DEHP in OF235 in the 22-year monitoring period. In particular, there is a consistent decrease in phthalate concentrations from the highest concentrations in WY2003 (Year 2) to WY2013 (Year 12) (see Figures 5-1.2, G-8, and G-18) which is believed to be due to the storm line cleaning project and other source control activities (see Section 5.2.2). The apparent uptick in organics concentrations observed in the last seven years of monitoring was evaluated by the City, as discussed in Section 3.5.2, and recent results were determined to be representative while earlier results were likely biased low. While this observed slight increase in organic concentrations is observed, concentrations remain substantially lower than the concentrations present early in the monitoring program (see boxplots in Appendix G).

SSPM Even though DEHP in OF235 was significantly elevated in stormwater (+5), in storm sediment, the average concentration is only slightly elevated (+1) compared to the other outfalls in the 22-year monitoring period and in the last five years (see Table 3-5 and Figure F-19). As shown in Figure 2-1.3, phthalate concentrations are at low levels in OF235, and concentrations are similar to other outfall and upland locations. Discrepancies between the stormwater and storm sediment data sets may be caused by differential transport of pollutants in dissolved and particulate phases.

5.2.1.d Pesticides

Stormwater Analysis for bifenthrin in stormwater began in WY2021 under the 2020 QAPP. Statistical analysis will be performed when sufficient data is available.

SSPM Analysis for bifenthrin began in WY2015 under the 2014 QAPP and while there are fewer data points available for statistical analysis, the results are significant ($p<0.05$), and concentrations are neutral (0) in OF235 relative to other outfalls based on available data.

5.2.1.e PCBs

Stormwater PCBs are not a COC tested for under the 2020 QAPP.

SSPM Of 235 was neutral (0) relative to other outfalls when looking at the entire 22-year monitoring record. There were no significant differences between outfalls when looking at the last five years of data (see Table 3-5).

At FD6, concentrations increased to medium levels for the first time in WY2019, with a concentration of 280 µg/kg and further increased to high levels WY2020 with a concentration of 420 µg/kg (see Figure 2-1.4). PCBs were not detected at this location in WY2021, WY2022 or WY2023. Following a thorough analysis, no cause for the increased PCB levels that were consistently present in WY2020 results was identified. Therefore, it was determined that WY2020 results were not accurate and will not be used to determine steps forward in source tracing investigations.

5.2.2 Source Control Program Activities

Outfall 235 Stormwater and Baseflow Lead, PAHs, and Phthalates Source Investigation Based on stormwater monitoring in OF235, this basin was identified as having ongoing issues with lead in stormwater. In August 2014, staff began an investigation to identify possible sources of the elevated lead concentrations in stormwater. Elevated concentrations of phthalates and PAHs were also observed in historic baseflow discharges. The intent of this work was to identify specific problem areas within the drainage basin for further investigation.

Through these investigations, three locations were identified where potentially contaminated groundwater was seeping from the hillside and discharging to the City's stormwater system. Construction activities are ongoing in two of these areas which will likely provide some level of control.

Through 2023, the City monitored the sites in this area with active construction to ensure proper BMPs were maintained. This project was on-hold while the new Foss Waterway outfall was being constructed. The construction for the new outfall and the re-routing of the stormwater system was completed in December 2022 and it was anticipated that construction for the Tacoma Center Project would continue in 2024. Upon completion of a development project, it will be determined whether construction in this area will eliminate runoff from possible contaminated groundwater in this drainage basin.

More detailed information regarding this investigation can be found in Appendix A.

Outfall 230/235 Copper Outlier Investigation Copper was newly identified as a contaminant of concern within OF235 and to a lesser extent OF230 in WY2021 due to intermittent elevated concentrations in stormwater with other potential outliers beginning in WY2016. All of these outliers as well as those detected since that time have been detected in the spring and summer. Due to the seasonal and intermittent nature of the outlier copper concentrations showing up in stormwater samples, it was theorized that it is possible that excess copper is caused by a seasonal commercial cleaning or maintenance operation taking place in the drainage basin. Copper is used as a moss killer on roofs and sidewalks as well as being present in some herbicides.

City staff identified buildings with copper exteriors as possible contributors including Tacoma's Union Station due to its large copper roof. On April 27, 2022, the City sampled five private catch basins around the property of Union Station, multiple of which had roof drain connections. The copper results ranged from 86 ppm to 4,360 ppm and all of the catch basins were heavily impacted with sediment. The stormwater leaving this site splits with approximately half going to OF230 and half going to OF235.

Based on these results, in June 2022, EC staff reached out to the property manager for this facility and requested that they clean their catch basins and connecting laterals. The City received confirmation that the catch basins were cleaned on March 27, 2023, and it was confirmed that roof cleaning is conducted using a "light solution of laundry detergent" and only in moss affected areas. As a federal building they are required to Safer-Choice (EPA) or Biobased (USDA) products. In 2024, EC staff will inspect the catch basins at this site and collect samples if there is sufficient sediment. The City will continue to look for other potential sources of copper within this drainage basin if needed based on future sampling results.

More detailed information regarding this investigation can be found in Appendix A.

Storm System Cleaning In 2007, the municipal storm system in OF235 was cleaned and video inspected. The objective of this project was to remove residual sediments in the storm drains that may contain legacy contaminants. As discussed in detail in the WY2011 report, storm system cleaning contributed to significant reductions in stormwater concentrations. Sewer line cleaning is an important component of the City's source control program, and the City is currently on a schedule of cleaning each storm system area on a 20-year cycle. Additional cleaning is performed on an as needed basis to address specific maintenance needs. In combination with other source control activities, storm system cleaning appears to have been effective at removing all seven of the compounds tested. The City is statistically evaluating the results to determine whether a maintenance schedule different from the City-wide schedule for pipe cleaning projects is needed within this sensitive basin.

Statistically significant reductions were evident for TSS, lead, zinc, PAHs and DEHP (see Table 2-2). Line cleaning, along with other source control activities, resulted in reductions of TSS at 58 percent, lead at 57 percent, zinc at 43 percent, DEHP at 76 percent, and PAHs (phenanthrene, pyrene, and indeno(1,2,3-c,d)pyrene) at 75-78 percent.

Enhanced Street Sweeping Program In January 2007, the City's street sweeping program was enhanced in an attempt to reduce sediment buildup in the storm sewer system. Under the enhanced program, the sweeping frequency was increased, air regenerative sweepers replaced mechanical sweepers, and the City also increased communications with residents, which helped raise awareness of the importance of the street sweeping program.

Statistically significant reductions were evident for TSS, lead, zinc, PAHs and DEHP (see Table 2-3.1). Street sweeping, along with other source control activities, resulted in reductions of TSS at 60 percent, lead at 58 percent, zinc at 44 percent, DEHP at 76 percent, and PAHs (phenanthrene, pyrene, and indeno(1,2,3-c,d)pyrene) at 73-76 percent.

General Source Control Activities In addition to the ongoing maintenance activities described above, the City is continuing to implement other source control program elements in the OF235 drainage basin which are summarized here and described in more detail in Appendix A. Several other source control actions have been completed or are currently underway in this basin, including the removal of a UST at one location under TPCHD oversight.

5.2.3 Outfall 235 2024 Work Plan

TSS, lead, zinc, DEHP, and PAHs have all shown a statistically significant improvement in stormwater quality from 2001 to present (see Table 3-6 and Figures 3-5.1 to 3-5.8). As shown in Table 3-6, TSS shows an estimated 75 percent reduction over 22 years, lead at 76 percent, zinc at 60 percent, DEHP at 80 percent and PAHs (both light and heavy PAH fractions) at 74-86 percent reductions. In addition, with eleven years of copper data now available for OF235 an overall evaluation of the source control program can include trends for this outfall, however, the results are not as statistically robust, so are not directly comparable. Copper concentrations in stormwater at OF235 show statistically significant improvement during this period with an estimated 37 percent reduction.

As described in detail above, OF235 results generally show:

- Stormwater – Slightly lower TSS and pyrene (-1) and slightly higher zinc (+1), and significantly higher lead (+6), copper (+6) and DEHP (+5) as compared to other outfalls when evaluating available data from the 22-year monitoring record (see Table 3-4). It should be noted that the data set for copper is smaller and the statistical analysis less robust than for other constituents. When looking at only the last two years of data, copper (+5) and lead (+6) are significantly elevated, zinc (+2) is slightly elevated, and DEHP (+3) is only moderately elevated.

- SSPM – Slightly higher lead (+2) compared to other sediment trap locations when evaluating the entire 22-year monitoring record but very little notable difference in SSPM quality at OF235 when looking at only the last five years (see Table 3-5).

Therefore, the following recommendation is included in the 2024Work Plan for the OF235 drainage basin:

- Evaluate the need for additional source control work for lead, copper and DEHP in stormwater following completion of construction activities in this area. These construction activities are expected to have a positive impact on controlling the flow of potentially contaminated groundwater into the storm drainage system.

- Continue evaluation of potential sources of spring/summer outliers for copper to stormwater.

5.3 OUTFALL 237A

Many source control efforts have been targeted in the OF237A drainage basin and have resulted in improvements in stormwater and SSPM quality. TSS, lead, zinc, phenanthrene, pyrene, and DEHP concentrations have all shown a statistically significant improvement in stormwater quality from 2001 to present. Indeno(1,2,3-c,d)pyrene showed statistically significant improvement for many years, however that trend was not present in WY2021, WY2022, or WY2023 apparently due to several higher concentrations detected in recent years. It is likely that the City's source control efforts have helped to reduce concentrations of the key constituents in OF237A. Figure 5-1.3 shows the annual average concentrations for stormwater, baseflow, and SSPM.

This section provides a summary of water/sediment quality results within the OF237A drainage basin and compares the water/sediment data results with the major source control and other activities that have occurred within the basin. A more detailed description of source control activities is provided in Appendix A.

5.3.1 Water and SSPM Quality

Annual and seasonal data for baseflow, stormwater and SSPM for the COCs and other parameters is used to identify ongoing areas of concern. The following paragraphs summarize the WY2002-WY2023 monitoring results for OF237A[22], where COCs in this outfall are different from other Foss drainage basins, and where subsequent source control activities may be focused.

5.3.1.a TSS and Metals

Stormwater Stormwater TSS, lead and zinc concentrations at OF237A (-2, -3 and -1, respectively) are slightly to moderately below average in the 22-year monitoring period (see Table 3-4). Concentrations are more neutral to slightly lower when looking at only the last two years of data (-1, -2, and -1, respectively). Analysis for copper at this outfall began in WY2015 so less data is currently available for a comprehensive statistical analysis. Based on available data, copper has slightly lower concentrations than other outfalls (-2) when looking at all eight years of and when looking at only the last two years.

In stormwater, OF237A has the among the second lowest mean and median TSS concentrations at 48.7 and 33.3 mg/L, respectively (see Table 3-3.1 and Figure F-1), despite having the highest TSS concentration detected during the monitoring period in WY2017 (668 mg/L in May 2017). The reason for this outlier is unknown but appears to be an anomalous event.

As shown in Figures 3-5.1, 3-5.3, 3-5.4 and Table 3-6, TSS, lead, and zinc have all shown statistically significant improvement, with TSS showing a 47 percent reduction, lead showing a 69 percent reduction, and zinc showing a 52 percent reduction in stormwater quality from 2001 to present. A statistically significant reduction is not yet realized for copper with a more limited data set.

SSPM OF237A exhibits lower concentrations of lead and mercury in SSPM compared to the smaller drains OF230, OF235 and OF243, and is lower for copper and zinc in these same outfalls as well as OF245, (see boxplots in Appendix F). ANOVA statistical tests on SSPM showed that OF237A is slightly lower in metals concentrations (copper, lead and mercury at -1, and zinc at 0) compared to other outfalls for the 22-year monitoring record (see Table 3-5). When looking at only the last five years of monitoring data, OF237A is neutral (0) for lead, mercury, and zinc in comparison to other outfalls. Analysis for copper at this outfall began in WY2015 so less data is currently available for

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[22] As described in Section 3.2.4 of the WY2012 report, the OF237A (for data prior to February 26, 2006) and OF237A New data sets (for data after February 26, 2006) were merged in 2012. While the data sets are generally the same, the box plots in Appendix G appear to show a change in the data in between WY2006 (Year 5) and WY2007 (Year 6). This suggests that there are small differences in the two sampling locations. The OF237A New monitoring location measures contributions from the entire basin whereas the OF237A monitoring location was upstream of the smaller FD2A branch of OF237A storm drain system

a comprehensive statistical analysis. Copper is neutral (0) compared to other outfalls when looking at the full nine years of data and when considering just the past 5 years.

5.3.1.b PAHs

Stormwater OF237A stormwater quality shows evidence of being somewhat enriched in HPAHs with higher max, mean and median concentrations of several HPAHs observed (see Table 3-3.1 and boxplots in Appendix F) compared to other drains. The maximum concentrations occurred in 2007. PAH concentrations over the last fourteen years (Years 8 through 21) are relatively low compared to the previous monitoring years (see boxplots in Appendix G).

ANOVA results show that OF237A is significantly higher than average for indeno(1,2,3-c,d)pyrene (+6), moderately higher for pyrene (+3), and slightly higher for phenanthrene (+1) relative to other drainages over the 22-year monitoring record (see Table 3-4). When looking at only the most recent two-year monitoring record, OF237A slightly higher in TSS, zinc, and DEHP (+1, +1, and +2, respectively), is significantly higher in concentration for phenanthrene, pyrene, and indeno(1,2,3-c,d)pyrene (+6 for all three). High outliers have been identified periodically throughout the monitoring period, including an extreme outlier for indeno(1,2,3-c,d)pyrene in WY2022, and these are likely contributing to this observation (see Figure G-6). The City is evaluating potential causes and seasonality for these outlier concentrations.

As shown in Table 3-6 and Figures 3-5.5, 3-5.6, and 3-5.7, phenanthrene and pyrene show a statistically significant improvement in stormwater quality from 2001 to present. There is an estimated 62 and 72 percent reduction in these PAHs, respectively in 22 years. This is likely due to a combination of actions including the point source removals and sewer line cleaning projects. While there has been a statistically significant improvement in indeno(1,2,3-c,d)pyrene concentrations in past years, this trend was not present in WY2021 through WY2023, likely due to several higher concentrations detected during these monitoring years. Boxplots in Appendix G also show the decreasing trends of PAHs in stormwater. A summary of the City's evaluation of the cause of the slight uptick in results over the past several years is included in Section 3.5.2.

SSPM As shown in Table 3-5, storm sediment in OF237A is slightly to moderately enriched in the indicator PAHs phenanthrene, indeno(1,2,3-c,d)pyrene and pyrene (+2, +4, and +2, respectively) during the 22-year monitoring period. When looking at just the last five years, all three indicator PAHs remain slightly elevated (+2, +1 and +2, respectively). PAHs in SSPM have remained fairly stable over the last 22 years (see Figure 5-1.3) with the exception of WY2009 which had slightly lower concentrations, immediately after the cleaning project.

Figure 2-1.2 shows that PAH concentrations at FD13B were elevated at high or medium levels from WY2003 to WY2011 but dropped to low levels in WY2012 and have remained there since that time. Because the FD13B sediment trap was submerged since construction of the stormwater treatment vault in this area, a new sediment trap (FD13B New) was placed in a location one manhole upstream from the FD13B trap, and the new trap is not affected by the backwater from the treatment vault. FD13B is no longer deployed as of WY2019. Between WY2013, when it was installed through WY2020, FD13B New fluctuated between medium and high levels of PAHs, with high levels detected in WY2017 and medium levels detected in WY2018 through WY2020. These results led to a source control investigation and identification of source(s) which are described further below. While this source control work is continuing at this time, actions to date led to the concentrations at FD13B New being detected at relatively low levels in WY2021 for the first time since this sediment trap was installed and they remained at these lower levels in WY2023. In WY2023, all other sediment traps in the OF237A basin were at low levels (see Figure 2-1.2).

5.3.1.c Phthalates

Stormwater As shown in Table 3-6 and Figure 3-5.8, DEHP shows a statistically significant improvement in stormwater quality from 2001 to present. There is an estimated 42 percent reduction in 22 years. The trend is gradual over time and does not lend itself to be a direct result of any one action (see boxplots in Appendix G and Figure 5-1.3) although concentrations did decrease somewhat immediately following the basin cleaning effort.

In comparison to other outfalls, DEHP in OF237A is of slightly better quality (-2) over the entire 22-year monitoring record and slightly higher (+2) when looking at only the last two years (see Table 3-4).

SSPM DEHP concentrations in OF237A is neutral (0) when looking at the 22-year monitoring record and the last five years of monitoring (see Table 3-5). Butylbenzylphthalate is slightly lower in concentration (-1) and total phthalates along with DEHP are neutral (0) relative to other outfalls when looking at the 22-year monitoring period. Butylbenzylphthalate, DEHP, and total phthalates are both neutral relative to other outfalls based on the last five years of data.

All sediment trap locations in this basin have consistently had low level concentrations since at least WY2014, and phthalates are no longer analyzed at any of the upland sediment traps located up in the basin for source control purposes.

5.3.1.d Pesticides

Stormwater Analysis for bifenthrin in stormwater began in WY2021 under the 2020 QAPP. Statistical analysis will be performed when sufficient data is available.

SSPM Analysis for bifenthrin began in WY2015 under the 2014 QAPP and while there are fewer data points available for statistical analysis, the results are significant ($p<0.05$). OF237A concentrations of bifenthrin are slightly higher relative to other locations in the 22-year monitoring record and the last two years (+2 and +1 respectively) (see Table 3-5). The highest average and median concentrations of bifenthrin are present in OF237A (32 and 33 ug/Kg, respectively) (Table 3-3.2).

5.3.1.e PCBs

Stormwater PCBs are not a COC tested for under the 2020 QAPP.

SSPM PCB concentrations at OF237A are neutral (0) relative to other outfalls when looking at the entire 22-year monitoring record, and there are no significant differences between outfalls when looking at just the last five years of data (see Table 3-5).

After the pipe cleaning project in 2007, PCB concentrations in SSPM at FD10 and FD10C decreased in concentration from previous medium to low levels. In WY2013, however, PCB concentrations increased back to medium levels at both locations (see Figure 2-1.4). Concentrations at FD10 generally decreased to low levels since WY2013, with the exception of one medium level detection in WY2016. This detection was right at the limit between the low and medium levels shown on Figure 2-1.4 (120 µg/Kg). As a result, this sediment trap has been removed at this time. Concentrations at FD10C, however, have fluctuated between medium and high levels since WY2013. The FD10C sediment trap had non-detectable levels of PCBs for WY2023. A source control investigation was completed in this area as further described below and in Appendix A.

At FD2A, concentrations increased to medium levels for the first time in WY2016, with a concentration of 170 µg/kg, but returned to low levels in WY2017 with a concentration of 99 µg/kg. In WY2018, concentrations returned to the medium range where they remained through WY2020. Concentrations during these three years ranged in concentration from 210 to 280 µg/kg. In WY2021, concentrations returned to the low range with a concentration of 100 µg/kg and in WY2022 and WY2023 they were not detected. At FD2, concentrations measured at the medium level in WY2015 and WY2020 with concentrations during those years measuring at 150 and 390 µg/kg, respectively. In WY2021, the concentration remained in the medium range with a concentration of 180 µg/kg and in WY2022 and WY2023, PCBs were not detected. Following a thorough analysis, no cause for the across-the-board increased PCB levels in WY2020 was identified (see Section 3.5.2). WY2021 SSPM concentrations returned to expected levels where they remained in WY2022. Therefore, it was determined that WY2020 results were not accurate and will not be used to determine steps forward in source tracing investigations.

5.3.2 Source Control Program Activities

Storm System Cleaning Targeted areas in the northern portion of the OF237A system were cleaned in 2008. The objective of this project was to remove residual sediments in the storm drains that may contain legacy contaminants. As discussed in detail in the WY2011 report, storm system cleaning contributed to significant reductions in stormwater concentrations. Sewer line cleaning is an important component of the City's source control program, and the City is currently on a schedule of cleaning each storm system area on a 20-year cycle. A second cleaning of approximately 17 percent of the OF237A system occurred in 2021. Additional cleaning is performed on an as needed basis to address specific maintenance needs. The City is statistically evaluating the results to determine whether a maintenance schedule different from the City-wide schedule for pipe cleaning projects is needed within this sensitive basin.

In combination with other source control activities, the original storm system cleaning was effective at reducing all seven of the compounds tested. With less post-cleaning data available following the second cleaning, statistics are not as robust, however reductions were observed for TSS, lead and zinc, while an increase was seen for indeno(1,2,3-c,d)pyrene.

Following the first cleaning, statistically significant reductions were evident for TSS, lead, zinc, PAHs, and DEHP (see Table 2-2). Line cleaning, along with other source control activities, resulted in reductions of TSS at 17 percent, lead at 32 percent, zinc at 30 percent, DEHP at 59 percent and PAHs (phenanthrene, pyrene and indeno(1,2,3-c,d)pyrene) at 66-76 percent. The second cleaning, along with other ongoing source control activities resulted in further reductions of lead at 55 percent and zinc at 42 percent. A statistically significant increase of 69 percent was observed for indeno(1,2,3-c,d)pyrene. An extreme outlier for this constituent was detected in OF237A, which may be the cause of this apparent increase (see Figure G-6).

Enhanced Street Sweeping Program In January 2007, the City's street sweeping program was enhanced in an attempt to reduce sediment buildup in the storm sewer system. Under the enhanced program, the sweeping frequency was increased, air regenerative sweepers replaced mechanical sweepers, and the City also increased communications with residents, which helped raise awareness of the importance of the street sweeping program.

Statistically significant reductions were evident for TSS, lead, zinc, PAHs and DEHP (see Table 2-3.1). Street sweeping, along with other source control activities, resulted in reductions of TSS at 8.5 percent, lead at 27 percent, zinc at 26 percent, DEHP at 53 percent and PAHs (phenanthrene, pyrene and indeno(1,2,3-c,d)pyrene) at 55-67 percent.

FD13 PAH Investigation / Media Filtration System Installation In 2010, the City installed a media filtration system that treats stormwater from the FD13 sub-basin, approximately 50 acres in size. Upstream of FD13, the FD13B sediment trap had been submerged since construction of this stormwater treatment vault. As a result, a new sediment trap (FD13B New) was placed in a location one manhole upstream from the FD13B trap, and the new trap is not affected by the backwater from the treatment vault. Since WY2013 when this new trap was installed, levels of PAHs have fluctuated between medium and high levels at FD13B-New, leading to the initiation of a source control investigation in this area. FD13B is no longer deployed as of WY2019.

During the investigation, City staff identified a significant concentration of PAHs discharging to the City's stormwater collection system from The News Tribune (TNT) employee parking lot. As a result of this finding, the City worked with the business owner and Ecology implement a cleanup plan and the City followed up with a plan for inspecting their private stormwater system quarterly.

Follow-up sampling indicated that the source was not yet eliminated, as PAH results at FD13B-New remained in the high range. Further investigative work led to additional cleanup at the TNT site. In addition, the City performed additional investigative work in the drainage area and determined that more sources were likely present at other private properties. The City continued to investigate with property owners in this area to clean and maintain their private drainage systems and monitor the sediment trap results to determine whether these efforts have been successful or if there are any additional sources of PAHs in this drainage area. WY2021 results showed a significant decrease in PAH concentrations (from 282,110 µg/kg in WY2020 to 159,944 µg/kg in WY2021), and the downward trend continued in WY2022 with a concentration of 142,919 µg/kg, indicating the success of source control actions performed to date. WY2023 sediment trap continued to show a significant decrease in PAH concentrations with a concentration of 58,330 ug/Kg, which is significantly lower than what is classified as relative low levels of contamination (<164,000 ug/Kg) (see Figure 2-1.2). Based on these results, no new investigations are planned in this basin for 2024. The City will continue to monitor the sediment trap results to determine if there are any additional sources of PAHs in this drainage area.

More detailed information regarding this investigation can be found in Appendix A.

FD10C Source Investigation The FD10C sediment trap drainage area was initially tracked for several years as a potential phthalate concern due to sediment trap monitoring results that showed moderately elevated phthalate levels since monitoring of this trap began in 2003. Starting in 2011, phthalate concentrations began decreasing, coinciding with a large business in the basin moving out, while mercury and PCB levels remained slightly elevated. Therefore, the tracking in this area continued with a focus on PCBs, and starting in 2015, on the moderately elevated mercury concentrations.

The stormwater system was cleaned in January 2014 to remove residual contamination. Following cleaning of the system, FD10C continued to show moderately elevated PCBs as well as mercury. As a result of these detections, an investigation was initiated in 2016 including sampling of catch basins in the drainage area as well as performance of business inspections. Through this work, the area for additional investigation was narrowed down to a smaller area.

Ongoing inspections and sampling have not identified a source for this contamination. In 2022, an additional investigation was performed to confirm that there were no errors in the mapping that might lead to identification of a potential source. With that mapping information confirmed, the City continued the investigation with installation of short-term sediment traps at two new locations in attempt to isolate the source. Results from these short-term traps exhibited non-detectable levels of PCBs. Additionally, the FD10C sediment trap had non-detectable levels of PCBs for WY2023. It is possible that the source of PCBs was historical contamination, and the system cleaning removed this contamination. No investigations are planned in this basin for 2024. The City will continue to monitor the sediment trap results to determine if there are any additional sources of PCBs in this drainage area.

More detailed information regarding this investigation can be found in Appendix A.

General Source Control Activities In addition to the ongoing investigation and maintenance activities described above, the City is continuing to implement other source control program elements in the OF237A drainage basin which are summarized here and described in more detail in Appendix A. Several other source control actions are currently underway in this basin, including UST removal actions at numerous sites under TPCHD oversight and installation of nine new private treatment devices. (see Appendix A).

5.3.3 Outfall 237A 2024 Work Plan

In Basin 237A, TSS, lead, zinc, phenanthrene, pyrene and DEHP concentrations have all shown a statistically significant improvement in stormwater quality from 2001 to present with an estimated 47 percent reduction in TSS concentration, 69 percent reduction in lead, 52 percent reduction of zinc, 42 percent reduction in DEHP, 62 percent reduction in phenanthrene, and 72 percent reduction in pyrene concentrations over the 22 years of monitoring (Table 3-6 and Figures 3-5.1 to 3-5.8). The decrease in these concentrations appears to have resulted not only from removal/control of point sources, but also from the combination of many other activities.

As described in detail above, OF237A results generally show:

- Stormwater – Slightly to moderately lower levels of TSS (-1), copper (-2), lead (-2), zinc (-1), and DEHP (-2) compared to other outfalls, and slightly to significantly higher phenanthrene (+1), pyrene (+3) and indeno(1,2,3-c,d)pyrene (+6) when evaluating the 22-year monitoring record (see Table 3-4). These levels are generally the same or more neutral when looking at only the last two years of data, except that zinc and DEHP becomes slightly higher (+1 and +2), phenanthrene, indeno(1,2,3-c,d)pyrene and pyrene become significantly elevated (+6).

- SSPM – Slightly lower copper, lead, mercury and butylbenzylphthalate (all -1), neutral zinc, total PCBs, DEHP, and total phthalates, slightly higher bifenthrin, pyrene and phenanthrene (all at +2), and moderately higher indeno(1,2,3-c,d)pyrene (+4) compared to other sediment trap locations (see Table 3-5) when evaluating the entire 22-year monitoring record. Levels are generally the same or more neutral when looking at only the last five years of data.

Therefore, the following recommendations are included in the 2024 Work Plan for OF237A:

- Monitor upcoming SSPM results and catch basin sample results near FD13B-New to evaluate whether source control work done to date in this area has been successful in eliminating the PAH source.
- Monitor upcoming SSPM results and catch basin sample results near FD10C to evaluate whether source control work done to date in this area has been successful in eliminating the PCB source.
- Evaluate potential sources and seasonality of occasional outliers of indeno(1,2,3-cd)pyrene and other PAHs in stormwater.

5.4 OUTFALL 237B

OF237B exhibits the best overall baseflow and stormwater quality with some of the lowest median concentrations for the COCs in baseflow, stormwater and stormwater SSPM found during the monitoring program (see figures in Appendix F). Figure 5-1.4 shows the annual average concentration for stormwater, baseflow and SSPM. All indicator parameters (TSS, metals, PAHs and DEHP) have shown a statistically significant improvement in stormwater concentrations through WY2023.

This section provides a summary of water/sediment quality results within the OF237B drainage basin and compares the water/sediment data results with the major source control and other activities that have occurred within the basin. A more comprehensive description of source control activities performed to date is provided in Appendix A.

5.4.1 Water and SSPM Quality

Annual and seasonal data for stormwater and SSPM for the COCs and other parameters is used to identify ongoing areas of concern. The following paragraphs summarize the WY2001-WY2023 monitoring results for OF237B, where COCs in this outfall are different from other Foss drainage basins, and where subsequent source control activities may be focused.

5.4.1.a TSS and Metals

<u>Stormwater</u> As shown in Table 3-6 and Figures 3-5.1, 3-5.3 and 3-5.4, TSS, lead and zinc concentrations show a statistically significant improvement in stormwater quality from 2001 to present. The best-fit regression equations result in an estimated 72 percent reduction in TSS, 82 percent reduction in lead, and 63 percent reduction in zinc concentrations in OF237B in the 22-year period. In addition, copper analysis was performed between WY2010 and WY2012 for stormwater at this outfall, and then began again in WY2015. Since trends have been assessed for copper with less data than other COCs, they are not fully comparable to the trends assessed for the other constituents.

OF237B showed statistically significant improvement during this time period, and the best-fit regression equation resulted in an estimated 47 percent reduction in copper.

In comparison to the other outfalls, TSS concentrations are slightly better (-1) while copper (-4), lead (-3) and zinc (-6) concentrations are moderately to significantly lower than other outfalls when looking at the 22-year monitoring record (11 years for copper) (see Table 3-4). When only the last two years of monitoring data are evaluated, OF237B results are similar with TSS at -2, copper at -3, lead at -1, and zinc at -5.

SSPM As shown in Table 3-5, SSPM in OF237B contains moderately to significantly lower concentrations of lead, mercury, and zinc (-3, -3 and -5) (also see boxplots in Appendix F). In addition, copper was added as an analyte in the 2014 QAPP. While statistical evaluation of this constituent will become more comparable in future years, based on available data, concentrations of copper are moderately better in SSPM in OF237B compared to other outfalls (-3). Within the OF237B drainage basin, there were no areas with elevated mercury concentrations in the upline sediment traps since WY2013 and is no longer analyzed at the one remaining upline trap (see Figure 2-1.1).

5.4.1.b PAHs

Stormwater As shown in Table 3-4, stormwater in OF237B contains moderately lower concentrations of phenanthrene (-3) and slightly lower concentrations of pyrene and indeno(1,2,3-c,d)pyrene (-2) when looking at the 22-year monitoring record. When looking only at the last two years of monitoring data, concentrations are more neutral for all three indicator PAHs (-1) when compared to other outfalls.

PAH concentrations in stormwater have shown a statistically significant improvement from WY2002 through WY2023 with an 80-84 percent reduction in pyrene, phenanthrene and indeno(1,2,3-c,d)pyrene in 22 years (see Table 3-6).

SSPM As shown in Table 3-5, PAH concentrations in SSPM in OF237B are slightly lower for the indicator PAHs, phenanthrene, pyrene and indeno(1,2,3-c,d)pyrene (-2, -2, and -1, respectively) when looking at both the 22-year monitoring period or only the last five years (0 to -1).

5.4.1.c Phthalates

Stormwater As shown in Table 3-6 and Figure 3-5.8, DEHP concentrations have shown a statistically significant improvement in stormwater quality from 2001 to present. The best fit regression equations result in an estimated 71 percent reduction in the 22-year monitoring period.

In comparison to other outfalls, DEHP in OF237B is slightly better in quality over both the entire 22-year monitoring record and in only the last two years of monitoring (-2 and -3, respectively) (see Table 3-4).

SSPM DEHP (-3), butylbenzylphthalate (-3) and total phthalate (-4) concentrations in SSPM are moderately lower than observed in other locations over the entire 22-year monitoring record (see Table 3-5 and boxplots in Appendix F). These results are generally similar, but much less pronounced when looking at only the last five years (-1). No new areas of concern have been identified in the upline sediment traps and phthalates have been removed as an analyte from all upline locations.

5.4.1.d Pesticides

Stormwater Analysis for bifenthrin in stormwater began in WY2021 under the 2020 QAPP. Statistical analysis will be performed when sufficient data is available.

SSPM Analysis for bifenthrin began in WY2015 under the 2014 QAPP and while there are fewer data points available for statistical analysis, the results are significant ($p<0.05$). OF237B concentrations were slightly lower (-1) to neutral (0) relative to other outfalls for bifenthrin when looking either all available data or only the last five years, respectively.

5.4.1.e PCBs

Stormwater PCBs are not a COC tested for under the 2020 QAPP.

SSPM PCB concentrations at OF237B were slightly lower (-1) relative to other outfalls when looking at the entire 22-year monitoring record and there were no significant differences between outfalls when looking at only the last five years of data (see Table 3-5).

5.4.2 Source Control Program Activities

PCB Source Tracing in FD34 and FD35. PCBs were found intermittently over time in the sub-basins draining to FD34 and FD35 (see Figure 2-1.4). In an attempt to remove any legacy contamination, the City completed a stormline cleaning project in the summer of 2011 that covered the majority of the OF237B drainage basin, including the FD34/FD35 area. In WY2011, concentrations in both sediment traps dropped to below levels of concern. However, in WY2012 and WY2013, the PCB concentrations in FD35 increased back to high levels, while the concentrations in FD34 remained low. A source tracing investigation to narrow the source of PCBs in this area was initiated in 2012.

Ultimately it was determined that the source of the contamination was one of the materials used during construction of a roadway in the area in 1975 likely contained PCBs, specifically the sealant used to seal the roadway at the curb line. The City completed replacement of this roadway to remove this source in summer 2016. The WY2018 sample at FD35 was the first representing a full year of the area in its remediated condition, and the concentration was in the low range (92 µg/kg). WY2019 PCB concentrations in FD35 remained in the low range (94 µg/kg), however WY2020 concentrations increased back to the medium range (250 µg/kg). Following a thorough data analysis, no cause for the increased PCB levels in WY2020 was identified. Because results were higher than usual at all locations where PCBs were detected, it was determined that these results were not accurate and will not be used to determine steps forward in source tracing investigations. However, to ensure that the PCB source in this area had been removed, SSPM was again monitored in WY2021 and WY2022, and PCBs were not detected. Therefore, the source control action is considered successful and the sediment trap at this location was removed in 2023.

More information on this investigation is included in Appendix A.

Storm System Cleaning In 2010-2011, the majority of the OF237B system was cleaned and video inspected. The objective of this project was to remove residual sediments in the storm drains that may contain legacy contaminants. As discussed in detail in the WY2011 report, storm system cleaning contributed to significant reductions in stormwater concentrations. Sewer line cleaning is an important component of the City's source control program, and the City is currently on a schedule of cleaning each storm system area on a 20-year cycle. Additional cleaning is performed on an as needed basis to address specific maintenance needs. In combination with other source control activities, storm system cleaning appears to have been effective at removing all seven of the compounds tested. The City is statistically evaluating the results to determine whether a maintenance schedule different from the City-wide schedule for pipe cleaning projects is needed within this sensitive basin.

Statistically significant reductions were evident for TSS, lead, zinc, PAHs and DEHP (see Table 2-2). Line cleaning, along with other source control activities, resulted in reductions of TSS at 55 percent, lead at 63 percent, zinc at 45 percent, DEHP at 68 percent and PAHs (phenanthrene, pyrene and indeno(1,2,3-c,d)pyrene) at 76-80 percent.

Enhanced Street Sweeping Program. In January 2007, the City's street sweeping program was enhanced in an attempt to reduce sediment buildup in the storm sewer system. Under the enhanced program, the sweeping frequency was increased, air regenerative sweepers replaced mechanical sweepers, and the City also increased communications with residents, which helped raise awareness of the importance of the street sweeping program.

Statistically significant reductions were evident for TSS, lead, zinc, PAHs and DEHP (see Table 2-3.1). Street sweeping, along with other source control activities, resulted in reductions of TSS at 47 percent, lead at 56 percent, zinc at 44 percent, DEHP at 66 percent and PAHs (phenanthrene, pyrene, and indeno(1,2,3-c,d)pyrene) at 71-76 percent.

General Source Control Activities. In addition to the ongoing investigation and maintenance activities described above, the City is continuing to implement other source control program elements in the OF237B drainage basin which are summarized here and described in more detail in Appendix A. Several other source control actions are currently underway in this basin, including a UST removal action at one site under TPCHD oversight. In addition, one warning letter was issued to a business in this drainage basin in 2023 for failure of a sanitary side sewer on the property. Finally, 14 new private treatment devices were installed in this basin in 2023.

5.4.3 Outfall 237B 2024 Work Plan

TSS, metals (copper, lead, and zinc), PAHs and DEHP concentrations in stormwater have shown a statistically significant improvement from WY2002 through WY2023 (see Figures 3-5.1 to 3-5.8). There has been an estimated 72 percent reduction in TSS, 83 percent reduction in lead, 63 percent reduction in zinc, and a 71 percent reduction of DEHP concentrations in the 22-year monitoring period (see Table 3-6). PAHs showed an 80-84 percent reduction in 22 years for the index PAHs (phenanthrene, pyrene, and indeno(1,2,3-c,d)pyrene). In addition, with eleven years of copper data now available for OF237B an overall evaluation of the source control program includes trends for this outfall, however, the results are not as statistically robust, so are not directly comparable. Based on available data, OF237B shows a statistically significant improvement in stormwater quality for copper during this period with an estimated 47 percent reduction.

These improvements are believed to be the result of the combination of all source control activities within the basin, including business and multi-family inspections, source control actions, maintenance activities and public education.

OF237B exhibits the best overall baseflow and stormwater quality with some of the lowest median concentrations for the COCs in stormwater (see Table 3-3.1 and Table 3-4, and

Appendix F). SSPM quality in OF237B is also generally of better quality than other Foss basins (see Table 3-5).

As described in detail above, OF237B results generally show:

- Stormwater – Slightly lower TSS (-1), DEHP (-2) pyrene (-2) and indeno(1,2,3-c,d) (-2), moderately lower lead(-3), copper (-4), and phenanthrene (-4), and significantly lower zinc (-6) compared to other outfalls when evaluating the 22-year monitoring record (see Table 3-4). These levels are generally similar when looking at only the last two years of data.

- SSPM – Moderately to significantly lower copper (-3), lead (-3), mercury (-3), zinc (-5), TPH-Heavy Oil (-5), DEHP (-3), butylbenzylphthalate (-3), and total phthalates (-4), and slightly lower phenanthrene and pyrene (both at -2) and slightly lower bifenthrin, indeno(1,2,3-cd)pyrene, and Total PCBs (all at -1) compared to other sediment trap locations (see Table 3-5) when evaluating the entire 22-year monitoring record. These levels are generally similar but less pronounced when looking at only the last five years of data.

Therefore, there are no source control activities included in the 2024 Work Plan for the OF237B drainage basin.

5.5 Outfall 243

Many activities have occurred in OF243 drainage basin in recent years. Some of these activities have resulted in improvements in stormwater and SSPM quality. Figure 5-1.5 shows the annual average contaminant concentrations for stormwater, baseflow and SSPM. Lead, zinc, PAHs and DEHP concentrations have shown a statistically significant improvement in stormwater quality since the beginning of the monitoring program (see Table 3-6).

This section provides a summary of water/sediment quality results within the OF243 drainage basin and compares the water/sediment data results with the major source control and other activities that have occurred within the basin. A more comprehensive description of source control activities performed to date is provided in Appendix A.

5.5.1 Water and SSPM Quality

Annual and seasonal data for stormwater and SSPM for the COCs and other parameters is used to identify ongoing areas of concern. The following paragraphs summarize the WY2001-WY2023 monitoring results for OF243, where COCs in this outfall are different from other Foss drainage basins, and where any subsequent source control activities may be focused.

5.5.1.a TSS and Metals

Stormwater TSS and total zinc are slightly lower in concentration (-1) while total copper and lead are moderately elevated (+3 and +4, respectively) in concentration at OF243 as compared to other outfalls when looking at the 22-year monitoring period. When looking at just the last two years, each of these is the same or more neutral with TSS, lead, and zinc -1 and copper at +1 (see Table 3-4 and boxplots in Appendix F). Analysis for copper at this outfall began in WY2015 so statistical analysis is less robust compared to other outfalls. The highest overall total lead concentration (379 µg/L) occurred in OF243 in 2009 (Table 3-3.1). This outlier appears to be relatively isolated occurrence, although additional high and moderate outliers have occurred throughout the monitoring program (see Figure G-2). In addition, the highest overall zinc concentration (1,170 µg/L) occurred at OF243 in 2004 (Table 3-3.1). This outlier also appears to be relatively isolated occurrence (see Figure G-3).

As shown in Figure 5-1.5, TSS concentrations in stormwater have fluctuated some over the last 22 years, in particular since 2012. TSS showed statistically significant improvement in starting WY2022 with a 60 percent reduction measured. Lead and zinc also show statistically significant improvement, with lead showing an 81 percent reduction, and zinc showing a 60 percent reduction in stormwater concentrations from 2001 to present (Table 3-6).

SSPM Storm sediment in OF243 is moderately elevated in lead (+3), mercury (+4) and zinc (+4) when looking at the 22-year monitoring record (see Table 3-5). When only looking at the most recent five-year data set, concentrations are generally similar or only slightly elevated with lead zinc, and mercury all at +1. Analysis for copper at this outfall began in WY2015 so less data is currently available for a comprehensive statistical analysis. Based on available data, copper is moderately elevated (+3) when looking at all available data, and slightly elevated compared to other outfalls (+1) when looking at just the last five years.

Most of the highest SSPM concentrations of lead, mercury, and zinc have been detected at FD23 (see Figures F-11 through F-13). As shown on Table 3-3.2, the highest mean and median concentrations of all metals are found in this drainage basin. Figures 5-1.5 and 5-2.5 show that zinc concentrations in SSPM samples have remained fairly consistent over the last 22 years while mercury concentrations appeared to have decreased early in the program and generally remained at the lower levels until WY2018, when the detected concentration increased back to nearly the high level in FD23 (see Figure 2-1.1). The concentration returned to the reduced level in WY2019 where it remained in WY2023. The source control investigation in this area is continuing. Additional information is available in Appendix A.

While somewhat elevated relative to other outfalls, lead and zinc are not currently of concern for recontamination in the Thea Foss Waterway sediments, but additional source control work may be considered when additional results are available. As described further below and in Appendix A, a street sweeping pilot project is underway and results show that an increased sweeping frequency is helping to reduce metals concentrations in industrial areas. This analysis of the effectiveness of this program is described further below.

5.5.1.b PAHs

Stormwater PAH concentrations in OF243 are neutral to slightly lower (phenanthrene at 0, pyrene at -2, and indeno(1,2,3-c,d)pyrene at -2) in comparison to other outfalls when looking at the entire 22-year monitoring period. When looking at only the last two years all three compounds are slightly lower (-1) relative to other locations (see Table 3-4 and boxplots in Appendix F). The highest dibenz(a,h)anthracene concentration (0.684 µg/L) detected at any location during the monitoring period occurred at OF243 in WY2017. This outlier appears to be an isolated occurrence with no apparent explanation and subsequent sample results are in the more typical range.

As shown in Table 3-6 and Figures 3-5.5, 3-5.6 and 3-5.7, PAHs (phenanthrene, pyrene, and indeno(1,2,3-c,d)pyrene) are showing a statistically significant improvement in stormwater quality from 2001 to present. The best-fit regression equations result in an estimated 63-72 percent reduction in PAHs in OF243 in the 22-year monitoring period. As shown in Figure 5-1.5, PAH concentrations in stormwater were fairly stable from WY2002 until WY2007. From WY2007 to WY2009 the concentrations decreased, and they remained fairly stable between WY2009 and WY2012. Gradual but consistent increases were noted after the minimum concentrations were detected in 2012. This is likely partially if not fully explained by the apparent uptick seen since implementation of the 2014 QAPP began. This apparent uptick in organics concentrations observed was evaluated by the City, as discussed in Section 3.5.2 and recent results were determined to be representative while earlier results were likely biased low. While this observed slight increase in organic concentrations is observed, concentrations remain substantially lower than the concentrations present early in the monitoring program (see boxplots in Appendix G).

SSPM In SSPM, phenanthrene, indeno(1,2,3-c,d)pyrene and pyrene concentrations at OF243 are similar (+1, 0 and +1) compared to other outfalls when looking at the entire 22-year monitoring period (see Table 3-5). PAH concentrations are neutral compared to other outfalls when looking at only the last five years (all three indicator PAHs at 0).

5.5.1.c Phthalates

Stormwater DEHP concentrations in OF243 were significantly or slightly lower when looking at both the 22-year monitoring period and the last two years (-3 and -1, respectively) (see Table 3-4). DEHP generally appears to be relatively consistent among all outfalls except OF230 and OF235 which are significantly higher, as discussed above. Figure 5-1.5 shows total phthalate concentrations in stormwater at OF243 were fairly stable from WY2002 to WY2008 and then decreased in WY2009. One unusually high peak concentration of DEHP (41 µg/L) was observed in 2008 stormwater in OF243 (see Table 3-3.1 and boxplots in Appendix G), but this appears to be an isolated occurrence and the source is unknown. Concentrations from WY2009 to WY2023 have fluctuated somewhat, but concentrations remain relatively low with the lowest mean concentration overall (see Figure 3-3.1 and Figure F-8).

As shown in Table 3-6 and Figure 3-5.8, DEHP is showing a statistically significant improvement in stormwater quality from 2001 to present. The best-fit regression equations result in an estimated 73 percent reduction in the 22-year monitoring period.

SSPM OF243 is slightly enriched in DEHP, butylbenzylphthalate, and total phthalates (+1)) when looking at the entire 22-year monitoring period, while all are neutral (0) between outfalls when looking at only the last five years (see Table 3-5). OF243, along with OF245, exhibit a notably different phthalate composition compared to other outfalls that has higher relative concentrations of butylbenzylphthalate. Figure F-20 show butylbenzylphthalate average, median and maximum concentrations in SSPM at OF243 well above all outfalls except OF245.

In Figure 2-1.3, total phthalate concentration levels at FD23 were at medium levels in WY2002 and WY2003. Since WY2004, total phthalate concentration levels at FD23 have been low relative to the threshold concentration set on this figure.

5.5.1.d Pesticides

Stormwater Analysis for bifenthrin in stormwater began in WY2021 under the 2020 QAPP. Statistical analysis will be performed when sufficient data is available.

SSPM Analysis for bifenthrin began in WY2015 under the 2014 QAPP and while there are fewer data points available for statistical analysis, the results are significant ($p<0.05$). OF243 is neutral (0) relative to other outfalls during the monitoring period.

5.5.1.e PCBs

Stormwater PCBs are not a COC tested for under the 2020 QAPP.

SSPM Concentrations of PCBs in OF243 were neutral (0) compared to other outfalls when reviewing the entire 22-year monitoring record. There are no significant differences between outfalls when looking at only the last five years of data (see Table 3-5).

As shown in Figure 5-1.5, from WY2009 to WY2012 PCBs were not detected at this location. PCBs were not required analytes at FD23 in WY2013 and WY2014. PCBs were in the medium range at FD23 in WY2015, just over the threshold concentration distinguishing low and medium levels on Figure 2-1.4. Since WY2016, PCBs have not been detected in FD23, indicating that the WY2015 results were likely an anomaly.

5.5.2 Source Control Program Activities

Enhanced Street Sweeping Program In January 2007, the City's street sweeping program was enhanced in an attempt to reduce sediment buildup in the storm sewer system. Under the enhanced program, the sweeping frequency was increased, air regenerative sweepers replaced mechanical sweepers, and the City also increased communications with residents, which helped raise awareness of the importance of the street sweeping program.

When comparing the standard sweeping schedule in place prior to 2006 to the enhanced schedule implemented from January 2007 through September 2013, statistically significant reductions were evident for zinc, PAHs and DEHP (see Table 2-3.1). Street sweeping, along with other source control activities, resulted in reductions of zinc at 36 percent, DEHP at 41 percent and PAHs (phenanthrene, pyrene, and indeno(1,2,3-c,d)pyrene) at 53-70 percent.

Street Sweeping Pilot Project Because OF243 and OF245 have shown somewhat elevated levels of lead and zinc in both stormwater and baseflow relative to other drains, it was theorized the increased amount of trucking in this industrial area may be the cause. Based on these results, the City initiated a pilot program in WY2014 to determine whether an increased frequency of street sweeping in this area would have an effect on these results. Starting on

October 1, 2013, the City began sweeping the ROW within the OF243 and OF245 drainage basins at a frequency of once every two weeks rather than the usual frequency of once per month for industrial areas. The pilot project continued in WY2023 and is ongoing at this time.

With several years of data available, statistical analysis of the effectiveness of this pilot sweeping schedule was done, although results will be more statistically robust as additional data becomes available. Based on this analysis, a statistically significant reduction was evident for TSS, lead, and zinc (see Table 2-3.2). When comparing data from the enhanced street sweeping program that was implemented between 2007 and 2013 to the more frequent street sweeping schedule which began in WY2013, it was found that this increased street sweeping, along with other source control activities, resulted in an additional 38 percent reduction in TSS, 69 percent reduction in lead concentrations and a 35 percent reduction in zinc concentrations.

Outfall 243 Mercury Source Tracing Mercury has been found in the medium to high range of concentrations in all samples analyzed from FD23 since WY2002 (see Figure 2-1.1). Some source tracing work was completed in 2008 and 2009, but no likely point-source of mercury was identified. After working with BNSF in 2009-2010 to gain access to the BNSF yard, the City completed focused business inspections for most of the yard. A follow up inspection, including the inspection of onsite ditches and swales, was conducted in 2012.

As moderately increased concentrations of mercury persisted, additional investigations of the right-of-way, the WSDOT pond and the LRI and BNSF sites, and other businesses were completed over the next several years. While several other actions were required at the sites to bring them into compliance (including cleaning and maintaining onsite drainage systems, cleanup of spilled material and a regular inspection process), no significant sources of mercury were detected.

In 2019, while reviewing past investigations and the extents of the drainage basin it was discovered that a small portion of this drainage basin was not included in previous investigations. Through additional investigation, a roof drain from a specific property was identified as being a likely source of mercury contamination. During 2021, the City worked with the property owner to ensure the roof drains from their property were adequately cleaned and subsequently re-cleaned the City’s catch basin and the curbline adjacent to the property.

During 2022 staff resampled the identified catch basin to determine if there is an ongoing mercury issue at that location. The catch basin was sampled on June 21, 2022, and the results were 1.38 mg/kg. Catch basin concentrations continue to trend downward and there are no other probable sources to investigate at this location. During 2023, EC staff requested to have the catch basin re-cleaned and will re-sample after sediment accumulates to determine if there is a continued source or residual contamination from the previously remediated source.

While the FD23 sediment trap results showed a very slight uptick in mercury concentrations within the basin during 2022, concentrations have shown an overall decrease from 2018 to 2022. The 2018 sediment trap concentrations were 0.6610 mg/kg, which have decreased significantly in 2021 and 2022 with concentrations of 0.206 mg/kg and 0.214 mg/kg, respectively. During 2023 there was insufficient sediment to analyze for mercury. Mercury will continue to be evaluated at this location.

A summary of the ongoing investigation is provided in Appendix A.

General Source Control Activities In addition to the ongoing investigation and maintenance activities described above, the City is continuing to implement other source control program elements in the OF243 drainage basin which are summarized here and described in more detail in Appendix A. This included removal of a UST at one location under TPCHD oversight.

5.5.3 Outfall 243 2024 Work Plan

TSS, lead, zinc, PAHs and DEHP concentrations in stormwater have shown a statistically significant improvement in OF243 from WY2002 through WY2023 (see Figures 3-5.3 through 3-5.8). There has been an estimated 60 percent reduction in TSS, 81 percent reduction in lead, 60 percent reduction in zinc, and 73 percent reduction in concentration for DEHP in 22 years (see Table 3-6). PAHs have shown a 63-72 percent reduction in 22 years for the index PAHs (phenanthrene, pyrene and indeno(1,2,3-c,d)pyrene).

As described in detail above, OF243 results generally show:

- Stormwater – Moderately higher lead (+4) and copper (+3, based on a smaller data set), slightly lower zinc (-1), and DEHP (-1) compared to other outfalls when evaluating the 22-year monitoring record. When looking at only the last two years copper remains slightly elevated (+1) relative to other outfalls while DEHP remains moderately lower (-3) (see Table 3-4).
- SSPM – Moderately higher lead (+3), copper (+3, based on a smaller data set), mercury (+4) and zinc (+4) compared to other sediment trap locations (see Table 3-5) when evaluating the entire 22-year monitoring record. These differences are less pronounced, but still present when looking at only the last five years of data +1for all four). Butylbenzylphthalate is slightly elevated (+1) when looking at the entire 22-year monitoring record but neutral in the last five years (0).

Therefore, the following recommendations are included in the 2024 Work Plan for OF243:

- Perform follow-up work with business owner and worker-sample catch basins in the area where elevated mercury concentrations were identified in catch basins in the FD23 drainage area.
- Review WY2024 sediment trap results for FD23 to evaluate the need for further work in this area.
- Continue evaluation of the effectiveness of the street sweeping pilot project on lead and zinc concentrations in the industrial area as additional data become available.

5.6 OUTFALL 245

A number of source control activities have occurred in the OF245 drainage basin since the beginning of the monitoring program. Some of these activities have resulted in statistically significant improvements in stormwater quality. Figure 5-1.6 shows the annual average contaminant concentrations for stormwater, baseflow, and SSPM. Several of the businesses in the area not only discharge stormwater to OF245 but discharge stormwater to the adjacent outfalls, OF248 and OF249.

This section provides a summary of water/sediment quality results within the OF245 drainage basin and compares the water/sediment data results with the major source control and other activities that have occurred within the basin. A more comprehensive description of source control activities performed to date is provided in Appendix A.

5.6.1 Water and SSPM Quality

Annual and seasonal data for stormwater and SSPM for the COCs and other parameters is used to identify ongoing areas of concern. The following paragraphs summarize the WY2001-WY2023 monitoring results for OF245, where COCs in this outfall are different from other Foss drainage basins, and where subsequent source control activities may be focused.

5.6.1.a TSS and Metals

Stormwater Stormwater TSS concentrations are slightly lower or neutral in OF245 when looking at the entire 22-year monitoring record or the most recent two-year data set (-1 and 0, respectively) (see Table 3-4).

Lead concentrations are moderately or slightly better than average in OF245 when looking at either the entire 22-year monitoring record or at only the most recent two-year data set (-3 and -1, respectively) (see Table 3-4). Copper concentrations in OF245 are slightly lower when looking at all of the available data and only the last two years (-1 for both).

The highest maximum mercury and cadmium concentrations found in stormwater during the monitoring program were found in OF245 in WY2008 and WY2011, respectively (see Table 3-3.1). In addition, the highest mean and median cadmium in stormwater were found in OF245 with concentrations of 0.293 µg/L and 0.204 µg/L, respectively.

The highest mean and median stormwater zinc concentrations are also found in OF245 with concentrations of 131.0 µg/L and 103.0 µg/L, respectively (see Table 3-3.1). Zinc is moderately elevated (+4) in OF245 in the 22-year monitoring record, while the two-year record shows that the outfall is only slightly elevated (+1) (see Table 3-4). Several high outliers for zinc have been detected throughout the 22-year monitoring period, particularly early in the program. Additional high outliers are present in more recent years, including one in WY2020, no high outliers were present in WY2022 or WY2023 (see Figure G-3).

As shown in Table 3-6 and Figures 3-5.1, 3-5.3, and 3-5.4, TSS, lead, and zinc all show a statistically significant improvement in stormwater quality from 2001 to present. The best-fit regression equations result in an estimated 54 percent reduction in TSS, 80 percent reduction in lead, and a 66 percent reduction in zinc in the 22-year monitoring period. In addition, copper shows a statistically significant improvement based on available data with an estimated 33 percent reduction.

SSPM When looking at the entire 22-year monitoring program, zinc is neutral (0) compared to the other outfalls, while lead (-3) and mercury (-2) are moderately and slightly lower than the other outfalls, respectively (see Table 3-5 and boxplots in Appendix F). When looking at only the last five years, these differences are still present but somewhat less pronounced with zinc, lead, and mercury all neutral (0. Available copper data indicates that concentrations in OF245 are slightly elevated (+1) based on all available data, and neutral (0) relative to other outfalls over the last five years.

Within the basins for OF 245/248, mercury has been detected at medium concentrations periodically at FD22 (WY2002, WY2010, WY2014, WY2015, and WY2016) (see Figure 2-1.1). When looking at the data for these moderate level concentrations, all are just over the concentration (0.20 mg/kg) which was set to differentiate the levels on Figure 2-1.1, ranging from 0.208 to 0.257 mg/kg). WY2017 concentrations returned to the low range where they remained through WY2021. Other sediment trap/sump locations in these basins have had low levels. As a result, mercury is no longer analyzed in FD22.

5.6.1.b PAHs

Stormwater OF245 is neutral for phenanthrene 0) and moderately to significantly lower for other index PAHs (pyrene at -2 and indeno(1,2,3-c,d)pyrene at -4) in comparison to other outfalls (see Table 3-4 and boxplots in Appendix F) when looking at the entire 22-year monitoring record. When looking at only the last two years of data, the results are more neutral with all three indicator PAHs at -1.

In stormwater, the highest maximum concentrations for several LPAHs including acenaphthene, acenaphthylene, fluorene, and phenanthrene were observed in OF245 (see Table 3-3.1). These maximum concentrations were all detected in 2004. The high concentrations have not been observed since the Northern Pacific Rail yard oil pipeline area was remediated in 2008 (see Appendix A).

As shown in Table 3-6 and Figures 3-5.5, 3-5.6 and 3-5.7, PAHs (phenanthrene, pyrene, and indeno(1,2,3-c,d)pyrene) are showing a statistically significant improvement in stormwater quality from 2001 to present. The best-fit regression equations result in an estimated 67-76 percent reduction in PAHs in the 22-year monitoring period. As shown in Figure 5-1.6, PAH concentrations in stormwater were fairly stable from WY2002 until WY2007. From WY2008 to WY2009 the concentrations decreased when the Northern Pacific Rail Line was remediated and have remained generally stable from WY2009 to present. The apparent uptick in organics concentrations observed in the last eight years of monitoring was evaluated by the City, as discussed in Section 3.5.2 and recent results were determined to be representative while earlier results were likely biased low. While this observed slight increase in organic concentrations is observed, concentrations remain substantially lower than the concentrations present early in the monitoring program (see boxplots in Appendix G).

SSPM OF245 SSPM has moderately to significantly lower concentrations of phenanthrene (-4), pyrene (-4) and indeno(1,2,3-c,d)pyrene (-5) relative to all other outfalls (see Table 3-5 and boxplots in Appendix F) when looking at the 22-year monitoring period. All three indicator PAHs remain slightly lower than other outfalls (-1) when looking at only the last five years of data. All three sediment traps/sumps throughout the OF245/OF248 basin have had low levels of PAHs throughout the 22-year monitoring period and as a result, PAHs have been removed from the analyte list for the source tracing sediment traps (FD21 and FD22) (see Figure 2-1.2).

5.6.1.c Phthalates

Stormwater DEHP appears to be relatively consistent among outfalls (except OF230 and OF235 as discussed above), with mean concentrations slightly lower (-1) in OF245 when looking at the entire 22-year monitoring record, and the last two years of data (see Table 3-4).

Unusually elevated DEHP concentrations were found in OF245 stormwater in WY2003 (Year 2) (see total phthalates in Figure 5-1.6 and Figure G-8). A possible source of phthalates in this drain is believed to be the former bulk liquid phthalate transloading facility located in the basin. This source is believed to be controlled since the water quality is improving and most of the peak phthalate concentrations occurred earlier in the monitoring program (2002 through 2005) (see Figure 5-1.6 and boxplots in Appendix G) and have remained relatively consistent since that time.

Like OF243, OF245 exhibits a notably different phthalate composition that contains higher relative concentrations of butylbenzylphthalate in both stormwater and SSPM. The highest maximum butylbenzylphthalate stormwater concentration found in the monitoring program (290 µg/L) was found in OF245 in 2003. Overall, the OF245 mean butylbenzylphthalate concentration is 8.79 µg/L as compared to approximately 0.3-0.9 µg/L in the other outfalls. An elevated concentration of diethylphthalate in stormwater (430 µg/L) was also detected at OF245 in 2002.

As shown in Table 3-6 and Figure 3-5.8, DEHP is showing a statistically significant improvement in stormwater quality from 2001 to present. The best-fit regression equations result in an estimated 72 percent reduction in DEHP in OF245 in the 22-year monitoring period.

SSPM OF245 is slightly lower (-1) for DEHP, moderately enriched in butylbenzylphthalate (+4), and slightly enriched in total phthalates (+1) when looking at the 22-year monitoring period (see Table 3-5). As with stormwater, SSPM composition is dominated by butylbenzylphthalate. Butylbenzylphthalate and total phthalates remain slightly higher (+2 and +1, respectively) relative to other outfalls when looking at only the last five years. DEHP phthalates is neutral (0) over the same time periods. Figure F-20 show OF245 butylbenzylphthalate average, median and maximum concentrations in SSPM well above all other outfalls. This could be due to an elevated value of 160,000 µg/kg for butylbenzylphthalate detected at OF245 in 2003.

Within OF245 and the adjacent OF248, additional sediment traps were located around a suspected source of phthalates, the former MPS site (see Section 5.6.2). At FD21 (OF245) total phthalate concentrations were in the high range in WY2002 and WY2003, decreased to medium range in WY2004, and have been in the low range since that time (see Figure 2-1.3). At FD22 (OF248), total phthalate concentrations fluctuated for many years between high (WY2003, WY2004, WY2005, and WY2010) and medium concentrations (WY2006 through WY2009, W2011, and WY2013). WY2012 and WY2014 through WY2023 concentrations have been in the low range. As discussed in Section 5.6.2, source control investigation and monitoring at the Truck Rail Handling (TRH) site (formerly MPS) has been an ongoing issue for many years due to the historically different phthalate signature for this area and the general ongoing observation of phthalates in waterway sediments. The City will continue to monitor work at this site to identify any ongoing issues.

5.6.1.d Pesticides

Stormwater Analysis for bifenthrin in stormwater began in WY2021 under the 2020 QAPP. Statistical analysis will be performed when sufficient data is available.

SSPM Analysis for bifenthrin began in WY2015 under the 2014 QAPP and while there are fewer data points available for statistical analysis, the results are significant ($p<0.05$). Based on available data, bifenthrin concentrations are slightly lower (-1) in OF245.

5.6.1.e PCBs

Stormwater PCBs are not a COC tested for under the 2020 QAPP.

SSPM PCB levels in all of the outfalls are fairly equivalent when looking at the entire 21-year monitoring record with levels ranging from -1 to +1. PCB concentrations at OF245 were slightly elevated (+1) relative to all other outfalls in the entire monitoring period and there were no significant differences between outfalls when looking at only the last five years of data (see Table 3-5).

5.6.2 Source Control Program Activities

Enhanced Street Sweeping Program In January 2007, the City's street sweeping program was enhanced in an attempt to reduce sediment build-up in the storm sewer system. Under the enhanced program, the sweeping frequency was increased, air regenerative sweepers replaced mechanical sweepers, and the City also increased communications with residents and business owners, which helped raise awareness of the importance of the street sweeping program.

When comparing the standard sweeping schedule in place prior to 2006 to the enhanced schedule implemented from January 2007 through September 2013, statistically significant reductions were evident for TSS, lead, PAHs, and DEHP (see Table 2-3.1). Street sweeping, along with other source control activities, resulted in reductions of TSS at 31 percent, lead at 22 percent, DEHP at 74 percent, and PAHs (phenanthrene, pyrene, and indeno(1,2,3-c,d)pyrene) at 61-68 percent.

Street Sweeping Pilot Project Because OF243 and OF245 showed somewhat elevated levels of lead and zinc in both stormwater and baseflow relative to other drains, it was thought that the increased amount of trucking in this industrial area may be the cause. Based on these results, the City initiated a pilot program in WY2014 to determine whether an increased frequency of street sweeping in this area would have an effect on these results. Starting on October 1, 2013, the City began sweeping the ROW within the OF243 and OF245 drainage basins at a frequency of once every two weeks rather than the usual frequency of once per month for industrial areas. The pilot project continued in WY2023 and is ongoing at this time.

With several years of data available, statistical analysis of the effectiveness of this pilot sweeping schedule was completed, although results will be more statistically robust as additional data becomes available. Based on this analysis, a statistically significant reduction was evident for lead, zinc, and pyrene (see Table 2-3.2). When comparing data from the enhanced street sweeping program that was implemented between 2007 and 2013 to the more frequent street sweeping schedule which began in WY2013, it was found that this increased street sweeping, along with other source control activities, resulted in an additional reduction in concentration of TSS at 16 percent, lead at 51 percent, and zinc at 45 percent.

Former MPS Site Investigation The investigation at this site has been ongoing through the years of this program. Additional information on this work can be found in Appendix A. With decreased phthalate levels in the sediment traps, it appears that efforts to date have been effective in addressing the issues at this site. However, the City will continue coordination with the property owner, and sediment traps will continue to be monitored to ensure that levels remain at the reduced levels.

General Source Control Activities In addition to the ongoing investigation and maintenance activities described above, the City is continuing to implement other source control program elements in the OF245 drainage basin which are summarized here and described in more detail in Appendix A.

5.6.3 Outfall 245 2024 Work Plan

TSS, metals (lead and zinc), PAHs and DEHP concentrations in stormwater have shown a statistically significant improvement from WY2002 through WY2023 (see Table 3-6 and Figures 3-5.1 to 3-5.8). There has been an estimated 54 percent reduction in TSS, 80 percent reduction in lead, and 66 percent reduction in zinc concentrations in the 22-year monitoring program. Based on more limited data, there has also been a 33 percent reduction in copper concentrations. In addition, there has been an estimated 72 percent reduction in concentration for DEHP, and PAHs showed an 67-76 percent reduction in 22 years for the index PAHs (phenanthrene, pyrene, and indeno(1,2,3-c,d)pyrene).

As described in detail above, OF245 results generally show:

- Stormwater Moderately higher zinc (+4), moderately lower lead (-3) and pyrene (-2), and significantly lower indeno(1,2,3-c,d)pyrene (-4) compared to other outfalls when evaluating the 22-year monitoring record (see Table 3-4). When looking at only the last two years of data, zinc is slightly higher (+1), TSS is neutral (0), and all of COCs are slightly lower (-1) when compared to the other outfalls.
- SSPM – Moderately higher butylbenzylphthalate (+4) and moderately to significantly lower lead (-3), phenanthrene (-4), indeno(1,2,3-c,d)pyrene (-5), and pyrene (-4) compared to other sediment trap locations (see Table 3-5) when evaluating the entire 22-year monitoring record. When looking at only the last five years of data, butylbenzylphthalate and total phthalates remains slightly higher (+2 and +1, respectively) while PAHs, lead and bifenthrin remain slightly lower (-1) compared to other outfalls.

Therefore, the following recommendations are included in the 2024 Work Plan for OF245:

- Continue evaluation of the effectiveness of the street sweeping pilot project on lead and zinc concentrations in the industrial area as additional data become available.

5.7 OUTFALL 254

Several source control activities have occurred in the OF254 drainage basin since the beginning of the monitoring program. Some of these activities have resulted in statistically significant improvements in stormwater quality. Figure 5-1.7 shows the annual average contaminant concentrations for stormwater and baseflow. Note that there are no sediment traps in the OF254 drainage basin due to tidal influence.

This section provides a summary of stormwater quality results within the OF254 drainage basin and compares these results with the major source control and other activities that have occurred within the basin. A more comprehensive description of source control activities performed to date is provided in Appendix A.

5.7.1 Water Quality

Annual and seasonal data for stormwater for the COCs and other parameters is used to identify ongoing areas of concern. The following paragraphs summarize the WY2001-WY2023 monitoring results for OF254, where COCs in this outfall are different from other Foss drainage basins, and where subsequent source control activities may be focused.

5.7.1.a TSS and Metals

Stormwater TSS concentrations in OF254 stormwater are significantly above average when looking at the entire 22-year monitoring record (+6) but only moderately higher when looking at the last two years of data (+3) (see Table 3-4). OF254 has the highest mean TSS (90.4 mg/L) and median (68.9 mg/L) of all the basins (see Table 3-3.1 and Figure F-1). Considerable amounts of unpaved industrial area are present in this drainage basin, likely leading to these elevated concentrations. As shown on Figure 5-1.7, TSS concentrations have remained fairly consistent during the monitoring period with a slight decrease in WY2019 and WY2020 coinciding with an increased level of sweep that began in a portion of this drainage basin in January 2019 generally stabilizing since that time.

Analysis for copper at this outfall began in WY2015. Based on available data, copper appears neutral in OF254 compared to other outfalls (0). Copper is slightly elevated (+2), when looking at only the last two years of data. This is due to two moderate outliers detected during WY2022.

Lead concentrations are slightly lower (-2) in OF254 when looking at the entire 22-year monitoring record and slightly lower (-1) when looking at only the most recent two-year data set (see Table 3-4).

Zinc is moderately elevated (+3) in OF254 when looking at the 22-year monitoring record, while the two-year record shows that the outfall is only slightly elevated (+1) (Table 3-4 and Figure F-3). Since OF245 is similarly elevated in zinc, this indicates that there may be a source(s) of zinc present in the industrialized basins. As discussed in Section 5.6.2, truck traffic is a source of zinc but may not be the only source.

As shown in Table 3-6 and Figures 3-5.3 and 3-5.4, lead and zinc are showing statistically significant improvements in stormwater quality from 2001 to present. The best-fit regression equations result in an estimated 79 percent reduction in lead and 71 percent reduction in zinc in the 22-year monitoring period.

SSPM No sediment traps are installed in OF254.

5.7.1.b PAHs

Stormwater. PAHs in OF254 are neutral to moderately elevated (phenanthrene at +1, pyrene at +4, and indeno(1,2,3-c,d)pyrene at 0) in comparison to other outfalls when looking at the entire 22-year monitoring record (see Table 3-4 and boxplots in Appendix F). When looking at only the last two years of data, all three indicator PAHs are slightly lower than other outfalls (-1).

OF254 has had some relatively higher concentrations of PAHs in water quality in the Thea Foss Basin (see boxplots in Appendix F), but these concentrations have generally improved since WY2008 (see boxplots in Appendix G). The highest mean, median, and or maximum concentrations of several LPAHs and HPAHs in stormwater were reported at OF254 including acenaphthylene, anthracene, fluorene, phenanthrene, total LPAHs, chrysene, benzo(a)anthracene, fluoranthene, pyrene, and total HPAHs (see Table 3-3.1), but the maximum concentrations occurred in 2002 and concentrations are much lower in more recent sampling.

As shown in Table 3-6 and Figures 3-5.5, 3-5.6, and 3-5.7, PAHs (phenanthrene, pyrene, and indeno(1,2,3-c,d)pyrene) show a statistically significant improvement in stormwater quality from 2001 to present. The best-fit regression equations result in an estimated 80-89 percent reduction in the indicator PAHs in the 21-year monitoring period. In particular, there was a consistent decrease from WY2007 to WY2011 (see Figure 5-1.7) that occurred following cleaning of the storm lines, with a slight increasing trend observed since that time in part due the organics uptick described above.
The apparent uptick in organics concentrations observed in the last seven years of monitoring was evaluated by the City, as discussed in Section 3.5.2 and recent results were determined to be representative while earlier results were likely biased low. While this observed slight increase in organic concentrations is observed, concentrations remain substantially lower than the concentrations present early in the monitoring program (see boxplots in Appendix G).

SSPM No sediment traps are installed in OF254.

5.7.1.c Phthalates

Stormwater DEHP appears to be relatively consistent among outfalls (with the exception of OF230 and OF235 as discussed above) (see Table 3-4). OF254 is slightly lower in concentration for DEHP when looking at the 22-year monitoring record (-1) and neutral (0) when looking at only the last two years. Figure 5-1.7 shows total phthalate concentrations in stormwater were fairly stable from WY2002 to WY2009 when they decreased.

As shown in Table 3-6 and Figure 3-5.8, DEHP shows a statistically significant improvement in stormwater quality from 2001 to present. The best-fit regression equations result in an estimated 48 percent reduction in the 22-year monitoring period.

SSPM No sediment traps are installed in OF254.

5.7.1.d Pesticides

Stormwater Analysis for bifenthrin in stormwater began in WY2021 under the 2020 QAPP. Statistical analysis will be performed when sufficient data is available.

SSPM No sediment traps are installed in OF254.

5.7.1.e PCBs

Stormwater PCBs are not a COC tested for under the 2020 QAPP.

SSPM No sediment traps are installed in OF254.

5.7.2 Source Control Program Activities

Storm System Cleaning. In 2006, the municipal storm system in OF254 was cleaned and video inspected. The objective of this project was to remove residual sediments in the storm drains that may contain legacy contaminants. As discussed in detail in the WY2011 report, storm system cleaning contributed to significant reductions in stormwater concentrations. Sewer line cleaning is an important component of the City's source control program, and the City is currently on a schedule of cleaning each storm system area on a 20-year cycle. A second cleaning of approximately 82 percent of the OF254 system occurred in 2021. Additional cleaning is performed on an as needed basis to address specific maintenance needs. The City is statistically evaluating the results to determine whether a maintenance schedule different from the City-wide schedule for pipe cleaning projects is needed within this sensitive basin.

In combination with other source control activities, initial storm system cleaning was effective at removing all seven of the compounds tested. With less post-cleaning data available following the second cleaning, statistics are not as robust, however reductions were observed for lead and zinc.

Following the first cleaning statistically significant reductions were evident for lead, zinc, PAHs, and DEHP (see Table 2-2). Line cleaning, along with other source control activities, resulted in reductions of lead at 32 percent, zinc at 42 percent, DEHP at 24 percent and PAHs (phenanthrene, pyrene and indeno(1,2,3-c,d)pyrene) at 68-82 percent. The second cleaning, along with other ongoing source control activities resulted in further reductions of lead at 65 percent and zinc at 47 percent and a TSS reduction of 44 percent.

Enhanced Street Sweeping Program In January 2007, the City's street sweeping program was enhanced in an attempt to reduce sediment buildup in the storm sewer system. Under the enhanced program, the sweeping frequency was increased, air regenerative sweepers replaced mechanical sweepers, and the City also increased communications with residents and business owners, which helped raise awareness of the importance of the street sweeping program.

Statistically significant reductions were evident for lead, zinc, PAHs, and DEHP (see Table 2-3.1). Street sweeping, along with other source control activities, resulted in reductions of lead at 26 percent, zinc at 40 percent, DEHP at 19 percent, and PAHs (phenanthrene, pyrene, and indeno(1,2,3-c,d)pyrene) at 69-82 percent.

As described above, a pilot study has been underway in the drainage basins for OF243 and OF245 since WY2014. This pilot study has shown that an increased level of street sweeping in industrial areas has been effective in further reducing concentrations of some indicator constituents. The City has expanded the reach of the pilot study into OF254 drainage basin in beginning in WY2021 and this additional enhanced street sweeping continued during WY2024. Based on enhanced sweeping performed to date in a portion of this basin, statistically significant reductions were evident for TSS, lead, and zinc (see Table 2-3.2). Enhanced street sweeping, along with other source control activities, resulted in reductions of TSS at 44 percent, lead at 63 percent, and zinc at 41 percent.

General Source Control Activities In addition to the ongoing investigation and maintenance activities described above, the City is continuing to implement other source control program elements in the OF254 drainage basin which are summarized here and described in more detail in Appendix A. This includes removal of a UST at one location under TPCHD oversight.

5.7.3 Outfall 254 2024 Work Plan

TSS, lead, zinc, PAHs and DEHP concentrations in stormwater have shown a statistically significant improvement in OF254 from WY2002 through WY2023 (see Table 3-6 and Figures 3-5.3 to 3-5.8). There has been an estimated 40 percent reduction in TSS, 79 percent reduction for lead, and a 71 percent reduction in zinc concentration in 22 years. DEHP concentration reductions are estimated at 48 percent and index PAHs (phenanthrene, pyrene, and indeno(1,2,3-c,d)pyrene) showed a 80-89 percent reduction in the 22-year monitoring period.

As described in detail above, OF254 results generally show:

- Stormwater – Significantly higher TSS (+6) and moderately elevated zinc (+3) and pyrene (+4) compared to other outfalls when evaluating the 22-year monitoring record (see Table 3-4). When evaluating only the last two years of data, TSS and copper are moderately elevated (+3 and +2), while other constituents are relatively neutral (+1 to -1) compared to other outfalls.

Therefore, the following recommendation is included in the 2024 Work Plan for the OF254 drainage basin:

- Continue to work toward expansion of the area of increased street sweeping frequency to the remainder of basin as resources become available.

5.8 SUMMARY OF CONSTITUENTS OF CONCERN BY OUTFALL

While overall trends show decreasing concentrations, analytical data has identified some areas where relatively higher concentrations of certain contaminants remain present in the drainage basins and source control investigations are currently underway as described above. Source control efforts are focused on the COCs for each basin and whether it is found in stormwater or SSPM at the outfall as follows:

Constituents of Interest in Each Basin

		230	235	237A	237B	243	245	254
TSS	Baseflow							
	Stormwater							✓
Copper[1]	Stormwater		✓			✓		✓
	SSPM					✓		n/a
Mercury	Baseflow							
	Stormwater	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	SSPM					✓		n/a
Zinc	Baseflow							
	Stormwater						✓	✓
	SSPM					✓		n/a
Lead	Baseflow							
	Stormwater		✓			✓		
	SSPM					✓		n/a
LPAHs[2]	Baseflow							
	Stormwater			✓				
	SSPM	✓						n/a
HPAHs[3]	Baseflow							
	Stormwater			✓				
	SSPM	✓		✓				n/a
Phthalates	Baseflow							
	Stormwater	✓	✓					
	SSPM							n/a
PCBs	SSPM	✓						n/a

✓ chemical of concern.
[1] For OF230, OF237A, OF243, and OF254, evaluation is based on only eight years of data
[2] As represented by indicator COC phenanthrene
[3] As represented by indicator COCs indeno(1,2,3-c,d)pyrene and pyrene
(shaded) shows statistically significant improvement.
n/a – not applicable

The 2024 Source Control Work Plan is included in Section 6.

The City believes some minor additional improvements in stormwater quality may be realized in the future with ongoing NPDES Permit programs and continuing improvements in source control implementation. Sediment trap results are valuable in that they provide an early warning of potential stormwater sources to the waterway sediments that can be investigated and addressed before SQO exceedances requiring action are identified in the waterways.
The City is continuing to move forward with ongoing source tracing investigations.

6.0 POLLUTANT LOADING ESTIMATES AND 2024 WORK PLAN

The improvements in stormwater quality since the mid-1990s indicate that source control efforts in the Foss Waterway Watershed have been effective in the reduction of chemical concentrations in stormwater. With the City's comprehensive 22-year monitoring data set, updated statistical analyses have been completed. Forty-eight statistically significant time trends (48 out of 49 tests or approximately 98 percent of the tests) were observed in Tacoma's stormwater monitoring record. All trends were in the direction of decreasing concentrations. This is the same number of and constituents with significant reductions that was observed in WY2022, when a trend was added for TSS at OF254, while the previously observed significant decreasing trend for indeno(1,2,3-c,d)pyrene was not observed.

In addition to the 49-time trend tests that have been evaluated in past years, the NPDES Permit requires the City to analyze and evaluate total copper. For three outfalls, OF235, OF237B, and OF245, the data collected from WY2015 through WY2023 has been added to data previously collected under the NPDES program between WY2010 and WY2012. With more data available, an evaluation of time trends has been performed for these outfalls for the last several years. Although with less data available, the statistical results are not fully comparable to data for the remaining constituents. With these seven tests added, there are 51 statistically significant time trends (51 out of 56 tests, or approximately 91 percent of the tests) shown in Year 22, with all trends in the direction of decreasing concentrations. As additional data becomes available, time trends for copper will become somewhat more comparable to remaining tests.

Overall, these results are significant and a testament to the City's ongoing comprehensive source control program. Source control activities currently being implemented by the City include business inspections, response to spills and illicit discharges, mapping/maintenance/cleaning of the stormwater system, pollutant source tracing, and implementation of the City's Surface Water Management Manual through our stormwater ordinance. With continued monitoring, enhanced maintenance, and ongoing source control actions, coupled with implementation of Phase 1 NPDES Permit programs, further improvements in stormwater quality may be realized.

It should be noted, however, that while considerable improvements to stormwater quality have been made, the largest changes were realized in the earlier years of the program when major sources were identified and eliminated. Because the source control program has been so effective through the years, fewer major issues remain, and the program is beginning to approach an equilibrium or maintenance mode. In other words, the concentrations of contaminants of concern in the stormwater in the Foss Waterway Watershed are reaching a level where the opportunities for large reductions are more limited. While this may over time lead to the appearance of fewer decreasing trends in contaminant concentrations if looking only at results from more recent years, the fact remains that the City's stormwater source control and monitoring program have been very effective in reducing contaminant levels in stormwater and SSPM.

Reduction of overall contaminant loads to the Foss Waterway has been achieved through the City's implementation of these stormwater source controls. Control of other sources, many of which are outside the City's jurisdiction and must be coordinated by other federal, state, and local authorities, have also led to reduction in contaminant loads. Reductions of air and marina pollution are achieved through Ecology's Air Program and through the Marina Source Control Program which was developed specifically for the Foss Waterway. Reductions in air pollution will decrease not only the direct loads from atmospheric fallout to the surface of the waterway but will also decrease the pollutant loads washed off upland surfaces and entrained in stormwater runoff. The marina improvements implemented by the Foss Waterway Marina, Foss Landing Marina, Johnny's Dock Marina, and Delin Docks, including installation of facility improvements, have undoubtedly translated into reduced source loads for marinas. Finally, upland and in-water remedial actions implemented by Ecology and the Utilities in 2003 and 2004 were directed at controlling tar seeps in the head of the waterway. The effectiveness of these combined actions will continue to be verified through long-term monitoring of stormwater, storm sediment, and marine sediment, and supplemented by source monitoring programs conducted by other parties.

6.1 Thea Foss Waterway Sediment Monitoring Program

When the waterway sediment remediation projects were completed, the majority of the sediment surface had no, or very low concentrations of contaminants present since the surface was for the most part either dredged to clean sediments or covered with new, clean capping materials. It was anticipated that ongoing low level source contributions to the waterway would cause concentrations of contaminants to increase gradually. Over time, the goal is to have the contaminant concentrations equilibrate at a level below the sediment cleanup standards set by the EPA.

The sediments in the waterway are the true barometer, however, of whether additional source controls are needed for compliance with regulatory requirements. The last sediment monitoring was performed by the City in 2023 in the portion of the waterway generally north of the SR509 Bridge and by the Utilities in the remainder of the waterway. An analysis of the results shows that the concentrations have generally stabilized and that the risk of wide scale recontamination appears low. In many cases, sediment concentrations remained relatively stable between the Year 7 and Year 17 monitoring events, indicating that waterway sediment concentrations appear to have largely equilibrated with modern sources since the completion of the remedial action in 2006. As a result, the risk of recontamination is not expected to be substantially higher in the future unless there is a change in the nature, strength, or distribution of waterway sources. EPA has initiated the process of deleting the waterway from the Commencement Bay Superfund site.

Long Term Monitoring Plans (LTMPs) are in place for the waterway for continued monitoring of site. In the City's work area, the LTMP covers monitoring to be performed through 2028, and for the Utilities' work area, the LTMP covers monitoring through 2037. New LTMP's are expected to be prepared for EPA approval when work under the existing plans is completed. The intent is that sediment monitoring results will be available from throughout the waterway to support EPA's development of each of their Five-Year Review reports. The next in-waterway sediment monitoring in both work areas will take place in 2028.

6.2 POLLUTANT LOAD ANALYSIS

As indicated in the 2020 QAPP, basin specific rainfall-runoff correlations were developed in WY2016 based on continuous flow data. Based on this information, mass loading calculations were done for WY2023 as described below. A summary of annual mass loadings for each outfall is compiled in Tables 6-1.2 through 6-1.6. Mass Loadings were not calculated for OF254 due to a lack of data[23]. Due to the changing flow regime and drainage area and a lack of samples at OF230[24] loadings were unable to be accurately calculated. The mass loading calculations were performed as described in the Pollutant Loading SOP (Thornburg and Lowe 2009), as modified per the procedures described below to incorporate the basin-specific rainfall-runoff relationship.

- The rain record was separated into discrete storm events based on previously established criteria for threshold rain amounts and antecedent dry periods.
- The five minute rainfall amounts were summed to provide a total rain depth for each storm. The corresponding runoff depth was then estimated from the rainfall-runoff correlations.
- The runoff depths (in inches) were converted to discharge volumes (in acre-feet) by multiplying by the basin area (in acres), with appropriate unit conversions. These were then converted to event mean flow rates by dividing the event discharge volume by the duration of the storm. The storm fraction was calculated as the ratio of the storm flow to the combined storm plus baseflow for each event.
- The total wet season, dry season, and annual discharge volumes were calculated by summing over the appropriate storm events. Mean seasonal storm flow rates were calculated by dividing the total discharge volume (wet season or dry season volume) by the time period of interest.
- Stormwater concentrations were “unmixed” from the combined flow concentrations (i.e., “as measured” concentrations) using the mass balance equations described in the Pollutant Load SOP. In a few instances, negative concentrations resulted from the “unmixing” calculation. Typically, these instances occurred when there were higher concentrations in baseflow, such that baseflow accounted for all (and more) of the combined storm flow concentration, and in some instances, they were an artifact of undetected concentrations with variable detection limits. In any instance where negative “unmixed” stormwater concentrations were calculated, these values were replaced with half the detection limit values (essentially, they are equivalent to undetected stormwater concentrations).
- Mean annual stormwater concentrations were calculated as volume-weighted average concentrations. The estimated storm volumes were paired with their corresponding analytical results and provided the weighting functions for calculating a volume-weighted concentration. A volume-weighted mean rather than a flow weight mean will be used

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[23] The additional equipment issues experienced at OF254 limited deployments and sampling success at this site. These issues have been resolved. There was only one sample collected at OF254 and thus not sufficient data points to calculate mass loadings for WY2023 at this outfall.

[24] There were eleven deployments at OF230 from October to December 2022 with eight unsuccessful due to low flows, (3 stormwater samples collected). 98 percent of the OF230 drainage area was rerouted to OF230A (including some drainage area and flow from OF235) from October to December 2022. Flow to OF230 was determined to be diminished and monitoring for this outfall ceased in December 2022 after discussions with Ecology.

because it is believed to provide a better statistic since it captures the significance of a storm event in terms of both flow and duration.

- The mean seasonal and annual baseflow and storm flow rates, the storm fraction in the combined discharges, and the mean annual baseflow and stormwater concentrations were input to the pollutant load worksheet provided in the Pollutant Load SOP. The worksheet calculated the seasonal and annual baseflow and stormwater pollutant loads as per the Pollutant Load SOP.
- Since baseflow is no longer monitored for the Foss on a regular basis, baseflow data from the last water year of baseflow analysis (WY2011) will be used in the calculator for most parameters. Since WY2011, new parameters have been analyzed and some analytical methods are analyzed at lower method detection limits. In WY2016 and WY2019, baseflow characterization data were collected at all outfalls to evaluate the effect of these changes.

Tables 6-1.2 through 6-1.6 include the following information[25]:

- Mean annual stormwater and baseflow[26] concentrations for stormwater contaminants of concern (COCs) and stormwater/baseflow concentration ratios; the mean annual concentrations are based on volume-weighted averages;
- Mean annual pollutant loads [in pounds], as well as itemized loads for baseflow and stormwater components, and wet season and dry season components; and
- Mean annual pollutant load densities [pounds per acre], as well as itemized load components as described above.

Stormwater mass loadings were not calculated for analytical parameters with fewer than 10 percent detected concentrations or only one detected sample in stormwater. Many of the constituents with low detection frequencies in stormwater were never detected in baseflow samples. Mass loadings were not calculated for grab sample parameters, since these parameters represent a single moment in time and are not average concentrations for the sampled volume.

It is further noted that constituents with less than 25 percent detections and/or less than five detected results (or less than three detected results in baseflow) will generate estimated mass loads with a high degree of uncertainty, even though mass loads may still be calculated. Cells are highlighted in Tables 6-1.2 through 6-1.6 to identify constituents that are confounded by low detection frequencies to identify mass loading estimates which are more uncertain.

6.2.1 Rainfall-Runoff Correlations

The City installed flow meters in its three NPDES drainage basins (OF235, OF237B, and OF245) and collected continuous flow data during all of WY2010, as required by the Phase I Permit. During WY2011, the flow records from WY2010 were analyzed to develop rainfall-runoff correlations for the three basins. The rainfall-runoff correlations for these basins are shown on Figures B2-8, B2-11, and B2-16 in Appendix B. The runoff has been normalized to basin size, such that both rainfall and runoff are presented in depth units, and the slope of the regression

[25] Tables 6-1.1 and 6-7.7 Mass Loading Summary for OF230 and OF254 are not calculated due to limited data set for WY2023.

[26] WY2016 and WY2019 baseflow concentrations were used in the calculations as an approximation of WY2019 baseflow quality.

line is the runoff coefficient. Separate correlations were developed for wet season and dry season conditions. The estimated runoff parameters are presented in Tables B9-1.2, B9-1.4, and B9-1.6, and summarized in Table B9-2 in Appendix B. Due to the OF230A construction and the altered drainage area for OF235, the City is in the process of collecting flow data to develop a new rainfall-runoff correlation for OF235 and OF230A.

During WY2016, the flow records from WY2015 and WY2016 were analyzed to develop rainfall-runoff correlations for OF230, OF237A, OF243, and OF254. The rainfall-runoff correlations are shown on Figures B2-6, B2-10, B2-13, and B2-18 in Appendix B. The runoff has been normalized to basin size, such that both rainfall and runoff are presented in depth units, and the slope of the regression line is the runoff coefficient. Separate correlations were developed for wet season and dry season conditions. The estimated runoff parameters are presented in Tables B9-1.1, B9-1.3, B9-1.5, and B9-1.7 and summarized in Table B9-2 in Appendix B. OF230 is currently only monitored for flow and the City is no longer collecting stormwater samples at this location.

Basin Comparisons Higher runoff coefficients were observed in OF235 compared to the larger basins OF230, OF237A, and OF237B. This was expected given the smaller basin size in comparison, the steeper slopes and higher percentage of impervious area in the OF235 basin, which is comprised of a large portion of downtown Tacoma.

The highest runoff coefficients were observed in OF245 and OF254, 0.99 and 0.84, respectively. This may be caused by the relatively small size and prevalence of hardened surfaces in these industrial drainages. However, the coefficients in this low-gradient and tidally influenced drain may also be artificially inflated to some degree by back-flushing tidal water. Separating tidal flows and storm flows was difficult in the eastside outfalls (OF243, OF245, and OF254) and complicated the analysis of the flow record.

Seasonal Comparisons The runoff coefficients for dry season conditions are consistently the same or lower than the coefficients for wet season conditions. This may be an indication that the ground is more saturated during the wet season and has less capacity for infiltration, leading to a higher percentage of runoff. The coefficient of determination (r^2) for the regression models shows a distinct seasonal effect, as shown in Appendix B on Figures B2-6, B2-8, B2-10, B2-11, B2-13, B2-16, and B2-18 (OF230, OF235, OF237A, OF237B, OF243, OF245, and OF254, respectively). Specifically, the rainfall-runoff relationship is better defined in the wet season, as evidenced by significantly higher r^2 values. The lower correlations during the dry season may be indicative of more erratic and variable runoff conditions.

Seasonal comparison is limited for OF230, OF237A, OF243, and OF254 because of the low number of dry weather storm events that weren't tidally influenced in WY2015 and WY2016.

Rain Threshold In the large basin for OF237B, there is a threshold of precipitation of a few hundredths of an inch, below which no runoff occurs. This is a large, primarily residential basin (see Appendix B, Figure B2-3) with more vegetated cover and soft shoulders on streets, and thus has more capacity to infiltrate compared to the other basins. The threshold is determined by the intercept of the regression line (see Figure B2-11) and indicates a capacity for the basin to assimilate some amount of rain before runoff occurs. As expected, the threshold is higher during the dry season (i.e., the dry ground has a greater capacity to assimilate incipient rainfall).

Results from WY2021 indicate that this might also be the case for the large mixed-use basin for OF237A, although it is difficult to discern at this time. In addition to OF235 and OF230A, the City has plans to refine rainfall runoff correlations for all outfalls to better determine the conditions in this basin.

6.2.2 Residential Pollutant Loading – OF237B

The following constituents were excluded from loading calculations because they were detected only once or not at all in this outfall during the WY2023 monitoring year: dissolved mercury, acenaphthene, fluorene, dibenz(a,h)anthracene, butylbenzylphthalate, diethylphthalate, dimethlyphthalate, and di-n-octylphthalate. Baseflow values were estimated as average concentrations from the WY2016 and WY2019 baseflow data for OF237B. Following are the key results of the mass loading calculations for OF237B:

- As shown on Appendix B, Table B9-2, baseflow accounts for over four-fifths (86 percent) of the total discharge from OF237B.
- Stormwater concentrations are substantially higher than baseflow concentrations for a majority of the constituents (see Table 6-1.4). Concentration ratios are especially high for TSS and some metals: TSS (40 times higher in stormwater compared to baseflow), total copper (31 times higher), total zinc (39 times higher) and total lead (185 times higher). Dissolved copper, dissolved zinc, total cadmium, and dissolved lead exhibited slightly lower ratios with concentrations ranging from 16 to 20 times higher than baseflow concentrations. Concentrations of organic constituents ranged from 1 to 20 times higher in stormwater (a value of one is where all concentrations are not detected or just above the detection limit).
- Even though baseflow accounts for 86 percent of the discharge from OF237B, because stormwater can exhibit substantially higher concentrations than those seen in baseflow, stormwater accounts for a large majority of the mass loading. Specifically, stormwater accounts for 87 percent of the TSS load, 41-97 percent of the total and dissolved metals loads, and 15-78 percent of the loads from organic compounds.
- When a large number of stormwater and baseflow concentrations are non-detected and where OF237B baseflow accounts for 81 percent of the discharge, the largest contribution of mass loadings is estimated from baseflow. This is seen for a few constituents with less than 25 percent detections and/or less than five detected results that generate estimated mass loads with a high degree of uncertainty, even though mass loads may still be calculated using one-half the detection limit for that non-detected value (total and dissolved cadmium, four PAHs, one phthalate and bifenthrin).
- Because approximately 90 percent of the storm flow in OF237B occurs during the wet season, significantly higher mass loadings occur during the wet season. Specifically, the wet season accounts for 88 percent of the TSS load, 59-71 percent of the nutrient loads, 72-91 percent of the total and dissolved metals loads, and 63-84 percent of the loads from organic compounds.
- MBAS, BOD_5, and nutrients appear to be similar in quality or higher in baseflow when comparing stormwater and baseflow concentrations. BOD_5 is confounded by one detection (low detection frequencies) in baseflow that have generated estimated mass loads with a high degree of uncertainty. During WY2023, stormwater concentrations are approximately four times higher than baseflow concentrations for MBAS, BOD_5, and for total phosphorus. The remaining nutrients exhibit either similar concentrations or higher concentrations in baseflow, than in stormwater. Baseflow accounts for 60 percent of the MBAS, BOD_5, and total phosphorus load, and 61-97 percent of the nutrient loads.

6.2.3 Commercial Pollutant Loading – OF235

Due to the construction and mid-year change of the OF235 drainage area, the first four samples were collected prior to this change and represent stormwater discharges from the historic drainage area. Samples collected after December 15, 2022, represent stormwater discharges from the new smaller OF235 drainage area. Due to these changes, loadings were calculated separately for these sample groupings and then combined for WY2023 annual loading for OF235. The City considers WY2023 a transition year and recognizes that Dec 15th and latter values are estimates (i.e., new rainfall to runoff calculations will be developed for loadings calculations for the new drainage acreage). As previously mentioned, once sufficient data is collected representing this new smaller drainage area, the City will determine if there is significant statistical difference between the water quality data of the two drainage area, which differ is size: 166 acres to 109 acres. Additionally, baseflow samples will be collected during WY2024 to assist with this characterization and ensure more accurate (if different) and representative baseflow loading calculations.

The following constituents were excluded from loading calculations because they were detected only once or not at all in this outfall during the WY2023 monitoring year: dissolved mercury, butylbenzylphthalate, diethlyphthalate, dimethlyphthalate, di-n-octylphthalate and bifenthrin. Baseflow values were estimated as average concentrations from WY2016 and WY2019 baseflow data for OF235.

Following are the key results of the mass loading calculations for OF235 based the new drainage area:

- As shown on Appendix B, Table B9-2, baseflow accounts for approximately forty-five percent of the total discharge from OF235.
- Stormwater concentrations are higher than baseflow concentrations for a majority of the constituents (see Table 6-1.2). The concentration ratio is especially high for TSS (25 times higher in stormwater compared to baseflow). The concentration ratio for the majority of metals ranges from 2 to 30 times higher for stormwater. Concentrations of many other constituents, both inorganic and organic, are from one time to 20 times higher in stormwater (a value of one is where all concentrations are not detected or just above the detection limit). The main exceptions are nutrients which exhibit higher concentrations in baseflow (see discussion below).
- Because storm flow accounts for a higher percentage of the discharge from OF235, and because stormwater concentrations are typically higher than baseflow concentrations, stormwater accounts for a large majority of the mass loading for most constituents. Specifically, stormwater accounts for 95 percent of the TSS load, 85 percent of the BOD load, and the majority of loads from most dissolved and total metal and organic compound loads. percent of the loads from organic compounds.
- Because 89 percent of the storm flow in OF235 occurs during the wet season, significantly higher mass loadings occur during the wet season. Specifically, the wet season accounts for 89 percent of the TSS load, 63-76 percent of the nutrient loads, 68- 90 percent of the total and dissolved metals loads, and 72-89 percent of the loads from organic compounds.
- Nutrient concentrations (total phosphorous, orthophosphorous, total nitrogen and nitrate/nitrite) appear to be either similar in quality or higher in baseflow. These nutrients

are 1 to 6 times higher in baseflow than stormwater concentrations for these nutrients. Specifically, baseflow accounts for 48 percent of the total phosphorus loads and 62 percent to 85 percent of the other nutrient loads.

6.2.4 Industrial Pollutant Loading – OF245

The following constituents were excluded from loading calculations because they were detected only once or not at all in this outfall during the WY2023 monitoring year: dissolved mercury, dibenz(a,h)anthracene, butylbenzylphthalate, dimethlyphthalate, and bifenthrin. Following are the key results of the mass loading calculations for OF245:

- As shown on Appendix B, Table B9-2 there is no measurable baseflow component in the discharge from OF245. Therefore, 100 percent of the mass loading from OF245 is attributed to stormwater.
- Because approximately 87 percent of the storm flow in OF245 occurs during the wet season, significantly higher mass loadings occur during the wet season (see Table 6-1.6). Specifically, the wet season accounts for 90 percent of the loadings for all stormwater COCs. This percentage does not vary because the same average COC concentrations were assumed for both wet season and dry season discharges; there is not yet enough data to determine whether there are statistically significant seasonal effects in stormwater quality.
- The estimated runoff coefficients are quite high for this basin (78-99 percent runoff in dry and wet seasons, respectively; see Appendix B, Figure B2-16). Therefore, it is suspected that the predicted runoff, and thus the resultant pollutant loads, may be overestimated due to the inclusion of some amount of backflushing tidal water in the discharge estimate.

There is a greater degree of uncertainty associated with the mass loadings from OF245 because this storm sewer has a low slope and elevation and is strongly influenced by tidal inundations. Significant portions of the flow record are obscured by tidal fluctuations. Tidal fluctuations also make it more difficult to sample this drain and estimate event mean concentrations. Tidal inundations have been estimated using WISKI programming. Refinements will be made in WISKI and will be used over time to estimate tidal inundations and recalculate runoff coefficients for OF245.

6.2.5 Overall Pollutant Loading

Annual flow was calculated for all outfalls except for OF230/OF230A baseflow and pollutant loadings were calculated for five of the seven major outfalls in WY2023. Due to limited data, overall pollutant loadings exclude loadings from OF230/OF230A and OF254. Some of these annual flows may be artificially inflated due to tidally induced flows (see Section 6.2.1). Annual total flow for stormwater and baseflow are presented in Appendix B, Table B9-2. In WY2023, the total combined annual flow was 17,509-acre feet, with the fraction of stormwater at 24 percent (4,143 acre feet). Most of the annual flows are from OF237A and OF237B and the percentages are follows:

OF237A and 237B Flow Summary	OF237A	OF237B	237A and 237B
% of Foss Basin Acreage	49.1%	34.7%	83.8%
Annual flow	34%	62%	95%
Baseflow	30%	68%	99%
Storm	47%	38%	85%
Pollutant Loadings for OF237A and 237B (TSS Pounds per Year) – These percentages do not include loadings from OF230/230A or OF254			
Annual	55%	39%	94%
Baseflow	42%	56%	98%
Storm	56%	37%	93%

Note: Baseflow data for OF230/230A was not included in these calculations due to drainage area changes. Loading data for OF230, OF230A and OF254 were not included in these calculations due to limited data. The percentages in this table are estimated based on this transition year.

Consistent with having the highest flow, the highest pollutant loadings for TSS and for most other constituents are from 237A and 237B (all but acenaphthene). When a large number of stormwater and baseflow concentrations are non-detected and where OF237A and OF237B baseflow accounts for the majority of the overall annual discharge, the largest contribution of mass loadings is estimated from baseflow. This can be seen at times with constituents with less than 25 percent detections and/or less than five detected results that generate estimated mass loads with a high degree of uncertainty, even though mass loads may still be calculated using one-half the detection limit for that non-detected value (see Table 6-4).

Pollutant loadings were also normalized to pounds per acre for each outfall. These results are shown in Table 6-3. Normalizing the loadings per acre illustrates where more pounds of constituents are found in an acre. This metric can be used to direct source control efforts where these efforts may result in a larger reduction of pollutants. In general, a greater number of constituents with maximum pounds per acre were found in OF235 with 20 different constituents. Other outfalls with maximum pounds per acre were OF237A with eight constituents, OF237B with five constituents, OF245 with seven constituents and OF243 with one constituent. As stated previously, loadings were not calculated for OF230 and OF254 due to insufficient flow and sample data for OF230/OF230A and insufficient samples collected at OF254. This is discussed further in Appendix B.

OF235 exhibited the maximum pounds per acre for MBAs, total phosphorus, orthophosphorus, total and dissolved copper, dissolved zinc, total and dissolved lead, the majority of LPAHs, four HPAHS, DEHP and dichlobenil. OF237A exhibited the maximum pounds per acre for the majority of the HPAHs, including total HPAHs, and one phthalate. OF245 exhibited the maximum pounds per acre for TSS, total zinc, total and dissolved cadmium, and phenanthrene).

Similar to previous years, the residential area discharging to OF237B discharged the highest loads per acre for BOD_5, and both nitrogen constituents. OF243 exhibited the highest loading per acre for one LPAH (anthracene).

6.2.6 Water Year Comparison – 237B, 235, and 245

Table 6-2.1 presents a summary of estimated pollutant loads (normalized on a per-acre basis) for WY2010-2012 and WY2015-2023 in the three monitoring basins (237B, 235, and 245), and the percent difference in the estimated loads for WY2023 compared to the previous water years. The majority of the estimated mass load comparisons for each WY to WY2023 were relatively consistent and within a factor of two of each other (i.e., the percent difference ranged from – 75 percent to +100 percent from each WY to WY2023). Such differences are not unexpected given the inherent variability in stormwater quality from year to year and from storm to storm. The statistical confidence in the estimated mass loads for these three basins will improve as more monitoring years are collected and included in the analysis.

The majority of the estimated mass load comparisons for each WY to WY2023 were within a factor of two of each other. Annual Rainfall in WY2023 (29.05 inches) was significantly less than the average (40.30 inches) for all water years (WY2002-WY2023) (see Table 3-1). WY2016 and WY2017 had the greatest rainfall amount for all the years with 50.11 inches and 51.73 inches, respectively. Not all constituent loads showed a consistent load increase in direct response to greater rainfall amounts. Lower concentrations would offset an increase due to rainfall volumes and/or rainfall intensities.

6.2.7 Water Years 2016 through 2022 Comparison

Tables 6-2.1 and 6-2.2 presents a summary of estimated pollutant loads (normalized on a per-acre basis) for WY2016 through WY2023 and the percent difference in the estimated loads for WY2016-21 compared to WY2023. The majority of the estimated mass load comparisons for WY2016 to WY2023 were relatively consistent and within a factor of two of each other (i.e., the percent difference ranged from – 75 percent to +100 percent from WY2016-22 to WY2023). Such differences are not unexpected given the inherent variability in stormwater quality from year to year and from storm to storm. The statistical confidence in the estimated mass loads for these basins will improve as more monitoring years are collected and included in the analysis.

6.2.8 Pollutant Loading Summary – WY2023

WY2023 discharge volume and chemical loadings are presented in Table 6-5. In WY2023, 76 percent of the freshwater volume discharging to the waterways is from baseflow, mainly from OF237A, OF237B, and OF235[27] (see Appendix B, Table B9-2).

For WY2023, baseflow was characterized by reduced maximum values and less frequent detections than in stormwater. When a large number of stormwater and baseflow concentrations are identified as non-detected and in OF237A and OF237B where baseflow accounts for 70 percent of the overall annual discharge, the largest contribution of mass loadings is estimated from baseflow. This is seen for a few constituents with less than 25 percent detections and/or less than five detected results that generate estimated mass loads with a high degree of uncertainty, even though mass loads may still be calculated using one-half the detection limit for that non-detected value (orthophosphorus, both nitrogen constituents, total cadmium, and two phthalates, see Table 6-4). The proportion of the WY2023 contaminant load attributed to baseflow for the following indicator parameters is (see Table 6-4 and Table 6-5):

- 25 percent of the load for phenanthrene
- 10 percent of the load for pyrene

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[27] OF235 rainfall-runoff calculations will be updated in WY2024 based on the total drainage area of 109 acres, December 16, 2022, to present. The WY2023 volume and loadings for OF235 are based on the total drainage area before December 15, 2022, 166 acres.

- 56 percent for dibenz(a,h)anthracene
- 34 percent of the total load for DEHP

The largest proportion of chemicals discharging into the waterways from municipal outfalls is from stormwater. The WY2023 contaminant loading from stormwater is:

- 75 percent of the total load for phenanthrene
- 90 percent of the total load for pyrene
- 44 percent for dibenz(a,h)anthracene
- 66 percent of the total load for DEHP

As shown in Table 6-3, a greater number of constituents with maximum pounds per acre were found in three outfalls: OF235 (20 different constituents) OF237A (8 different constituents), OF245 (7 different constituents). Maximum pounds per acre for the remaining constituents were found in OF237B (5 different constituents) and OF243 (1 constituent). Loadings were not calculated for OF230/230A and OF254[28].

6.3 2024 Work Plan

In December 2020, EPA determined that the City had fully performed the sediment remedial action in the Thea Foss and Wheeler-Osgood. As such, and because the waterway sediments have reached equilibrium with modern sources at levels generally below EPA's required cleanup levels for the Superfund site, no new source control investigations are slated to begin at this time. There are still several source control investigations and actions that are underway and will be carried out to completion. Monitoring will continue and if future monitoring identifies the potential of a new source that may be affecting sediment quality in the waterway, additional source control actions will be undertaken. The WY2024 source control work plan is provided below:

- **OF230:** Continue follow-up on private property cleanups performed, and complete ongoing system cleaning and monitoring for PCBs and PAHs as appropriate in the areas draining to FD3C and FD16.
- **OF230/OF235:** Continue to evaluate potential sources of spring/summer outliers for copper to stormwater.
- **OF235:** Evaluate the need for additional source control work for lead, copper, and DEHP in stormwater following completion of construction activities in this area. These construction activities are expected to have a positive impact on controlling the flow of potentially contaminated groundwater into the storm drainage system.
- **OF237A:** Continue to monitor sediment trap results in FD13B-new to determine if there are any additional sources of PAHs in this drainage area.
- **OF237A:** Continue to monitor sediment trap results in FD10C to determine if there are any additional sources of PCBs in this drainage area.

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[28] Mass Loading Summary for OF230 and OF254 are not calculated due to limited data set for WY2023

- **OF237A**: Evaluate potential sources and seasonality of occasional outliers of indeno(1,2,3-cd)pyrene and other PAHs in stormwater.
- **OF243:** Perform follow-up work with the business owner and system cleaning work in the area where elevated mercury concentrations were identified in catch basins in the FD23 drainage area.
- **OF243/OF245/OF254:** Continue evaluation of the effectiveness of the street sweeping pilot project on lead and zinc concentrations in the industrial area as additional data become available.

In addition, the City will perform a number of tasks as part of the source control program:

- Continue Foss Stormwater Monitoring for WY2024.
- Review WY2024 SSPM data in all areas when available to evaluate the effectiveness of treatment systems installed and confirm the effectiveness of source control actions that have been taken over time.
- Monitor the major construction activities throughout the watershed including the WSDOT Nalley Valley Viaduct/SR-16 rebuild.
- Monitor and conduct inspections at new developments as completed to review appropriate BMPs for each site.
- Implement the City's Stormwater Management Manual, 2021 Edition.
- Continue NPDES business inspections program and document the inspections using the business inspections database. Respond and track all complaints/spills in the complaints database.
- Monitor TPCHD and Ecology UST/LUST removal projects along with any other remediation projects in the watershed.

It should be noted that there are other sources that could also potentially affect sediment quality in the waterways, including groundwater seeps, marinas, atmospheric fallout, NPDES-permitted industrial discharges, and other private stormwater discharges. These sources are outside the scope of the City's Source Control Strategy for municipal stormwater, and largely outside the City's jurisdiction.

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TABLES

Table 2-1
Sediment Trap Monitoring Locations for 2002-2023

Dates Deployed		WY2002	WY2003	WY2004	WY2005	WY2006	WY2007	WY2008	WY2009	WY2010	WY2011	WY2012	WY2013	WY2014	WY2015	WY2016	WY2017	WY2018	WY2019	WY2020	WY2021	WY2022	WY2023
		8/31/01 3/25/02-3/26/02	8/27/02-8/29/02 4/28/03	8/27/03 4/8/04	8/24/04- 8/26/04 4/05	8/26/05- 8/30/05 4/06/06	8/21/06- 8/23/06 3/1/07-4/20/07	8/21/07- 8/24/07 4/3/08-4/4/08	8/28/2008 5/4/09-5/8/09	8/27/2009 8/23/10- 8/24/10	8/2310- 8/24/10 8/25/11- 8/26/11	8/24/11- 8/25/11 8/14/12- 8/23/12	8/13/12- 8/23/12 8/30/13	7/10/13- 8/23/13 8/25/14- 8/27/14	8/26/14- 9/3/14 8/10/15- 8/14/15	8/10/15- 8/17/15 8/15/16- 8/26/16	8/15/16 - 8/26/16 8/21/17- 8/23/17	8/21/17 - 8/23/17 8/17/18 - 8/21/18	8/17/18 - 8/21/18 8/19/19 - 8/21/19	8/19/19 - 8/21/19 8/17/20 - 8/18/20	8/17/20 - 8/18/20 8/24/21- 8/25/21	8/24/21 - 8/25/21 8/22/22- 8/23/22	8/22/22 - 8/23/22 8/22/23- 8/24/23
OF237A	FD2	X	X	X	X	X 9/26/05	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	FD2A	X	Pulled 3/10/03	Site gone	X	X 1/9/06	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	FD5	X	X	X	X	X	X	X	X	X	X	X	X										
	FD10		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	pulled			
	FD10B		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	pulled			
	FD10C		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	FD13		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	pulled			
	FD13B		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X					
	FD13B NEW												X	X	X	X	X 10/4/16	X	X	X	X	X	X
OF237B	FD1	X	X	X	X	X 9/26/05	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	FD30		X		X			X	X														
	FD31		X		X			X	X	X	X	X	X	X	X	X	X	X	X	X	pulled		
	FD32		X		X			X	X														
	FD33		X		X			X	X														
	FD34		X		X			X	X	X	X	X	X	X	X	X	X	X	X	pulled			
	FD35		X		X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	pulled
	FD36		X		X			X	X														
	FD37		X		X			X	X														
	FD38		X		X			X	X														
OF230	FD3NEW	X	X	X	X	X	X *	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	FD3	X	X	X	X	X	X *	X	X	X	X	X	X										
	FD3A/FD3C	X	X	X	X	X	X *	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X*	X*
	FD3B	X	Pulled	X	X	X	X *	X	X	X	X	X	X	X	X	X	X	X	X	pulled			
	FD16		Lost	X	X	X	X *	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	FD16B		X	X	X	X	X *	X	X	X	X	X	X										
	FD18		X	X	X	X	X *	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	FD18B		X	X	X	X	X *	X	X	X	X 1/24/11	X	X	X	X	X	X	X	X	X	pulled		
OF235	FD6	X	X	X	X	X	X *	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	FD6-A					X 10/7/05	X *	X	X	X	X	X	X										
	FD6-B					X 10/6/05	X *	X	X	X	X	X	X										
OF243	FD23	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
OF245	MH390	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	FD21	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
OF248	FD22	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

**FD3A removed on December 17, 2021 due to construction of new OF230A. Replace during WY2023 with FD3C in an upstream location but representing the same drainage basin.*

Table 2-2
Stormwater Summary Statistics, Before and After Line Cleaning

	TSS (mg/l)		Lead (ug/l)		Zinc (ug/l)		Phenanthrene (ug/l)		Pyrene (ug/l)		Indeno(1,2,3-c,d)pyrene (ug/l)		Bis(2EH)phthalate (ug/l)	
	Pre-Cleaning	Post-Cleaning	Pre-Cleaning	Post-Cleaning	Pre-Cleaning	Post-Cleaning	Pre-Cleaning	Post-Cleaning	Pre-Cleaning	Post-Cleaning	Pre-Cleaning	Post-Cleaning	Pre-Cleaning	Post-Cleaning
OF230*														
Count	49	145	50	150	50	150	50	150	50	150	50	150	49	150
Minimum	13.9	4.8	7.8	2.1	53.6	31.8	0.011	0.000	0.035	0.000	0.002	0.000	0.05	0.13
Median	49.5	26.8	22.6	8.2	120.0	71.7	0.143	0.026	0.307	0.041	0.102	0.014	5.00	1.51
Arithmetic Mean	61.3	44.4	28.9	14.3	136.7	98.1	0.181	0.040	0.368	0.067	0.110	0.025	5.66	2.37
Maximum	232.0	322.0	125.0	229.0	721.0	670.0	0.653	0.235	1.200	0.467	0.346	0.161	24.90	44.10
Standard Deviation	43.3	53.7	20.0	21.7	98.3	81.1	0.150	0.040	0.276	0.078	0.083	0.032	4.23	3.84
Standard Error	6.2	4.5	2.8	1.8	13.9	6.6	0.021	0.003	0.039	0.006	0.012	0.003	0.60	0.31
t-statistic	1.999		4.207		2.761		10.491		12.029		10.470		5.074	
p-value	0.024		<0.001		0.014		<0.001		<0.001		<0.001		<0.001	
Significant? (p < 0.05)	**Yes**		**Yes**		**Yes**		**Yes**		**Yes**		**Yes**		**Yes**	
Percent Reduction in Mean	**28%**		**51%**		**28%**		**78%**		**82%**		**77%**		**58%**	
OF235*														
Count	54	180	54	186	54	185	54	187	54	187	54	187	53	187
Minimum	10.4	5.6	23.2	2.5	37.3	34.3	0.012	0.001	0.034	0.003	0.001	0.000	0.31	0.37
Median	78.0	33.9	80.0	32.5	137.5	77.7	0.138	0.024	0.328	0.054	0.073	0.013	6.20	1.56
Arithmetic Mean	101.0	42.0	95.8	41.6	165.1	94.5	0.170	0.038	0.339	0.081	0.080	0.020	9.63	2.33
Maximum	441.0	247.0	368.0	204.0	475.0	598.0	0.479	0.689	1.010	0.854	0.280	0.145	97.00	19.30
Standard Deviation	77.8	33.4	57.0	25.9	95.3	63.4	0.108	0.058	0.215	0.090	0.056	0.022	13.45	2.43
Standard Error	10.6	2.5	7.8	1.9	13.0	4.7	0.015	0.004	0.029	0.007	0.008	0.002	1.85	0.18
t-statistic	8.034		9.928		6.362		11.844		13.012		11.951		7.061	
p-value	<0.001		<0.001		<0.001		<0.001		<0.001		<0.001		<0.001	
Significant? (p < 0.05)	**Yes**		**Yes**		**Yes**		**Yes**		**Yes**		**Yes**		**Yes**	
Percent Reduction in Mean	**58%**		**57%**		**43%**		**78%**		**76%**		**75%**		**76%**	
OF237B*														
Count	91	112	91	122	91	123	91	124	91	124	91	124	90	124
Minimum	3.6	7.8	1.5	1.4	15.0	15.9	0.001	0.001	0.010	0.000	0.000	0.000	0.09	0.03
Median	52.4	24.2	11.7	4.3	63.4	36.7	0.050	0.017	0.126	0.031	0.039	0.011	2.70	0.88
Arithmetic Mean	68.5	30.6	15.3	5.7	81.4	44.4	0.080	0.020	0.180	0.037	0.054	0.012	3.12	1.01
Maximum	278.0	107.0	64.2	23.8	243.0	285.0	0.838	0.078	1.493	0.190	0.546	0.046	12.00	2.95
Standard Deviation	51.5	20.6	11.6	4.4	49.9	30.4	0.105	0.013	0.212	0.028	0.071	0.010	2.61	0.60
Standard Error	5.4	1.9	1.2	0.4	5.2	2.7	0.011	0.001	0.022	0.002	0.007	0.001	0.28	0.05
t-statistic	7.124		8.349		6.704		6.369		7.448		6.450		8.724	
p-value	<0.001		<0.001		<0.001		<0.001		<0.001		<0.001		<0.001	
Significant? (p < 0.05)	**Yes**		**Yes**		**Yes**		**Yes**		**Yes**		**Yes**		**Yes**	
Percent Reduction in Mean	**55%**		**63%**		**45%**		**76%**		**80%**		**77%**		**68%**	
OF243* First Cleaning in 2021. Pre-cleaning: 2001 through August 29, 2021. Post-cleaning: November 25, 2021 to present														
Count	126	12	129	12	129	12	129	12	129	12	129	12	128	12
Minimum	4.4	6.2	0.1	2.3	12.3	28.3	0.002	0.012	0.012	0.016	0.000	0.002	0.01	0.40
Median	42.7	21.5	17.2	6.7	69.1	47.0	0.033	0.025	0.057	0.036	0.016	0.013	0.94	0.67
Arithmetic Mean	66.2	26.1	35.1	10.2	94.9	47.7	0.051	0.032	0.098	0.052	0.029	0.015	1.94	1.05
Maximum	300.0	76.7	379.0	45.9	1170.0	91.1	0.221	0.113	0.620	0.187	0.620	0.048	41.00	4.18
Standard Deviation	60.1	20.2	52.7	12.1	111.5	17.2	0.046	0.027	0.102	0.046	0.059	0.013	3.85	1.03
Standard Error	5.4	5.8	4.6	3.5	9.8	5.0	0.004	0.008	0.009	0.013	0.005	0.004	0.34	0.30
t-statistic	2.293		1.627		1.463		1.434		1.556		0.810		0.793	
p-value	<0.001		<0.001		<0.001		0.042		0.008		0.033		0.056	
Significant? (p < 0.05)	**Yes**		**Yes**		**Yes**		**Yes**		**Yes**		**Yes**		**No**	
Percent Reduction in Mean	**61%**		**71%**		**50%**		**38%**		**47%**		**48%**		**46%**	
OF245* First Cleaning in 2021. Pre-cleaning: 2001 through September 20, 2021. Post-cleaning: October 1, 2021 to present														
Count	182	19	188	20	187	20	186	20	186	20	186	20	184	20
Minimum	6.2	10.5	0.0	1.1	27.7	35.8	0.0	0.0	0.0	0.0	0.0	0.0	0.01	0.74
Median	51.5	25.5	8.2	2.5	112.0	54.4	0.0	0.0	0.1	0.0	0.0	0.0	1.38	0.98
Arithmetic Mean	62.8	30.6	10.2	2.9	138.3	62.7	0.1	0.0	0.1	0.0	0.0	0.0	2.41	1.05
Maximum	296.0	77.0	60.0	7.9	585.0	133.0	1.7	0.1	1.3	0.1	0.1	0.0	31.00	1.69
Standard Deviation	44.6	17.6	8.6	1.6	97.7	28.2	0.1	0.0	0.1	0.0	0.0	0.0	3.61	0.25
Standard Error	3.3	4.0	0.6	0.4	7.1	6.3	0.0	0.0	0.0	0.0	0.0	0.0	0.27	0.06
t-statistic	6.162		10.111		7.928		3.474		4.493		6.609		4.978	
p-value	<0.001		<0.001		<0.001		<0.001		<0.001		<0.001		<0.001	
Significant? (p < 0.05)	**Yes**		**Yes**		**Yes**		**Yes**		**Yes**		**Yes**		**Yes**	
Percent Reduction in Mean	**51%**		**72%**		**55%**		**57%**		**53%**		**58%**		**56%**	
First Cleaning in 2008. OF237A* Pre-cleaning: 2001 through April 28, 2008. Post-cleaning: August 8, 2008 through July 7, 2021														
Count	60	126	60	128	60	128	60	127	60	127	60	127	59	127
Minimum	3.5	5.3	1.7	1.4	41.8	30.6	0.005	0.002	0.035	0.005	0.005	0.002	0.50	0.20
Median	49.0	27.0	12.7	6.6	105.5	62.7	0.125	0.025	0.326	0.048	0.096	0.021	3.30	1.17
Arithmetic Mean	56.5	46.7	15.0	10.2	117.1	82.4	0.162	0.047	0.423	0.102	0.126	0.043	3.41	1.41
Maximum	281.0	668.0	43.2	80.6	361.0	352.0	0.893	0.831	2.930	1.730	0.680	0.578	13.70	5.48
Standard Deviation	41.0	72.6	8.4	11.5	52.7	58.1	0.159	0.093	0.446	0.197	0.130	0.071	2.50	0.93
Standard Error	5.3	6.5	1.1	1.0	6.8	5.1	0.021	0.008	0.058	0.017	0.017	0.006	0.32	0.08
t-statistic	3.503		5.305		5.758		9.136		11.058		7.263		6.634	
p-value	0.001		<0.001		<0.001		<0.001		<0.001		<0.001		<0.001	
Significant? (p < 0.05)	**Yes**		**Yes**		**Yes**		**Yes**		**Yes**		**Yes**		**Yes**	
Percent Reduction in Mean	**17%**		**32%**		**30%**		**71%**		**76%**		**66%**		**59%**	
Second Cleaning in 2021. OF237A* Pre-cleaning: August 8, 2008 through July 7, 2021. Post-cleaning: September 21, 2021 to present														
Count	126	20	128	21	128	21	127	21	127	21	127	21	127	21
Minimum	5.3	10.8	1.4	1.7	30.6	33.4	0.001	0.020	0.006	0.034	0.000	0.015	0.01	0.84
Median	27.0	32.9	6.6	5.5	62.7	58.0	0.026	0.041	0.048	0.095	0.021	0.044	1.18	1.40
Arithmetic Mean	46.7	38.5	10.2	6.5	82.4	65.4	0.048	0.054	0.102	0.117	0.043	0.065	1.42	1.51
Maximum	668.0	156.0	80.6	25.4	352.0	158.0	0.831	0.199	1.730	0.542	0.578	0.313	5.48	3.73
Standard Deviation	72.6	31.5	11.5	5.0	58.1	30.6	0.093	0.043	0.196	0.109	0.071	0.068	0.93	0.64
Standard Error	6.5	7.0	1.0	1.1	5.1	6.7	0.008	0.009	0.017	0.024	0.006	0.015	0.08	0.14
t-statistic	0.495		1.444		1.308		-0.298		-0.338		-1.333		-0.429	
p-value	0.311		0.075		0.096		0.617		0.632		0.908		0.666	
Significant? (p < 0.05)	**No**		**No**		**No**		**No**		**No**		**No**		**No**	
Percent Reduction in Mean	**18%**		**36%**		**21%**		--		--		--		--	
First Cleaned in 2006: OF254* Pre-cleaning: 2001 through January 26, 2006. Post-cleaning: June 15, 2006 through September 23, 2021														
Count	37	112	37	115	37	115	37	114	37	114	37	114	37	114
Minimum	5.2	14.3	4.2	1.6	73.7	38.9	0.018	0.002	0.086	0.002	0.012	0.002	0.50	0.14
Median	77.0	69.2	16.7	8.8	157.0	81.7	0.133	0.039	0.402	0.063	0.060	0.014	2.20	1.31
Arithmetic Mean	83.4	94.4	20.4	13.8	181.9	105.5	0.159	0.051	0.572	0.103	0.071	0.018	2.61	2.03
Maximum	240.0	354.0	49.5	68.0	427.0	334.0	0.657	0.283	4.120	0.773	0.239	0.110	6.60	10.20
Standard Deviation	48.2	74.4	10.7	12.7	83.1	62.8	0.116	0.047	0.654	0.131	0.042	0.020	1.73	2.02
Standard Error	7.9	7.0	1.8	1.2	13.7	5.9	0.019	0.004	0.108	0.012	0.007	0.002	0.28	0.19
t-statistic	-0.436		4.172		6.330		8.544		10.757		9.392		2.508	
p-value	0.663		<0.001		<0.001		<0.001		<0.001		<0.001		0.013	
Significant? (p < 0.05)	No		**Yes**		**Yes**		**Yes**		**Yes**		**Yes**		**Yes**	
Percent Reduction in Mean	--		**29%**		**41%**		**68%**		**82%**		**74%**		**21%**	
Second Cleaning in 2021. OF254* Pre-cleaning: June 15, 2006 through September 23, 2021. Post-cleaning: October 7, 2021 to present														
Count	112	10	115	10	115	10	114	10	114	10	114	10	114	10
Minimum	14.3	12.7	1.2	1.4	38.9	27.6	0.002	0.001	0.001	0.020	0.000	0.007	0.03	0.37
Median	69.2	48.4	8.8	4.9	81.7	59.8	0.039	0.034	0.063	0.058	0.014	0.015	1.30	1.05
Arithmetic Mean	94.4	52.5	13.8	4.8	105.5	55.7	0.051	0.029	0.103	0.063	0.018	0.014	2.01	0.98
Maximum	354.0	98.3	68.0	7.3	334.0	72.1	0.283	0.050	0.773	0.143	0.110	0.022	10.20	1.55
Standard Deviation	74.4	25.5	12.7	2.0	62.8	14.1	0.047	0.016	0.131	0.034	0.020	0.005	2.02	0.33
Standard Error	7.0	8.1	1.2	0.6	5.9	4.5	0.004	0.005	0.012	0.011	0.002	0.002	0.19	0.10
t-statistic	1.765		2.213		2.492		1.483		0.968		0.661		1.607	
p-value	0.040		0.014		0.007		0.070		0.167		0.255		0.055	
Significant? (p < 0.05)	**Yes**		**Yes**		**Yes**		No		No		No		No	
Percent Reduction in Mean	**44%**		**65%**		**47%**		43%		39%		23%		51%	

Notes:

**Following are the dates of the City's sewer-line cleaning activities:*

OF230: March 12 through May 14, 2007.

OF235: May 15 through June 25, 2007

OF237A: April 28 through August 8, 2008 (only the northern half of this drainage basin was cleaned), July 8 through Sept 20, 2021 (FS08 and FS04 497 acres cleaned (17%)).

OF237B: November 7, 2010 to February 24, 2011

OF243: August 31 through October 12, 2021. Will be evaluated in WY2022

OF245: September 21 through 23, 2021. Will be evaluated in WY2022

OF254: January 26 through June 14, 2006. September 24 through October 6, 2021.

**Any monitoring events within the window of cleaning activities were excluded from the analysis.*

OF237A location includes data from OF237A New sampling location for all data collected after to February 26, 2006.

Table 2-3.1
Stormwater Summary Statistics, Before and After Street Sweeping

	TSS (mg/l)		Lead (ug/l)		Zinc (ug/l)		Phenanthrene (ug/l)		Pyrene (ug/l)		Indeno(1,2,3-c,d)pyrene (ug/l)		Bis(2EH)phthalate (ug/l)	
	Pre-Sweeping	Post-Sweeping	Pre-Sweeping	Post-Sweeping	Pre-Sweeping	Post-Sweeping	Pre-Sweeping	Post-Sweeping	Pre-Sweeping	Post-Sweeping	Pre-Sweeping	Post-Sweeping	Pre-Sweeping	Post-Sweeping
Outfall 230*														
Count	41	144	41	150	41	150	41	150	41	150	41	150	40	150
Minimum	13.9	4.8	7.8	2.1	53.6	31.8	0.011	0.002	0.035	0.005	0.005	0.002	0.50	0.14
Median	49.5	26.9	24.4	8.4	122.0	72.7	0.157	0.026	0.316	0.042	0.102	0.014	4.55	1.56
Arithmetic Mean	64.9	44.8	30.4	14.8	141.1	98.8	0.192	0.042	0.383	0.073	0.112	0.028	5.65	2.47
Maximum	232.0	322.0	125.0	229.0	721.0	670.0	0.653	0.235	1.200	0.553	0.346	0.228	24.90	44.10
Standard Deviation	45.6	53.8	21.4	21.8	106.0	81.2	0.161	0.044	0.296	0.092	0.089	0.037	4.66	3.86
Standard Error	7.1	4.5	3.3	1.8	16.6	6.6	0.025	0.004	0.046	0.008	0.014	0.003	0.74	0.32
t-statistic	3.905		7.174		4.141		10.060		10.318		7.699		5.794	
p-value	<0.001		<0.001		<0.001		<0.001		<0.001		<0.001		<0.001	
Significant? (p < 0.05)	**Yes**		**Yes**		**Yes**		**Yes**		**Yes**		**Yes**		**Yes**	
Percent Reduction in Mean	**31%**		**51%**		**30%**		**78%**		**81%**		**75%**		**56%**	
Outfall 235*														
Count	44	183	44	189	44	188	44	190	44	190	44	190	43	190
Minimum	10.4	5.6	23.2	2.5	37.3	34.3	0.012	0.001	0.034	0.003	0.001	0.000	0.31	0.37
Median	81.8	34.6	81.5	32.7	135.0	78.7	0.147	0.024	0.355	0.055	0.078	0.014	6.24	1.60
Arithmetic Mean	107.6	43.1	99.5	42.0	169.5	95.4	0.178	0.042	0.359	0.089	0.083	0.022	10.11	2.37
Maximum	441.0	247.0	368.0	204.0	475.0	598.0	0.479	0.776	1.010	1.164	0.280	0.338	97.00	19.30
Standard Deviation	82.6	34.7	61.1	26.1	102.7	63.5	0.115	0.079	0.224	0.123	0.058	0.033	14.77	2.44
Standard Error	12.5	2.6	9.2	1.9	15.5	4.6	0.017	0.006	0.034	0.009	0.009	0.002	2.3	0.2
t-statistic	5.070		6.105		4.590		7.412		7.708		6.740		3.425	
p-value	<0.001		<0.001		<0.001		<0.001		<0.001		<0.001		0.001	
Significant? (p < 0.05)	**Yes**		**Yes**		**Yes**		**Yes**		**Yes**		**Yes**		**Yes**	
Percent Reduction in Mean	**60%**		**58%**		**44%**		**76%**		**75%**		**73%**		**77%**	
Outfall 237A*														
Count	43	159	43	161	43	161	43	160	43	160	43	160	42	160
Minimum	13.1	3.5	5.0	1.4	41.8	30.6	0.002	0.000	0.041	0.006	0.002	0.000	0.26	0.01
Median	51.0	29.3	13.3	6.6	102.0	63.0	0.125	0.028	0.342	0.056	0.102	0.024	2.61	1.32
Arithmetic Mean	52.5	48.0	14.3	10.5	113.0	83.4	0.163	0.057	0.407	0.133	0.118	0.053	3.34	1.58
Maximum	120.0	668.0	31.5	80.6	238.0	352.0	0.893	0.831	1.770	2.930	0.669	0.680	13.70	7.90
Standard Deviation	23.3	69.3	6.8	11.5	41.8	56.0	0.148	0.108	0.327	0.296	0.116	0.089	2.70	1.15
Standard Error	3.5	5.5	1.0	0.9	6.4	4.4	0.023	0.009	0.050	0.023	0.018	0.007	0.42	0.09
t-statistic	0.681		2.822		3.808		4.409		4.979		3.384		4.142	
p-value	0.497		0.006		<0.001		<0.001		<0.001		0.001		<0.001	
Significant? (p < 0.05)	No		**Yes**		**Yes**		**Yes**		**Yes**		**Yes**		**Yes**	
Percent Reduction in Mean	8.5%		**27%**		**26%**		**65%**		**67%**		**55%**		**53%**	
Outfall 237B*														
Count	44	158	44	168	44	169	44	170	44	170	44	170	43	170
Minimum	7.5	3.6	3.8	1.4	31.3	15.0	0.001	0.001	0.028	0.000	0.000	0.000	0.49	0.01
Median	57.7	29.4	14.3	5.2	69.7	40.7	0.093	0.017	0.246	0.032	0.061	0.011	3.00	0.95
Arithmetic Mean	76.3	40.3	17.9	7.8	92.4	52.1	0.103	0.029	0.240	0.056	0.067	0.019	3.89	1.32
Maximum	278.0	211.0	64.2	54.8	232.0	285.0	0.423	0.838	0.972	1.493	0.277	0.546	12.00	8.70
Standard Deviation	55.7	36.0	12.6	7.6	54.3	37.6	0.072	0.067	0.175	0.125	0.052	0.046	3.02	1.25
Standard Error	8.4	2.9	1.9	0.6	8.2	2.9	0.011	0.005	0.026	0.010	0.008	0.004	0.46	0.10
t-statistic	4.050		5.084		4.647		6.159		6.537		5.482		5.458	
p-value	<0.001		<0.001		<0.001		<0.001		<0.001		<0.001		<0.001	
Significant? (p < 0.05)	**Yes**		**Yes**		**Yes**		**Yes**		**Yes**		**Yes**		**Yes**	
Percent Reduction in Mean	**47%**		**56%**		**44%**		**72%**		**77%**		**71%**		**66%**	
Outfall 243[*ab] Note: Includes comparison of Standard Sweeping schedule in place prior to 2006 to enhanced schedule implemented from January 2007 through September 2013. New, increased street sweeping frequency in this area started in October 2013 at locations 243 and 245 and a comparison of those results is provided on Table 2-3.2.														
Count	32	37	32	38	32	38	32	38	32	38	32	38	31	38
Minimum	10.7	4.4	9.7	1.4	51.1	19.6	0.023	0.006	0.033	0.012	0.004	0.000	0.11	0.02
Median	58.4	49.0	27.1	28.3	99.9	67.7	0.098	0.019	0.163	0.039	0.033	0.006	3.10	0.59
Arithmetic Mean	69.4	78.8	46.5	52.1	147.2	94.7	0.100	0.030	0.180	0.070	0.041	0.019	3.26	1.93
Maximum	220.0	300.0	353.0	379.0	1170.0	392.0	0.221	0.116	0.620	0.452	0.121	0.113	8.40	41.00
Standard Deviation	50.2	72.3	61.5	70.0	193.8	76.1	0.055	0.028	0.124	0.096	0.029	0.031	2.19	6.58
Standard Error	8.9	11.9	10.9	11.4	34.3	12.3	0.010	0.004	0.022	0.016	0.005	0.005	0.39	1.07
t-statistic	-0.631		-0.354		1.442		6.597		4.059		3.014		1.166	
p-value	0.530		0.724		0.157		<0.001		<0.001		0.004		0.250	
Significant? (p < 0.05)	No		No		No		**Yes**		**Yes**		**Yes**		**No**	
Percent Reduction in Mean	--		**--**		36%		**70%**		**61%**		**53%**		**41%**	
Outfall 245[*a] Note: Includes comparison of Standard Sweeping schedule in place prior to 2006 to enhanced schedule implemented from January 2007 through September 2013. New, increased street sweeping frequency in this area started in October 2013 at locations 243 and 245 and a comparison of those results is provided on Table 2-3.2.														
Count	41	57	41	61	41	60	41	60	41	60	41	60	40	59
Minimum	17.6	6.2	2.7	2.1	54.8	27.7	0.019	0.002	0.026	0.003	0.002	0.000	0.37	0.01
Median	72.4	51.2	12.2	9.2	146.0	135.0	0.083	0.025	0.123	0.026	0.025	0.005	3.40	0.93
Arithmetic Mean	83.8	58.2	14.8	11.5	186.9	160.5	0.136	0.043	0.162	0.056	0.026	0.010	5.57	1.43
Maximum	243.0	186.0	38.8	60.0	585.0	498.0	1.650	0.477	1.310	0.295	0.057	0.051	31.00	6.90
Standard Deviation	52.9	39.4	8.5	10.1	122.8	107.6	0.256	0.065	0.200	0.070	0.014	0.012	6.55	1.42
Standard Error	8.3	5.2	1.3	1.3	19.2	13.9	0.040	0.008	0.031	0.009	0.002	0.002	1.04	0.18
t-statistic	2.625		1.142		1.114		2.268		3.250		5.704		3.927	
p-value	0.011		0.046		0.269		0.028		0.002		<0.001		<0.001	
Significant? (p < 0.05)	**Yes**		**Yes**		No		**Yes**		**Yes**		**Yes**		**Yes**	
Percent Reduction in Mean	**31%**		**22%**		14%		**68%**		**65%**		**61%**		**74%**	
Outfall 254[*] Note: Includes comparison of Standard Sweeping schedule in place prior to 2019. New, increased street sweeping frequency in a portion of the 254 basin started in January 2019 and a comparison of those results is provided on Table 2-3.2.														
Count	35	88	35	90	35	90	35	90	35	90	35	90	35	90
Minimum	5.2	14.3	8.6	1.2	73.7	38.9	0.018	0.002	0.086	0.001	0.012	0.001	0.07	0.03
Median	78.8	80.8	17.3	11.0	179.0	89.3	0.133	0.034	0.402	0.059	0.060	0.013	2.32	1.31
Arithmetic Mean	86.0	102.7	21.0	15.6	186.6	111.8	0.161	0.051	0.584	0.104	0.073	0.019	2.66	2.15
Maximum	240.0	354.0	49.5	68.0	427.0	334.0	0.657	0.283	4.120	0.773	0.239	0.110	6.60	10.20
Standard Deviation	48.0	80.2	10.6	13.6	83.0	65.1	0.118	0.050	0.670	0.143	0.042	0.022	1.79	2.23
Standard Error	8.1	8.6	1.8	1.4	14.0	6.9	0.020	0.005	0.113	0.015	0.007	0.002	0.30	0.23
t-statistic	-1.409		2.366		4.788		5.333		4.196		7.259		1.330	
p-value	0.162		0.020		<0.001		<0.001		<0.001		<0.001		0.188	
Significant? (p < 0.05)	No		**Yes**		**Yes**		**Yes**		**Yes**		**Yes**		**No**	
Percent Reduction in Mean	--		**26%**		**40%**		**69%**		**82%**		**74%**		**19%**	

Notes:

**Street sweeping program started in January 2006 and was in full swing by January 2007. Any monitoring events within the startup window (1/1/06 to 1/1/07) were excluded from the analysis.*
237A location includes data from 237A New sampling location for all data collected after to 2/26/06.

[a] Includes comparison of Standard Sweeping schedule to enhanced schedule implemented from January 2007 through September 2013. New increased street sweeping frequency started in October 2013 at locations 243 and 245 and those results are shown on Table 2-3.2.

[b] Indeno(1,2,3-cd)pyrene value of 0.62 ug/l on 11/15/2016 was excluded from this analysis as an outlier.

Table 2-3.2

Stormwater Summary Statistics, Before and After Street Sweeping - Enhanced[a]

	TSS (mg/l)		Lead (ug/l)		Zinc (ug/l)		Phenanthrene (ug/l)		Pyrene (ug/l)		Indeno(1,2,3-c,d)pyrene (ug/l)		Bis(2EH)phthalate (ug/l)	
	Sweeping	Enh Sweeping	Sweeping	Enh Sweeping	Sweeping	Enh Sweeping	Sweeping	Enh Sweeping	Sweeping	Enh Sweeping	Sweeping	Enh Sweeping	Sweeping	Enh Sweeping
Outfall 243[ab]														
Count	37	67	38	69	38	69	38	69	38	69	38	69	38	69
Minimum	4.4	6.2	1.4	0.1	19.6	12.3	0.006	0.002	0.012	0.012	0.000	0.000	0.02	0.01
Median	49.0	33.1	28.3	9.8	67.7	51.9	0.019	0.028	0.039	0.047	0.006	0.014	0.59	0.81
Arithmetic Mean	78.8	49.1	52.1	16.1	94.7	61.2	0.030	0.032	0.070	0.059	0.019	0.024	1.93	1.07
Maximum	300.0	289.0	379.0	115.0	392.0	233.0	0.116	0.113	0.452	0.293	0.113	0.620	41.00	4.18
Standard Deviation	72.3	52.2	70.0	19.4	76.1	33.0	0.028	0.018	0.096	0.045	0.031	0.074	6.58	0.82
Standard Error	11.9	6.4	11.4	2.3	12.3	4.0	0.004	0.002	0.016	0.005	0.005	0.009	1.07	0.10
t-statistic	2.412		4.018		3.169		-0.649		0.865		-0.415		1.077	
p-value	0.009		<0.001		0.001		0.741		0.195		0.661		0.142	
Significant? (p < 0.05)	**Yes**		**Yes**		**Yes**		No		No		**No**		No	
Percent Reduction in Mean	**38%**		**69%**		**35%**		--		**17%**		--		**45%**	
	TSS (mg/l)		**Lead (ug/l)**		**Zinc (ug/l)**		**Phenanthrene (ug/l)**		**Pyrene (ug/l)**		**Indeno(1,2,3-c,d)pyrene (ug/l)**		**Bis(2EH)phthalate (ug/l)**	
	Sweeping	Enh Sweeping	Sweeping	Enh Sweeping	Sweeping	Enh Sweeping	Sweeping	Enh Sweeping	Sweeping	Enh Sweeping	Sweeping	Enh Sweeping	Sweeping	Enh Sweeping
Outfall 245[a]														
Count	57	94	61	97	60	97	60	96	60	96	60	96	59	96
Minimum	6.2	10.0	2.1	0.0	27.7	29.4	0.002	0.001	0.003	0.011	0.000	0.000	0.01	0.26
Median	51.2	41.0	9.2	4.7	135.0	79.5	0.025	0.030	0.026	0.044	0.005	0.007	0.93	1.22
Arithmetic Mean	58.2	49.0	11.5	5.6	160.5	87.8	0.043	0.032	0.056	0.050	0.010	0.009	1.43	1.33
Maximum	186.0	296.0	60.0	33.8	498.0	306.0	0.477	0.105	0.295	0.173	0.051	0.026	6.90	3.39
Standard Deviation	39.4	38.6	10.1	4.4	107.6	48.0	0.065	0.018	0.070	0.028	0.012	0.006	1.42	0.64
Standard Error	5.2	4.0	1.3	0.4	13.9	4.9	0.008	0.002	0.009	0.003	0.002	0.001	0.18	0.07
t-statistic	1.409		5.024		5.795		1.648		0.757		0.889		0.617	
p-value	0.081		<0.001		<0.001		0.051		0.225		0.188		0.269	
Significant? (p < 0.05)	No		**Yes**		**Yes**		No		No		No		No	
Percent Reduction in Mean	16%		**51%**		**45%**		**27%**		11%		13%		7.19%	
	TSS (mg/l)		**Lead (ug/l)**		**Zinc (ug/l)**		**Phenanthrene (ug/l)**		**Pyrene (ug/l)**		**Indeno(1,2,3-c,d)pyrene (ug/l)**		**Bis(2EH)phthalate (ug/l)**	
	Sweeping	Enh Sweeping	Sweeping	Enh Sweeping	Sweeping	Enh Sweeping	Sweeping	Enh Sweeping	Sweeping	Enh Sweeping	Sweeping	Enh Sweeping	Sweeping	Enh Sweeping
Outfall 254[c]														
Count	88	32	90	33	90	33	90	32	90	32	90	32	90	32
Minimum	14.3	12.7	1.2	1.3	38.9	27.6	0.002	0.001	0.001	0.020	0.001	0.000	0.03	0.37
Median	80.8	56.9	11.0	5.4	89.3	63.4	0.034	0.039	0.059	0.068	0.013	0.015	1.31	1.14
Arithmetic Mean	102.7	56.9	15.6	5.8	111.8	66.2	0.051	0.040	0.104	0.077	0.019	0.014	2.15	1.30
Maximum	354.0	128.0	68.0	13.0	334.0	135.0	0.283	0.106	0.773	0.203	0.110	0.029	10.20	3.18
Standard Deviation	80.2	26.4	13.6	2.7	65.1	20.6	0.050	0.021	0.143	0.039	0.022	0.007	2.23	0.61
Standard Error	8.6	4.7	1.4	0.5	6.9	3.6	0.005	0.004	0.015	0.007	0.002	0.001	0.23	0.11
t-statistic	3.155		4.076		3.935		1.140		1.048		1.123		2.127	
p-value	0.001		<0.001		<0.001		0.128		0.148		0.132		0.018	
Significant? (p < 0.05)	**Yes**		**Yes**		**Yes**		No		No		No		**Yes**	
Percent Reduction in Mean	**45%**		**63%**		**41%**		21%		26%		24%		**40%**	

Notes:

[a] *Provides a comparison of sweeping schedule in place from January 2007 through September 2013 to the new street sweeping frequency started in October 2013 at locations 243 and 245 and continuing through 2023.*

[b] *Indeno(1,2,3-cd)pyrene value of 0.62 ug/l on 11/15/2016 was excluded from this analysis as an outlier.*

[c] *Provides a comparison of sweeping schedule in place from January 2007 through December 2019 to the new street sweeping frequency started in January 2019 in a portion of 254 Basin and continuing through 2023.*

Table 3-1
Total Rain Depth (Inches) During Past and Present Monitoring Years

		WY2002	WY2003	WY2004	WY2005	WY2006	WY2007	WY2008	WY2009	WY2010	WY2011	WY2012	WY2013	WY2014	WY2015	WY2016	WY2017	WY2018	WY2019	WY2020	WY2021	WY2022	WY2023	WY2002 -WY2023 Average	Historical Monthly	
																									Mean NCDC 1971-2000	Mean NCDC 1981 - 2010
WET	October	3.32	0.41	8.88	3.61	3.00	1.28	3.64	2.36	4.18	4.64	3.39	5.97	1.57	6.20	5.92	10.57	5.60	3.89	3.66	3.06	5.03	2.03	4.19	3.39	3.70
	November	10.13	2.96	6.15	2.81	6.25	15.81	2.64	7.61	7.74	5.37	5.98	7.12	3.40	6.53	8.22	7.57	9.38	4.15	1.85	5.41	10.54	5.64	6.51	6.10	6.68
	December	6.82	6.58	4.65	4.03	6.28	8.05	8.36	4.03	2.67	6.83	6.44	8.33	1.91	4.88	12.22	3.66	5.74	6.93	7.36	5.64	5.55	6.98	6.09	5.89	5.52
	January	6.68	8.5	6.79	4.71	11.93	6.92	4.63	7.15	7.40	5.17	7.02	3.31	4.29	3.98	7.20	2.99	7.90	3.70	9.66	8.65	7.28	2.80	6.30	5.38	5.93
	February	3.56	1.71	2.55	0.79	2.59	4.09	2.84	1.61	3.95	3.54	3.19	1.58	7.68	4.61	5.55	9.24	2.75	4.19	3.35	4.00	3.56	1.79	3.58	4.44	3.86
	March	4.16	5.08	2.18	3.14	1.91	6.09	4.16	4.68	4.91	6.57	7.11	2.50	8.81	3.89	5.80	8.27	2.15	1.86	3.47	2.06	3.10	2.52	4.29	4.18	4.06
	April	3.64	3.3	0.91	4.74	2.46	1.34	1.76	3.31	2.90	5.13	3.74	4.52	4.22	1.56	1.37	4.67	5.81	2.65	1.24	0.85	3.34	3.49	3.04	2.87	3.00
DRY	May	1.14	0.55	2.56	3.34	1.56	1.31	1.01	3.03	4.15	3.77	2.33	2.86	3.23	0.74	0.58	2.02	0.09	0.46	2.49	1.29	3.04	0.62	1.92	2.01	2.11
	June	1.36	0.36	0.64	1.26	2.25	1.44	1.26	0.33	3.05	1.40	2.54	1.85	0.94	0.22	1.41	1.54	0.69	0.19	1.90	1.85	2.72	0.32	1.34	1.58	1.57
	July	0.42	0.13	0.00	1.16	0.11	1.30	0.26	0.00	0.78	0.74	0.87	0.01	0.57	0.47	0.61	0.00	0.02	0.77	0.20	0.00	0.19	0.11	0.40	0.86	0.68
	August	0.06	0.29	2.75	0.04	0.00	0.90	2.32	1.04	0.24	0.27	0.00	1.05	1.72	2.21	0.10	0.09	0.10	1.19	0.42	0.05	0.57	0.26	0.71	0.83	0.82
	September	0.36	0.69	3.26	0.92	0.74	2.22	0.39	2.82	3.93	0.96	0.02	8.29	2.26	1.12	1.13	1.11	1.54	2.69	2.30	3.20	0.00	2.49	1.93	1.42	1.29
	Wet Season	38.31	28.54	32.11	23.83	34.42	43.58	28.03	30.75	33.75	37.25	36.87	33.33	31.88	31.65	46.28	46.97	39.33	27.37	30.59	29.67	38.40	25.25	34.01	32.25	32.75
	Dry Season	3.34	2.02	9.21	6.72	4.66	7.17	5.24	7.22	12.15	7.14	5.76	14.06	8.72	4.76	3.83	4.76	2.44	5.30	7.31	6.39	6.52	3.80	6.30	6.70	6.47
	Total	41.65	30.56	41.32	30.55	39.08	50.75	33.27	37.97	45.90	44.39	42.63	47.39	40.60	36.41	50.11	51.73	41.77	32.67	37.90	36.06	44.92	29.05	40.30	38.95	39.22

Key:

	Months	***Seasons/Years***
(dark green)	*> 2" above historical monthly average*	*> 8" above historical seasonal/yearly average*
(light green)	*> 1" above historical monthly average*	*> 4" above historical seasonal/yearly average*
(white)	*≤ 1" above/below historical monthly average*	*≤ 4" above/below historical seasonal/yearly average*
(yellow)	*> 1" below historical monthly average*	*> 4" below historical seasonal/yearly average*
(orange)	*> 2" below historical monthly average*	*> 8" below historical seasonal/yearly average*

Table 3-2.1
Summary Statistics for WY2001-WY2011 Baseflow

	Overall Data						OF230				OF235				OF237A				OF237B				OF243				OF245				OF254			
	Overall Detections	% Detections	Arithmetic Mean	Weighted Mean	Max	Date of Max	Min	Max	Arithmetic Mean	Median	Min	Max	Arithmetic Mean	Median	Min	Max	Arithmetic Mean	Median	Min	Max	Arithmetic Mean	Median	Min	Max	Arithmetic Mean	Median	Min	Max	Arithmetic Mean	Median	Min	Max	Arithmetic Mean	Median
Conventionals																																		
Hardness (mg/L as CaCO3)	281/281	100		N/A	N/A	N/A	27.9	249	144	142	123	199	155	149	85.4	134	105	105	61	129	111	113	463	2,310	1418	1,345	136	2,880	874	808	386	4,410	2799	3,030
pH (pH units)	296/296	100		N/A	N/A	N/A	6.8	9.0	7.7	7.7	7.1	8.0	7.7	7.7	6.8	7.8	7.4	7.4	5.9	8.0	7.2	7.3	6.6	7.8	7.1	7.1	7.1	8.0	7.4	7.4	6.7	7.6	7.1	7.2
TSS (mg/L)	273/295	93	12.29	12.2	319	3/12/09	0.26	319	15.8	5.90	0.31	258	25.4	6.85	0.26	16.3	3.08	2.1	0.26	16.9	2.54	1.3	1.5	42.7	13.6	10.7	0.3	78.9	9.6	6.40	1.8	140	16.1	7.7
Metals in ug/L																																		
Lead	209/289	72	5.52	5.53	112	8/7/06	0.97	29.8	5.56	4.0	1.64	112	14.29	6.5	0.06	6.11	1.21	0.70	0.07	6.6	0.99	0.60	0.385	43.9	7.56	3.99	0.13	18.2	3.30	1.65	0.24	39.0	5.75	2.9
Mercury	18/293	6	0.03	0.03	0.38	7/26/04	0.025	0.250	0.036	0.025	0.025	0.38	0.041	0.025	0.025	0.196	0.031	0.025	0.025	0.025	0.025	0.025	0.025	0.075	0.029	0.025	0.025	0.125	0.029	0.025	0.025	0.055	0.026	0.025
Zinc	283/286	99	46.55	47.5	1,950	8/28/07	19.3	108	46.6	34.0	6.6	355	41.9	17.20	1.65	27.0	9.5	9.3	1.05	14.2	4.43	3.7	5.3	73.6	21.60	15.4	11.8	1,950	174.1	52.3	7.24	95.2	27.7	23.6
Dissolved Lead	169/288	59	2.88	2.86	47.2	8/28/07	0.140	5.5	1.52	1.25	0.210	6.0	1.56	1.10	0.051	4.5	0.81	0.60	0.016	4.0	0.83	0.65	0.013	35.6	5.38	2.13	0.007	18.9	2.80	0.80	0.013	47.2	7.26	2.10
Dissolved Mercury	9/289	3	0.028	0.03	0.193	7/27/04	0.025	0.059	0.031	0.025	0.025	0.025	0.025	0.025	0.025	0.135	0.031	0.025	0.025	0.025	0.025	0.025	0.025	0.193	0.030	0.025	0.025	0.125	0.029	0.025	0.025	0.114	0.028	0.025
Dissolved Zinc	274/286	96	25.3	25.9	1,220	8/28/07	6.42	95.0	29.15	24.4	3.80	29.9	10.78	9.24	2.30	12.6	7.7	7.4	0.60	14.3	4.6	3.7	0.130	45.8	12.3	8.9	0.600	1,220	91.4	20.9	0.325	54.7	21.3	16.3
PAHs in ug/L																																		
2-Methylnaphthalene	55/297	19	0.015	0.015	2.100	2/12/02	0.002	0.122	0.013	0.005	0.002	0.023	0.006	0.005	0.002	2.100	0.063	0.005	0.002	0.019	0.005	0.005	0.002	0.006	0.004	0.005	0.002	0.018	0.005	0.005	0.002	0.022	0.006	0.005
Acenaphthene	124/297	42	0.014	0.014	0.103	11/21/02	0.002	0.013	0.005	0.005	0.002	0.032	0.011	0.012	0.002	0.031	0.005	0.005	0.002	0.005	0.004	0.005	0.005	0.069	0.030	0.028	0.002	0.103	0.031	0.026	0.002	0.096	0.012	0.005
Acenaphthylene	7/297	2	0.004	0.004	0.019	7/17/08	0.002	0.005	0.004	0.005	0.002	0.005	0.004	0.005	0.002	0.016	0.004	0.005	0.002	0.005	0.004	0.005	0.002	0.005	0.004	0.005	0.002	0.008	0.004	0.005	0.002	0.019	0.005	0.005
Anthracene	36/297	12	0.006	0.006	0.077	7/17/05	0.002	0.012	0.004	0.005	0.002	0.031	0.006	0.005	0.002	0.005	0.004	0.005	0.002	0.005	0.004	0.005	0.002	0.022	0.007	0.005	0.002	0.014	0.006	0.005	0.002	0.077	0.008	0.005
Fluorene	56/291	19	0.006	0.006	0.086	2/12/02	0.002	0.012	0.005	0.005	0.002	0.060	0.009	0.005	0.002	0.086	0.007	0.005	0.002	0.005	0.004	0.005	0.002	0.013	0.005	0.005	0.002	0.017	0.006	0.005	0.002	0.060	0.008	0.005
Naphthalene	139/297	47	0.023	0.023	3.000	2/12/02	0.005	0.228	0.026	0.014	0.003	0.054	0.011	0.009	0.002	3.000	0.088	0.010	0.002	0.025	0.007	0.005	0.001	0.017	0.007	0.006	0.003	0.057	0.011	0.009	0.002	0.034	0.008	0.005
Phenanthrene	134/297	45	0.013	0.013	0.684	7/17/05	0.002	0.060	0.012	0.011	0.002	0.115	0.014	0.005	0.002	0.149	0.011	0.005	0.002	0.008	0.004	0.005	0.002	0.057	0.011	0.005	0.002	0.028	0.011	0.008	0.002	0.684	0.028	0.005
Total LPAHs[1,2]	496/1776	28	0.066	0.011	3.276	N/A	0.016	0.270	0.056	0.043	0.013	0.206	0.056	0.045	0.010	3.276	0.119	0.031	0.011	0.050	0.028	0.030	0.025	0.151	0.065	0.061	0.013	0.181	0.068	0.064	0.010	0.898	0.068	0.030
Benzo(a)anthracene	72/297	24	0.012	0.012	1.110	1/13/09	0.001	0.066	0.007	0.005	0.001	0.114	0.013	0.005	0.001	0.022	0.006	0.005	0.001	0.045	0.005	0.005	0.001	0.055	0.008	0.005	0.001	0.021	0.006	0.005	0.001	1.110	0.043	0.005
Benzo(a)pyrene	42/297	14	0.007	0.007	0.142	1/24/06	0.002	0.057	0.006	0.005	0.002	0.142	0.013	0.005	0.002	0.020	0.006	0.005	0.002	0.041	0.005	0.005	0.002	0.042	0.007	0.005	0.002	0.048	0.006	0.005	0.002	0.131	0.010	0.005
Benzo(g,h,i)perylene	52/297	18	0.007	0.007	0.166	8/7/06	0.002	0.023	0.007	0.005	0.002	0.166	0.012	0.005	0.002	0.022	0.006	0.005	0.002	0.044	0.006	0.005	0.002	0.046	0.008	0.005	0.002	0.033	0.006	0.005	0.002	0.055	0.008	0.005
Benzo(b,k)fluoranthenes	115/297	39	0.015	0.015	0.376	7/17/05	0.002	0.113	0.013	0.007	0.002	0.344	0.026	0.006	0.002	0.047	0.011	0.005	0.002	0.107	0.008	0.005	0.002	0.105	0.013	0.005	0.002	0.062	0.009	0.005	0.002	0.376	0.027	0.013
Chrysene	76/297	26	0.011	0.011	0.362	3/12/09	0.002	0.087	0.010	0.005	0.002	0.199	0.018	0.005	0.002	0.026	0.006	0.005	0.002	0.060	0.005	0.005	0.002	0.098	0.011	0.005	0.002	0.063	0.008	0.005	0.002	0.362	0.020	0.005
Dibenz(a,h)anthracene	14/297	5	0.005	0.005	0.028	8/7/06	0.002	0.011	0.005	0.005	0.002	0.028	0.005	0.005	0.002	0.010	0.005	0.005	0.002	0.011	0.005	0.005	0.002	0.012	0.005	0.005	0.002	0.013	0.005	0.005	0.002	0.017	0.005	0.005
Fluoranthene	177/297	60	0.021	0.021	1.140	3/12/09	0.003	0.133	0.017	0.011	0.003	0.295	0.029	0.012	0.002	0.046	0.010	0.005	0.003	0.088	0.007	0.005	0.003	0.133	0.022	0.015	0.003	0.046	0.013	0.011	0.003	1.140	0.051	0.013
Indeno(1,2,3-c,d)pyrene	32/297	11	0.006	0.006	0.115	8/7/06	0.002	0.019	0.005	0.005	0.002	0.115	0.009	0.005	0.002	0.018	0.005	0.005	0.002	0.039	0.005	0.005	0.002	0.034	0.006	0.005	0.002	0.018	0.005	0.005	0.002	0.053	0.007	0.005
Pyrene	234/297	79	0.026	0.026	0.879	7/17/05	0.004	0.173	0.021	0.015	0.003	0.253	0.034	0.018	0.002	0.056	0.013	0.005	0.002	0.078	0.007	0.005	0.005	0.116	0.030	0.021	0.004	0.081	0.024	0.023	0.002	0.879	0.051	0.022
Total HPAHs[1]	814/2673	30	0.112	0.012	3.287	N/A	0.025	0.671	0.091	0.060	0.025	1.639	0.162	0.068	0.022	0.249	0.067	0.045	0.022	0.513	0.052	0.045	0.031	0.606	0.109	0.072	0.029	0.368	0.081	0.073	0.024	3.287	0.222	0.078
Total PAHs[1]	1310/4449	29	0.178	0.012	4.185	N/A	0.041	0.840	0.147	0.121	0.038	1.845	0.217	0.116	0.034	3.464	0.186	0.087	0.033	0.543	0.081	0.075	0.055	0.757	0.174	0.133	0.042	0.436	0.149	0.141	0.034	4.185	0.290	0.116
Phthalates in ug/L																																		
Bis(2-ethylhexyl)phthalate	85/290	29	1.07	1.06	33.0	3/23/10	0.26	33.00	2.00	0.50	0.20	21.30	1.84	0.72	0.20	1.60	0.56	0.50	0.20	0.80	0.50	0.50	0.20	16.00	1.03	0.50	0.20	3.30	0.72	0.50	0.08	10.00	0.82	0.50
Butylbenzylphthalate	29/297	10	0.56	0.56	16.0	7/28/04	0.09	0.70	0.39	0.50	0.09	1.60	0.44	0.50	0.09	0.50	0.37	0.50	0.05	0.50	0.36	0.50	0.09	1.80	0.43	0.50	0.09	16.00	1.49	0.50	0.09	1.40	0.41	0.50
Diethylphthalate	65/297	22	0.92	0.92	32.0	2/5/03	0.07	8.40	0.69	0.50	0.04	15.00	0.91	0.50	0.04	32.00	1.99	0.50	0.04	17.00	0.99	0.50	0.05	10.00	0.71	0.50	0.04	4.40	0.65	0.50	0.04	3.80	0.48	0.50
Dimethylphthalate	2/297	1	0.36	0.36	0.5	N/A	0.02	0.50	0.36	0.50	0.02	0.50	0.36	0.50	0.02	0.50	0.35	0.50	0.02	0.50	0.35	0.50	0.02	0.50	0.38	0.50	0.02	0.50	0.35	0.50	0.02	0.50	0.36	0.50
Di-n-butylphthalate	59/297	20	0.43	0.43	4.3	3/23/10	0.10	0.50	0.40	0.50	0.05	0.50	0.40	0.50	0.05	0.50	0.41	0.50	0.05	0.50	0.39	0.50	0.05	4.30	0.55	0.50	0.15	1.30	0.46	0.50	0.05	0.50	0.40	0.50
Di-n-octyl phthalate	5/297	2	0.38	0.38	3.9	7/26/04	0.04	2.00	0.40	0.50	0.04	3.90	0.44	0.50	0.04	0.50	0.35	0.50	0.04	0.50	0.35	0.50	0.04	0.50	0.37	0.50	0.04	0.50	0.36	0.50	0.04	0.50	0.36	0.50
Total Phthalates[3]	245/1782	14			33.4	N/A	0.23	33.40	4.44	0.94	0.12	22.90	4.06	1.60	0.20	32.00	4.60	1.00	0.20	32.10	5.28	1.21	0.10	22.87	3.14	1.10	0.21	18.70	3.91	1.30	0.22	13.80	2.21	1.27

Notes:

1 = PAH summations based on 1/2 detection limit for nondetects.

2 = Calculation of Total LPAHs does not include 2-Methylnaphthalene.

3 = Phthalate summations exclude nondetect values.

OF237Anew isn't included in the count of samples.

Highest average or highest median concentration detected in Years 1-10 monitoring.

Highest maximum concentration detected in Years 1-10 monitoring.

Results in italics indicate nondetected values.

Table 3-2.2
Summary Statistics for WY2016 and WY2019 Baseflow

	Overall Data						OF230					OF235					OF237A					OF237B					OF243					OF245/254				
	Overall Detections	% Detections	Arithmetic Mean	Weighted Mean	Max	Date of Max	Min	Max	Arithmetic Mean	Weighted Mean	Median	Min	Max	Arithmetic Mean	Weighted Mean	Median	Min	Max	Arithmetic Mean	Weighted Mean	Median	Min	Max	Arithmetic Mean	Weighted Mean	Median	Min	Max	Arithmetic Mean	Weighted Mean	Median	Min	Max	Arithmetic Mean	Weighted Mean	Median
Conventionals																																				
Anionic Surfactants - MBAS (ug/L)	30/40	75	0.03	0.0	0.0962	7/26/16	0.0125	0.0464	0.0302	0.151	0.0327	0.005	0.054	0.0309	0.216	0.029	0.0048	0.0466	0.02	0.194	0.0125	0.0125	0.0299	0.02	0.112	0.0169	0.0267	0.0962	0.06	0.424	0.0586	0.0251	0.0553	0.043	0.2	0.0468
BOD (mg/L)	3/39	8	1.24	1.0	6.20	6/21/19	1.0	4.9	1.8	8.9	1.0	1.0	1.0	1.0	7.0	1.0	1.0	1.0	1.0	9.0	1.0	1.0	3.6	1.4	8.6	1.0	1.0	1.0	1.0	7.0	1.0	1.0	6.2	2.0	10.2	1.0
Chloride (mg/L)	38/38	100	N/A	N/A	N/A	N/A	13.3	44.4	21.6	108	17.2	15.8	50.4	27.3	163.9	22.3	11.5	21.3	16.3	163.3	15.95	8.6	90.6	25.3	126.3	9.13	2490	13100	8143	57000	8080	18.2	13900	4485	22,423.1	3980
Conductivity (uS/cm)	44/44	100	N/A	N/A	N/A	N/A	126	20900	3202	22413	248	323	714	419	2934	337	304	423	347.6	3476	334.5	261	281	272.0	1632	273	8080	35300	22685	181480	23200	6170	38100	22695	136,170.0	22950
Hardness (mg CaCO3/L)	44/44	100	N/A	N/A	N/A	N/A	67.0	150	103	722	97.1	129	155	139	972	136	126	141	130.8	1308	131	109	124	116.7	700	117.5	808	3770	2215	17718	1915	728	4430	2581.3	15,488.0	2600
pH (pH units)	44/44	100	N/A	N/A	N/A	N/A	7.0	8.1	7.7	53.7	7.9	6.9	8.1	7.7	54.1	7.8	7.1	8.1	7.7	77.3	7.9	7.1	7.7	7.4	44.5	7.4	7	7.5	7.3	58.1	7.3	7.3	7.6	7.5	44.8	7.45
TSS (mg/L)	36/44	82	4.80	4.2	21.8	10/2/19	1.7	12.7	5.3	37.4	2.7	0.50	4.27	1.98	13.9	1.80	0.5	2.94	1.7	17.3	1.68	0.5	2.8	1.2	7.4	0.91	4.92	21.8	13.7	109.7	14.9	2.0	20.8	8.4	50.3	7.0
Turbidity (NTU)	40/40	100	5.49	4.5	27.3	10/2/19	1.84	15.5	6.5	32.6	5.39	0.80	9.53	3.17	22.22	1.74	0.53	2	1.1	10.80	1.01	0.74	2.49	1.3	8.09	1.23	7.36	27.3	15.3	107.18	14.8	2.75	13.8	7.1	35.5	5.06
Nutrients																																				
Nitrate+Nitrite as N (mg/L)	42/42	100	1.56	1.4	3.68	3/31/16	0.513	1.57	0.998	6.0	0.934	0.980	1.280	1.160	8.120	1.210	2.160	2.560	2.369	23.7	2.395	2.900	3.480	3.107	18.6	3.06	0.046	0.306	0.161	1.3	0.151	0.196	3.68	0.962	4.8	0.334
Phosphate, Ortho (mg/L)	41/42	98	0.283	0.240	1.280	8/14/19	0.057	0.165	0.116	0.7	0.113	0.980	1.280	1.160	8.120	1.210	0.028	0.042	0.034	0.3	0.0335	0.028	0.051	0.034	0.2	0.030	0.003	0.139	0.070	0.5	0.063	0.037	0.176	0.096	0.5	0.097
Phosphorus, Total (mg/L)	41/41	100	0.124	0.106	0.595	10/2/19	0.070	0.184	0.128	0.8	0.126	0.093	0.143	0.119	0.716	0.125	0.023	0.037	0.029	0.3	0.0295	0.028	0.037	0.033	0.2	0.034	0.181	0.566	0.310	2.2	0.267	0.080	0.595	0.254	1.0	0.171
Total Nitrogen (mg/L)	42/42	100	1.66	1.5	3.35	10/2/19	0.600	2.00	1.09	6.6	1.06	1.080	1.630	1.337	9.360	1.350	2.180	2.450	2.299	23.0	2.270	2.940	3.150	3.042	18.3	3.035	0.420	0.790	0.541	4.3	0.480	0.430	3.35	1.522	7.6	0.980
Metals (ug/L)																																				
Cadmium (ug/L)	10/44	23	0.14	0.1	2.50	9/13/16	0.017	0.062	0.036	0.252	0.031	0.009	0.250	0.054	0.380	0.030	0.0105	0.25	0.1	1.153	0.030	0.007	0.25	0.1	0.597	0.030	0.0215	2.5	0.4	3.013	0.0705	0.072	1.1	0.3	1.8	0.151
Cadmium, Dissolved (ug/L)	7/44	16	0.12	0.1	1.25	9/13/16	0.013	0.040	0.024	0.166	0.0250	0.011	0.250	0.119	0.836	0.025	0.0	0.25	0.2	1.600	0.250	0.0	0.25	0.1	0.348	0.025	0.0	1.25	0.2	1.807	0.055	0.0	0.183	0.1	0.6	0.1
Copper (ug/L)	37/43	86	2.89	2.4	23.7	7/31/19	2.89	10.1	5.00	35.0	4.04	1.34	6.00	3.20	22.4	2.60	0.1835	1.060	0.466	4.7	0.4455	0.1235	0.677	0.325	1.9	0.28075	2.53	10.5	5.456	38.2	4.89	1.43	23.7	11.977	71.9	12.85
Copper, Dissolved (ug/L)	43/43	100	1.49	1.2	7.06	6/21/19	1.78	7.06	3.19	22.3	2.68	1.02	4.50	2.03	14.20	1.73	0.2	0.538	0.3	3.13	0.3	0.0	0.284	0.2	1.06	0.2	0.3	3.42	1.7	12.04	1.6	0.6	3.63	1.7	10.0	1.3
Lead (ug/L)	37/44	84	1.748	1.523	25.4	10/2/19	0.380	3.55	1.25	8.76	0.748	0.51	4.79	1.88	13.1	1.65	0.037	0.520	0.152	1.5	0.079	0.014	0.092	0.044	0.3	0.039	0.788	25.4	5.416	43.3	2.655	0.201	2.230	0.849	5.093	0.678
Dissolved Lead (ug/L)	26/44	59	0.264	0.219	2.73	6/21/19	0.010	0.386	0.202	1.42	0.232	0.08	2.73	0.74	5.16	0.39	0.007	0.080	0.029	0.29	0.019	0.006	0.070	0.031	0.19	0.026	0.017	1.810	0.322	2.58	0.088	0.017	0.083	0.061	0.363	0.083
Mercury (ug/L)	12/44	27	0.0024	0.0021	0.004	8/23/19	0.0008	0.004	0.002	0.014	0.001	0.0008	0.004	0.0027	0.0189	0.0025	0.0008	0.004	0.0028	0.0278	0.0025	0.0008	0.004	0.0027	0.0163	0.0025	0.0010	0.004	0.0017	0.0138	0.0012	0.0008	0.004	0.0035	0.0208	0.0040
Dissolved Mercury (ug/L)	1/44	2	0.0028	0.0024	0.0045	6/21/19	0.0009	0.0045	0.0026	0.0180	0.0025	0.0009	0.0045	0.0028	0.0199	0.0025	0.0009	0.0045	0.0029	0.0294	0.0025	0.0009	0.0045	0.0029	0.0174	0.0025	0.0025	0.0045	0.0028	0.0220	0.0025	0.0009	0.0045	0.0039	0.0234	0.0045
Zinc (ug/L)	43/43	100	11.01	9.1	125	8/23/19	10.3	85.7	29.4	206	15.0	5.00	10.5	6.60	46.2	5.93	0.99	4.090	2.585	25.9	2.775	0.9	2.760	1.635	9.8	1.545	4.33	30.300	14.839	103.9	13.4	9.39	125	50.448	302.7	28.7
Dissolved Zinc (ug/L)	43/43	100	5.65	4.7	74.9	6/21/19	6.47	34.2	14.3	100.4	11.3	3.64	5.38	4.27	29.9	4.11	0.7	3.39	1.9	19.3	2.0	0.8	1.83	1.3	7.9	1.3	2.5	11.9	6.4	44.8	5.3	4.3	74.9	28.7	172.1	23.2
Insecticides																																				
Chlorpyrifos (ug/L)	0/44	0	0.027	0.023	0.031	N/A	0.026	0.030	0.027	0.19	0.026	0.026	0.030	0.027	0.19	0.026	0.026	0.030	0.027	0.27	0.026	0.026	0.030	0.028	0.17	0.02775	0.026	0.0305	0.026	0.21	0.026	0.030	0.0305	0.030	0.2	0.030
PAHs																																				
LPAHs																																				
2-Methylnaphthalene (ug/L)	7/44	16	0.006	0.005	0.029	10/2/19	0.005	0.013	0.007	0.049	0.005	0.0015	0.015	0.006	0.042	0.005	0.004	0.005	0.005	0.049	0.005	0.005	0.005	0.005	0.030	0.005	0.005	0.005	0.005	0.040	0.005	0.0015	0.029	0.008	0.1	0.005
Acenaphthene (ug/L)	11/44	25	0.011	0.009	0.132	10/20/19	0.0025	0.007	0.005	0.035	0.005	0.0025	0.005	0.005	0.033	0.005	0.0025	0.005	0.005	0.048	0.005	0.0025	0.023	0.008	0.047	0.005	0.005	0.132	0.032	0.254	0.00925	0.0025	0.035	0.015	0.1	0.012
Acenaphthylene (ug/L)	2/44	5	0.005	0.004	0.007	8/6/16	0.0015	0.005	0.004	0.031	0.005	0.0015	0.005	0.005	0.032	0.005	0.0015	0.005	0.005	0.047	0.005	0.0015	0.005	0.004	0.027	0.005	0.005	0.007	0.005	0.042	0.005	0.0015	0.005	0.004	0.0	0.005
Anthracene (ug/L)	13/44	30	0.007	0.007	0.053	10/2/19	0.003	0.008	0.005	0.034	0.005	0.003	0.008	0.005	0.034	0.005	0.003	0.005	0.004	0.042	0.005	0.003	0.005	0.004	0.024	0.004	0.005	0.053	0.019	0.153	0.013	0.003	0.017	0.009	0.1	0.008
Fluorene (ug/L)	5/44	11	0.005	0.004	0.013	8/23/16	0.004	0.007	0.006	0.039	0.005	0.003	0.005	0.004	0.031	0.005	0.003	0.005	0.005	0.045	0.005	0.003	0.005	0.004	0.026	0.0045	0.005	0.005	0.005	0.040	0.005	0.003	0.013	0.005	0.0	0.004
Naphthalene (ug/L)	10/44	23	0.009	0.007	0.026	10/2/19	0.005	0.026	0.015	0.107	0.015	0.005	0.02	0.008	0.056	0.005	0.004	0.01	0.006	0.064	0.006	0.005	0.01	0.007	0.042	0.007	0.003	0.01	0.006	0.049	0.005	0.006	0.022	0.010	0.1	0.009
Phenanthrene (ug/L)	23/44	52	0.009	0.008	0.037	10/2/19	0.008	0.026	0.017	0.118	0.017	0.005	0.020	0.008	0.055	0.005	0.004	0.016	0.007	0.065	0.005	0.004	0.013	0.006	0.039	0.005	0.005	0.019	0.008	0.061	0.006	0.004	0.037	0.016	0.1	0.012
Total LPAHs	28/44	64	0.040	0.034	0.223	10/2/19	0.035	0.07	0.047	0.3	0.046	0.012	0.06	0.027	0.187	0.019	0.019	0.04	0.024	0.244	0.020	0.019	0.05	0.028	0.167	0.024	0.019	0.2225	0.072	0.579	0.045	0.026	0.122	0.057	0.3	0.049
HPAHs in ug/L																																				
Benzo(a)anthracene (ug/L)	4/44	9	0.005	0.004	0.008	3/31/16	0.003	0.008	0.005	0.034	0.005	0.003	0.005	0.004	0.030	0.005	0.004	0.006	0.005	0.047	0.005	0.003	0.005	0.004	0.025	0.004	0.003	0.006	0.005	0.038	0.005	0.00	0.0035	0.0031667	0.019	0.004
Benzo(a)pyrene (ug/L)	5/44	14	0.005	0.004	0.010	3/31/16	0.002	0.01	0.005	0.035	0.005	0.002	0.005	0.004	0.029	0.005	0.004	0.006	0.005	0.047	0.005	0.002	0.005	0.004	0.024	0.004	0.004	0.007	0.005	0.041	0.005	0.002	0.009	0.004	0.024	0.004
Benzo(g,h,i)perylene (ug/L)	4/44	9	0.009	0.008	0.026	3/31/16	0.005	0.026	0.011	0.078	0.01	0.005	0.011	0.008	0.058	0.01	0.006	0.011	0.009	0.090	0.01	0.005	0.011	0.008	0.047	0.008	0.006	0.018	0.011	0.085	0.010	0.005	0.019	0.008	0.046	0.006
Benzo(b,k)fluoranthenes (ug/L)	9/44	20	0.005	0.004	0.011	8/6/19	0.003	0.01	0.005	0.034	0.004	0.003	0.005	0.004	0.029	0.005	0.003	0.005	0.004	0.042	0.005	0.003	0.005	0.004	0.024	0.004	0.003	0.011	0.006	0.047	0.005	0.003	0.008	0.004	0.023	0.003
Chrysene (ug/L)	7/44	16	0.005	0.004	0.018	6/20/19	0.002	0.007	0.005	0.034	0.005	0.002	0.005	0.004	0.026	0.005	0.002	0.006	0.004	0.042	0.005	0.002	0.005	0.004	0.021	0.004	0.005	0.014	0.007	0.054	0.005	0.002	0.018	0.005	0.031	0.002
Dibenz(a,h)anthracene (ug/L)	1/44	2	0.004	0.004	0.005	6/21/19	0.002	0.005	0.004	0.030	0.005	0.002	0.005	0.004	0.029	0.005	0.002	0.005	0.004	0.044	0.005	0.002	0.005	0.004	0.024	0.004	0.004	0.005	0.005	0.039	0.005	0.002	0.004	0.003	0.019	0.004
Fluoranthene (ug/L)	16/44	36	0.007	0.006	0.032	10/2/19	0.004	0.015	0.008	0.058	0.007	0.003	0.005	0.004	0.030	0.005	0.004	0.009	0.005	0.050	0.005	0.004	0.005	0.004	0.026	0.004	0.008	0.032	0.013	0.103	0.009	0.004	0.020	0.007	0.042	0.004
Indeno(1,2,3-cd)pyrene (ug/L)	2/44	5	0.005	0.004	0.013	3/31/16	0.003	0.013	0.006	0.040	0.005	0.003	0.005	0.005	0.032	0.005	0.003	0.005	0.005	0.046	0.005	0.003	0.005	0.004	0.027	0.005	0.005	0.008	0.005	0.043	0.005	0.003	0.005	0.004	0.023	0.005
Pyrene (ug/L)	19/44	43	0.008	0.007	0.053	10/2/19	0.004	0.016	0.007	0.049	0.005	0.003	0.011	0.005	0.038	0.005	0.003	0.010	0.005	0.048	0.005	0.003	0.005	0.004	0.025	0.004	0.007	0.053	0.018	0.141	0.012	0.008	0.038	0.016	0.097	0.009
Total HPAHs	20/44	45	0.037	0.032	0.131	10/2/19	0.023	0.107	0.042	0.295	0.034	0.022	0.04	0.027	0.187	0.024	0.022	0.05	0.029	0.289	0.025	0.022	0.03	0.026	0.158	0.025	0.036	0.1305	0.060	0.480	0.044	0.030	0.110	0.054	0.324	0.039
Total PAHs	29/44	66	0.076	0.066	0.353	10/2/19	0.061	0.143	0.089	0.624	0.084	0.036	0.09	0.05	0.374	0.041	0.040	0.08	0.05	0.533	0.045	0.041	0.08	0.05	0.325	0.047	0.059	0.353	0.13	1.059	0.095	0.060	0.19	0.111	0.667	0.092
Phthalates																																				
bis(2-Ethylhexyl)phthalate (ug/L)	8/44	18	0.536	0.469	5.60	5/11/16	0.188	0.820	0.484	3.39	0.515	0.188	0.515	0.37	2.59	0.483	0.189	0.515	0.37	3.75	0.472	0.190	0.515	0.35	2.11	0.352	0.197	5.60	1.10	8.81	0.508	0.189	2.820	0.63	3.79	0.194
Butyl benzyl phthalate (ug/L)	0/44	0	0.413	0.358	0.525	N/A	0.213	0.520	0.429	3.00	0.51	0.213	0.520	0.390	2.73	0.505	0.213	0.515	0.398	3.98	0.505	0.215	0.515	0.369	2.21	0.372	0.238	0.525	0.478	3.82	0.510	0.214	0.239	0.228	1.37	0.233
Diethylphthalate (ug/L)	10/44	23	0.438	0.381	1.20	3/31/16	0.139	1.20	0.600	4.20	0.52	0.139	0.520	0.364	2.54	0.505	0.265	0.575	0.430	4.30	0.488	0.140	0.510	0.328	1.97	0.315	0.182	0.525	0.471	3.77	0.510	0.140	0.183	0.167	1.00	0.178
Dimethyl phthalate (ug/L)	0/44	0	0.397	0.345	0.525	N/A	0.134	0.520	0.414	2.90	0.51	0.134	0.520	0.370	2.59	0.505	0.134	0.515	0.381	3.81	0.505	0.135	0.515	0.346	2.07	0.357	0.207	0.525	0.474	3.79	0.510	0.135	0.208	0.182	1.09	0.203
Di-n-butylphthalate (ug/L)	10/44	23	0.343	0.294	0.521	8/23/16	0.138	0.521	0.359	2.52	0.51	0.140	0.520	0.374	2.62	0.505	0.139	0.515	0.303	3.03	0.218	0.138	0.515	0.326	1.96	0.327	0.142	0.515	0.352	2.81	0.365	0.142	0.507	0.232	1.39	0.145
Di-n-Octyl phthalate (ug/L)	0/44	0	0.405	0.351	0.525	N/A	0.174	0.520	0.421	2.95	0.51	0.174	0.520	0.380	2.66	0.505	0.174	0.515	0.389	3.89	0.505	0.175	0.515	0.357	2.14	0.364	0.222	0.525	0.476	3.81	0.510	0.174	0.224	0.205	1.23	0.218
Total Phthalates	10/44	23	0.420	0.377	5.81	5/11/16	--	2.26	0.716	5.01	--	--	0.5	0.11	0.766	--	--	1.0	0.36	3.646	0.334	--	0.5	0.08	0.452	--	--	5.81	0.84	6.699	0.099	--	3.1	0.61	3.636	0.000
Herbicides																																				
2,4-D (ug/L)	12/42	29	0.088	0.073	0.970	8/14/19	0.044	0.970	0.211	1.26	0.05	0.017	0.061	0.044	0.305	0.050	0.009	0.093	0.048	0.428	0.050	0.009	0.050	0.031	0.185	0.034	0.009	0.570	0.110	0.879	0.050	0.009	0.026	0.014	0.081	0.0085
Dichlobenil (ug/L)	2/44	5	0.045	0.039	0.0525	3/31/16	0.020	0.052	0.043	0.302	0.0505	0.010	0.052	0.039	0.274	0.046	0.020	0.052	0.046	0.464	0.051	0.020	0.052	0.044	0.265	0.048	0.047	0.0525	0.051	0.405	0.051	0.020	0.047	0.037	0.224	0.046
TPH																																				
NWTPH-Diesel (mg/L)	0/27	0	0.022	0.020	0.050	N/A	0.015	0.050	0.022	0.11	0.015	0.015	0.050	0.022	0.110	0.015	0.015	0.050	0.022	0.110	0.015	0.015	0.050	0.022	0.110	0.015	0.015	0.050	0.022	0.110	0.015	0.050	0.050	0.050	0.100	0.050
NWTPH-Gasoline (ug/L)	0/27	0	6.87	6.4	25.0	N/A	2.3	25.0	6.9	34.4	2.34	2.3	25.0	6.87	34.4	2.34	2.3	25.0	6.87	34.4	2.34	2.3	25.0	6.87	34.4	2.34	2.3	25.0	6.87	34.4	2.34	25.0	25.0	25.0	50.0	25.0
NWTPH-Heavy Oil (mg/L)	0/27	0	0.101	0.094	0.105	N/A	0.100	0.105	0.102	0.51	0.10	0.100	0.105	0.102	0.510	0.10	0.095	0.105	0.101	0.505	0.10	0.100	0.105	0.101	0.505	0.10	0.100	0.105	0.101	0.505	0.10	0.100	0.100	0.100	0.200	0.100
Bacteria																																				
Coliform, Fecal (CFU/100 ml)	23/27	85	1,237.5	1,145.8	16,000	2/1/19	10	2,400	669	3,343	110	110	16,000	5,062	25,310	2400	40	490	257	1,285	220	10	68	31	156	20	10	790	169	843	13	20	45	33	65	33
BTEX																																				
Benzene (ug/L)	5/27	19	0.32	0.30	1.00	7/26/16	0.100	0.250	0.220	1.10	0.250	0.500	1.000	0.740	3.70	0.700	0.100	0.250	0.220	1.10	0.250	0.100	0.250	0.220	1.10	0.250	0.100	0.250	0.220	1.10	0.250	0.100	0.100	0.100	0.20	0.100
Ethylbenzene (ug/L)	3/278	11	0.21	0.20	0.250	N/A	0.100	0.250	0.220	1.10	0.250	0.100	0.250	0.190	0.95	0.200	0.100	0.250	0.220	1.10	0.250	0.100	0.250	0.220	1.10	0.250	0.100	0.250	0.220	1.10	0.250	0.100	0.100	0.100	0.20	0.100
m,p-Xylene (ug/L)	1/27	4	0.82	0.76	1.00	N/A	0.200	1.000	0.840	4.20	1.00	0.200	1.000	0.720	3.60	1.00	0.200	1.000	0.840	4.20	1.00	0.200	1.000	0.840	4.20	1.00	0.200	1.000	0.840	4.20	1.00	0.200	0.200	0.200	0.40	0.200
o-Xylene (ug/L)	0/27	0	0.22	0.20	0.250	N/A	0.100	0.250	0.220	1.10	0.250	0.100	0.250	0.220	1.10	0.250	0.100	0.250	0.220	1.10	0.250	0.100	0.250	0.220	1.10	0.250	0.100	0.250	0.220	1.10	0.250	0.100	0.100	0.100	0.20	0.100
Toluene (ug/L)	4/27	15	0.21	0.20	0.250	N/A	0.100	0.250	0.220	1.10	0.250	0.100	0.250	0.190	0.95	0.200	0.100	0.250	0.210	1.05	0.250	0.100	0.250	0.220	1.10	0.250	0.100	0.250	0.220	1.10	0.250	0.100	0.100	0.100	0.20	0.100

(green) Highest average or highest median concentration detected in WY2016 and WY2019 monitoring.
(orange) Highest maximum concentration detected in WY2016 and WY2019 monitoring.
Results in italics indicate nondetected values.

Table 3-3.1
Summary Statistics for Stormwater

	Overall Data						OF230					OF235					OF237A New[7]					OF237B					OF243					OF245					OF254				
	Overall Detections	% Detections	Arithmetic Mean[4]	Weighted Mean[5]	Max	Date of Max	Min	Max	Arithmetic Mean	Weighted Mean	Median	Min	Max	Arithmetic Mean	Weighted Mean	Median	Min	Max	Arithmetic Mean	Weighted Mean	Median	Min	Max	Arithmetic Mean	Weighted Mean	Median	Min	Max	Arithmetic Mean	Weighted Mean	Median	Min	Max	Arithmetic Mean	Weighted Mean	Median	Min	Max	Arithmetic Mean	Weighted Mean	Median
Conventionals																																										
Anionic Surfactants - MBAS (ug/L)	473/498	95	0.055	0.056	0.665	8/22/11	0.001	0.199	0.043	2.322	0.036	0.004	0.665	0.062	5.952	0.047	0.008	0.096	0.043	2.752	0.040	0.002	0.357	0.051	4.539	0.042	1.20E-02	0.158	0.049	2.597	0.044	0.001	0.434	0.069	6.072	0.057	0.008	0.175	0.066	3.564	0.054
BOD (mg/L)	355/447	79	3.4	3.3	69.0	6/8/17	0.2	9.7	3.8	212.8	3.2	0.1	9.7	3.6	285	3.2	0.3	9.2	3.1	182	2.7	0.4	9.8	3.1	232	2.7	0.2	8.5	3.0	156.4	2.4	6.E-02	8.1	3.1	244.1	2.7	0.1	69.0	3.7	179.0	2.4
Chloride (mg/L)	486/491	99	N/A	N/A	25400	10/7/16	0.51	551	22.9	1305.30	4.54	3.E-03	114	10.30	917	4.49	0.36	154	13.90	890	7.22	3.0E-03	68.60	5.90	507	4.59	261	25400	1890	102060	1180	0.01	1260	143.0	12298	74.2	493	8000	2340	128700	2220
Conductivity (uS/cm)	962/962	100	N/A	N/A	23000	2/21/22	14.9	2260	124	17112.0	57.5	7.2	1590	127.0	22225	82.9	7.5	1190	117	17199	91.3	39.5	708	133	20349	123	942	13300	5080	497840	4220	46.8	6360	579	83376	331	4.9	23000	6250	668750	5530
Hardness (mg CaCO3/L)	1390/1390	100	N/A	N/A	3150	N/A	8.7	206	21.4	4322.8	16.1	9.8	63.9	30.0	7230	28.0	14.5	68.8	30.6	6426	28.3	20.7	1220	54.6	11957	48.3	59.3	3150	515	74160	432	14.0	626	73.9	15371	52.0	49.5	2380	589	97774	496
pH (pH units)	1390/1390	100	N/A	N/A	10.6	N/A	5.0	10.6	6.9	1401.9	7.0	5.4	8.6	7.0	1692	7.1	5.3	8.3	6.9	1434	6.9	5.7	8.8	6.9	1527	7.0	6.1	7.8	7.1	1015	7.1	5.6	8.4	7.0	1450	7.0	6.2	8.1	7.1	1174	7.1
TSS (mg/L)	1352/1352	100	59.1	58.0	668	5/4/17	4.8	322	48.7	9545.2	30.8	5.6	441	55.7	13090	40.8	3.5	668	48.8	10150	33.6	3.6	278	48.3	10046	35.0	4.4	300	62.2	8770	40.6	6.2	296	59.8	12020	50.3	5.2	354	90.4	14735	68.9
Turbidity (NTU)	420/420	100	34.0	33.2	216	N/A	5.5	85.2	19.1	1050.5	14.1	5.1	79.5	19.0	1254	16.2	6.1	57.1	19.8	1287	17.9	7.2	50.2	19.6	1196	18.2	0.2	169	45.6	2417	33.3	11.1	139.0	44.4	2930	37.4	0.5	216	70.8	3823	57.0
Nutrients																																										
Nitrate+Nitrite as N (mg/L)	609/609	100	0.385	0.435	2.720	3/21/15	0.062	0.436	0.157	11.147	0.129	0.028	1.650	0.337	40.78	0.244	0.161	1.090	0.413	33.45	0.383	0.190	2.720	1.190	135.66	1.130	0.089	0.799	0.253	15.18	0.217	0.034	1.010	0.201	20.10	0.142	0.036	0.287	0.142	8.804	0.136
Phosphate, Total (mg/L)	603/604	100	0.177	0.162	0.689	10/26/18	0.042	0.688	0.124	8.804	0.085	0.019	0.532	0.124	14.756	0.097	0.041	1.150	0.110	8.910	0.086	0.017	0.564	0.105	11.865	0.088	0.043	3.680	0.419	25.140	0.211	0.054	1.510	0.184	18.03	0.140	0.068	1.090	0.171	10.602	0.120
Phosphorus, Ortho (mg/L)	612/617	99	0.029	0.029	3.680	9/17/21	0.004	0.098	0.029	2.233	0.023	1.00E-05	0.143	0.027	3.24	0.024	0.009	0.069	0.024	1.896	0.021	2.00E-05	0.128	0.022	2.464	0.020	0.007	0.138	0.034	2.04	0.032	6.00E-06	0.689	0.039	4.10	0.025	0.007	0.097	0.028	1.792	0.024
Total Nitrogen (mg/L)	603/609	99	0.78	0.82	3.28	8/22/11	0.13	2.10	0.57	40.12	0.46	2.0E-03	3.28	0.80	96.20	0.65	0.36	2.03	0.72	58.00	0.64	0.02	3.19	1.32	150.48	1.26	0.26	2.11	0.75	45.00	0.74	0.03	2.90	0.74	73.90	0.61	0.05	1.95	0.59	36.52	0.49
Metals in ug/L																																										
Cadmium (ug/L)	498/721	69	0.155	0.153	2.410	3/12/11	7.00E-04	0.466	0.082	6.970	0.065	3.00E-03	0.960	0.131	20.44	0.093	0.001	0.615	0.078	7.098	0.067	0.002	0.455	0.085	11.05	0.068	0.008	1.250	0.231	15.02	0.188	0.007	2.410	0.293	37.50	0.204	0.003	0.543	0.185	12.21	0.166
Cadmium, Dissolved (ug/L)	358/721	50	0.063	0.062	1.850	3/12/11	0.001	0.125	0.029	2.436	0.028	1.00E-04	0.379	0.050	7.85	0.036	1.00E-04	0.098	0.024	2.184	0.023	9.00E-04	0.153	0.034	4.45	0.030	0.001	0.173	0.079	5.14	0.080	2.00E-04	1.850	0.130	16.64	0.074	0.021	0.273	0.097	6.27	0.089
Copper (ug/L)	719/719	100	15.53	15.99	162	7/26/15	3.72	66.40	11.30	960.50	8.30	3.45	162	28.10	4384	22.70	4.09	69.10	10.40	946	8.06	2.93	27.90	7.89	1010	6.35	3.22	110.00	20.90	1359	17.20	3.00	42.60	13.70	1754	12.20	5.81	56.30	16.40	1082	13.20
Copper, Dissolved (ug/L)	711/715	99	4.65	5.26	79.10	8/22/11	0.84	18.10	4.13	346.92	3.19	1.79	79.10	11.80	1853	9.81	1.51	12.10	3.33	303	2.82	0.75	8.06	2.60	325	2.22	0.95	9.19	4.01	261	3.75	0.02	26.10	3.73	474	3.13	0.53	11.30	2.97	196.0	2.25
Lead (ug/L)	1380/1389	99	21.45	21.82	379	9/5/09	2.09	229	18.10	3656.20	11.30	2.46	368	53.80	12966	41.20	1.40	80.60	11.30	2373	8.11	1.40	64.20	9.94	2167	6.65	0.12	379	32.60	4694	15.40	0.03	60.00	9.54	1984	7.41	1.21	68.0	14.90	2473	10.70
Lead, Dissolved (ug/L)	1051/1390	76	1.727	1.810	145	8/6/04	0.018	9.05	0.907	182.307	0.500	0.156	28.00	6.10	1476	4.590	0.009	3.460	0.532	111.7	0.309	0.002	11.400	0.518	114	0.245	0.002	145.0	2.540	366	0.311	0.007	6.270	0.470	97.8	0.230	0.009	12.20	1.020	168	0.229
Mercury (ug/L)	483/1408	34	0.0217	0.0215	0.870	5/20/08	3.000E-07	0.1300	0.0220	4.4880	0.0100	2.000E-08	0.1900	0.0230	5.64	0.0095	5.000E-07	0.174	0.0180	3.8520	0.0079	1.000E-07	0.2160	0.0180	4.01	0.0077	1.000E-06	0.1880	0.0240	3.48	0.0110	9.000E-08	0.8700	0.0210	4.39	0.0077	7.000E-07	0.3070	0.0260	4.37	0.0150
Mercury, Dissolved (ug/L)	112/1406	8	0.0161	0.0160	0.552	7/23/14	2.000E-07	0.1670	0.0150	3.0450	0.0070	4.000E-07	0.0500	0.0150	3.68	0.0068	2.000E-07	0.067	0.0150	3.1950	0.0073	2.000E-07	0.1820	0.0160	3.57	0.0069	3.000E-07	0.5520	0.0170	2.47	0.0075	3.000E-07	0.1450	0.0170	3.55	0.0072	5.000E-07	0.2110	0.0180	3.02	0.0087
Zinc (ug/L)[6]	1388/1388	100	101.7	101.5	1170	8/6/04	31.8	721	108.0	21816.0	80.7	34.3	598	110.0	26400	86.5	30.6	361.0	91.0	19110	72.1	15.0	285.0	60.7	13293	45.0	12.3	1170	90.4	13018	64.8	27.7	585	131.0	27117	103.0	27.6	427	121.0	20086	95.2
Zinc, Dissolved (ug/L)[6]	1386/1388	100	42.8	42.9	910	8/6/04	11.5	543	55.0	11055.0	42.4	9.7	347	42.4	10176	33.5	16.9	289.0	45.7	9597	34.0	6.8	260.0	24.4	5368	18.8	5.6	910	33.8	4867	22.9	0.8	335	53.6	11095	36.5	5.1	239	44.4	7370	31.6
Insecticides																																										
2,4-D (ug/L)	223/395	56	0.246	0.290	12.0	4/5/17	0.002	1.700	0.181	7.964	0.060	0.001	12.0	0.587	49.31	0.133	9.00E-04	2.500	0.299	14.95	0.135	0.001	2.100	0.363	26.14	0.165	2.00E-03	0.190	0.047	1.551	0.034	0.001	1.500	0.156	11.23	0.039	0.001	1.000	0.088	3.520	0.028
Carbaryl (ug/L)	0/184	0	0.15	0.14	0.50	N/A	0.002	0.50	0.13	3.30	0.04	3.0E-03	0.49	0.11	3.56	0.03	1.2E-02	0.47	0.13	4.15	0.08	2.0E-04	0.45	0.12	3.22	0.06	0.01	0.48	0.20	3.65	0.15	0.01	0.47	0.13	3.59	0.05	1.0E-03	0.49	0.21	4.85	0.16
Chlorpyrifos (ug/L)	13/546	2	0.028	0.027	1.420	2/23/20	1.00E-04	1.420	0.041	2.911	0.009	6.00E-05	0.707	0.026	2.964	0.010	3.00E-04	0.365	0.028	2.016	0.012	3.00E-05	0.106	0.019	1.786	0.009	0.000	0.443	0.030	1.500	0.012	8.00E-05	0.754	0.025	2.300	0.009	0.001	0.320	0.026	1.378	0.010
Bifenthrin (ug/L)	10/210	5	0.006	0.006	0.054	11/4/21	1.00E-04	0.009	0.004	0.112	0.004	9.00E-05	0.010	0.005	0.195	0.005	3.00E-04	0.054	0.008	0.269	0.006	3.00E-04	0.036	0.007	0.215	0.007	1.00E-03	0.010	0.006	0.142	0.006	4.00E-04	0.009	0.006	0.188	0.005	0.002	0.010	0.006	0.130	0.007
PAHs in ug/L																																										
LPAHs in ug/L																																										
2-Methylnaphthalene (ug/L)	938/1388	68	0.021	0.022	4.130	3/16/02	3.00E-04	0.469	0.025	5.050	0.013	2.00E-04	4.130	0.033	7.99	0.010	2.00E-05	0.104	0.015	3.135	0.011	1.00E-04	0.250	0.012	2.640	0.008	4.00E-05	0.136	0.012	1.728	0.009	4.00E-05	1.140	0.030	6.18	0.010	4.00E-04	0.435	0.022	3.63	0.012
Acenaphthene (ug/L)	554/1388	40	0.012	0.011	0.855	8/6/04	5.00E-05	0.080	0.007	1.353	0.004	8.00E-05	0.086	0.009	2.13	0.005	2.00E-04	0.532	0.009	1.902	0.004	8.00E-06	0.063	0.005	1.188	0.004	2.00E-04	0.105	0.021	3.024	0.018	4.00E-05	0.855	0.016	3.30	0.009	2.00E-04	0.352	0.016	2.64	0.009
Acenaphthylene (ug/L)	395/1388	28	0.007	0.007	0.095	8/6/04	2.00E-04	0.060	0.006	1.232	0.005	5.00E-06	0.060	0.006	1.50	0.005	2.00E-05	0.061	0.005	1.108	0.004	2.00E-06	0.064	0.005	1.100	0.004	2.00E-04	0.064	0.009	1.267	0.007	3.00E-06	0.095	0.008	1.65	0.005	3.00E-06	0.070	0.010	1.65	0.007
Anthracene (ug/L)	649/1388	47	0.016	0.015	0.389	2/21/02	4.00E-06	0.122	0.011	2.222	0.006	4.00E-05	0.138	0.013	3.15	0.008	8.00E-05	0.225	0.012	2.508	0.006	2.00E-04	0.097	0.007	1.496	0.004	9.00E-04	0.079	0.029	4.176	0.028	5.00E-05	0.289	0.011	2.27	0.007	3.00E-04	0.389	0.031	5.12	0.009
Fluorene (ug/L)	715/1388	52	0.013	0.013	0.928	8/6/04	1.00E-04	0.246	0.011	2.222	0.007	1.00E-05	0.083	0.011	2.66	0.006	2.00E-04	0.110	0.010	2.027	0.007	2.00E-05	0.078	0.007	1.628	0.005	2.00E-04	0.098	0.014	2.016	0.010	8.00E-05	0.928	0.021	4.33	0.009	2.00E-04	0.159	0.019	3.14	0.010
Naphthalene (ug/L)	955/1377	69	0.028	0.029	4.430	3/16/02	2.00E-04	0.528	0.032	6.432	0.020	1.00E-05	4.430	0.042	10.04	0.016	3.00E-04	0.150	0.024	4.992	0.019	4.00E-05	0.130	0.017	3.706	0.014	1.00E-03	0.135	0.022	3.146	0.018	3.00E-05	0.795	0.037	7.55	0.021	4.00E-04	0.126	0.025	4.10	0.021
Phenanthrene (ug/L)	1302/1388	94	0.066	0.066	1.650	8/6/04	5.00E-05	0.653	0.076	15.352	0.036	6.00E-04	0.776	0.070	16.9	0.029	4.00E-04	0.893	0.081	16.93	0.038	0.001	0.838	0.045	9.900	0.021	0.002	0.221	0.049	7.056	0.032	0.001	1.650	0.060	12.36	0.034	0.001	0.657	0.078	12.87	0.044
Total LPAHs[1,2]	1381/1381	100	0.138	0.137	4.930	3/16/02	0.008	0.923	0.138	27.738	0.080	0.009	4.93	0.148	35.8	0.071	0.003	1.090	0.136	28.29	0.081	0.006	1.130	0.080	17.440	0.054	0.030	0.473	0.140	20.020	0.121	0.007	4.610	0.149	30.55	0.084	0.005	1.240	0.176	28.86	0.102
HPAHs in ug/L																																										
Benzo(a)anthracene (ug/L)	1060/1388	76	0.041	0.041	0.915	2/21/02	8.00E-05	0.439	0.046	9.292	0.017	2.00E-04	0.555	0.042	10.16	0.018	1.00E-04	0.902	0.062	12.96	0.022	6.00E-05	0.685	0.029	6.380	0.010	2.00E-04	0.615	0.033	4.752	0.015	2.00E-06	0.247	0.017	3.50	0.008	2.00E-04	0.915	0.059	9.74	0.019
Benzo(a)pyrene (ug/L)	1041/1388	75	0.044	0.044	0.865	2/18/07	1.00E-05	0.563	0.055	11.110	0.021	2.00E-04	0.498	0.044	10.65	0.020	2.00E-05	0.865	0.069	14.42	0.029	1.00E-04	0.690	0.034	7.480	0.013	2.00E-04	0.654	0.033	4.752	0.015	3.00E-05	0.133	0.018	3.71	0.010	1.00E-04	0.428	0.052	8.58	0.025
Benzo(b,k)fluoranthenes (ug/L)	1181/1388	85	0.121	0.121	2.430	9/4/07	2.00E-03	1.400	0.152	30.704	0.053	1.00E-04	1.200	0.111	26.9	0.052	1.00E-04	2.430	0.216	45.14	0.088	1.00E-05	1.760	0.095	20.900	0.036	4.00E-04	1.430	0.088	12.672	0.041	3.00E-04	0.414	0.045	9.27	0.025	1.00E-03	1.660	0.139	22.9	0.064
Benzo(g,h,i)perylene (ug/L)	1223/1388	88	0.049	0.049	0.794	9/4/07	8.00E-05	0.457	0.062	12.524	0.028	7.00E-05	0.410	0.052	12.6	0.028	1.00E-03	0.794	0.078	16.30	0.041	3.00E-05	0.614	0.042	9.240	0.019	1.00E-04	0.503	0.035	5.040	0.019	2.00E-04	0.112	0.025	5.15	0.018	2.00E-04	0.253	0.046	7.59	0.030
Chrysene (ug/L)	1241/1388	89	0.086	0.085	1.910	2/21/02	3.00E-04	0.860	0.100	20.200	0.032	4.00E-04	0.678	0.083	20.1	0.034	2.00E-04	1.490	0.131	27.38	0.052	1.00E-04	0.965	0.061	13.420	0.021	8.00E-04	0.788	0.062	8.928	0.026	7.00E-06	0.420	0.039	8.03	0.017	5.00E-04	1.910	0.123	20.3	0.045
Dibenz(a,h)anthracene (ug/L)	549/1388	40	0.011	0.011	0.684	11/15/16	3.00E-04	0.088	0.013	2.626	0.007	4.00E-05	0.154	0.010	2.40	0.005	4.00E-05	0.305	0.017	3.55	0.007	4.00E-05	0.143	0.008	1.848	0.004	3.00E-05	0.684	0.012	1.728	0.005	4.00E-05	0.028	0.005	1.05	0.003	6.00E-07	0.071	0.010	1.65	0.006
Fluoranthene (ug/L)	1368/1388	99	0.138	0.138	3.960	2/21/02	4.00E-04	1.690	0.156	31.512	0.054	0.002	1.550	0.140	33.9	0.055	0.008	2.640	0.214	44.73	0.082	0.001	1.830	0.094	20.680	0.035	0.013	0.444	0.088	12.672	0.052	0.001	1.720	0.064	13.18	0.033	4.00E-04	3.960	0.211	34.8	0.078
Indeno(1,2,3-cd)pyrene (ug/L)	1082/1388	78	0.036	0.037	0.680	9/4/07	2.00E-04	0.346	0.048	9.696	0.021	2.00E-04	0.338	0.035	8.47	0.019	8.00E-05	0.680	0.069	14.42	0.034	8.00E-05	0.546	0.030	6.600	0.014	6.00E-05	0.620	0.028	4.032	0.016	3.00E-06	0.058	0.013	2.68	0.009	7.00E-05	0.239	0.031	5.12	0.019
Pyrene (ug/L)	1359/1388	98	0.138	0.138	4.120	2/21/02	2.00E-04	1.200	0.145	29.290	0.056	0.003	1.160	0.143	34.6	0.066	0.006	2.930	0.195	40.76	0.085	2.00E-04	1.490	0.096	21.186	0.041	0.012	0.620	0.093	13.392	0.054	0.003	1.310	0.081	16.69	0.048	0.001	4.120	0.215	35.5	0.084
Retene (ug/L)	175/201	87	0.013	0.013	0.222	11/4/21	6.00E-04	0.031	0.010	0.270	0.009	0.000	0.115	0.015	0.6	0.010	0.001	0.222	0.024	0.74	0.013	4.00E-04	0.029	0.008	0.251	0.007	0.002	0.023	0.009	0.216	0.009	0.004	0.021	0.011	0.35	0.011	0.002	0.027	0.015	0.3	0.013
Total HPAHs[1]	1386/1386	100	0.660	0.569	13.60	2/21/02	0.025	6.680	0.774	156.348	0.294	0.027	6.50	0.657	158	0.307	0.029	12.300	1.050	219.5	0.458	0.019	8.730	0.488	106.872	0.193	0.031	5.840	0.466	67.104	0.246	0.011	4.390	0.302	62.21	0.167	0.027	13.600	0.884	18	0.374
Total PAHs[1]	2767/2767	100	0.798	0.400	14.70	2/21/02	0.037	7.490	0.911	184.022	0.380	0.045	7.55	0.802	194	0.368	0.033	13.300	1.190	248.7	0.520	0.028	9.870	0.568	124.392	0.255	0.065	6.050	0.606	87.264	0.373	0.020	9.000	0.450	92.70	0.264	0.040	14.700	1.060	175	0.475
Phthalates in ug/L																																										
bis(2-Ethylhexyl)phthalate (ug/L)	1061/1216	87	2.47	2.60	97	10/3/02	0.05	44.10	3.21	645.2	1.95	0.31	97.0	3.95	952	1.96	0.01	13.70	2.01	418.1	1.42	0.01	12.00	1.89	413.9	1.12	8.7E-03	41.00	1.83	261.7	0.93	0.01	31.00	2.28	465.1	1.31	0.03	10.20	2.11	0	1.42
Butyl benzyl phthalate (ug/L)	489/1388	35	1.721	1.767	290	2/15/03	0.005	8.400	0.468	94.5	0.292	0.001	7.93	0.895	217	0.511	0.001	5.570	0.379	79.2	0.254	0.001	2.80	0.322	70.8	0.233	0.004	9.200	0.776	111.7	0.243	0.013	290	8.790	1810.7	0.307	0.002	6.10	0.416	68.6	0.268
Diethylphthalate (ug/L)	400/1388	29	1.476	1.563	590	12/10/02	0.002	9.300	0.553	111.7	0.269	0.004	590	2.880	697	0.258	0.008	230	1.810	378.3	0.252	0.002	52.00	0.962	211.6	0.241	0.018	7.600	0.464	66.8	0.312	4.00E-04	430	2.440	502.6	0.238	9.00E-04	120.0	1.220	201	0.211
Dimethyl phthalate (ug/L)	100/1382	7	0.264	0.261	4.7	9/29/05	4.00E-04	4.700	0.316	63.8	0.182	0.002	2.4	0.228	54.7	0.137	0.001	0.998	0.241	50.1	0.179	4.00E-04	0.956	0.227	49.7	0.175	1.00E-03	1.730	0.260	37.2	0.174	2.00E-04	1.100	0.259	53.1	0.165	0.004	3.200	0.314	51.8	0.164
Di-n-butylphthalate (ug/L)	522/1388	38	0.387	0.388	4.8	6/12/04	0.013	1.600	0.399	80.6	0.378	0.001	1.6	0.354	85.7	0.304	0.002	4.800	0.386	80.7	0.322	2.00E-04	1.000	0.336	73.9	0.300	0.006	1.270	0.319	45.9	0.258	0.002	2.360	0.514	105.9	0.406	2.00E-04	1.300	0.400	66.0	0.378
Di-n-Octyl phthalate (ug/L)	334/1380	24	0.358	0.361	4.5	8/6/04	0.001	3.200	0.475	95.0	0.322	0.001	3.2	0.432	104.1	0.271	0.005	2.500	0.330	68.3	0.216	0.002	2.300	0.316	69.2	0.217	6.90E-03	1.490	0.292	41.5	0.211	2.00E-04	4.100	0.297	61.2	0.193	0.004	4.500	0.361	59.6	0.219
Total Phthalates[3]	1174/1385	85	5.48	5.70	596.0	12/10/02	0.00	44.10	4.22	852	2.68	0.0	596.00	7.70	1863	2.98	0.00	230	3.95	825.6	1.96	0.00	66.20	2.84	622.0	1.42	0.00	41.00	2.69	387.4	1.37	0.00	593	13.40	2760	2.12	0.00	123.00	3.58	584	1.88
Herbicides																																										
Dichlobenil (ug/L)	413/659	63	0.054	0.065	3.39	3/21/15	0.003	0.730	0.072	6.912	0.052	1.00E-03	3.390	0.099	14.41	0.034	7.00E-05	1.080	0.067	6.767	0.046	0.001	1.380	0.067	8.241	0.037	6.00E-04	0.088	0.017	1.224	0.013	7.00E-04	0.167	0.027	3.294	0.019	5.00E-04	0.263	0.030	2.160	0.017
Total Petroleum Hydrocarbons																																										
NWTPH-Diesel (mg/L)	38/371	10	0.05	0.06	0.34	1/24/12	1.0E-04	0.13	0.05	2.65	0.05	3.0E-05	0.31	0.05	4.05	0.04	1.0E-03	0.32	0.05	2.59	0.03	2.0E-04	0.34	0.05	3.93	0.04	3.0E-04	0.19	0.05	2.06	0.05	3.0E-03	0.33	0.06	4.41	0.06	2.0E-03	0.16	0.07	3.47	0.07
NWTPH-Gasoline (mg/L)	59/378	16	18.1	18.2	395	1/24/12	3.E-02	48.0	20.6	948	18.6	2.E-02	50.0	16.2	1085	13.0	0.5	47.1	16.3	749.8	10.0	0.4	395.0	23.6	1652.0	15.7	6.E-03	43.4	14.8	518.0	6.7	0.1	62.3	20.0	1260.0	15.2	0.3	48.2	15.5	682.00	13.7
NWTPH-Heavy Oil (mg/L)	327/415	79	0.5	0.5	4.2	12/15/20	0.04	1.90	0.61	32.3	0.53	4.0E-03	1.70	0.62	46.43	0.54	0.01	2.10	0.57	30.78	0.54	0.01	1.30	0.48	36.65	0.42	4.0E-04	0.96	0.33	13.86	0.33	0.01	1.10	0.35	24.64	0.34	4.0E-03	4.20	0.81	41.31	0.56
Bacteria																																										
Coliform, Fecal (CFU/100 ml)	352/352	100	16,926	18,675	1,300,000	9/17/21	80	1300000	39100	2,033,200	4250	80	160000	11700	807,300	3500	230	80000	7090	368,680	2200	130	280000	8720	627,840	2400	170	80000	8370	343,170	2400	50	240000	15400	1,016,400	2300	220	800000	28100	1376900.00	3300
E.Coli (CFU/100 ml)	100/100	100	21,354	12,493	280,000	10/21/22	90	110000	20900	188,100	11000	1300	50000	10700	74,900	4900	1100	14000	3890	35,010	2800	790	140000	19900	159,200	3100	130	50000	7490	67,410	1300	5	240000	31900	287,100	3500	1.65	280000	54700	437600.00	10200
Enterococci (CFU/100 ml)	60/61	98	77,286	78,303	820,000	9/17/21	6200	210000	58200	523,800	16000	3700	350000	92500	740,000	35000	3400	110000	25400	228,600	9200	3100	220000	36400	327,600	6700	3000	110000	29500	265,500	12000	1200	820000	141000	1,269,000	48000	2200	820000	158000	1422000.00	26000
BTEX																																										
Benzene (ug/L)	26/271	10	0.1	0.1	1.2	5/5/15	3.E-03	1.2	0.1	6.3	0.1	2.E-03	1.2	0.3	12.0	0.2	5.E-03	0.2	0.1	4.7	0.1	1.E-02	0.3	0.1	5.0	0.1	1.E-03	0.2	0.1	3.2	0.1	1.E-03	0.2	0.1	3.5	0.1	4.E-03	0.2	0.1	4.00	0.1
Ethylbenzene (ug/L)	19/272	7	0.1	0.1	0.8	11/21/14	2.E-04	0.4	0.1	4.7	0.1	2.E-03	0.4	0.1	5.7	0.1	6.E-04	0.2	0.1	4.0	0.1	3.E-03	0.8	0.1	5.5	0.1	3.E-03	0.2	0.1	3.7	0.1	3.E-03	0.2	0.1	4.3	0.1	3.E-03	0.2	0.1	4.23	0.1
m,p-Xylene (ug/L)	10/263	4	0.2	0.2	3.5	11/21/14	1.E-02	1.1	0.2	8.9	0.1	4.E-03	0.6	0.2	9.3	0.2	7.E-03	0.4	0.2	9.6	0.2	1.E-03	3.5	0.3	12.9	0.2	1.E-02	0.6	0.2	7.6	0.2	2.E-02	0.4	0.2	7.2	0.2	4.E-03	0.4	0.2	9.20	0.2
o-Xylene (ug/L)	5/307	2	0.1	0.1	1.6	11/21/14	6.E-03	0.5	0.1	5.5	0.1	8.E-04	0.2	0.1	5.0	0.1	1.E-02	0.2	0.1	5.4	0.1	2.E-03	1.6	0.1	5.9	0.1	1.E-02	0.2	0.1	3.2	0.1	2.E-04	0.2	0.1	3.4	0.1	4.E-03	0.2	0.1	4.18	0.1
Toluene (ug/L)	35/307	11	0.2	0.2	4.0	11/21/14	1.E-02	1.2	0.2	8.6	0.1	1.E-03	1.2	0.2	8.5	0.1	3.E-03	0.8	0.1	6.9	0.2	2.E-02	4.0	0.2	10.1	0.1	3.E-02	0.5	0.1	4.6	0.1	9.E-03	0.5	0.1	4.7	0.1	1.E-02	1.0	0.2	6.73	0.1

Notes:

[1] PAH summations based on 1/2 detection limit for nondetects.
[2] Calculation of Total LPAHs does not include 2-Methylnaphthalene.
[3] Phthalate summations exclude nondetect values.
[4] Overall data arithmetic mean is average of individual outfall means.
[5] Overall data weighted mean is average of all sample results.
[6] While elevated zinc values of 4570 ug/l total and 4430 ug/l dissolved were measured on 2/1/18, these values were nearly 4 times higher than the previously identified extreme outliers with no apparent cause so these values were not included in the summary statistics
[7] OF237A New location includes data from old OF 237A sampling location for all data collected prior to 2/26/06.

Highest average or highest median concentration detected in Years 1-22 monitoring. (green shading)
Highest maximum concentration detected in Years 1-22 monitoring. (orange shading)

Table 3-3.2
Summary Statistics for SSPM

	Overall Data							
	Overall Detections	% Detections	Arithmetic Mean	Weighted Mean	Highest Mean	Highest Median	Max	Date of Max
Conventionals								
Total Organic Carbon (mg/Kg)	127/127	100	N/A	N/A	8	8	17	2021
Total Solids (%)	132/132	100	N/A	N/A	70	70	92	2021
Total Volatile Solids (%)	54/54	100	N/A	N/A	21	21	31	2022
Nutrients								
Phosphorus, Total (mg/Kg)	49/49	100	2255	1899	8890	9570	13700	2021
Metals in ug/L								
Cadmium (mg/Kg dry)	58/60	97	1.0	1.0	3.3	2.9	5.6	2011
Copper (mg/Kg dry)	61/61	100	114.0	112.7	225.0	224.0	288.0	2011
Lead (mg/Kg dry)	126/126	100	174.9	161.2	516.0	433.0	1420.0	2006
Mercury (mg/Kg dry)	125/127	98	0.2	0.1	0.4	0.3	1.4	2008
Zinc (mg/Kg dry)	126/126	100	463.6	450.7	759.0	764.0	3200.0	2007
TPH								
NWTPH-Diesel (mg/Kg)	96/131	73	166	165	240	190	1100	2001
NWTPH-Heavy Oil (mg/Kg)	131/131	100	2967	2956	4300	4100	8300	2001
PAHs								
LPAHs								
2-Methylnaphthalene (ug/Kg)	86/131	66	70	69	113	110	310	2001
Acenaphthene (ug/Kg)	82/131	63	67	68	123	124	350	2009
Acenaphthylene (ug/Kg)	51/131	39	31	31	63	56	179	2010,11,12
Anthracene (ug/Kg)	116/131	89	215	214	330	312	1000	2001
Fluorene (ug/Kg)	98/131	75	100	100	171	160	577	2020
Naphthalene (ug/Kg)	95/131	73	99	99	184	170	480	2020
Phenanthrene (ug/Kg)	129/131	98	1265	1268	2290	2400	5400	2009
Total LPAHs[1]	60/131	46	1329	1332	3200	2120	16500	
HPAHs								
Benzo(a)anthracene (ug/Kg)	126/131	96	882	883	1750	1650	3700	2001
Benzo(a)pyrene (ug/Kg)	125/131	95	906	908	1740	1700	5870	2014
Benzo(b,k)fluoranthenes (ug/Kg)	127/131	97	2338	2342	4630	4280	17900	2010
Benzo(g,h,i)perylene (ug/Kg)	129/131	98	836	838	1660	1300	9300	2021
Chrysene (ug/Kg)	130/131	99	1359	1359	2630	2350	6900	2004
Dibenz(a,h)anthracene (ug/Kg)	96/131	73	227	227	466	332	2800	2005
Fluoranthene (ug/Kg)	130/131	99	1934	1937	3630	3720	7700	2005
Indeno(1,2,3-c,d)pyrene (ug/Kg)	119/131	91	646	648	1340	1300	4260	2014
Pyrene (ug/Kg)	130/131	99	2372	2373	4160	4250	9500	2001
Retene	17/18	94	134	134	357	458	475	2022
Total HPAHs[2]	60/131	46	7260	7260	15900	11400	45700	
Total PAHs[3]	60/131	46	8602	8605	18200	14300	49100	
Phthalates								
bis(2-Ethylhexyl)phthalate (ug/Kg)	130/131	99	11318	11289	17400	15600	43000	2008
Butyl benzyl phthalate (ug/Kg)	128/131	98	5849	5833	23900	9400	160000	2003
Diethylphthalate (ug/Kg)	30/131	23	42	42	54	44	250	2001
Dimethyl phthalate (ug/Kg)	80/131	61	169	169	374	110	7200	2001
Di-n-butylphthalate (ug/Kg)	110/131	84	385	386	1060	236	15000	2003
Di-n-Octyl phthalate (ug/Kg)	83/131	63	892	891	1620	948	9290	2014
Total Phthalates[4]	131/131	100	18583	18538	34500	18800	207000	
Insecticides								
Bifenthrin (ug/Kg)	51/54	94	16	16	30	31	142	2015
PCBs								
Aroclor-1016 (ug/Kg)	0/125	0	8.0	7.9	12.4	4	99	2015
Aroclor-1221 (ug/Kg)	1/125	1	6.9	7.0	10.4	5	54	2006
Aroclor-1232 (ug/Kg)	1/125	1	9.2	9.2	13.0	6	121	2006
Aroclor-1242 (ug/Kg)	1/125	1	12.3	12.4	27.7	4	420	2020
Aroclor-1248 (ug/Kg)	0/125	0	8.2	7.9	17.7	6	147	2015
Aroclor-1254 (ug/Kg)	39/125	31	55.0	56.1	185.0	108	581	2005
Aroclor-1260 (ug/Kg)	21/124	17	29.9	30.9	85.5	26	910	2020
TOTAL PCBs[5]	51/122	42	77.4	80.9	264.0	190	910	2021
Herbicides								
Dichlobenil (ug/L)	18/18	100	18.3	18.3	41.0	41	76	2023
Phenolics								
2-Methylphenol (ug/Kg dry)	4/26	15	18.9	21.3	31.1	30	119	8/25/2011
4-Methylphenol (ug/Kg dry)	34/44	77	616.1	527.4	1240.0	585	5400	4/28/2003
Pentachlorophenol (ug/Kg dry)	13/24	54	732.9	856.8	3600.0	190	17800	8/15/2012

	OF230					OF235					OF237A New				
	Min	Max	Arithmetic Mean	Weighted Mean	Median	Min	Max	Arithmetic Mean	Weighted Mean	Median	Min	Max	Arithmetic Mean	Weighted Mean	Median
Conventionals															
Total Organic Carbon (mg/Kg)	0.67	13.5	6.3	139.5	6	3.45	10	6	128.3	6	2.86	17	7	156.4	6
Total Solids (%)	30.1	65	51	1,128.6	53	54.5	73	63	1,390.4	63	48.6	92	61	1,346.4	61
Total Volatile Solids (%)	6.1	22	12	109.8	10	10.4	15	13	114.3	13	8.8	19	14	126.9	15
Nutrients															
Phosphorus, Total (mg/Kg)	543	1560	1030	7,210	1110	549	1180	867	7,803	884	584	1880	985	8,865	808
Metals in ug/L															
Cadmium (mg/Kg dry)	0.286	0.926	0.535	4.280	0.518	0.000	0.819	0.425	4.675	0.557	0.399	0.853	0.562	5.620	0.519
Copper (mg/Kg dry)	48.2	132	79	632.8	80	84.4	199	134	1,474	137	57.7	100	81	809	79
Lead (mg/Kg dry)	28.2	1420	200.0	4,200.0	141.0	88.2	286	157.0	3,454	146.0	50.9	114.0	83.0	1,826	80.4
Mercury (mg/Kg dry)	0.033	0.827	0.176	3.696	0.122	0.048	1.35	0.139	3.058	0.080	0.029	0.129	0.067	1.474	0.066
Zinc (mg/Kg dry)	219	3200	612	12,852.0	438	219	789	447	9,834	386	220	540	356	7,832	336
TPH															
NWTPH-Diesel (mg/Kg)	1.62	960	162	3,564.0	123	1.42	1000	161	3,542.0	125	0.637	780	137	3,014	125
NWTPH-Heavy Oil (mg/Kg)	25	8300	3500	77,000	3250	1600	4700	3000	66,000	2600	1400	4300	2840	62,480	2550
PAHs															
LPAHs															
2-Methylnaphthalene (ug/Kg)	4.37	310	90	1969	66	6.2	150	72	1,584	75	0.041	184	68	1,494	62
Acenaphthene (ug/Kg)	3.18	350	123	2706	124	2.48	270	59	1,289	45	6.95	300	91	2,000	66
Acenaphthylene (ug/Kg)	1.47	93	43	937.2	37	0.687	179	37	807	24	0.91	29	15	339	16
Anthracene (ug/Kg)	38	640	288	6336	302	35	430	177	3,894	170	43	890	330	7,260	312
Fluorene (ug/Kg)	6.26	577	171	3762	160	16.3	270	87	1,910	66	18	270	137	3,014	125
Naphthalene (ug/Kg)	45	480	134	2948	115	14.1	251	88	1,934	83	13	220	101	2,222	109
Phenanthrene (ug/Kg)	238	5400	2290	50380	2400	263	2400	1030	22,660	963	247	4600	2210	48,620	2140
Total LPAHs[1]	382	5990	2230	49060	1720	2.63	2030	934	20,548	895	42.8	16500	3200	70,400	2120
HPAHs															
Benzo(a)anthracene (ug/Kg)	128	3400	1530	33660	1650	120	1300	588	12,936	535	194	3700	1750	38,500	1590
Benzo(a)pyrene (ug/Kg)	253	5870	1740	38280	1580	184	1100	582	12,804	550	260	3300	1730	38,060	1700
Benzo(b,k)fluoranthenes (ug/Kg)	641	17900	4630	101860	4280	439	2700	1320	29,040	1280	721	8500	4330	95,260	4220
Benzo(g,h,i)perylene (ug/Kg)	78	3000	1380	30360	1190	176	1600	500	11,000	340	180	9300	1660	36,520	1300
Chrysene (ug/Kg)	283	5000	2220	48840	2220	297	1800	922	20,284	935	305	6900	2630	57,860	2350
Dibenz(a,h)anthracene (ug/Kg)	22	2700	430	9460	332	2	900	121	2,662	73	5.51	2800	466	10,252	328
Fluoranthene (ug/Kg)	368	6800	3490	76780	3640	432	2650	1330	29,260	1150	671	7700	3630	79,860	3720
Indeno(1,2,3-c,d)pyrene (ug/Kg)	122	4260	1340	29480	1300	23.9	930	348	7,656	300	205	2800	1280	28,160	1240
Pyrene (ug/Kg)	388	9400	4010	88220	4250	560	4200	1810	39,820	1840	551	9500	4160	91,520	4080
Retene	31	218	97	291	42	73	196	129	387	119	138	475	357	1,071	458
Total HPAHs[2]	1270	45700	15900	349800	11200	520	11500	5040	110,880	3670	43.5	24000	11900	261,800	11400
Total PAHs[3]	2200	49100	18200	400400	14300	586	13500	5980	131,560	4640	978	27700	15100	332,200	13500
Phthalates															
bis(2-Ethylhexyl)phthalate (ug/Kg)	3530	43000	17400	382800	15600	1600	22000	12500	275,000	12800	1300	24000	9510	209,220	7460
Butyl benzyl phthalate (ug/Kg)	42	4700	976	21472	617	17.9	3800	1180	25,960	1180	140	2200	808	17,776	658
Diethylphthalate (ug/Kg)	4.48	170	49	1069.2	44	2.28	89	34	750	28	3.02	250	54	1,197	35
Dimethyl phthalate (ug/Kg)	3.58	1200	130	2860	51	17.1	493	120	2,640	87	9.66	2200	226	4,972	110
Di-n-butylphthalate (ug/Kg)	3.64	2400	420	9240	236	41	370	195	4,290	180	28.6	1100	304	6,688	234
Di-n-Octyl phthalate (ug/Kg)	4.73	9290	1620	35640	948	7.25	2800	839	18,458	848	3.51	4800	925	20,350	845
Total Phthalates[4]	3600	48800	20500	451000	18600	2960	28900	14800	325,600	15800	1660	31200	11800	259,600	10300
Insecticides															
Bifenthrin (ug/Kg)	0.04	142	28	252.9	17	6	24	13	120	13	12	44	30	270	31
PCBs															
Aroclor-1016 (ug/Kg)	0.05	45	8	179.96	3	0.139	55	10	216.7	2	0.472	45	7	148	4
Aroclor-1221 (ug/Kg)	0.17	49	9	187.44	3	0.203	54	10	228.8	5	0.016	22	6	139	3
Aroclor-1232 (ug/Kg)	0.07	74	11	235.40	2	0.13	45	11	231.0	6	0.0001	65	11	238	4
Aroclor-1242 (ug/Kg)	0.00	65	10	218.02	3	0.18	420	28	609.4	3	0.254	68	11	249	4
Aroclor-1248 (ug/Kg)	0.02	31	8	175.12	6	0.183	55	8	170.3	2	0.418	47	8	185	2
Aroclor-1254 (ug/Kg)	0.13	581	185	4070.00	108	0.344	280	34	756.8	17	0.0098	390	47	1030	6
Aroclor-1260 (ug/Kg)	0.10	910	86	1881.00	9	0.052	44	10	220.0	5	0.996	150	44	972	26
TOTAL PCBs[5]	0.00	910	264	5808.00	190	0	420	52	1,133	0	0	390	77	1,694	64
Herbicides															
Dichlobenil (ug/L)	8.00	33	21	62.10	21	6	76	41	123.00	41	19	38	27	81.90	25
Phenolics															
2-Methylphenol (ug/Kg dry)	0.08	30	20	60.30	30	2.51	67	28	170	26	2.48	22	12	24	12
4-Methylphenol (ug/Kg dry)	26.00	2300	694	3470.00	121	44	440	219	1971	210	56	4700	1240	7440	585
Pentachlorophenol (ug/Kg dry)	18.70	830	333	999.00	149	4.69	17800	3600	18000	39	158	326	225	675	190

	OF237B					OF243					OF245				
	Min	Max	Arithmetic Mean	Weighted Mean	Median	Min	Max	Arithmetic Mean	Weighted Mean	Median	Min	Max	Arithmetic Mean	Weighted Mean	Median
Conventionals															
Total Organic Carbon (mg/Kg)	0.572	11	3	67.3	2	3.71	14	8	138.4	8	0.933	13	5	99.7	4
Total Solids (%)	54.5	83	70	1,537.8	70	18.6	47	31	688.6	31	43.8	81	67	1,478.4	69
Total Volatile Solids (%)	3.1	15	6	52.1	5	17	26	21	190.8	21	3	31	13	116.1	10
Nutrients															
Phosphorus, Total (mg/Kg)	375	662	540	4,860	529	1900	13700	8890	53,340	9570	587	3290	1220	10,980	944
Metals in ug/L															
Cadmium (mg/Kg dry)	0.034	2.030	0.497	5.467	0.362	1.790	5.550	3.270	29.43	2.870	0.541	1.800	1.010	11.11	0.791
Copper (mg/Kg dry)	30.9	64	44	484	41	174	288	225	2,025	224	45.2	276	121	1,452	114
Lead (mg/Kg dry)	20.6	129.0	47.3	1,041	40.6	343.0	913.0	516.0	8,772	433.0	8.3	85.7	46.1	1,014	42
Mercury (mg/Kg dry)	0.0073	0.162	0.046	1.012	0.040	0.206	0.972	0.419	7.542	0.316	0.000282	0.211	0.065	1.431	0.054
Zinc (mg/Kg dry)	123	280	199	4,378	195	440	936	759	12,903	764	80.9	679	409	8,992	394
TPH															
NWTPH-Diesel (mg/Kg)	0.761	780	76	1,681	39	8.11	670	219	4,599	190	1.03275	1100	240	5,277	117
NWTPH-Heavy Oil (mg/Kg)	520	3000	1310	28,820	1300	1700	7400	4300	90,300	4100	230	6900	2850	62,700	2800
PAHs															
LPAHs															
2-Methylnaphthalene (ug/Kg)	1.52	120	33	730	23	12.3	260	113	2,373	110	11.3	86	43	946	37
Acenaphthene (ug/Kg)	0.219	170	47	1,025	18	1.19	211	55	1,153	38	1.17	97	31	671	24
Acenaphthylene (ug/Kg)	1.39	32	13	288	9	14.1	130	63	1,319	56	0.237	29	16	341	16
Anthracene (ug/Kg)	2.01	500	120	2,640	50	40	1000	302	6,342	290	4.02	530	71	1,558	34
Fluorene (ug/Kg)	0.352	240	63	1,388	29	0.891	330	105	2,205	88	0.873	260	35	763	17
Naphthalene (ug/Kg)	1.71	160	36	801	29	52	393	184	3,864	170	3.26	124	52	1,140	52
Phenanthrene (ug/Kg)	36	3500	902	19,844	476	134	2900	950	19,950	710	13.5	810	209	4,598	135
Total LPAHs[1]	4.11	555	296	6,512	263	264	1930	937	19,677	1050	16.9	1050	379	8,338	299
HPAHs															
Benzo(a)anthracene (ug/Kg)	52	2200	566	12,452	329	91	1700	714	14,994	710	1.57	740	144	3,168	84
Benzo(a)pyrene (ug/Kg)	62	2200	553	12,166	344	112	1200	701	14,721	660	21.4	490	130	2,860	100
Benzo(b,k)fluoranthenes (ug/Kg)	147	7300	1660	36,520	874	287	4200	1820	38,220	1780	9.4	824	268	5,896	190
Benzo(g,h,i)perylene (ug/Kg)	47	2900	674	14,828	256	157	2100	670	14,070	510	5.38	300	134	2,948	116
Chrysene (ug/Kg)	68	3000	818	17,996	487	184	2400	1320	27,720	1200	24.5	1000	242	5,324	160
Dibenz(a,h)anthracene (ug/Kg)	8.86	410	125	2,750	61	10.6	1700	182	3,822	95	2.65	168	37	823	32
Fluoranthene (ug/Kg)	77	4700	1370	30,140	902	186	3770	1510	31,710	1400	24.9	1040	275	6,050	210
Indeno(1,2,3-c,d)pyrene (ug/Kg)	65	1600	426	9,372	242	59.2	950	421	8,841	380	2.62	220	63	1,390	51
Pyrene (ug/Kg)	73	7400	1550	34,100	851	316	5700	2260	47,460	1780	47.3	1200	444	9,768	332
Retene	22	45	32	97	30	70	240	155	465	154	22	39	32	95	34
Total HPAHs[2]	25.4	4170	1940	42,680	1610	224	13100	7220	151,620	7790	97.4	4700	1560	34,320	1320
Total PAHs[3]	29.5	4730	2230	49,060	1860	666	15000	8160	171,360	8240	406	5750	1940	42,680	1490
Phthalates															
bis(2-Ethylhexyl)phthalate (ug/Kg)	1360	17000	4160	91,520	3200	1830	41000	15200	319,200	12800	780	34000	9140	201,080	4460
Butyl benzyl phthalate (ug/Kg)	17	1700	289	6,358	145	150	51000	7940	166,740	2700	2500	160000	23900	525,800	9400
Diethylphthalate (ug/Kg)	0.458	190	37	807	29	0.892	180	42	886	22	0.784	128	38	836	31
Dimethyl phthalate (ug/Kg)	1.06	7200	374	8,228	25	2.72	390	98	2,054	42	3.43	211	64	1,412	49
Di-n-butylphthalate (ug/Kg)	3.79	490	106	2,332	59	19.1	725	225	4,725	181	25.1	15000	1060	23,320	202
Di-n-Octyl phthalate (ug/Kg)	1.96	2000	498	10,956	502	0.981	4000	1050	22,050	684	9.7	4250	422	9,284	82
Total Phthalates[4]	1570	21100	5400	118,800	3720	1990	96400	24500	514,500	18800	5330	207000	34500	759,000	14000
Insecticides															
Bifenthrin (ug/Kg)	2	21	9	81	7	2	29	14	124	14	0.017	9	4	33	3
PCBs															
Aroclor-1016 (ug/Kg)	0.102	60	7	154	2	0.045	99	12	210.8	2	0.037	29	4	76.8	2
Aroclor-1221 (ug/Kg)	0.029	36	6	134	2	0.233	28	6	94.5	2	0.274	14	4	89.8	2
Aroclor-1232 (ug/Kg)	0.304	32	7	147	2	0.118	121	13	221.0	3	0.03	12	4	75.6	3
Aroclor-1242 (ug/Kg)	0.0007	52	9	205	2	0.093	127	11	190.4	1	0.151	25	4	83.8	2
Aroclor-1248 (ug/Kg)	0.041	21	3	76	2	0.041	147	18	300.9	1	0.162	19	4	83.0	2
Aroclor-1254 (ug/Kg)	0.039	43	7	162	2	0.0092	220	44	749.7	2	0.402	70	12	242.0	3
Aroclor-1260 (ug/Kg)	0.025	45	12	262	7	0.081	96	17	283.9	3	0.035	130	11	214.7	4
TOTAL PCBs[5]	0	88	8	171	0	0	220	46	736	0	0	130	18	333	0
Herbicides															
Dichlobenil (ug/L)	2	7	4	11	2	2	7	5	15.0	6	8	18	12	36.0	10
Phenolics															
2-Methylphenol (ug/Kg dry)	4.4	34	16	96	14	0.842	11	6	17	5	2.4	119	31	187	11
4-Methylphenol (ug/Kg dry)	19	900	311	2799	263	14	5400	1190	7140	146	1.29	100	43	385	35
Pentachlorophenol (ug/Kg dry)	0.542	204	50	248	9	106	193	154	462	162	0.257	111	36	179	10

Notes:

[1] *Total LPAHs is the sum of the concentration or non-detected calculated value of the following compounds: Naphthalene, acenaphthene, acenaphthylene, anthracene, fluorene, and phenanthrene*

[2] *Total HPAHs is the sum of the concentration of non-detected calculated value of the following compounds: Fluoranthene, pyrene, benzo(a)anthracene, chrysene, benzo(b,k)fluoranthene,*

[3] *Total PAHs is the sum of the LPAHs and HPAHs.*

[4] *Total phthalates is the sum of detected values only.*

[5] *Total value for PCBs is the sum of detected values only.*

(green) *Highest average or highest median concentration detected in Years 1-22 monitoring.*

(orange) *Highest maximum concentration detected in Years 1-22 monitoring.*

OF237A New location includes data from old OF 237A sampling location for all data collected prior to 2/26/06.

Table 3-4
Spatial Analysis of Stormwater Quality (ANOVA Results)

A. Parametric Outfall Pair Comparisons, Years 1-22							
Analyte	**OF230**	**OF235**	**OF237A**	**OF237B**	**OF243**	**OF245**	**OF254**
TSS	-1	-1	-1	-1	-1	-1	6
Total Copper [1]	-2	6	-2	-4	3	-1	0
Total Lead	0	6	-2	-3	4	-3	-2
Total Zinc	0	1	-1	-6	-1	4	3
DEHP	3	5	-2	-2	-2	-1	-1
Phenanthrene	1	0	1	-3	0	0	1
Pyrene	0	-1	3	-2	-2	-2	4
Indeno(1,2,3-c,d)pyrene	2	0	6	-2	-2	-4	0
	2	2	5	8	5	6	1

B. Parametric Outfall Pair Comparisons, Year 21-22							
Analyte	**OF230**	**OF235**	**OF237A**	**OF237B**	**OF243**	**OF245**	**OF254**
TSS	0	-1	1	-2	-1	0	3
Total Copper	-3	5	-1	-3	1	-1	2
Total Lead	-1	6	-1	-1	-1	-1	-1
Total Zinc	1	2	1	-5	-1	1	1
DEHP	2	3	2	-3	-3	-1	0
Phenanthrene	-1	-1	6	-1	-1	-1	-1
Pyrene	-1	-1	6	-1	-1	-1	-1
Indeno(1,2,3-c,d)pyrene	-1	-1	6	-1	-1	-1	-1

[1] Stormwater analysis for copper was performed initially for OF235, OF237B and OF245 from WY2010 to WY2012, and began again in WY2015. Therefore, the ANOVA data set for these outfalls includes eleven years of non-sequential data. Stormwater analysis for OF230, OF237A, OF243 and OF254 began in WY2015 and have eight years of data. Therefore, copper results are not comparable to other results.

Key:
- *Well Below Average (-6 to -3)*
- *Below Average (-2 to -1)*
- *Neutral (0)*
- *Above Average (1 to 2)*
- *Well Above Average (3 to 6)*

Table 3-5
Spatial Analysis of Storm Sediment Quality (ANOVA Results)

A. Nonparametric Outfall Pair Comparisons, Years 1-22						
Analyte	**OF230**	**OF235**	**OF237A**	**OF237B**	**OF243**	**OF245**
Copper	-1	1	-1	-3	3	1
Lead	2	2	-1	-3	3	-3
Mercury	2	0	-1	-3	4	-2
Zinc	1	0	0	-5	4	0
TPH-OIL	1	1	1	-5	1	1
Bifenthrin	0	0	2	-1	0	-1
Phenanthrene	2	1	2	-2	1	-4
Indeno(1,2,3-cd)pyrene	3	-1	4	-1	0	-5
Pyrene	2	1	2	-2	1	-4
Total PCBs	2	0	0	-1	0	-1
DEHP	2	1	0	-3	1	-1
Butylbenzylphthalate	-1	0	-1	-3	1	4
Total Phthalates	1	1	0	-4	1	1

B. Nonparametric Outfall Pair Comparisons, Years 17-22						
Analyte	**OF230**	**OF235**	**OF237A**	**OF237B**	**OF243**	**OF245**
Copper	0	1	0	-2	1	0
Lead	0	1	0	-2	1	0
Mercury	0	0	0	-1	1	0
Zinc	0	1	0	-2	1	0
TPH-OIL	No Significant Differences					
Bifenthrin	0	0	1	0	0	-1
Phenanthrene	0	0	2	-1	0	-1
Indeno(1,2,3-cd)pyrene	0	0	1	0	0	-1
Pyrene	0	0	2	-1	0	-1
Total PCBs	No Significant Differences					
DEHP	0	1	0	-1	0	0
Butylbenzylphthalate	-1	0	0	-1	0	2
Total Phthalates	0	0	0	-1	0	1

Key:

Well Below Average (-6 to -3)
Below Average (-2 to -1)
Neutral (0)
Above Average (1 to 2)
Well Above Average (3 to 6)

Table 3-6
Regression Statistics of Stormwater Time Trends

Analyte	Outfall Number	Sample Count	S_x	S_y^2	slope	y-intercept	R^2	t - statistic	Significance Level	Year 1 Concentration (log)	Present Year Concentration (log)	Year 1 Concentration	Present Year Concentration (log)	Est % Reduction Over Study Period
Total Suspended Solids	OF230	196	2329	0.124	-0.00004	1.67	0.055	-3.37	>99.9%	1.67	1.40	46.9	24.9	47%
	OF235	235	2321	0.117	-0.00008	1.92	0.266	-9.18	>99.9%	1.92	1.31	82.8	20.4	75%
	OF237A*	207	2338	0.100	-0.00003	1.69	0.064	-3.75	>99.9%	1.69	1.41	48.7	25.9	47%
	OF237B	207	2334	0.115	-0.00007	1.82	0.224	-7.68	>99.9%	1.82	1.27	65.7	18.5	72%
	OF243	141	2463	0.138	-0.00005	1.84	0.108	-4.11	>99.9%	1.84	1.44	68.4	27.4	60%
	OF245	201	2396	0.097	-0.00004	1.84	0.104	-4.80	>99.9%	1.84	1.50	69.1	31.8	54%
	OF254	163	2318	0.096	-0.00003	1.96	0.046	-2.78	99.4%	1.96	1.74	90.5	54.6	40%
Copper [1]	OF235	156	1579	0.050	-0.00004	1.48	0.077	-3.57	>99.9%	1.48	1.28	30.4	19.1	37%
	OF237B	128	1568	0.039	-0.00005	0.99	0.182	-5.29	>99.9%	0.99	0.71	9.7	5.1	47%
	OF245	128	1547	0.053	-0.00003	1.17	0.053	-2.65	99.1%	1.17	0.99	14.7	9.8	33%
Lead	OF230	202	2306	0.135	-0.00010	1.46	0.364	-10.69	>99.9%	1.46	0.72	29.1	5.2	82%
	OF235	241	2308	0.079	-0.00008	1.95	0.399	-12.60	>99.9%	1.95	1.34	89.7	21.7	76%
	OF237A*	209	2347	0.098	-0.00006	1.19	0.229	-7.83	>99.9%	1.19	0.68	15.4	4.7	69%
	OF237B	217	2325	0.128	-0.00009	1.22	0.376	-11.38	>99.9%	1.22	0.46	16.5	2.9	83%
	OF243	144	2448	0.241	-0.00009	1.61	0.206	-6.07	>99.9%	1.61	0.88	40.4	7.6	81%
	OF245	208	2383	0.118	-0.00009	1.19	0.356	-10.67	>99.9%	1.19	0.50	15.6	3.2	80%
	OF254	166	2308	0.121	-0.00009	1.37	0.343	-9.26	>99.9%	1.37	0.69	23.6	4.9	79%
Zinc	OF230	202	2306	0.056	-0.00004	2.11	0.151	-5.97	>99.9%	2.11	1.81	129.9	63.8	51%
	OF235	240	2310	0.059	-0.00005	2.17	0.225	-8.30	>99.9%	2.17	1.77	148.5	59.4	60%
	OF237A*	209	2347	0.047	-0.00004	2.05	0.183	-6.80	>99.9%	2.05	1.74	113.0	54.7	52%
	OF237B	218	2320	0.065	-0.00005	1.92	0.246	-8.41	>99.9%	1.92	1.48	82.4	30.1	63%
	OF243	144	2448	0.071	-0.00005	2.05	0.211	-6.17	>99.9%	2.05	1.65	113.2	44.9	60%
	OF245	207	2388	0.074	-0.00006	2.26	0.259	-8.47	>99.9%	2.26	1.80	182.6	62.6	66%
	OF254	166	2308	0.061	-0.00007	2.27	0.426	-11.04	>99.9%	2.27	1.74	187.2	54.6	71%
Phenanthrene	OF230	202	2306	0.216	-0.00009	-1.02	0.204	-7.17	>99.9%	-1.02	-1.73	0.095	0.019	80%
	OF235	242	2309	0.255	-0.00010	-1.02	0.229	-8.45	>99.9%	-1.02	-1.86	0.095	0.014	86%
	OF237A*	208	2352	0.273	-0.00005	-1.18	0.057	-3.51	>99.9%	-1.18	-1.61	0.066	0.025	62%
	OF237B	219	2322	0.199	-0.00009	-1.24	0.232	-8.09	>99.9%	-1.24	-1.98	0.058	0.010	82%
	OF243	144	2448	0.138	-0.00006	-1.21	0.170	-5.40	>99.9%	-1.21	-1.71	0.061	0.019	68%
	OF245	206	2387	0.158	-0.00007	-1.14	0.200	-7.15	>99.9%	-1.14	-1.74	0.072	0.018	75%
	OF254	165	2306	0.165	-0.00009	-0.96	0.261	-7.60	>99.9%	-0.96	-1.66	0.109	0.022	80%
Pyrene	OF230	202	2306	0.295	-0.00010	-0.77	0.184	-6.72	>99.9%	-0.77	-1.56	0.168	0.028	84%
	OF235	242	2309	0.210	-0.00009	-0.73	0.194	-7.60	>99.9%	-0.73	-1.43	0.185	0.037	80%
	OF237A*	208	2352	0.273	-0.00007	-0.75	0.099	-4.76	>99.9%	-0.75	-1.31	0.177	0.049	72%
	OF237B	219	2322	0.249	-0.00010	-0.92	0.217	-7.75	>99.9%	-0.92	-1.72	0.120	0.019	84%
	OF243	144	2448	0.149	-0.00007	-0.93	0.196	-5.89	>99.9%	-0.93	-1.49	0.117	0.032	72%
	OF245	206	2387	0.172	-0.00006	-1.06	0.120	-5.28	>99.9%	-1.06	-1.54	0.087	0.029	67%
	OF254	165	2306	0.287	-0.00013	-0.52	0.300	-8.36	>99.9%	-0.52	-1.50	0.301	0.032	89%
Indeno(1,2,3-c,d)pyrene	OF230	202	2306	0.371	-0.00009	-1.34	0.111	-5.00	>99.9%	-1.34	-2.02	0.046	0.010	79%
	OF235	242	2309	0.286	-0.00007	-1.46	0.097	-5.07	>99.9%	-1.46	-2.04	0.035	0.009	74%
	OF237A*	208	2352	0.373	-0.00002	-1.46	0.004	-0.91	63.8%	-1.46	-1.59	0.035	0.026	26%
	OF237B	219	2322	0.301	-0.00009	-1.52	0.137	-5.88	>99.9%	-1.52	-2.22	0.030	0.006	80%
	OF243	144	2448	0.243	-0.00005	-1.63	0.072	-3.32	99.9%	-1.63	-2.07	0.023	0.009	63%
	OF245	206	2387	0.192	-0.00008	-1.77	0.172	-6.52	>99.9%	-1.77	-2.38	0.017	0.004	76%
	OF254	165	2306	0.259	-0.00010	-1.38	0.213	-6.64	>99.9%	-1.38	-2.16	0.042	0.007	83%
Bis(2-ethylhexyl)phthalate	OF230	201	2299	0.153	-0.00007	0.58	0.149	-5.89	>99.9%	0.58	0.07	3.8	1.2	69%
	OF235	241	2302	0.159	-0.00009	0.73	0.253	-8.99	>99.9%	0.73	0.03	5.3	1.1	80%
	OF237A *	207	2345	0.115	-0.00003	0.28	0.041	-2.96	99.7%	0.28	0.05	1.9	1.1	42%
	OF237B	218	2315	0.148	-0.00007	0.36	0.161	-6.44	>99.9%	0.36	-0.17	2.3	0.7	71%
	OF243	143	2439	0.170	-0.00007	0.31	0.179	-5.55	>99.9%	0.31	-0.26	2.1	0.6	73%
	OF245	204	2385	0.137	-0.00007	0.45	0.198	-7.06	>99.9%	0.45	-0.11	2.8	0.8	72%
	OF254	165	2306	0.146	-0.00004	0.31	0.050	-2.94	99.6%	0.31	0.02	2.0	1.1	48%

237A - Includes data from 237A New site for all samples collected after 2/26/06.*

[1] Copper was added as a key constituent for stormwater and SSPM in the 2014 QAPP. Analysis for copper in stormwater began for OF235, OF237B and OF245 in WY2010 under the NPDES program, and continued through WY2012. Under the 2014 QAPP, analysis began for all of the outfalls in WY2015.

Table 6-1.2
Mass Loading Summary for OF235

	Conventals/Nutrients							Metals										LPAHs							
	TSS (mg/L)	MBAS (mg/L)	BOD_5 (mg/L)	Total P (mg/L)	Ortho-P (mg/L)	TN (mg/L)	Nitrate/ Nitrite (mg/L)	Total Cu (ug/L)	Dissolved Cu (ug/L)	Total Zn (ug/L)	Dissolved Zn (ug/L)	Total Cd (ug/L)	Dissolved Cd (ug/L) Est	Total Hg (ug/L) Est	Dissolved Hg (ug/L)	Total Pb (ug/L)	Dissolved Pb (ug/L)	2-Methyl-naphthalene (ug/L)	Acenaphthene (ug/L)	Acenaphthylene (ug/L)	Anthracene (ug/L)	Fluorene (ug/L)	Naphthalene (ug/L)	Phenanthrene (ug/L)	Total LPAHs (ug/L)
Baseflow																									
Mean WY2011&2016 Concentration	1.98	0.031	1.00	0.13	0.12	1.34	1.16	3.20	2.03	6.60	4.27	0.05	0.02	0.0027	0.0019	1.88	0.74	0.006	0.005	0.005	0.005	0.004	0.008	0.006	0.025
Number of Detects	6	6	0	6	6	7	7	7	7	7	7	1	0	1	0	7	7	1	0	0	1	0	1	2	2
Number of Samples	7	7	7	6	6	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
Detection Frequency	86%	86%	0%	100%	100%	100%	100%	100%	100%	100%	100%	14%	0%	14%	0%	100%	100%	14%	0%	0%	14%	0%	14%	29%	29%
Stormwater, October 1, 2022 - December 15, 2022																									
Mean Annual Concentration	47.24	0.081	9.94	0.20	0.06	1.25	0.31	32.16	13.98	128.00	51.52	0.12	0.02	0.0041	0.0058	56.98	6.89	0.028	0.008	0.011	0.007	0.015	0.033	0.049	0.124
Number of Detects	4	2	1	4	4	4	4	4	4	4	4	3	0	0	0	4	4	3	1	2	1	3	2	4	4
Number of Samples	4	2	1	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Detection Frequency	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	75%	0%	0%	0%	100%	100%	75%	25%	50%	25%	75%	50%	100%	100%
Stormwater / Baseflow Concentration	24	2.62	9.94	1.54	0.53	0.93	0.27	10.05	6.89	19.39	12.06	2.24	--	--	--	30.3	9.35	4.78	1.77	2.38	1.49	3.40	4.18	7.75	4.89
Stormwater, December 15, 2022 - September 30, 2023																									
Mean Annual Concentration	49.28	0.059	3.93	0.13	0.03	0.76	0.18	31.14	12.62	104.55	37.24	0.10	0.05	0.0042	0.0041	47.95	5.91	0.015	0.009	0.006	0.011	0.010	0.015	0.043	0.097
Number of Detects	6	3	3	7	6	7	7	7	7	7	7	4	3	3	0	7	7	2	1	1	3	2	2	7	7
Number of Samples	6	3	3	7	6	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
Detection Frequency	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	57%	43%	43%	0%	100%	100%	29%	14%	14%	43%	29%	29%	100%	100%
Stormwater / Baseflow Concentration	25	1.90	3.93	1.06	0.22	0.57	0.16	9.73	6.22	15.84	8.72	1.90	2.37	1.54	--	25.5	8.02	2.46	1.83	1.38	2.20	2.28	1.84	6.74	3.81
Wet Season Load (Pounds)																									
Baseflow	556	8.65	280	35.6	33.4	374.7	325.0	0.9	0.6	1.8	1.2	0.02	0.01	0.00076	--	0.5	0.2	0.002	0.001	0.001	0.001	0.001	0.002	0.002	0.007
Stormwater	17,659	25.48	2,521	60.36	16.15	365.11	89.5	11.6	4.9	42.5	16.2	0.04	0.01	0.00077	--	19.2	2.3	0.008	0.003	0.003	0.003	0.005	0.009	0.017	0.040
Subtotal:	18,215	34.13	2,801	96.0	49.6	739.8	414.6	12.5	5.4	44.3	17.4	0.06	0.02	0.00153	--	19.7	2.5	0.009	0.004	0.004	0.005	0.006	0.011	0.019	0.048
Dry Season Load (Pounds)																									
Baseflow	401	6.24	202	25.7	24.1	270.4	234.6	0.6	0.4	1.3	0.9	0.01	0.00	0.00055	--	0.4	0.1	0.001	0.001	0.001	0.001	0.001	0.002	0.001	0.005
Stormwater	1,903	2.26	152	5.2	1.0	29.2	7.1	1.2	0.5	4.0	1.4	0.00	0.00	0.00016	--	1.9	0.2	0.001	0.000	0.000	0.000	0.000	0.001	0.002	0.004
Subtotal:	2,304	8.50	354	30.9	25.1	299.6	241.6	1.8	0.9	5.4	2.3	0.01	0.01	0.00071	--	2.2	0.4	0.002	0.001	0.001	0.001	0.001	0.002	0.003	0.009
Total Annual Load (Pounds)																									
Baseflow	957	14.89	482	61.3	57.6	645.0	559.6	1.54	0.98	3.2	2.1	0.026	0.01	0.00130	--	0.9	0.36	0.003	0.002	0.002	0.002	0.002	0.004	0.003	0.012
Stormwater	19,562	27.74	2,672	65.6	17.1	394.3	96.6	12.78	5.35	46.5	17.6	0.045	0.01	0.00093	--	21.0	2.57	0.008	0.003	0.003	0.004	0.005	0.009	0.018	0.044
Grand Total: (Pounds)	20,519	42.63	3,154	126.9	74.7	1,039.3	656.2	14.32	6.33	49.7	19.7	0.071	0.02	0.00223	--	21.9	2.92	0.011	0.006	0.005	0.006	0.007	0.013	0.022	0.056
Stormflow Percent of Annual Load	95%	65%	85%	52%	23%	38%	15%	89%	85%	94%	90%	63%	52%	42%	--	96%	88%	75%	60%	60%	61%	70%	71%	86%	78%
Wet Season Percent of Annual Load	89%	80%	89%	76%	66%	71%	63%	87%	86%	89%	88%	79%	71%	68%	--	90%	87%	84%	77%	79%	77%	82%	83%	86%	84%
Wet Season Load Density (Pounds per Acre)																									
Baseflow	5.1	0.079	2.6	0.33	0.31	3.44	2.98	0.0082	0.0052	0.0170	0.0110	0.00014	0.00006	0.0000069	--	0.0048	0.0019	0.000015	0.000012	0.000012	0.000012	0.000011	0.000021	0.000016	0.000065
Stormwater	162.0	0.234	23.1	0.55	0.15	3.35	0.82	0.1062	0.0446	0.3897	0.1486	0.00038	0.00009	0.0000071	--	0.1759	0.0215	0.000072	0.000028	0.000028	0.000030	0.000041	0.000080	0.000155	0.000370
Subtotal:	167.1	0.313	25.7	0.88	0.45	6.79	3.80	0.1144	0.0498	0.4067	0.1596	0.00052	0.00014	0.0000140	--	0.1807	0.0234	0.000087	0.000040	0.000040	0.000043	0.000053	0.000101	0.000171	0.000436
Dry Season Load Density (Pounds per Acre)																									
Baseflow	3.7	0.057	1.9	0.24	0.22	2.48	2.15	0.0059	0.0038	0.0122	0.0079	0.00010	0.00004	0.0000050	--	0.0035	0.0014	0.000011	0.000009	0.000008	0.000009	0.000008	0.000015	0.000012	0.000047
Stormwater	17.5	0.021	1.4	0.05	0.01	0.27	0.06	0.0110	0.0045	0.0370	0.0132	0.00004	0.00002	0.0000015	--	0.0170	0.0021	0.000005	0.000003	0.000002	0.000004	0.000004	0.000005	0.000015	0.000034
Subtotal:	21.1	0.078	3.2	0.28	0.23	2.75	2.22	0.0170	0.0082	0.0493	0.0211	0.00014	0.00006	0.0000065	--	0.0205	0.0035	0.000016	0.000012	0.000011	0.000013	0.000012	0.000020	0.000027	0.000082
Total Annual Load Density (Pounds per Acre)																									
Baseflow	8.8	0.137	4.4	0.56	0.53	5.92	5.13	0.0142	0.0090	0.0292	0.0189	0.00024	0.00010	0.000012	--	0.0083	0.0033	0.000026	0.000021	0.000020	0.000021	0.000019	0.000035	0.000028	0.000113
Stormwater	179.5	0.255	24.5	0.60	0.16	3.62	0.89	0.1172	0.0491	0.4267	0.1618	0.00041	0.00010	0.000009	--	0.1929	0.0236	0.000077	0.000031	0.000030	0.000034	0.000045	0.000086	0.000170	0.000405
Grand Total: (Pounds per Acre)	188.3	0.391	28.9	1.16	0.69	9.54	6.02	0.1314	0.0581	0.4559	0.1807	0.00065	0.00020	0.000020	--	0.2012	0.0268	0.000103	0.000052	0.000050	0.000055	0.000064	0.000121	0.000198	0.000517

Note: Stormwater mass loadings were not calculated for analytical parameters with fewer than 10 percent detected concentrations or only one detected sample in stormwater.

[1] *Effective 12/15/2022, the drainage area for OF235 was modified. All calculations are based on new drainage area. Table 6-1.2.b represents data starting from 12/19/2022.*

Drainage Area: 109 *Acres* [1]

<3 Detects

<5 Detects

<25% Detection Frequency

	Wet Season	Dry Season
Mean Annual Baseflow (gpm)	110	110
Mean Annual Stormwater (gpm)	116	21

Table 6-1.2 (Cont'd)
Mass Loading Summary for OF235

	HPAHs											Phthalates				Herbicide
	Benzo(a)-anthracene (ug/L)	Benzo(a)-pyrene (ug/L)	Benzo(g,h,i)-perylene (ug/L)	Benzo(b,k)-fluoranthenes (ug/L)	Chrysene (ug/L)	Dibenz(a,h)-anthracene (ug/L)	Fluoranthene (ug/L)	Indeno(1,2,3-c,d)pyrene (ug/L)	Pyrene (ug/L)	Retene (ug/L)	Total HPAHs (ug/L)	Di(2-eh)-phthalate (ug/L)	Diethyl-phthalate (ug/L)	Di-n-butyl-phthalate (ug/L)	Total Phthalates (ug/L)	Dichlobenil (ug/L)
Baseflow																
Mean WY2011&2016 Concentration	0.003	0.003	0.008	0.007	0.004	0.004	0.004	0.005	0.005	0.003	0.027	0.264	0.165	0.189	0.480	0.039
Number of Detects	0	0	0	0	0	0	0	0	1	0	1	1	0	1	2	1
Number of Samples	7	7	7	7	7	7	7	7	7	1	7	7	7	7	7	7
Detection Frequency	0%	0%	0%	0%	0%	0%	0%	0%	14%	0%	14%	14%	0%	14%	29%	14%
Stormwater																
Mean Annual Concentration	0.014	0.004	0.030	0.051	0.027	0.004	0.076	0.013	0.076	0.022	0.295	2.480	0.202	0.205	2.651	0.342
Number of Detects	3	1	4	3	3	1	4	2	3	4	4	4	1	1	4	4
Number of Samples	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Detection Frequency	75%	25%	100%	75%	75%	25%	100%	50%	75%	100%	100%	100%	25%	25%	100%	100%
Stormwater / Baseflow Concentration	5.05	1.22	3.63	7.01	7.19	0.96	17.72	2.92	14.11	8.65	10.94	9.39	1.22	1.08	5.52	8.72
Stormwater																
Mean Annual Concentration	0.024	0.024	0.038	0.067	0.032	0.004	0.074	0.024	0.107	0.017	0.397	2.060	0.157	0.240	2.177	0.161
Number of Detects	7	6	7	7	7	1	7	7	7	7	7	7	0	3	7	7
Number of Samples	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
Detection Frequency	100%	86%	100%	100%	100%	14%	100%	100%	100%	100%	100%	100%	0%	43%	100%	100%
Stormwater / Baseflow Concentration	8.75	7.47	4.65	9.21	8.61	0.87	17.20	5.42	19.98	6.73	14.71	7.80	--	1.27	4.53	4.11
Wet Season Load (Pounds)																
Baseflow	0.001	0.001	0.002	0.002	0.001	0.001	0.001	0.001	0.002	0.001	0.008	0.046	--	0.033	0.08	0.01
Stormwater	0.007	0.005	0.013	0.022	0.011	0.001	0.027	0.007	0.033	0.007	0.127	1.056	--	0.11	1.12	0.11
Subtotal:	0.008	0.006	0.015	0.024	0.012	0.003	0.029	0.008	0.035	0.008	0.135	1.103	--	0.14	1.21	0.12
Dry Season Load (Pounds)																
Baseflow	0.001	0.001	0.002	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.005	0.053	--	0.04	0.10	0.01
Stormwater	0.001	0.001	0.001	0.003	0.001	0.000	0.003	0.001	0.004	0.001	0.015	0.080	--	0.01	0.08	0.01
Subtotal:	0.001	0.002	0.003	0.004	0.002	0.001	0.004	0.002	0.005	0.001	0.021	0.133	--	0.05	0.18	0.01
Total Annual Load (Pounds)																
Baseflow	0.001	0.002	0.004	0.004	0.002	0.002	0.002	0.002	0.003	0.001	0.013	0.100	--	0.07	0.18	0.01
Stormwater	0.008	0.006	0.014	0.024	0.012	0.002	0.030	0.008	0.038	0.008	0.142	1.136	--	0.12	1.21	0.12
Grand Total: (Pounds)	0.009	0.008	0.018	0.028	0.014	0.004	0.032	0.010	0.040	0.009	0.155	1.236	--	0.19	1.39	0.13
Stormflow Percent of Annual Load	86%	80%	78%	87%	87%	43%	94%	78%	94%	86%	92%	92%	--	62%	87%	89%
Wet Season Percent of Annual Load	84%	79%	82%	85%	86%	72%	88%	81%	87%	87%	87%	89%	--	75%	87%	89%
Wet Season Load Density (Pounds per Acre)																
Baseflow	0.000007	0.000008	0.000021	0.000019	0.000010	0.000011	0.000011	0.000012	0.000014	0.000006	0.000069	0.000426	--	0.0003	0.0008	0.0001
Stormwater	0.000064	0.000048	0.000115	0.000199	0.000099	0.000013	0.000251	0.000063	0.000307	0.000064	0.001165	0.009690	--	0.0010	0.0103	0.0010
Subtotal:	0.000071	0.000056	0.000136	0.000217	0.000108	0.000023	0.000262	0.000075	0.000321	0.000071	0.001234	0.010116	--	0.0013	0.0111	0.0011
Dry Season Load Density (Pounds per Acre)																
Baseflow	0.000005	0.000006	0.000015	0.000014	0.000007	0.000008	0.000008	0.000008	0.000010	0.000005	0.000050	0.000490	--	0.0003	0.0009	0.00007
Stormwater	0.000009	0.000009	0.000014	0.000024	0.000011	0.000001	0.000026	0.000009	0.000038	0.000006	0.000141	0.000730	--	0.0001	0.0008	0.00006
Subtotal:	0.000014	0.000015	0.000029	0.000037	0.000018	0.000009	0.000034	0.000017	0.000048	0.000011	0.000191	0.001220	--	0.0004	0.0017	0.0001
Total Annual Load Density (Pounds per Acre)																
Baseflow	0.000012	0.000014	0.000037	0.000032	0.000016	0.000018	0.000019	0.000020	0.000024	0.000011	0.000119	0.000916	--	0.0007	0.0017	0.0001
Stormwater	0.000072	0.000056	0.000128	0.000222	0.000110	0.000014	0.000277	0.000072	0.000345	0.000070	0.001305	0.010420	--	0.0011	0.0111	0.0011
Grand Total: (Pounds per Acre)	0.000085	0.000071	0.000165	0.000255	0.000126	0.000032	0.000296	0.000092	0.000369	0.000081	0.001425	0.011335	--	0.0017	0.0127	0.0012

Note: Stormwater mass loadings were not calculated for analytical parameters with fewer than 10 percent detected concentrations or only one detected sample in stormwater.
[1] *Effective 12/15/2022, the drainage area for OF235 was modified. All calculations are based on new drainage area. Table 6-1.2.b represents data starting from 12/19/2022.*

Drainage Area: 109 *Acres* [1]
Baseflow Detects <3
Stormwater Detects <5
<25% Detection Frequency

	Wet Season	Dry Season
Mean Annual Baseflow (gpm)	110	110
Mean Annual Stormwater (gpm)	116	21

Table 6-1.3
Mass Loading Summary for OF237A

	Conventals/Nutrients							Metals									LPAHs					
	TSS (mg/L)	MBAS (mg/L)	BOD_5 (mg/L)	Total P (mg/L)	Ortho-P (mg/L)	TN (mg/L)	Nitrate/ Nitrite (mg/L)	Total Cu (ug/L)	Dissolved Cu (ug/L)	Total Zn (ug/L)	Dissolved Zn (ug/L)	Total Cd (ug/L)	Dissolved Cd (ug/L)	Total Hg (ug/L)	Total Pb (ug/L)	Dissolved Pb (ug/L)	2-Methyl-naphthalene (ug/L)	Anthracene (ug/L)	Fluorene (ug/L)	Naphthalene (ug/L)	Phenanthrene (ug/L)	Total LPAHs (ug/L)
Baseflow																						
Mean WY2011&2016 Concentration	1.73	0.02	1.00	0.03	0.03	2.30	2.37	0.48	0.31	2.49	1.93	0.12	0.02	0.0025	0.13	0.03	0.005	0.004	0.005	0.006	0.006	0.019
Number of Detects	7	4	0	10	10	10	10	7	10	10	10	0	0	0	7	6	1	0	0	1	4	4
Number of Samples	10	10	9	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
Detection Frequency	70%	40%	0%	100%	100%	100%	100%	70%	100%	100%	100%	0%	0%	0%	70%	60%	10%	0%	0%	10%	40%	40%
Stormwater																						
Mean Annual Concentration	46.59	0.05	5.14	0.13	0.03	0.53	0.03	12.40	4.01	89.46	39.85	0.07	0.04	0.0049	8.43	0.52	0.036	0.014	0.007	0.038	0.068	0.140
Number of Detects	11	4	2	9	7	9	9	12	12	12	12	4	3	4	12	12	11	5	3	6	12	12
Number of Samples	11	4	3	9	7	9	9	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
Detection Frequency	100%	100%	67%	100%	100%	100%	100%	100%	100%	100%	100%	33%	25%	33%	100%	100%	92%	42%	25%	50%	100%	100%
Stormwater / Baseflow Concentration	26.99	2.9	5.14	4.29	0.96	0.23	0.01	25.58	12.82	35.98	20.61	0.58	2.31	1.97	65.07	17.96	7.35	3.44	1.63	6.00	11.91	7.43
Wet Season Load (Pounds)																						
Baseflow	10,797	117	6,255	183.9	212.7	14,381	14,819	3.0	2.0	15.6	12.1	0.72	0.11	0.016	0.8	0.2	0.031	0.026	0.028	0.040	0.036	0.118
Stormwater	223,649	261	24,695	605.0	156.1	2,566	143.4	59.5	19.3	429.4	191.3	0.32	0.20	0.024	40.5	2.5	0.173	0.069	0.035	0.183	0.326	0.671
Subtotal:	234,445	378	30,951	789	369	16,947	14,962	62.6	21.2	445.0	203.4	1.04	0.31	0.039	41.3	2.7	0.204	0.096	0.063	0.223	0.362	0.789
Dry Season Load (Pounds)																						
Baseflow	7,792	84	4,514	132.7	153.5	10,379	10,695	2.2	1.4	11.2	8.7	0.52	0.08	0.011	0.6	0.1	0.022	0.019	0.020	0.029	0.026	0.085
Stormwater	25,616	30	2,829	69.3	17.9	293.9	16.4	6.8	2.2	49.2	21.9	0.04	0.02	0.003	4.6	0.3	0.020	0.008	0.004	0.021	0.037	0.077
Subtotal:	33,408	114	7,343	202.0	171.4	10,672	10,711	9.0	3.6	60.4	30.6	0.56	0.10	0.014	5.2	0.4	0.042	0.027	0.024	0.050	0.063	0.162
Total Annual Load (Pounds)																						
Baseflow	18,588	201	10,770	316.6	366.2	24,759	25,513	5.2	3.4	26.8	20.8	1.24	0.19	0.027	1.4	0.3	0.053	0.045	0.048	0.068	0.061	0.203
Stormwater	249,265	291	27,524	674.3	174.0	2,860	160	66.4	21.5	478.6	213.2	0.36	0.22	0.026	45.1	2.8	0.193	0.077	0.039	0.204	0.363	0.748
Grand Total: (Pounds)	267,853	492	38,293	990.9	540.2	27,619	25,673	71.6	24.8	505.4	234.0	1.60	0.42	0.053	46.5	3.1	0.245	0.123	0.088	0.272	0.425	0.951
Stormflow Percent of Annual Load	93%	59%	72%	68%	32%	10%	1%	93%	86%	95%	91%	22%	53%	50%	97%	90%	79%	63%	45%	75%	86%	79%
Wet Season Percent of Annual Load	88%	77%	81%	80%	68%	61%	58%	87%	85%	88%	87%	65%	75%	74%	89%	87%	83%	78%	72%	82%	85%	83%
Wet Season Load Density (Pounds per Acre)																						
Baseflow	3.8	0.042	2.2	0.07	0.08	5.11	5.27	0.0011	0.0007	0.0055	0.0043	0.0003	0.0000	0.0000056	0.0003	0.0001	0.000011	0.000009	0.000010	0.000014	0.000013	0.000042
Stormwater	79.5	0.093	8.8	0.22	0.06	0.91	0.05	0.0212	0.0068	0.1527	0.0680	0.0001	0.0001	0.0000084	0.0144	0.0009	0.000061	0.000025	0.000012	0.000065	0.000116	0.000239
Subtotal:	83.3	0.134	11.0	0.28	0.13	6.02	5.32	0.0222	0.0075	0.1582	0.0723	0.0004	0.0001	0.0000140	0.0147	0.0009	0.000072	0.000034	0.000023	0.000079	0.000129	0.000281
Dry Season Load Density (Pounds per Acre)																						
Baseflow	2.8	0.030	1.6	0.05	0.05	3.69	3.80	0.0008	0.0005	0.0040	0.0031	0.0002	0.0000	0.0000040	0.0002	0.0000	0.000008	0.000007	0.000007	0.000010	0.000009	0.000030
Stormwater	9.1	0.011	1.0	0.02	0.01	0.10	0.01	0.0024	0.0008	0.0175	0.0078	0.0000	0.00001	0.0000010	0.0016	0.0001	0.000007	0.000003	0.000001	0.000007	0.000013	0.000027
Subtotal:	11.9	0.041	2.6	0.07	0.06	3.79	3.81	0.0032	0.0013	0.0215	0.0109	0.0002	0.0000	0.0000050	0.0019	0.0001	0.000015	0.000010	0.000009	0.000018	0.000022	0.000058
Total Annual Load Density (Pounds per Acre)																						
Baseflow	6.6	0.072	3.8	0.11	0.13	8.80	9.07	0.0019	0.0012	0.0095	0.0074	0.0004	0.0001	0.0000096	0.0005	0.0001	0.000019	0.000016	0.000017	0.000024	0.000022	0.000072
Stormwater	88.6	0.103	9.8	0.24	0.06	1.02	0.06	0.0236	0.0076	0.1701	0.0758	0.0001	0.0001	0.0000094	0.0160	0.0010	0.000069	0.000027	0.000014	0.000072	0.000129	0.000266
Grand Total: (Pounds per Acre)	95.2	0.175	13.6	0.35	0.19	9.82	9.13	0.0254	0.0088	0.1797	0.0832	0.0006	0.0001	0.0000190	0.0165	0.0011	0.000087	0.000044	0.000031	0.000097	0.000151	0.000338

Note: Stormwater mass loadings were not calculated for analytical parameters with fewer than 10 percent detected concentrations or only one detected sample in stormwater.

Drainage Area: 2,813 Acres

Baseflow Detects <3

Stormwater Detects <5

<25% Detection Frequency

	Wet Season	Dry Season
Mean Annual Baseflow (gpm)	2455	2455
Mean Annual Stormwater (gpm)	1884	299

Table 6-1.3 (Cont'd)
Mass Loading Summary for OF237A

	HPAHs											Phthalates				Herbicide	
	Benzo(a)-anthracene (ug/L)	Benzo(a)-pyrene (ug/L)	Benzo(g,h,i)-perylene (ug/L)	Benzo(b,k)-fluoranthenes (ug/L)	Chrysene (ug/L)	Dibenz(a,h)-anthracene (ug/L)	Fluoranthene (ug/L)	Indeno(1,2,3-c,d)pyrene (ug/L)	Pyrene (ug/L)	Retene (ug/L)	Total HPAHs (ug/L)	Di(2-eh)-phthalate (ug/L)	Diethyl-phthalate (ug/L)	Di-n-butyl-phthalate (ug/L)	Total Phthalates (ug/L)	Bifenthrin (ug/L)	Dichlobenil (ug/L)
Baseflow																	
Mean WY2011&2016 Concentration	0.005	0.005	0.004	0.009	0.004	0.004	0.005	0.005	0.005	0.003	0.024	0.375	0.430	0.303	0.365	0.005	0.046
Number of Detects	1	1	1	0	1	0	1	0	2	0	2	2	6	2	6	0	0
Number of Samples	10	10	10	10	10	10	10	10	10	1	10	10	10	10	10	1	10
Detection Frequency	10%	10%	10%	0%	10%	0%	10%	0%	20%	0%	20%	20%	60%	20%	60%	0%	0%
Stormwater																	
Mean Annual Concentration	0.051	0.040	0.065	0.217	0.092	0.006	0.160	0.064	0.139	0.022	0.839	1.857	0.142	0.325	2.974	0.008	0.044
Number of Detects	12	8	12	12	12	3	12	12	11	12	12	12	3	9	12	2	12
Number of Samples	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
Detection Frequency	100%	67%	100%	100%	100%	25%	100%	100%	92%	100%	100%	100%	25%	75%	100%	17%	100%
Stormwater / Baseflow Concentration	10.87	8.54	15.45	25.07	22.51	1.29	34.69	13.97	30.32	8.89	34.96	4.96	0.33	1.07	8.16	1.61	0.96
Wet Season Load (Pounds)																	
Baseflow	0.029	0.029	0.026	0.054	0.026	0.027	0.029	0.029	0.029	0.016	0.150	2.34	2.69	1.89	2.28	0.031	0.290
Stormwater	0.243	0.191	0.312	1.041	0.443	0.027	0.766	0.309	0.666	0.107	4.028	8.91	0.68	1.56	14.27	0.039	0.213
Subtotal:	0.272	0.220	0.338	1.095	0.469	0.054	0.795	0.337	0.694	0.122	4.178	11.26	3.37	3.45	16.56	0.070	0.503
Dry Season Load (Pounc																	
Baseflow	0.021	0.021	0.019	0.039	0.019	0.020	0.021	0.021	0.021	0.011	0.108	1.69	1.94	1.37	1.65	0.023	0.209
Stormwater	0.028	0.022	0.036	0.119	0.051	0.003	0.088	0.035	0.076	0.012	0.461	1.02	0.08	0.18	1.63	0.004	0.024
Subtotal:	0.049	0.043	0.055	0.158	0.069	0.023	0.109	0.056	0.097	0.024	0.570	2.71	2.02	1.55	3.28	0.027	0.234
Total Annual Load (Pour																	
Baseflow	0.050	0.050	0.045	0.093	0.044	0.047	0.050	0.050	0.049	0.027	0.258	4.04	4.63	3.26	3.93	0.054	0.499
Stormwater	0.270	0.213	0.347	1.160	0.494	0.030	0.854	0.344	0.742	0.119	4.489	9.93	0.76	1.74	15.91	0.043	0.237
Grand Total: (Pounds)	0.320	0.263	0.392	1.253	0.538	0.077	0.903	0.393	0.791	0.146	4.747	13.97	5.39	5.00	19.84	0.097	0.736
Stormflow Percent of Annual Load	84%	81%	88%	93%	92%	39%	95%	87%	94%	82%	95%	71%	14%	35%	80%	44%	32%
Wet Season Percent of Annual Load	85%	84%	86%	87%	87%	70%	88%	86%	88%	84%	88%	81%	63%	69%	83%	72%	68%
Wet Season Load Density (Pounds per Acre)																	
Baseflow	0.000010	0.000010	0.000009	0.000019	0.000009	0.000010	0.000010	0.000010	0.000010	0.000006	0.000053	0.0008	0.0010	0.0007	0.0008	0.00001	0.00010
Stormwater	0.000086	0.000068	0.000111	0.000370	0.000157	0.000010	0.000272	0.000110	0.000237	0.000038	0.001432	0.0032	0.0002	0.0006	0.0051	0.00001	0.00008
Subtotal:	0.000097	0.000078	0.000120	0.000389	0.000167	0.000019	0.000283	0.000120	0.000247	0.000043	0.001485	0.0040	0.0012	0.0012	0.0059	0.00002	0.00018
Dry Season Load Density (Pounds per Acre)																	
Baseflow	0.000007	0.000007	0.000007	0.000014	0.000007	0.000007	0.000007	0.000007	0.000007	0.000004	0.000039	0.0006	0.0007	0.0005	0.0006	0.00001	0.00007
Stormwater	0.000010	0.000008	0.000013	0.000042	0.000018	0.000001	0.000031	0.000013	0.000027	0.000004	0.000164	0.0004	0.0000	0.0001	0.0006	0.00000	0.00001
Subtotal:	0.000017	0.000015	0.000019	0.000056	0.000025	0.000008	0.000039	0.000020	0.000034	0.000008	0.000203	0.0010	0.0007	0.0005	0.0012	0.00001	0.00008
Total Annual Load Density (Pounds per Acre)																	
Baseflow	0.000018	0.000018	0.000016	0.000033	0.000016	0.000017	0.000018	0.000018	0.000018	0.000010	0.000092	0.0014	0.0016	0.0012	0.0014	0.00002	0.00018
Stormwater	0.000096	0.000076	0.000123	0.000412	0.000176	0.000011	0.000304	0.000122	0.000264	0.000042	0.001596	0.0035	0.0003	0.0006	0.0057	0.00002	0.00008
Grand Total: (Pounds per Acre)	0.000114	0.000093	0.000140	0.000446	0.000191	0.000027	0.000321	0.000140	0.000281	0.000052	0.001688	0.0050	0.0019	0.0018	0.0071	0.00003	0.00026

Note: Stormwater mass loadings were not Note: Stormwater mass loadings were not calculated for analytical parameters with fewer than 10 percent detected concentrations or only one detected sample in stormwater.

Drainage Area: 2,823 Acres — *Drainage Area: 2,813 Acres*

	<3 Detects		*Baseflow Detects <3*
	<5 Detects		*Stormwater Detects <5*
	<25% Detection Frequency		*<25% Detection Frequency*

	Wet Season	Dry Season
Mean Annual Baseflow (gpm)	2455	2455
Mean Annual Stormwater (gpm)	1884	299

Table 6-1.4
Mass Loading Summary for OF237B

	Conventals/Nutrients							Metals										LPAHs					
	TSS (mg/L)	MBAS (mg/L)	BOD_5 (mg/L)	Total P (mg/L)	Ortho-P (mg/L)	TN (mg/L)	Nitrate/ Nitrite (mg/L)	Total Cu (ug/L)	Dissolved Cu (ug/L)	Total Zn (ug/L)	Dissolved Zn (ug/L)	Total Cd (ug/L)	Dissolved Cd (ug/L)	Total Hg (ug/L)	Total Pb (ug/L)	Dissolved Pb (ug/L)	2-Methyl-naphthalene (ug/L)	Acenaphthylene (ug/L)	Anthracene (ug/L)	Naphthalene (ug/L)	Phenanthrene (ug/L)	Total LPAHs (ug/L)
Baseflow																						
Mean WY2011&2016 Concentration	0.98	0.019	1.43	0.03	0.03	3.04	3.11	0.32	0.18	1.51	1.18	0.01	0.01	0.0017	0.04	0.02	0.004	0.003	0.003	0.007	0.005	0.025
Number of Detects	2	4	1	6	6	6	6	3	6	6	6	0	0	0	2	4	1	0	0	0	0	3
Number of Samples	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
Detection Frequency	33%	67%	17%	100%	100%	100%	100%	50%	100%	100%	100%	0%	0%	0%	33%	67%	17%	0%	0%	0%	0%	50%
Stormwater																						
Mean Annual Concentration	38.81	0.077	5.57	0.12	0.03	1.33	0.54	10.00	3.56	59.30	23.15	0.08	0.04	0.0069	6.71	0.39	0.006	0.006	0.003	0.017	0.033	0.07
Number of Detects	8	4	4	7	6	7	7	8	8	8	8	1	1	4	8	8	1	1	1	1	8	8
Number of Samples	8	4	4	7	6	7	7	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
Detection Frequency	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	13%	13%	50%	100%	100%	13%	13%	13%	13%	100%	100%
Stormwater / Baseflow Concentration	40	4	3.89	3.73	1.02	0.44	0.17	31	20	39	20	16	5	4	185	17	2	2	1	3	7	3
Wet Season Load (Pounds)																						
Baseflow	14,246	273	20,854	480.1	487.4	44,255	45,200	4.7	2.6	22.0	17.2	0.07	0.10	0.025	0.5	0.3	0.056	0.048	0.042	0.097	0.073	0.364
Stormwater	151,190	301	21,695	479.2	133.3	5,195	2,103.5	39.0	13.9	231.0	90.2	0.30	0.14	0.027	26.1	1.5	0.023	0.025	0.012	0.066	0.127	0.273
Subtotal:	165,437	574	42,549	959	621	49,450	47,304	43.7	16.4	253.0	107.4	0.38	0.24	0.052	26.7	1.9	0.079	0.074	0.054	0.163	0.200	0.637
Dry Season Load (Pounds)																						
Baseflow	10,282	197	15,050	346.5	351.8	31,939	32,621	3.4	1.8	15.9	12.4	0.05	0.07	0.018	0.4	0.2	0.040	0.035	0.031	0.070	0.053	0.263
Stormwater	13,059	26.02	1,874	41.4	11.5	448.8	181.7	3.4	1.2	20.0	7.8	0.03	0.01	0.002	2.3	0.1	0.002	0.002	0.001	0.006	0.011	0.024
Subtotal:	23,341	223	16,924	388	363	32,387	32,803	6.8	3.0	35.8	20.2	0.08	0.08	0.020	2.6	0.4	0.042	0.037	0.032	0.076	0.063	0.286
Total Annual Load (Pounds)																						
Baseflow	24,528	469	35,905	826.6	839.2	76,193	77,822	8.1	4.4	37.9	29.6	0.13	0.17	0.042	0.9	0.6	0.096	0.083	0.073	0.167	0.125	0.627
Stormwater	164,250	327	23,568	520.6	144.8	5,644	2,285	42.3	15.1	250.9	98.0	0.33	0.15	0.029	28.4	1.6	0.025	0.027	0.013	0.071	0.138	0.296
Grand Total: (Pounds)	188,778	796	59,473	1,347	984	81,837	80,107	50.5	19.5	288.8	127.6	0.46	0.33	0.072	29.3	2.2	0.121	0.111	0.086	0.238	0.263	0.923
Stormflow Percent of Annual Load	87%	41%	40%	39%	15%	7%	3%	84%	77%	87%	77%	73%	47%	41%	97%	74%	21%	25%	15%	30%	52%	32%
Wet Season Percent of Annual Load	88%	72%	72%	71%	63%	60%	59%	87%	84%	88%	84%	83%	74%	72%	91%	83%	65%	66%	63%	68%	76%	69%
Wet Season Load Density (Pounds per Acre)																						
Baseflow	7.2	0.138	10.5	0.24	0.25	22.36	22.84	0.0024	0.0013	0.0111	0.0087	0.000037	0.0001	0.0000124	0.0003	0.0002	0.000028	0.000025	0.000021	0.000049	0.000037	0.000184
Stormwater	76.4	0.152	11.0	0.24	0.07	2.63	1.06	0.0197	0.0070	0.1167	0.0456	0.000154	0.0001	0.0000137	0.0132	0.0008	0.000012	0.000013	0.000006	0.000033	0.000064	0.000138
Subtotal:	83.6	0.290	21.5	0.48	0.31	24.99	23.90	0.0221	0.0083	0.1278	0.0543	0.000191	0.0001	0.0000261	0.0135	0.0009	0.000040	0.000037	0.000027	0.000082	0.000101	0.000322
Dry Season Load Density (Pounds per Acre)																						
Baseflow	5.2	0.099	7.6	0.18	0.18	16.14	16.48	0.0017	0.0009	0.0080	0.0063	0.000027	0.0000	0.0000090	0.0002	0.0001	0.000020	0.000018	0.000015	0.000035	0.000027	0.000133
Stormwater	6.6	0.013	0.9	0.02	0.01	0.23	0.09	0.0017	0.0006	0.0101	0.0039	0.000013	0.00001	0.0000012	0.0011	0.0001	0.000001	0.000001	0.000001	0.000003	0.000006	0.000012
Subtotal:	11.8	0.113	8.6	0.20	0.18	16.37	16.58	0.0034	0.0015	0.0181	0.0102	0.000040	0.0000	0.0000102	0.0013	0.0002	0.000021	0.000019	0.000016	0.000038	0.000032	0.000145
Total Annual Load Density (Pounds per Acre)																						
Baseflow	12.4	0.237	18.1	0.42	0.42	38.50	39.32	0.0041	0.0022	0.0191	0.0150	0.000063	0.0001	0.0000214	0.0005	0.0003	0.000049	0.000042	0.000037	0.000084	0.000063	0.000317
Stormwater	83.0	0.165	11.9	0.26	0.07	2.85	1.15	0.0214	0.0076	0.1268	0.0495	0.000167	0.0001	0.0000148	0.0143	0.0008	0.000013	0.000014	0.000006	0.000036	0.000070	0.000150
Grand Total: (Pounds per Acre)	95.4	0.402	30.1	0.68	0.50	41.35	40.48	0.0255	0.0098	0.1459	0.0645	0.000231	0.0002	0.0000363	0.0148	0.0011	0.000061	0.000056	0.000043	0.000121	0.000133	0.000467

Note: Stormwater mass loadings were not calculated for analytical parameters with fewer than 10 percent detected concentrations or only one detected sample in stormwater.

Drainage Area: 1,979 Acres

Baseflow Detects <3

Stormwater Detects <5

<25% Detection Frequency

	Wet Season	Dry Season
Mean Annual Baseflow (gpm)	5711	5711
Mean Annual Stormwater (gpm)	1529	183

Table 6-1.4 (Cont'd)
Mass Loading Summary for OF237B

	HPAHs										Phthalates			Herbicide	
	Benzo(a)-anthracene (ug/L)	Benzo(a)-pyrene (ug/L)	Benzo(g,h,i)-perylene (ug/L)	Benzo(b,k)-fluoranthenes (ug/L)	Chrysene (ug/L)	Fluoranthene (ug/L)	Indeno(1,2,3-c,d)pyrene (ug/L)	Pyrene (ug/L)	Retene (ug/L)	Total HPAHs (ug/L)	Di(2-eh)-phthalate (ug/L)	Di-n-butyl-phthalate (ug/L)	Total Phthalates (ug/L)	Bifenthrin (ug/L)	Dichlobenil (ug/L)
Baseflow															
Mean WY2011&2016 Concentration	0.003	0.003	0.002	0.005	0.002	0.003	0.003	0.003	0.003	0.026	0.194	0.167	0.452	0.005	0.022
Number of Detects	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Number of Samples	6	6	6	6	6	6	6	6	1	6	6	6	6	1	6
Detection Frequency	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	17%	0%	0%
Stormwater															
Mean Annual Concentration	0.015	0.017	0.026	0.057	0.019	0.058	0.018	0.061	0.013	0.274	1.327	0.169	1.537	0.009	0.053
	5	5	8	7	5	8	7	7	6	8	7	1	8	2	8
	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
Detection Frequency	63%	63%	100%	88%	63%	100%	88%	88%	75%	100%	88%	13%	100%	25%	100%
Stormwater / Baseflow Concentration	6	6	11	11	9	19	6	20	5	10	7	1	3	2	2
Wet Season Load (Pounds)															
Baseflow	0.040	0.042	0.034	0.076	0.030	0.045	0.042	0.044	0.036	0.383	2.83	2.43	6.58	0.073	0.326
Stormwater	0.059	0.064	0.101	0.223	0.075	0.226	0.071	0.239	0.049	1.068	5.17	0.66	5.99	0.037	0.207
Subtotal:	0.099	0.107	0.135	0.299	0.105	0.271	0.113	0.283	0.086	1.451	8.00	3.09	12.56	0.109	0.533
Dry Season Load (Pounds)															
Baseflow	0.029	0.031	0.025	0.055	0.022	0.032	0.031	0.032	0.026	0.277	2.04	1.76	4.75	0.053	0.235
Stormwater	0.005	0.006	0.009	0.019	0.006	0.020	0.006	0.021	0.004	0.092	0.45	0.06	0.52	0.003	0.018
Subtotal:	0.034	0.036	0.033	0.074	0.028	0.052	0.037	0.052	0.030	0.369	2.49	1.81	5.26	0.056	0.253
Total Annual Load (Pounds)															
Baseflow	0.069	0.073	0.058	0.132	0.052	0.077	0.073	0.075	0.063	0.660	4.87	4.19	11.32	0.125	0.562
Stormwater	0.064	0.070	0.109	0.242	0.081	0.245	0.077	0.260	0.053	1.160	5.62	0.71	6.50	0.040	0.225
Grand Total: (Pounds)	0.133	0.143	0.168	0.373	0.133	0.323	0.150	0.335	0.116	1.819	10.49	4.91	17.83	0.165	0.786
Stormflow Percent of Annual Load	48%	49%	65%	65%	61%	76%	51%	78%	46%	64%	54%	15%	36%	24%	29%
Wet Season Percent of Annual Load	74%	75%	80%	80%	79%	84%	75%	84%	74%	80%	76%	63%	70%	66%	68%
Wet Season Load Density (Pounds per Acre)															
Baseflow	0.000020	0.000021	0.000017	0.000039	0.000015	0.000023	0.000021	0.000022	0.000018	0.000194	0.0014	0.0012	0.0033	0.00004	0.00016
Stormwater	0.000030	0.000033	0.000051	0.000112	0.000038	0.000114	0.000036	0.000121	0.000025	0.000539	0.0026	0.0003	0.0030	0.00002	0.00010
Subtotal:	0.000050	0.000054	0.000068	0.000151	0.000053	0.000137	0.000057	0.000143	0.000043	0.000733	0.0040	0.0016	0.0063	0.00006	0.00027
Dry Season Load Density (Pounds per Acre)															
Baseflow	0.000015	0.000015	0.000012	0.000028	0.000011	0.000016	0.000015	0.000016	0.000013	0.000140	0.0010	0.0009	0.0024	0.00003	0.00012
Stormwater	0.000003	0.000003	0.000004	0.000010	0.000003	0.000010	0.000003	0.000010	0.000002	0.000047	0.0002	0.0000	0.0003	0.00000	0.00001
Subtotal:	0.000017	0.000018	0.000017	0.000038	0.000014	0.000026	0.000019	0.000026	0.000015	0.000186	0.0013	0.0009	0.0027	0.00003	0.00013
Total Annual Load Density (Pounds per Acre)															
Baseflow	0.000035	0.000037	0.000030	0.000066	0.000026	0.000039	0.000037	0.000038	0.000032	0.000333	0.0025	0.0021	0.0057	0.00006	0.00028
Stormwater	0.000032	0.000035	0.000055	0.000122	0.000041	0.000124	0.000039	0.000131	0.000027	0.000586	0.0028	0.0004	0.0033	0.00002	0.00011
Grand Total: (Pounds per Acre)	0.000067	0.000072	0.000085	0.000189	0.000067	0.000163	0.000076	0.000169	0.000059	0.000919	0.0053	0.0025	0.0090	0.00008	0.00040

Note: Stormwater mass loadings were not calculated for analytical parameters with fewer than 10 percent detected concentrations or only one detected sample in stormwater.

Drainage Area: 2,147 Acres

<3 Detects

<5 Detects

<25% Detection Frequency

	Wet Season	Dry Season
Mean Annual Baseflow (gpm)	5711	5711
Mean Annual Stormwater (gpm)	1529	183

Table 6-1.5
Mass Loading Summary for OF243

	Conventals/Nutrients							Metals									LPAHs							
	TSS (mg/L)	MBAS (mg/L)	BOD5 (mg/L)	Total P (mg/L)	Ortho-P (mg/L)	TN (mg/L)	Nitrate/ Nitrite (mg/L)	Total Cu (ug/L)	Dissolved Cu (ug/L)	Total Zn (ug/L)	Dissolved Zn (ug/L)	Total Cd (ug/L)	Dissolved Cd (ug/L)	Total Hg (ug/L)	Total Pb (ug/L)	Dissolved Pb (ug/L)	2-Methyl-naphthalene (ug/L)	Acenaphthene (ug/L)	Acenaphthylene (ug/L)	Anthracene (ug/L)	Fluorene (ug/L)	Naphthalene (ug/L)	Phenanthrene (ug/L)	Total LPAHs (ug/L)
Baseflow																								
Mean WY2011&2016 Concentration	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Number of Detects	8	7	0	7	6	8	8	7	7	7	7	3	2	6	8	3	0	5	1	6	1	1	5	7
Number of Samples	8	7	7	7	7	8	8	7	7	7	7	8	8	8	8	8	8	8	8	8	8	8	8	8
Detection Frequency	100%	100%	0%	100%	86%	100%	100%	100%	100%	100%	100%	38%	25%	75%	100%	38%	0%	63%	13%	75%	13%	13%	63%	88%
Stormwater																								
Mean Annual Concentration	27.98	0.064	1.56	0.18	0.038	0.76	0.26	19.88	5.37	52.14	26.41	0.20	0.10	0.01	12.91	0.47	0.007	0.016	0.016	0.041	0.009	0.018	0.040	0.141
Number of Detects	7	5	3	7	6	7	7	7	7	7	7	5	6	2	7	7	1	5	5	7	2	2	7	7
Number of Samples	7	5	6	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
Detection Frequency	100%	100%	50%	100%	86%	100%	100%	100%	100%	100%	100%	71%	86%	29%	100%	100%	14%	71%	71%	100%	29%	29%	100%	100%
Stormwater / Baseflow Concentration	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Wet Season Load (Pounds)																								
Baseflow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Stormwater	2,816	6	157	17.8	3.8	76.0	26.0	2.0	0.5	5.2	2.7	0.0205	0.0099	0.000507	1.30	0.0476	0.001	0.002	0.002	0.004	0.001	0.002	0.004	0.014
Subtotal:	2,816	6	157	17.8	3.8	76.0	26.0	2.0	0.5	5.2	2.7	0.0205	0.0099	0.000507	1.30	0.0476	0.001	0.002	0.002	0.004	0.001	0.002	0.004	0.014
Dry Season Load (Pounds)																								
Baseflow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Stormwater	190	0	11	1.2	0.3	5.1	1.8	0.1	0.037	0.4	0.2	0.0014	0.0007	0.000034	0.09	0.0032	0.00005	0.00011	0.00011	0.00028	0.00006	0.00012	0.00028	0.00096
Subtotal:	190	0	11	1.2	0.3	5.1	1.8	0.1	0.037	0.4	0.2	0.0014	0.0007	0.000034	0.09	0.0032	0.00005	0.00011	0.00011	0.00028	0.00006	0.00012	0.00028	0.00096
Total Annual Load (Pounds)																								
Baseflow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Stormwater	3,006	7	168	19.1	4.1	81.2	27.7	2.1	0.6	5.6	2.8	0.0219	0.0105	0.00054	1.39	0.05	0.001	0.002	0.002	0.004	0.001	0.002	0.004	0.015
Grand Total: (Pounds)	3,006	7	168	19.1	4.1	81.2	27.7	2.1	0.6	5.6	2.8	0.0219	0.0105	0.00054	1.39	0.05	0.001	0.002	0.002	0.004	0.001	0.002	0.004	0.015
Stormflow Percent of Annual Load	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Wet Season Percent of Annual Load	94%	94%	94%	94%	94%	94%	94%	94%	94%	94%	94%	94%	94%	94%	94%	94%	94%	94%	94%	94%	94%	94%	94%	94%
Wet Season Load Density (Pounds per Acre)																								
Baseflow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Stormwater	47.7	0.11	2.7	0.30	0.07	1.29	0.44	0.034	0.009	0.089	0.045	0.00035	0.00017	0.000009	0.0220	0.0008	0.000013	0.000028	0.000027	0.000070	0.000016	0.000030	0.000069	0.000240
Subtotal:	47.7	0.11	2.7	0.30	0.07	1.29	0.44	0.034	0.009	0.089	0.045	0.00035	0.00017	0.000009	0.0220	0.0008	0.000013	0.000028	0.000027	0.000070	0.000016	0.000030	0.000069	0.000240
Dry Season Load Density (Pounds per Acre)																								
Baseflow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Stormwater	3.2	0.01	0.2	0.02	0.00	0.09	0.03	0.002	0.001	0.006	0.003	0.00002	0.00001	0.0000006	0.0015	0.00005	0.000001	0.000002	0.000002	0.000005	0.000001	0.000002	0.000005	0.000016
Subtotal:	3.2	0.01	0.2	0.02	0.00	0.09	0.03	0.002	0.001	0.006	0.003	0.00002	0.00001	0.0000006	0.0015	0.00005	0.000001	0.000002	0.000002	0.000005	0.000001	0.000002	0.000005	0.000016
Total Annual Load Density (Pounds per Acre)																								
Baseflow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Stormwater	51.0	0.12	2.8	0.32	0.07	1.38	0.47	0.036	0.010	0.095	0.048	0.0004	0.0002	0.000009	0.0235	0.0009	0.000014	0.000030	0.000029	0.000075	0.000017	0.000033	0.000074	0.000256
Grand Total: (Pounds per Acre)	51.0	0.12	2.8	0.32	0.07	1.38	0.47	0.036	0.010	0.095	0.048	0.0004	0.0002	0.000009	0.0235	0.0009	0.000014	0.000030	0.000029	0.000075	0.000017	0.000033	0.000074	0.000256

Note: Stormwater mass loadings were not calculated for analytical parameters with fewer than 10 percent detected concentrations or only one detected sample in stormwater.

Drainage Area: 59 *Acres*

Baseflow Detects <3

Stormwater Detects <5

<25% Detection Frequency

	Wet Season	Dry Season
Mean Annual Baseflow (gpm)	0	0
Mean Annual Stormwater (gpm)	39.5	3.7

Table 6-1.5 (Cont'd)
Mass Loading Summary for OF243

	HPAHs										Phthalates				Herbicide
	Benzo(a)-anthracene (ug/L)	Benzo(a)-pyrene (ug/L)	Benzo(g,h,i)-perylene (ug/L)	Benzo(b,k)-fluoranthenes (ug/L)	Chrysene (ug/L)	Fluoranthene (ug/L)	Indeno(1,2,3-c,d)pyrene (ug/L)	Pyrene (ug/L)	Retene (ug/L)	Total HPAHs (ug/L)	Di(2-eh)-phthalate (ug/L)	Diethyl-phthalate (ug/L)	Di-n-butyl-phthalate (ug/L)	Total Phthalates (ug/L)	Dichlobenil (ug/L)
Baseflow															
Mean WY2011&2016 Concentration	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Number of Detects	2	2	1	5	2	8	1	8	0	8	2	0	3	0	0
Number of Samples	8	8	8	8	8	8	8	8	1	8	8	8	8	8	8
Detection Frequency	25%	25%	13%	63%	25%	100%	13%	100%	0%	100%	25%	0%	38%	0%	0%
Stormwater															
Mean Annual Concentration	0.018	0.019	0.017	0.056	0.022	0.056	0.018	0.063	0.010	0.271	0.897	0.249	0.203	0.994	0.013
Number of Detects	4	4	6	6	4	7	6	7	6	7	6	3	2	7	5
Number of Samples	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
Detection Frequency	57%	57%	86%	86%	57%	100%	86%	100%	86%	100%	86%	43%	29%	100%	71%
Stormwater / Baseflow Concentration	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Wet Season Load (Pounds)															
Baseflow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Stormwater	0.002	0.002	0.002	0.006	0.002	0.006	0.002	0.006	0.001	0.027	0.09	0.03	0.02	0.100	0.001
Subtotal:	0.002	0.002	0.002	0.006	0.002	0.006	0.002	0.006	0.001	0.027	0.09	0.03	0.02	0.100	0.001
Dry Season Load (Pounds)															
Baseflow	0	0	0	0	0	0	0	0	0	0	0.000	0	0	0	0
Stormwater	0.00012	0.00013	0.00011	0.00038	0.00015	0.00038	0.00012	0.00043	0.00007	0.00184	0.006	0.002	0.001	0.007	0.0001
Subtotal:	0.00012	0.00013	0.00011	0.00038	0.00015	0.00038	0.00012	0.00043	0.00007	0.00184	0.006	0.002	0.001	0.007	0.0001
Total Annual Load (Pounds)															
Baseflow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Stormwater	0.002	0.002	0.002	0.006	0.002	0.006	0.002	0.007	0.001	0.029	0.10	0.03	0.02	0.107	0.001
Grand Total: (Pounds)	0.002	0.002	0.002	0.006	0.002	0.006	0.002	0.007	0.001	0.029	0.10	0.03	0.02	0.107	0.001
Stormflow Percent of Annual Load	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Wet Season Percent of Annual Load	94%	94%	94%	94%	94%	94%	94%	94%	94%	94%	94%	94%	94%	94%	94%
Total Annual Load (Pounds)															
Baseflow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Stormwater	0.000030	0.000032	0.000028	0.000095	0.000038	0.000095	0.000030	0.000107	0.000017	0.000462	0.0015	0.0004	0.0003	0.00170	0.00002
Subtotal:	0.000030	0.000032	0.000028	0.000095	0.000038	0.000095	0.000030	0.000107	0.000017	0.000462	0.0015	0.0004	0.0003	0.00170	0.00002
Dry Season Load Density (Pounds per Acre)															
Baseflow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Stormwater	0.000002	0.000002	0.000002	0.000006	0.000003	0.000006	0.000002	0.000007	0.000001	0.000031	0.0001	0.0000	0.0000	0.00011	0.00000
Subtotal:	0.000002	0.000002	0.000002	0.000006	0.000003	0.000006	0.000002	0.000007	0.000001	0.000031	0.0001	0.0000	0.0000	0.00011	0.00000
Total Annual Load Density (Pounds per Acre)															
Baseflow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Stormwater	0.000032	0.000034	0.000030	0.000101	0.000040	0.000102	0.000032	0.000115	0.000018	0.000493	0.0016	0.0005	0.0004	0.00181	0.00002
Grand Total: (Pounds per Acre)	0.000032	0.000034	0.000030	0.000101	0.000040	0.000102	0.000032	0.000115	0.000018	0.000493	0.0016	0.0005	0.0004	0.00181	0.00002

Note: Stormwater mass loadings were not calculated for analytical parameters with fewer than 10 percent detected concentrations or only one detected sample in stormwater.

Drainage Area: 59 Acres

<3 Detects

<5 Detects

<25% Detection Frequency

	Wet Season	Dry Season
Mean Annual Baseflow (gpm)	0	0
Mean Annual Stormwater (gpm)	39.5	3.7

Table 6-1.6
Mass Loading Summary for OF245

	Conventals/Nutrients						
	TSS (mg/L)	MBAS (mg/L)	BOD5 (mg/L)	Total P (mg/L)	Ortho-P (mg/L)	TN (mg/L)	Nitrate/ Nitrite (mg/L)
Baseflow							
Mean WY2016 & 2019 Concentration	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Number of Detects	6	5	1	5	6	5	5
Number of Samples	6	5	5	5	6	5	5
Detection Frequency	100%	100%	20%	100%	100%	100%	100%
Stormwater							
Mean Annual Concentration	37.45	0.06	3.19	0.15	0.04	0.60	0.17
Number of Detects	9	7	7	8	8	8	8
Number of Samples	9	7	7	8	8	8	8
Detection Frequency	100%	100%	100%	100%	100%	100%	100%
Stormwater / Baseflow Concentration	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Wet Season Load (Pounds)							
Baseflow	0	0	0	0	0	0	0
Stormwater	7,357	12.13	627	30.4	8.7	117.6	32.5
Subtotal:	7,357	12.13	627	30.4	8.7	117.6	32.5
Dry Season Load (Pounds)							
Baseflow	0	0	0	0	0	0	0
Stormwater	833	1.37	71	3.4	1.0	13.3	3.7
Subtotal:	833	1.37	71	3.4	1.0	13.3	3.7
Total Annual Load (Pounds)							
Baseflow	0	0	0	0	0	0	0
Stormwater	8,191	13.50	698	33.8	9.6	130.9	36.2
Grand Total: (Pounds)	8,191	13.50	698	33.8	9.6	130.9	36.2
Stormflow Percent of Annual Load	100%	100%	100%	100%	100%	100%	100%
Wet Season Percent of Annual Load	90%	90%	90%	90%	90%	90%	90%
Wet Season Load Density (Pounds per Acre)							
Baseflow	0	0	0	0	0	0	0
Stormwater	189	0.311	16.1	0.78	0.22	3.02	0.83
Subtotal:	189	0.311	16.1	0.78	0.22	3.02	0.83
Dry Season Load Density (Pounds per Acre)							
Baseflow	0	0	0	0	0	0	0
Stormwater	21.4	0.035	1.8	0.09	0.03	0.34	0.09
Subtotal:	21.4	0.035	1.8	0.09	0.03	0.34	0.09
Total Annual Load Density (Pounds per Acre)							
Baseflow	0	0	0	0	0	0	0
Stormwater	210	0.346	17.9	0.87	0.25	3.36	0.93
Grand Total: (Pounds per Acre)	210	0.346	17.9	0.87	0.25	3.36	0.93

	Metals								
	Total Cu (ug/L)	Dissolved Cu (ug/L)	Total Zn (ug/L)	Dissolved Zn (ug/L)	Total Cd (ug/L)	Dissolved Cd (ug/L)	Total Hg (ug/L)	Total Pb (ug/L)	Dissolved Pb (ug/L)
Baseflow									
Mean WY2016 & 2019 Concentration	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Number of Detects	6	6	6	6	4	3	0	6	0
Number of Samples	6	6	6	6	6	6	6	6	6
Detection Frequency	100%	100%	100%	100%	67%	50%	0%	100%	0%
Stormwater									
Mean Annual Concentration	11.10	3.042	75.60	25.80	0.140	0.055	0.004	3.58	0.16
Number of Detects	9	9	9	9	7	6	1	9	9
Number of Samples	9	9	9	9	9	9	9	9	9
Detection Frequency	100%	100%	100%	100%	78%	67%	11%	100%	100%
Stormwater / Baseflow Concentration	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Wet Season Load (Pounds)									
Baseflow	0	0	0	0	0	0	0	0	0
Stormwater	2.2	0.6	14.9	5.1	0.0275	0.0108	0.000706	0.70	0.0310
Subtotal:	2.2	0.6	14.9	5.1	0.0275	0.0108	0.000706	0.70	0.0310
Dry Season Load (Pounds)									
Baseflow	0	0	0	0	0	0	0	0	0
Stormwater	0.2	0.068	1.7	0.6	0.0031	0.0012	0.000080	0.08	0.0035
Subtotal:	0.2	0.068	1.7	0.6	0.0031	0.0012	0.000080	0.08	0.0035
Total Annual Load (Pounds)									
Baseflow	0	0	0	0	0	0	0	0	0
Stormwater	2.4	0.7	16.5	5.6	0.0307	0.0120	0.00079	0.78	0.03
Grand Total: (Pounds)	2.4	0.7	16.5	5.6	0.0307	0.0120	0.00079	0.78	0.03
Stormflow Percent of Annual Load	100%	100%	100%	100%	100%	100%	100%	100%	100%
Wet Season Percent of Annual Load	90%	90%	90%	90%	90%	90%	90%	90%	90%
Wet Season Load Density (Pounds per Acre)									
Baseflow	0	0	0	0	0	0	0	0	0
Stormwater	0.056	0.015	0.381	0.130	0.00071	0.00028	0.000018	0.0180	0.0008
Subtotal:	0.056	0.015	0.381	0.130	0.00071	0.00028	0.000018	0.0180	0.0008
Dry Season Load Density (Pounds per Acre)									
Baseflow	0	0	0	0	0	0	0	0	0
Stormwater	0.006	0.002	0.043	0.015	0.00008	0.00003	0.0000021	0.0020	0.00009
Subtotal:	0.006	0.002	0.043	0.015	0.00008	0.00003	0.0000021	0.0020	0.00009
Total Annual Load Density (Pounds per Acre)									
Baseflow	0	0	0	0	0	0	0	0	0
Stormwater	0.062	0.017	0.424	0.145	0.0008	0.0003	0.000020	0.0201	0.0009
Grand Total: (Pounds per Acre)	0.062	0.017	0.424	0.145	0.00079	0.0003	0.000020	0.0201	0.0009

	LPAHs							
	2-Methyl-naphthalene (ug/L)	Acenaphthene (ug/L)	Acenaphthylene (ug/L)	Anthracene (ug/L)	Fluorene (ug/L)	Naphthalene (ug/L)	Phenanthrene (ug/L)	TotalLPAHs (ug/L)
Baseflow								
Mean WY2016 & 2019 Concentration	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Number of Detects	2	3	0	5	1	1	5	6
Number of Samples	6	6	6	6	6	6	6	6
Detection Frequency	33%	50%	0%	83%	17%	17%	83%	100%
Stormwater								
Mean Annual Concentration	0.009	0.006	0.005	0.003	0.009	0.019	0.038	0.079
Number of Detects	3	1	1	3	2	3	9	9
Number of Samples	9	9	9	9	9	9	9	9
Detection Frequency	33%	11%	11%	33%	22%	33%	100%	100%
Stormwater / Baseflow Concentration	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Wet Season Load (Pounds)								
Baseflow	0	0	0	0	0	0	0	0
Stormwater	0.002	0.001	0.001	0.001	0.002	0.004	0.007	0.016
Subtotal:	0.002	0.001	0.001	0.001	0.002	0.004	0.007	0.016
Dry Season Load (Pounds)								
Baseflow	0	0	0	0	0	0	0	0
Stormwater	0.00021	0.00013	0.00011	0.00007	0.00019	0.00042	0.00083	0.00176
Subtotal:	0.00021	0.00013	0.00011	0.00007	0.00019	0.00042	0.00083	0.00176
Total Annual Load (Pounds)								
Baseflow	0	0	0	0	0	0	0	0
Stormwater	0.002	0.001	0.001	0.001	0.002	0.004	0.008	0.017
Grand Total: (Pounds)	0.002	0.001	0.001	0.001	0.002	0.004	0.008	0.017
Stormflow Percent of Annual Load	100%	100%	100%	100%	100%	100%	100%	100%
Wet Season Percent of Annual Load	90%	90%	90%	90%	90%	90%	90%	90%
Wet Season Load Density (Pounds per Acre)								
Baseflow	0	0	0	0	0	0	0	0
Stormwater	0.000047	0.000029	0.000025	0.000017	0.000044	0.000095	0.000189	0.000399
Subtotal:	0.000047	0.000029	0.000025	0.000017	0.000044	0.000095	0.000189	0.000399
Dry Season Load Density (Pounds per Acre)								
Baseflow	0	0	0	0	0	0	0	0
Stormwater	0.000005	0.000003	0.000003	0.000002	0.000005	0.000011	0.000021	0.000045
Subtotal:	0.000005	0.000003	0.000003	0.000002	0.000005	0.000011	0.000021	0.000045
Total Annual Load Density (Pounds per Acre)								
Baseflow	0	0	0	0	0	0	0	0
Stormwater	0.000053	0.000032	0.000028	0.000019	0.000049	0.000106	0.000210	0.000444
Grand Total: (Pounds per Acre)	0.000053	0.000032	0.000028	0.000019	0.000049	0.000106	0.000210	0.000444

Note: Stormwater mass loadings were not calculated for analytical parameters with fewer than 10 percent detected concentrations or only one detected sample in stormwater.

Drainage Area: 39 Acres

Baseflow Detects <3

Stormwater Detects <5

<25% Detection Frequency

	Wet Season	Dry Season
Mean Annual Baseflow (gpm)	0	0
Mean Annual Stormwater (gpm)	77.1	12.1

Table 6-1.6 (Cont'd)
Mass Loading Summary for OF245

	HPAHs										Phthalates			
	Benzo(a)-anthracene (ug/L)	Benzo(a)-pyrene (ug/L)	Benzo(g,h,i)-perylene (ug/L)	Benzo(b,k)-fluoranthenes (ug/L)	Chrysene (ug/L)	Fluoranthene (ug/L)	Indeno(1,2,3-c,d)pyrene (ug/L)	Pyrene (ug/L)	Retene (ug/L)	Total HPAHs (ug/L)	Di(2-eh)-phthalate (ug/L)	Diethyl-phthalate (ug/L)	Di-n-butyl-phthalate (ug/L)	Total Phthalates (ug/L)
Baseflow														
Mean WY2011&2016 Concentration	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Number of Detects	0	1	1	1	2	2	0	6	0	5	1	0	2	2
Number of Samples	6	6	6	6	6	6	6	6	1	6	6	6	6	6
Detection Frequency	0%	17%	17%	17%	33%	33%	0%	100%	0%	83%	17%	0%	33%	33%
Stormwater														
Mean Annual Concentration	0.004	0.004	0.014	0.019	0.010	0.032	0.006	0.037	0.011	0.129	1.121	0.166	1.293	2.386
Number of Detects	2	3	9	5	4	9	4	8	9	9	8	1	9	9
Number of Samples	9	9	9	9	9	9	9	9	9	9	9	9	9	9
Detection Frequency	22%	33%	100%	56%	44%	100%	44%	89%	100%	100%	89%	11%	100%	100%
Stormwater / Baseflow Concentration	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Wet Season Load (Pounds)														
Baseflow	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Stormwater	0.001	0.001	0.003	0.004	0.002	0.006	0.001	0.007	0.002	0.025	0.22	0.03	0.25	0.469
Subtotal:	0.001	0.001	0.003	0.004	0.002	0.006	0.001	0.007	0.002	0.025	0.22	0.03	0.25	0.469
Dry Season Load (Pounds)														
Baseflow	0	0	0	0	0	0	0	0	0	0	0.000	0	0	0
Stormwater	0.00010	0.00009	0.00030	0.00043	0.00022	0.00071	0.00013	0.00083	0.00025	0.00288	0.025	0.004	0.029	0.053
Subtotal:	0.00010	0.00009	0.00030	0.00043	0.00022	0.00071	0.00013	0.00083	0.00025	0.00288	0.025	0.004	0.029	0.053
Total Annual Load (Pounds)														
Baseflow	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Stormwater	0.001	0.001	0.003	0.004	0.002	0.007	0.001	0.008	0.002	0.028	0.25	0.04	0.28	0.522
Grand Total: (Pounds)	0.001	0.001	0.003	0.004	0.002	0.007	0.001	0.008	0.002	0.028	0.25	0.04	0.28	0.522
Stormflow Percent of Annual Load	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Wet Season Percent of Annual Load	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%
Total Annual Load (Pounds)														
Baseflow	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Stormwater	0.000022	0.000021	0.000069	0.000098	0.000049	0.000162	0.000029	0.000188	0.000057	0.000652	0.0056	0.0008	0.0065	0.01202
Subtotal:	0.000022	0.000021	0.000069	0.000098	0.000049	0.000162	0.000029	0.000188	0.000057	0.000652	0.0056	0.0008	0.0065	0.01202
Dry Season Load Density (Pounds per Acre)														
Baseflow	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Stormwater	0.000002	0.000002	0.000008	0.000011	0.000006	0.000018	0.000003	0.000021	0.000006	0.000074	0.0006	0.0001	0.0007	0.00136
Subtotal:	0.000002	0.000002	0.000008	0.000011	0.000006	0.000018	0.000003	0.000021	0.000006	0.000074	0.0006	0.0001	0.0007	0.00136
Total Annual Load Density (Pounds per Acre)														
Baseflow	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Stormwater	0.000024	0.000023	0.000076	0.000109	0.000055	0.000180	0.000032	0.000209	0.000064	0.000726	0.0063	0.0009	0.0072	0.01338
Grand Total: (Pounds per Acre)	0.000024	0.000023	0.000076	0.000109	0.000055	0.000180	0.000032	0.000209	0.000064	0.000726	0.0063	0.0009	0.0072	0.01338

Note: Stormwater mass loadings were not calculated for analytical parameters with fewer than 10 percent detected concentrations or only one detected sample in stormwater.

Drainage Area: 38 Acres

<3 Detects

<5 Detects

<25% Detection Frequency

	Wet Season
Mean Annual Baseflow (gpm)	0
Mean Annual Stormwater (gpm)	77.1

Table 6-2.1
Pollutant Loading Summary Comparison - WY2010-12 and WY2015-2023

	OF235 - Commercial																						
													Percent Difference										
	WY2010	WY2011	WY2012	WY2015	WY2016	WY2017	WY2018	WY2019	WY2020	WY2021	WY2022	WY2023 Est.	WY2010 to WY2023	WY2011 to WY2023	WY2012 to WY2023	WY2015 to WY2023	WY2016 to WY2023	WY2017 to WY2023	WY2018 to WY2023	WY2019 to WY2023	WY2020 to WY2023	WY2021 to WY2023	WY2022 to WY2023
Conventionals (lbs per acre)																							
TSS	278	319	200	193	178	166	187	164	109	114	126	188	-32%	-41%	-6%	-2%	6%	13%	0%	15%	72%	66%	50%
MBAS	0.33	0.52	0.51	0.39	0.29	0.39	0.28	0.30	0.29	0.21	0.32	0.39	18%	-25%	-23%	1%	33%	0%	41%	31%	37%	90%	24%
BOD_5	21	20	25	14	27	16	13	18	19	16	15	29	35%	46%	16%	109%	8%	85%	117%	63%	52%	81%	98%
Total Phosphorus	0.83	0.78	0.62	0.61	1.05	0.82	0.87	0.89	0.76	0.70	0.95	1.16	40%	48%	89%	90%	11%	42%	33%	31%	53%	65%	23%
Orthophophorus	0.37	0.27	0.26	0.31	0.41	0.43	0.40	0.46	0.42	0.44	0.59	0.69	87%	152%	168%	121%	67%	59%	72%	49%	63%	56%	16%
TN	6.5	4.7	4.0	3.2	5.2	5.3	4.9	6.4	6.5	6.2	6.6	9.5	47%	105%	136%	198%	85%	81%	96%	48%	47%	55%	44%
Nitrate/Nitrite -Total	5.7	3.7	3.4	4.8	4.5	4.7	4.4	4.4	4.1	4.5	4.3	6.0	6%	63%	75%	25%	33%	28%	36%	36%	46%	35%	41%
Metals (lbs/1000 per acre)																							
Cu - Total	173	181	170	124	148	129	120	103	96	91	90	131	-24%	-27%	-23%	6%	-12%	2%	9%	28%	37%	45%	46%
Cu - Dissolved	65	64	60	60	62	59	43	50	47	40	43	58	-11%	-9%	-4%	-4%	-7%	-1%	34%	15%	22%	46%	35%
Zn - Total	547	567	551	369	444	406	380	334	316	282	308	456	-17%	-20%	-17%	23%	3%	12%	20%	36%	44%	62%	48%
Zn - Dissolved	225	208	193	194	194	201	156	161	149	119	143	181	-20%	-13%	-7%	-7%	-7%	-10%	16%	12%	21%	52%	26%
Cd - Total	1.3	1.6	1.2	0.53	0.64	0.57	0.70	0.43	0.38	0.39	0.46	0.65	-48%	-58%	-47%	23%	1%	14%	-7%	51%	74%	66%	42%
Cd - Dissolved	0.6	0.6	0.5	0.23	0.25	0.25	0.30	--	--	--	--	0.20004	-64%	-68%	-60%	-12%	-20%	-20%	-34%	--	--	--	--
Hg - Total[1]	0.304	0.214	0.208	0.050	0.038	0.038	0.033	0.039	--	--	--	0.020	-93%	-90%	-90%	-59%	-46%	-46%	-38%	-48%	--	--	--
Hg - Dissolved[1]	--	--	--	--	0.012	0.015	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Pb - Total	307	293	253	144	208	166	155	116	126	156	117	201	-35%	-31%	-20%	40%	-3%	21%	30%	73%	60%	29%	72%
Pb - Dissolved	38.7	30.6	30.9	23.1	28.0	22.2	17.6	21.8	22.5	23.1	20.4	26.8	-31%	-12%	-13%	16%	-4%	21%	52%	23%	19%	16%	32%
LPAHs (lbs/1000 per acre)																							
2-Methylnaphthalene	0.070	0.075	0.065	0.047	0.156	0.082	0.097	0.069	0.053	0.052	0.099	0.103	48%	38%	57%	120%	-34%	25%	6%	48%	95%	97%	5%
Acenaphthene	0.040	0.035	0.032	--	0.062	0.046	0.029	--	0.042	0.047	--	0.052	29%	46%	62%	--	-17%	12%	79%	--	24%	10%	--
Acenaphthylene	0.026	0.029	0.026	--	--	0.056	0.050	0.048	--	--	--	0.050	97%	75%	91%	--	--	-11%	1%	4%	--	--	--
Anthracene	0.035	0.044	0.033	0.047	0.061	0.090	0.081	0.090	0.058	0.065	0.085	0.055	60%	26%	67%	18%	-9%	-38%	-32%	-39%	-4%	-14%	-35%
Fluorene	0.040	0.067	0.065	--	0.053	0.068	0.047	0.043	--	--	--	0.064	59%	-5%	-1%	--	22%	-5%	36%	49%	--	--	--
Naphthalene	0.086	0.094	0.076	0.060	0.298	0.106	0.179	0.130	0.100	0.085	0.113	0.121	40%	28%	59%	103%	-59%	14%	-32%	-7%	21%	43%	7%
Phenanthrene	0.161	0.158	0.180	0.109	0.197	0.202	0.171	0.220	0.119	0.130	0.155	0.198	23%	26%	10%	82%	1%	-2%	15%	-10%	66%	52%	28%
LPAH - Total	0.395	0.436	0.378	0.351	0.737	0.556	0.545	0.560	0.345	0.371	0.453	0.517	31%	19%	37%	47%	-30%	-7%	-5%	-8%	50%	39%	14%
HPAHs (lbs/1000 per acre)																							
Benzo(a)anthracene	0.033	0.066	0.066	0.066	0.066	0.269	0.253	0.254	0.081	0.077	0.131	0.085	155%	29%	28%	28%	28%	-69%	-67%	-67%	4%	10%	-35%
Benzo(a)pyrene	0.057	0.050	0.064	0.064	0.064	0.043	0.046	0.036	0.096	0.088	0.119	0.071	23%	41%	11%	11%	11%	65%	53%	95%	-26%	-20%	-41%
Benzo(g,h,i)perylene	0.090	0.100	0.106	0.106	0.106	0.393	0.395	0.419	0.162	0.142	0.154	0.165	84%	65%	56%	56%	56%	-58%	-58%	-61%	2%	16%	7%
Benzo(b,L)fluoranthenes	0.147	0.132	0.158	0.170	0.446	0.415	0.436	0.371	0.260	0.247	0.326	0.255	74%	94%	62%	50%	-43%	-39%	-42%	-31%	-2%	3%	-22%
Chrysene	0.127	0.118	0.102	0.130	0.302	0.271	0.256	0.257	0.183	0.162	0.199	0.126	-1%	7%	24%	-3%	-58%	-53%	-51%	-51%	-31%	-22%	-36%
Dibenz(a,h)anthracene	--	--	0.021	0.037	0.052	0.044	0.047	0.039	0.028	--	--	0.032	--	--	56%	-12%	-38%	-26%	-32%	-17%	14%	--	--
Fluoranthene	0.281	0.274	0.270	0.204	0.417	0.385	0.388	0.407	0.255	0.234	0.294	0.296	5%	8%	10%	45%	-29%	-23%	-24%	-27%	16%	26%	1%
Indeno(1,2,3-c,d)pyrene	0.054	0.053	0.066	0.092	0.158	0.141	0.158	0.144	0.102	0.089	0.101	0.092	70%	74%	40%	0%	-42%	-35%	-42%	-36%	-10%	4%	-9%
Pyrene	0.309	0.313	0.279	0.251	0.574	0.476	0.464	0.476	0.322	0.261	0.374	0.369	19%	18%	32%	47%	-36%	-23%	-21%	-22%	15%	41%	-1%
Retene	--	--	--	--	--	--	--	--	--	0.041	0.077	0.081	--	--	--	--	--	--	--	--	--	98%	6%
HPAH - Total	1.14	1.12	1.10	1.18	2.54	2.21	2.25	2.162	1.445	1.282	1.680	1.425	25%	27%	30%	21%	-44%	-35%	-37%	-34%	-1%	11%	-15%
Phthalates (lbs/1000 per acre)																							
DEHP	10.7	8.2	7.2	8.6	18.3	13.5	10.4	10.0	6.7	5.6	6.4	11.3	6%	38%	57%	33%	-38%	-16%	9%	13%	69%	101%	78%
Butylbenzyl-phthalate	2.0	3.08	2.30	3.72	3.76	4.49	2.59	5.28	5.20	3.07	3.78	--	--	--	--	--	--	--	--	--	--	--	--
Diethyl-phthalate	1.9	--	1.13	1.33	1.80	1.60	1.47	2.07	1.95	2.51	1.75	--	--	--	--	--	--	--	--	--	--	--	--
Dimethyl-phthalate	0.29	--	--	1.24	2.11	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Di-n-butyl-phthalate	1.8	1.5	2.0	1.5	2.2	1.9	1.4	1.4	1.4	1.3	1.8	1.7	-3%	17%	-13%	18%	-21%	-8%	21%	20%	20%	33%	-6%
Di-n-octylphthalate	--	0.8	--	1.4	3.5	2.0	1.5	1.7	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Phthalates - Total	16.2	11.9	10.0	13.1	25.5	19.0	13.4	17.4	13.7	10.4	11.5	12.7	-21%	7%	27%	-3%	-50%	-33%	-5%	-27%	-7%	22%	11%
Pesticides (lbs/1000 per acre)																							
Bifenthrin	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Dichlobenil	4.22	0.74	0.26	0.67	0.50	0.39	0.26	0.30	0.25	0.24	0.58	1.20	-72%	61%	369%	78%	140%	203%	364%	301%	386%	396%	107%

Note: Mass loadings were not calculated for parameters with fewer than 10 percent detected concentrations or only one detected sample in stormwater.

[1] *In WY2015, total and dissolved mercury detection limits were lowered by a factor of 1,000 from parts per billion to part per trillion. The WY2012 loadings are based on ppb and may be a factor of 1000 higher than actual loadings.*

The estimated mass load comparisons to WY2020 are greater than a factor of two of each other (i.e., the percent difference greater than 100%). (yellow)

The estimated mass load comparisons to WY2020 are less than a factor of two of each other (i.e., the percent difference less than – 75%). (green)

Table 6-2.1 (Cont'd)
Pollutant Loading Summary Comparison - WY2010-12 and WY2015-2023

	OF237B - Residential																						
													Percent Difference										
	WY2010	WY2011	WY2012	WY2015	WY2016	WY2017	WY2018	WY2019	WY2020	WY2021	WY2022	WY2023 Est.	WY2010 to WY2023	WY2011 to WY2023	WY2012 to WY2023	WY2015 to WY2023	WY2016 to WY2023	WY2017 to WY2023	WY2018 to WY2023	WY2019 to WY2023	WY2020 to WY2023	WY2021 to WY2023	WY2022 to WY2023
Conventionals (lbs per acre)																							
TSS	270	494	144	131	209	161	178	105	133	96	117	95	-65%	-81%	-34%	-27%	-54%	-41%	-46%	-9%	-28%	-1%	-18%
MBAS	0.38	0.65	0.43	0.19	0.41	0.13	0.43	0.34	0.42	0.32	0.40	0.40	6%	-38%	-7%	116%	-2%	213%	-6%	20%	-4%	26%	1%
BOD_5	21	24	31	16	52	8	46	20	27	25	26	30	43%	27%	-4%	84%	-43%	262%	-34%	52%	13%	18%	15%
Total Phosphorus	0.91	1.40	0.86	0.89	0.89	0.42	0.83	0.66	0.81	0.76	0.73	0.68	-25%	-51%	-21%	-24%	-24%	62%	-18%	3%	-16%	-11%	-6%
Orthophophorus	0.50	0.37	0.48	0.41	0.44	0.06	0.45	0.39	0.36	0.44	0.44	0.50	-1%	34%	3%	20%	12%	701%	10%	29%	38%	14%	12%
TN	5.1	7.7	4.5	6.4	36.9	2.1	38.5	35.7	36.8	37.3	38.1	41.4	708%	435%	811%	549%	12%	1889%	7%	16%	12%	11%	8%
Nitrate/Nitrite -Total	36.4	36.7	32.2	37.2	36.8	1.2	38.0	35.0	34.8	37.3	37.4	40.5	11%	10%	26%	9%	10%	3390%	6%	16%	16%	8%	8%
Metals (lbs/1000 per acre)																							
Cu - Total	52	94	61	36	48	35	27	20	29	28	28	26	-51%	-73%	-58%	-28%	-47%	-26%	-7%	26%	-12%	-8%	-9%
Cu - Dissolved	19	25	25	13	14	11	10	7	11	10	12	10	-47%	-60%	-61%	-24%	-31%	-10%	0%	42%	-9%	-3%	-17%
Zn - Total	276	511	278	216	278	264	174	125	188	162	151	146	-47%	-71%	-48%	-32%	-48%	-45%	-16%	16%	-22%	-10%	-3%
Zn - Dissolved	123	222	126	105	119	147	85	57	79	69	74	64	-47%	-71%	-49%	-38%	-46%	-56%	-24%	12%	-18%	-7%	-13%
Cd - Total	1.6	1.5	1.1	0.67	0.61	0.23	0.30	0.15	0.24	0.23	--	0.23	-85%	-85%	-80%	-66%	-62%	2%	-23%	56%	-4%	2%	--
Cd - Dissolved	1.6	0.8	0.8	0.61	0.25	0.09	--	--	--	--	--	0.16	-90%	-79%	-80%	-73%	-33%	90%	--	--	--	--	--
Hg - Total[1]	0.585	--	--	0.043	0.046	0.035	0.023	0.060	--	--	--	0.036	-94%	--	--	-16%	-20%	4%	55%	-39%	--	--	--
Hg - Dissolved[1]	--	--	--	0.015	0.017	0.012	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Pb - Total	53	107	52	37	50	28	21	13	19	18	17	15	-72%	-86%	-71%	-60%	-71%	-48%	-28%	17%	-20%	-18%	-11%
Pb - Dissolved	2.1	2.5	2.5	1.4	4.5	0.8	1.0	1.1	1.3	1.0	1.3	1.1	-47%	-56%	-54%	-21%	-75%	37%	9%	-1%	-13%	16%	-12%
LPAHs (lbs/1000 per acre)																							
2-Methylnaphthalene	0.072	0.070	0.225	0.055	0.079	0.031	0.065	0.096	0.096	0.064	0.080	0.061	-15%	-12%	-73%	12%	-23%	100%	-5%	-36%	-36%	-5%	-24%
Acenaphthene	0.045	--	--	--	--	--	0.077	--	0.061	0.108	--	--	--	--	--	--	--	--	--	--	--	--	--
Acenaphthylene	0.044	--	--	--	0.056	0.017	0.049	0.031	--	--	--	0.056	26%	--	--	--	1%	227%	15%	80%	--	--	--
Anthracene	0.041	--	--	--	--	0.016	--	--	--	--	--	0.043	6%	--	--	--	--	176%	--	--	--	--	--
Fluorene	0.049	0.052	0.060	0.051	0.043	0.018	0.045	0.043	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Naphthalene	0.149	0.136	0.223	0.122	0.174	0.056	0.161	0.147	0.138	--	0.144	0.121	-19%	-11%	-46%	-2%	-31%	117%	-25%	-18%	-13%	--	-17%
Phenanthrene	0.117	0.146	0.137	0.111	0.243	0.155	0.152	0.130	0.120	0.121	0.104	0.133	14%	-9%	-3%	20%	-45%	-14%	-12%	2%	11%	10%	28%
LPAH - Total	0.364	0.523	0.534	0.501	0.638	0.267	0.510	0.430	0.451	0.475	0.481	0.467	28%	-11%	-13%	-7%	-27%	75%	-9%	8%	4%	-2%	-3%
HPAHs (lbs/1000 per acre)																							
Benzo(a)anthracene	0.052	0.102	0.053	0.062	0.145	0.081	0.078	0.062	0.068	0.051	0.065	0.067	28%	-34%	27%	8%	-54%	-17%	-14%	8%	-1%	33%	3%
Benzo(a)pyrene	0.062	0.087	0.053	0.068	0.200	0.112	0.121	0.076	0.076	0.068	0.084	0.072	17%	-17%	37%	7%	-64%	-35%	-41%	-5%	-5%	7%	-14%
Benzo(g,h,i)perylene	0.103	0.143	0.053	0.085	0.185	0.131	0.115	0.116	0.124	0.091	0.091	0.085	-18%	-41%	60%	0%	-54%	-35%	-26%	-27%	-31%	-7%	-7%
Benzo(b,L)fluoranthenes	0.155	0.230	0.075	0.118	0.469	0.259	0.285	0.179	0.198	0.178	0.228	0.189	22%	-18%	151%	60%	-60%	-27%	-34%	5%	-5%	6%	-17%
Chrysene	0.090	0.142	0.051	0.073	0.279	0.175	0.140	0.104	0.113	0.092	0.099	0.067	-25%	-52%	32%	-7%	-76%	-62%	-52%	-35%	-40%	-27%	-32%
Dibenz(a,h)anthracene	--	--	--	0.045	0.063	0.027	0.040	0.033	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Fluoranthene	0.159	0.233	0.125	0.133	0.373	0.252	0.200	0.169	0.182	0.139	0.171	0.163	3%	-30%	31%	23%	-56%	-35%	-18%	-4%	-10%	17%	-5%
Indeno(1,2,3-c,d)pyrene	0.068	0.091	0.041	0.066	0.159	0.110	0.098	0.084	0.086	0.071	0.084	0.076	11%	-17%	85%	15%	-52%	-31%	-23%	-10%	-12%	6%	-9%
Pyrene	0.181	0.286	0.144	0.150	0.450	0.285	0.224	0.190	0.226	0.148	0.198	0.169	-7%	-41%	17%	13%	-62%	-41%	-24%	-11%	-25%	14%	-14%
Retene	--	--	--	--	--	--	--	--	--	--	0.047	0.059	--	--	--	--	--	--	--	--	--	--	24%
HPAH - Total	0.793	1.354	0.534	0.800	2.32	1.43	1.30	1.01	1.11	0.87	1.06	0.92	16%	-32%	72%	15%	-60%	-36%	-29%	-9%	-17%	5%	-13%
Phthalates (lbs/1000 per acre)																							
DEHP	9.6	8.4	5.5	6.0	11.5	8.1	5.6	6.5	6.2	5.1	5.7	5.3	-45%	-37%	-4%	-12%	-54%	-35%	-6%	-18%	-15%	4%	-8%
Butylbenzyl-phthalate	2.1	--	--	2.25	2.99	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Diethyl-phthalate	2.0	--	--	3.33	12.66	0.21	--	4.24	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Dimethyl-phthalate	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Di-n-butyl-phthalate	3.2	2.4	3.7	2.4	1.8	1.0	1.6	2.3	2.6	2.6	3.0	2.5	-23%	3%	-32%	4%	39%	138%	54%	10%	-4%	-6%	-17%
Di-n-octylphthalate	--	1.2	0.9	1.3	3.6	1.1	--	2.6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Phthalates - Total	13.5	14.8	11.2	12.8	26.9	9.7	9.3	12.7	9.9	8.3	9.5	9.0	-33%	-39%	-19%	-29%	-66%	-7%	-3%	-29%	-9%	8%	-5%
Pesticides (lbs/1000 per acre)																							
Bifenthrin	0.45	0.79	1.14	--	--	--	0.00			--	--	0.08	-81%	-89%	-93%	--	--	--	--	--	--	--	--
Dichlobenil	0.45	0.79	1.14	0.31	2.97	0.23	0.28	0.38	0.45	0.40	0.53	0.40	-11%	-49%	-65%	29%	-87%	73%	41%	5%	-13%	-1%	-25%

Note: Mass loadings were not calculated for parameters with fewer than 10 percent detected concentrations or only one detected sample in stormwater.

[1] *In WY2015, total and dissolved mercury detection limits were lowered by a factor of 1,000 from parts per billion to part per trillion. The WY2012 loadings are based on ppb and may be a factor of 1000 higher than actual loadings.*

The estimated mass load comparisons to WY2020 are greater than a factor of two of each other (i.e., the percent difference greater than 100%).

The estimated mass load comparisons to WY2020 are less than a factor of two of each other (i.e., the percent difference less than – 75%).

Table 6-2.1 (Cont'd)
Pollutant Loading Summary Comparison - WY2010-12 and WY2015-2023

	OF245 - Industrial																						
													Percent Difference										
	WY2010	WY2011	WY2012	WY2015	WY2016	WY2017	WY2018	WY2019	WY2020	WY2021	WY2022	WY2023 Est.	WY2010 to WY2023	WY2011 to WY2023	WY2012 to WY2023	WY2015 to WY2023	WY2016 to WY2023	WY2017 to WY2023	WY2018 to WY2023	WY2019 to WY2023	WY2020 to WY2023	WY2021 to WY2023	WY2022 to WY2023
Conventionals (lbs per acre)																							
TSS	392	323	181	278	637	462	362	504	247	410	184	210	-46%	-35%	16%	-24%	-67%	-55%	-42%	-58%	-15%	-49%	14%
MBAS	0.59	0.66	0.77	0.30	0.35	0.57	0.31	0.31	0.48	0.27	0.48	0.35	-41%	-48%	-55%	14%	-2%	-40%	13%	13%	-28%	27%	-28%
BOD_5	24	18	13	14	28	35	25	25	25	20	20	18	-26%	-1%	35%	29%	-35%	-49%	-29%	-27%	-28%	-10%	-8%
Total Phosphorus	1.22	1.16	0.59	1.67	2.49	2.31	1.24	1.44	1.25	1.08	0.92	0.87	-29%	-25%	47%	-48%	-65%	-62%	-30%	-40%	-30%	-20%	-5%
Orthophophorus	0.19	0.09	0.11	0.41	0.26	0.57	0.25	0.30	0.25	0.18	0.24	0.25	30%	174%	133%	-40%	-6%	-57%	0%	-17%	-1%	38%	1%
TN	6.9	5.2	2.7	3.6	6.6	7.4	7.0	5.3	5.3	3.7	3.9	3.4	-51%	-35%	24%	-7%	-49%	-55%	-52%	-37%	-36%	-9%	-14%
Nitrate/Nitrite -Total	2.4	0.9	0.9	1.0	1.5	1.5	1.9	1.8	1.4	0.8	0.9	0.9	-61%	2%	-1%	-6%	-40%	-39%	-51%	-48%	-33%	12%	6%
Metals (lbs/1000 per acre)																							
Cu - Total	101	118	94	71	181	126	84	110	71	84	60	62	-38%	-47%	-34%	-12%	-66%	-50%	-26%	-44%	-13%	-26%	3%
Cu - Dissolved	24	27	32	21	41	29	--	26	23.239	18.904	20	17	-29%	-37%	-46%	-19%	-59%	-41%	--	-35%	-27%	-10%	-16%
Zn - Total	639	880	734	430	1116	796	694	787	607	556	399	424	-34%	-52%	-42%	-1%	-62%	-47%	-39%	-46%	-30%	-24%	6%
Zn - Dissolved	300	491	368	181	338	290	324	210	291	176	184	145	-52%	-71%	-61%	-20%	-57%	-50%	-55%	-31%	-50%	-18%	-22%
Cd - Total	2.2	6.6	2.5	0.96	4.62	2.69	1.22	4.23	1.15	1.31	1.06	0.79	-65%	-88%	-68%	-18%	-83%	-71%	-36%	-81%	-32%	-40%	-26%
Cd - Dissolved	0.8	4.2	1.4	0.36	1.98	1.04	0.49	1.35	0.47	0.44	0.52	0.31	-61%	-93%	-78%	-13%	-84%	-70%	-38%	-77%	-35%	-31%	-41%
Hg - Total[1]	0.247	--	--	0.030	0.067	0.047	0.023	0.030	0.040	0.035	--	0.020	-92%	--	--	-34%	-70%	-57%	-11%	-33%	-50%	-43%	--
Hg - Dissolved[1]	--	--	--	0.008	0.016	--	--	0.031	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Pb - Total	61	69	44	34	106	74	41	50	25	35	18	20	-67%	-71%	-55%	-40%	-81%	-73%	-51%	-60%	-21%	-42%	9%
Pb - Dissolved	3.5	2.5	2.0	0.9	2.7	1.2	1.2	1.7	1.2	1.1	1.0	0.9	-75%	-65%	-56%	-7%	-67%	-27%	-24%	-47%	-24%	-16%	-11%
LPAHs (lbs/1000 per acre)																							
2-Methylnaphthalene	0.075	0.061	0.045	0.136	0.144	0.182	0.130	0.076	0.058	0.149	0.202	0.053	-30%	-14%	17%	-61%	-63%	-71%	-60%	-31%	-9%	-65%	-74%
Acenaphthene	0.065	0.064	0.063	0.066	0.189	0.314	0.064	0.062	0.096	0.077	--	0.032	-51%	-50%	-49%	-52%	-83%	-90%	-50%	-49%	-67%	-59%	--
Acenaphthylene	0.041	0.034	0.042	0.051	0.096	0.075	0.040	0.047	--	--	--	0.028	-31%	-17%	-33%	-45%	-71%	-62%	-29%	-39%	--	--	--
Anthracene	0.033	0.036	0.032	0.044	0.103	0.109	0.049	0.073	0.038	--	--	0.019	-42%	-48%	-42%	-58%	-82%	-83%	-62%	-74%	-50%	--	--
Fluorene	0.066	0.059	0.052	0.076	0.102	0.282	0.051	0.074	0.040	--	0.066	0.049	-27%	-18%	-7%	-36%	-52%	-83%	-5%	-34%	21%	--	-27%
Naphthalene	0.177	0.105	0.098	0.173	0.176	0.260	0.209	0.249	0.140	0.277	0.589	0.106	-40%	1%	8%	-39%	-40%	-59%	-49%	-57%	-24%	-62%	-82%
Phenanthrene	0.245	0.138	0.161	0.247	0.403	0.605	0.224	0.264	0.183	0.204	0.173	0.210	-14%	52%	30%	-15%	-48%	-65%	-6%	-20%	15%	3%	21%
LPAH - Total	0.637	0.436	0.407	0.657	1.139	1.645	0.638	0.768	0.531	0.693	0.981	0.444	-30%	2%	9%	-32%	-61%	-73%	-30%	-42%	-16%	-36%	-55%
HPAHs (lbs/1000 per acre)																							
Benzo(a)anthracene	0.048	0.042	0.025	0.078	0.153	0.131	0.061	0.069	0.039	0.034	--	0.024	-50%	-43%	-4%	-69%	-84%	-82%	-60%	-65%	-38%	-29%	--
Benzo(a)pyrene	0.044	0.035	--	0.081	0.212	0.149	0.086	0.095	0.050	0.076	0.047	0.023	-48%	-33%	--	-71%	-89%	-84%	-73%	-76%	-53%	-69%	-50%
Benzo(g,h,i)perylene	0.087	0.059	0.050	0.149	0.224	0.205	0.149	0.172	0.089	0.159	0.094	0.076	-12%	29%	53%	-49%	-66%	-63%	-49%	-56%	-14%	-52%	-19%
Benzo(b,L)fluoranthenes	0.112	0.080	--	0.137	0.456	0.326	0.208	0.222	0.129	0.171	0.141	0.109	-2%	36%	--	-21%	-76%	-67%	-48%	-51%	-15%	-36%	-23%
Chrysene	0.092	0.067	0.039	0.166	0.219	0.272	0.113	0.151	0.074	0.118	0.089	0.055	-40%	-18%	42%	-67%	-75%	-80%	-51%	-64%	-25%	-53%	-38%
Dibenz(a,h)anthracene	--	--	--	0.052	0.053	0.044	0.030	0.028	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Fluoranthene	0.203	0.142	0.121	0.168	0.529	0.519	0.257	0.356	0.198	0.249	0.186	0.180	-11%	27%	49%	7%	-66%	-65%	-30%	-49%	-9%	-28%	-3%
Indeno(1,2,3-c,d)pyrene	0.044	0.031	0.025	0.095	0.147	0.134	0.081	0.158	0.046	0.052	0.043	0.032	-27%	3%	29%	-66%	-78%	-76%	-60%	-80%	-30%	-39%	-25%
Pyrene	0.242	0.203	0.153	0.344	0.853	0.617	0.372	0.512	0.295	0.470	0.277	0.209	-13%	3%	37%	-39%	-75%	-66%	-44%	-59%	-29%	-55%	-24%
Retene	--	--	--	--	--	--	--	--	--	0.086	0.071	0.064	--	--	--	--	--	--	--	--	--	-26%	-10%
HPAH - Total	0.906	0.676	0.393	1.269	2.843	2.40	1.36	1.67	0.94	1.35	0.94	0.73	-20%	7%	85%	-43%	-74%	-70%	-46%	-57%	-23%	-46%	-23%
Phthalates (lbs/1000 per acre)																							
DEHP	5.0	4.3	5.4	12.7	26.7	16.7	9.0	10.4	7.6	7.6	8.8	6.3	25%	48%	16%	-51%	-76%	-62%	-30%	-39%	-17%	-18%	-29%
Butylbenzyl-phthalate	1.8	--	1.34	2.27	3.33	2.30	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Diethyl-phthalate	1.3	--	--	--	3.96	2.13	--	3.03	--	--	--	0.931	-27%	--	--	--	-76%	-56%	--	-69%	--	--	--
Dimethyl-phthalate	0.23	--	--	--	1.82	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Di-n-butyl-phthalate	2.3	2.1	2.1	2.7	2.3	2.8	1.5	2.5	2.3	5.6	11.8	7.2	213%	245%	240%	165%	212%	159%	378%	187%	222%	29%	-38%
Di-n-octylphthalate	--	--	--	1.1	2.9	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Phthalates - Total	11.1	7.2	6.7	17.3	35.9	21.5	9.7	14.6	9.6	13.1	21.0	13.4	21%	86%	99%	-23%	-63%	-38%	39%	-8%	39%	2%	-36%
Pesticides (lbs/1000 per acre)																							
Bifenthrin	0.24	0.14	0.16	--	--	--	--		--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Dichlobenil	0.24	0.14	0.16	0.40	0.46	0.22	0.22	0.33	0.34	0.11	0.20	0.08	-67%	-45%	-52%	-81%	-83%	-64%	-65%	-76%	-77%	-31%	-62%

Note: Mass loadings were not calculated for parameters with fewer than 10 percent detected concentrations or only one detected sample in stormwater.

[1] In WY2015, total and dissolved mercury detection limits were lowered by a factor of 1,000 from parts per billion to part per trillion. The WY2012 loadings are based on ppb and may be a factor of 1000 higher than actual loadings.

(yellow) The estimated mass load comparisons to WY2020 are greater than a factor of two of each other (i.e., the percent difference greater than 100%).

(green) The estimated mass load comparisons to WY2020 are less than a factor of two of each other (i.e., the percent difference less than – 75%).

Table 6-2.2
Pollutant Loading Summary Comparison - WY2016-WY2023

	OF237A - Residential														
									Precent Difference						
	WY2016	WY2017	WY2018	WY2019	WY2020	WY2021	WY2022	WY2023	WY2016 to WY2023	WY2017 to WY2023	WY2018 to WY2023	WY2019 to WY2023	WY2020 to WY2023	WY2021 to WY2023	WY2022 to WY2023
Conventionals (lbs per acre)															
TSS	97.7	130.8	118	68	55	145	113	95	-3%	-27%	-20%	40%	75%	-34%	-16%
MBAS	0.19	0.22	0.17	0.14	0.17	0.18	0.21	0.17	-6%	-19%	2%	26%	4%	-3%	-15%
BOD$_5$	11.46	10.33	11.69	8.58	9.64	16.37	14.69	13.61	19%	32%	16%	59%	41%	-17%	-7%
Total Phosphorus	0.46	0.41	0.37	0.26	0.31	0.40	0.37	0.35	-24%	-15%	-5%	38%	15%	-13%	-5%
Orthophosphorus	0.22	0.21	0.18	0.15	0.18	0.17	0.16	0.19	-14%	-7%	6%	25%	4%	13%	18%
TN	9.93	9.91	9.82	9.15	9.81	9.37	9.72	9.82	-1%	-1%	0%	7%	0%	5%	1%
Nitrate/Nitrite -Total	9.90	9.67	9.40	9.06	9.14	9.35	8.70	9.13	-8%	-6%	-3%	1%	0%	-2%	5%
Metals (lbs/1000 per acre)															
Cu - Total	37	31	27	15	20	34	26	25	-32%	-19%	-7%	66%	27%	-26%	-1%
Cu - Dissolved	15	11	8	5	11	9	10	9	-42%	-20%	8%	70%	-22%	-5%	-12%
Zn - Total	355	247	172	107	134	207	178	180	-49%	-27%	4%	68%	34%	-13%	1%
Zn - Dissolved	220	134	74	50	75	78	90	83	-62%	-38%	12%	67%	11%	6%	-7%
Cd - Total	0.88	0.74	0.84	0.53	0.51	0.65	0.58	0.57	-35%	-23%	-32%	7%	11%	-13%	-2%
Cd - Dissolved	0.91	0.09	--	--	--	--	--	0.15	-84%	71%	--	--	--	--	--
Hg - Total[1]	0.043	0.027	0.023	0.020	--	--	--	0.019	-56%	-30%	-18%	-4%	--	--	--
Hg - Dissolved[1]	0.014	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Pb - Total	25.2	25.3	22.5	10.8	11.1	25.1	17.6	16.5	-35%	-35%	-26%	54%	49%	-34%	-6%
Pb - Dissolved	1.15	0.98	0.88	0.52	0.89	0.75	0.87	1.09	-5%	12%	24%	111%	23%	46%	26%
LPAHs (lbs/1000 per acre)															
2-Methylnaphthalene	0.063	0.041	0.057	0.519	0.048	0.058	0.056	0.087	39%	114%	54%	-83%	80%	49%	57%
Acenaphthene	--	--	0.028	0.047	0.032	0.058	--	--	--	--	--	--	--	--	--
Acenaphthylene	0.036	0.027	0.031	0.025	--	0.044	0.044	--	--	--	--	--	--	--	--
Anthracene	--	0.039	0.048	0.028	--	0.038	--	0.04	--	11%	-9%	56%	--	15%	--
Fluorene	0.032	0.034	0.036	0.025	--	0.038	0.044	0.031	-3%	-9%	-14%	24%	--	-18%	-29%
Naphthalene	0.116	0.070	0.101	0.029	0.075	0.096	0.093	0.097	-17%	37%	-4%	238%	29%	1%	4%
Phenanthrene	0.158	0.202	0.233	0.072	0.108	0.240	0.178	0.151	-4%	-25%	-35%	109%	40%	-37%	-15%
LPAH - Total	0.383	0.364	0.440	0.091	0.263	0.475	0.391	0.338	-12%	-7%	-23%	270%	29%	-29%	-13%
HPAHs (lbs/1000 per acre)															
Benzo(a)anthracene	0.127	0.193	0.181	0.069	0.065	0.149	0.113	0.114	-11%	-41%	-37%	65%	76%	-24%	1%
Benzo(a)pyrene	0.175	0.277	0.266	0.101	0.086	0.219	0.173	0.093	-47%	-66%	-65%	-8%	8%	-57%	-46%
Benzo(g,h,i)perylene	0.168	0.254	0.251	0.111	0.124	0.239	0.300	0.140	-17%	-45%	-44%	26%	13%	-42%	-53%
Benzo(b,k)fluoranthenes	0.488	0.812	0.662	0.250	0.232	0.601	1.025	0.446	-9%	-45%	-33%	78%	92%	-26%	-57%
Chrysene	0.261	0.425	0.343	0.130	0.138	0.307	0.358	0.191	-27%	-55%	-44%	47%	39%	-38%	-47%
Dibenz(a,h)anthracene	0.052	0.072	0.069	0.031	0.028	0.051	0.212	0.027	-47%	-62%	-60%	-13%	-1%	-47%	-87%
Fluoranthene	0.334	0.542	0.510	0.193	0.185	0.509	0.409	0.321	-4%	-41%	-37%	66%	74%	-37%	-22%
Indeno(1,2,3-c,d)pyrene	0.162	0.257	0.268	0.107	0.108	0.226	0.321	0.140	-14%	-45%	-48%	31%	30%	-38%	-56%
Pyrene	0.371	0.487	0.459	0.182	0.198	0.424	0.400	0.281	-24%	-42%	-39%	54%	42%	-34%	-30%
Retene	--	--	--	--	--	0.055	0.176	0.052	--	--	--	--	--	-5%	-70%
HPAH - Total	2.053	3.224	2.916	1.101	1.093	2.657	3.245	1.688	-18%	-48%	-42%	53%	54%	-36%	-48%
Phthalates (lbs/1000 per acre)															
DEHP	9.45	8.91	6.24	3.84	4.76	5.23	5.78	4.97	-47%	-44%	-20%	29%	4%	-5%	-14%
Butylbenzyl-phthalate	2.41	2.64	--	--	--	--	--	--	--	--	--	--	--	--	--
Diethyl-phthalate	3.17	2.22	--	2.92	1.96	--	--	1.92	-40%	-14%	--	-34%	-2%	--	--
Dimethyl-phthalate	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Di-n-butyl-phthalate	2.24	2.40	2.31	1.70	1.59	1.65	2.26	1.78	-21%	-26%	-23%	4%	11%	7%	-21%
Di-n-octylphthalate	3.66	3.09	2.46	1.87	--	--	--	--	--	--	--	--	--	--	--
Phthalates - Total	13.36	10.50	6.60	5.93	5.72	5.71	7.64	7.05	-47%	-33%	7%	19%	23%	24%	-8%
Pesticides (lbs/1000 per acre)															
Bifenthrin	--	--	--	--	--	0.04	0.07	0.03	--	--	--	--	--	-3%	-51%
Dichlobenil	0.41	0.35	0.33	0.30	0.35	0.37	0.34	0.26	-37%	-25%	-20%	-13%	-26%	-29%	-23%

Note: Mass loadings were not calculated for parameters with fewer than 10 percent detected concentrations or only one detected sample in stormwater.

OF230 and OF254 are not reported due to change in basin area and limited qualifying storm events or accepted samples for WY2023.

(yellow)	*The estimated mass load comparisons to WY2020 are greater than a factor of two of each other (i.e., the percent difference greater than 100%).*
(green)	*The estimated mass load comparisons to WY2020 are less than a factor of two of each other (i.e., the percent difference less than – 75%).*

Table 6-2.2 (Cont'd)
Pollutant Loading Summary Comparison - WY2016-WY2023

OF243 - Industrial														
								Percent Difference						
WY2016	WY2017	WY2018	WY2019	WY2020	WY2021	WY2022	WY2023	WY2016 to WY2023	WY2017 to WY2023	WY2018 to WY2023	WY2019 to WY2023	WY2020 to WY2023	WY2021 to WY2023	WY2022 to WY2023
101	366	143	211	70	80	80	51	-50%	-86%	-64%	-76%	-27%	-36%	-36%
0.16	0.21	0.11	0.11	0.07	0.08	0.12	0.12	-28%	-44%	5%	3%	66%	44%	-1%
6.17	12.02	9.65	12.29	2.92	8.10	7.36	2.84	-54%	-76%	-71%	-77%	-2%	-65%	-61%
1.30	1.94	1.41	2.56	0.41	0.51	0.68	0.32	-75%	-83%	-77%	-87%	-21%	-37%	-53%
0.15	0.09	0.09	0.06	0.05	0.07	0.08	0.07	-52%	-25%	-26%	20%	31%	0%	-12%
1.74	1.95	2.22	2.46	1.51	1.42	1.54	1.38	-21%	-29%	-38%	-44%	-9%	-3%	-11%
0.83	0.98	0.60	0.68	0.46	0.47	0.65	0.47	-44%	-52%	-22%	-31%	2%	0%	-28%
58	154	67	78	36	38	39	36	-37%	-76%	-46%	-53%	0%	-4%	-7%
10	16	9	14	6	9	12	10	-5%	-39%	4%	-29%	75%	9%	-16%
219	361	204	217	106	124	133	95	-57%	-74%	-53%	-56%	-10%	-23%	-29%
93	80	52	64	34	48	57	48	-48%	-40%	-8%	-25%	40%	1%	-16%
0.98	1.45	1.01	0.75	0.41	0.56	0.62	0.37	-62%	-74%	-63%	-50%	-10%	-34%	-40%
0.48	0.29	0.31	0.24	0.14	0.20	0.21	0.18	-63%	-38%	-42%	-27%	25%	-11%	-14%
0.026	0.151	0.031	0.074	0.011	0.010	--	0.009	-65%	-94%	-71%	-88%	-13%	-9%	--
0.006	0.005	--	0.012	--	--	--	--	--	--	--	--	--	--	--
36.7	125.2	51.3	76.1	17.6	27.0	24.8	23.5	-36%	-81%	-54%	-69%	34%	-13%	-5%
0.19	0.22	0.30	0.98	0.28	0.56	0.84	0.86	343%	289%	183%	-12%	210%	53%	3%
0.060	0.013	0.023	0.028	0.028	0.027	0.034	0.014	-77%	1%	-41%	-51%	-51%	-50%	-60%
0.162	0.026	0.047	0.050	0.081	0.053	0.042	0.030	-82%	13%	-37%	-41%	-63%	-44%	-29%
0.041	0.033	0.023	0.030	0.011	0.016	0.021	0.029	-30%	-13%	24%	-4%	165%	82%	34%
0.095	0.130	0.098	0.124	0.107	0.086	0.103	0.075	-21%	-42%	-23%	-39%	-30%	-13%	-27%
0.075	0.036	0.026	0.035	0.015	0.016	0.023	0.017	-78%	-54%	-35%	-53%	11%	6%	-27%
0.104	0.027	0.063	0.072	0.054	0.054	0.057	0.033	-69%	21%	-48%	-55%	-40%	-40%	-43%
0.154	0.099	0.087	0.098	0.064	0.068	0.072	0.074	-52%	-26%	-15%	-25%	16%	8%	2%
0.631	0.351	0.342	0.409	0.331	0.292	0.333	0.256	-59%	-27%	-25%	-37%	-23%	-12%	-23%
0.085	0.318	0.060	0.041	0.028	0.029	0.032	0.032	-62%	-90%	-46%	-21%	17%	11%	2%
0.092	0.352	0.078	0.050	0.031	0.036	0.038	0.034	-63%	-90%	-56%	-30%	11%	-4%	-9%
0.076	0.312	0.073	0.067	0.039	0.038	0.041	0.030	-60%	-90%	-59%	-55%	-23%	-21%	-27%
0.224	0.772	0.179	0.122	0.076	0.090	0.104	0.101	-55%	-87%	-43%	-17%	33%	13%	-2%
0.142	0.448	0.101	0.081	0.050	0.054	0.054	0.040	-72%	-91%	-60%	-51%	-19%	-26%	-26%
0.021	0.310	0.016	0.008	--	--	--	--	--	--	--	--	--	--	--
0.223	0.269	0.174	0.162	0.097	0.094	0.094	0.102	-54%	-62%	-41%	-37%	6%	9%	8%
0.068	0.342	0.063	0.045	0.031	0.033	0.042	0.032	-53%	-91%	-49%	-28%	4%	-3%	-22%
0.280	0.335	0.180	0.189	0.113	0.091	0.110	0.115	-59%	-66%	-36%	-39%	2%	26%	4%
--	--	--	--	--	0.016	0.026	0.018	--	--	--	--	--	14%	-29%
1.210	3.457	0.924	0.764	0.472	0.471	0.519	0.493	-59%	-86%	-47%	-36%	4%	5%	-5%
4.24	7.74	3.28	4.04	1.58	1.12	2.01	1.63	-62%	-79%	-50%	-60%	4%	45%	-19%
0.66	1.05	--	--	--	--	--	--	--	--	--	--	--	--	--
0.72	0.38	--	0.83	0.63	0.55	1.80	0.45	-37%	20%	--	-45%	-28%	-18%	-75%
0.75	--	--	--	--	--	--	--	--	--	--	--	--	--	--
0.58	0.95	0.66	0.77	0.47	0.53	0.51	0.37	-36%	-61%	-44%	-52%	-22%	-31%	-27%
0.93	1.58	0.67	1.09	--	--	--	--	--	--	--	--	--	--	--
5.11	10.87	3.90	5.93	2.41	1.59	3.98	1.81	-65%	-83%	-54%	-69%	-25%	14%	-54%
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
0.041	0.042	0.06	0.09	0.07	--	0.05	0.02	-43%	-44%	-63%	-73%	-68%	--	-48%

Table 6-3
Pollutant Loading per Acre - WY2023

Conventionals	OF230 Commercial	OF235 Commercial	OF237A Residential	OF237B Residential	OF243 Industrial	OF245 Industrial	OF254 Industrial
TSS	--	188	95	95	51	210	--
MBAS	--	0.39	0.17	0.40	0.12	0.35	--
BOD_5	--	28.9	13.6	30.1	2.8	17.9	--
Total Phosphorus	--	1.164	0.35	0.681	0.323	0.868	--
Orthophosphorus	--	0.69	0.19	0.497	0.070	0.247	--
TN	--	9.5	9.8	41.4	1.4	3.4	--
Nitrate/Nitrite -Total	--	6.0	9.1	40.5	0.5	0.9	--
Metals (lbs/1000 per acre)							
Cu - Total	--	131	25	26	36	62	--
Cu - Dissolved	--	58	9	10	10	17	--
Zn - Total	--	456	180	146	95	424	--
Zn - Dissolved	--	181	83	64	48	145	--
Cd - Total	--	0.65	0.57	0.23	0.37	0.79	--
Cd - Dissolved	--	0.20	0.15	0.16	0.18	0.31	--
Hg - Total	--	0.020	0.019	0.036	0.009	0.02	--
Hg - Dissolved	--	--	--	--	--	--	--
Pb - Total	--	201	17	15	24	20	--
Pb - Dissolved	--	26.8	1.1	1.1	0.9	0.9	--
LPAHs (lbs/1000 per acre)							
2-Methylnaphthalene	--	0.103	0.087	0.061	0.014	0.053	--
Acenaphthene	--	0.052	--	--	0.030	0.032	--
Acenaphthylene	--	0.050	--	0.056	0.029	0.028	--
Anthracene	--	0.055	0.044	0.043	0.075	0.019	--
Fluorene	--	0.064	0.031	--	0.017	0.049	--
Naphthalene	--	0.121	0.097	0.121	0.033	0.106	--
Phenanthrene	--	0.198	0.151	0.133	0.074	0.210	--
LPAH - Total	--	0.517	0.338	0.467	0.256	0.444	--
HPAHs (lbs/1000 per acre)							
Benzo(a)anthracene	--	0.085	0.114	0.067	0.032	0.024	--
Benzo(a)pyrene	--	0.071	0.093	0.072	0.034	0.023	--
Benzo(g,h,i)perylene	--	0.165	0.140	0.085	0.030	0.076	--
Benzo(b,k)fluoranthenes	--	0.255	0.446	0.189	0.101	0.109	--
Chrysene	--	0.126	0.191	0.067	0.040	0.055	--
Dibenz(a,h)anthracene	--	0.032	0.027	--	--	--	--
Fluoranthene	--	0.296	0.321	0.163	0.102	0.180	--
Indeno(1,2,3-c,d)pyrene	--	0.092	0.140	0.076	0.032	0.032	--
Pyrene	--	0.369	0.281	0.169	0.115	0.209	--
Retene	--	0.081	0.052	0.059	0.018	0.064	--
HPAH - Total	--	1.425	1.688	0.919	0.493	0.726	--
Phthalates (lbs/1000 per acre)							
DEHP	--	11.3	5.0	5.3	1.6	6.3	--
Butylbenzyl-phthalate	--	--	--	--	--	--	--
Diethyl-phthalate	--	--	1.92	--	0.45	0.9	--
Dimethyl-phthalate	--	--	--	--	--	--	--
Di-n-butyl-phthalate	--	1.7	1.8	2.5	0.4	7.2	--
Di-n-octylphthalate	--	--	--	--	--	--	--
Phthalates - Total	--	12.7	7.1	9.0	1.8	13.4	--
Pesticides (lbs/1000 per acre)							
Bifenthrin	--	--	0.03	0.083	--	--	--
Dichlobenil	--	1.197	0.262	0.397	0.024	0.077	--

Note: Mass loadings were not calculated for parameters with fewer than 10 percent detected concentrations or only one detected sample in stormwater. OF230 and OF254 are not reported due to change in basin area and limited qualifying storm events or accepted samples for WY2023.

Maximum Pollutant Loading per Acre Value (green shading)

Table 6-4
WY2023 Annual Pollutant Loading

Pounds per Year

	OF230 - Commercial			OF235 - Commercial			OF237A - Residential			OF237B - Residential		
Conventionals	Baseflow	Stormwater	Grand Total	Baseflow	Stormwater	Grand Total	Baseflow	Stormwater	Grand Total	Baseflow	Stormwater	Grand Total
TSS	--	--	--	957	19,562	20,519	18,588	249,265	267,853	24,528	164,250	188,778
MBAS	--	--	--	14.89	27.74	42.63	201.18	290.62	491.79	469.27	327.20	796.47
BOD_5	--	--	--	482	2,672	3,154	10,770	27,524	38,293	35,905	23,568	59,473
Total Phosphorus	--	--	--	61	66	127	317	674	991	827	521	1,347
Orthophosphorus	--	--	--	58	17	75	366	174	540	839	145	984
TN	--	--	--	645	394	1,039	24,759	2,860	27,619	76,193	5,644	81,837
Nitrate/Nitrite -Total	--	--	--	560	97	656	25,513	160	25,673	77,822	2,285	80,107
Metals												
Cu - Total	--	--	--	1.54	12.78	14.32	5.22	66.35	71.57	8.13	42.34	50.47
Cu - Dissolved	--	--	--	0.98	5.35	6.33	3.37	21.46	24.82	4.41	15.05	19.47
Zn - Total	--	--	--	3.18	46.51	49.70	26.78	478.61	505.39	37.87	250.95	288.82
Zn - Dissolved	--	--	--	2.06	17.64	19.70	20.82	213.17	233.99	29.64	97.97	127.61
Cd - Total	--	--	--	0.026	0.045	0.071	1.241	0.355	1.597	0.125	0.331	0.456
Cd - Dissolved	--	--	--	0.010	0.011	0.022	0.195	0.224	0.418	0.172	0.154	0.326
Hg - Total	--	--	--	0.001	0.001	0.002	0.027	0.026	0.053	0.042	0.029	0.072
Hg - Dissolved	--	--	--	--	--	--	--	--	--	--	--	--
Pb - Total	--	--	--	0.906	21.021	21.927	1.395	45.098	46.493	0.908	28.385	29.293
Pb - Dissolved	--	--	--	0.356	2.568	2.924	0.310	2.767	3.077	0.584	1.644	2.229
LPAHs												
2-Methylnaphthalene	--	--	--	0.003	0.008	0.011	0.053	0.193	0.245	0.096	0.025	0.121
Acenaphthene	--	--	--	0.002	0.003	0.006	--	--	--	--	--	--
Acenaphthylene	--	--	--	0.002	0.003	0.005	--	--	--	0.083	0.027	0.111
Anthracene	--	--	--	0.002	0.004	0.006	0.045	0.077	0.123	0.073	0.013	0.086
Fluorene	--	--	--	0.002	0.005	0.007	0.048	0.039	0.088	--	--	--
Naphthalene	--	--	--	0.004	0.009	0.013	0.068	0.204	0.272	0.167	0.071	0.238
Phenanthrene	--	--	--	0.003	0.018	0.022	0.061	0.363	0.425	0.125	0.138	0.263
LPAH - Total	--	--	--	0.012	0.044	0.056	0.203	0.748	0.951	0.627	0.296	0.923
HPAHs												
Benzo(a)anthracene	--	--	--	0.001	0.006	0.008	0.050	0.270	0.320	0.069	0.064	0.133
Benzo(a)pyrene	--	--	--	0.002	0.005	0.006	0.050	0.213	0.263	0.073	0.070	0.143
Benzo(g,h,i)perylene	--	--	--	0.004	0.012	0.016	0.045	0.347	0.392	0.058	0.109	0.168
Benzo(b,k)fluoranthenes	--	--	--	0.004	0.020	0.024	0.093	1.160	1.253	0.132	0.242	0.373
Chrysene	--	--	--	0.002	0.010	0.012	0.044	0.494	0.538	0.052	0.081	0.133
Dibenz(a,h)anthracene	--	--	--	0.002	0.001	0.003	0.047	0.030	0.077	--	--	--
Fluoranthene	--	--	--	0.002	0.026	0.028	0.050	0.854	0.903	0.077	0.245	0.323
Indeno(1,2,3-c,d)pyrene	--	--	--	0.002	0.006	0.009	0.050	0.344	0.393	0.073	0.077	0.150
Pyrene	--	--	--	0.003	0.031	0.034	0.049	0.742	0.791	0.075	0.260	0.335
Retene	--	--	--	0.001	0.007	0.008	0.027	0.119	0.146	0.063	0.053	0.116
HPAH - Total	--	--	--	0.013	0.059	0.072	0.258	4.489	4.747	0.660	1.160	1.819
Phthalates												
DEHP	--	--	--	0.13	0.78	0.90	4.04	9.93	13.97	4.87	5.62	10.49
Butylbenzyl-phthalate	--	--	--	--	--	--	--	--	--	--	--	--
Diethyl-phthalate	--	--	--	--	--	--	4.627	0.761	5.387	--	--	--
Dimethyl-phthalate	--	--	--	--	--	--	--	--	--	--	--	--
Di-n-butyl-phthalate	--	--	--	0.091	0.076	0.167	3.262	1.737	4.999	4.192	0.715	4.906
Di-n-octylphthalate	--	--	--	--	--	--	--	--	--	--	--	--
Phthalates - Total	--	--	--	0.23	0.40	0.63	3.93	15.91	19.84	11.32	6.50	17.83
Pesticides												
Bifenthrin	--	--	--	--	--	--	0.054	0.043	0.097	0.125	0.040	0.165
Dichlobenil	--	--	--	0.019	0.086	0.105	0.499	0.237	0.736	0.562	0.225	0.786

Note: Mass loadings were not calculated for parameters with fewer than 10 percent detected concentrations or only one detected sample in stormwater.
Highlighted cells are the highest loadings values for baseflow, stormwater and total.
OF230 and OF254 are not reported due to change in basin area and limited qualifying storm events or accepted samples for WY2023.

Table 6-4 (Cont'd)
WY2023 Annual Pollutant Loading

Pounds per Year

	OF243 - Industrial			OF245 - Industrial			OF254 - Industrial			Overall Total		
Conventionals	Baseflow	Stormwater	Grand Total	Baseflow	Stormwater	Grand Total	Baseflow	Stormwater	Grand Total	Baseflow	Stormwater	Grand Total
TSS	0	3,006	3,006	0	8,191	8,191	--	--	--	44,074	444,273	488,347
MBAS	0.00	6.84	6.84	0.00	13.50	13.50	--	--	--	685	666	1,351
BOD_5	0	168	168	0	698	698	--	--	--	47,157	54,630	101,787
Total Phosphorus	0	19	19	0	34	34	--	--	--	1,205	1,313	2,518
Orthophosphorus	0	4	4	0	10	10	--	--	--	1,263	350	1,613
TN	0	81	81	0	131	131	--	--	--	101,598	9,110	110,708
Nitrate/Nitrite -Total	0	28	28	0	36	36	--	--	--	103,894	2,606	106,500
Metals												
Cu - Total	0.00	2.14	2.14	0.00	2.43	2.43	--	--	--	14.90	126.03	140.93
Cu - Dissolved	0.00	0.58	0.58	0.00	0.67	0.67	--	--	--	8.76	43.10	51.86
Zn - Total	0.00	5.60	5.60	0.00	16.53	16.53	--	--	--	67.83	798.21	866.04
Zn - Dissolved	0.00	2.84	2.84	0.00	5.64	5.64	--	--	--	52.52	337.26	389.78
Cd - Total	0.000	0.022	0.022	0.000	0.031	0.031	--	--	--	1.39	0.78	2.18
Cd - Dissolved	0.000	0.011	0.011	0.000	0.012	0.012	--	--	--	0.377	0.411	0.79
Hg - Total	0.000	0.001	0.001	0.000	0.001	0.001	--	--	--	0.0706	0.0580	0.129
Hg - Dissolved	--	--	--	--	--	--	--	--	--	--	--	--
Pb - Total	0.000	1.387	1.387	0.000	0.783	0.783	--	--	--	3.21	96.67	99.88
Pb - Dissolved	0.000	0.051	0.051	0.000	0.035	0.035	--	--	--	1.25	7.06	8.31
LPAHs												
2-Methylnaphthalene	0.000	0.001	0.001	0.000	0.002	0.002	--	--	--	0.152	0.229	0.381
Acenaphthene	0.000	0.002	0.002	0.000	0.001	0.001	--	--	--	0.002	0.006	0.009
Acenaphthylene	0.000	0.002	0.002	0.000	0.001	0.001	--	--	--	0.086	0.033	0.119
Anthracene	0.000	0.004	0.004	0.000	0.001	0.001	--	--	--	0.121	0.099	0.219
Fluorene	0.000	0.001	0.001	0.000	0.002	0.002	--	--	--	0.051	0.047	0.098
Naphthalene	0.000	0.002	0.002	0.000	0.004	0.004	--	--	--	0.239	0.291	0.530
Phenanthrene	0.000	0.004	0.004	0.000	0.008	0.008	--	--	--	0.190	0.532	0.722
LPAH - Total	0.000	0.015	0.015	0.000	0.017	0.017	--	--	--	0.842	1.121	1.963
HPAHs												
Benzo(a)anthracene	0.000	0.002	0.002	0.000	0.001	0.001	--	--	--	0.120	0.344	0.464
Benzo(a)pyrene	0.000	0.002	0.002	0.000	0.001	0.001	--	--	--	0.125	0.290	0.415
Benzo(g,h,i)perylene	0.000	0.002	0.002	0.000	0.003	0.003	--	--	--	0.108	0.473	0.581
Benzo(b,k)fluoranthenes	0.000	0.006	0.006	0.000	0.004	0.004	--	--	--	0.228	1.432	1.660
Chrysene	0.000	0.002	0.002	0.000	0.002	0.002	--	--	--	0.098	0.590	0.688
Dibenz(a,h)anthracene	--	--	--	--	--	--	--	--	--	0.049	0.031	0.080
Fluoranthene	0.000	0.006	0.006	0.000	0.007	0.007	--	--	--	0.129	1.138	1.266
Indeno(1,2,3-c,d)pyrene	0.000	0.002	0.002	0.000	0.001	0.001	--	--	--	0.125	0.430	0.555
Pyrene	0.000	0.007	0.007	0.000	0.008	0.008	--	--	--	0.127	1.048	1.175
Retene	0.000	0.001	0.001	0.000	0.002	0.002	--	--	--	0.091	0.182	0.273
HPAH - Total	0.000	0.029	0.029	0.000	0.028	0.028	--	--	--	0.931	5.765	6.696
Phthalates												
DEHP	0.00	0.10	0.10	0.00	0.25	0.25	--	--	--	9.03	16.67	25.70
Butylbenzyl-phthalate	--	--	--	--	--	--	--	--	--	--	--	--
Diethyl-phthalate	0.000	0.027	0.027	0.000	0.036	0.036	--	--	--	4.63	0.82	5.45
Dimethyl-phthalate	--	--	--	--	--	--	--	--	--	--	--	--
Di-n-butyl-phthalate	0.000	0.022	0.022	0.000	0.283	0.283	--	--	--	7.54	2.83	10.38
Di-n-octylphthalate	--	--	--	--	--	--	--	--	--	0.00	0.00	0.00
Phthalates - Total	0.00	0.11	0.11	0.00	0.52	0.52	--	--	--	15.48	23.44	38.92
Pesticides												
Bifenthrin	--	--	--	--	--	--	--	--	--	0.18	0.08	0.26
Dichlobenil	0.000	0.001	0.001	0.000	0.003	0.003	--	--	--	1.08	0.55	1.632

Note: Mass loadings were not calculated for parameters with fewer than 10 percent detected concentrations or only one detected sample in stormwater.
Highlighted cells are the highest loadings values for baseflow, stormwater and total.
OF230 and OF254 are not reported due to change in basin area and limited qualifying storm events or accepted samples for WY2023.

Table 6-4 (Cont'd)
WY2023 Annual Pollutant Loading

Percentage of Total Pounds per Year

	OF230 - Commercial			OF235 - Commercial			OF237A - Residential			OF237B - Residential		
Conventionals	Baseflow	Stormwater	Grand Total	Baseflow	Stormwater	Grand Total	Baseflow	Stormwater	Grand Total	Baseflow	Stormwater	Grand Total
TSS	--	--	--	2%	4%	4%	42%	56%	55%	56%	37%	39%
MBAS	--	--	--	2%	4%	3%	29%	44%	36%	68%	49%	59%
BOD_5	--	--	--	1%	5%	3%	23%	50%	38%	76%	43%	58%
Total Phosphorus	--	--	--	5%	5%	5%	26%	51%	39%	69%	40%	54%
Orthophosphorus	--	--	--	5%	5%	5%	29%	50%	33%	66%	41%	61%
TN	--	--	--	1%	4%	1%	24%	31%	25%	75%	62%	74%
Nitrate/Nitrite -Total	--	--	--	1%	4%	1%	25%	6%	24%	75%	88%	75%
Metals												
Cu - Total	--	--	--	10%	10%	10%	35%	53%	51%	55%	34%	36%
Cu - Dissolved	--	--	--	11%	12%	12%	38%	50%	48%	50%	35%	38%
Zn - Total	--	--	--	5%	6%	6%	39%	60%	58%	56%	31%	33%
Zn - Dissolved	--	--	--	4%	5%	5%	40%	63%	60%	56%	29%	33%
Cd - Total	--	--	--	2%	6%	3%	89%	45%	73%	9%	42%	21%
Cd - Dissolved	--	--	--	3%	3%	3%	52%	54%	53%	46%	37%	41%
Hg - Total	--	--	--	2%	2%	2%	38%	45%	41%	60%	51%	56%
Hg - Dissolved	--	--	--	--	--	--	--	--	--	--	--	--
Pb - Total	--	--	--	28%	22%	22%	43%	47%	47%	28%	29%	29%
Pb - Dissolved	--	--	--	28%	36%	35%	25%	39%	37%	47%	23%	27%
LPAHs												
2-Methylnaphthalene	--	--	--	2%	4%	3%	35%	84%	64%	63%	11%	32%
Acenaphthene	--	--	--	100%	53%	65%	--	--	--	--	--	--
Acenaphthylene	--	--	--	3%	10%	5%	--	--	--	97%	82%	93%
Anthracene	--	--	--	2%	4%	3%	37%	78%	56%	61%	13%	39%
Fluorene	--	--	--	4%	10%	7%	96%	83%	90%	--	--	--
Naphthalene	--	--	--	2%	3%	2%	29%	70%	51%	70%	25%	45%
Phenanthrene	--	--	--	2%	3%	3%	32%	68%	59%	66%	26%	36%
LPAH - Total	--	--	--	1%	4%	3%	24%	67%	48%	74%	26%	47%
HPAHs												
Benzo(a)anthracene	--	--	--	1%	2%	2%	42%	79%	69%	57%	19%	29%
Benzo(a)pyrene	--	--	--	1%	2%	2%	40%	73%	63%	59%	24%	34%
Benzo(g,h,i)perylene	--	--	--	4%	2%	3%	42%	73%	68%	54%	23%	29%
Benzo(b,k)fluoranthenes	--	--	--	2%	1%	1%	41%	81%	75%	58%	17%	22%
Chrysene	--	--	--	2%	2%	2%	45%	84%	78%	53%	14%	19%
Dibenz(a,h)anthracene	--	--	--	4%	4%	4%	96%	96%	96%	--	--	--
Fluoranthene	--	--	--	2%	2%	2%	38%	75%	71%	60%	22%	25%
Indeno(1,2,3-c,d)pyrene	--	--	--	2%	1%	2%	40%	80%	71%	59%	18%	27%
Pyrene	--	--	--	2%	3%	3%	39%	71%	67%	59%	25%	29%
Retene	--	--	--	1%	4%	3%	30%	65%	53%	69%	29%	42%
HPAH - Total	--	--	--	1%	1%	1%	28%	78%	71%	71%	20%	27%
Phthalates												
DEHP	--	--	--	1%	5%	4%	45%	60%	54%	54%	34%	41%
Butylbenzyl-phthalate	--	--	--	--	--	--	--	--	--	--	--	--
Diethyl-phthalate	--	--	--	--	--	--	100%	92%	99%	--	--	--
Dimethyl-phthalate	--	--	--	--	--	--	--	--	--	--	--	--
Di-n-butyl-phthalate	--	--	--	1%	3%	2%	43%	61%	48%	56%	25%	47%
Di-n-octylphthalate	--	--	--	--	--	--	--	--	--	--	--	--
Phthalates - Total	--	--	--	1%	2%	2%	25%	68%	51%	73%	28%	46%
Pesticides												
Bifenthrin	--	--	--	--	--	--	30%	52%	37%	70%	48%	63%
Dichlobenil	--	--	--	2%	16%	6%	46%	43%	45%	52%	41%	48%

Note: Mass loadings were not calculated for parameters with fewer than 10 percent detected concentrations or only one detected sample in stormwater.
Highlighted cells are the highest loadings values for baseflow, stormwater and total.
OF230 and OF254 are not reported due to change in basin area and limited qualifying storm events or accepted samples for WY2023.

Table 6-4 (Cont'd)
WY2023 Annual Pollutant Loading

Percentage of Total Pounds per Year

	OF243 - Industrial			OF245 - Industrial			OF254 - Industrial			Overall Total		
Conventionals	Baseflow	Stormwater	Grand Total	Baseflow	Stormwater	Grand Total	Baseflow	Stormwater	Grand Total	Baseflow	Stormwater	Grand Total
--	0%	1%	1%	0%	2%	2%	--	--	--	9%	91%	100%
MBAS	0%	1%	1%	0%	2%	1%	--	--	--	51%	49%	100%
BOD_5	0%	0%	0%	0%	1%	1%	--	--	--	46%	54%	100%
Total Phosphorus	0%	1%	1%	0%	3%	1%	--	--	--	48%	52%	100%
Orthophosphorus	0%	1%	0%	0%	3%	1%	--	--	--	78%	22%	100%
TN	0%	1%	0%	0%	1%	0%	--	--	--	92%	8%	100%
Nitrate/Nitrite -Total	0%	1%	0%	0%	1%	0%	--	--	--	98%	2%	100%
Cu - Total	0%	2%	2%	0%	2%	2%	--	--	--	11%	89%	100%
Cu - Dissolved	0%	1%	1%	0%	2%	1%	--	--	--	17%	83%	100%
Zn - Total	0%	1%	1%	0%	2%	2%	--	--	--	8%	92%	100%
Zn - Dissolved	0%	1%	1%	0%	2%	1%	--	--	--	13%	87%	100%
Cd - Total	0%	3%	1%	0%	4%	1%	--	--	--	64%	36%	100%
Cd - Dissolved	0%	3%	1%	0%	3%	2%	--	--	--	48%	52%	100%
Hg - Total	0%	1%	0%	0%	1%	1%	--	--	--	55%	45%	100%
Hg - Dissolved	--	--	--	--	--	--	--	--	--	--	--	--
Pb - Total	0%	1%	1%	0%	1%	1%	--	--	--	3%	97%	100%
Pb - Dissolved	0%	1%	1%	0%	0%	0%	--	--	--	15%	85%	100%
2-Methylnaphthalene	0%	0%	0%	0%	1%	1%	--	--	--	40%	60%	100%
Acenaphthene	0%	27%	20%	0%	20%	14%	--	--	--	26%	74%	100%
Acenaphthylene	0%	5%	1%	0%	3%	1%	--	--	--	72%	28%	100%
Anthracene	0%	4%	2%	0%	1%	0%	--	--	--	55%	45%	100%
Fluorene	0%	2%	1%	0%	4%	2%	--	--	--	52%	48%	100%
Naphthalene	0%	1%	0%	0%	1%	1%	--	--	--	45%	55%	100%
Phenanthrene	0%	1%	1%	0%	2%	1%	--	--	--	26%	74%	100%
LPAH - Total	0%	1%	1%	0%	2%	1%	--	--	--	43%	57%	100%
Benzo(a)anthracene	0%	1%	0%	0%	0%	0%	--	--	--	26%	74%	100%
Benzo(a)pyrene	0%	1%	0%	0%	0%	0%	--	--	--	30%	70%	100%
Benzo(g,h,i)perylene	0%	0%	0%	0%	1%	1%	--	--	--	19%	81%	100%
Benzo(b,k)fluoranthenes	0%	0%	0%	0%	0%	0%	--	--	--	14%	86%	100%
Chrysene	0%	0%	0%	0%	0%	0%	--	--	--	14%	86%	100%
Dibenz(a,h)anthracene	--	--	--	--	--	--	--	--	--	61%	39%	100%
Fluoranthene	0%	1%	0%	0%	1%	1%	--	--	--	10%	90%	100%
Indeno(1,2,3-c,d)pyrene	0%	0%	0%	0%	0%	0%	--	--	--	22%	78%	100%
Pyrene	0%	1%	1%	0%	1%	1%	--	--	--	11%	89%	100%
Retene	0%	1%	0%	0%	1%	1%	--	--	--	33%	67%	100%
HPAH - Total	0%	1%	0%	0%	0%	0%	--	--	--	14%	86%	100%
DEHP	0%	1%	0%	0%	1%	1%	--	--	--	35%	65%	100%
Butylbenzyl-phthalate	--	--	--	--	--	--	--	--	--	--	--	--
Diethyl-phthalate	0%	3%	0%	0%	4%	1%	--	--	--	85%	15%	100%
Dimethyl-phthalate	--	--	--	--	--	--	--	--	--	--	--	--
Di-n-butyl-phthalate	0%	1%	0%	0%	10%	3%	--	--	--	73%	27%	100%
Di-n-octylphthalate	--	--	--	--	--	--	--	--	--	--	--	--
Phthalates - Total	0%	0%	0%	0%	2%	1%	--	--	--	40%	60%	100%
Bifenthrin	--	--	--	--	--	--	--	--	--	68%	32%	100%
Dichlobenil	0%	0%	0%	0%	1%	0%	--	--	--	66%	34%	100%

Note: Mass loadings were not calculated for parameters with fewer than 10 percent detected concentrations or only one detected sample in stormwater.

Highlighted cells are the highest loadings values for baseflow, stormwater and total.

OF230 and OF254 are not reported due to change in basin area and limited qualifying storm events or accepted samples for WY2023.

Table 6-5
Percent of Annual Loading Rates by Outfall

Stormwater Outfalls		Phenanthrene			Pyrene			Dibenz(ah)anthracene			Bis(2-ethylhexyl)phthalate			Volume, ac-ft/yr	% of Total Volume
		Contaminant Load in Kg/Year	% of Total SW Load	% of Total Load	Contaminant Load in Kg/Year	% of Total SW Load	% of Total Load	Contaminant Load in Kg/Year	% of Total SW Load	% of Total Load	Contaminant Load in Kg/Year	% of Total SW Load	% of Total Load		
OF237A	SW	0.165	48.8%	7.5%	0.337	59.9%	9.3%	0.014	34.6%	5.0%	4.51	37.4%	18.9%	1,967	11.2%
	BF	0.028	8.2%	1.3%	0.022	4.0%	0.6%	0.021	54.0%	7.8%	1.83	15.2%	7.7%	3,970	22.7%
OF237B[2]	SW	0.063	18.6%	2.9%	0.118	21.0%	3.3%	0.000	0.0%	0.0%	2.55	21.2%	10.7%	1,557	8.9%
	BF	0.057	16.8%	2.6%	0.034	6.1%	0.9%	0.000	0.0%	0.0%	2.21	18.3%	9.3%	9,218	52.6%
OF230	SW	0			0			0			0			141	0.8%
	BF	0			0			0			0			-	0.0%
OF235	SW	0.008	2.5%	0.4%	0.014	2.5%	0.4%	0.001	1.5%	0.2%	0.35	2.9%	1.5%	148	0.8%
	BF	0.001	0.4%	0.1%	0.001	0.2%	0.0%	0.001	2.3%	0.3%	0.06	0.5%	0.2%	178	1.0%
OF245[2]		0.004	1.1%	0.2%	0.004	0.7%	0.1%	0.000	0.0%	0.0%	0.11	0.9%	0.5%	80	0.5%
OF243[2]		0.002	0.6%	0.1%	0.003	0.5%	0.1%	0.000	0.0%	0.0%	0.04	0.4%	0.2%	40	0.2%
OF254		0			0			0			0			210	1.2%
All Other SW Outfalls[1]		0.010	3.0%	0.5%	0.029	5.2%	0.8%	0.003	7.6%	1.1%	0.38	3.2%	1.6%	72	0.4%
BF Total		**0.086**	**25%**	**4%**	**0.058**	**10%**	**2%**	**0.022**	**56%**	**8%**	**4.10**	**34%**	**17%**	**13,366**	**76%**
SW Total		**0.252**	**75%**	**11%**	**0.504**	**90%**	**14%**	**0.017**	**44%**	**6%**	**7.94**	**66%**	**33%**	**4,143**	**24%**
Loading values for SW Outfalls and Other Sources (Total Loadings) were based on the WASP2006 Model Update														**Total 2023 Volume**	
Total Outfall Loadings		**0.338**		**15.4%**	**0.562**		**15.5%**	**0.039**		**14.4%**	**12.04**		**50.5%**	**17,509**	**ac-ft/yr**
Total Loadings		**2.192**		**100.0%**	**3.624**		**100.0%**	**0.273**		**100.0%**	**23.86**		**100.0%**		

Note: New OF230A and OF254 are not reported for WY2023 due to insufficient number of qualifying storms.

[1] Loading values for SW Outfalls and Other Sources (Total Loadings) were based on the WASP2006 Model Update

[2] As the concentrations of stormwater and baseflow converge and where baseflow accounts for >65 of the discharge, the largest contribution of mass loadings is estimated from baseflow. This is seen for a few constituents with less than 25 percent detections and/or less than five detected results that generate estimated mass loads with a high degree of uncertainty, even though mass loads may still be calculated using one-half the detection limit for that non-detected value

SW - Stormwater

BF- Baseflow

FIGURES

Figure 1-1
Thea Foss Post-Remediation Source Control Strategy

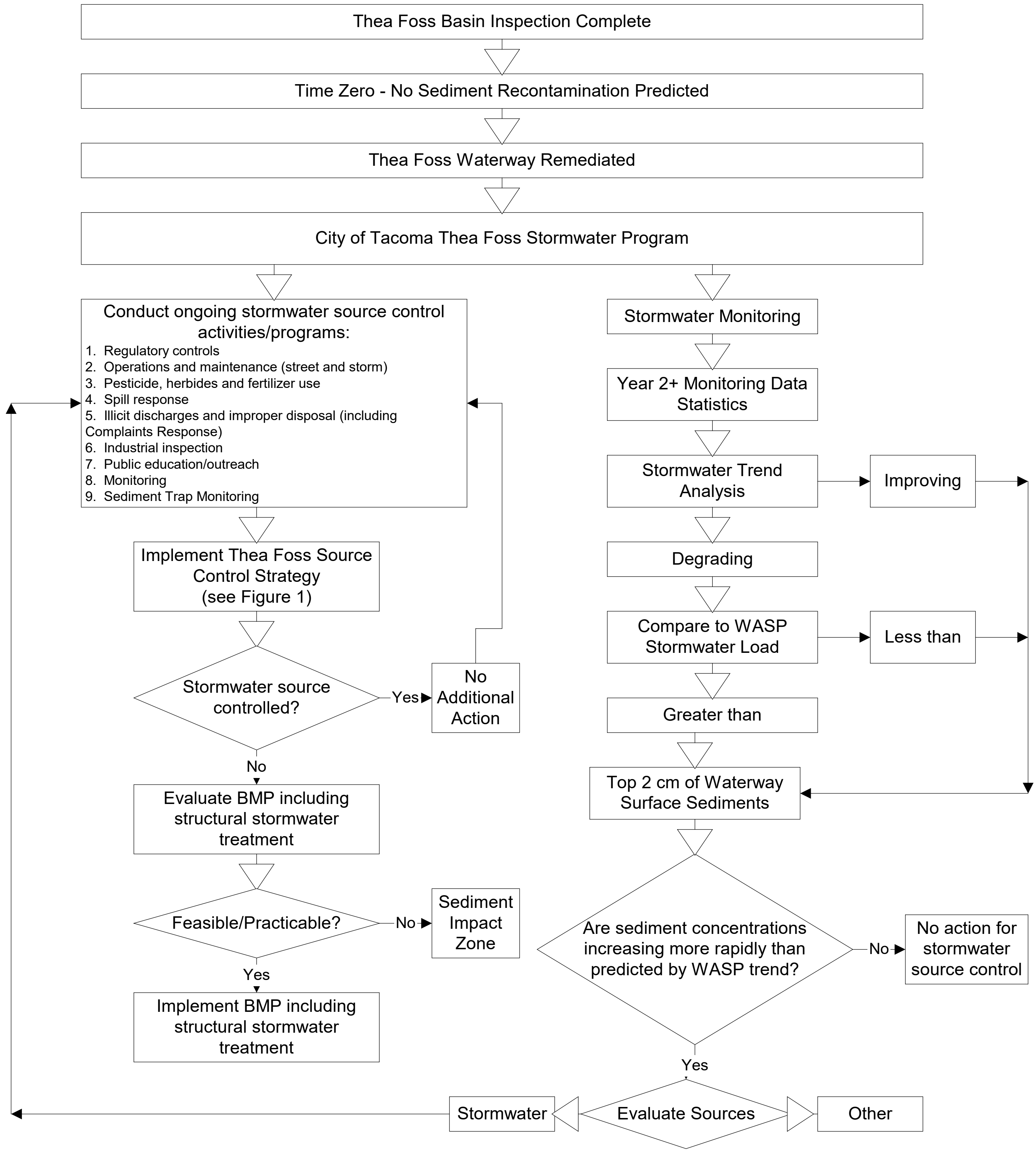
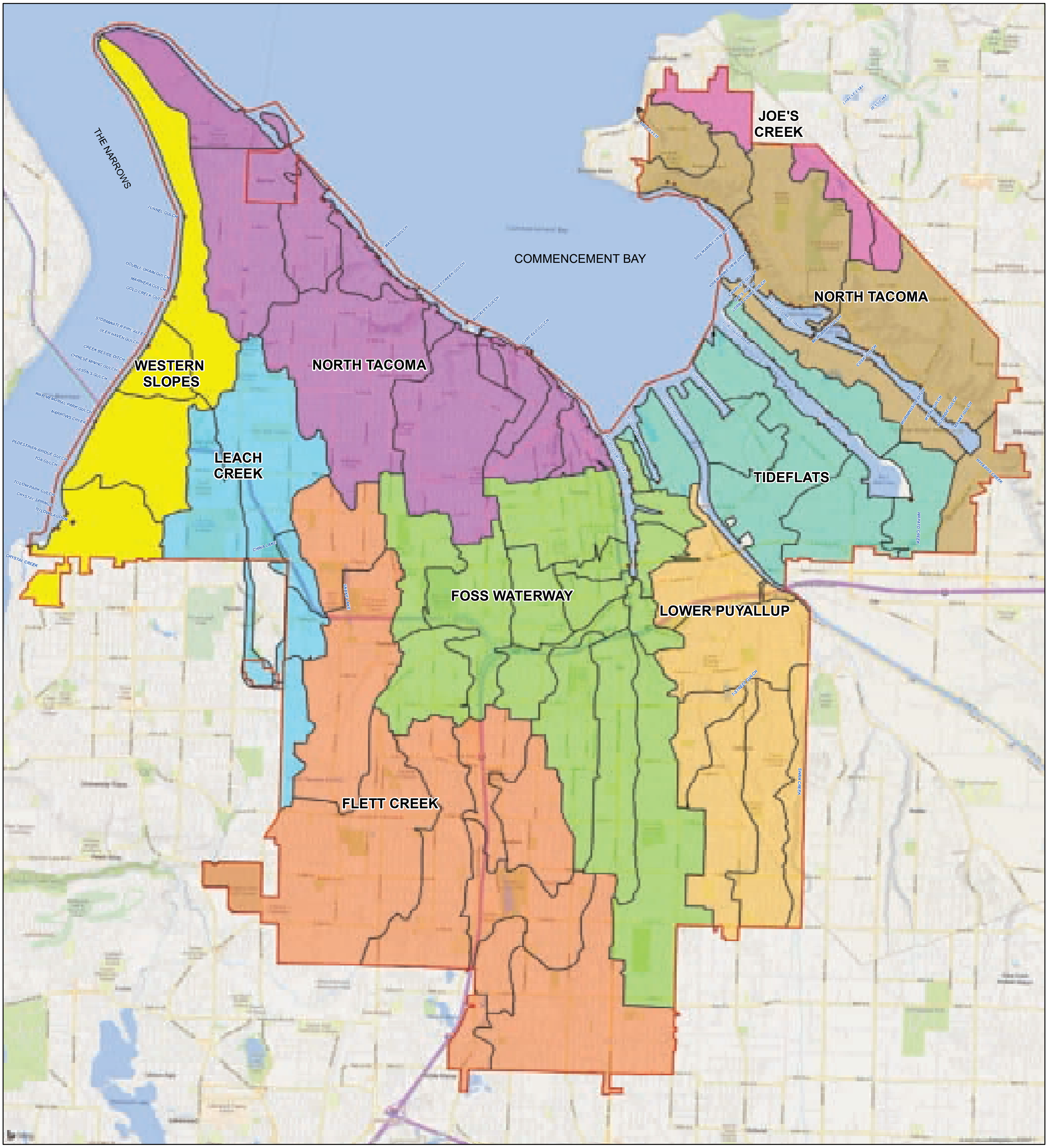


Figure 1-2
City of Tacoma Watersheds

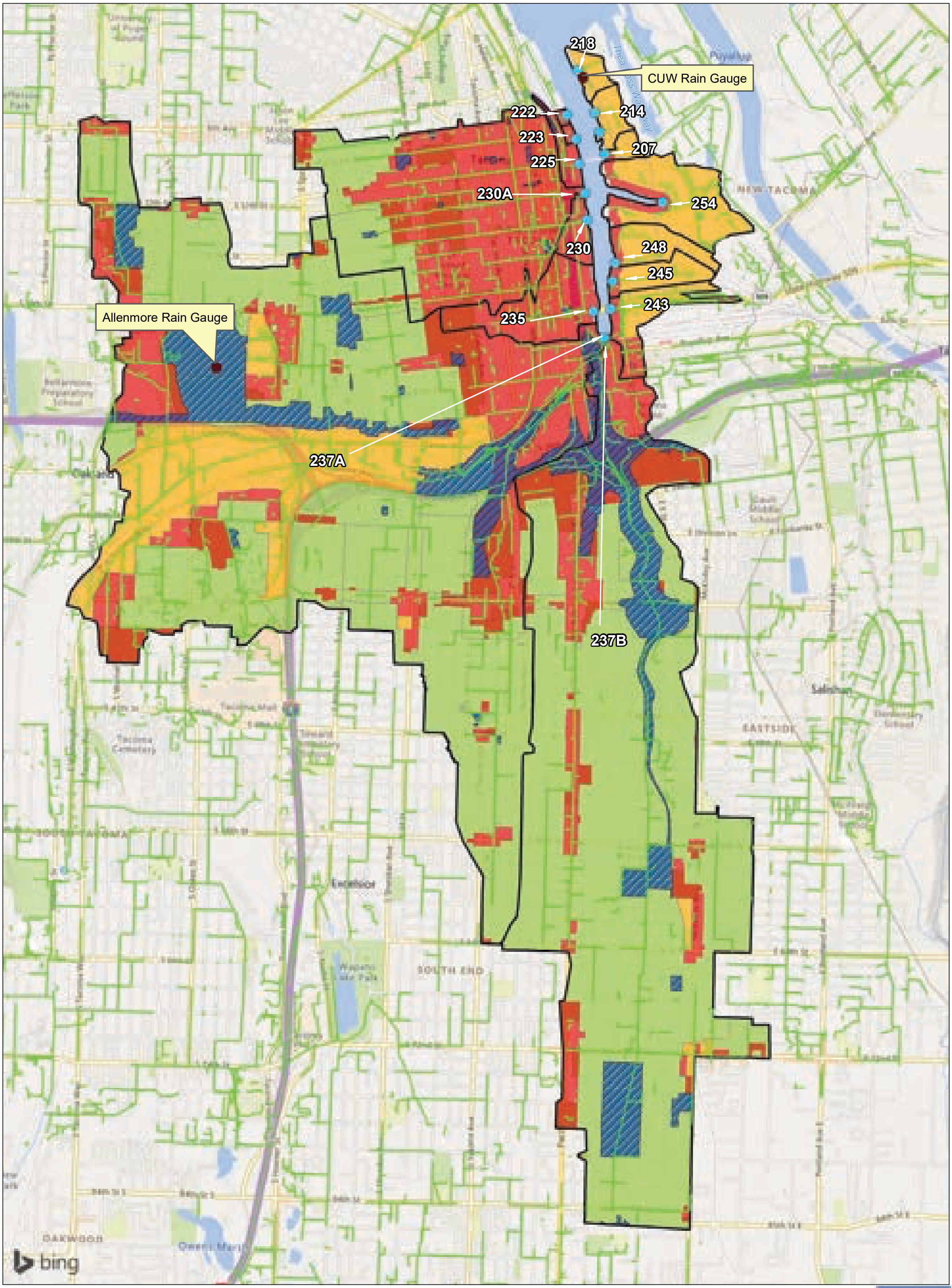


WATERSHEDS

WESTERN SLOPES	LOWER PUYALLUP	FLETT CREEK
TIDEFLATS	LEACH CREEK	OUTFALLS
NORTH TACOMA	JOE'S CREEK	TACOMA CITY LIMITS
NE TACOMA	FOSS WATERWAY	STORMWATER SUBBASINS

Map Date: 11/14/2023
Source: Science and Engineering Division
Environmental Services Department
City of Tacoma
326 East D Street, Tacoma WA 98421
(253) 591-5588

Figure 1-3
Thea Foss Basins Land use



Land Use

- Thea Foss Outfalls
- Rain Gauge
- Surfacewater Mains
- Open Space
- Industrial
- Commercial
- Residential

Map Date: 11/17/2023
Source: Science and Engineering Division
Environmental Services Department
City of Tacoma
326 East D Street, Tacoma WA 98421
(253) 591-5588

0 1,000 2,000 4,000 Feet

Tacoma

Figure 2-1.1
Sediment Trap Results - Mercury

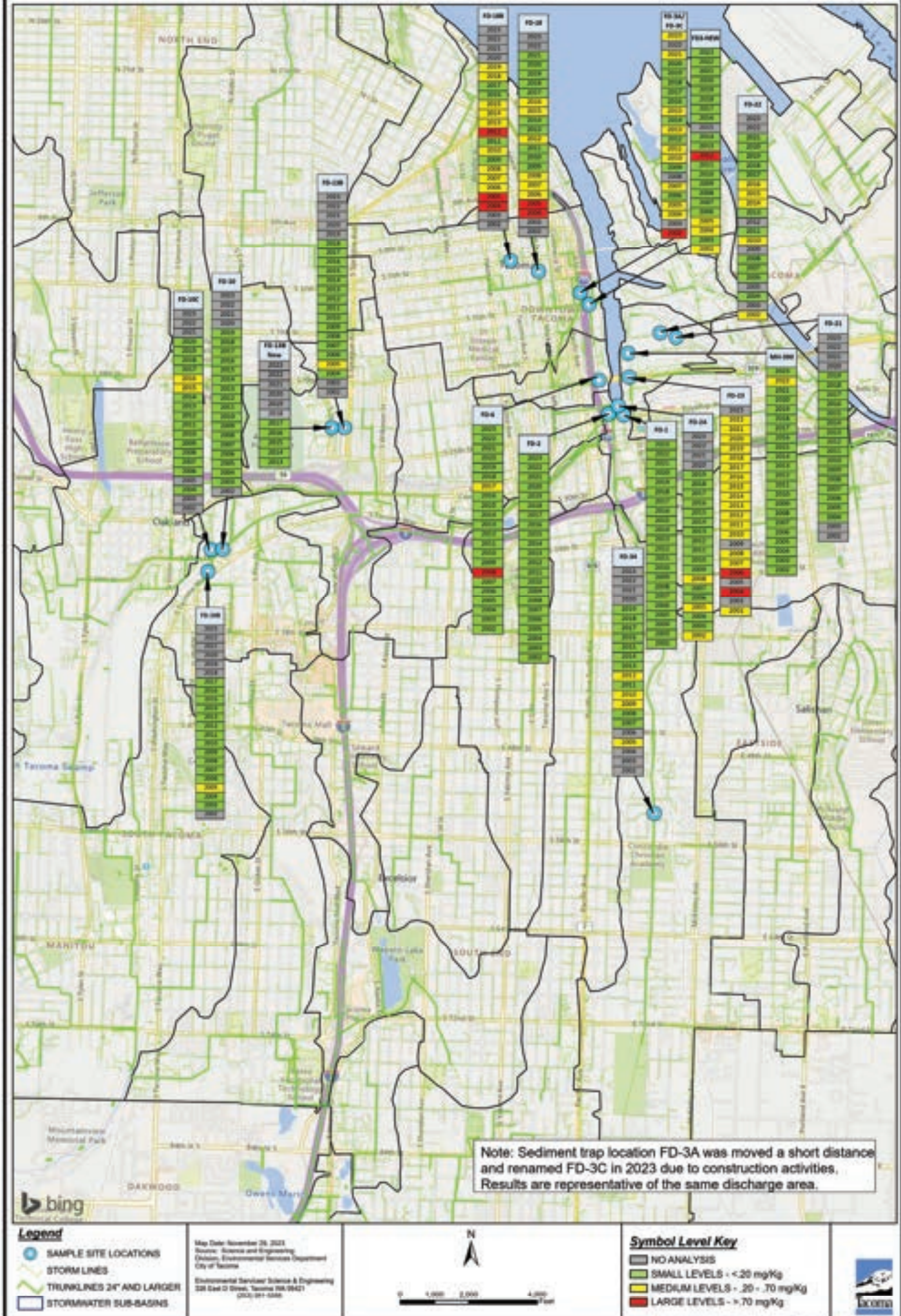


Figure 2-1.2
Sediment Trap Results - PAHs

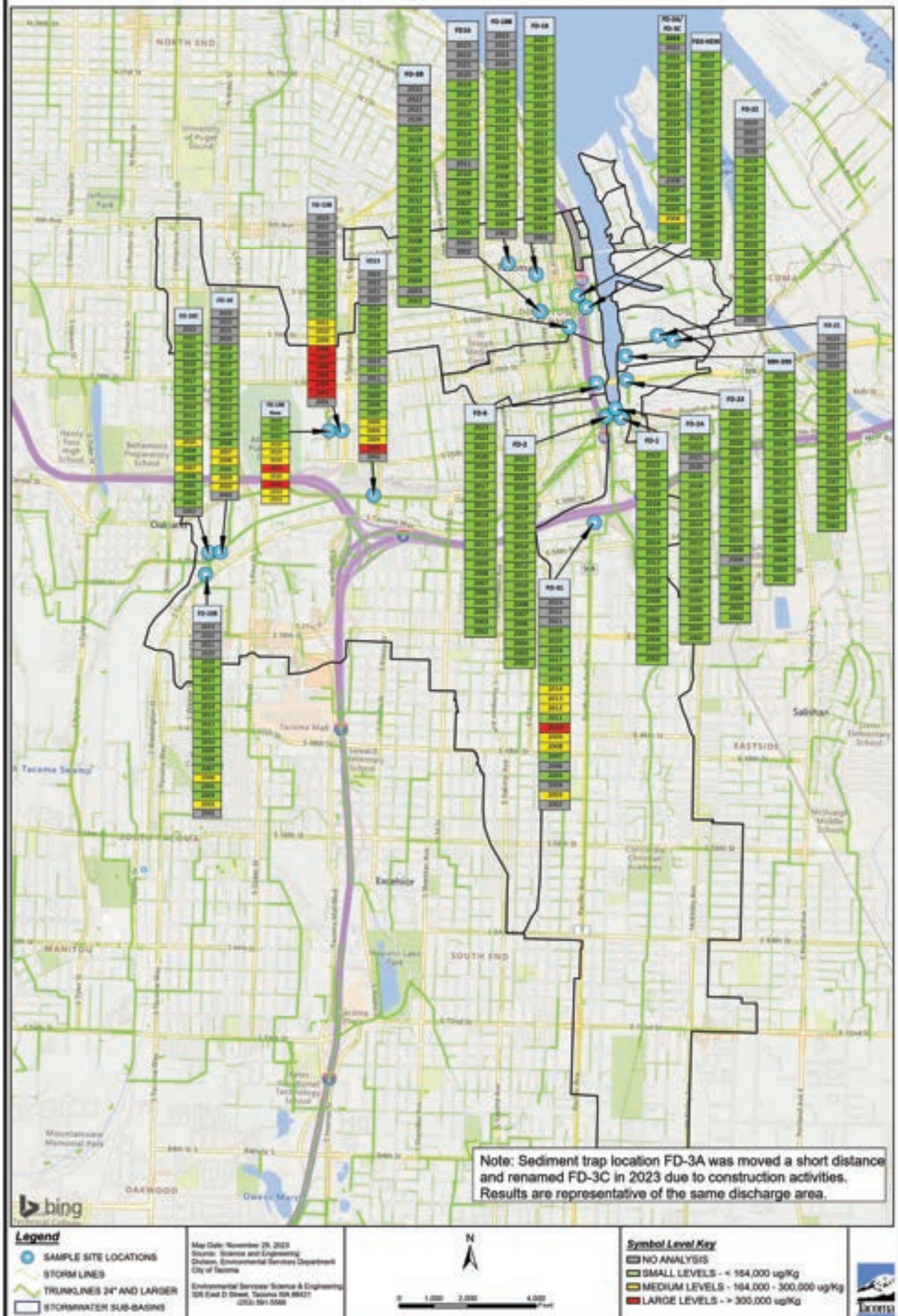


Figure 2-1.3
Sediment Trap Results - Phthalates

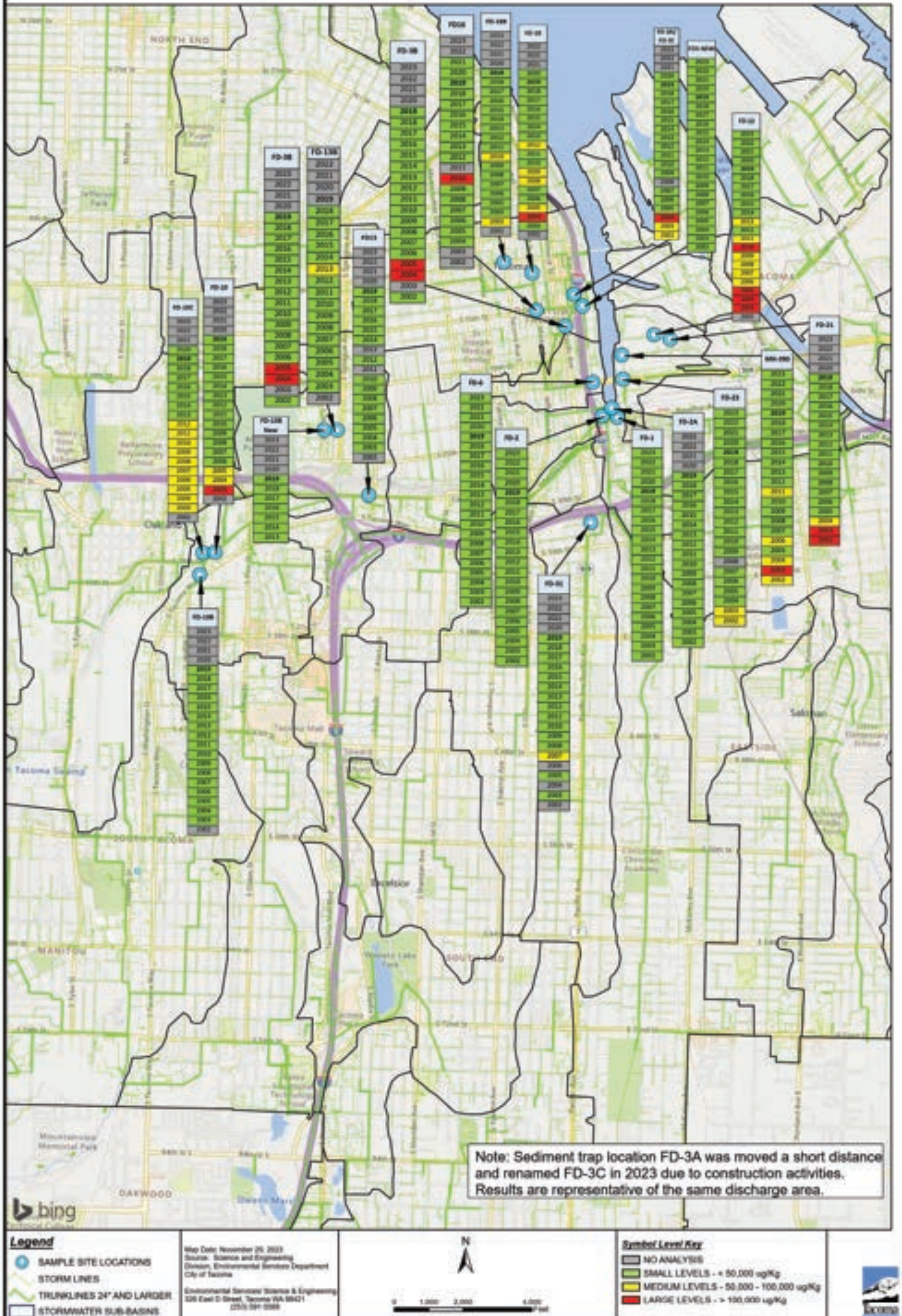


Figure 2-1.4
Sediment Trap Results - PCBs

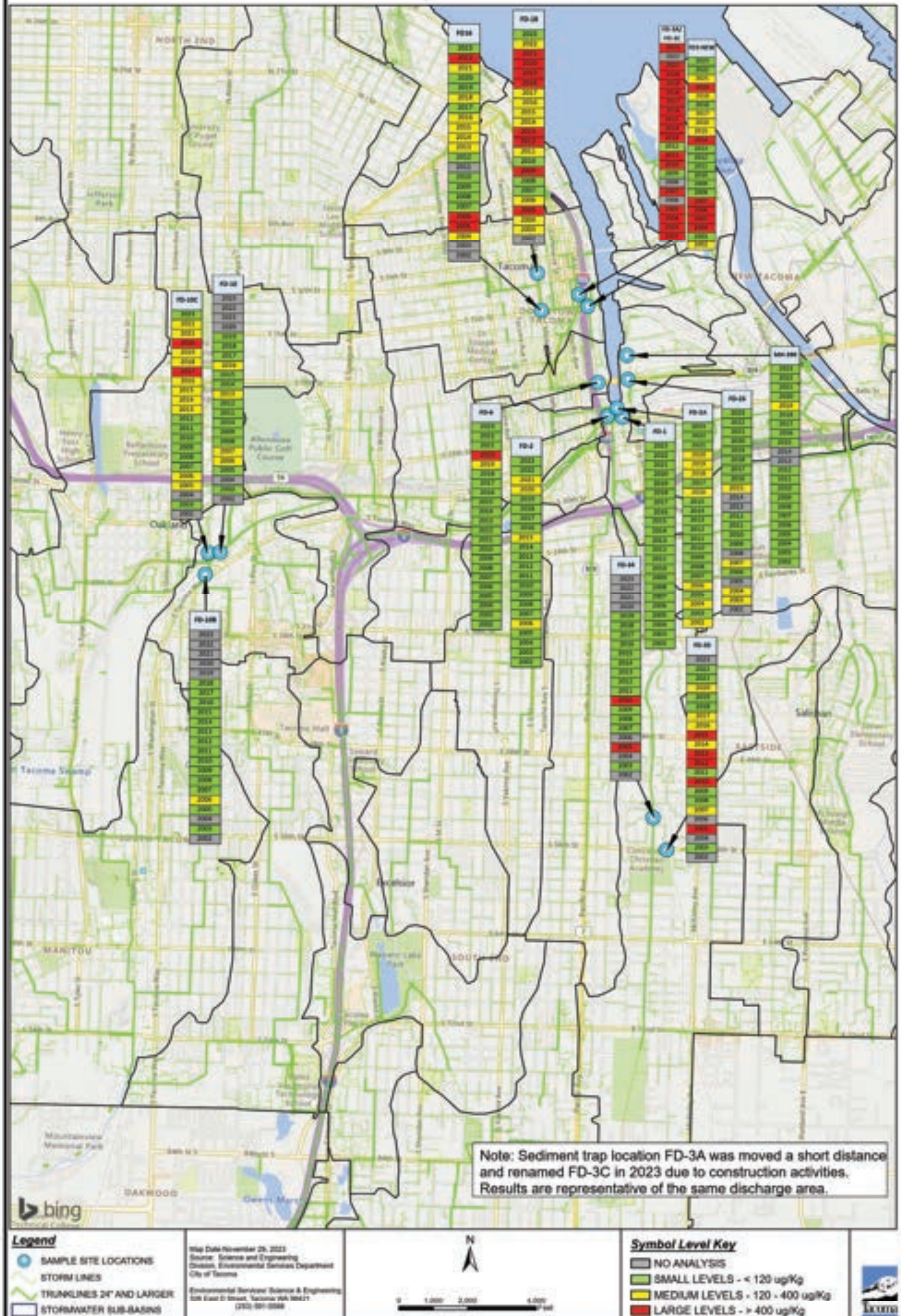
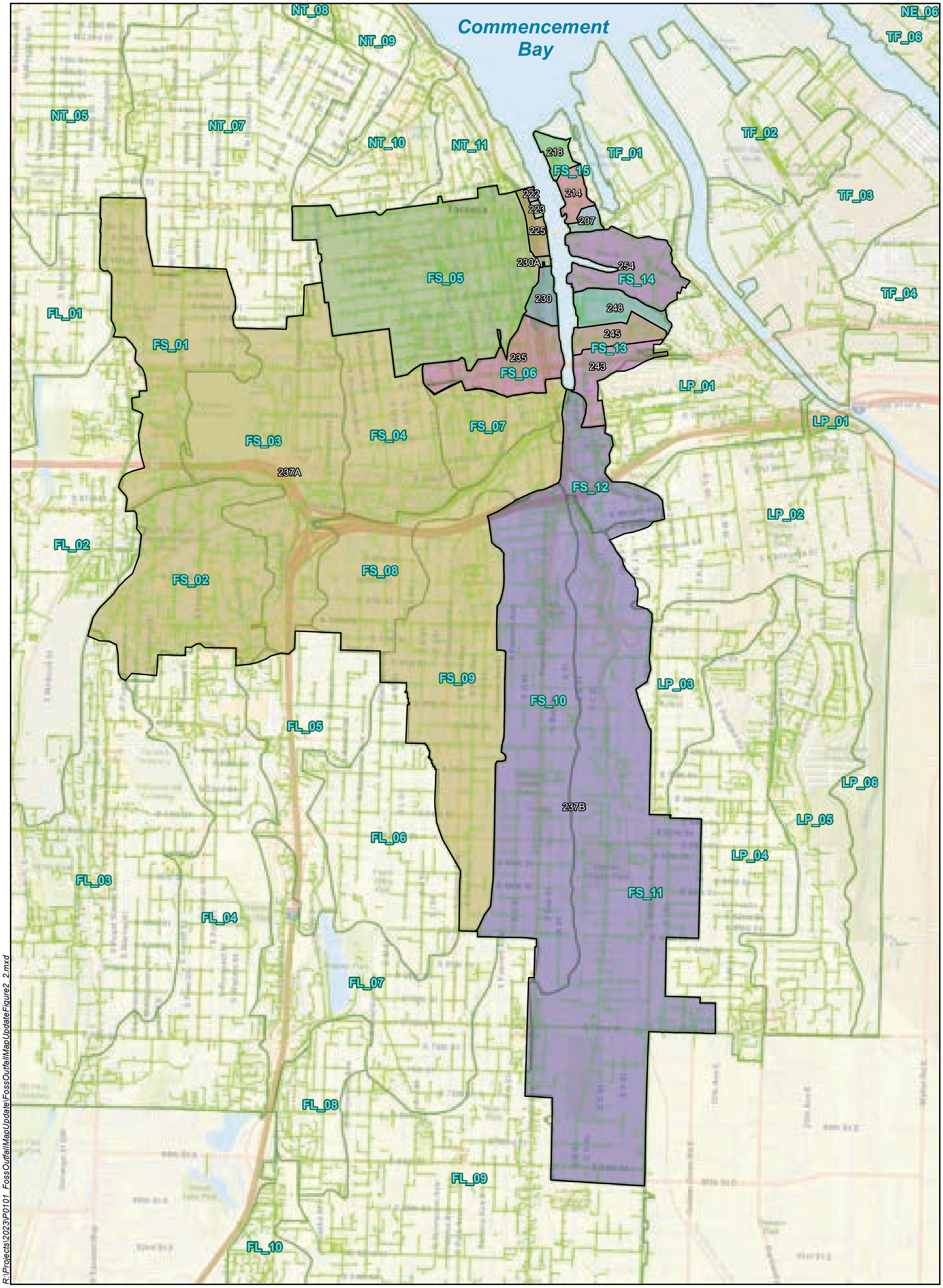


Figure 2-2
Foss Outfall Map Update



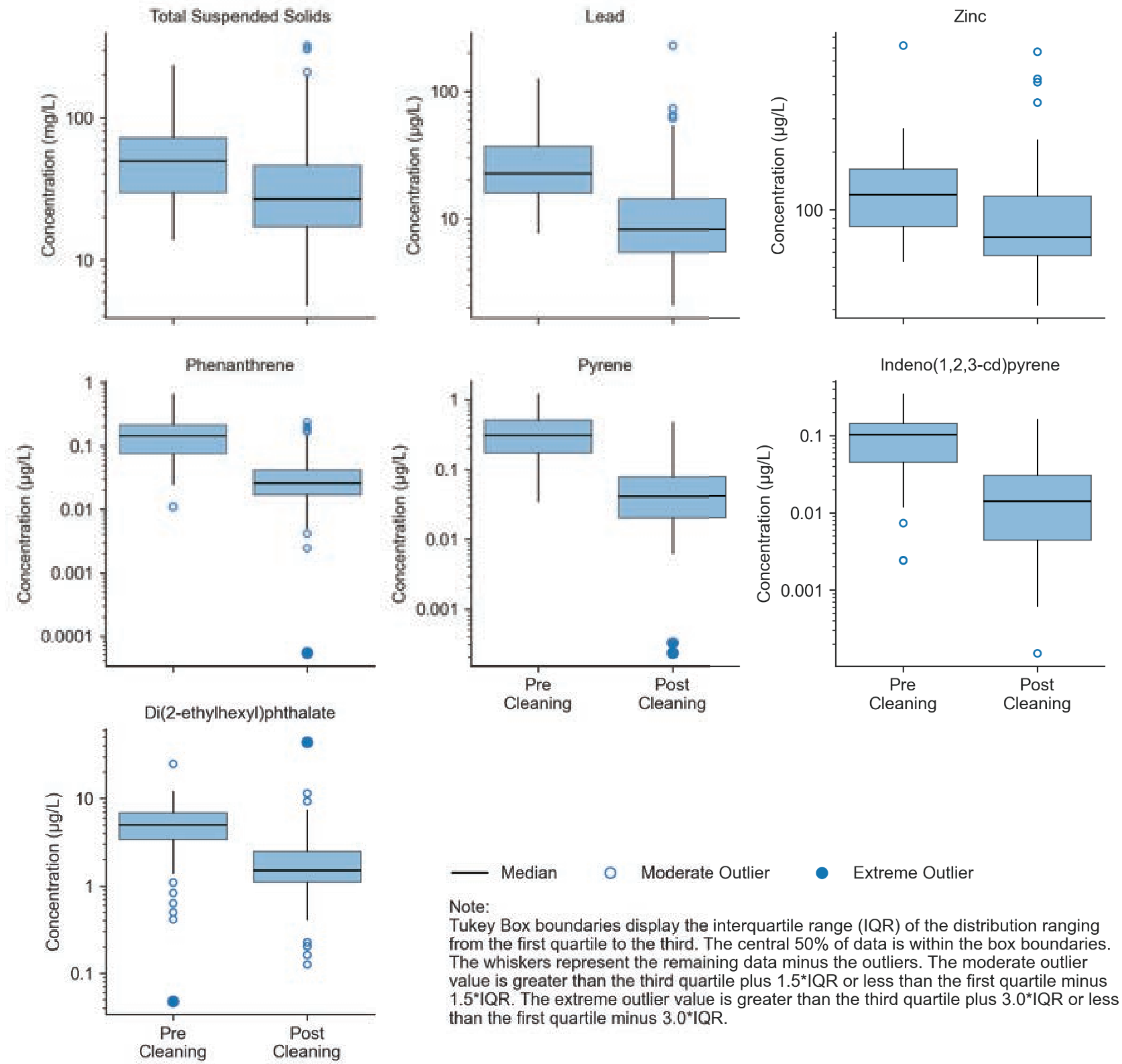
Legend

NEW OUTFALL 230A SURFACEWATER SUBBASINS

0 1,250 2,500 5,000 Feet

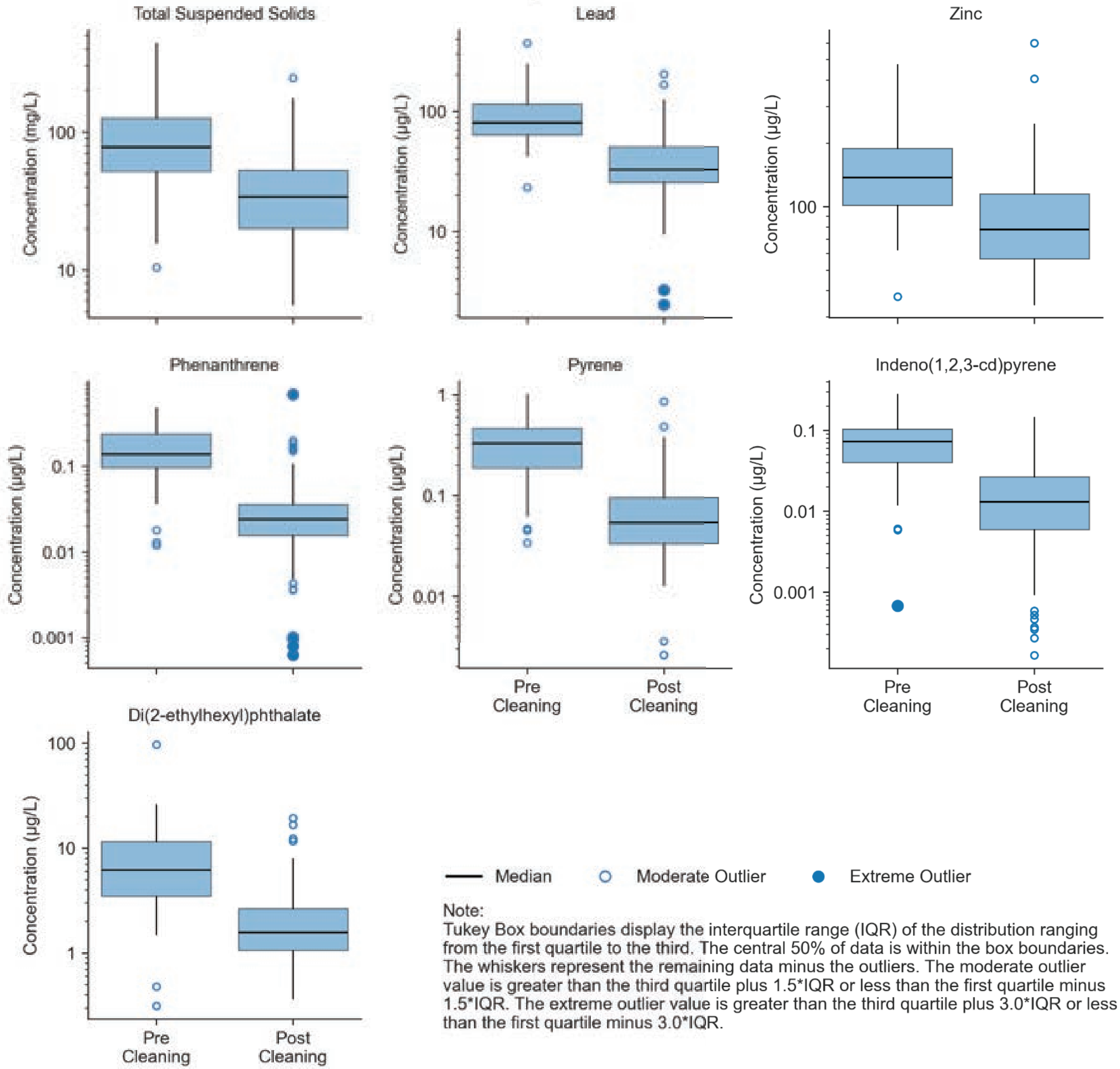
Map Date: 12/4/2023
Source: Science and Engineering Division
Environmental Services Department
City of Tacoma
326 East D Street, Tacoma WA 98421
(253) 591-5588

Figure 2-3.1 OF230 Storm Line Cleaning Comparison [Log Scale]



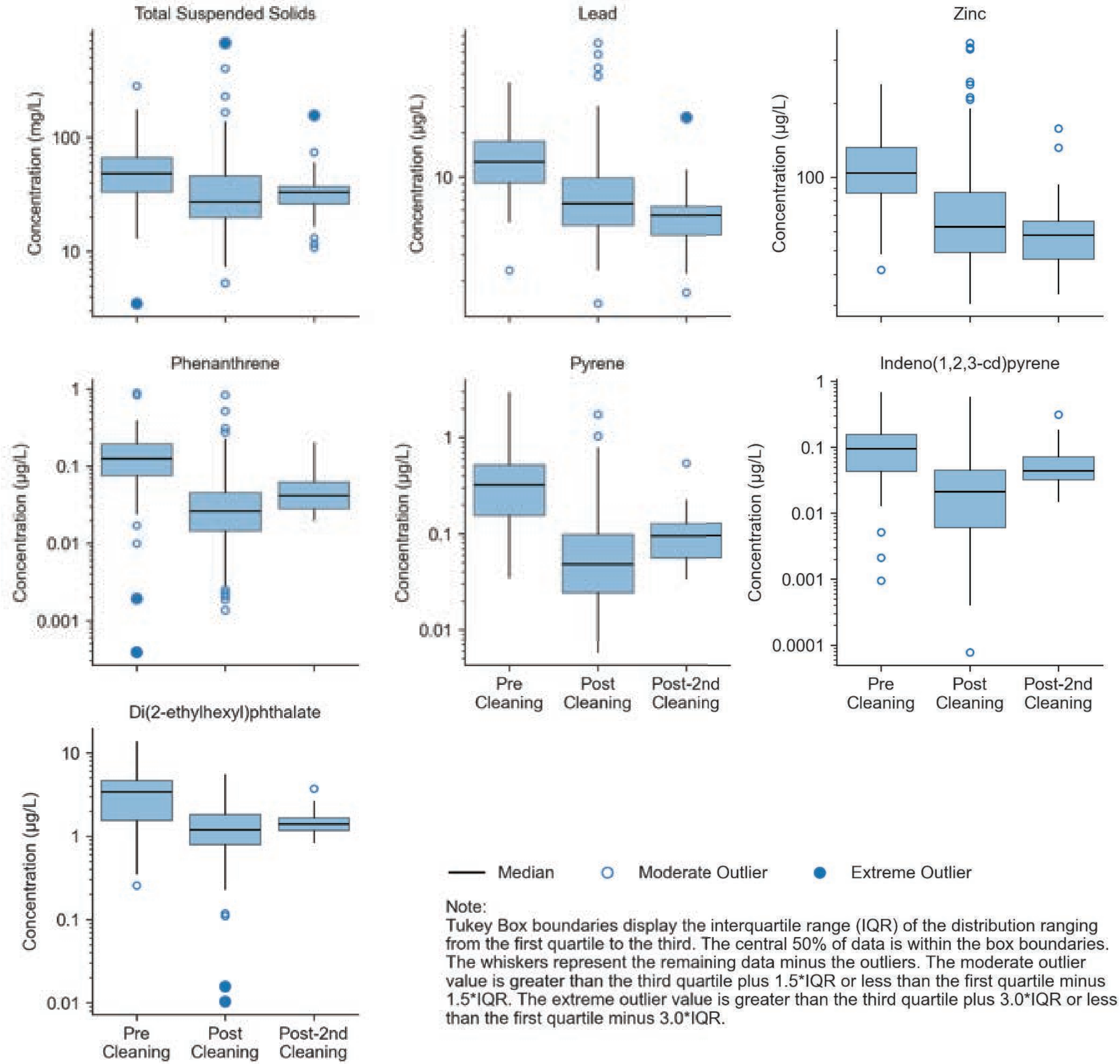
Note:
Tukey Box boundaries display the interquartile range (IQR) of the distribution ranging from the first quartile to the third. The central 50% of data is within the box boundaries. The whiskers represent the remaining data minus the outliers. The moderate outlier value is greater than the third quartile plus 1.5*IQR or less than the first quartile minus 1.5*IQR. The extreme outlier value is greater than the third quartile plus 3.0*IQR or less than the first quartile minus 3.0*IQR.

Figure 2-3.2 OF235 Storm Line Cleaning Comparison [Log Scale]



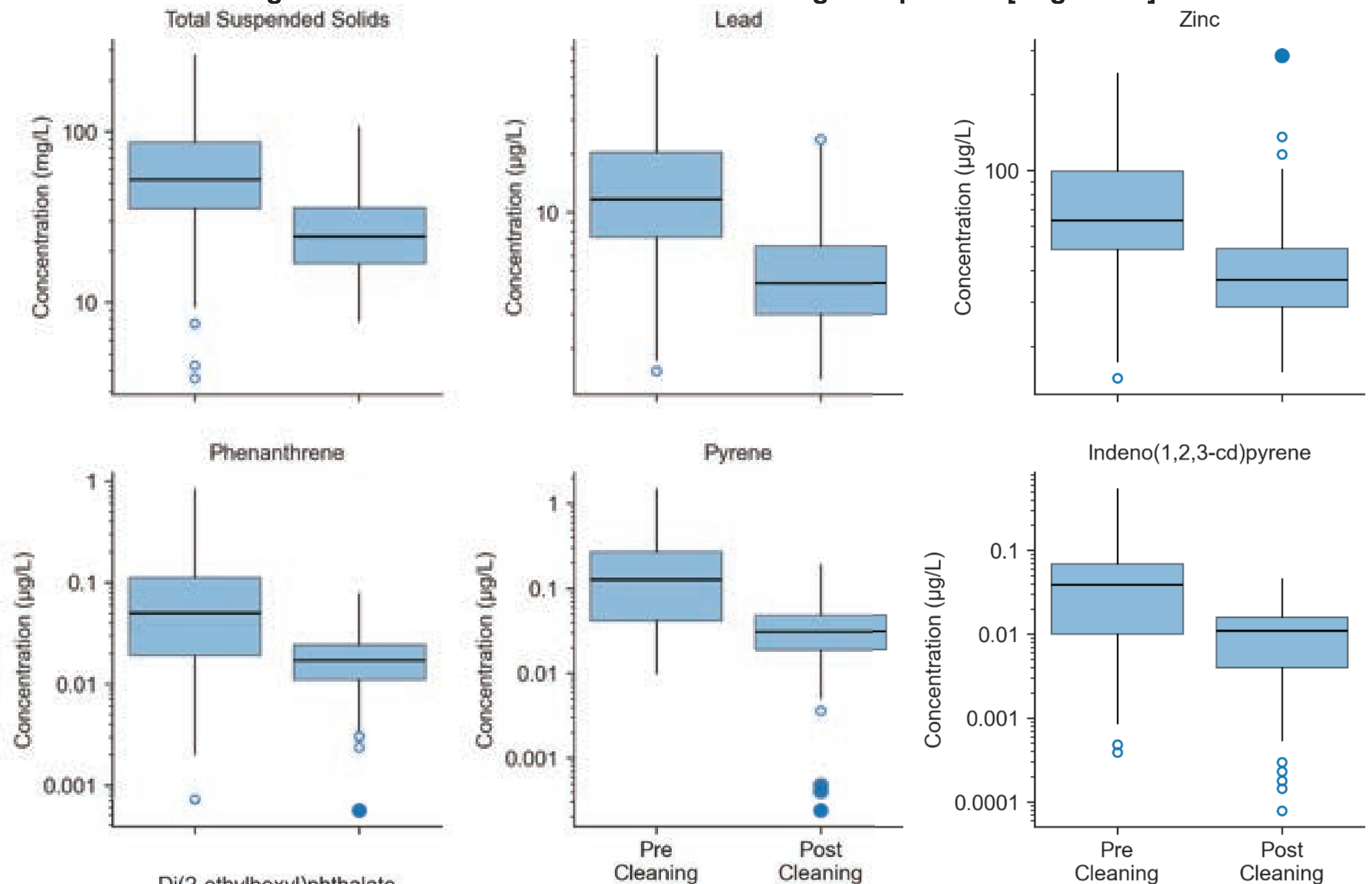
Note:
Tukey Box boundaries display the interquartile range (IQR) of the distribution ranging from the first quartile to the third. The central 50% of data is within the box boundaries. The whiskers represent the remaining data minus the outliers. The moderate outlier value is greater than the third quartile plus 1.5*IQR or less than the first quartile minus 1.5*IQR. The extreme outlier value is greater than the third quartile plus 3.0*IQR or less than the first quartile minus 3.0*IQR.

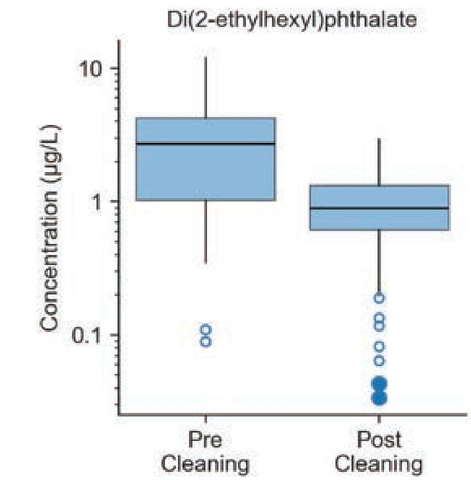
Figure 2-3.3 OF237A Storm Line Cleaning Comparison [Log Scale]



Note:
Tukey Box boundaries display the interquartile range (IQR) of the distribution ranging from the first quartile to the third. The central 50% of data is within the box boundaries. The whiskers represent the remaining data minus the outliers. The moderate outlier value is greater than the third quartile plus 1.5*IQR or less than the first quartile minus 1.5*IQR. The extreme outlier value is greater than the third quartile plus 3.0*IQR or less than the first quartile minus 3.0*IQR.

Figure 2-3.4 OF237B Storm Line Cleaning Comparison [Log Scale]

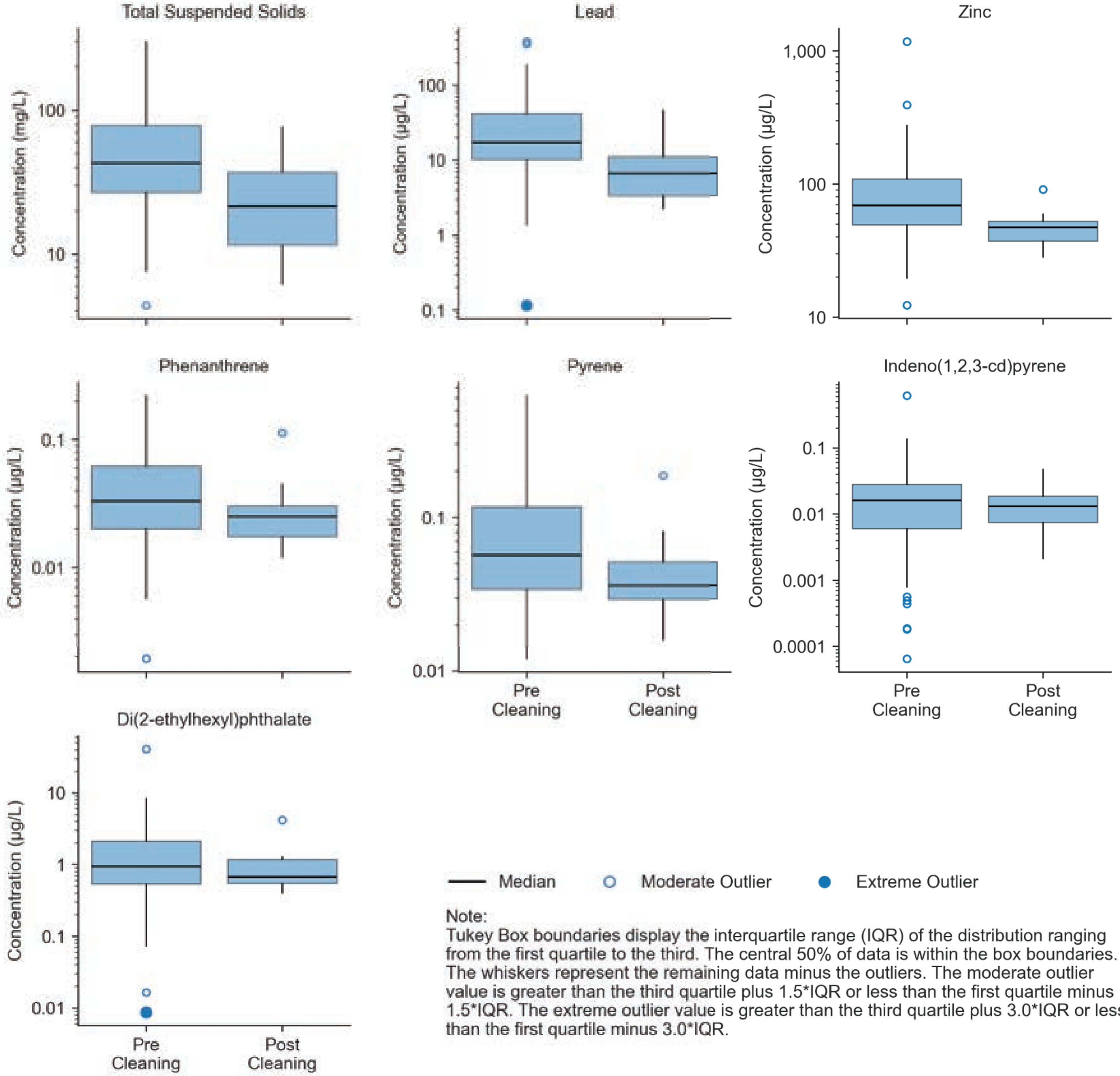




Median Moderate Outlier Extreme Outlier

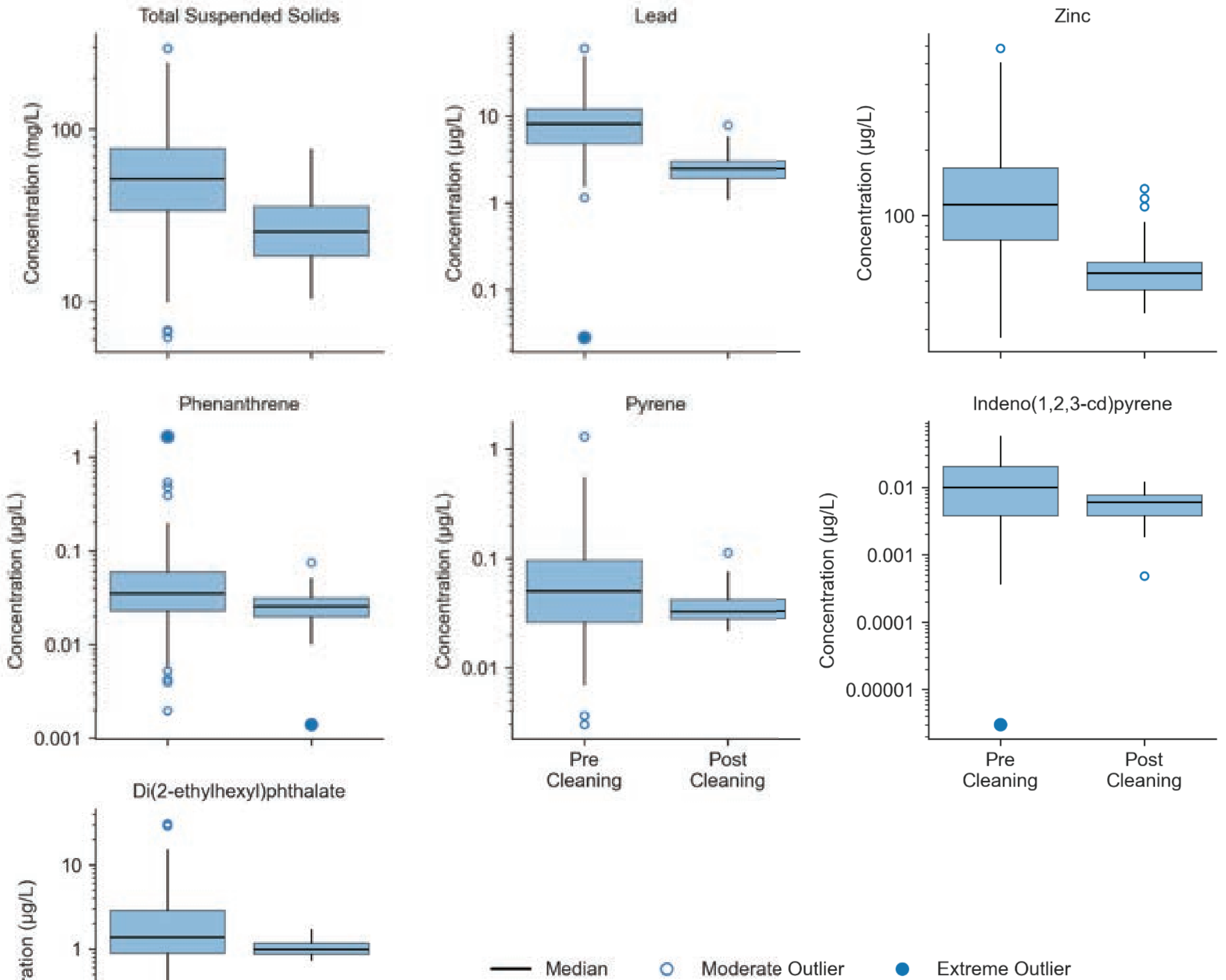
Note:
Tukey Box boundaries display the interquartile range (IQR) of the distribution ranging from the first quartile to the third. The central 50% of data is within the box boundaries. The whiskers represent the remaining data minus the outliers. The moderate outlier value is greater than the third quartile plus 1.5*IQR or less than the first quartile minus 1.5*IQR. The extreme outlier value is greater than the third quartile plus 3.0*IQR or less than the first quartile minus 3.0*IQR.

Figure 2-3.5 OF243 Storm Line Cleaning Comparison [Log Scale]



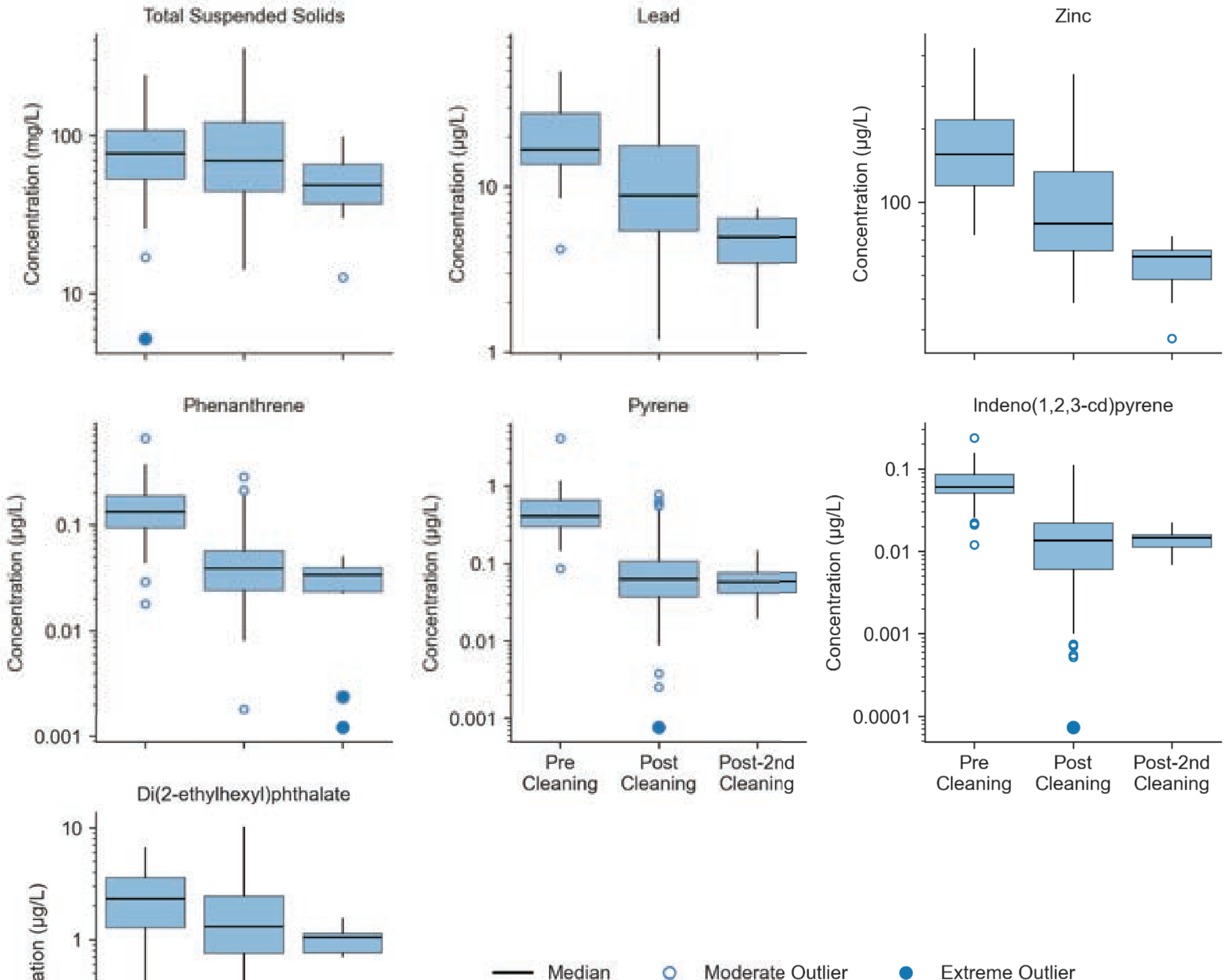
Note:
Tukey Box boundaries display the interquartile range (IQR) of the distribution ranging from the first quartile to the third. The central 50% of data is within the box boundaries. The whiskers represent the remaining data minus the outliers. The moderate outlier value is greater than the third quartile plus 1.5*IQR or less than the first quartile minus 1.5*IQR. The extreme outlier value is greater than the third quartile plus 3.0*IQR or less than the first quartile minus 3.0*IQR.

Figure 2-3.6 OF245 Storm Line Cleaning Comparison [Log Scale]



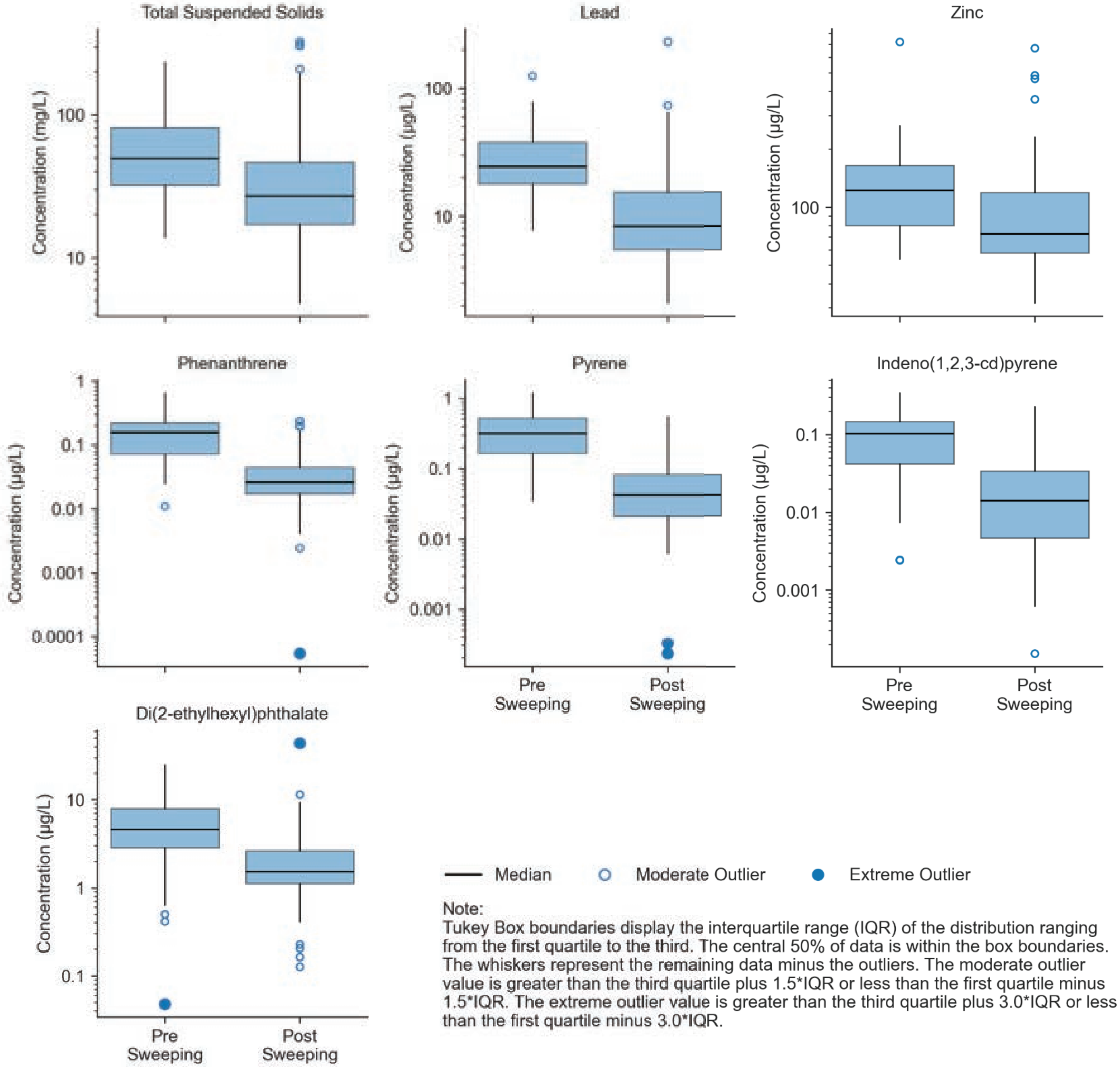
Note:
Tukey Box boundaries display the interquartile range (IQR) of the distribution ranging from the first quartile to the third. The central 50% of data is within the box boundaries. The whiskers represent the remaining data minus the outliers. The moderate outlier value is greater than the third quartile plus 1.5*IQR or less than the first quartile minus 1.5*IQR. The extreme outlier value is greater than the third quartile plus 3.0*IQR or less than the first quartile minus 3.0*IQR.

Figure 2-3.7 OF254 Storm Line Cleaning Comparison [Log Scale]



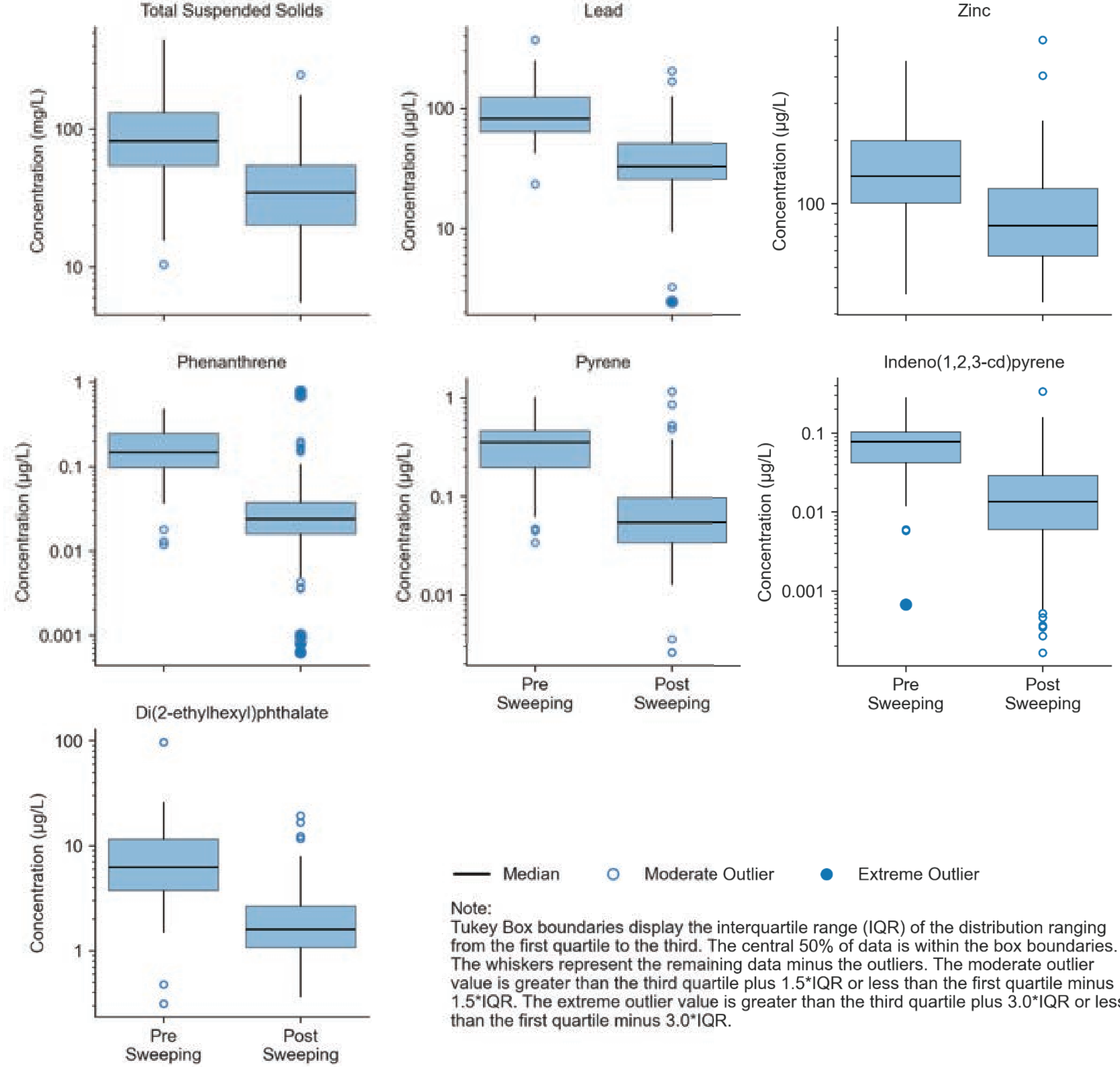
Note:
Tukey Box boundaries display the interquartile range (IQR) of the distribution ranging from the first quartile to the third. The central 50% of data is within the box boundaries. The whiskers represent the remaining data minus the outliers. The moderate outlier value is greater than the third quartile plus 1.5*IQR or less than the first quartile minus 1.5*IQR. The extreme outlier value is greater than the third quartile plus 3.0*IQR or less than the first quartile minus 3.0*IQR.

Figure 2-4.1 OF230 Street Sweeping Comparison [Log Scale]



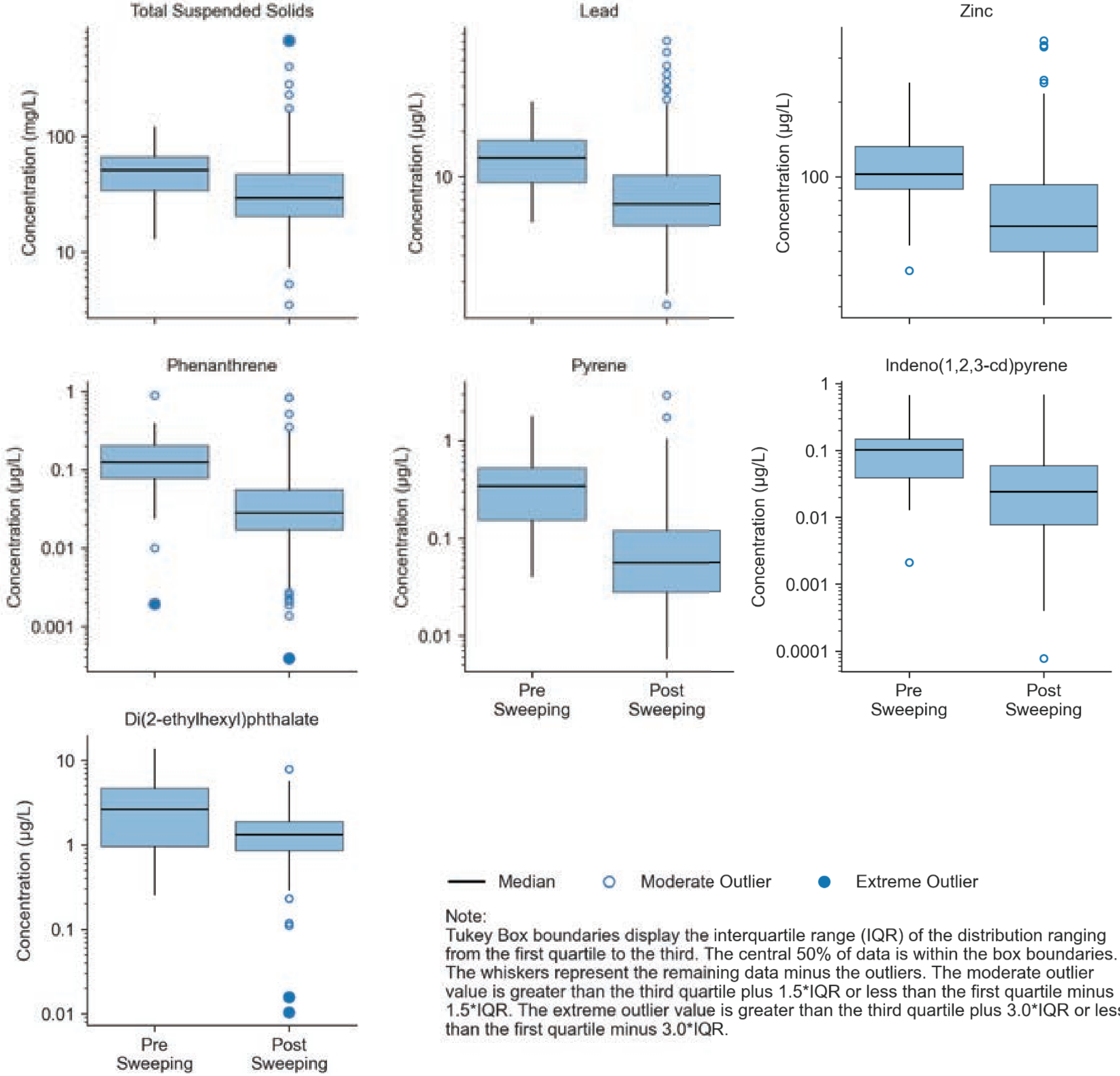
Note:
Tukey Box boundaries display the interquartile range (IQR) of the distribution ranging from the first quartile to the third. The central 50% of data is within the box boundaries. The whiskers represent the remaining data minus the outliers. The moderate outlier value is greater than the third quartile plus 1.5*IQR or less than the first quartile minus 1.5*IQR. The extreme outlier value is greater than the third quartile plus 3.0*IQR or less than the first quartile minus 3.0*IQR.

Figure 2-4.2 OF235 Street Sweeping Comparison [Log Scale]



Note:
Tukey Box boundaries display the interquartile range (IQR) of the distribution ranging from the first quartile to the third. The central 50% of data is within the box boundaries. The whiskers represent the remaining data minus the outliers. The moderate outlier value is greater than the third quartile plus 1.5*IQR or less than the first quartile minus 1.5*IQR. The extreme outlier value is greater than the third quartile plus 3.0*IQR or less than the first quartile minus 3.0*IQR.

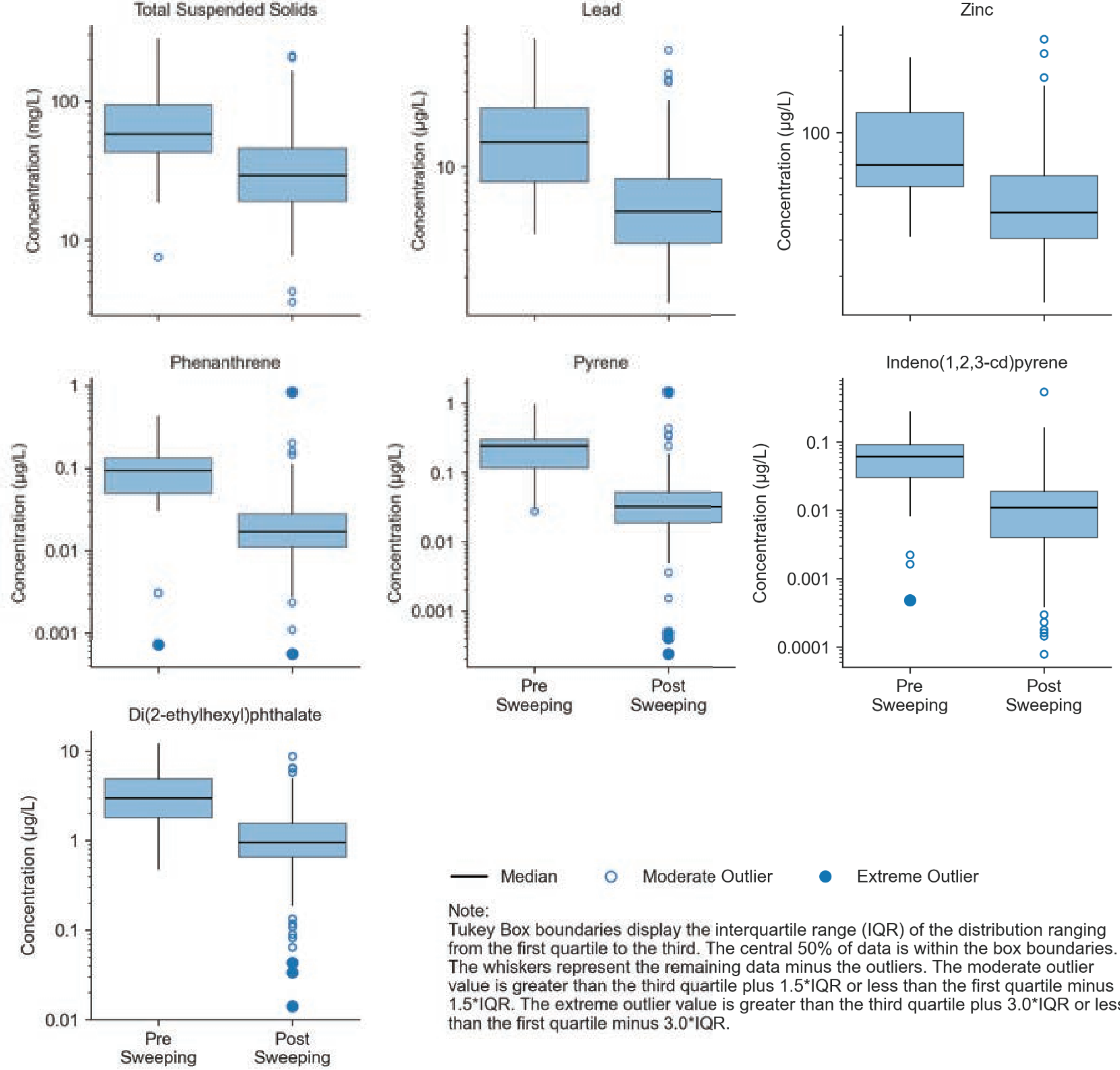
Figure 2-4.3 OF237A Street Sweeping Comparison [Log Scale]



Median Moderate Outlier Extreme Outlier

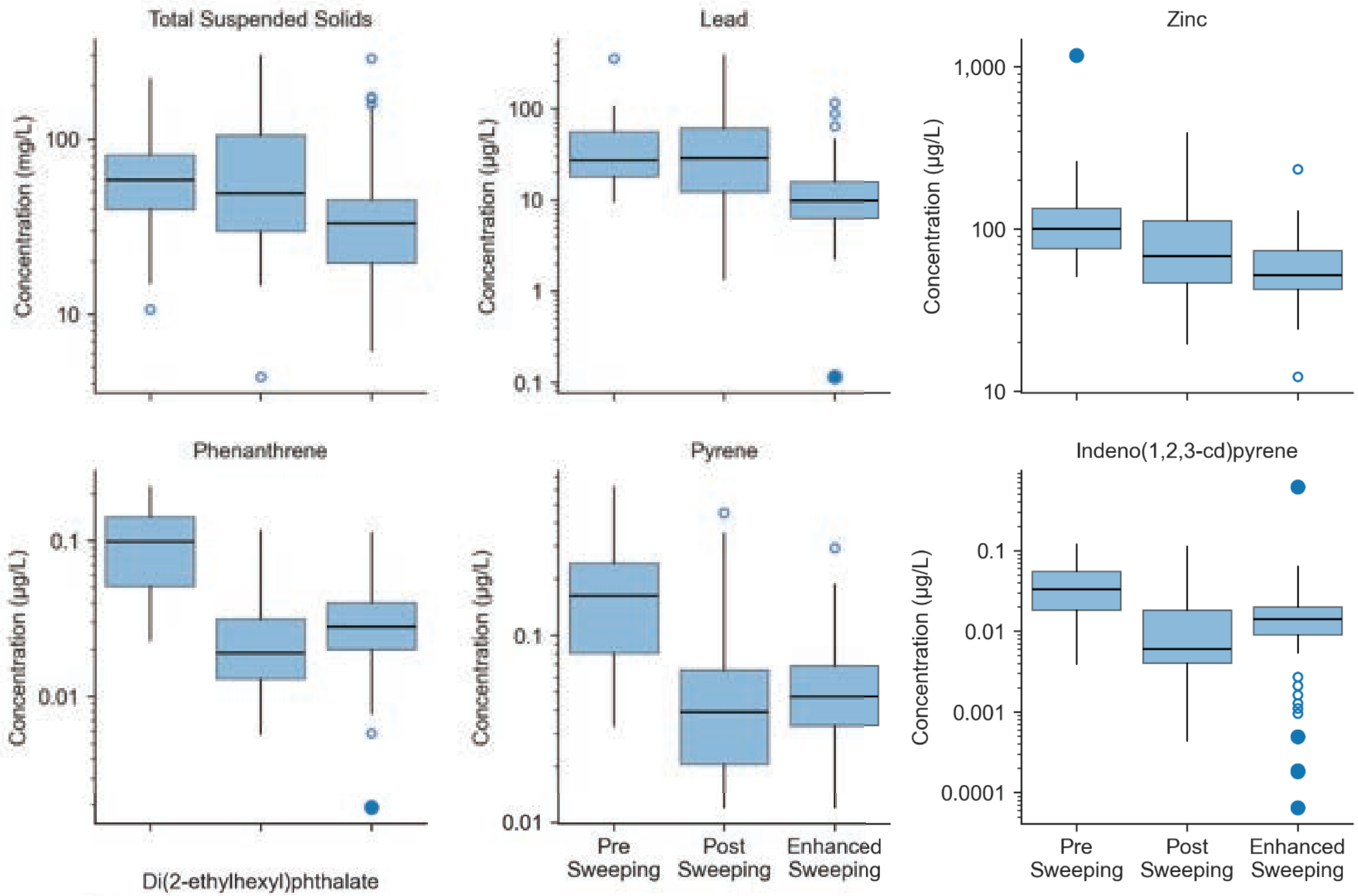
Note:
Tukey Box boundaries display the interquartile range (IQR) of the distribution ranging from the first quartile to the third. The central 50% of data is within the box boundaries. The whiskers represent the remaining data minus the outliers. The moderate outlier value is greater than the third quartile plus 1.5*IQR or less than the first quartile minus 1.5*IQR. The extreme outlier value is greater than the third quartile plus 3.0*IQR or less than the first quartile minus 3.0*IQR.

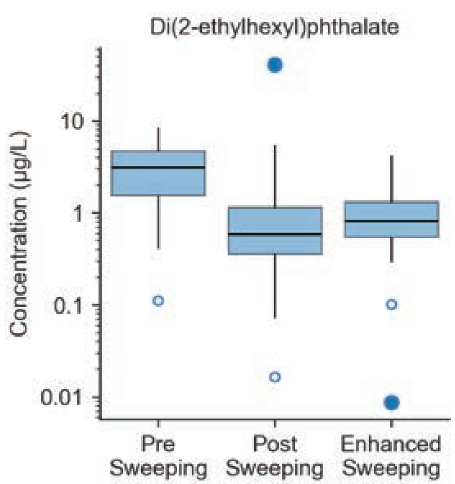
Figure 2-4.4 OF237B Street Sweeping Comparison [Log Scale]



Note:
Tukey Box boundaries display the interquartile range (IQR) of the distribution ranging from the first quartile to the third. The central 50% of data is within the box boundaries. The whiskers represent the remaining data minus the outliers. The moderate outlier value is greater than the third quartile plus 1.5*IQR or less than the first quartile minus 1.5*IQR. The extreme outlier value is greater than the third quartile plus 3.0*IQR or less than the first quartile minus 3.0*IQR.

Figure 2-4.5 OF243 Street Sweeping Comparison [Log Scale]

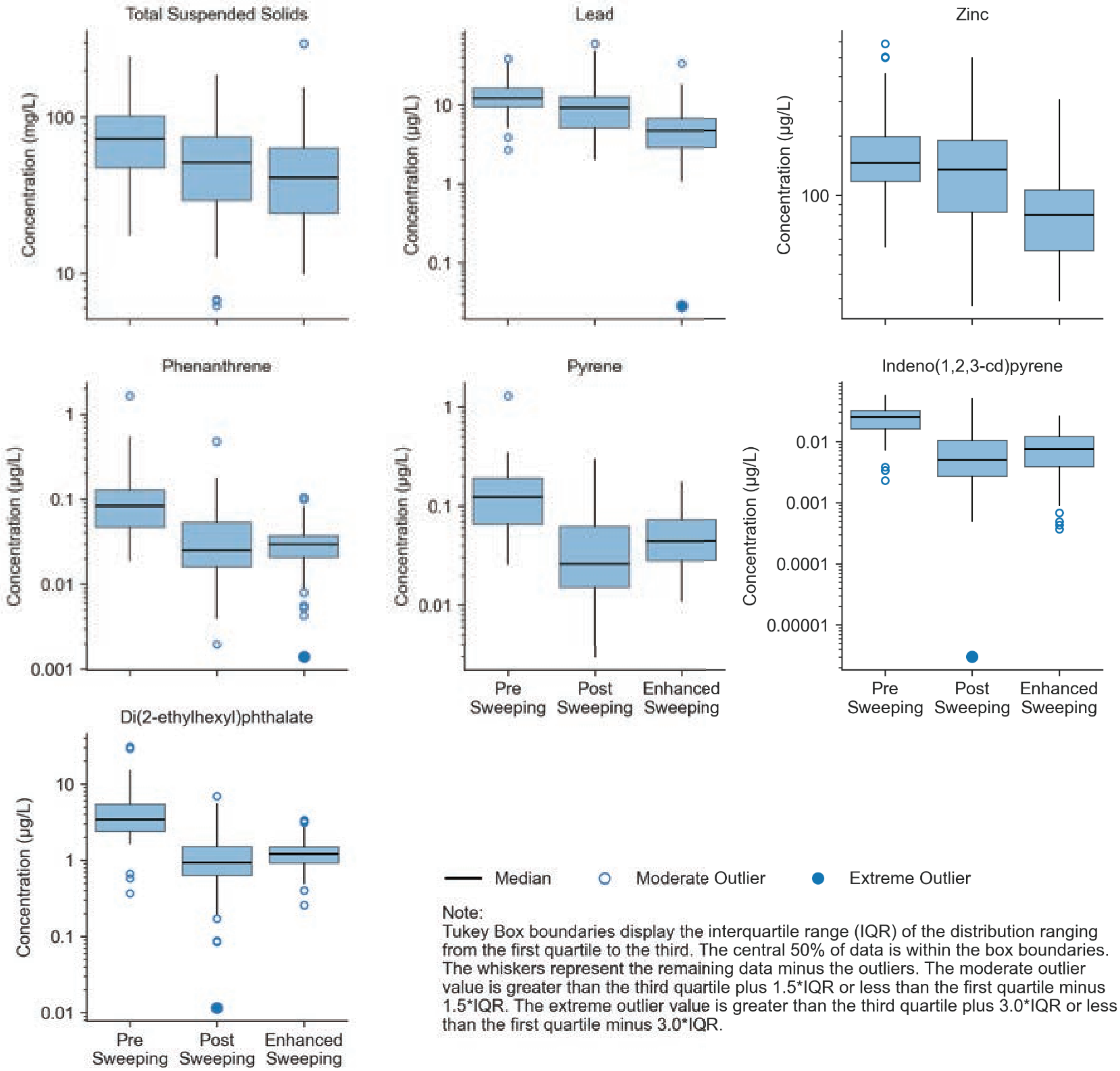




Median Moderate Outlier Extreme Outlier

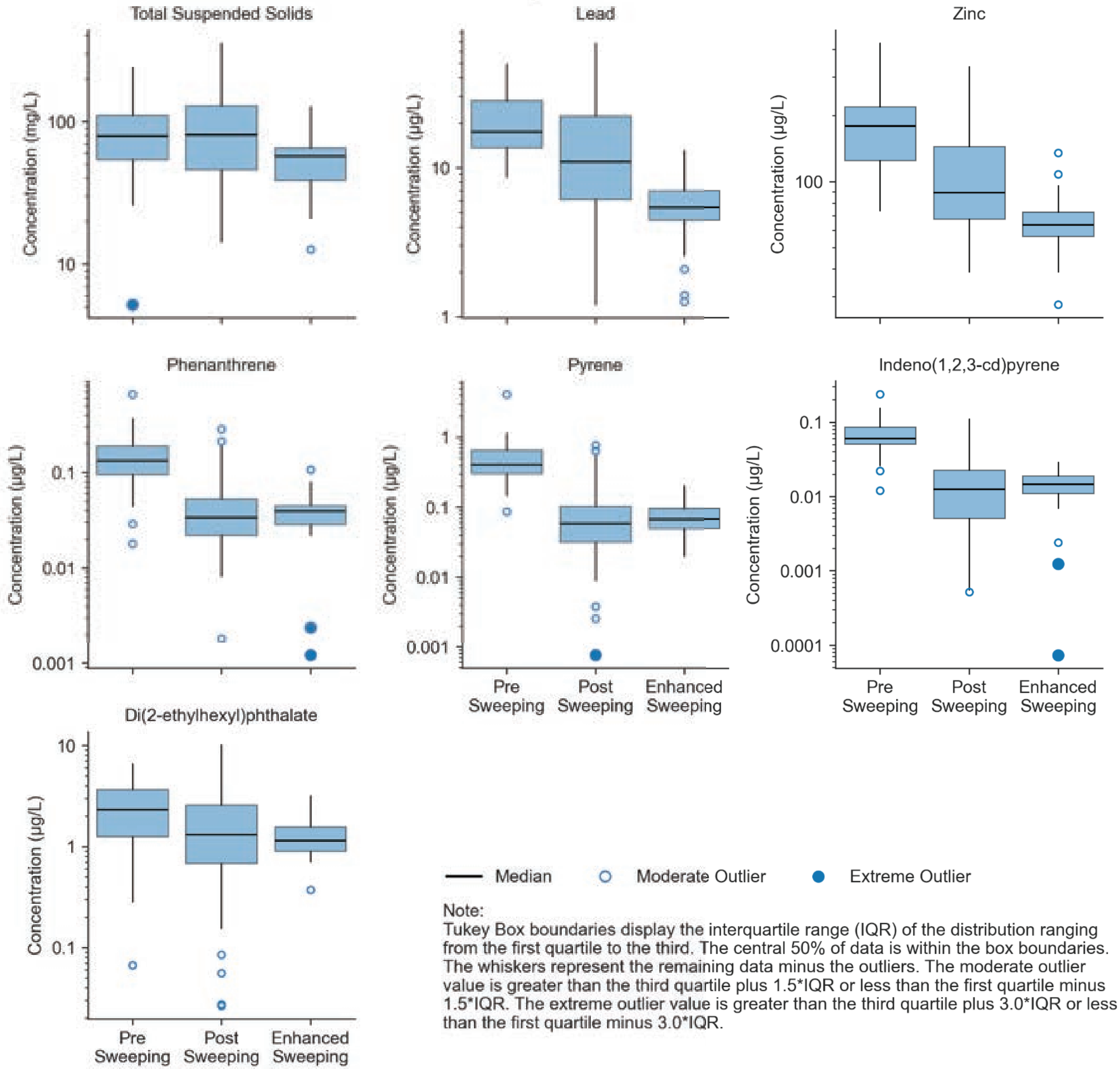
Note:
Tukey Box boundaries display the interquartile range (IQR) of the distribution ranging from the first quartile to the third. The central 50% of data is within the box boundaries. The whiskers represent the remaining data minus the outliers. The moderate outlier value is greater than the third quartile plus 1.5*IQR or less than the first quartile minus 1.5*IQR. The extreme outlier value is greater than the third quartile plus 3.0*IQR or less than the first quartile minus 3.0*IQR.

Figure 2-4.6 OF245 Street Sweeping Comparison [Log Scale]



Note:
Tukey Box boundaries display the interquartile range (IQR) of the distribution ranging from the first quartile to the third. The central 50% of data is within the box boundaries. The whiskers represent the remaining data minus the outliers. The moderate outlier value is greater than the third quartile plus 1.5*IQR or less than the first quartile minus 1.5*IQR. The extreme outlier value is greater than the third quartile plus 3.0*IQR or less than the first quartile minus 3.0*IQR.

Figure 2-4.7 OF254 Street Sweeping Comparison [Log Scale]



Note:
Tukey Box boundaries display the interquartile range (IQR) of the distribution ranging from the first quartile to the third. The central 50% of data is within the box boundaries. The whiskers represent the remaining data minus the outliers. The moderate outlier value is greater than the third quartile plus 1.5*IQR or less than the first quartile minus 1.5*IQR. The extreme outlier value is greater than the third quartile plus 3.0*IQR or less than the first quartile minus 3.0*IQR.

Figure 3-1
Daily Rainfall - Monthly Averages WY2002-2023

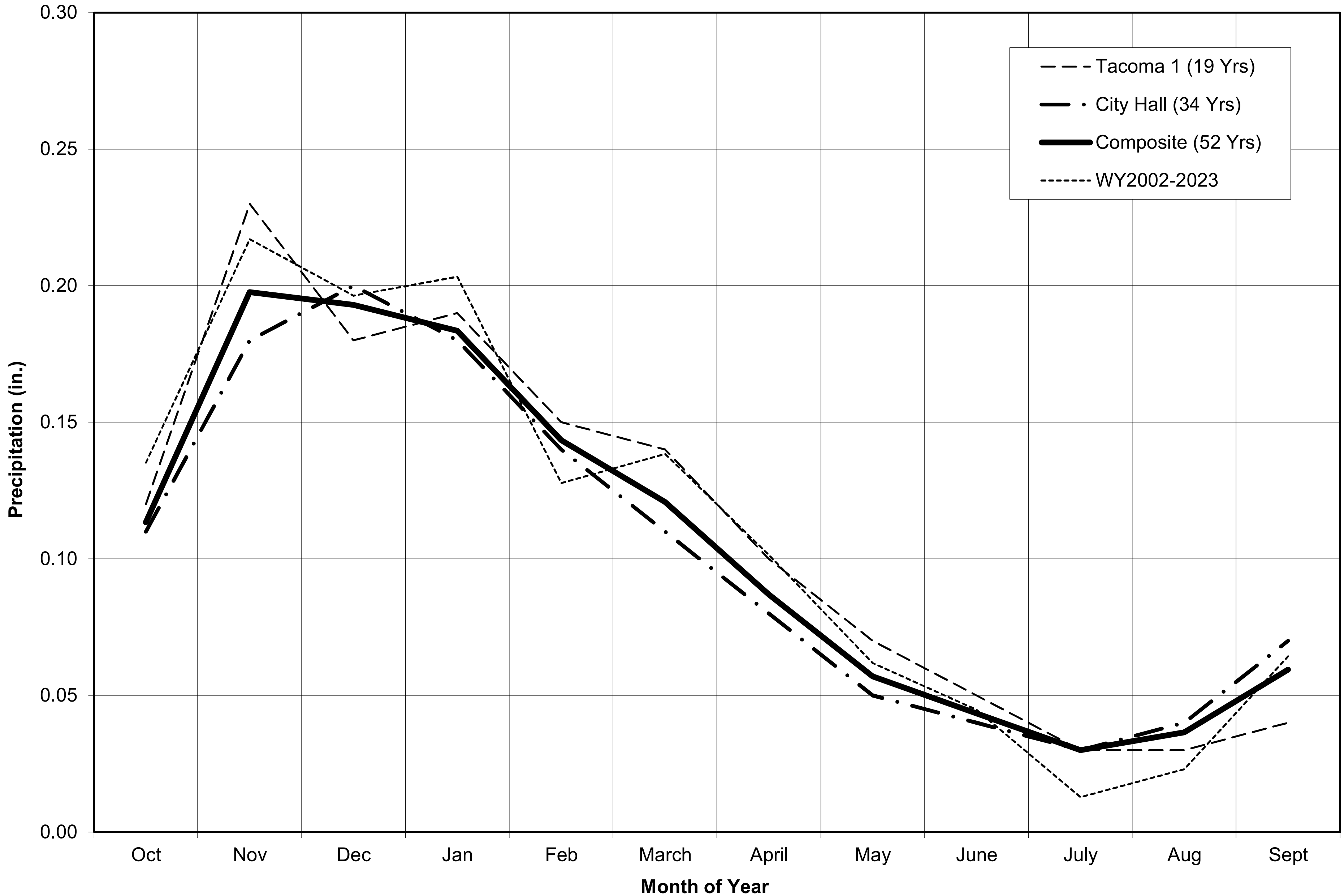


Figure 3-2.1
Storm Event Hydrologic Parameters, October 2001 - September 2023

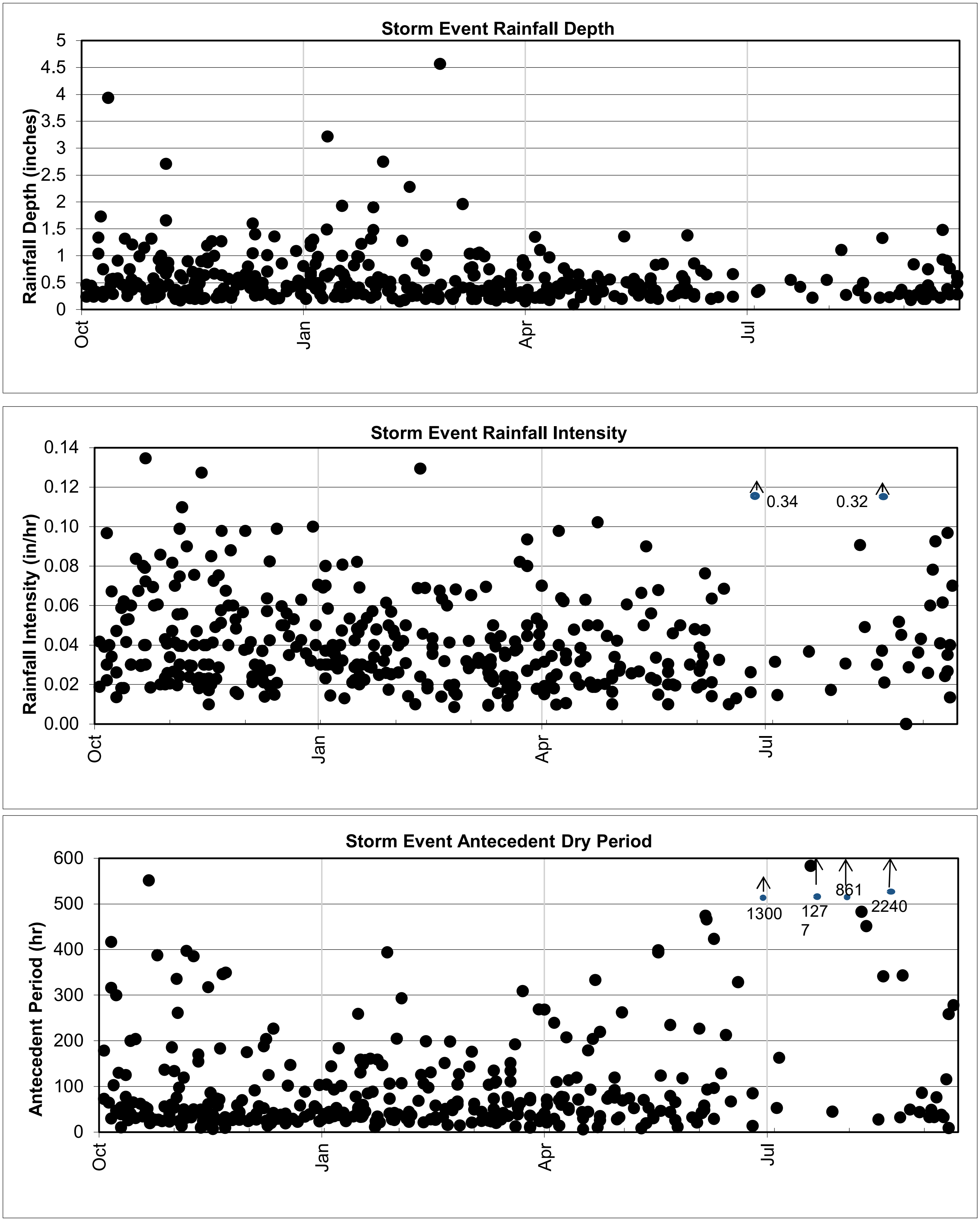


Figure 3-2.2
Storm Event Hydrologic Parameters, October 2001 - September 2023

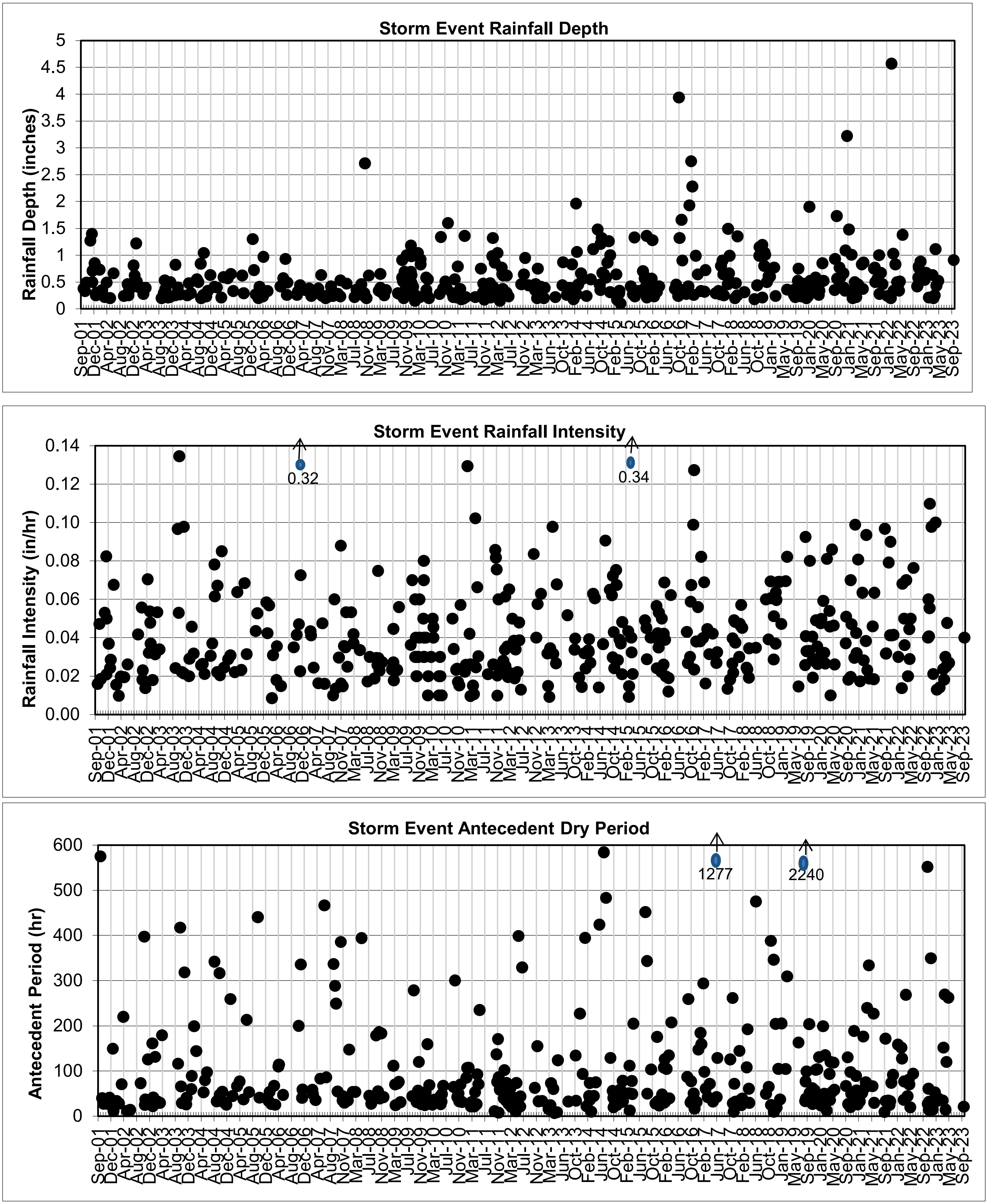
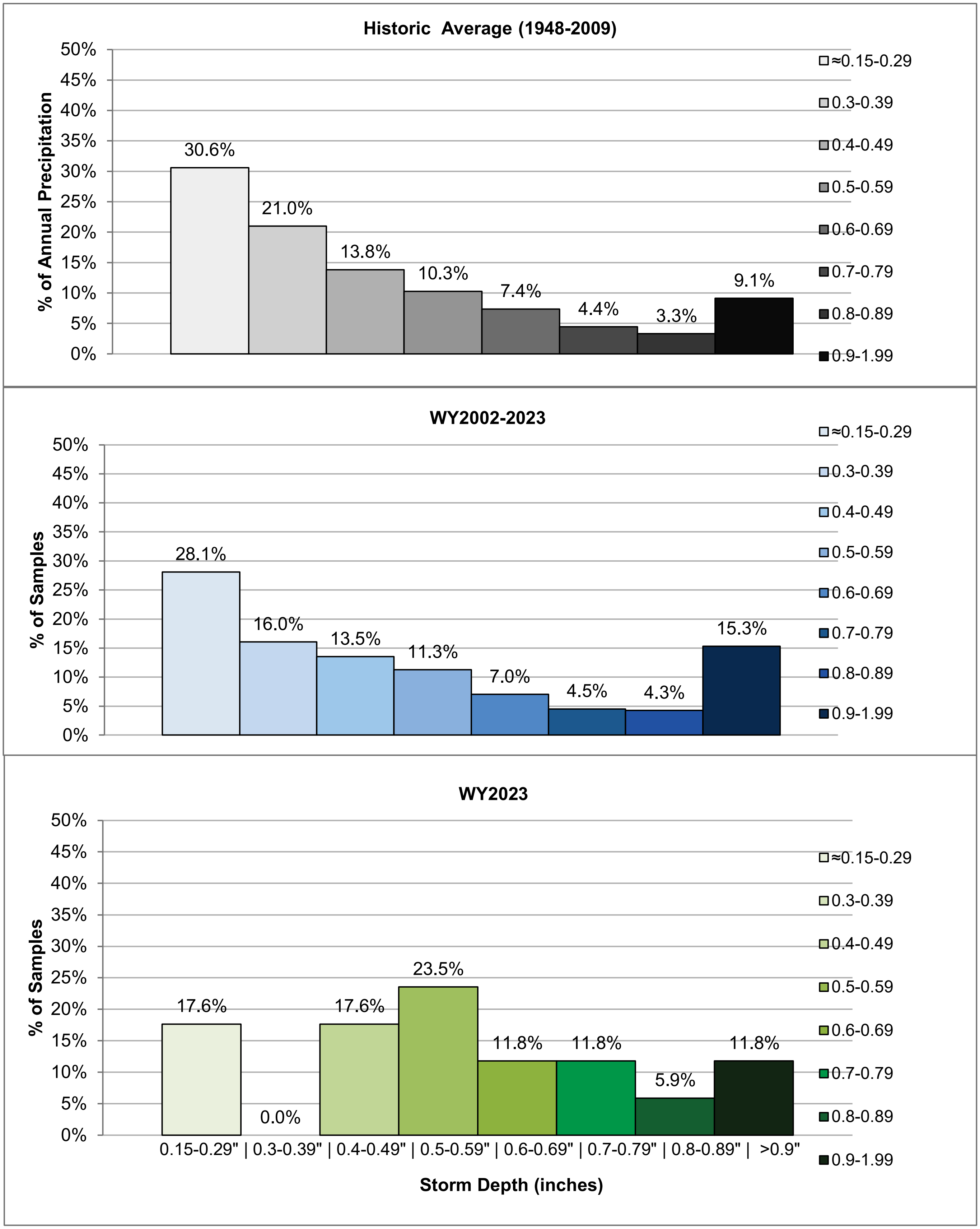


Figure 3-3
Representativeness of Sampled Storm Sizes



Note: Data for 237A is from the original 237A site through WY2011. The 237A New sampling site data was used for WY2012 and later.

Figure 3-4
Representativeness of Seasonal Sampling Distribution

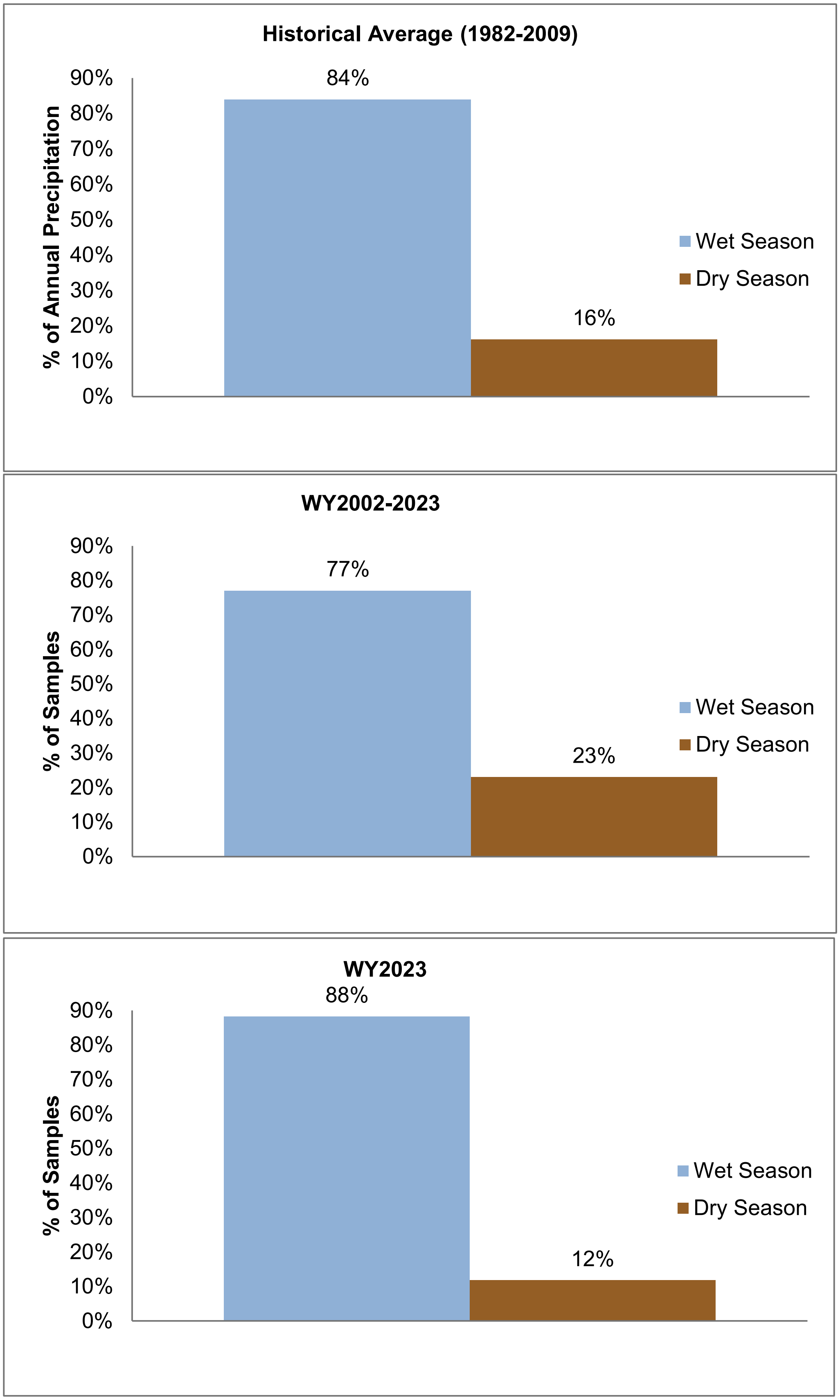


Figure 3-5.1
Linear Regression Analysis of Stormwater Time Trends
Time Series for Total Suspended Solids (TSS)

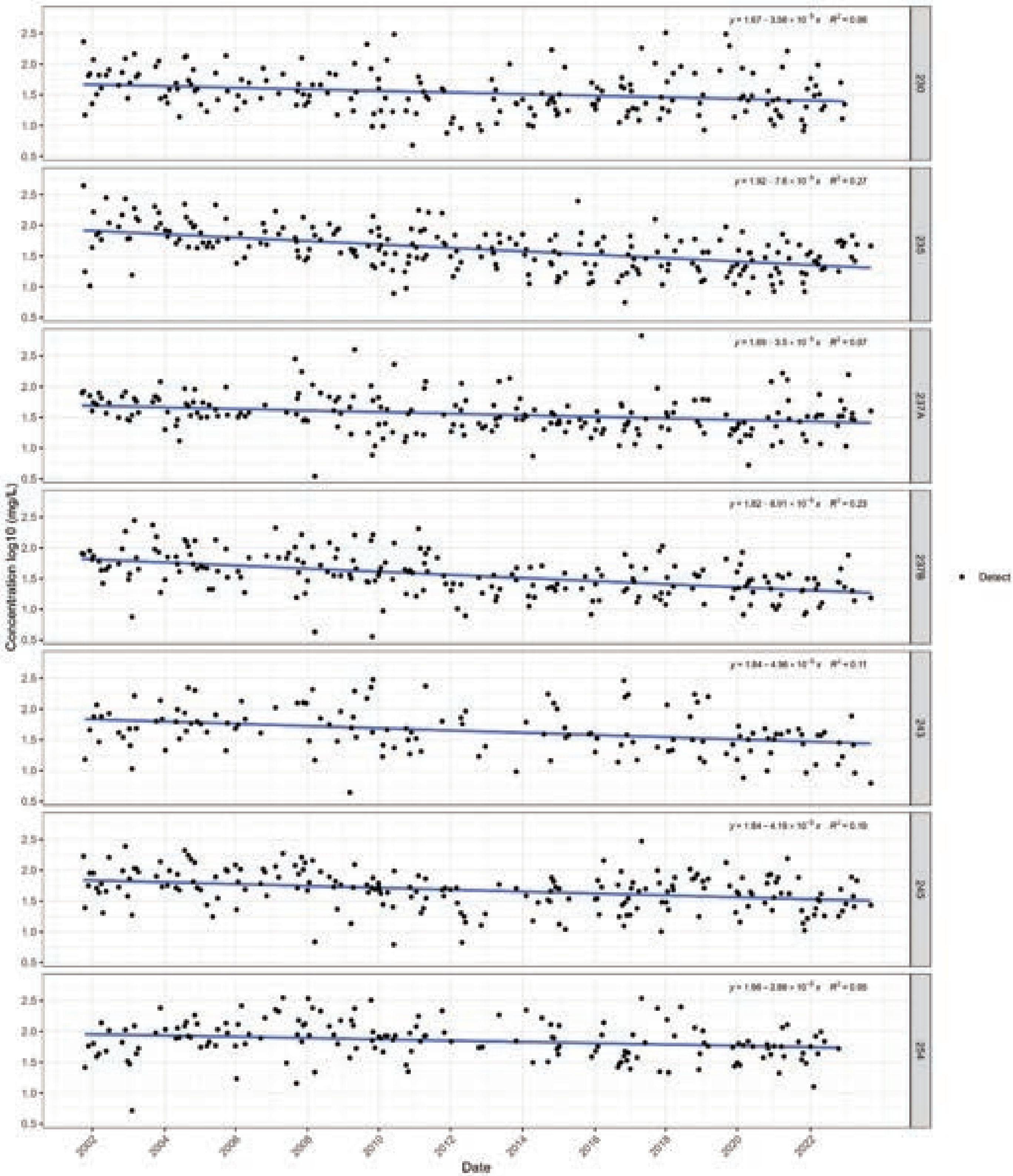


Figure 3-5.2
Linear Regression Analysis of Stormwater Time Trends
Time Series for Total Copper

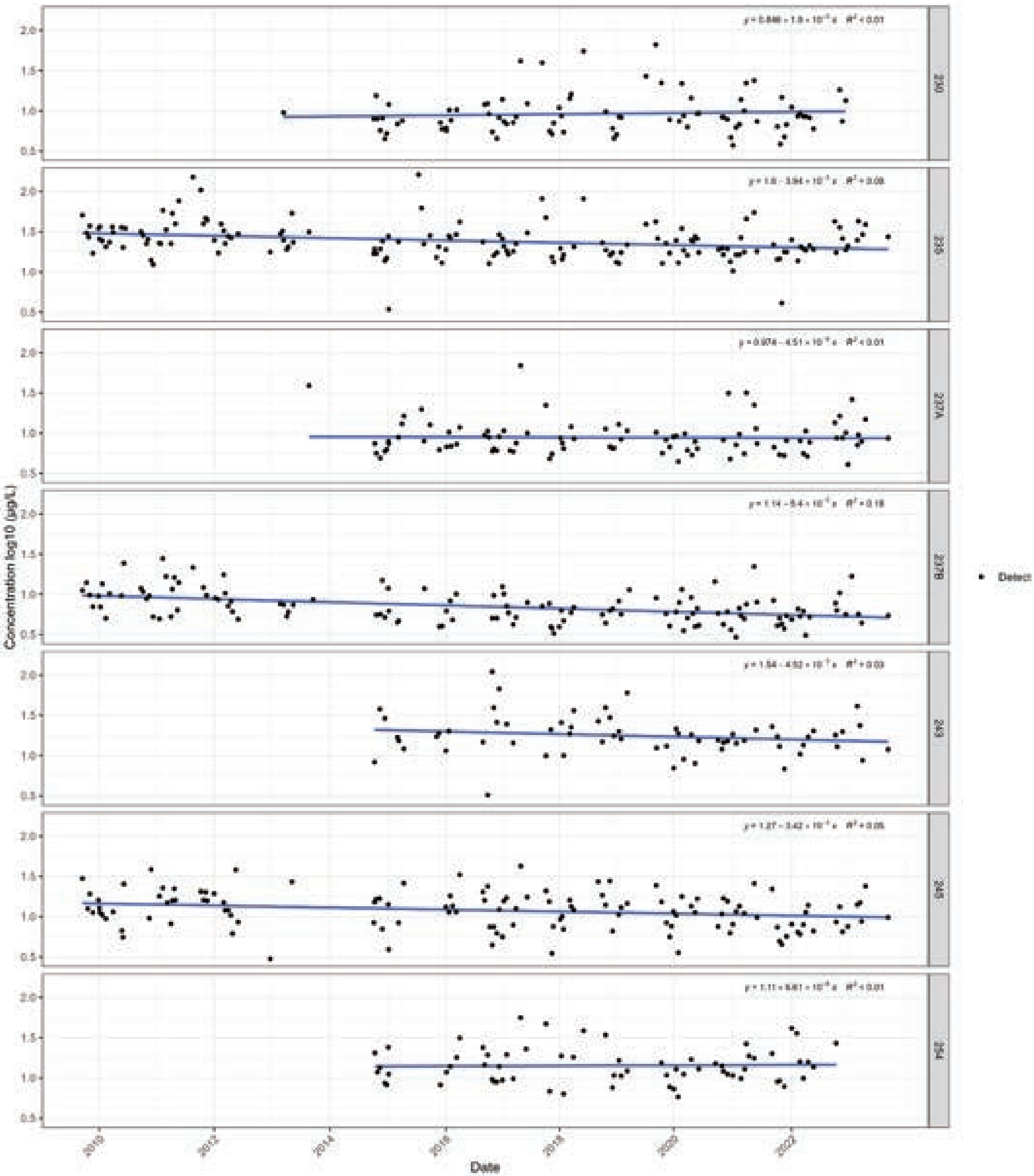


Figure 3-5.3
Linear Regression Analysis of Stormwater Time Trends
Time Series for Total Lead

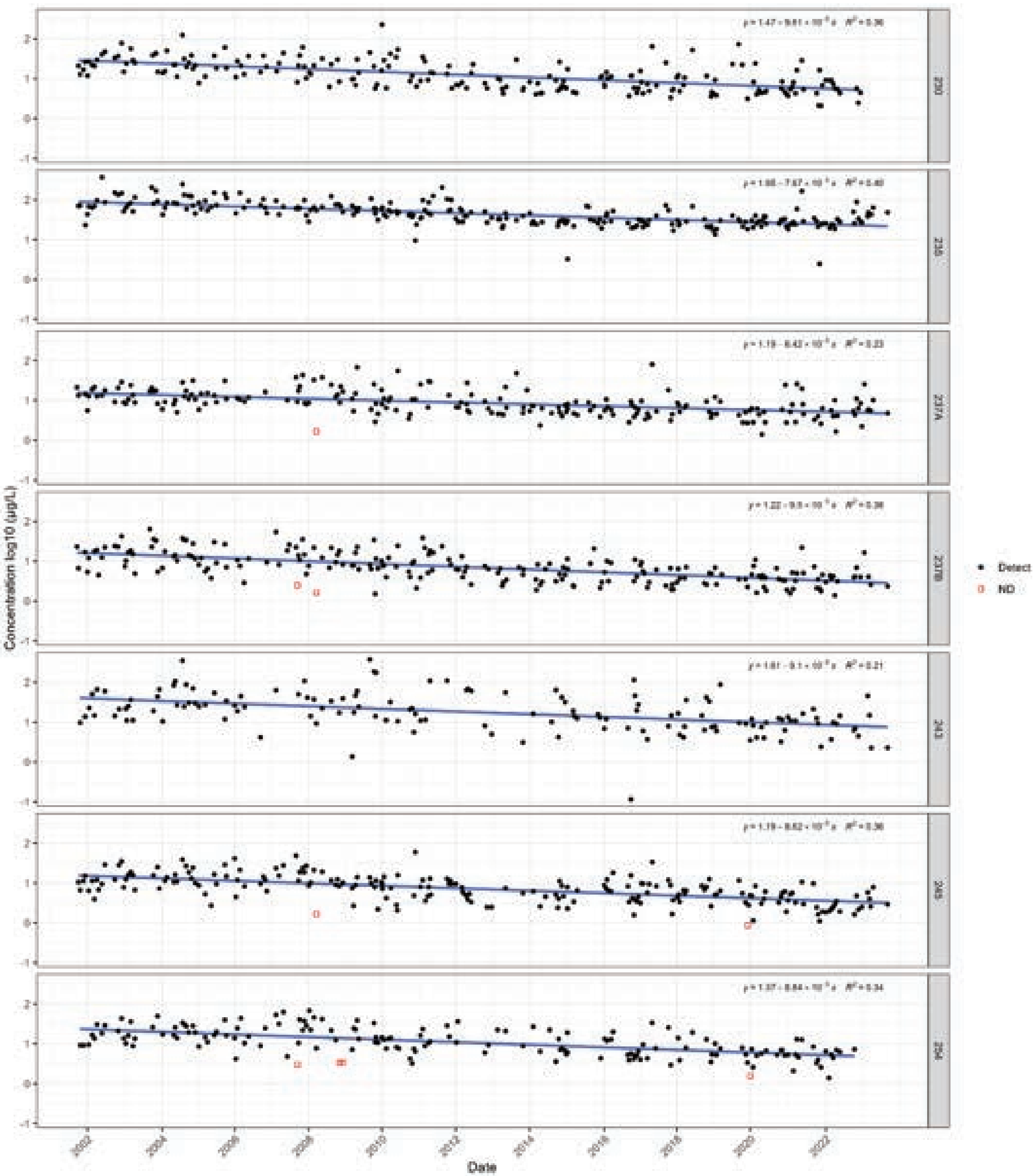


Figure 3-5.4
Linear Regression Analysis of Stormwater Time Trends
Time Series for Total Zinc

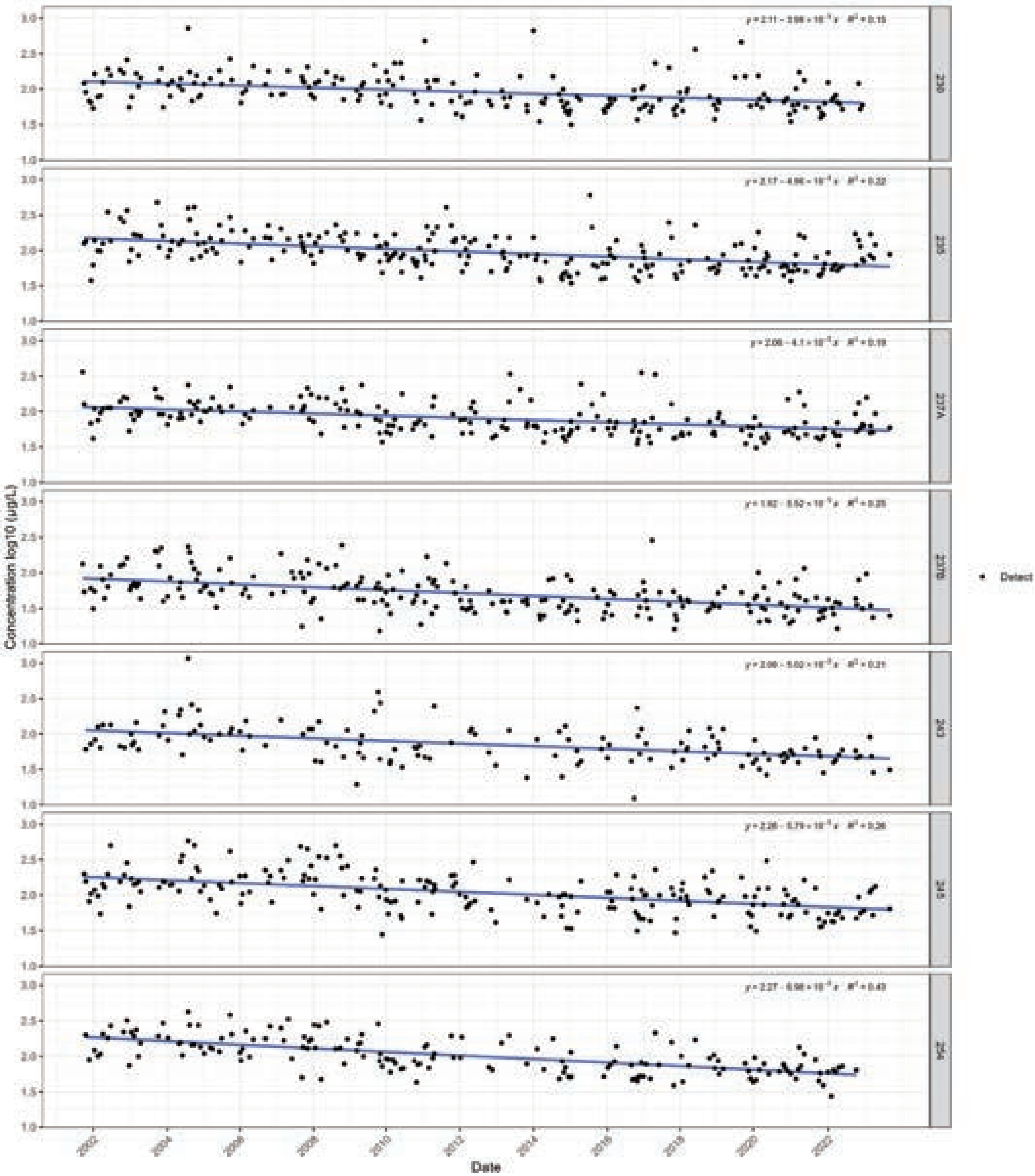


Figure 3-5.5
Linear Regression Analysis of Stormwater Time Trends
Time Series for Total Phenanthrene

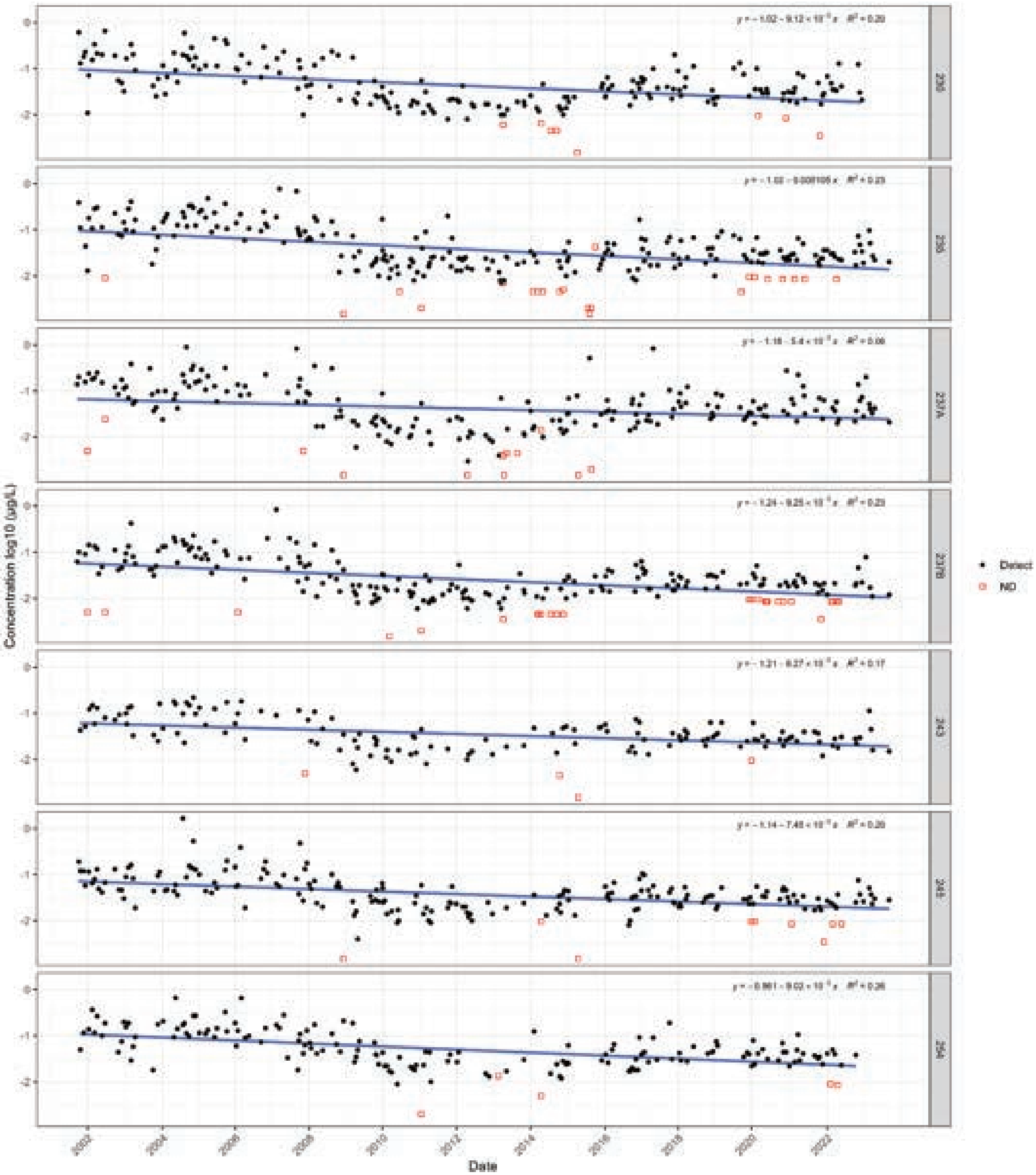


Figure 3-5.6
Linear Regression Analysis of Stormwater Time Trends
Time Series for Total Pyrene

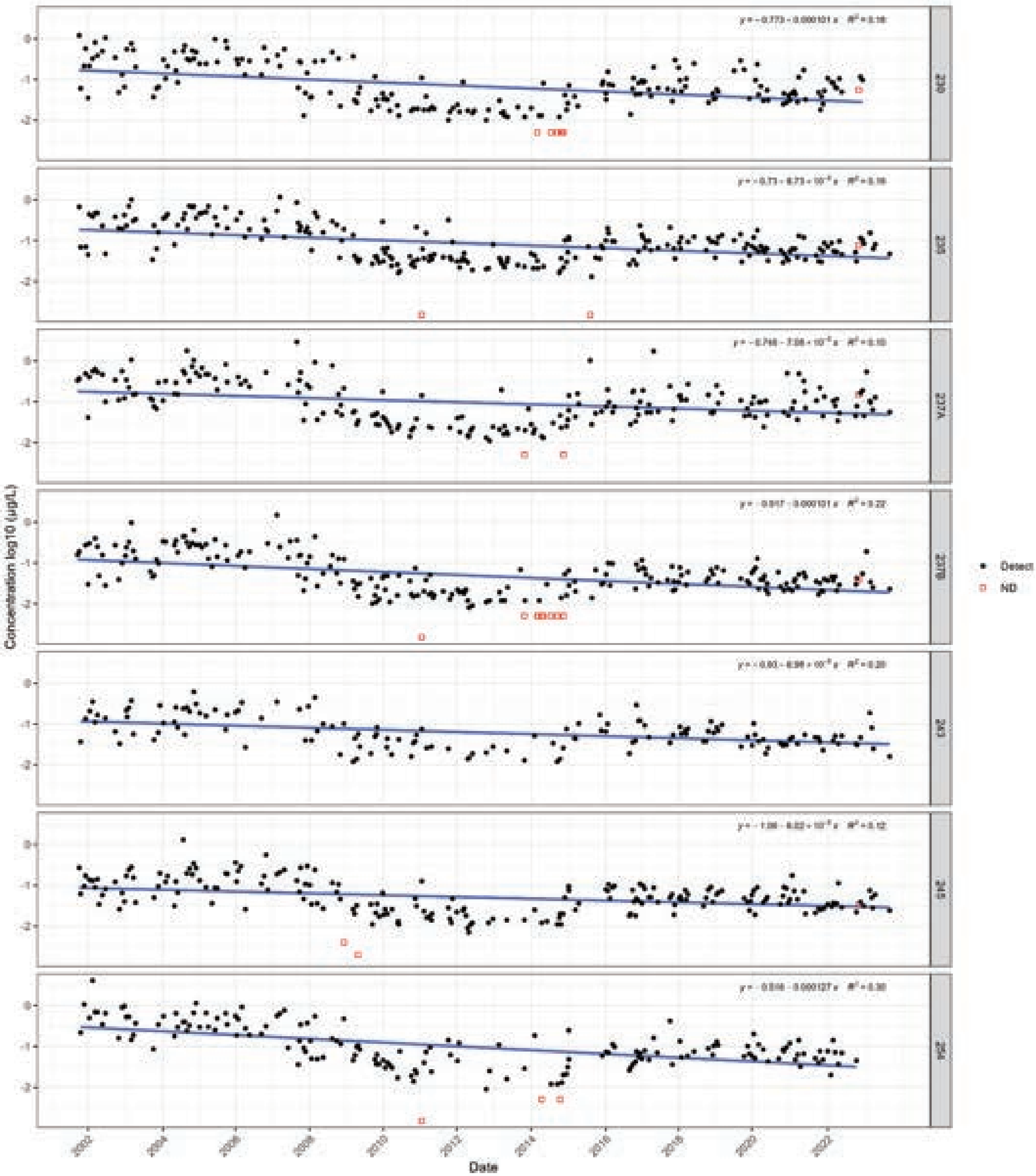


Figure 3-5.7
Linear Regression Analysis of Stormwater Time Trends
Time Series for Indeno(1,2,3-c,d)pyrene

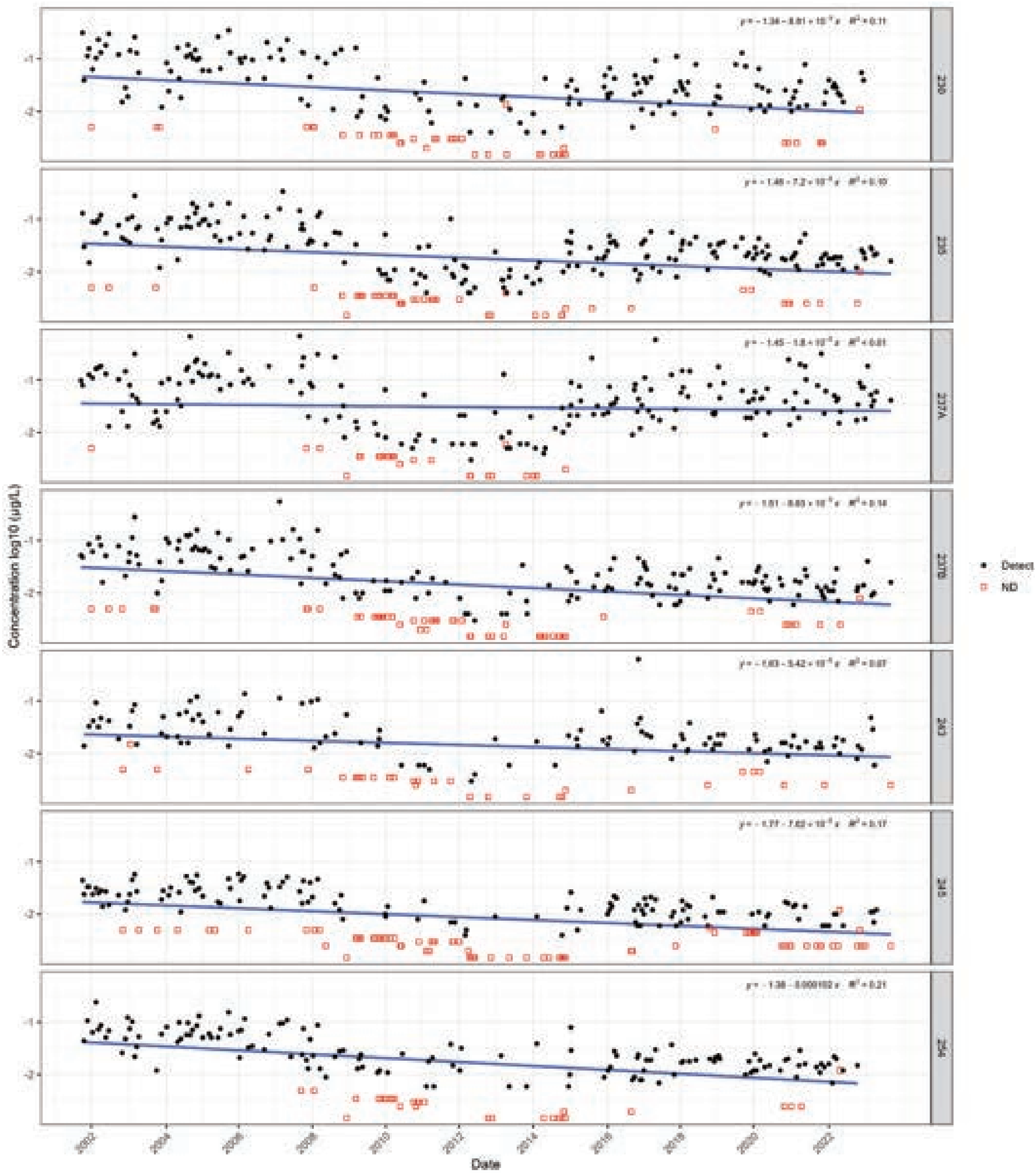
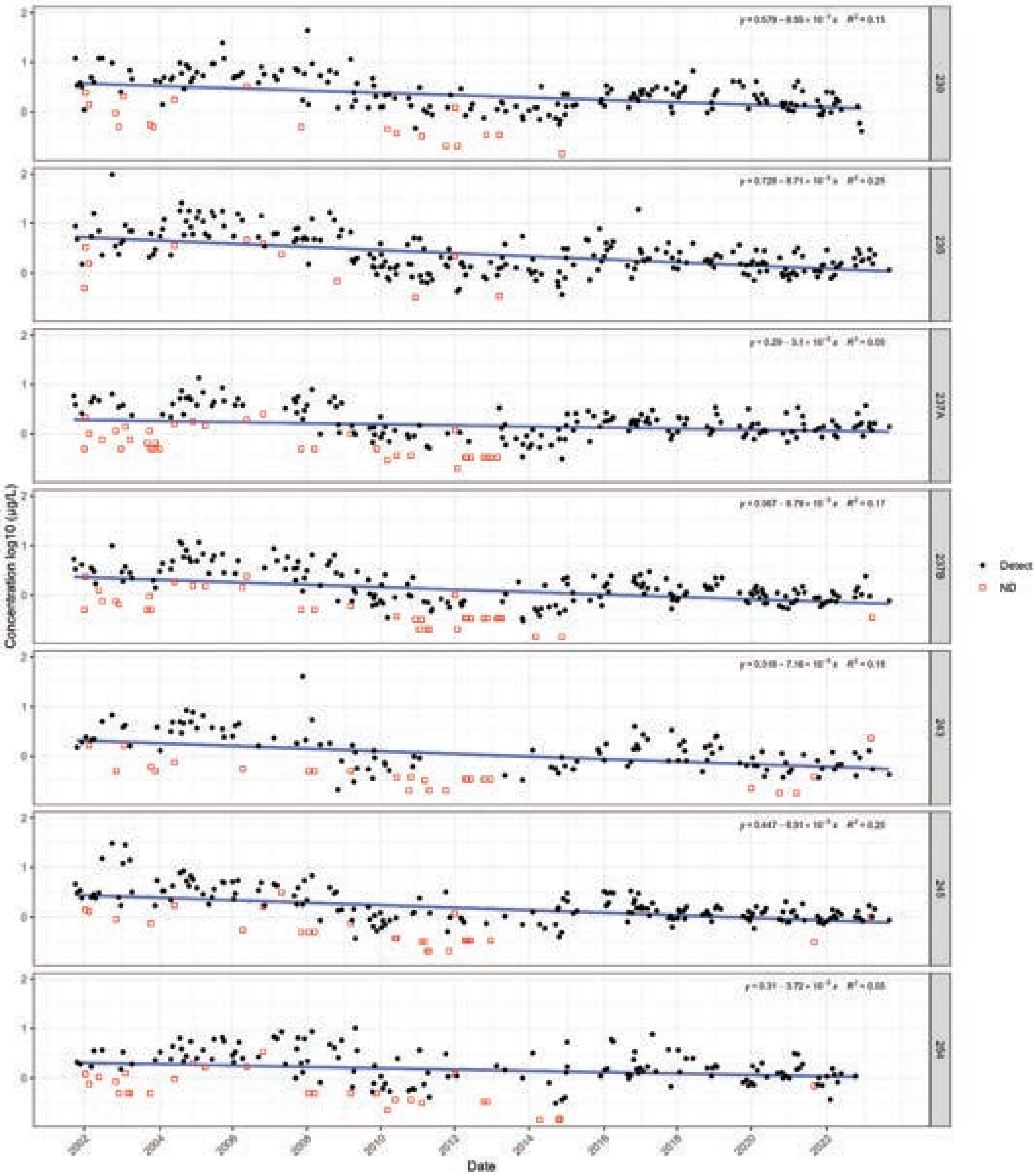
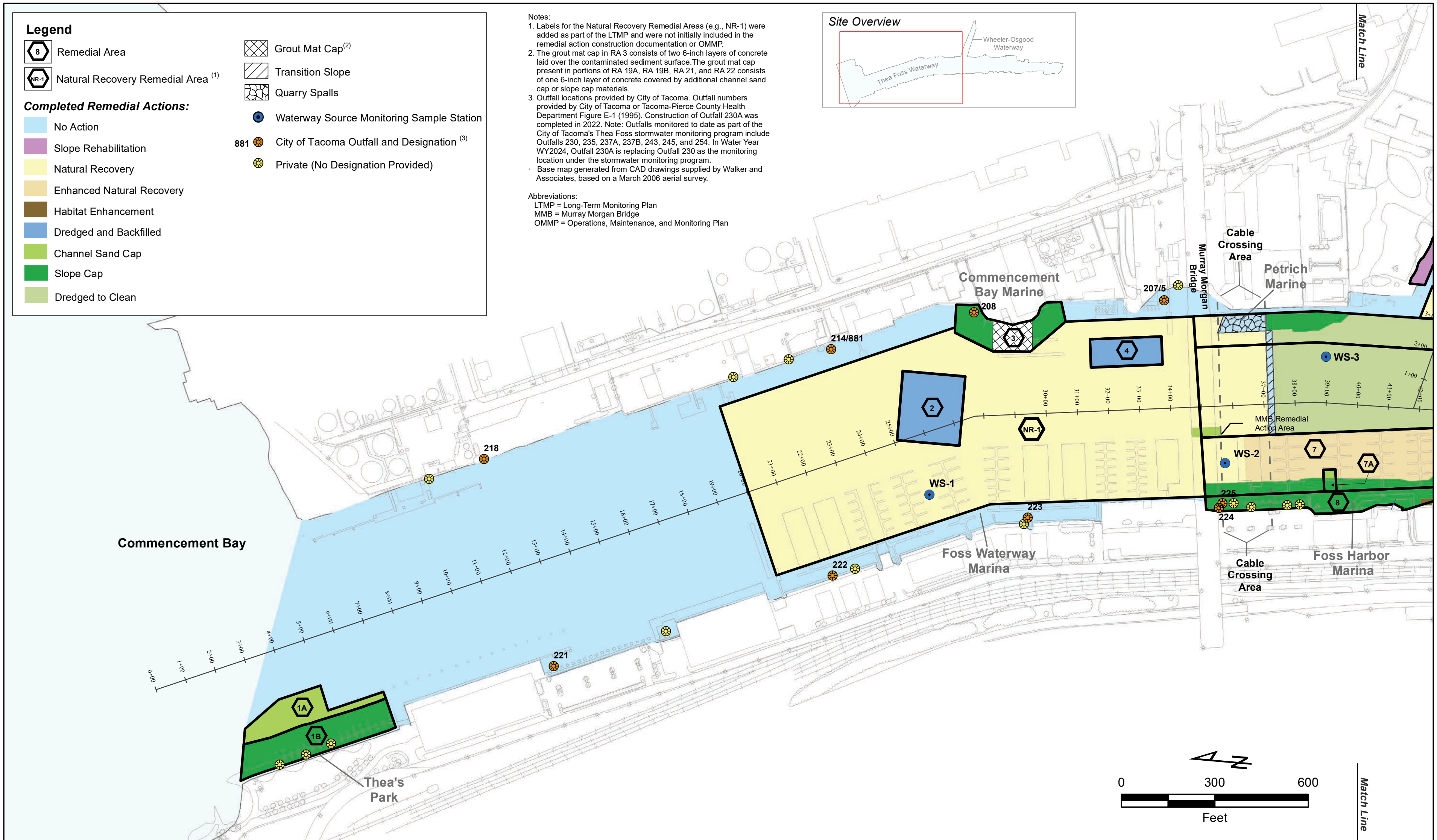


Figure 3-5.8
Linear Regression Analysis of Stormwater Time Trends
Time Series for Bis(2-ethylhexyl)phthalate (DEHP)





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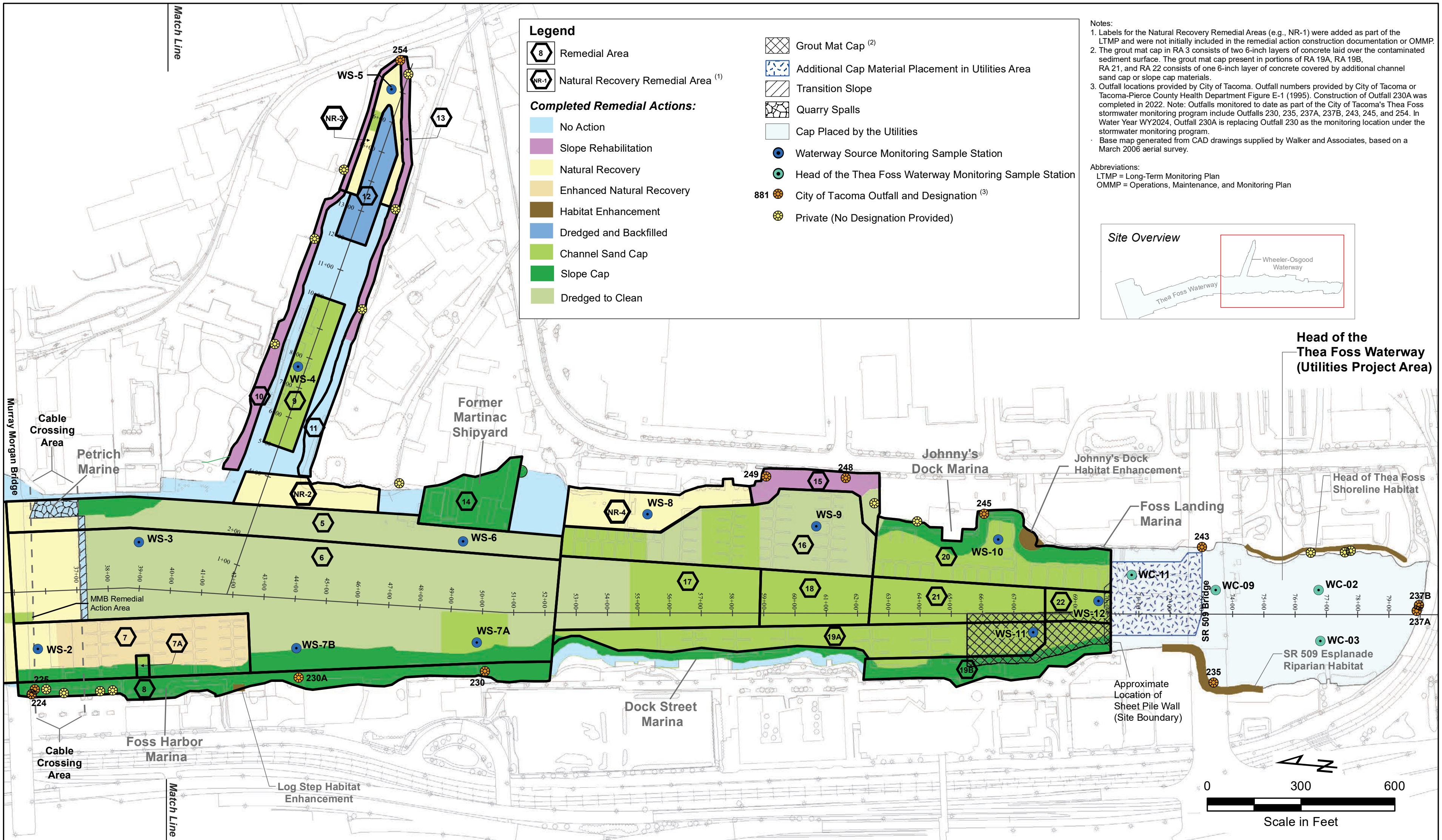
Thea Foss and Wheeler-Osgood Waterways
2023 Source Control and WY2023
Stormwater Monitoring Report

Figure 4-1 (Page 1 of 2)
Waterway Source and Head of the Thea Foss Waterway Monitoring Sample Stations



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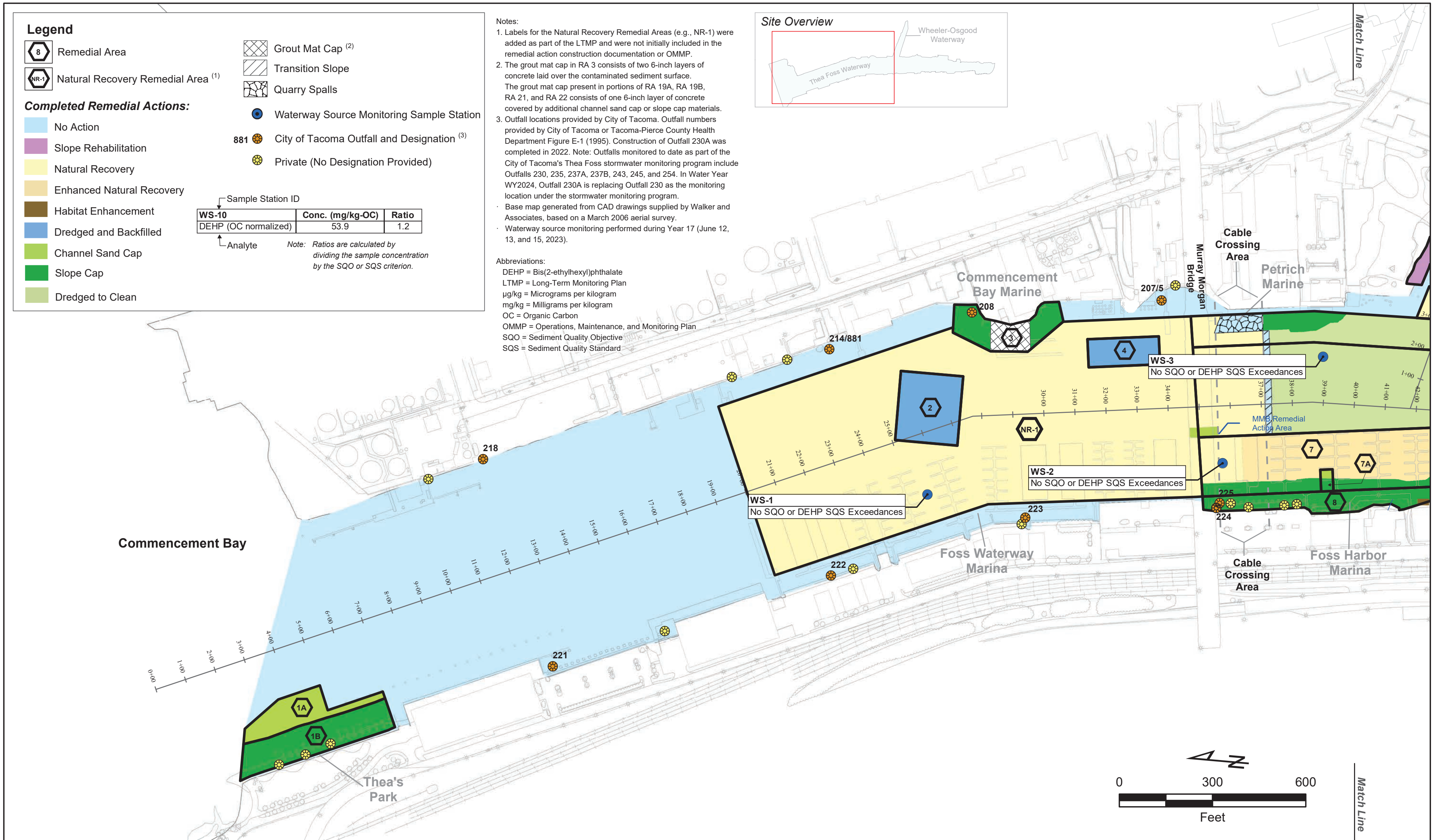
Thea Foss and Wheeler-Osgood Waterways
2023 Source Control and WY2023
Stormwater Monitoring Report

Figure 4-1 (Page 2 of 2)
Waterway Source and Head of the Thea Foss Waterway Monitoring Sample Stations



Notes:
1. Labels for the Natural Recovery Remedial Areas (e.g., NR-1) were added as part of the LTMP and were not initially included in the remedial action construction documentation or OMMP.
2. The grout mat cap in RA 3 consists of two 6-inch layers of concrete laid over the contaminated sediment surface. The grout mat cap present in portions of RA 19A, RA 19B, RA 21, and RA 22 consists of one 6-inch layer of concrete covered by additional channel sand cap or slope cap materials.
3. Outfall locations provided by City of Tacoma. Outfall numbers provided by City of Tacoma or Tacoma-Pierce County Health Department Figure E-1 (1995). Construction of Outfall 230A was completed in 2022. Note: Outfalls monitored to date as part of the City of Tacoma's Thea Foss stormwater monitoring program include Outfalls 230, 235, 237A, 237B, 243, 245, and 254. In Water Year WY2024, Outfall 230A is replacing Outfall 230 as the monitoring location under the stormwater monitoring program.

· Base map generated from CAD drawings supplied by Walker and Associates, based on a March 2006 aerial survey.
· Waterway source monitoring performed during Year 17 (June 12, 13, and 15, 2023).

Abbreviations:
DEHP = Bis(2-ethylhexyl)phthalate
LTMP = Long-Term Monitoring Plan
µg/kg = Micrograms per kilogram
mg/kg = Milligrams per kilogram
OC = Organic Carbon
OMMP = Operations, Maintenance, and Monitoring Plan
SQO = Sediment Quality Objective
SQS = Sediment Quality Standard

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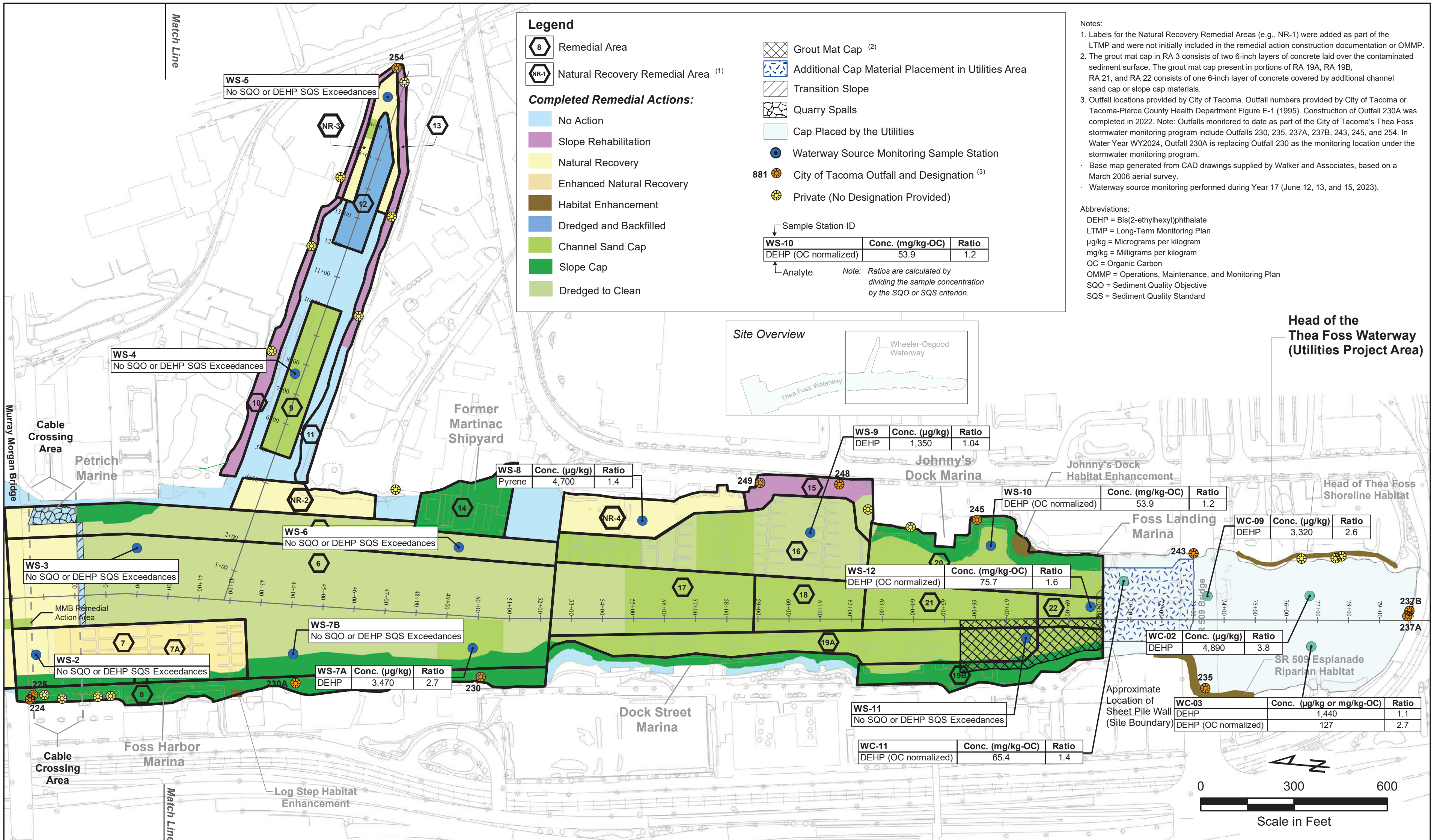
Thea Foss and Wheeler-Osgood Waterways
2023 Source Control and WY2023
Stormwater Monitoring Report

Figure 4-2 (Page 1 of 2)
Year 17 (2023) Exceedances in Waterway Source and Head of the Thea Foss Monitoring Surface Sediment Samples



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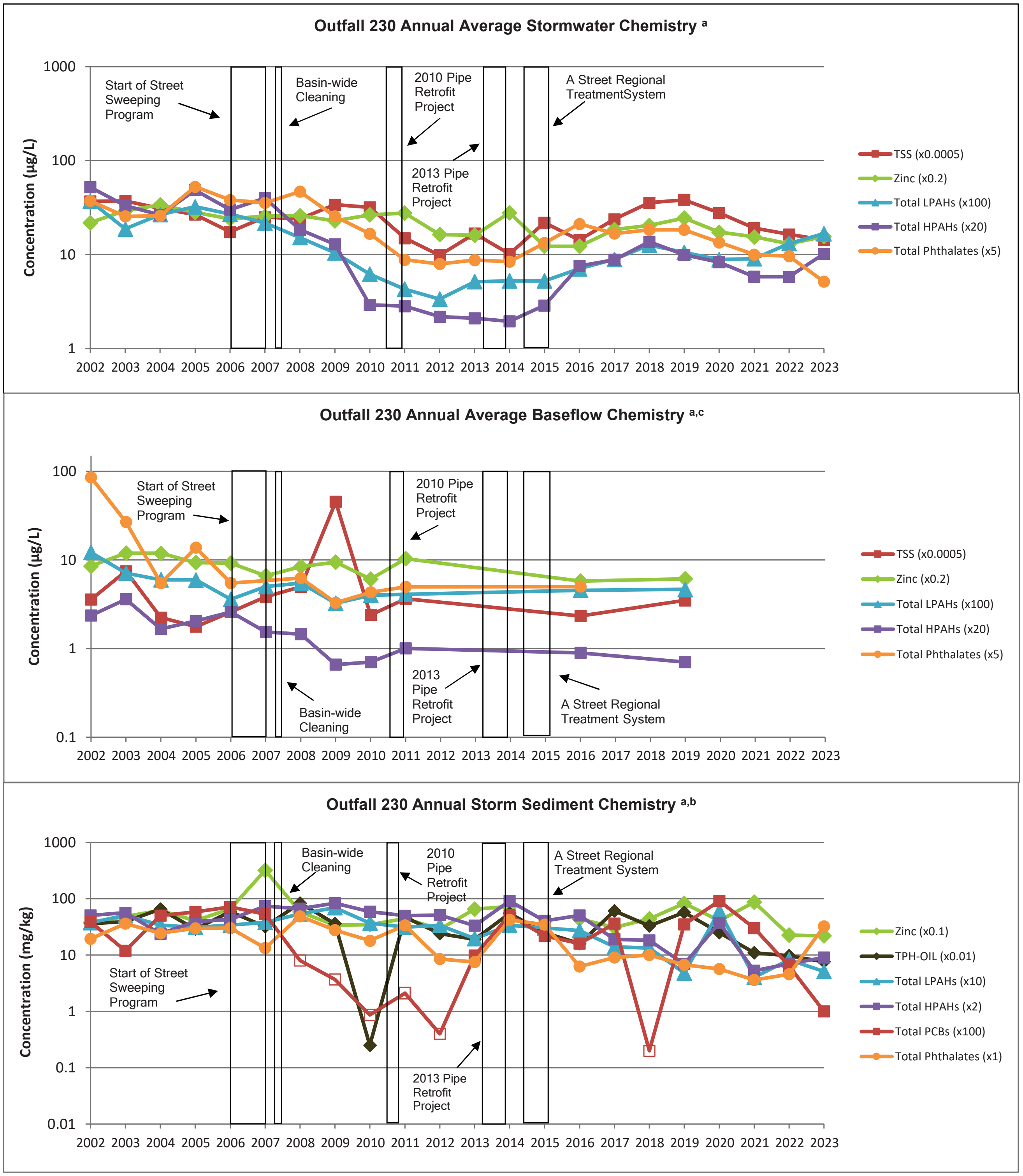
Thea Foss and Wheeler-Osgood Waterways 2023 Source Control and WY2023 Stormwater Monitoring Report

Figure 4-2 (Page 2 of 2)
Year 17 (2023) Exceedances in Waterway Source and Head of the Thea Foss Monitoring Surface Sediment Samples

Figure 5-1.1
Analysis of Monitoring Trends in Stormwater, Baseflow, and Storm Sediment
OF230



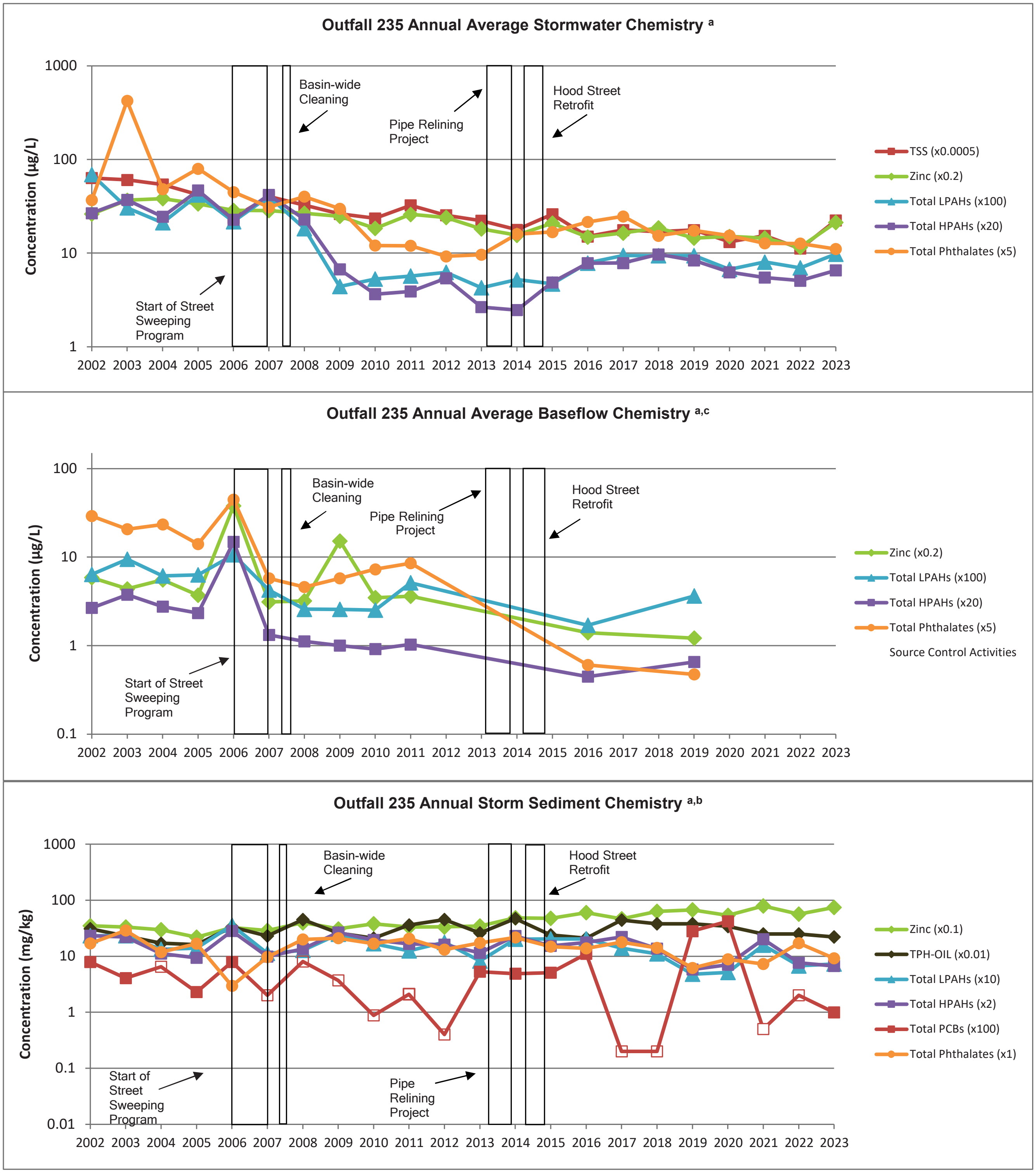
Notes:

[a] Results shown are a product of chemistry data and an analyte-specific multiplier in order to display results on a common scale

[b] Open symbols denote censored data; highest detection limit posted as value

[c] Baseflow sampling was discontinued after WY2011.

Figure 5-1.2
Analysis of Monitoring Trends in Stormwater, Baseflow, and Storm Sediment
OF235



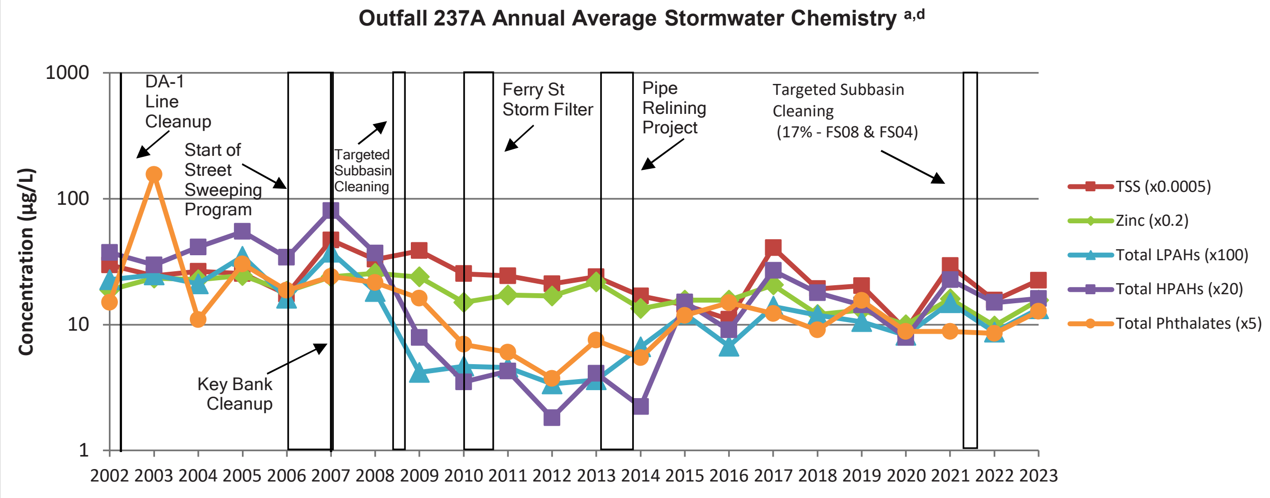
Notes:

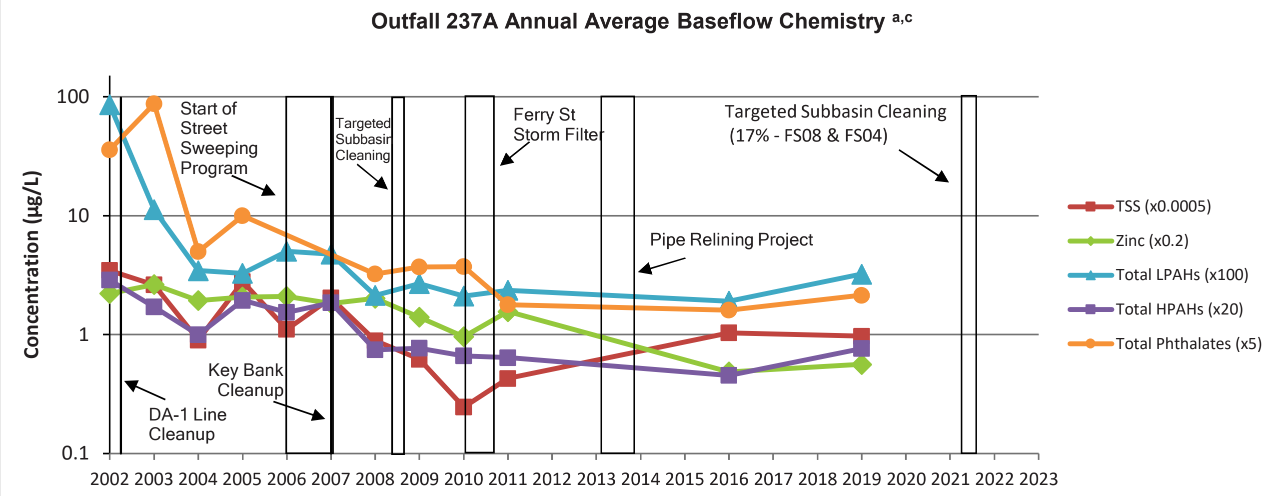
[a] Results shown are a product of chemistry data and an analyte-specific multiplier in order to display results on a common scale

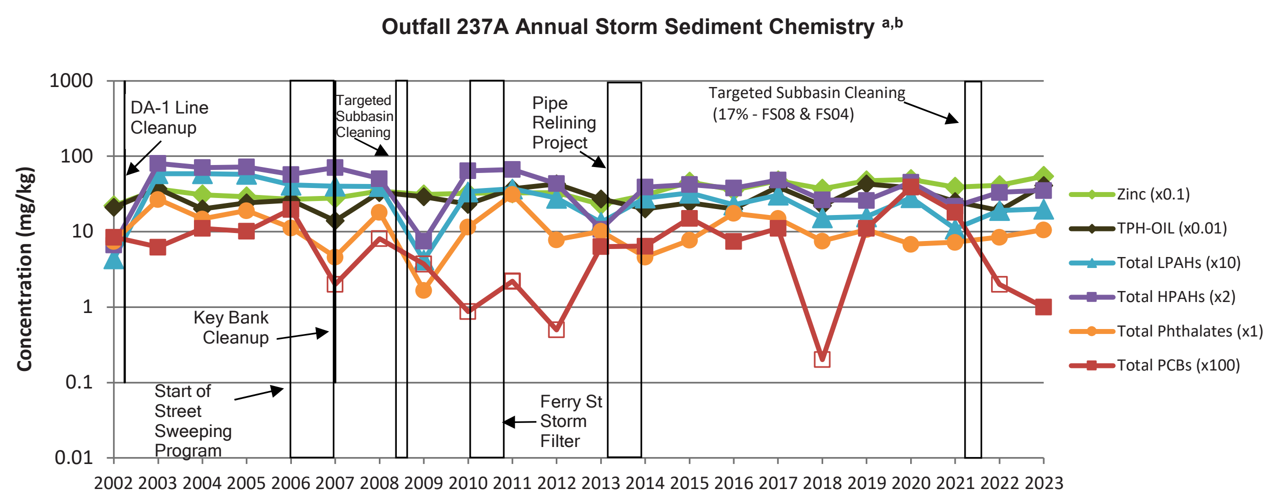
[b] Open symbols denote censored data; highest detection limit posted as value

[c] Baseflow sampling was discontinued after WY2011.

Figure 5-1.3
Analysis of Monitoring Trends in Stormwater, Baseflow, and Storm Sediment
OF237A







Notes:

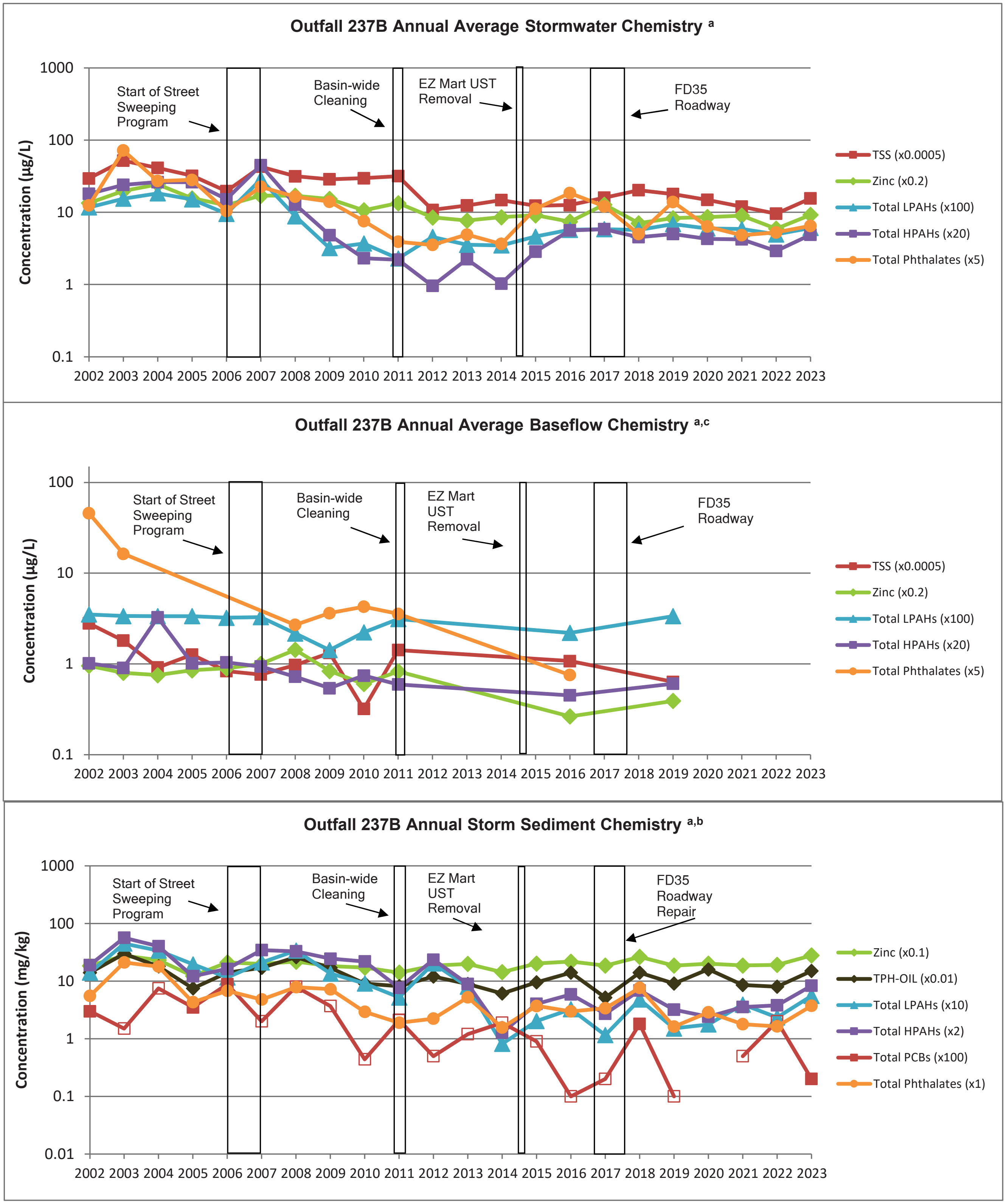
[a] Results shown are a product of chemistry data and an analyte-specific multiplier in order to display results on a common scale

[b] Open symbols denote censored data; highest detection limit posted as value

[c] Baseflow sampling was discontinued after WY2011.

[d] 237A data includes data from the old 237A site for events prior collected prior to 2/26/06. Events after 2/26/06 were from the 237A New site.

Figure 5-1.4
Analysis of Monitoring Trends in Stormwater, Baseflow, and Storm Sediment
OF237B



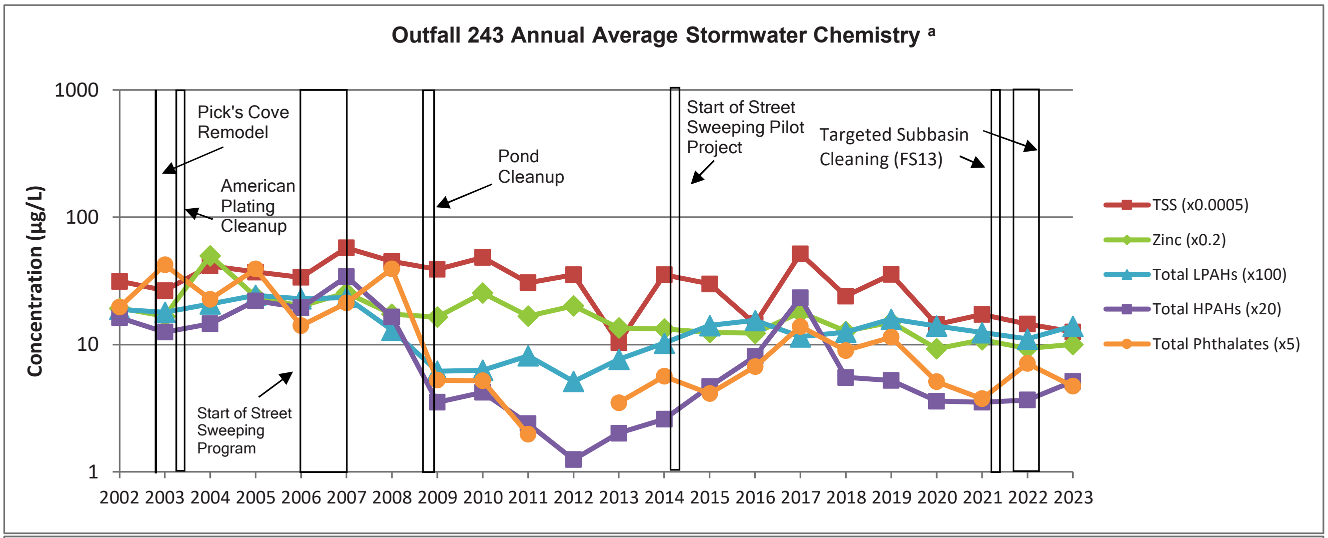
Notes:

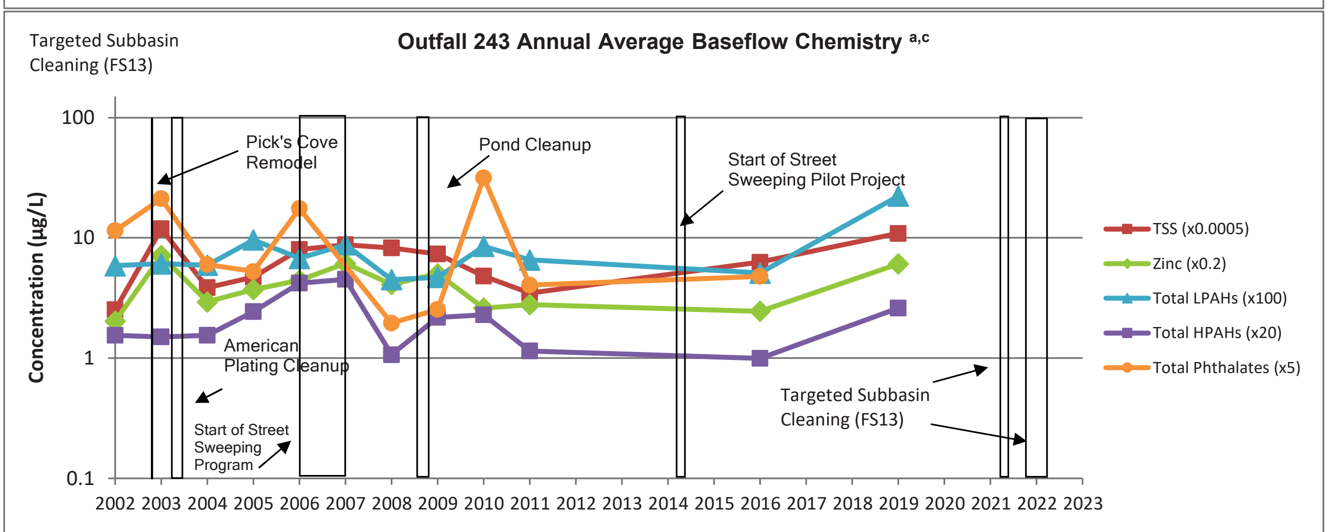
[a] Results shown are a product of chemistry data and an analyte-specific multiplier in order to display results on a common scale

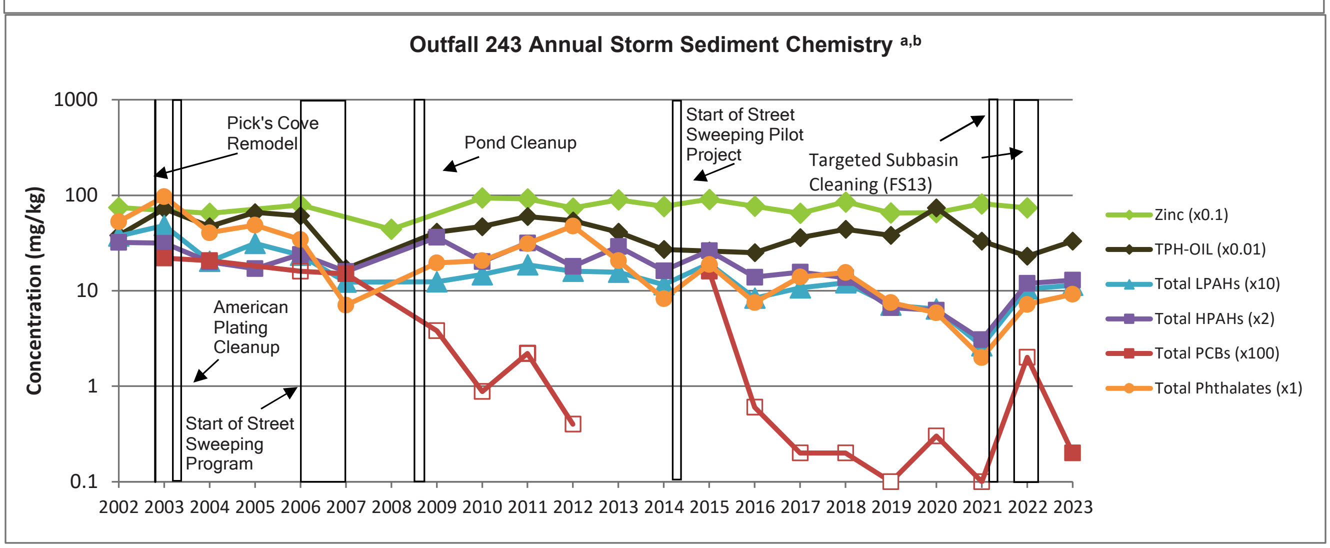
[b] Open symbols denote censored data; highest detection limit posted as value

[c] Baseflow sampling was discontinued after WY2011.

Figure 5-1.5
Analysis of Monitoring Trends in Stormwater, Baseflow, and Storm Sediment
OF243







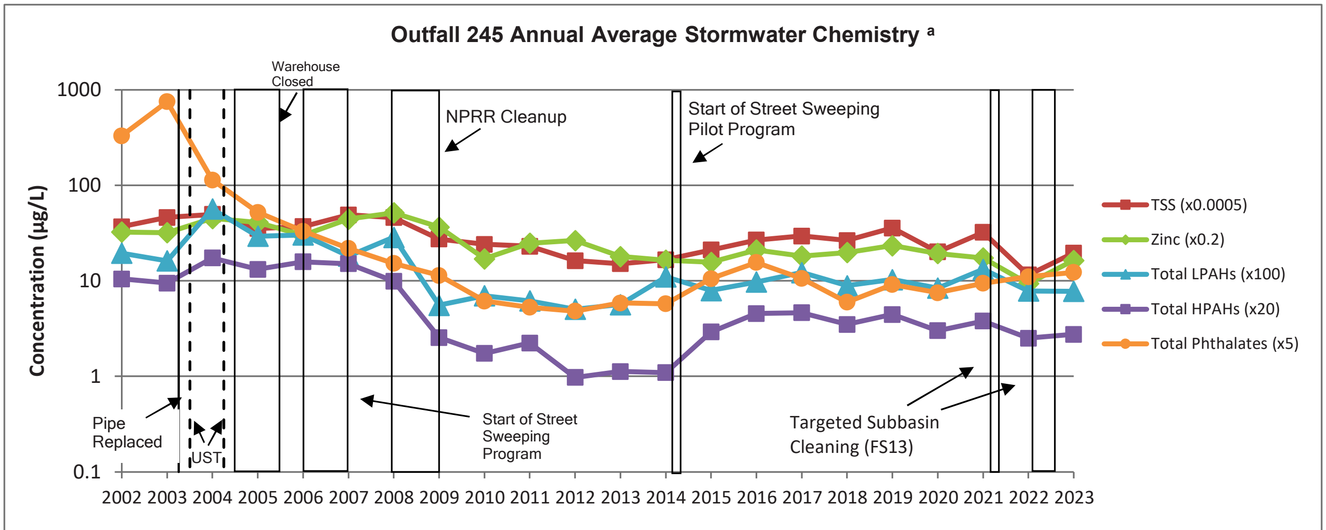
Notes:

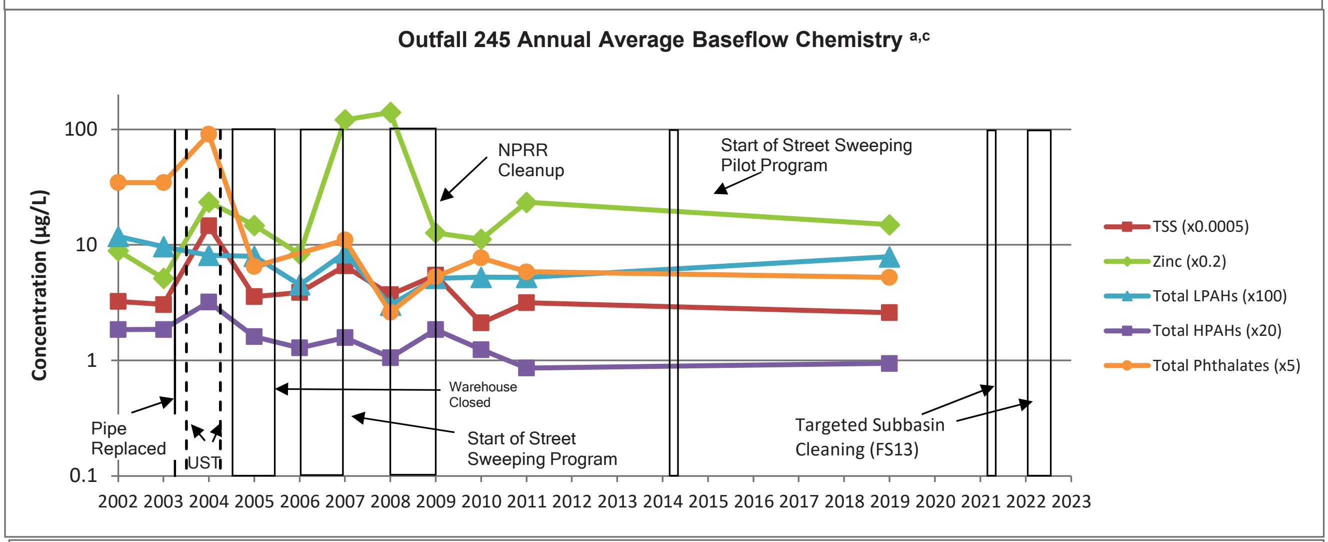
[a] Results shown are a product of chemistry data and an analyte-specific multiplier in order to display results on a common scale

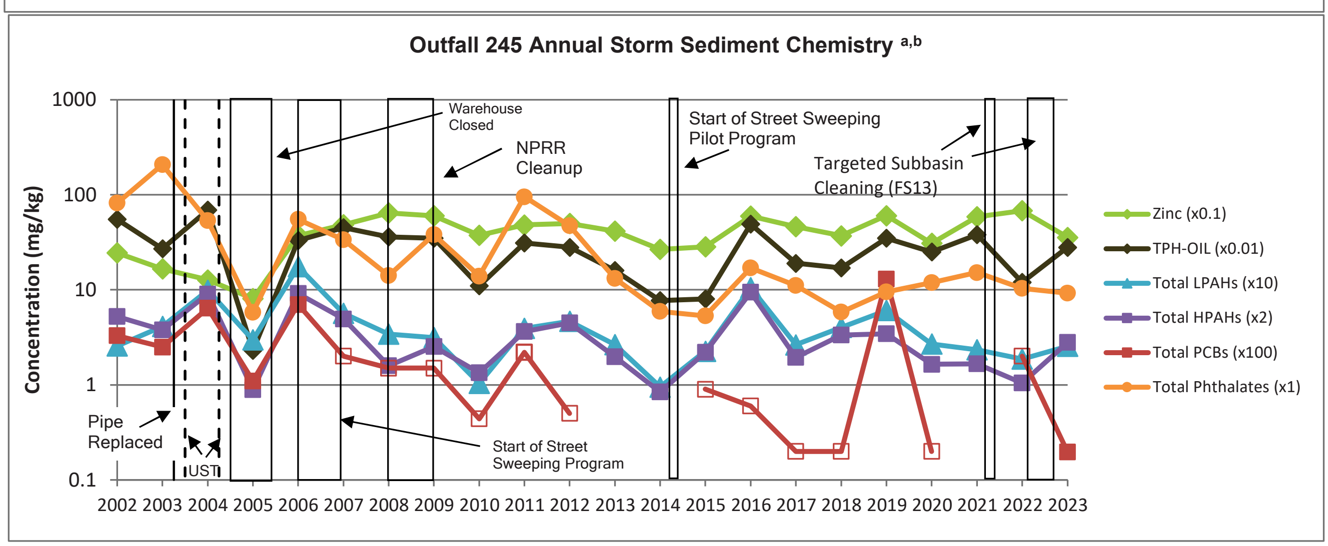
[b] Open symbols denote censored data; highest detection limit posted as value

[c] Baseflow sampling was discontinued after WY2011.

Figure 5-1.6
Analysis of Monitoring Trends in Stormwater, Baseflow, and Storm Sediment
OF245







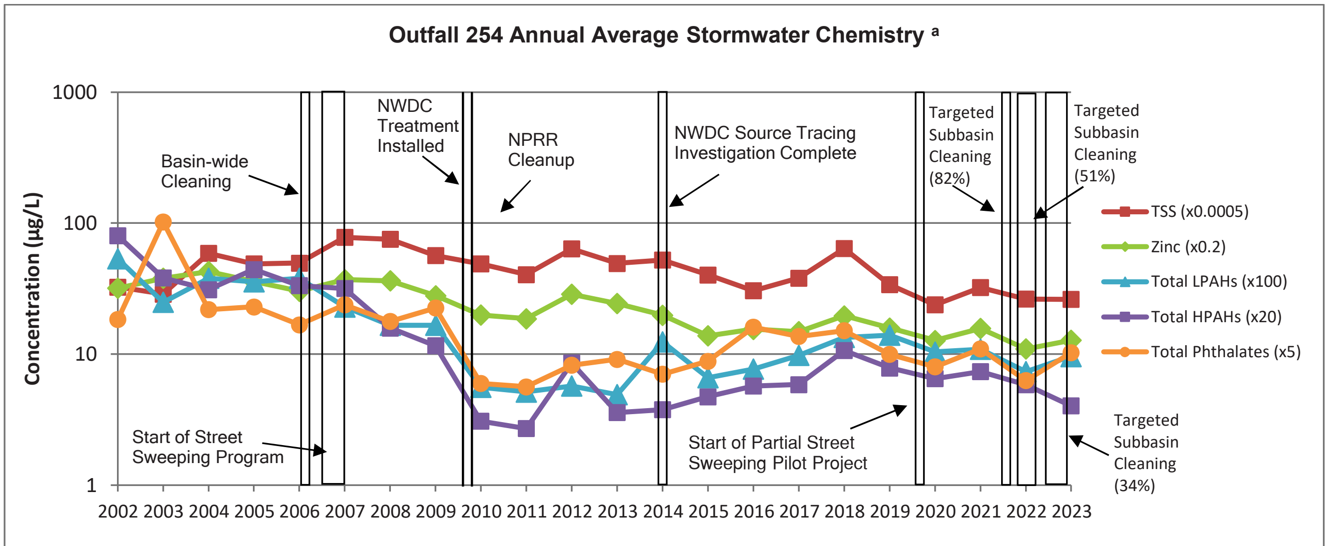
Notes:

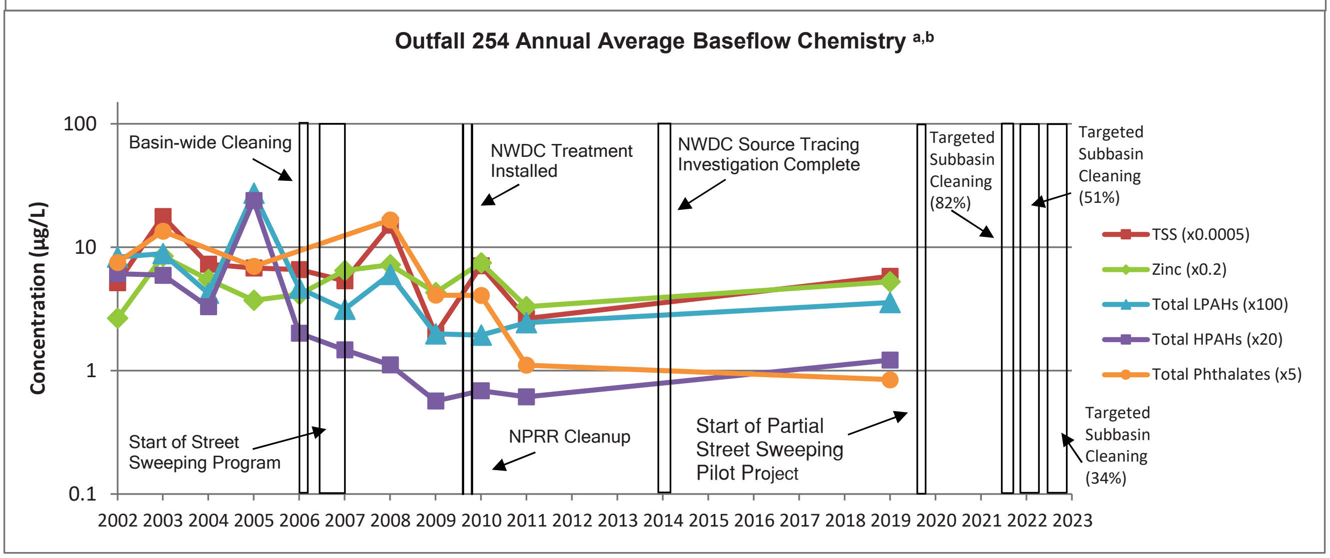
[a] Results shown are a product of chemistry data and an analyte-specific multiplier in order to display results on a common scale

[b] Open symbols denote censored data; highest detection limit posted as value

[c] Baseflow sampling was discontinued after WY2011.

Figure 5-1.7
Analysis of Monitoring Trends in Stormwater and Baseflow, and Storm Sediment
OF254



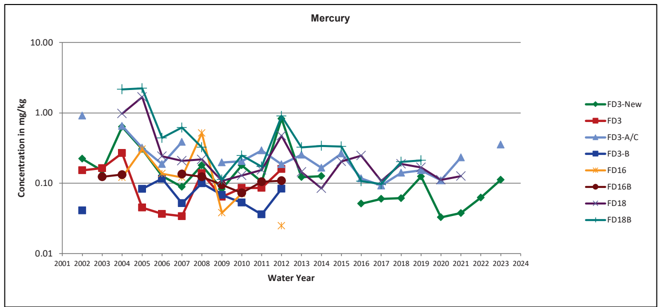


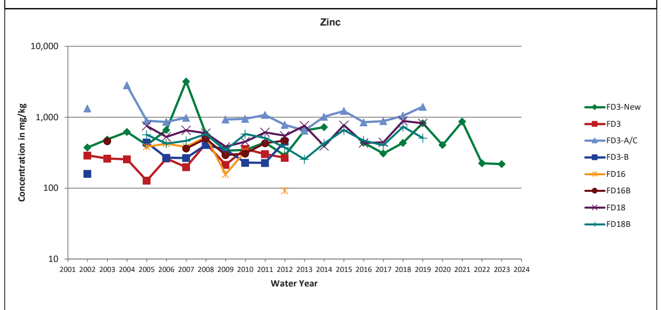
Notes:

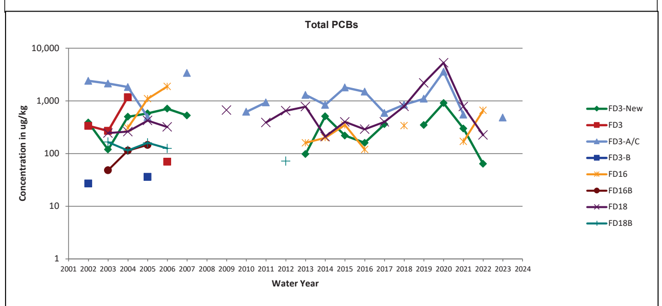
[a] Results shown are a product of chemistry data and an analyte-specific multiplier in order to display results on a common scale

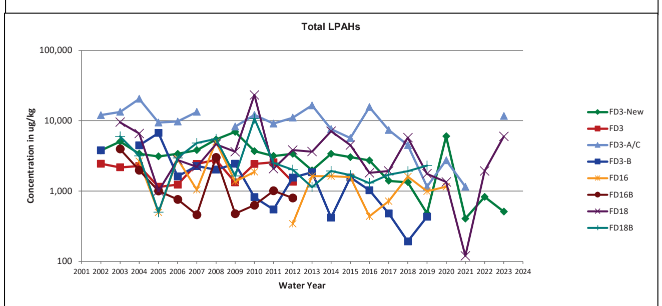
[b] Baseflow sampling was discontinued after WY2011.

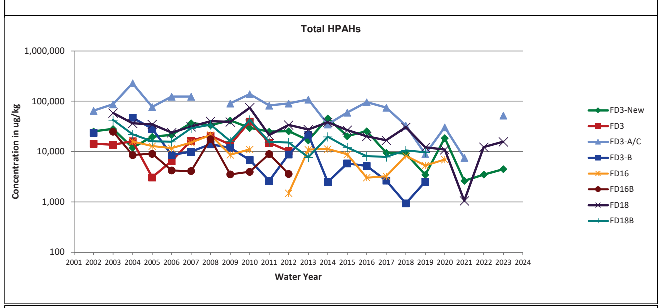
Figure 5-2.1
Analysis of Monitoring Trends in Storm Sediment in OF230

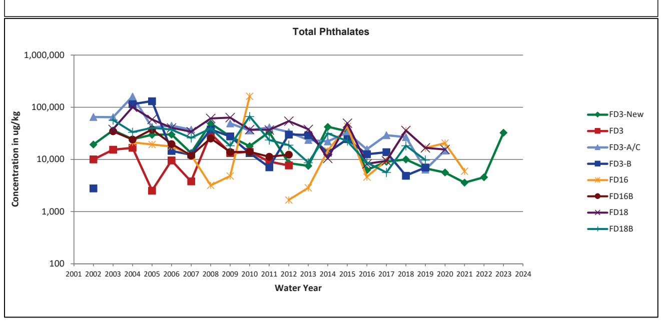












Note:The upline FD3A sediment trap was removed due to the construction of the new OF230A on 12/17/2021 and no sediment was analyzed for WY2022.
FD3 was installed upstream and represents the previous FD3A drainage area.

Figure 5-2.2
Analysis of Monitoring Trends in Storm Sediment in OF235

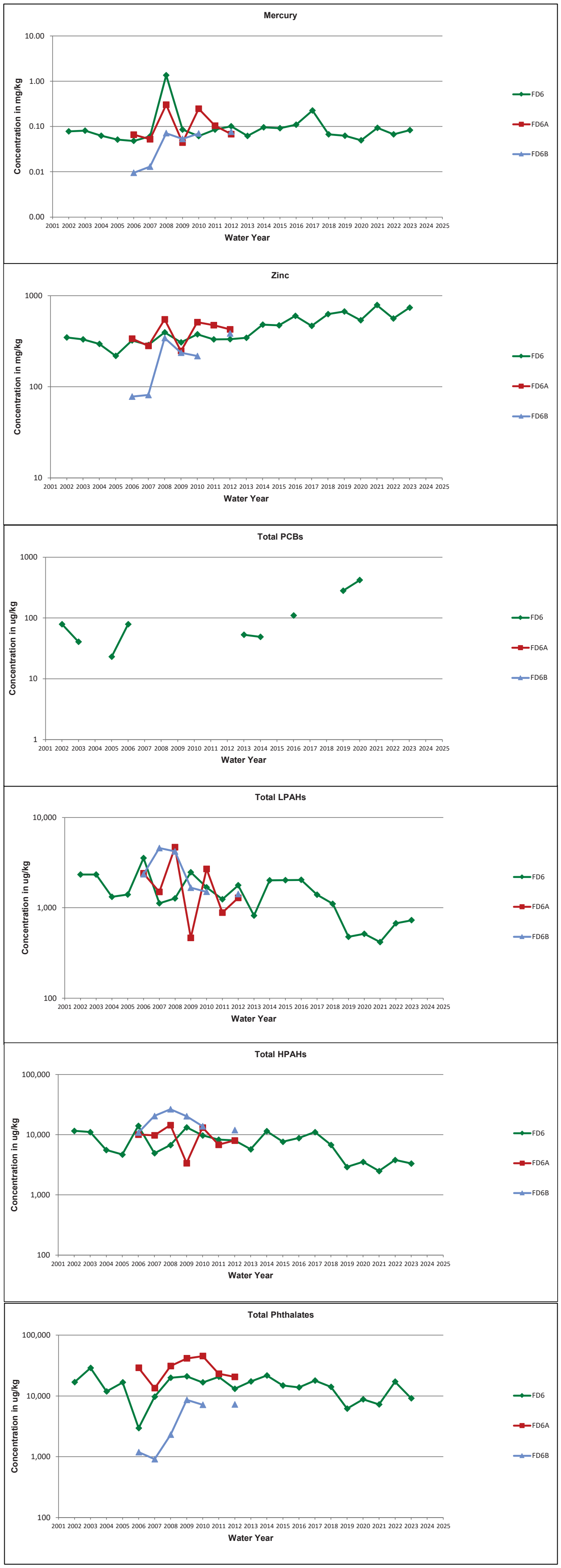


Figure 5-2.3
Analysis of Monitoring Trends in Storm Sediment in OF237A

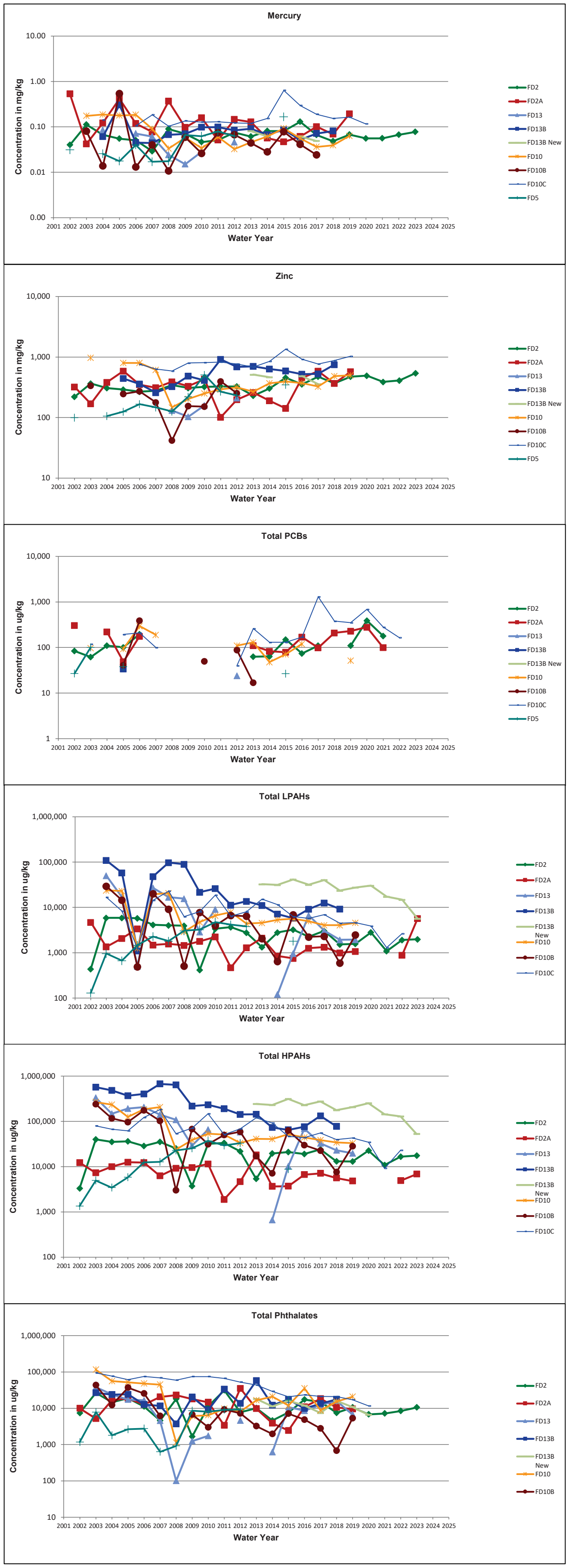


Figure 5-2.4
Analysis of Monitoring Trends in Storm Sediment in OF237B

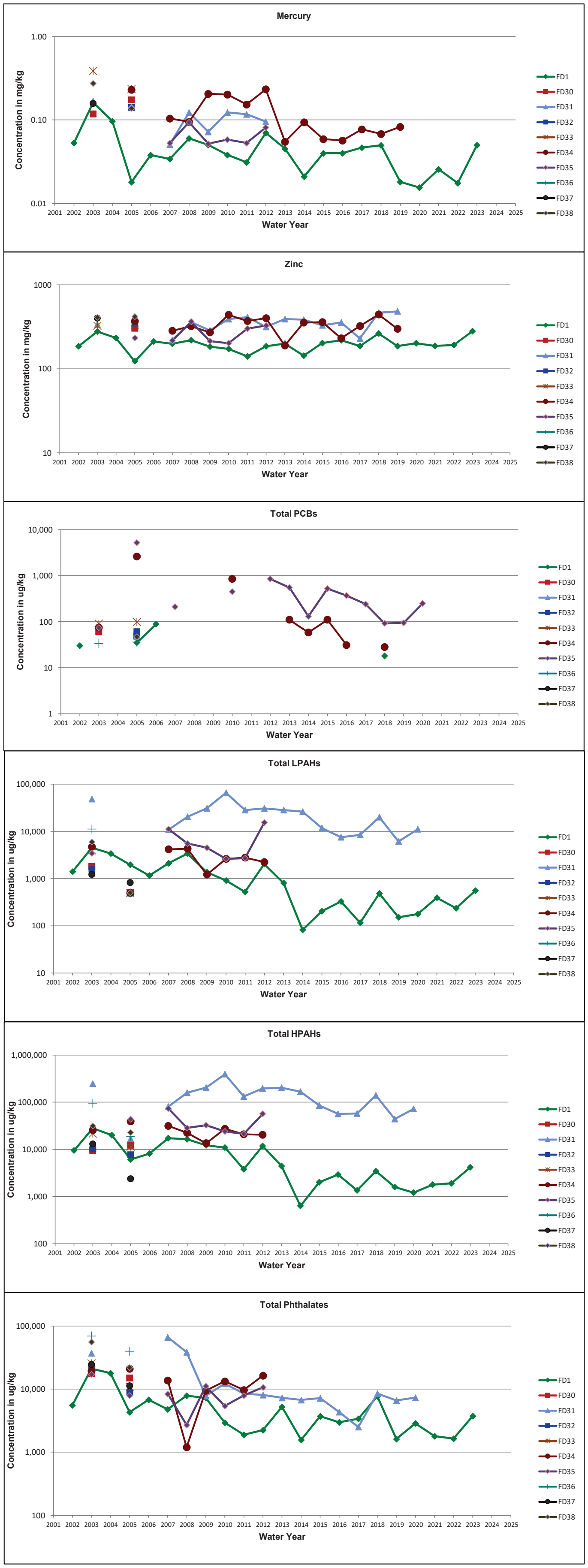
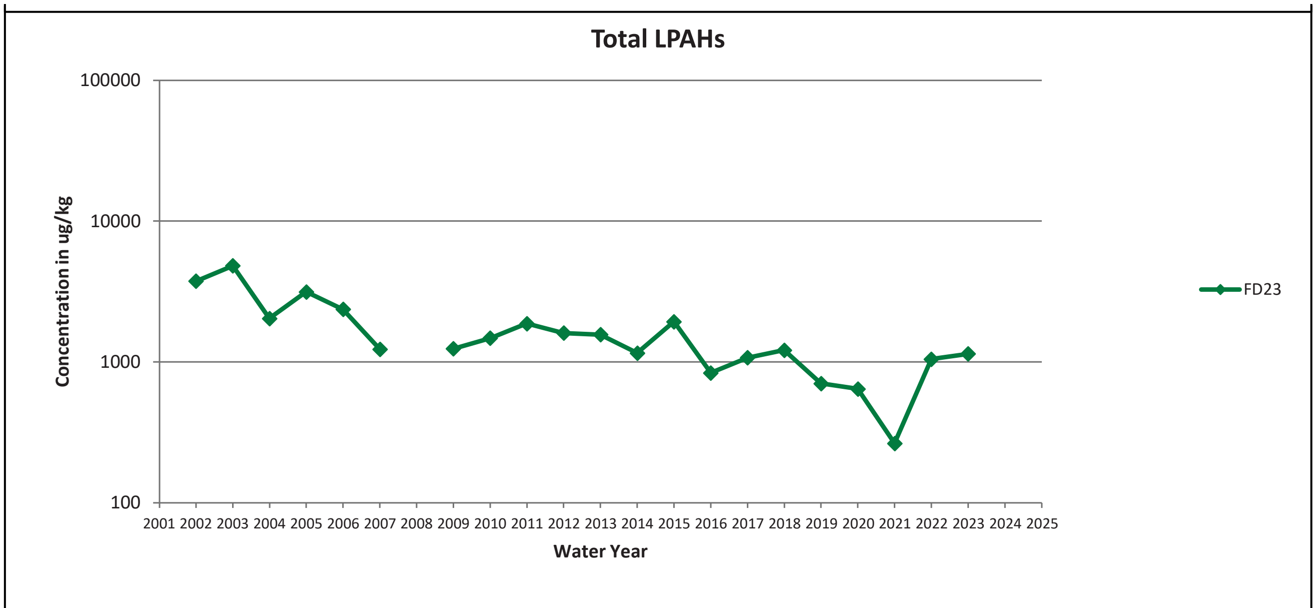
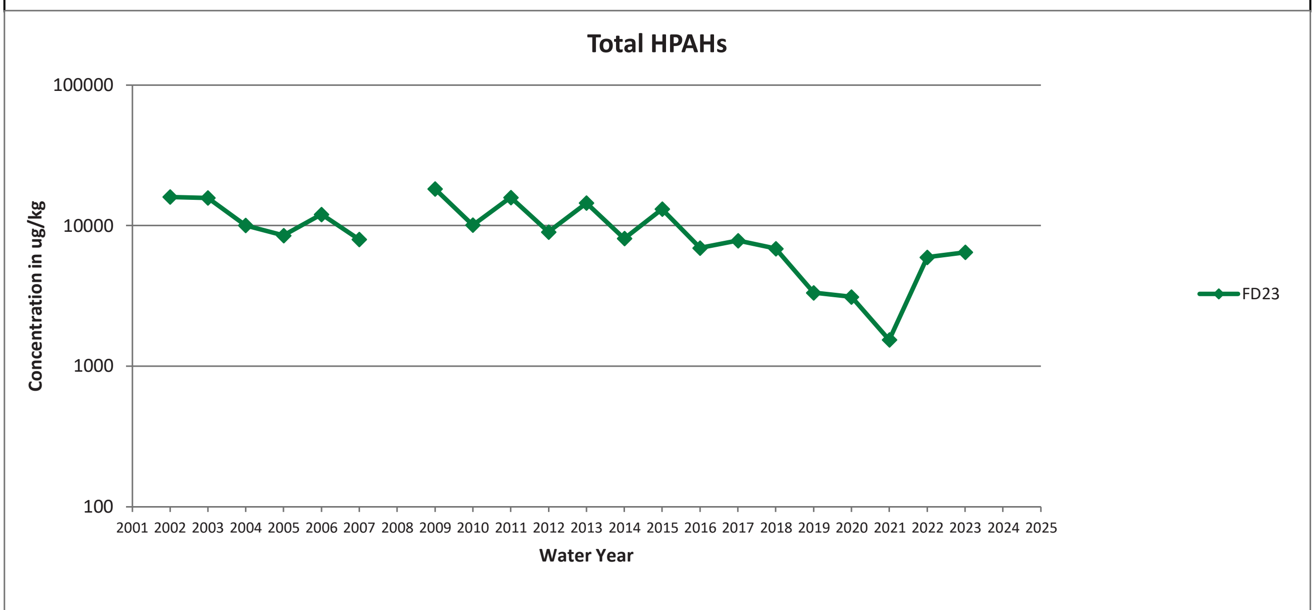


Figure 5-2.5
Analysis of Monitoring Trends in Storm Sediment in OF243





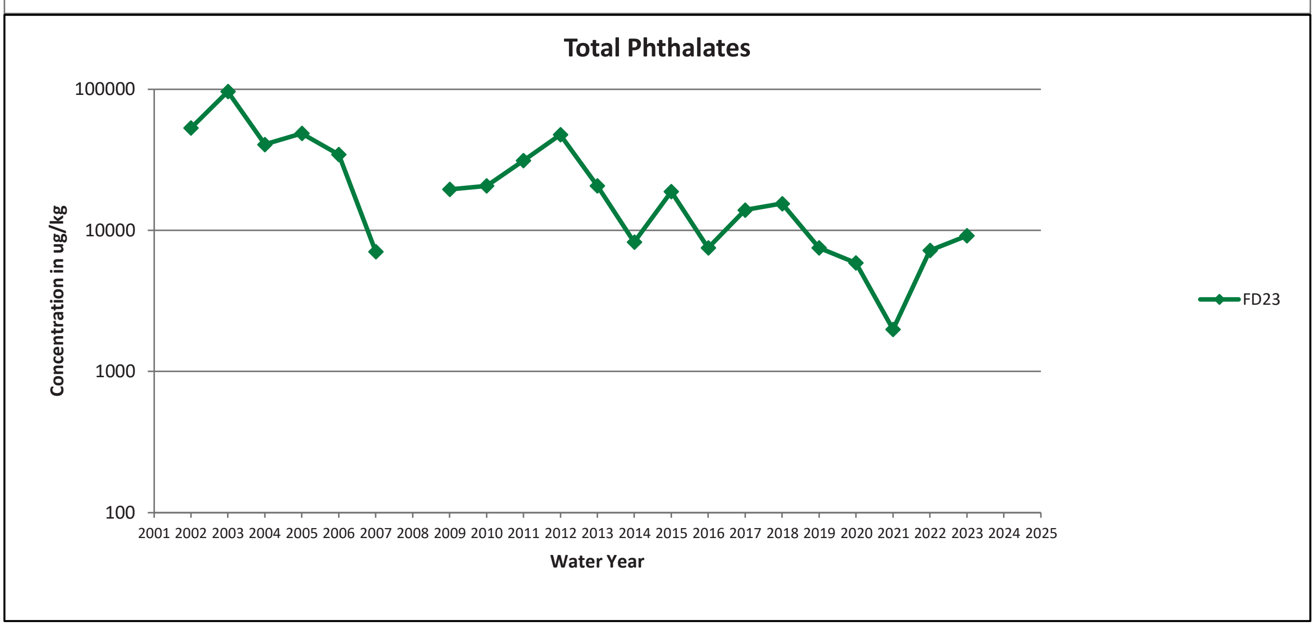
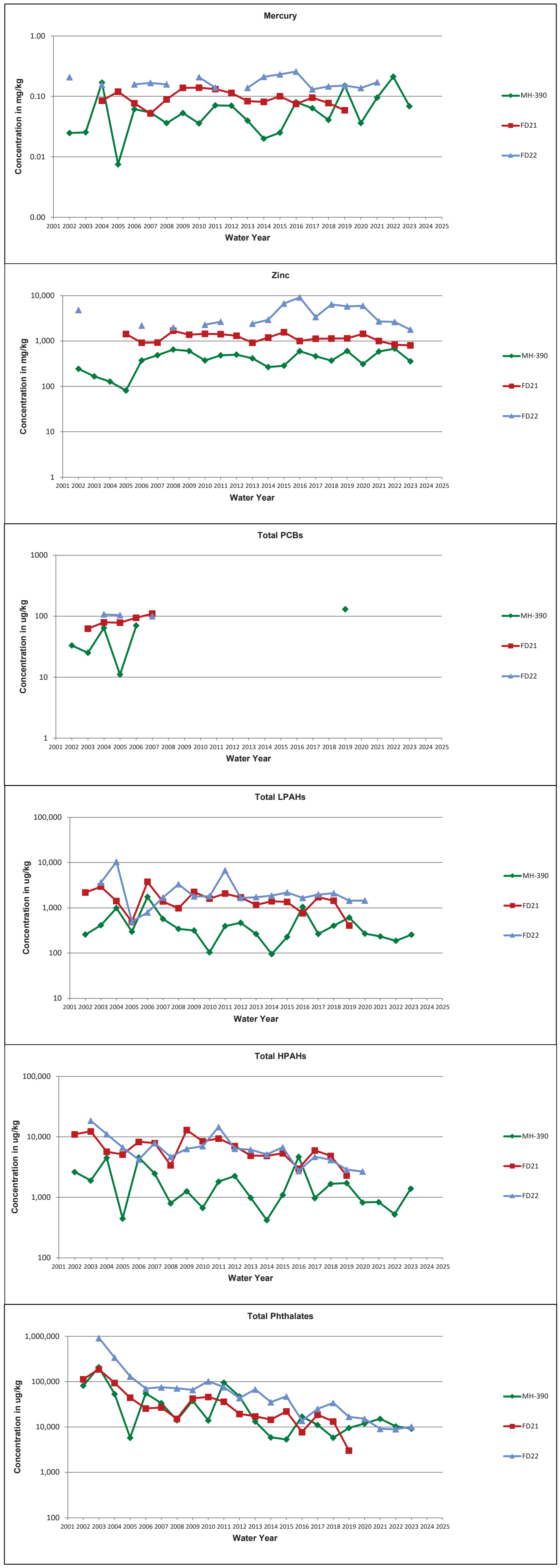


Figure 5-2.6
Analysis of Monitoring Trends in Storm Sediment in OF245



APPENDIX A

Thea Foss and Wheeler-Osgood Waterways
2023 Source Control and WY2023 Stormwater Monitoring Report

Appendix A – Drain-by-Drain Analysis of Source Control Activities




March 2024

Prepared for
Washington State Department of Ecology and
U.S. Environmental Protection Agency

Prepared by
City of Tacoma

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A.1 SOURCE CONTROL SUMMARY

This appendix presents the source control summary for the major outfalls discharging to the Thea Foss and Wheeler-Osgood Waterways. For each of the outfalls, the following Sections A.2 through A.8 provide a review of current and completed source control investigations, major actions conducted, and other studies performed under the program. Information presented in this appendix includes a description of the action, the end results of the action, the status of actions that are still underway, and identification of any follow up needed.

Based on the review of the source control investigations performed to date and evaluation of whole-water and Stormwater Suspended Particulate Matter (SSPM) data, ongoing source control activities and the work plan for 2024 have been developed and are presented in Section 6.0 of the WY2023 Report.

In the 2015-2019 Commencement Bay Five Year Review Report, the Environmental Protection Agency (EPA) found that the remedial action goals for the Thea Foss Waterway have been achieved. While waterway source monitoring requirements are ongoing to ensure continued protection of the waterway sediments, efforts by the City of Tacoma and others have been effective in reducing sediment concentrations to levels which meet regulatory compliance. On December 11, 2021, the EPA approved the City's Remedial Action Report, initiating the process of partial delisting of the Thea Foss and Wheeler-Osgood Waterways from the National Priorities List as part of the Commencement Bay Superfund Site. It is unknown at this time when the delisting will be completed.

With the success of the City's source control efforts to date, there are fewer sites in the watershed that require ongoing active source control work. These ongoing investigations and activities are described in detail below. The City has removed upline sediment traps in areas that no longer exhibit ongoing issues with pollutants of concern. Traps will remain in areas with ongoing investigations until work is complete. In addition, the National Pollutant Discharge Elimination System (NPDES) required sediment trap locations at the end of outfall pipes will remain throughout the monitoring period.

A.2 OUTFALL 230/OUTFALL 230A

A.2.1 OUTFALL 230 AND OUTFALL 230A DRAINAGE BASINS

With construction of the new OF230A, the size of the drainage basin for OF230 was substantially reduced. The remaining area still draining to the OF230 drainage basin is a small area located on the west side of the Foss Waterway. The drainage area is approximately 24 acres, a fraction of the 582 acres previously draining to this outfall (see figure below). The area discharges to the waterway through a 60-inch outfall pipe (Table B2-2) located at South 15th Street and Dock Street in the right of way (ROW) just south of Pacific Seafood (retail). The OF230 drainage basin is now primarily commercial land use and heavily developed. There is minimal baseflow and/or stormwater flow discharging from this outfall location. These changes are described in detail in Appendix B, Section B.2.2.1

Prior to 2023, the OF230 source control activities were related to the historic OF230 drainage basin. The City began re-routing the stormwater drainage system from portions of OF230 and OF235 to the new OF230A on October 20, 2022, and completed the re-routing transition in mid-December 2022. Since the contributing area change occurred in 2022, the discussion herein for activities during 2023 will be based on the new OF230A and OF235 drainage areas.

The OF230A drainage basin is located on the mid-portion of the west side of the Foss Waterway and covers 98 percent of the historic OF230 drainage basin. The basin boundaries are shown on Figure B2-3. The area is approximately 583 acres and discharges to the waterway through a 60-inch outfall pipe (Table B2-2). The general basin boundaries are South 8th Street to the north, South 19th Street to the south, South Ainsworth Avenue to the west, and Dock Street to the east. Most of the storm drainage discharges to South 15th Street via a main trunk line along Market Street and then to the new Jefferson Street Interceptor. Storm lines along Dock Street are susceptible to saltwater intrusion from high tides.

The OF230A drainage basin is heavily developed throughout with primarily commercial land use and some residential use on the west side of the basin (Figure B2-3). The northern portion of the University of Washington–Tacoma (UWT) and the St. Joseph Medical Center Complex discharges to OF230A. The drainage area for UWT is bounded by Pacific Avenue, South 21st Street, Tacoma Avenue, and South 17th Street. Also included in the basin is Tacoma Link light rail, the Greater Tacoma Convention and Trade Center, downtown revitalization (condos and retail), and a portion of Dock Street redevelopment.

The whole water monitoring site is located in MH ID# 6783605 on "A" Street. Due to turbulent flow conditions in this manhole the City will install the flow sensor and monitoring equipment downstream using an extension cable. While the sampler is currently located in the manhole structure, the City will work towards installing a job-box at this location to store sampling equipment and batteries (Figure B2-5). At that time, the sampling line and sensor would be routed through conduit pipe to the storm system at MH ID# 6783474. Confined space entry is needed to maintain the sample line and flow sensor. The sediment monitoring trap (FD7) is also installed in MH ID# 6783605 as reflected on Figure B2-5.

OF230A baseflow (estimated as continuous at approximately 0.12 cubic feet per second at ½-inch depth) consists of groundwater from footing drains being pumped into several catch basins and potentially non-contact cooling water. The City will continue to evaluate flow data at this location and baseflow conditions will be re-evaluated for comparison purposes (see Appendix B, Table B2-2). Sources of baseflow are discussed in Appendix B.

A.2.2 WY2002-2023 SOURCE CONTROL ACTIVITIES

Since 2002, significant work has been accomplished in the OF230A[1] drainage basin, including intense business inspections, complete line cleaning, significant pipe relining projects and identification, and removal of point sources. A discussion of specific major source control activities is provided in the following paragraphs.

As part of the City-wide inspection program, 23 business inspections were completed in the OF230/230A basins in 2023. Business inspections provide source control through education and through implementation of non-structural Best Management Practices (BMPs). These actions help prevent rainfall and stormwater from coming into contact with surfaces or materials that may pollute the runoff, and help promote activities and behaviors to keep stormwater cleaner.

Stormwater treatment devices (structural BMPs) currently in place remove solids and the associated particulate-bound chemicals from stormwater. The locations of private and public stormwater treatment devices in the OF230A drainage basin are shown on Figure A-1a and A-1b, respectively. In 2023, one new treatment BMP was installed on private property in this drainage basin (see Table A.1-1 and Figure A-1a). An Oil Water Separator (OWS) was installed at a multi-family property. With future redevelopment in the OF230A drainage basin, more of these onsite treatment systems will be installed, and over time they will help to decrease the solids load and the associated particulate chemical load to the waterway.

Mercury, PCBs, and Phthalates Source Tracing Investigation

There has been an ongoing investigation in a portion of the historic OF230 (now OF230A) drainage basin since 2012 to identify possible sources of intermittent mercury and Polychlorinated biphenyls (PCBs) discovered during annual sediment monitoring. Prior to this investigation, the FD3A branch was video inspected and cleaned in June 2006. The FD3A branch is one of the oldest stormwater lines in the City of Tacoma and it was not believed to have been cleaned prior to 2006. Since the stormwater lines had never been cleaned, one of the possible sources of Contaminants of Concern (COCs) found in past sampling was residual accumulated storm sediments from historical sources. The video inspection also revealed that the pipe along Court “A” from South 15th to South 13th Streets was in disrepair. This pipe section was abandoned and filled with controlled density fill. The stormwater was redirected to a new pipe on “A” Street in the summer of 2007.

In response to high concentrations of mercury found in upline sediment traps in 2006, mercury samples were collected from all branches in FD3A, FD18, and FD18B. A point source of mercury was found in a private catch basin (associated with a private parking area by Bates Technical College) near South 11th Street and Yakima Avenue in July 2006. The catch basin and private system were subsequently cleaned. Post-cleaning samples confirmed that the mercury source in that area appeared to have been removed.

In 2010, concentrations of mercury in the upline sediment traps increased in FD3A and FD18B, indicating the potential of a recurring or new source. In addition, PCB concentrations increased from low to high range in FD3A in 2010. On June 24, 2011, upline from FD3A, a source control

[1] Drainage area changes for OF230, OF230A, and OF235 are discussed in detail in Appendix B, Section B.2.2.

inspector collected dry weather water samples for mercury and PCB analysis. These water samples were grab samples that were collected after a five-day dry period. Mercury and PCBs were not detected in any of the samples. Therefore, it was determined that the source of mercury and PCBs was unlikely to be from dry weather water discharges.

Mercury concentrations in the OF230 drainage basin have fluctuated between medium and low levels since WY2004, apart from a relatively higher concentration measured in the FD18B and FD3A-New sediment traps in 2012. Mercury concentrations have remained fairly low since that time with occasional medium concentrations seen in the FD3A sediment trap just over the 0.20 mg/kg level set to describe relative medium concentrations on Figure 2-1.1. There were no mercury results for the FD3A drainage area during WY2022. Due to construction of the new outfall (OF230A), this sediment trap was removed in December 2021 and was installed in January 2023 after construction was complete. This sediment trap was moved to an upstream manhole due to the construction and is now FD3C. It is considered representative of the FD3A drainage area. Mercury concentrations during WY2023 remained at medium levels with a slight increase from WY2021 concentrations at 0.355 mg/kg. There were no active mercury investigations in this drainage basin during WY2023. The City will evaluate additional source control investigations in this basin during 2024.

PCB concentrations at FD3A were at relatively high levels in WY2010 and WY2011, decreased to low levels in WY2012, and increased back to the high range in WY2013, where they remained through WY2021. At FD3-New, PCB concentrations were at high levels between WY2004 and WY2007, decreased to low levels between WY2008 and WY2013 following cleaning of the drainage system, and increased back to high levels in WY2014. Concentrations fluctuated between low and high levels throughout WY2021. PCB concentrations in FD18 increased from low to medium levels in WY2011 and from medium to high levels in WY2012 and WY2013. From WY2014 to WY2017, PCB concentrations decreased back to the medium range before returning to the high range in WY2018, where they remained in WY2021. The WY2021 concentration was 780 µg/kg, which is a significant decrease in concentration from the highest concentration of 5300 µg/kg detected at this location in WY2020. During WY2020 SSPM results showed consistently higher levels of PCBs wherever they were detected. Because these higher concentrations were dispersed across several locations and drainage basins, it did not appear to be caused by a specific event or source. While a cause for these elevated concentrations was not identified during data evaluation, based on the lower-than-expected results exhibited during WY2021 it was determined that WY2020 results were not accurate and will not be used to determine steps forward in source tracing investigations. There were no PCB results for the FD3A drainage area during WY2022. Due to construction of the new outfall (OF230A) this sediment trap was removed in December 2021 and was installed in January 2023 after construction was complete. This sediment trap was moved to an upstream manhole due to the construction and is now FD3C. It is considered representative of the FD3A drainage area. PCB concentrations during WY2023 remained at high levels with a slight decrease from WY2021 concentrations at 485 µg/kg. Concentrations during WY2023 were the lowest seen since the investigation began in this basin. During 2024 the City will continue to follow up on private property cleanups performed, and complete ongoing system cleaning and monitoring for PCBs in this drainage basin.

As stated above, a source tracing investigation was launched in 2012 and continued through 2023 to further investigate potential sources of COC in OF230. The investigation generally began with analysis of composite samples representing different segments of the drainage area for each of the sediment trap locations. The intent of this work initially was to attempt to isolate specific problem spots within the drainage area. As branches with higher concentrations of contaminants in composite samples were identified, subsequent phases of the investigation were performed to further isolate potential source areas. Individual catch basin and product samples were taken in the branches with higher concentrations. Subsequently, building inspections were completed in the areas with the highest catch basin and product sample results. Each component of this investigation is described in more detail below.

Mercury: Results from the mercury portion of the investigation and business inspections of the surrounding area indicated that the mercury sources were likely attributable to the presence of contaminated sediments in two areas: a catch basin located at South 11th and Broadway, and two sidewalk roof drains draining to a catch basin at the corner of South 12th and Court “A” in downtown Tacoma. Both areas drain to FD3A (now FD3C).

11th and Broadway: The initial investigation and subsequent catch basin sampling identified a catch basin on the sidewalk near the corner of South 11th and Broadway Avenue with relatively higher concentrations of mercury. The basin was resampled in 2016, however staff could not verify that the catch basin had been cleaned prior to sampling. The basin was cleaned on August 16, 2016, and resampled on October 31, 2017. The 2017 sample results showed a decrease from past sampling results; however, the mercury concentration was still higher than typical concentrations found in catch basins. The basins were cleaned in November 2018 and when inspected in August 2019, insufficient sediment was present for sampling. The City resampled the targeted basin in WY2020, and results showed a significant decrease from the 2016 sampling results and the City has determined that there is no longer a mercury source issue at this location.

South 12th and Court “A”: Following inspection of the surrounding buildings and inability to locate a source, the initial response action was to clean the system and then resample to determine if it was a historic or ongoing source. The drain was resampled in January 2015. With results showing continued higher levels of mercury, the system was again cleaned, and at that time it was discovered that the drain bottoms were rotted out. Resampling showed that, while mercury levels had decreased somewhat, they were still present. Once it was confirmed that no building drains entered this system, the historic drains were capped over to prevent further contaminated sediment from entering the stormwater conveyance system. The capping work was completed in January 2016, and the system cleaned once again in 2016. The catch basin was resampled in 2017, and the result was lower than previous samples, but still higher than typical concentrations. The basin was cleaned in November 2018 and when inspected in August 2019, insufficient sediment was present for sampling. The City resampled the targeted basin in WY2020, and results showed a significant decrease from the 2016 sampling results and the City has determined that there is no longer a mercury source issue at this location.

There are no current investigations for mercury in OF230A. Due to the increased mercury concentrations in the FD3A/FD3C sediment traps the City will evaluate the need for additional source tracing for mercury in this basin.

PCBs: Results from the initial PCB portion of the investigation indicated that elevated levels of PCBs were present in the caulking materials from two properties (the Wells Fargo and Sound Physicians (now known as 1123 Pacific Partners) properties located in the vicinity of South 12th and South 13th Streets, between Pacific Avenue and Court “A” in downtown Tacoma). While this area was identified as the highest priority area, several other areas with lower levels of PCB contamination were also identified through the initial investigation. Storm drains throughout this area were cleaned in February 2015, and the area was resampled in

March/April 2016. Results indicated ongoing lower-level sources of PCBs in several areas, leading to additional investigation beginning in 2016 and continuing in 2023. Updates on each of these PCB investigations are provided below.

South 12th and Pacific: Previous reports have indicated that the caulking materials present on the both the Wells Fargo Complex and the 1123 Pacific Partners property are the source of PCB contamination found in the nearby catch basins in the targeted drainage areas. The business owners and the regulatory agencies were notified of the PCB discovery and were provided a copy of the sampling results. To ensure that the contamination did not reach the waterway, the system was cleaned in early 2015.

Significant work was performed at the Wells Fargo building, and it is expected that this work will reduce the PCB contributions from this site. During 2017, the City requested an update of the status of work at the Wells Fargo site. The response from Unico Properties LLC (Unico) provided an update regarding the remediation of the plaza using proper removal and disposal techniques. Additionally, Unico indicated that they would like to see additional monitoring of the catch basins post-abatement to determine if this work removed the main source of contamination. Environmental Compliance (EC) staff resampled the catch basins surrounding this property during 2017 and the results exhibited continued elevated concentrations of PCBs. However, the catch basins were not cleaned after the remediation project was complete and the catch basin socks were still present. The catch basins were cleaned in October 2017 and it was anticipated that they would be resampled during 2019 when sufficient sediment had accumulated. The system was inspected for the availability of sediment for sampling in August 2019, and sediment levels ranged from zero to one inch of sediment in some basins while other catch basins had yet to be cleaned. Sampling was attempted at the targeted catch basins receiving drainage from Wells Fargo in June 2020 to determine if a source of PCB contamination remains at this site. Results from this sampling were inconclusive due to the inability to collect from the majority of the targeted catch basin due to lack of access and sediment.

During 2022, the City resampled the catch basins adjacent to this location and found that there is a continuing source of contamination at the southeast corner of this location (Figure 1). The catch basin in the southeast corner of the site showed a concentration of 0.9 parts per million (ppm) in 2016 and 1.8 ppm in 2017, and as a result the system was cleaned in 2017. Following this cleaning, this same catch basin had a concentration of 12 ppm in 2022. During discussions with the property owners/managers of this site, it was agreed that EC would clean and then sample again in 2023 to ensure that the concentration detected in 2022 was not an anomaly. All of the catch basins surrounding this complex were cleaned in October 2022.

EC staff attempted to sample the catch basins surrounding the Wells Fargo complex and 1123 Pacific Avenue in March and July of 2023. During both site visits there was insufficient sediment to sample. During 2024, staff will attempt to sample the targeted catch basins surrounding the entire Wells Fargo Complex and in front of 1123 Pacific Avenue early in the year to determine if the sources of PCBs are ongoing or if the remediation efforts at these locations were successful.

During 2017, the City requested an update of the status of work at the 1123 Pacific Partners site. A written plan of action and timeline were requested. No report was received, and the City initiated the enforcement process. A warning letter was mailed in October 2017. Subsequently, staff worked with the property owner for the 1123 Pacific

Partners building to obtain a written plan of action for addressing the PCB contamination on this site. On October 12, 2018, the City received correspondence from the property managers stating the remediation had been completed. Sampling of the targeted catch basins was completed in June 2020 to determine if a source of PCB contamination remained at this site. The City successfully sampled two catch basins receiving drainage from this site. The results from this sampling event indicate either a continued source of PCBs at this location or insufficient catch basin cleaning after the remediation of this property. During 2021, the City requested that these catch basins be cleaned, however they were not resampled during WY2021 due to insufficient sediment.

During 2022, the City attempted to resample three catch basins adjacent to this location. One of the locations did not have enough sediment to sample and the two other catch basin samples exhibited concentrations that were reduced from 2020 levels but were still considered elevated concentrations. It was discovered that the property was purchased by new owners in 2022 and they were unaware of the PCB remediation at this location. The City met with the new owners to provide the history and status of the work. Based on the lack of sediment at one of the three catch basins targeted for sampling in 2022 and the reduction in concentration at the others, the City cleaned all of the targeted catch basins in 2022.

EC staff attempted to sample the catch basins surrounding the Wells Fargo complex and 1123 Pacific Avenue in March and July of 2023. During both site visits there was insufficient sediment to sample. During 2024, staff will attempt to sample the targeted catch basins surrounding the entire Wells Fargo Complex and in front of 1123 Pacific Avenue early in the year to determine if the sources of PCBs are ongoing or if the remediation efforts at these locations were successful.

South 13th and Commerce: During the 2013 investigation, catch basins in this drainage area exhibited detectable levels of PCBs. These catch basins receive drainage from two parking garages and retail businesses on Commerce Street. Two of the catch basins were resampled during the 2016 investigation. Both catch basins sampled exhibited higher concentrations than were found during the 2013 investigation. During 2017, City staff resampled the catch basins in this drainage area and collected samples from the ROW caulking to determine if this was the source of ongoing PCB contamination. Results indicate that the caulking is unlikely to be the source of the PCB contamination found in the catch basin sediment.

In August 2019, catch basins were inspected for sediment loading to determine whether sampling could occur. Some were found to have insufficient sediment and others were found to have not been cleaned due to coordination needed to de-energize the adjacent light rail.

Due to staffing issues during COVID-19, the system cleaning scheduled for 2020 was not completed and was instead completed in May of 2021. Staff attempted to resample the catch basins during 2022 but were unable to collect samples due to insufficient sediment. On July 31, 2023, EC staff sampled the targeted catch basins and found them heavily impacted with sediment. Due to the amount of material in the basins staff could not determine when the basins were previously cleaned. The catch basins will be cleaned in 2024 and resampled when sufficient sediment is present. Based on the findings of this next round of sampling, site inspections will be scheduled if necessary to look for the sources of contaminants in the adjacent structures.

South 10th and Pacific: The presence of PCBs and ongoing investigation at the Park Plaza parking garage at South 10th and Pacific Avenue were discussed in the WY2016 Source Control Report. In 2016, staff collected samples of roof top material, including caulking, sealant, and sediment, for PCB analysis. All the samples collected from the roof of the parking garage exhibited elevated concentrations of PCBs. Additional sampling was performed in 2017 in an attempt to determine the specific building materials that were the source of the PCBs. The property owner (the City of Tacoma) and regulatory agencies were notified in writing of the PCB discovery and were provided a copy of the sampling results. The City worked with the EPA to finalize a sampling plan in July 2020 to assess the extent of contamination at the site to assist in the development of a remediation plan. Sampling was subsequently performed, and the City submitted a PCB Sampling Results Report to the EPA in January 2022. In that document, the City proposed an iterative remediation plan. There was no movement towards remediation for this site during 2023.

South 9th and Fawcett: This location is in the FD18 drainage area. During the 2013 investigation, the catch basin on South 9th and Fawcett Avenue exhibited an elevated PCB concentration. A business inspection was conducted during 2014, and no obvious sources of PCBs were identified. The storm drainage system was cleaned in 2015 and resampled in 2016. Concentrations of PCBs detected during this sampling event were higher than those previously detected, indicating an ongoing source.

The investigation in this area continued in 2017. EC staff contacted the property management company for the 757 Fawcett Avenue building and received permission to collect caulking samples from the outside of the building. In addition to the caulking samples, staff collected samples from three catch basins located around the building and three samples of dirt from the sidewalk planting areas receiving drainage from the building. All these samples exhibited elevated concentrations of PCBs, with the caulking material from the building showing very high concentrations. This is likely the source of PCB contamination found in the nearby catch basins. The business and regulatory agencies were notified in writing of the PCB discovery and were provided a copy of the sampling results.

During 2018, City staff continued efforts to obtain a written plan of action for addressing the PCB contamination from the 757 Fawcett Avenue building. In December 2018, a warning letter was sent, with a forty-five day deadline for submitting a written plan of action and schedule. Building representatives responded to the letter and indicated that they are working with a consultant to develop a plan.

During 2019, staff continued to work with the business and regulatory agencies to stop the source of PCBs discharging from this site. At the end of 2019 they were working on getting permits to encapsulate the building in metal panels. During 2020, the City continued to work with this property owner and monitored the project to completion.

During 2021, the City required the catch basins receiving discharge from this site be cleaned after the project was completed. The City confirmed that the catch basins were cleaned on April 9, 2021. The catch basins were resampled on September 24, 2021, to determine if there continues to be a source of PCBs entering the catch basins. The catch basin sediment exhibited elevated concentrations of PCBs. On October 20, 2021, EC staff emailed Lumen Technologies, Inc. (formerly CenturyLink, Inc.) to inform them of the sampling results and requesting them to clean the sidewalks to potentially remove any residual PCB contamination from the building, and this work was completed on November 18, 2021.

In July 2022, EC staff resampled the catch basins that received discharge from this location. The results continued to exhibit elevated concentrations of PCBs in the catch basin sediment, ranging from 170-2000 µg/kg. It appeared that the sediment socks in place during the pressure washing in November 2021 may have failed. The City cleaned the catch basins on July 26, 2022. Before the cleaning took place, a construction project began at this location, which involved the removal and replacement of all of the curb/gutter and sidewalk at this intersection. The project also removed one of the catch basins sampled during this investigation. Due to the duration of this project, no further investigation or cleaning of the system was completed in this drainage area during 2022. After completion of the sidewalk replacement project, EC Staff planned to sample the catch basins in early 2023, however due to a fire at a neighboring building the catch basins and storm system had to be cleaned. A sediment check in October 2023 showed insufficient sediment to resample.

Sediment trap PCB concentrations in FD18 have continued to decrease since remediation work was completed in 2020. PCB concentrations dropped to from high to medium levels for the first time since 2017 in this basin and were below detection limits in the 2023 FD18 sediment trap sample (see Figure 2-1.4). It is possible that the curb/gutter/sidewalk construction removed any lingering PCBs that were trapped in the concrete. There are no further investigations planned for 2024. Sediment trap data will continue to be reviewed and additional investigations will be conducted if concentrations increase.

<u>Phthalates:</u> The catch basin at South 9th and Commerce had ongoing issues since 2013 with relatively elevated phthalate concentrations. Catch basins were cleaned in November 2018. In August 2019, catch basins were inspected and it was noted that insufficient sediment was present for sampling. A sample was collected on June 17, 2020, at the South 9th and Commerce location. There was a significant decrease in sediment concentrations from 2018 and no further sampling is planned at this location.

The City will continue to work with the regulatory agencies and businesses throughout this drainage area to eliminate the sources of these contaminants in the stormwater drainage system through normal source control efforts.

A copy of the OF230 2023 Source Tracing Investigation Report, and the OF230 (FD18) South 9th and Fawcett 2023 Report are included in Attachment A.2.

South 14th and Court “A” PAH Source Tracing Investigation

Based on sediment monitoring in OF230, the FD3A drainage area was identified as having ongoing issues with Polycyclic Aromatic Hydrocarbons (PAH) sediment contamination. The City conducted source tracing investigations in 2012 and 2013 (see Mercury and PCBs Source Tracing Investigation section above). During these investigations, elevated levels of PAHs were found in a specific segment of the FD3A drainage area. Additional investigation was then performed to identify potential sources of this contamination.

In 2014, individual catch basins in the targeted segment were sampled to identify specific catch basins with elevated levels of PAHs. The catch basins with the highest PAH concentrations were those located at the corner of Court “A” and South 14th Street. Based on these results, staff conducted another site investigation to determine whether the adjacent parking lot was draining to these catch basins and found that it was not. With no specific source of this contamination identified, the system was cleaned in early 2015 and subsequently resampled in 2016 to determine whether the elevated PAH levels were the result of a historic release or an ongoing source of PAH contamination. Results showed continued presence of PAHs in this area. As a result, a business inspection of the adjacent parking lots was conducted, including the collection of several samples from the private storm drainage system on this property. While no significant processes were noted during the inspection that would attribute to the elevated PAHs, the sediment samples contained elevated concentrations. The City’s evaluation ultimately pointed to coal tar asphalt sealant as a source of the contamination.

The City followed up with the property owner in 2017 to discuss next steps in eliminating this source of PAHs. A letter was sent by the City in April 2017 to the property owner, Arletta Development Corporation, requesting a written plan of action and timeline to eliminate the discharge of PAHs from its facilities to the City’s stormwater system. The City met with representatives of the site owner to develop a plan of action. The property management company performed initial sampling of the catch basins in June 2017, then swept the parking lots and cleaned the private catch basins later that month. Follow up catch basin sampling was initially required on a quarterly basis.

During 2018, City staff reviewed the quarterly catch basin sampling performed to date, and the results exhibited non-detectable concentrations for PAHs. As a result, the City agreed to reduce required maintenance and sampling to an annual frequency. In addition, City staff resampled the ROW catch basins exhibiting elevated concentrations of PAHs in previous investigations. While five catch basins were targeted, samples were only collected from three due to lack of collectable sediment in the other two. Two of the three samples exhibited a significant decrease in PAH concentrations, however one sample exhibited similar concentrations to those found in the 2016 sample. It was subsequently determined that, while the City requested cleaning of the catch basins in this area during 2017, the catch basin containing higher concentrations was not cleaned at that time. Staff re-requested the cleaning for this basin and confirmed cleaning occurred during December 2018.

During 2020, the City resampled several ROW catch basins. One catch basin receiving drainage from the “A” Street parking lot had significant sediment in the sump and elevated concentrations of PAHs. After additional investigation, a collapsed and heavily impacted stormline was discovered in the private storm sewer system. The property owner agreed to repair and clean the private storm system.

While progress was made during 2021 to repair this private system, permitting delays with the state delayed this project. During 2022, the property manager of this location was able to obtain the necessary permits to fix the two broken stormwater laterals located at their properties at 14th Street and Court “A”. Both laterals were repaired in early October 2022 and the municipal catch basins that the private systems connect to were cleaned in November 2022.

EC staff attempted to sample sediment at this location on July 13, 2023, and there was no sediment present to sample. In addition, the FD3C sediment trap (formerly FD3A and in a slightly different location but representing the same area) showed PAH concentrations had decreased in 2023 to 64,215 µg/kg (Table 1), which is significantly lower than what is classified as relative low levels of contamination (<164,000 µg/kg). EC suspects that the repairs made by Neil Walters and Republic Parking have eliminated the significant sources of PAH contamination within this drainage basin.

There are no PAH investigations are planned in this basin for 2024. Staff will review the 2024 sediment trap data for FD3C (Formerly FD3A) when it becomes available to see if the PAH contamination has returned or remains at reduced levels.

A copy of the OF230 (FD3A/FD3C) South 14th Street and Court "A" 2023 Source Tracing Report is included in Attachment A.2.

FD16 PCB Investigation

During 2017, the City began a source tracing investigation in response to recurring detections of Polychlorinated Biphenyls (PCBs) in the FD16 drainage area. Small drainage areas/segments of FD16 were targeted by combining sub-samples from the ROW catch basins into a larger composite sample. This approach assisted with identifying problem areas in FD16. The City discovered elevated PCBs in catch basin sediments from three segments in the FD16 drainage basin.

The goal of the 2018 investigation was to further pinpoint sources of PCB contamination in the FD16 drainage area. In June 2018, the City collected discrete samples from catch basins in the drainage area which were identified as contributors to the 2017 composite samples with elevated PCB concentrations. Five locations were identified as having relatively elevated concentrations of PCBs. The five discrete catch basin locations were cleaned after receipt of laboratory results.

During 2019, City staff narrowed down the contributing area by collecting discrete samples from the catch basins that were part of the composite samples from the previous sampling effort with elevated PCB concentrations. Based on the results of this event, additional sampling was performed to further isolate the area of concern. Results suggested that the relatively low-level contamination is emanating from building materials located at 1301 and 1331 Tacoma Avenue South. With cleaning in the area complete, the City continued to monitor sediment collected in traps to determine if PCBs are continuing to discharge to the storm system. PCB concentrations were below detection in WY2021 then rebounded to high levels in 2022 with a concentration of 430 µg/kg, and then in WY2023 sediment PCB concentrations were back down below detection limits.

During 2023, short term sediment traps were installed in multiple locations within the FD16 sub basin to try and narrow down the source of PCB contamination within the basin. The traps were deployed during October 2023 in drainage areas that had previously exhibited elevated concentrations of PCBs. These sediment traps are currently scheduled to be removed the first week in February 2024. The PCB concentrations for the FD16 sediment trap once again exhibited non-detect results. The city will continue to monitor the sediment trap results to determine if this is an ongoing issue requiring further investigation.

CHB Auto Care PIE Grant

In 2006, Communities for a Healthy Bay (CHB) conducted a public education program in the OF230 drainage basin that included a survey, working with school children, meeting with neighborhood organizations, and providing residents with material on proper automobile care with coupons for neighborhood services. Curb marking with “drains to stream” labels was also completed by CHB and the City. Public surveys showed some improvement in public awareness. However, there was no measurable difference in stormwater data between OF230 and the OF235 control basin where no public education was offered.

Storm System Cleaning

In 2007, at a cost of $300,000, the entire municipal storm drainages for OF230 and OF235 were cleaned and video inspected by the City’s Transmission Maintenance crews. One hundred years of accumulated historical stormwater particulate matter in the trunk lines and laterals (totaling approximately 220 cubic yards) was removed. Eighty thousand feet of 8 to 56-inch lines were cleaned between March 12 and June 25, 2007. Throughout the duration of the project, standardized cleaning practices were used (i.e., plugs downstream of vactor truck) to prevent any mobilized materials from entering the Thea Foss Waterway. The decant water from the vactor trucks was diverted to settling tanks prior to discharge to the sanitary sewer.

Since the time of the complete cleaning of the OF230 drainage basin, additional cleaning has been performed in isolated areas. These cleaning and video inspection activities have been done for a variety of reasons, including areas identified as needing maintenance through the Stormwater Rapid Assessment Program (STRAP), complaints, business inspection follow ups, etc. A summary of pipe cleaning and maintenance activities completed during 2023 in the OF230 drainage basin is provided in Table A.2-1 in Attachment A.2.

Enhanced Street Sweeping

In January 2007, the City’s street sweeping program was transferred from the Streets and Grounds Division to the Sewer Transmission Maintenance Division for continued implementation. The program was enhanced at that time in an attempt to reduce sediment buildup in the storm sewer system. The schedule was set to sweep all areas of the City twice per year, with more frequent sweeping in the business districts and on major arterials. The City also increased communications with residents and business owners, which helped raise awareness of the importance of the street sweeping program.

In 2007, when the work was transferred over, sweeping was done with a combination of mechanical and vacuum sweepers. In 2008, the City started the transition from mechanical sweepers to regenerative air machines. At this point in the program, the City used four regenerative air sweepers. In mid-2018, due to the end of usable life of one of the City’s regenerative air sweepers and a staff retirement, Tacoma temporarily reduced its street sweeping program. This resulted in Tacoma reducing the frequency of arterial sweeping to quarterly and residential streets to annually.

The City received a grant from the Washington State Department of Ecology (Ecology) in 2021 to purchase an additional street sweeper which will allow staff to return to the higher sweeping frequency. The new schedule increases the frequency of sweeping at arterials from every 12 weeks to every six weeks and increases residential sweeping to twice per year City-wide. The sweeper was purchased during 2021, however there were delivery delays, and the sweeper was not delivered until November 2022. After set-up and the addition of a water tank, operations of the new sweeper began in March 2023. Global Positioning System (GPS) is used to track the number of miles swept and the amount of material removed is recorded.

2010 Stormwater Pipe Retrofit Project

From June to November 2010, 13,500 linear feet of existing storm sewer main was structurally rehabilitated in the downtown district. The main segments targeted were tributary to OF230. Defects (cracks, holes, etc.) in the aging system could allow groundwater and soil (potentially contaminated from historic "hot spots") to enter the system and ultimately discharge to the Thea Foss Waterway. Rehabilitation of the existing main segments was accomplished by means of Cured-In-Place Pipe (CIPP) construction technologies. Prior to installation of the CIPP liner, the main line is thoroughly cleaned to remove all debris and to verify if a segment can be retrofitted using the CIPP construction technology. Resin-impregnated liners were inserted into the main segments through existing manholes and the liner was then pressurized, causing it to expand and form to the inside of the existing main segment. A source of heat was then applied which caused the resins to catalyze. This resin liner is molded on to the existing pipe, providing similar strength and durability characteristics as PVC pipe. It is anticipated that these projects will also result in improvements in water and SSPM quality.

When properly installed, the CIPP liner results in continuous stormwater pipe segments with no joints (except for manhole connections), that are free of leaks associated with structural defects. The resulting reduction in inflow and infiltration may reduce the contaminant load to waters of the state if contaminated groundwater is present. Final project costs, including design and management, were $741,506. This project was funded by a $1,000,000 Ecology grant.

2013 Stormwater Pipe Retrofit Project

From August 8 through November 15, 2013, 13,807 linear feet of existing storm sewer main, 65 segments, were structurally rehabilitated in asset management area FS05. The segments that were rehabilitated in OF230 ranged in size from eight inches to 21 inches in diameter. Similar to the 2010 Stormwater Pipe Retrofit project, rehabilitation of the existing main segments was accomplished by means of CIPP construction technologies. It is anticipated that these projects will also result in improvements in water and SSPM quality. Final project costs were $1,048,158, which includes all work completed in asset management areas FS05, FS06, and FS07.

In additional basins, 16,274 linear feet of pipe, 76 segments, were cleaned and video inspected between July 24 and October 7, 2013. During cleaning, the main line was plugged, and the cleaning water and material was removed from the main using a vactor truck. The cleaning water and entrained sediment was pumped into a sediment removal system to separate the solids from the water. After filtration the water was discharged into the sanitary sewer. Approximately ten tons of material was removed from the main segments cleaned in asset management areas FS05, FS06, and FS07.

Sauro's Cleanerama Site Remediation

The Sauro's Cleanerama, which is now closed, released dry cleaning solvents into the environment. The City completed an interim action (IA) cleanup at the Sauro's Cleanerama site during December 2009, under an agreed order with Ecology. During the IA the City removed and disposed of 12,010 tons of soil contaminated by dry cleaning solvents released to the environment during facility operations.

During 2015, the City of Tacoma signed a revised agreed order with Ecology to remediate groundwater contamination by natural attenuation. The final cleanup action to remediate the groundwater will take approximately ten years. The Cleanup Action Plan includes ongoing groundwater monitoring to assess remediation progress during the cleanup action. For the first two years under the order, monitoring was performed semi-annually. During 2018, monitoring was reduced to annually. Data is reported annually to Ecology. January 2023 monitoring results continue to show the capacity for natural attenuation to occur at this site as well as down-gradient (closest to the Thea Foss Waterway).

March 2011 Sanitary Sewer Discharge

A sanitary sewer main in the vicinity of South 15th Street and Market Street collapsed on March 15, 2011. The pipe in this area was originally installed in 1906. The City replaced both the sanitary and storm pipes in this intersection as a result of the failure. It was estimated that 18,000 gallons of sewage discharged to the storm sewer and eventually to the Thea Foss Waterway over a two-hour period. The sanitary sewer overflow (SSO) was reported to Ecology.

Pacific Avenue Streetscape Project

The Pacific Avenue Streetscape Project from 2012 - 2014 included beautification in addition to innovative stormwater improvements. The project area is a ten-block area on Pacific Avenue between South 7th Street and South 17th Street. Key components include innovative stormwater design and pedestrian, bicycle, public transit, and vehicle complete streets concepts. Improvements include new and upgraded sidewalks, new curbs and curb ramps, landscaping, public art, street furnishings, historic streetlights, and roadway repaving. Lastly, a total of 14 rain gardens now treat stormwater prior to it entering the Thea Foss Waterway, as well as new landscaping with over 3,000 new plants.

'A' Street Treatment System

Construction of the "A" Street regional treatment system was completed in January 2015. The project is located in the area with historically higher levels of PCBs and mercury, along with lower levels of PAHs and phthalates. The project included replacement of approximately 1,100 feet of pipe and construction of two underground treatment vaults with Baysaver treatment units sized to treat the water quality design storm event for the 34-acre tributary area. The City's work toward removal of sources of PCBs and mercury to this system, along with PAHs and phthalates, is continuing as described above, but the line replacement and treatment project help to ensure that these contaminants do not get to the waterway. The treatment system was funded from a $1,000,000 fiscal year Statewide Stormwater Grant from Ecology.

Underground Storage Tank (UST) and Leaking UST (LUST) Removal

The Tacoma-Pierce County Health Department (TPCHD) is overseeing the removal of USTs at four active sites in the drainage basin (see Attachment A.1) including:

- UST at the Seven Eleven store located at 4635 South Yakima Avenue. There is soil contamination at this site and this permit remains active.
- UST at the parking garage located at 1114 Pacific Avenue. There are two tanks at this site and this permit remains active.
- UST at Bryant Montessori School at 717 South Grant Avenue. This permit became active during 2023.
- UST at Olympic Building at 1222 Tacoma Avenue South. There is one tank at this site and this permit became active during 2023.

Notice of Violation and Warning Letters

One warning letter was issued in the OF230A drainage basin in 2023:

- A warning letter was issued on March 22, 2023, to Drip House Coffee, LLC, for the illicit discharge of wash water to the City's storm system. Wash water is considered a wastewater and cannot be discharged to the stormwater system.

  A copy of this letter is included in Attachment A.2.

A.3 OUTFALL 235

A.3.1 OUTFALL 235 DRAINAGE BASIN

The OF235 drainage basin encompasses a section of downtown between the OF230 and OF237A drainage basins (see WY2023 Report, Figure 1-3). The OF235 drainage basin is heavily developed and covers an area of approximately 156 acres which drains through a 42-inch outfall pipe located on the west bank of the Thea Foss Waterway at South 21st Street and Dock Street under the State Route (SR) 509 bridge. The general basin boundaries are South 18th Street to the north, South 23rd Street to the south, South “L” Street to the west, and Dock Street to the east.

Commercial land use accounts for the majority of the area in this basin, with a small residential area on the western side (see WY2023 Report, Figure 1-3). A small portion of freeway ROWs in the lower part of this basin, including Interstate-705 (I-705) and the entire I-705 and SR 509 interchange. Most of the stormwater runoff from freeways discharges to a Washington State Department of Transportation (WSDOT) infiltration pond and not to the City-owned storm drains.

The southern portion of the UWT and a portion of the St. Joseph Medical Complex discharges to OF235. The drainage area for UWT is bounded by Pacific Avenue, South 21st Street, Tacoma Avenue, and South 17th Street. Also included in the basin is Tacoma Link Light Rail, downtown revitalization, Dock Street redevelopment, and the Thea Foss Waterway Public Esplanade from South 21st Street to South 17th Street.

Baseflow in OF235 is continuous at approximately 0.4 cubic feet per second (cfs) (see Appendix B, Table B2-2). Sources of baseflow are discussed in Appendix B.

As discussed in Section A.2.1, the City began construction of a new 60-inch stormwater outfall discharging to the Thea Foss Waterway in October 2021 due to capacity issues. The new outfall (OF230A) does not change the nature, strength, or amount of stormwater entering the waterway and receives stormwater from approximately 26 percent (42 acres) of the area historically discharging to OF235. Stormwater from the remaining two percent of the tributary area for OF230 will continue to discharge to the existing OF230, and stormwater from 74 percent of the tributary area for OF235 will continue to discharge to the existing OF235. The new basin boundaries are shown on Figure B2-3.

A.3.2 2002-2023 SOURCE CONTROL ACTIVITIES

Since 2002, significant work has been accomplished in the OF235 drainage basin, including intense business inspections, complete stormline cleaning, and identification and removal of point sources. A discussion of specific major source control activities is provided in the following paragraphs.

As part of the City-wide inspection program, nine business inspections were completed in the OF235 drainage basin in 2023. Business inspections provide source control through education and through implementation of nonstructural BMPs. These actions help prevent materials from coming into contact with stormwater and help promote activities that reduce pollutants in stormwater.

Structural BMPs, also called stormwater treatment devices, currently in place remove solids and the associated particulate-bound chemicals from stormwater. The locations of private and public stormwater treatment devices in the OF235 drainage basin are shown on Figures A-1a and

A-1b, respectively. No new treatment BMP was installed on private property in this drainage basin in 2023 (see Table A.1-1 and Figure A-1a). With future redevelopment in the OF235 drainage basin, private treatment systems will be installed and over time they will help to decrease the solids load and the associated particulate-bound chemical load to the waterway.

2006 Turbid Water Discharge

On June 14, 2006, June 27, 2006, and July 31, 2006, turbid water was observed discharging from OF235. This corresponds to the highest chemical concentrations in baseflow at this location which were observed in WY2006 (Year 5), (see Table 3-2, and Figure 5-1.2 and boxplots in Appendix G in the 2012 Report). A follow up inspection on July 31, 2006, confirmed that there is not a sanitary sewer cross-connection, but the source of these discrete discharges was not identified. These outliers appear to be relatively isolated occurrences.

Storm System Cleaning

In 2007, at a cost of $300,000, the entire municipal storm drainages for OF230 and OF235 were cleaned, and video inspected by the City's Transmission Maintenance crews. One hundred years of accumulated historical stormwater particulate matter in the trunk lines and laterals, 220 cubic yards, was removed. Eighty thousand feet of eight to 56-inch lines were cleaned between March 12 and June 25, 2007. Throughout the duration of the project, standardized cleaning practices were used (i.e., plugs downstream of vactor truck) to prevent any mobilized materials from entering the Thea Foss Waterway. The decant water from the vactor trucks was diverted to settling tanks prior to discharge to the sanitary sewer.

The 2007 video inspection revealed eroded pipe segments and other pipes drilled through the storm lines in some areas. The 2007 video inspections and resulting pipe conditions are tracked as part of the City's STRAP program. A number of relining or replacement projects were added to the City's list of Capital Improvement Projects (CIP) from the STRAP. One of the relining projects, which included pipes in portions of the OF230, OF235, and OF237A drainage basins, was constructed in 2013 as further described below.

Since the 2007 complete cleaning of the OF235 basin, additional cleaning has been performed in the basin in isolated areas. These cleaning and video inspection activities have been done for a variety of reasons, including areas identified as needing maintenance through the STRAP program, complaints, business inspection follow ups, etc. A summary of pipe cleaning and maintenance activities completed during 2023 in the OF235 drainage basin is provided in Table A.3-1 in Attachment A.3.

Enhanced Street Sweeping

In January 2007, the City's street sweeping program was transferred from the Streets and Grounds Division to the Sewer Transmission Maintenance Division for continued implementation. The program was enhanced at that time in an attempt to reduce sediment buildup in the storm sewer system. The schedule was set to sweep all areas of the City twice per year, with more frequent sweeping in the business districts and on major arterials. The City also increased communications with residents and business owners, which helped raise awareness of the importance of the street sweeping program.

In 2007, when the work was transferred over, sweeping was done with a combination of mechanical and vacuum sweepers. In 2008, the City started the transition from mechanical sweepers to regenerative air machines. At this point in the program, the City used four regenerative air sweepers. In mid-2018 due to the end of usable life of one of the City's regenerative air sweepers and a staff retirement, Tacoma temporarily reduced its street sweeping program. This resulted in Tacoma reducing the frequency of arterial sweeping to quarterly and residential streets to annually.

The City received a grant from Ecology in 2021 to purchase an additional street sweeper which will allow staff to return to the higher sweeping frequency. The new schedule increases the frequency of sweeping at arterials from every 12 weeks to every six weeks and increases residential sweeping to twice per year City-wide. The sweeper was purchased during 2021, however there were delivery delays, and the sweeper was not delivered until November 2022. After set-up and addition of a water tank, operations of the new sweeper began in March 2023. GPS is used to track the number of miles swept and the amount of material removed is recorded.

2013 Stormwater Pipe Retrofit Project

From July 26 through November 13, 2013, 5,479 linear feet of existing storm sewer main, 32 segments, was structurally rehabilitated in asset management area FS06. The segments that were rehabilitated in OF235 ranged in size from eight inches to 18 inches in diameter. Defects (cracks, holes, etc.) in the aging system could allow groundwater and soil (potentially contaminated from historic "hot spots") to enter the system and ultimately discharge to the Thea Foss Waterway. Rehabilitation of the existing main segments was accomplished by means of CIPP construction technologies. Resin impregnated liners were inserted into the main segments through existing manholes and the liner was then pressurized, causing it to expand and form to the inside of the existing main segment. A source of heat was then applied which caused the resins to catalyze. The result was a new pipe within the existing pipe that has similar strength and durability characteristics of PVC pipe. It is anticipated that these projects will also result in improvements in water and SSPM quality.

When properly installed, the CIPP liner results in continuous stormwater pipe segments with no joints (except for manhole connections), that are free of leaks associated with structural defects. The resulting reduction in inflow and infiltration may reduce the contaminant load to waters of the state if contaminated groundwater is present. Final project costs are approximately $1,048,158, which includes all work completed in asset management areas FS05, FS06, and FS07.

Prior to installation of the CIPP liner, the main line is thoroughly cleaned to remove all debris and to verify if a segment can be retrofitted using the CIPP construction technology. In FS06, 34 segments, 5,738 linear feet of pipe, were cleaned and video inspected from July 12 through October 7, 2013. During cleaning, the main line was plugged, and the cleaning water and material was removed from the main using a vactor truck. The cleaning water and entrained sediment was pumped into a sediment removal system to separate the solids from the water. After filtration the water was discharged into the sanitary sewer. Approximately ten tons of material was removed from the main segments cleaned in asset management areas FS05, FS06, and FS07.

Hood Street Treatment Retrofit Project

The City was awarded a $1,000.000 fiscal year 2011 Stormwater Retrofit and Low Impact Development (LID) Competitive Grant from Ecology for a $2,100,000 regional stormwater treatment facility in the Hood Street Corridor through the Brewery District (South 21st Street to South 19th Street). This modified bioretention facility provides regional treatment for stormwater runoff discharged from 42 acres of the FS06 drainage basin in Tacoma's downtown area. The water quality facility has been operational since fall 2014. The Hood Street Treatment Retrofit project was built in cooperation with the development of the Prairie Line Trail-UWT Station by the University of Washington Tacoma. The project is a rail-to-trail conversion of Tacoma's historic freight corridor through the heart of downtown. The Prairie Line Trail is a landmark urban trail for pedestrians and bicyclists.

Outfall 235 Stormwater and Baseflow Lead, PAHs, and Phthalates Source Investigation

Based on stormwater monitoring in OF235, this basin was identified in the Thea Foss Work Plan as having ongoing issues with lead in stormwater. In August 2014, staff began an investigation to identify possible sources of the elevated lead concentrations in stormwater. Elevated concentrations of phthalates and PAHs were also observed in baseflow discharges (Tacoma 2013). Because of this, the focus of the investigation began with an investigation of baseflow in the OF235 basin. The intent of this work was to identify specific problem areas within the drainage basin for further investigation.

Due to lack of baseflow during sample collection, staff was unable to target the entire drainage basin. The preceding summer yielded very little precipitation and it is possible that the baseflow was not fully charged during this sampling event. The results of this investigation initiated in 2014 did not identify a specific segment or drainage area in this basin for additional source tracing.

Staff continued this investigation of the drainage basin in 2015. Nine locations were targeted for baseflow sampling in March 2015, and samples were collected at six of the nine locations. Three of these areas showed relatively higher concentrations of lead, and one of these locations also had relatively higher phthalates. Based on the results of this phase of the investigation, these three locations were targeted for additional source tracing. Due to lack of baseflow during sample collection, staff were unable to complete the investigation in these specific areas in 2015. Again, the preceding winter and summer yielded very little precipitation and it is possible that the baseflow was not fully charged during the Round 2 sampling event.

Staff conducted Round 3 of this investigation in spring 2016 when baseflow was flowing at its peak, with additional investigation of the three drainage areas where higher concentrations were found. While progress was made during 2016, specific sources of lead, PAHs, and phthalates were still not identified. Investigations continued in 2017 to further trace sources of these COCs as well as copper and zinc, which were identified in WY2016 as potential COCs.

During the 2017 investigation, no specific sources of lead, phthalates, PAHs, copper, or zinc were identified. Instead, it appears that there are three locations where potentially contaminated groundwater is seeping from the hillside and discharging to the City's stormwater system. Construction activities planned in two of these areas in 2018 were expected to provide some level of appropriate control of the groundwater.

Through 2023, the City monitored the sites in this area with active construction to ensure proper BMPs were maintained. Upon project completion, it will be determined whether construction in this area will eliminate runoff from possible contaminated groundwater in this drainage basin. If it is determined that additional groundwater samples will be collected during any continued investigation in this area, the City will research and gain approval of a sampling protocol that will ensure representative samples and limit contamination from surrounding soils/sediment. This project is on hold until the new Thea Foss Waterway outfall is constructed. The construction for the new outfall and the re-routing of the stormwater system was completed in December 2022 and it is anticipated that construction for the Tacoma Town Center Jefferson Street Project will continue in 2024.

OF235 Copper Investigation

Copper was newly identified as a contaminant of concern within OF235 and to a lesser extent OF230 in WY2021 due to intermittent elevated concentrations in stormwater with other potential outliers beginning in WY2016. All of these outliers, as well as those detected since that time, have been detected in the spring and summer. Due to the seasonal and intermittent nature of the outlier copper concentrations showing up in stormwater samples, it was theorized that it is possible that excess copper is caused by a seasonal commercial cleaning or maintenance operation taking place in the drainage basin. Copper is used as a moss killer on roofs and sidewalks as well as being present in some herbicides.

The Downtown Tacoma Business Improvement Area (BIA) maintains large portions of the downtown area (i.e., pressure washing buildings, sidewalks, etc.). In August of 2022, EC staff contacted the BIA asking what, if any, products they use to assist with their cleaning activities. It was learned that the BIA does not use anything other than water (pressure washers) to perform their cleaning and maintenance activities. In addition, City staff identified buildings with copper exteriors as possible contributors. Tacoma's Union Station was identified as a possible source due to its large copper roof. On April 27, 2022, EC staff sampled five private catch basins around the property of Union Station, multiple of which had roof drain connections. The copper results ranged from 86 ppm to 4,360 ppm and the catch basins were heavily impacted with sediment. The stormwater leaving this site splits, with approximately half going to OF230 and half going to OF235.

Based on these results, in June 2022, EC staff reached out to the property manager and requested that they clean their catch basins and connecting laterals. In November 2022, the property manager confirmed that they had procured funding for the cleaning and the City received confirmation that the catch basins were cleaned on March 27, 2023. Additionally, it was confirmed that roof cleaning is conducted using a "light solution of laundry detergent" and only in moss-affected areas. As a federal building they are required to use Safer-Choice (EPA) or Biobased (USDA) products. In 2024, EC staff will inspect the catch basins at this site and collect samples if there is sufficient sediment. Additionally, staff will continue to look for other potential sources of copper within this drainage basin if needed. A copy of the OF235 Copper Source Tracing Investigation is included in Attachment A.3.

Former Heidelberg Brewery USTs

In January 2012, five USTs were located on the Former Heidelberg Brewery site located at 2120 South "C" Street. Four of the five were uncovered and removed in January 2012, and two areas were found to be contaminated with possible diesel and/or heavy oil. TPCHD worked with the property owner to remove the tanks and complete the remediation of the contamination. Final documentation of the site actions was presented to TPCHD. Based on this review it was determined that the soil remediation project appeared to have been successful in removing petroleum-contaminated soil at the site, but PAH-contaminated soil remained at the eastern property line and the extent of PAH contamination into the ROW was unknown.

The site was entered into Ecology's Voluntary Cleanup Program (TPCHD maintains oversight during this interaction), and Ecology issued their determination dated January 28, 2013, reiterating that the site didn't meet minimum cleanup standards, as the PAH and the groundwater condition of the site needed further investigation. In 2017, following additional cleanup work, the site received a ‘property specific’ No Further Action determination, acknowledging that, while contamination within the site’s property boundary was cleaned up, contamination remained outside the property within the “C” Street ROW

TPCHD had previously issued a notice to the site owner requiring further action and attached a Certificate of Non-Compliance onto the property title in 2015, which will remain on the title until amended with a Notice of Compliance once cleanup is complete.

In 2018, the owners hired a new consultant and in 2021 renewed their Site Cleanup permit with TPCHD, which is required along with further work leading to a completed cleanup. The permit is currently in place, and as of the end of 2023, the site remains ‘open’. The site owner complied with one of the TPCHD’s requirements to maintain and annually renew their Site Cleanup permit. However, they failed to comply with the second requirement to continue with the cleanup action identified for the ROW and eastern property line. Residual contamination remains towards and within the ROW and will need to be completed before issuing satisfactory Site Closure letter.

UST and LUST Removal

TPCHD is overseeing the removal of USTs at one site in the drainage basin (see Attachment A.1):

- UST at Heidelberg Brewery at 2120 South “C” Street, the permit remains active.

Notice of Violation and Warning Letters

There were no Warning or Notice of Violation letters issued in this drainage basin in 2023.

A.4 OUTFALL 237A

A.4.1 OUTFALL 237A DRAINAGE BASIN

The OF237A drainage basin is approximately 2,823 acres and drains to the Thea Foss Waterway through the west 96-inch outfall located in the 2300 block of East Dock Street at the head of the waterway. As shown in Figure 1-3 of the WY2023 Report, the drainage basin generally extends in the south and west directions from the outfall. The general boundaries are South 19th Street to the north, South 40th Street to the south, Lawrence Street to the west, and Tacoma Avenue to the east.

The OF237A drainage basin contains residential, commercial, and industrial land uses. In addition, freeway ROW for I-5, SR 16, the entire I-5/SR 16 interchange, and a portion of the I-5/I-705 interchange are located within this drainage basin.

Baseflow in OF237A is continuous at approximately 4.4 cfs (see Appendix B, Table B2-2) and consists primarily of former creeks that were piped. Sources of baseflow are discussed in more detail in Appendix B.

During periods of increased precipitation, the Leach Creek Holding Basin located to the west of the drainage basin is pumped to the OF237A storm drainage system. The Leach Creek Holding Basin is located within the city limits of Fircrest (west of Tacoma) and has functioned as a stormwater facility since 1961, when a dike was constructed along the southern edge of the current site. Several storm pipelines feed the holding basin, draining approximately 2,450 acres of residential, commercial, highways, and other high-use developed properties in Tacoma and Fircrest. The primary outflow from the holding basin is a gated 42-inch outlet pipe which conveys stormwater to Leach Creek.

The pump station was constructed in 1991 and consists of four pumps, each with a capacity of 24 cfs and maximum combined capacity of 96 cfs. During more intense rain events, stormwater from the Leach Creek Holding Basin is pumped through a 42-inch pipe to the Nalley Valley trunk line and discharged into the Thea Foss Waterway through OF237A. The number of pumps operating depends on the intensity of a given storm event, with any number of the four pumps potentially operating at a given time. At low levels of precipitation, no pumps operate and the water discharges to Leach Creek. At increased levels of precipitation[2], pumps sequentially engage up to a maximum of four pumps. The range of flow to the Nalley Valley system from the Leach Creek Holding Basin is from zero to 96 cfs. Emergency overflow from the holding basin is provided by a 40-foot-wide emergency spillway which discharges to Leach Creek.

In 2005, 60 feet of the OF237A outfall pipe was replaced by Burlington Northern Railroad as part of their rail track realignment project. Construction included extending the outfall, constructing a new manhole structure, and replacing pipe from the City's sanitary pump station yard (known as Dock Street) to the outfall. The new manhole was constructed downstream of the current stormwater sampling location and FD2 and FD2A. The 23rd Street lateral (FD2A) was rerouted to the new manhole structure in the OF237A main trunk line. Since 2023, this manhole is now used as the end-of-pipe stormwater sampling location and is designated as OF237A New. This sampling location represents discharge from the entire drainage basin.

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[2] According to the City's best estimation, this occurs when greater than ¾-inch of precipitation falls within a 24-hour period.

A.4.2 2002-2023 Source Control Activities

Since 2002, significant work has been accomplished in the OF237A drainage basin, including intense business inspections, complete line cleaning in many sub-basins, and identification and removal of point sources. A discussion of specific major source control activities is provided in the following paragraphs.

As part of the City-wide inspection program, 100 business inspections were completed in the OF237A drainage basin in 2023. Business inspections provide source control through education and through implementation of nonstructural BMPs. These actions help prevent materials from coming into contact with stormwater and help promote activities that reduce pollutants in stormwater.

Stormwater treatment devices currently in place also remove solids and the associated particulate-bound chemicals from stormwater. The locations of private and public stormwater treatment devices in the OF237A drainage basin are shown on Figures A-1a and A-1b, respectively. In 2023, the following nine new BMPs were installed on private properties in this drainage basin (see Table A.1-1):

- one drywell was installed at a single-family dwelling on South Puget Sound Avenue;
- three Infiltration Facilities were installed on commercial vacant land on Chelan Place;
- one Detention Vault was installed on vacant industrial land on South State Street; and
- two stormfilters, one infiltration facility, and one perk filter, were installed at a multi-family apartment complex on the 4000 block on South "G" Street.

With future redevelopment in the OF237A drainage basin, more onsite stormwater treatment systems will be installed and over time these will help to decrease flow, suspended solids, and the associated particulate-bound chemicals to the waterway.

South Tacoma Groundwater Protection District

The South Tacoma Groundwater Protection District also falls within this basin and the TPCHD conducts industrial/business inspections in this basin. As part of their inspection program, stormwater treatment devices and other onsite BMPs are inspected for proper installation, maintenance, and operations. Improvements to stormwater quality discharging from these sites may be realized with proper maintenance and implementation of these BMPs. During this reporting period, TPCHD did note several violations during routine inspections and they've either been resolved or they're working to resolve with the facilities.

Storm Line Cleaning

Between April 28 and August 8, 2008, targeted areas of the storm sewer system, including trunk lines, laterals, and catch basins, were cleaned and video inspected at a cost of $374,000. Approximately 320 cubic yards of historical SSPM which had accumulated over 100 years was removed from 157,200 feet of lines and 754 catch basins using Tacoma's standardized cleaning practices (i.e., plugs downstream of vactor truck). The video inspections revealed a large void in the pipe at the intersection of South 26th Street and Jefferson Avenue. The City's Sewer Transmission Maintenance Division and Streets and Grounds Division repaired the storm pipe at this location.

The City's STRAP program is designed to visually inspect and rank the entire City storm conveyance system. The City maintains a map-based asset management database that helps guide our CIP. Over time, video inspections have revealed eroded pipe segments, root intrusion, and poorly constructed tap-in connections. A number of relining or replacement projects have been added the City's list of CIPs from the STRAP program.

Since the time of the cleaning project in the OF237A basin, additional cleaning and maintenance has been performed in the basin in isolated areas. These cleaning and video inspection activities have been done for a variety of reasons, including areas identified as needing maintenance through the STRAP program, complaints, business inspection follow ups, etc. A summary of pipe cleaning and maintenance projects completed in the OF237A drainage basin during 2023 is provided in Table A.4-1 of Attachment A.4.

Enhanced Street Sweeping

In January 2007, the City's street sweeping program was transferred from the Streets and Grounds Division to the Sewer Transmission Maintenance Division for continued implementation. The program was enhanced at that time in an attempt to reduce sediment buildup in the storm sewer system. The schedule was set to sweep all areas of the City twice per year, with more frequent sweeping in the business districts and on major arterials. The City also increased communications with residents and business owners, which helped raise awareness of the importance of the street sweeping program.

In 2007, when the work was transferred over, sweeping was done with a combination of mechanical and vacuum sweepers. In 2008, the City started the transition from mechanical sweepers to regenerative air machines. At this point in the program, the City used four regenerative air sweepers. In mid-2018, due to the end of usable life of one of the City's regenerative air sweepers and a staff retirement, Tacoma temporarily reduced its street sweeping program. This resulted in Tacoma reducing the frequency of arterial sweeping to quarterly and residential streets to annually.

The City received a grant from Ecology in 2021 to purchase an additional street sweeper which will allow staff to return to the higher sweeping frequency. The new schedule increases the frequency of sweeping at arterials from every 12 weeks to every six weeks and increases residential sweeping to twice per year City-wide. The sweeper was purchased during 2021, however there were delivery delays, and the sweeper was not delivered until November 2022. After set-up and addition of a water tank, operations of the new sweeper began in March 2023. GPS is used to track the number of miles swept and the amount of material removed is recorded.

DA-1 Line/Coal Gas Site Cleanup

During construction of I-705, WSDOT installed a French drain to pick up surfacing groundwater that was affecting their construction of a road near South 23rd Street and South "A" Street. In 1992, it was determined that this drain was picking up coal tar-contaminated groundwater and conveying it to the storm drain system, and subsequently to the waterway. The DA-1 line was thus believed to be a source of PAHs discharging to OF237A in the FD2A branch. The line was immediately plugged, and the site was partially remediated in May 2003. As part of this remediation, in February and March 2003 WSDOT removed and sealed the DA-1 line French drain system that crossed through the standard chemical site and its underlying coal tar deposits.

In 2016, Ecology reconvened the group of Potentially Liable Parties to begin negotiation of the new agreed order for Remedial Action needed to complete work on the Coal Gasification Site, including this area. This new agreed order was executed in 2018 and work on the Remedial Investigation and Feasibility Study (RI/FS) is currently underway. PacifiCorp and Puget Sound Energy are working as the performing parties in coordination with the City and WSDOT. Work with Ecology to gather additional sufficient information to complete the RI is ongoing. Upon completion, work on evaluation of cleanup alternatives can begin.

FD13 PAH Investigation / Media Filtration System Installation

In 2010, the City installed a media filtration system that treats stormwater from the FD13 sub-basin, which is approximately 50 acres in size. This CIP was funded by a grant from Ecology. When initially installed, this media filtration system appeared to remove almost all the SSPM from the stormwater as evidenced by the fact that insufficient accumulation prevented enough for a sample to be collected from FD13, which is located downstream of the treatment device in WY2011. In WY2012, an SSPM sample from FD13 was obtained, and results for mercury, PCBs, PAHs, and phthalates were in the low range (see WY2021 Report, Figures 2-1.1 through 2-1.4). In WY2013, the sample was accidentally acidified in the laboratory prior to analysis, so no results are available for mercury, PCBs, PAHs, or phthalates. Since WY2014, PAHs and phthalates have been in the low range in FD13, and mercury and PCBs have not been analyzed. Based on these results, FD13 was removed in WY2020. The media filtration system is inspected annually to determine the optimum maintenance cycle for the system.

When the treatment system was installed, it caused the upstream sediment trap (FD13B) to become submerged. In August 2012, when the sediment traps were redeployed for WY2013, a new sediment trap was installed further upstream of the prior location. This new location is designated FD13B-New. Results are presented in this report for both upstream traps FD13B and FD13B-New, as well as for downstream trap FD13 where data is available. Sediment trap FD13B was removed in 2018 and was not redeployed, so only results through WY2018 are provided for that location.

At FD13B, mercury concentrations were in the low range between WY2006 and WY2018 and PCBs were in the low range throughout the monitoring period and are no longer analyzed. Phthalate concentrations at FD13B were in the low range throughout the monitoring period, with the exception of WY2013 when they were in the medium range. They returned to low levels in WY2014 and remained there through WY2018, when sampling at this location was discontinued. At FD13B-New, where samples are available, mercury and phthalate concentrations have been in the low range since monitoring began in WY2013. They are no longer analyzed at this location.

PAH concentrations have fluctuated between medium and high-level concentrations at FD13B-New since the trap was installed in WY2013. The WY2018 PAH concentration at FD13B-New was in the medium range at 200,735 µg/kg, a decrease from the high range concentration of 316,529 µg/kg detected in WY2017. In WY2019 and WY2020, the concentrations increased slightly to 233,444 µg/kg and 282,110 µg/kg, respectively. Concentrations exhibited a downward trend in WY2021 and WY2022 to 159,994 µg/kg and 142,919 µg/kg, respectively.

There has been an ongoing investigation in this portion of the OF237A drainage basin since 2005 to identify possible sources of PAHs found during sediment monitoring. Several source control activities have taken place in the area as described further in this section and below. While great strides were made to identify sources of PAHs during previous investigations, sediment trap monitoring results indicated a continued source of PAHs discharging from this sub-basin located upstream of the filtration system. In response, City staff began an investigation to evaluate potential sources of PAHs in the FD13B-New basin during 2015 and it continued through 2022.

The first phase of the 2015 investigation was to determine whether the ROW drainage area was a potential source of PAHs and to attempt to identify a specific area or private drainage system for additional source tracing efforts. Results from this phase showed an area with significantly higher PAH concentrations and subsequent sampling confirmed the presence of significant concentrations of PAHs throughout a parking lot on the Tacoma News Tribune (TNT) property.

As a result of this finding, the City worked with the business owner and Ecology to develop a plan to address the contamination. In July 2016, it was confirmed that the cleanup plan had been implemented, and the City followed up with an outline for a plan for inspecting their private stormwater system quarterly. In October 2016, the municipal stormwater conveyance system from the TNT property to the FD13B–New sediment trap was cleaned. The sediment trap was then reinstalled on October 4, 2016, after the cleaning was completed.

WY2017 sediment trap results showed PAH results at FD13B-New remained in the high range, indicating an ongoing source of PAHs in this area. On October 31, 2017, City staff resampled several ROW catch basins in the FD13B-New drainage area that exhibited relatively elevated concentrations for PAHs during the 2015 investigation. While two of the 2017 samples exhibited only slightly higher concentrations than measured in 2015, another sample located immediately adjacent to the TNT property exhibited a concentration more than double the concentration of the 2015 sample.

Based on these elevated results, City staff conducted a business inspection at the TNT property and resampled several private catch basins that had exhibited elevated PAH concentrations during the 2015 investigation. Results from the sampling indicated a continuing source of PAHs discharging from the TNT property. During the investigation, it was noted that several of the catch basins are not sealed properly, and dirt is likely entering the catch basin from this pathway. Property owners sealed the catch basins and conducted cleaning of the targeted stormwater collection system.

On December 14, 2017, City staff installed two short-term sediment traps in the FD13B-New drainage basin to determine if there were other areas in the drainage basin discharging PAHs by isolating flow discharging from the south/west and flow discharging from the north. Sediment trap A was installed to capture flow discharging from the south and the west while sediment trap B was installed to capture flow discharging from the north. These sediment samples were collected in January 2018.

Results indicated some decreased but still elevated concentrations on the TNT property. The City met with their representatives in early 2018 to discuss next steps. Additional maintenance of their onsite system was performed, and the property owner has committed to additional efforts as needed to control any ongoing issues. In addition, the City cleaned the stormwater system downstream from the TNT to remove historical pollutants, and the City continued to monitor PAH concentrations in ROW catch basins downstream from the property when sufficient sediment has accumulated to determine whether source control strategies have been successful.

Investigations of the private storm systems upstream of two of the short-term traps continued in 2021 in attempt to identify other potential sources. EC staff continued to evaluate the drainage area and discovered that an additional property has stormwater drainage to this system. The CHI Franciscan Education and Support Center complex (2420 South State Street) has several catch basins on their property that were not included in past investigations. On June 7, 2021, EC staff sampled all the catch basins located on the CHI Franciscan property in addition to resampling the three catch basins at General Mechanical, Inc., (2316 South State Street) that were not accessible during the previous investigation. Elevated concentrations of PAHs were found in the catch basins at the southernmost parking lot on the CHI Franciscan Education and Support Center complex property and the City required the property owner to clean the entire storm system at this site. This cleaning was completed on September 22, 2021. A quick inspection on November 19, 2021, showed that the sediment level in these catch basins was insufficient for resampling.

During 2022, staff were able to resample the catch basins located at the CHI Franciscan properties to ensure that the contamination has been effectively removed. The catch basin sediment concentrations from this sampling event remained in the higher range for PAHs, ranging from 709,230–5,424,490 µg/kg. EC staff sent CHI Franciscan a 30-day letter to submit a written plan of action and timeline to effectively eliminate the discharge of PAHs from its facility to the City's stormwater system. CHI Franciscan hired a consulting firm for the issue. Based on recommendations from the consultant and previous historical parking lot investigations, it was determined that the failing asphalt in the parking lot was likely the source of PAH contamination. During 2023, CHI Franciscan completed work to resurface the parking lot and on August 18, 2023, EC staff received confirmation that all parking lot repairs were completed, and that the private stormwater system had been cleaned post-construction. WY2023 Sediment trap results exhibited a significant decrease in PAH concentrations with a concentration of 58,330 µg/kg, which is significantly lower than what is classified as relative low levels of contamination (<164,000 µg/kg) (see Figure 2-1.2).

No investigations are planned in this basin for 2024. The City will continue to monitor the sediment trap results to determine if there are any additional sources of PAHs in this drainage area. A copy of the OF237A 2023 Source Tracing Status Update – FD13B Polyaromatic Hydrocarbons Investigation report is included in Attachment A.4.

FD10C Source Investigation

The FD10C sediment trap drainage area was initially tracked for several years as a potential phthalate concern. The annual sediment trap monitoring results showed moderately elevated phthalate levels since monitoring of this trap began in 2003. In addition, this trap had intermittent moderate- to high-level PCB concentrations since 2013, and moderately elevated mercury concentrations in 2015 and 2016. Starting in 2011, phthalate concentrations began decreasing, coinciding with a large business closing in this area.

Due to these historic phthalate concentrations as well as the PCB detections, the stormwater system was cleaned in January 2014 to remove residual contamination. Following cleaning of the system, FD10C continued to show moderately elevated PCBs and mercury concentrations. As a result of these detections, an investigation was initiated in 2016 that included sampling of catch basins in the drainage area as well as performance of business inspections. Through this work, the area for additional investigation was narrowed down to a smaller area.

Two additional business inspections were conducted in 2017 to further explore the potential for ongoing source contributions. In addition, sediment samples were collected from private catch basins discharging to the City's stormwater collection system. This phase of the source tracing investigation was intended to identify possible sources of PCB and mercury contamination as well as PAHs and phthalates, which were included based on the annual sediment trap monitoring results.

Although a specific source of the contamination was not identified through this investigation, some private stormwater systems and City catch basins upstream from the sediment trap were cleaned with a plan to resample in 2018 to determine if there was a historical component to the contamination.

During 2018, one additional business inspection was conducted, and sediment samples were collected and analyzed from one private catch basin and one City catch basin. The analytical results indicated detectable concentrations for PAHs and phthalates and minor concentrations for PCBs and mercury. Sediment was cleaned from all the City's collection pipes in 2018 to remove historical sediment from the lines.

In 2019 the City continued efforts to get permission from the private property owner at 3033 South Lawrence Street to collect sediment from their private stormwater oil/water separator. Since these efforts were not successful, short-term sediment traps were redeployed to try to get a sample of material leaving the site. These results showed moderately high levels of PAHs and low levels of phthalates and PCBs. The City wrote a letter on February 28, 2020, to the owner of 3035 South Lawrence Street requesting that they clean their oil/water separator, and a follow-up inspection on July 6, 2020, confirmed that it had been cleaned.

In 2021, a short-term sediment trap was installed at the connection point of the 3035 South Lawrence Street private system and oil/water separator. The purpose was to determine if the source of contaminants entering the municipal system had been removed after the cleaning of the oil/water separator at this location. Those results show small concentrations of PAHs, but no PCBs were detected. Additionally, four private catch basins were sampled along Lawrence Street that had previously shown low concentrations of PCBs. These catch basins continue to exhibit relatively low concentrations of PCBs compared to annual sediment trap concentrations, and it is unlikely that this property is the source of the contamination.

Since the sediment trap results in this basin continued to exhibit medium-level PCB concentrations, there was determined to be a possibility of unknown discharges to the storm system. During 2022, staff reviewed the private systems in this basin and confirmed that they are accurately represented on the City's mapping system. Additionally, short-term sediment traps were installed at two new locations along South Lawrence Street upstream from FD10C in attempt to identify the source of PCBs in the larger drainage area. These locations isolated several private drainage systems that discharge to South Lawrence Street. The short-term trap towards the north end of South Lawrence Street exhibited a concentration of 65 mg/kg, while the downstream sediment trap exhibited a concentration of 230 mg/kg, which more closely aligns with our historic data for the FD10C sediment trap. The municipal storm system where the sediment traps were installed was heavily impacted by sediment, making it difficult to determine if the contamination is ongoing or historic. There were several construction projects on South Lawrence Street completed in 2022, so it is possible that the sediment impacting the storm main could be from those activities. The City cleaned the entire storm system in this drainage basin, and the sediment traps were re-installed in December 2022.

The short-term sediment traps were retrieved and submitted to the lab on July 11, 2023. Results showed that both sediment traps had non-detectable levels of PCBs. Additionally, the FD10c sediment trap had non-detectable levels of PCBs for 2023. It is possible that the source of PCBs was historical contamination, and the system cleaning removed this contamination. No investigations are planned in this basin for 2024. The City will continue to monitor the sediment trap results to determine if there are any additional sources of PCBs in this drainage area.

A copy of the OF237A Source Tracing Status Update – FD10C Source Tracing Investigation Report is included in Attachment A.4.

2013 Stormwater Pipe Retrofit Project

From July 18 through November 15, 2013, 5,126 linear feet of existing storm sewer main, 31 segments, was structurally rehabilitated in asset management area FS07. The segments that were rehabilitated in OF237A ranged in size from eight inches to 18 inches in diameter. Defects (cracks, holes, etc.) in the aging system could allow groundwater and soil (potentially contaminated from historic “hot spots”) to enter the system and ultimately discharge to the Thea Foss Waterway. Rehabilitation of the existing main segments was accomplished by means of CIPP construction technologies. Resin impregnated liners were inserted into the main segments through existing manholes and the liner was then pressurized, causing it to expand and form to the inside of the existing main segment. A source of heat was then applied which caused the resins to catalyze. The result was a new pipe within the existing pipe that has similar strength and durability characteristics of PVC pipe. It is anticipated that these projects will also result in improvements in water and SSPM quality.

When properly installed, the CIPP liner results in continuous stormwater pipe segments with no joints (except for manhole connections), that are free of leaks associated with structural defects. The resulting reduction in inflow and infiltration may reduce the contaminant load to waters of the state if contaminated groundwater is present. Final project costs are approximately $1,048,158, which includes all work completed in asset management areas FS05, FS06, and FS07.

Prior to installation of the CIPP liner, the main line was thoroughly cleaned to remove all debris and to verify if the segment could be retrofitted using the CIPP construction technology. In FS07, 34 segments, 5,666 linear feet of pipe, were cleaned and video inspected between July 11 and October 28, 2013. During cleaning, the main line was plugged, and the cleaning water and material was removed from the main using a vactor truck. The cleaning water and entrained sediment was pumped into a sediment removal system to separate the solids from the water. After filtration the water was discharged into the sanitary sewer. Approximately ten tons of material was removed from the main segments cleaned in asset management areas FS05, FS06, and FS07.

Key Bank LUST Removal

Following identification of a LUST, the owner of this site completed a voluntary cleanup under Ecology oversight in 2007. A return fuel line from a back-up generator had ruptured and leaked diesel into surrounding soils and eventually seeped into a catch basin that drains to FD13B.

UST and LUST Removal

TPCHD is currently overseeing the removal of USTs at fourteen sites in the drainage basin (see Attachment A.1).

Notice of Violation and Warning Letters

One Notice of Violation letter issued in this drainage basin in 2023.

- A Notice of Violation with monetary penalties and a corrective action order was issued for Tekni-Plex, Inc. located at 3101 South Tacoma Way for discharging process-associated wastewater into the MS4 and failing to notify ES of the illicit discharge. The City assessed a $2,000 penalty for the violation and required the facility to implement controls to prevent prohibited discharges and to prevent contaminants from coming into contact with stormwater.

  A copy of this letter is included in Attachment A.4.

A.5 OUTFALL 237B

A.5.1 OUTFALL 237B DRAINAGE BASIN

The OF237B drainage basin encompasses 1,991 acres of south and east Tacoma. This area drains to the Thea Foss Waterway through a 96-inch outfall pipe located on East Dock Street at the head of the waterway. The general basin boundaries are East 23rd Street and East Dock Street to the north, East 84th Street to the south, South Fawcett Avenue to the west, and McKinley Avenue to the east. Most of the storm drainage is channeled to the main trunk line, which flows south to north along East “D” Street.

Primary land use in this drainage basin is residential with some commercial and a very small industrial area (see WY2023 Report, Figure 1-3). Commercial areas are mostly linear and spread out in strips along Pacific Avenue and McKinley Avenue with some areas around I-5 to the Thea Foss Waterway. Freeway ROW makes up a small percentage of this basin, and includes a portion of the I-5, I-705, SR 7 interchange, and SR 7. This ROW area may increase slightly with the expansions and HOV lanes on I-5. Streets, parks, and open or undeveloped property account for the remaining land use in the basin.

Baseflow from OF237B is continuous at approximately 8.3 cfs (see Appendix B, Table B2-2) and originates primarily from former creeks that were piped. Sources of baseflow are discussed in more detail in Appendix B.

As part of the Burlington Northern Santa Fe Railway (BNSF) railroad realignment project, OF237B was reconstructed between July and September 2005. This work included installation of a new manhole structure downstream of the whole-water and SSPM (FD1) sampling location and included extension of the outfall pipe through installation of 60 feet of new concrete pipe. The SSPM and the whole-water monitoring station remained at the same location since that location captures contributions from the entire basin.

A.5.2 2002-2023 SOURCE CONTROL ACTIVITIES

Since 2002, significant work has been accomplished in the OF237B drainage basin, including intense business inspections, targeted line cleaning, and identification and removal of point sources. A discussion of specific major source control activities is provided in the following paragraphs.

As part of the City-wide inspection program, twenty-two inspections were completed in the OF237B drainage basin in 2023. Business inspections provide source control through education and through implementation of nonstructural BMPs. These actions help prevent materials from coming into contact with stormwater and help promote activities that reduce pollutants in stormwater.

Stormwater treatment devices currently in place also remove solids and the associated particulate-bound chemicals from stormwater. The locations of private and public onsite stormwater treatment devices in the OF237B drainage basin are shown on Figures A-1a and A-1b, respectively. In 2023, there were 14 new treatment devices installed on private properties in this drainage basin, including five bioretention facilities, seven infiltration facilities, one dispersion trench, and a Biopod facility (see Table A.1-1). With future redevelopment in the OF237B drainage basin, more of these private treatment systems will be installed and over time they will help to decrease the solids load and the associated particulate-bound chemical load to the waterway.

FD31 PAH Investigation

HPAHs were found in baseflow in WY2004 (see WY2012 Report, Figures G-19a and G-39a). As shown in Figure 2-1.2 of the WY2023 Report, FD31 PAH concentrations in SSPM in WY2003 were considered to be in the medium range (yellow). In 2004-2005, source control inspectors performed a source tracing investigation and identified two sources of PAHs in the FD31 branch of the OF237B drainage: an existing 1950s UST for heating fuels at Tacoma Public Schools Willard Early Learning Center, and a neighborhood fueling station which had recently closed. The City cleaned and video inspected the FD31 branch as part of the PAH source tracing investigation. Source control inspectors worked with the school district's maintenance staff to implement proper BMPs for the site.

Because of these efforts, PAH concentrations decreased in FD31 to the low range of concentrations in WY2005 (see WY2023 Report, Figure 2-1.2). However, PAH concentrations at FD31 increased back to medium range starting in WY2008 and to the high range in WY2010. As a result of the known presence of USTs, these sites were referred to TPCHD for follow up.

In December 2011, the UST at Tacoma Public Schools Willard Early Learning Center was removed in accordance with a TPCHD permit. TPCHD considered the work completed and closed on October 22, 2012. In response to the elevated PAH concentrations at the former fueling station at 3402 Pacific Avenue (EZ Food Mart), TPCHD initiated a Phase I/II assessment in 2011. TPCHD determined that the site had improperly abandoned USTs which needed to be removed. They began working with the property owner to remove these USTs, but the work was delayed for two years until cleanup was finally completed in 2014. The Site Closure determination was issued by TPCHD on August 6, 2014.

Because sediment trap concentrations were in the medium range at this location in WY2013, and due to the lack of progress in removing the USTs at the EZ Food Mart site, the City initiated additional source tracing efforts for PAHs in this sub-basin in 2014 to identify any other sources of PAHs present in this area (Figure 2-1.2). The approach for this investigation was to sample individual catch basins in the targeted drainage area in an attempt to identify any specific catch basins with elevated levels of PAHs. During the initial investigation, it was discovered that the stormwater collection system in this area was cleaned in February 2014. Because of this, insufficient sediment was present for sampling until September 2014. Five catch basins were sampled at that time, and none showed detectable levels of PAHs.

As shown in Figure 2-1.2, PAH concentrations in FD31 were in the medium range in WY2014 but decreased to low levels in WY2015, where they have remained through WY2019. With the cleaning of the drainage system and the removal of the USTs at the EZ Food Mart site, it appears that the elevated PAH levels found in the stormwater system were the result of these historic sources at the Willard Early Learning Center and EZ Food Mart, and that control of these sources has eliminated this source. While in the low range, the WY2018 concentration at FD31 of 159,791 µg/kg represented an increase from the WY2017 concentration of 66,262 µg/kg. Concentrations have continued to fluctuate at this sampling location with a decrease in PAH concentration to 50,323 µg/kg in WY2019 and a slight increase in concentration to 91,139 µg/kg in WY2020. Despite the fluctuations, concentrations have remained comparatively low, indicating that source control work was effective. Therefore, the FD31 sediment trap was removed in WY2020.

PCB Source Tracing in FD34 and FD35

Since 2005, PCBs were found intermittently at high-range concentrations in the south-central portion of the OF237B drainage basin at FD34 and FD35 (see WY2023 Report, Figure 2-1.4). Through the years, numerous source control activities were undertaken in attempt to identify the source of this ongoing intermittent issue. In the summer of 2011, source control inspectors initiated an investigation to isolate possible source(s) of PCBs in the area. Sediment and soil samples were also collected from a catch basin and from the ground adjacent to a transformer on the property of the former Globe Ticket Facility. PCBs were not detected in any of these samples.

In an attempt to remove any legacy contamination, the City completed a stormline cleaning project in the summer of 2011 that covered the majority of the OF237B drainage basin, including the FD35 area. In WY2011, concentrations in both sediment traps dropped to below levels of concern. However, in WY2012 and WY2013, the PCB concentrations in FD35 increased back to high levels, while the concentrations in FD34 remained low. In WY2014, concentrations at FD35 decreased to medium levels, but increased back to the high range in WY2015, while remaining in the low range in FD34.

Another source tracing investigation to try to narrow the source of PCBs in this area was initiated in late 2012. Initial results narrowed the source to one leg of the drainage system leading to FD35. The results from this investigation were included in the WY2012 Report. Substantial additional work was performed in 2013 to further isolate the source of the contamination in this leg of the drainage system. Ultimately it was determined that the source of the contamination was a material used during construction of the roadway in the area in 1975, specifically the sealant used to seal the roadway at the curbline that likely contained PCBs. The final report on this investigation was included in the WY2013 report.

On May 22, 2013, the City sent formal letters of notification to Ecology outlining the discovery of the PCBs in the City's stormwater conveyance system. In 2015, the City completed the first phase of roadway repair to eliminate this source of PCBs and completed the second and final phase in fall 2016. FD34 remained in the low range in WY2019, and that sediment trap was removed. FD35 decreased from the medium range in WY2017 to the low range in WY2018, where it remained in WY2019. FD35 was in place in the pipe during the time that the remediation project was being completed. Therefore, the WY2018 sample was the first representing a full year of the area in its remediated condition. WY2019 PCB concentrations in FD35 remained in the low range (94 µg/kg), however WY2020 concentrations increased back to the medium range (250 µg/kg). FD35 remained in place during WY2021 and WY2022, and no PCBs were detected. Since concentrations have remained low and the WY2020 results were considered inaccurate[3], the source control action is considered successful and the sediment trap at this location will be removed.

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[3] During WY2020 SSPM results showed consistently higher levels of PCBs wherever they were detected. Because these higher concentrations were dispersed across several locations and drainage basins, it did not appear to be caused by a specific event or source. While a cause for these elevated concentrations was not identified during the investigation, based on the lower expected results exhibited during WY2021 it was determined that WY2020 results were not accurate.

Storm System Cleaning

At a cost of $274,200, the majority of the municipal storm drainage basin for OF237B was cleaned and video inspected by the City's Transmission Maintenance crews between November 7, 2010, and February 24, 2011. Fifty to 100 years of accumulated historical stormwater particulate matter was present in the trunk lines and laterals. During the cleaning project, 175 cubic yards were removed from 144,199 feet of lines and laterals and 1,072 catch basins. The cleaning was performed using Tacoma's standardized cleaning practices (i.e., plugs downstream of vactor truck).

The 2011 video inspection also revealed eroded pipe segments and other pipes drilled through the storm lines in some areas. These issues will be addressed as part of future CIPs. Since the time of the complete cleaning of the OF237B basin, additional cleaning has been performed in the basin in isolated areas. These cleaning and video inspection activities have been done for a variety of reasons, including areas identified as needing maintenance through the STRAP program, complaints, and business inspection follow ups.

A summary of pipe cleaning and maintenance projects completed in the OF237B drainage basin during 2023 is provided in Table A.5-1 in Attachment A.5.

Enhanced Street Sweeping

In January 2007, the City's street sweeping program was transferred from the Streets and Grounds Division to the Sewer Transmission Maintenance Division for continued implementation. The program was enhanced at that time to reduce sediment buildup in the storm sewer system. The schedule was set to sweep all areas of the City twice per year, with more frequent sweeping in the business districts and on major arterials. The City also increased communications with residents and business owners, which helped raise awareness of the importance of the street sweeping program.

In 2007, when the work was transferred over, sweeping was done with a combination of mechanical and vacuum sweepers. In 2008, the City started the transition from mechanical sweepers to regenerative air machines. At this point in the program, the City used four regenerative air sweepers. In mid-2018, due to the end of usable life of one of the City's regenerative air sweepers and a staff retirement, Tacoma temporarily reduced its street sweeping program. This resulted in Tacoma reducing the frequency of arterial sweeping to quarterly and residential streets to annually.

The City received a grant from Ecology in 2021 to purchase an additional street sweeper which will allow staff to return to the higher sweeping frequency. The new schedule increases the frequency of sweeping at arterials from every 12 weeks to every six weeks and increases residential sweeping to twice per year City-wide. The sweeper was purchased during 2021, however there were delivery delays, and the sweeper was not delivered until November 2022. After set-up and the addition of a water tank, operations of the new sweeper began in March 2023. GPS is used to track the number of miles swept and the amount of material removed is recorded.

UST and LUST Removal

TPCHD is currently overseeing the removal of USTs at the following property in this drainage basin (see Attachment A.1):

- UST at Erickson Autobody Repair/Hi Tech Erickson LLC located at 4006 Pacific Avenue. The permit expired in November 2022, but the site remains open at this time.

Notice of Violation and Warning Letters

One Warning letter was issued to the following party in this drainage basin in 2023:

- A warning letter was issued on December 13, 2023, to a Tacoma Resident at 5918 E “I” Street. The resident was notified of a sanitary sewage wastewater discharging from an RV on their property and was required to immediately cease discharge.

  A copy of this letter is included in Attachment A.5.

A.6 OUTFALL 243

A.6.1 OUTFALL 243 DRAINAGE BASIN

The OF243 drainage basin is 59 acres and discharges to the east side of the waterway at East 21st Street through a 42-inch outfall (see WY2023 Report, Figure 1-3). The storm drainage is carried in two main laterals, one south to north on East "D" Street from East 26th Street to East 21st Street and the second east to west on East 21st Street. The majority of runoff in this basin is from BNSF property and the portion of SR 509 between Portland Avenue and the Thea Foss Waterway. Land uses in the basin are primarily industrial, with some commercial at the west side of the basin and some highway with SR 509.

The outfall has a tide valve which was originally installed in 1999 then re-installed in 2001 when the outfall pipe was extended. In 2008, "D" Street was raised over the BNSF main line increasing the drainage area by half an acre. The stormwater runoff from the new half-acre is treated through a VortFilter unit which then discharges to OF243 through a new 15-inch pipe.

Baseflow from OF243 is continuous at approximately 0.4 cfs (see Appendix B, Table B2-2) and originates primarily from tidal backflushing. Sources of baseflow are discussed in more detail in Appendix B.

A.6.2 2002-2023 SOURCE CONTROL ACTIVITIES

Since 2002, significant work has been accomplished in the OF243 drainage basin, including removal of significant sources. A discussion of specific major source control activities is provided in the following paragraphs.

As part of the City-wide inspection program, four business inspections were completed in the OF243 drainage basin in 2022. Business inspections provide source control through education and through implementation of nonstructural BMPs. These actions help prevent materials from coming into contact with stormwater and help promote activities that reduce pollutants in stormwater.

Stormwater treatment devices currently in place also remove solids and the associated particulate-bound chemicals from stormwater. The locations of private and public stormwater treatment devices in the OF243 drainage basin are shown on Figures A-1a and A-1b, respectively. No new public or private treatment BMPs were installed in this drainage basin in 2023. With future re-development in the OF243 drainage basin, more onsite treatment systems will be installed, and over time they will help to decrease the solids load and the associated particulate-bound chemical load to the waterway.

A summary of pipe cleaning and maintenance projects completed in the OF243 drainage basin during 2023 is provided in Table A.6-1 of Attachment A.6.

Redevelopment of the Area

In 2002 and 2003, Pick's Cove Marina (now Foss Landing Marina) and American Plating were remediated. These sites were sources of mercury and bis(2-ethylhexyl) phthalate (DEHP) (Pick's Cove) and metals (American Plating). In addition, the "D" Street Grade separation/bridge was completed in 2008 and stormwater from the new impervious surfaces (0.49 acres) were routed through a treatment system.

SR 509 WSDOT Pond Black Oil/Tar Releases

Historically, black oil/tar emanating from the old Northern Pacific Rail yard oil pipeline was found in the SR 509 WSDOT stormwater treatment pond located within this drainage basin. In 2002, the pond was rebuilt to remediate the black oil/tar. In 2009, the pond was again remediated as directed by Ecology when the entire length of the Northern Pacific Rail yard oil pipeline along East "D" Street and East 19th Street was cleaned up.

Outfall 243 Mercury Source Tracing

Mercury has been found in the medium to high range of concentrations in all samples analyzed from FD23 since WY2002 (see WY2021 Report, Figure 2-1.1). Results have been in the medium range since WY2007, and the WY2018 concentration was 0.661 mg/kg, which was the highest concentration detected at this location since WY2006. The WY2019 concentration decreased to 0.2830 mg/kg.

Based on these results, a source control investigation was initiated in 2008. Stormwater sediment samples were collected at several locations in the basin and analyzed for Foss parameters. On May 28, 2009, four sediment samples were collected from portions of the system that represent independent and comingled branches of the storm sewer system. Mercury concentrations found in these samples (0.129-0.54 mg/kg) are comparatively similar to the mid-range of concentrations (yellow in color) as represented in Figure 2-1.1 with no likely point-source of mercury for any one of the branches.

Over the next ten years, the investigation continued, with a focus on the BNSF property and the WSDOT pond. Sources were not identified, but significant work was done on the BNSF and Land Recovery, Inc. (LRI) properties to clean and map their drainage systems. Detectable mercury was found but levels did not suggest a significant source.

In 2018, the City continued investigations in this drainage basin and conducted additional business inspections at BNSF, LRI, and Berg, the three main businesses discharging to the FD23 sediment trap. During the inspections, no signs of mercury contamination were discovered.

In 2019, while reviewing past investigations and the extent of the drainage basin, it was discovered that a small portion of this drainage basin was not included in previous investigations. The City sampled various catch basins in May 2019 throughout the previously un-sampled segment. The majority of the sampling results exhibited minimal concentrations of mercury with the exception of one catch basin with an elevated mercury concentration. Based on these results, a follow-up investigation took place in June 2019. Samples were collected from the gutter-lines discharging to the contaminated catch basin as well as the curb drains coming from the building. These sample results for mercury ranged from 1 mg/kg to 12.8 mg/kg, the highest of which came from the roof drain coming from 414 Puyallup Avenue. This roof drain was blocked with debris which allowed sediment buildup. The catch basin, curb-line, and roof drain were cleaned in October 2019.

The City re-sampled the catch basin that contained the elevated mercury concentration to determine whether this source has been successfully removed or if there is an ongoing mercury issue in this area. The catch basin sediment continued to exhibit elevated concentrations of mercury. During 2021, the City worked with the property owner to ensure the roof drains were adequately cleaned, and subsequently re-cleaned the catch basin and the curbline on October 8, 2021.

During 2022 staff re-sampled the identified catch basin to determine if there is an ongoing mercury issue at that location. The catch basin was sampled on June 21, 2022, and the results were 1.38 mg/kg. Catch basin concentrations continue to trend downward and there are no other probable sources to investigate at this location. During 2023, EC staff requested to have the catch basin re-cleaned and will re-sample after sediment accumulates to determine if there is a continued source or residual contamination from the previously remediated source.

While the FD23 sediment trap results showed a very slight uptick in mercury concentrations within the basin over the past year, concentrations have shown an overall decrease from 2018 to 2022. The 2018 sediment trap concentrations were 0.6610 mg/kg, which have decreased significantly in 2021 and 2022 with concentrations of 0.206 mg/kg and 0.214 mg/kg, respectively. During 2023 there was insufficient sediment to analyze for mercury. The analyte priority list has been updated to mercury as the top priority.

A copy of the OF243 Source Tracing Status Update – FD23 Mercury Investigation is included in Attachment A.6.

Enhanced Street Sweeping

In January 2007, the City's street sweeping program was transferred from the Streets and Grounds Division to the Sewer Transmission Maintenance Division for continued implementation. The program was enhanced at that time in an attempt to reduce sediment buildup in the storm sewer system. The schedule was set to sweep all areas of the City twice per year, with more frequent sweeping in the business districts and on major arterials. The City also increased communications with residents and business owners, which helped raise awareness of the importance of the street sweeping program.

In 2007, when the work was transferred over, sweeping was done with a combination of mechanical and vacuum sweepers. In 2008, the City started the transition from mechanical sweepers to regenerative air machines. At this point in the program, the City used four regenerative air sweepers. In mid-2018, due to the end of usable life of one of the City's regenerative air sweepers and a staff retirement, Tacoma temporarily reduced its street sweeping program. This resulted in Tacoma reducing the frequency of arterial sweeping to quarterly and residential streets to annually.

The City received a grant from Ecology in 2021 to purchase an additional street sweeper which will allow staff to return to the higher sweeping frequency. The new schedule increases the frequency of sweeping at arterials from every 12 weeks to every six weeks and increases residential sweeping to twice per year City-wide. The sweeper was purchased during 2021, however there were delivery delays, and the sweeper was not delivered until November 2022. After set-up and the addition of a water tank, operations of the new sweeper began in March 2023. GPS is used to track the number of miles swept and the amount of material removed is recorded.

Street Sweeping Pilot Project

OF243 and OF245 have shown somewhat elevated levels of lead and zinc in both stormwater and baseflow relative to other drains. It is theorized that this may be due to the increased amount of trucking in this industrial area. Based on these results, the City initiated a pilot program in WY2014 to determine whether an increased frequency of street sweeping in this area would have an effect on these results. Starting on October 1, 2013, the City began sweeping the ROW within the OF243 and OF245 drainage basins at a frequency of once every two weeks rather than the usual frequency of once per month for industrial areas.

The pilot project continued in WY2023 and has now become a permanent change in street sweeping frequency for this area. With several years of data available, statistical analysis of the effectiveness of this enhanced sweeping schedule was done for the first time in WY2017 and is included again in this report. Results will be more statistically robust as additional data becomes available. Results of this analysis are presented in Section 5 of the WY2023 Stormwater Monitoring Report.

UST and LUST Removal

TPCHD is currently overseeing the removal a UST at the following location in this drainage basin (see Attachment A.1):

- UST at Industrial Tire Service located at 423 Puyallup Avenue. Permits were renewed in July 2023.

Notice of Violation and Warning Letters

There were no Warning or Notice of Violation letters issued in this drainage basin in 2023.

A.7 OUTFALL 245

A.7.1 OUTFALL 245 DRAINAGE BASIN

The OF245 drainage basin is located in the Tideflats of Tacoma on the southern portion of the east side of the waterway. Basin boundaries are shown on Figure 1-3 in the WY2023 Report. The outfall is located at East 19th Street, just south of Johnny's Dock Restaurant. The drainage area is approximately 39 acres in size and the main trunkline of the storm drainage system extends east from the Thea Foss Waterway, down East 19th Street to East "I" Street.

Because of the low basin elevation, the entire storm system is influenced by saltwater at high tide. Baseflow from OF245 is continuous at approximately 0.1 cfs (see Appendix B, Table B2-2) and originates primarily from tidal backflushing. Sources of baseflow are discussed in more detail in Appendix B.

Land use in this basin is primarily industrial with the restaurants providing a small commercial area at the west side of the basin. Most facilities in the drainage basin are engaged in storage, transloading and warehousing of materials and products, and manufacturing.

Directly upstream of the outfall is a deep bottom sump manhole known as MH390 (see Appendix B, Figure B2-4). MH390 is 60 inches (inside diameter) and approximately 18 feet in depth, with the inlet pipe and outlet pipe at 55.5 inches above the bottom. A plastic tide gate (swing valve) is located on the inlet pipe. Even with the tide gate some tidal water can get into the upper reaches of the system. In fall 2004, the last 24 feet of pipe from MH390 to the waterway was replaced with HPDE. Drainage from MH390 was improved with the new slope of the outfall pipe, which replaced the old line that had a sag in it.

In August 2004, Tacoma replaced a 300-foot segment of the stormwater line and associated laterals in East 19th Street. This action sealed this segment from groundwater, sediment, and product migration from the surrounding contaminated soil that remained in place after an interim action remediation project was completed in this area.

Several of the businesses in the area not only discharge stormwater to OF245, but also discharge stormwater to adjacent outfalls, OF248 and OF249. Source control activities for all these basins are discussed in the following subsections.

A.7.2 2002-2023 SOURCE CONTROL ACTIVITIES

Since 2002, significant work has been accomplished in the OF245 drainage basin, including removal of significant sources. A discussion of major source control activities associated with these areas is provided in the following paragraphs.

As part of the City-wide inspection program, one business inspection was completed in the OF245/OF248 drainage basin in 2023. Business inspections provide source control through education and through implementation of non-structural BMPs. These actions help prevent materials from coming into contact with stormwater and help promote activities that reduce pollutants in stormwater.

Stormwater treatment devices currently in place also remove solids and the associated particulate-bound chemicals from stormwater. The locations of private and public stormwater treatment devices in Basins 245/248/249 are shown on Figures A-1a and A-1b, respectively. No new public or private treatment BMPs were installed in this drainage basin in 2023. With future redevelopment in the OF245 drainage basin, more of these onsite treatment systems will be installed and over time they will help to decrease the solids load and the associated particulate-bound chemical load to the waterway.

A summary of pipe cleaning and maintenance projects completed in the OF245/248 drainage basins during 2023 is provided in Table A.7-1 of Attachment A.7.

MH390/Outfall 245 Black Oil/Tar Releases

At the beginning of the monitoring program, black oil and tar-blobs were observed seeping into the storm drains through joints and cracks. Before the extent of the contamination was understood, Tacoma completed three maintenance projects (two line replacements and one re-lining) to alleviate this issue. After these projects were complete, seeps continued to leak into the storm drain system. Further investigations found contamination along the entire length of the old Northern Pacific Rail yard oil pipeline area along East “D” Street and East 19th Street. Ecology ordered remediation of the pipeline in 2008 and 2009. During this period, five UST/LUSTs were also removed or filled.

After completion of all these activities, oil-absorbent snares placed in the storm lines remained clean. Use of the oil snares in this basin was discontinued in 2010.

Former MPS Site Investigation

OF245 (as evidenced by sediments in MH390) exhibited a notably different phthalate composition in the stormwater sediments in comparison to other outfalls and has relatively higher concentrations of butylbenzylphthalate. This difference is much less pronounced when looking at only the last five years of data. Early in the monitoring program, butylbenzylphthalate concentrations in OF245 were among the highest of any reported phthalates (see Tables 3-3.1 and 3-3.2 and boxplots in Appendix F of the WY2023 Report), although levels are much reduced at this time. WY2012 through WY2019 SSPM results for FD21 and WY2012 through WY2023 results for MH390 showed that phthalates were in the low range, while for FD22 they were in the medium range in WY2013 but returned to the low range in WY2014 and have remained there since that time. FD21 was removed after WY2019.

This site has operated under the name of MPS, Quality Transport, Inc., and currently as Truck-Rail Handling, Inc. In 1997 and in 2000, Quality Transport, Inc., the owner at the time, cleaned a majority of their system with no effect on the sediment trap phthalate concentrations downstream of their facility. Average total phthalate concentrations show a peak in WY2003 with a decline in stormwater and baseflow chemistry in WY2004 and WY2005 (see WY2023 Report, Figure 5-1.6). Baseflow concentrations appeared to remain generally stable between WY2005 and WY2011[4], while stormwater concentrations decreased or remained stable until WY2014, with slight intermittent increases in subsequent years.

Because of the intermittent medium to high SSPM concentrations at FD22 until WY2013, this site was referred to Ecology and TPCHD for follow-up while the City continued to monitor the site for wastewater discharges. The site was re-mapped in 2012 as a result of that work. Through that mapping and inspection effort, the presence of a dry well was identified onsite. Additional follow up from all involved agencies is needed to fully assess the operations and site

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[4] Baseflow monitoring was discontinued in WY2011 since baseflow was well characterized.

conditions at this property. Joint inspections at the property have occurred and follow-up actions were required. While some work was completed in 2015, there were delays in fully addressing the environmental concerns due to issues with 'in-lieu of' assessment fees.

In 2016, City EC staff revisited the site, now operating as Truck-Rail Handling, Inc., along with the City's wastewater pretreatment permit manager, to conduct an additional in-depth inspection and collect additional samples. Several issues with both the wastewater and stormwater systems on the site were identified. While many of these issues were successfully resolved during 2016, the City continues to work with the property owner to develop and implement a long-term maintenance plan for the facility, site BMPs, and an accurate map of the private stormwater and wastewater systems to prevent future discharges of contaminants from the site. With decreased phthalate levels in the sediment traps, it appears that efforts to date have been effective in addressing the issues at this site. The City will continue coordination with the property owner, and sediment traps will continue to be monitored for now to ensure that levels remain at the reduced levels.

Petroleum Spills in Basins 245, 248, and 249

One of the trucking warehouses in the basin, SuperValu, was fined for repeated petroleum spills to the waterway in 2007 through OF245, OF248, and OF249. As a result, they are under an order from Ecology to implement BMPs. In 2010, SuperValu installed three oil/water separators and have implemented spill response BMPs as required by Ecology. Another oil/water separator was installed in 2011. In 2013, SuperValu installed a StormFilter treatment system on their property. These actions should reduce contributions of total petroleum hydrocarbons and other petroleum-related chemicals from this facility.

As a result of several inspections performed at the site in recent years, SuperValu reached a settlement with the EPA under which it was issued a penalty in 2015 of $120,000 in part for violations at two sites discharging to the Thea Foss Waterway through OF248 and OF249. The enforcement action was based on SuperValu's failure to comply with the conditions of their NPDES Permit.

Anhydrous Ammonia Spill in Basin 245

On June 7, 2017, there was a spill of anhydrous ammonia at the SuperValu site in this drainage basin. The release resulted from a leak from a valve and piping of a system used to keep a food warehouse refrigerated. When the leak was discovered by the business owner, the leak was isolated by closing valves upstream and downstream of the leak site. The leaking ammonia valve was connected, via a hose, outside the facility to allow the charged pipe to purge the leaking ammonia. Purging the ammonia was necessary to allow repair to the leaking valve. The ammonia purge hose was connected to a mixing valve which was also connected to a water source. The ammonia and water were then mixed and allowed to flow over an asphalt parking lot to an onsite storm drain. The storm drain is connected to an oil water separator and then to a sand filter designed to remove oil and zinc. After the water and ammonia mixture flowed through the sand filter, the solution was discharged directly to the City of Tacoma storm sewer which leads to MH390 and OF245. The volume of discharged ammonia and/or ammonia/water solution was estimated at 24 gallons, but the amount entering the waterway is unknown. The system was pumped to remove solids and liquids from the drainage system.

Enhanced Street Sweeping

In January 2007, the City's street sweeping program was transferred from the Streets and Grounds Division to the Sewer Transmission Maintenance Division for continued implementation. The program was enhanced at that time in an attempt to reduce sediment buildup in the storm sewer system. The schedule was set to sweep all areas of the City twice per year, with more frequent sweeping in the business districts and on major arterials. The City also increased communications with residents and business owners, which helped raise awareness of the importance of the street sweeping program.

In 2007, when the work was transferred over, sweeping was done with a combination of mechanical and vacuum sweepers. In 2008, the City started the transition from mechanical sweepers to regenerative air machines. At this point in the program, the City used four regenerative air sweepers. In mid-2018, due to the end of usable life of one of the City's regenerative air sweepers and a staff retirement, Tacoma temporarily reduced its street sweeping program. This resulted in Tacoma reducing the frequency of arterial sweeping to quarterly and residential streets to annually.

The City received a grant from Ecology in 2021 to purchase an additional street sweeper which will allow staff to return to the higher sweeping frequency. The new schedule increases the frequency of sweeping at arterials from every 12 weeks to every six weeks and increases residential sweeping to twice per year City-wide. The sweeper was purchased during 2021, however there were delivery delays, and the sweeper was not delivered until November 2022. After set-up and addition of a water tank, operations of the new sweeper began in March 2023. GPS is used to track the number of miles swept and the amount of material removed is recorded.

Street Sweeping Pilot Project

OF243 and OF245 have shown somewhat elevated levels of lead and zinc in both stormwater and baseflow relative to other drains. It is theorized that this may be due to the increased amount of trucking in this industrial area. Based on these results, the City initiated a pilot program in WY2014 to determine whether an increased frequency of street sweeping in this area would have an effect on these results. Starting on October 1, 2013, the City began sweeping the ROW within the OF243 and OF245 drainage basins at a frequency of once every two weeks rather than the usual frequency of once per month for industrial areas.

The pilot project continued in WY2023 and has now become a permanent change in street sweeping frequency for this area. With several years of data available, statistical analysis of the effectiveness of this enhanced sweeping schedule was done for the first time in WY2017 and is included again in this report. Results will be more statistically robust as additional data becomes available. Results of this analysis are presented in Section 5 of the WY2023 Stormwater Monitoring Report.

UST and LUST Removal

There were no active UST or LUST permits in this drainage basin during 2023 (see Attachment A.1):

Notice of Violation and Warning Letters

There were no Warning or Notice of Violation letters issued in this drainage basin in 2023.

A.8 OUTFALL 254

A.8.1 OUTFALL 254 DRAINAGE BASIN

The OF254 drainage basin is located on the Tideflats and is the fifth largest basin in the Foss Waterway Watershed (see WY2023 Report, Figure 1-3). It is approximately 119 acres and drains through a 42-inch outfall pipe located at the head of the Wheeler-Osgood Waterway on East “F” Street just north of East 15th Street. The drainage area includes East 15th Street from East “D” Street to St. Paul Avenue, East “J” Street from East 15th Street to the 1600 block, and St. Paul Avenue from East 11th Street to Portland Avenue.

The majority of the OF254 drainage basin is zoned for industrial use, but small commercial areas are present near the shoreline.

Because of the low basin elevation, the entire storm system is influenced by saltwater at high tide. Baseflow from OF254 is continuous at approximately 0.4 cfs (see Appendix B, Table B2-2) and originates primarily from tidal backflushing. Sources of baseflow are discussed in more detail in Appendix B.

Several of the businesses in the area not only discharge stormwater to OF254 but also discharge stormwater to adjacent northern outfalls, OF207, OF214, and OF218 (See Figure 2-2 in WY2023 Report). Source control activities for all these basins are discussed in the following subsections.

A.8.2 2002-2023 SOURCE CONTROL ACTIVITIES

Since 2002, significant work has been accomplished in the OF254 drainage basin, including intense business inspections, complete line cleaning, and identification and removal of point sources. A discussion of specific major source control activities is provided in the following paragraphs.

As part of the City-wide inspection program, nine business inspections were completed in the OF254 drainage basin in 2023. In addition, one business inspection was completed in the OF207 drainage basin, two inspections were completed in the OF214 drainage area, and twelve inspections were completed in the OF218 drainage area. Business inspections provide source control through education and through implementation of nonstructural BMPs. These actions help prevent materials from coming into contact with stormwater and help promote activities that reduce pollutants in stormwater.

Stormwater treatment devices currently in place also remove solids and the associated particulate-bound chemical from stormwater. The locations of private and public stormwater treatment devices in the OF254 drainage basin are shown on Figures A-1a and A-1b, respectively. No new public or private treatment BMPs were installed in this drainage basin in 2023. With future redevelopment in the basin, more onsite treatment systems will be installed and over time they will help to decrease the solids load and the associated particulate chemical load to the waterway.

A summary of pipe cleaning and maintenance projects completed in the OF254 drainage basin during 2023 is provided in Table A.8-1 of Attachment A.8.

Storm System Cleaning

Between January and June 2006, the entire storm sewer system in the OF254 drainage basin was cleaned, including laterals and catch basins. Sweeping and installation of onsite treatment systems are expected to reduce the solids load and associated PAHs load to the waterway.

Since the time of the complete cleaning of the OF254 basin, additional cleaning has been performed in the basin in isolated areas. These cleaning and video inspection activities have been done for a variety of reasons, including areas identified as needing maintenance through the STRAP program, complaints, and business inspection follow ups.

Northern Pacific Rail Yard Oil Pipeline and Standard Oil Site Cleanup

A possible source of PAHs in the OF254 drainage basin may have been associated with the Northern Pacific Rail yard oil pipeline area along East "D" Street to the old Standard Oil site. In 2009, the Northern Pacific Rail yard oil pipeline area along East "D" Street and East 19th Street was remediated as directed by Ecology. In 2010, the final phase of this cleanup within the OF254 drainage basin was completed. Ecology provided oversight of this remediation project.

Northwest Detention Center DEHP Investigation

The Northwest Detention Center (NWDC, formerly known as INS), a private immigration-related prison, was constructed at the former Hygrade Meat site. Previous sediment results collected from the City's storm system showed that NWDC was a point source of DEHP. In WY2006 through WY2008, DEHP was found in the inlet pipe to the stormwater pond at concentrations up to 790,000 µg/kg.

In 2009, NWDC was remodeled, and media filtration stormwater treatment devices were installed. In 2010, Tacoma confirmed that the DEHP-laden sediments were retained in the stormwater treatment devices. DEHP was less than 1,500 µg/kg immediately downstream in the City system. However, DEHP-laden sediment remained at levels up to 2.7M µg/kg in one part of the private drainage. Further sampling and source tracing identified one source of the DEHP to be laundry lint that accumulated on the open ground and eventually washed into the private storm drain system. Filters were placed in the catch basins, and EC required the property owner to provide regular maintenance of these devices. In 2012, inspectors returned to the facility for the annual inspection and found the filters to be impacted. The City submitted a corrective action letter and subsequently confirmed compliance during a follow-up inspection. During facility inspections in 2013, it was found that the filters continued to be impacted but the stormfilter system appeared to be effective in keeping the material on site. It was also determined that the lint collection system had not been properly installed. This system has now been repaired. Inspections performed at the site in 2015 indicated that the filters were continuing to be properly maintained and no concerns were noted. Annual inspections will continue, however, at this time it appears that NWDC has a good maintenance plan and is following their operation and maintenance requirements.

Outfall 254 Source Tracing

In response to the somewhat elevated levels of total suspended solids (TSS) and zinc in stormwater in this area, the City conducted a concentrated source control effort in the OF254 drainage basin. This is a highly industrial area and many of the businesses here do not have paved yards with private collection systems, which leads to high amounts of track out onto the public ROW in the OF254 drainage basin.

In 2019, the City did an initial visual assessment of the drainage basin, noting which businesses had unpaved driveways and storage yards, as well as which businesses appeared to have the possibility of contributing contaminants to the municipal stormwater system. Inspections were completed in 2020 at identified businesses, and all passed with no issues noted. This area will continue to be evaluated over time to determine whether increased street sweeping leads to a reduction in TSS and zinc in the stormwater.

In January 2020, the City increased street sweeping in a portion of this basin to help limit the amount of sediment entering the municipal stormwater system. During 2023, the City continued with enhanced street sweeping in this basin.

Baseflow Quality in WY2007 and WY2008

In two different years for several different chemicals, baseflow quality was above average. In WY2008 (Year 7), TSS and DEHP were detected at higher concentrations in the dry weather events, well above all the other years (see boxplots in Appendix G in the WY2012 Report). In WY2007 (Year 6), lead was detected at higher concentrations in the dry weather events, well above all the other years (see boxplots in Appendix G in the WY2012 Report). The dry-weather DEHP and lead concentrations for those years were at the same levels as the average stormwater concentrations for OF254. In contrast, these TSS baseflow concentrations were well below TSS stormwater concentrations. The source of the dry-weather concentrations is unknown. These concentrations were not repeated in the following baseflow monitoring years, WY2009 through WY2011.

Enhanced Street Sweeping

In January 2007, the City's street sweeping program was transferred from the Streets and Grounds Division to the Sewer Transmission Maintenance Division for continued implementation. The program was enhanced at that time in an attempt to reduce sediment buildup in the storm sewer system. The schedule was set to sweep all areas of the City twice per year, with more frequent sweeping in the business districts and on major arterials. The City also increased communications with residents and business owners, which helped raise awareness of the importance of the street sweeping program.

In 2007, when the work was transferred over, sweeping was done with a combination of mechanical and vacuum sweepers. In 2008, the City started the transition from mechanical sweepers to regenerative air machines. At this point in the program, the City used four regenerative air sweepers. In mid-2018, due to the end of usable life of one of the City's regenerative air sweepers and a staff retirement, Tacoma temporarily reduced its street sweeping program. This resulted in Tacoma reducing the frequency of arterial sweeping to quarterly and residential streets to annually.

The City received a grant from Ecology in 2021 to purchase an additional street sweeper which will allow staff to return to the higher sweeping frequency. The new schedule increases the frequency of sweeping at arterials from every 12 weeks to every six weeks and increases residential sweeping to twice per year City-wide. The sweeper was purchased during 2021, however there were delivery delays, and the sweeper was not delivered until November 2022. After set-up and addition of a water tank, operations of the new sweeper began in March 2023. GPS is used to track the number of miles swept and the amount of material removed is recorded.

Street Sweeping Pilot Project

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UST and LUST Removal

TPCHD is currently overseeing the removal of one UST in the drainage basin (see Attachment A.1):

- UST at Rainier Plywood located at 624 15th Street East. Contaminated soils and contaminated groundwater are present at the site and monitoring wells are in place. The permit was renewed in October 2023 and remains active at this time.

Notice of Violation and Warning Letters

The following two warning letters and one Notice of Violation was issued during 2023 for the OF218 drainage basin.

- A Warning Letter was issued to Jackson Energy located at 510 East 3rd Street to an illicit discharge to the stormwater system on March 7, 2023. Recent fill and grad work caused turbid water to flow off the property and impact the storm system. A second warning letter was issued on June 30, 2023, for additional track out and turbid water discharges. The site was issued corrective actions to fix the site entrance to prevent track out and to regularly monitor to ensure track out and turbid water does not leave the site.

- A Notice of Violation was issued to Capital Lumber Company located at 304 E “F” Street for prohibited discharge of silt and sediment laden stormwater to the municipal stormwater system. The event occurred on April 10, 2023, and the letter was issued on April 14, 2023.

ATTACHMENT A.1 - CITYWIDE

Table A.1-1

Thea Foss Waterway New Treatment Device Information by Outfall

Outfall Location	Subbasin	Date	Approved Permits	Land Use	Address	Treatment Device	Owned By
237A	FS_01	4/1/2023	SDEV22-0173	SINGLE FAMILY DWELLING	2911 S PUGET SOUND AVE	Dry Well	Private
237A	FS_02	11/1/2023	SDEV21-0327	COMM VAC LAND	2 CHELAN PL	Infiltration	Private
237A	FS_02	11/1/2023	SDEV21-0327	COMM VAC LAND	2 CHELAN PL	Infiltration	Private
237A	FS_02	11/1/2023	SDEV21-0327	COMM VAC LAND	2 CHELAN PL	Infiltration	Private
237A	FS_03	7/1/2023	SDEV21-0310	VAC INDUSTRIAL LAND	1950 S STATE ST	Detention	Private
230A	FS_05	1/1/2023	SDEV20-0288	MULTI FAM HIGH RISE 5 UNITS OR MORE	1909 FAWCETT AVE	OWS	Private
237A	FS_09	11/1/2023	SDEV20-0469	MULTI FAM APTS 5 UNITS OR MORE	3639 S G ST	Infiltration	Private
237A	FS_09	11/1/2023	SDEV20-0469	MULTI FAM APTS 5 UNITS OR MORE	3639 S G ST	Perk Filter	Private
237A	FS_09	11/1/2023	SDEV20-0469	MULTI FAM APTS 5 UNITS OR MORE	3639 S G ST	Stormfilter	Private
237A	FS_09	11/1/2023	SDEV20-0469	MULTI FAM APTS 5 UNITS OR MORE	3639 S G ST	Stormfilter	Private
237B	FS_10	11/1/2023	SDEV19-0167	GOVERNMENTAL SERVICES	3580 PACIFIC AVE	Bioretention	Private
237B	FS_10	11/1/2023	SDEV19-0167	GOVERNMENTAL SERVICES	3580 PACIFIC AVE	Bioretention	Private
237B	FS_10	11/1/2023	SDEV19-0167	GOVERNMENTAL SERVICES	3580 PACIFIC AVE	Bioretention	Private
237B	FS_10	11/1/2023	SDEV19-0167	GOVERNMENTAL SERVICES	3580 PACIFIC AVE	Bioretention	Private
237B	FS_10	11/1/2023	SDEV19-0167	GOVERNMENTAL SERVICES	3580 PACIFIC AVE	Bioretention	Private
237B	FS_11	10/1/2023	SDEV21-0297	COMM VAC LAND	7624 TO 7626 PACIFIC AVE	Infiltration	Private
237B	FS_11	10/1/2023	SDEV21-0297	COMM VAC LAND	7624 TO 7626 PACIFIC AVE	Infiltration	Private
237B	FS_11	10/1/2023	SDEV21-0297	COMM VAC LAND	7624 TO 7626 PACIFIC AVE	Infiltration	Private
237B	FS_11	10/1/2023	SDEV21-0297	COMM VAC LAND	7624 TO 7626 PACIFIC AVE	Infiltration	Private
237B	FS_11	4/1/2023	SDEV22-0119	SINGLE FAMILY DWELLING	7005 E D ST	Infiltration	Private
237B	FS_11	4/1/2023	SDEV22-0120	SINGLE FAMILY DWELLING	7001 E D ST	Infiltration	Private
237B	FS_11	4/1/2023	SDEV21-0491	SINGLE FAMILY DWELLING	607 E 68TH ST	Dispersion	Private
237B	FS_11	11/1/2023	WO19-0107	ROW	3580 Pacific Ballasted SW	Infiltration	Public
237B	FS_11	2/1/2023	WO22-0016	ROW	402 E 70th	Biopod	Public

Figure A-1a
Private Treatment Facilities in the Thea Foss Watershed

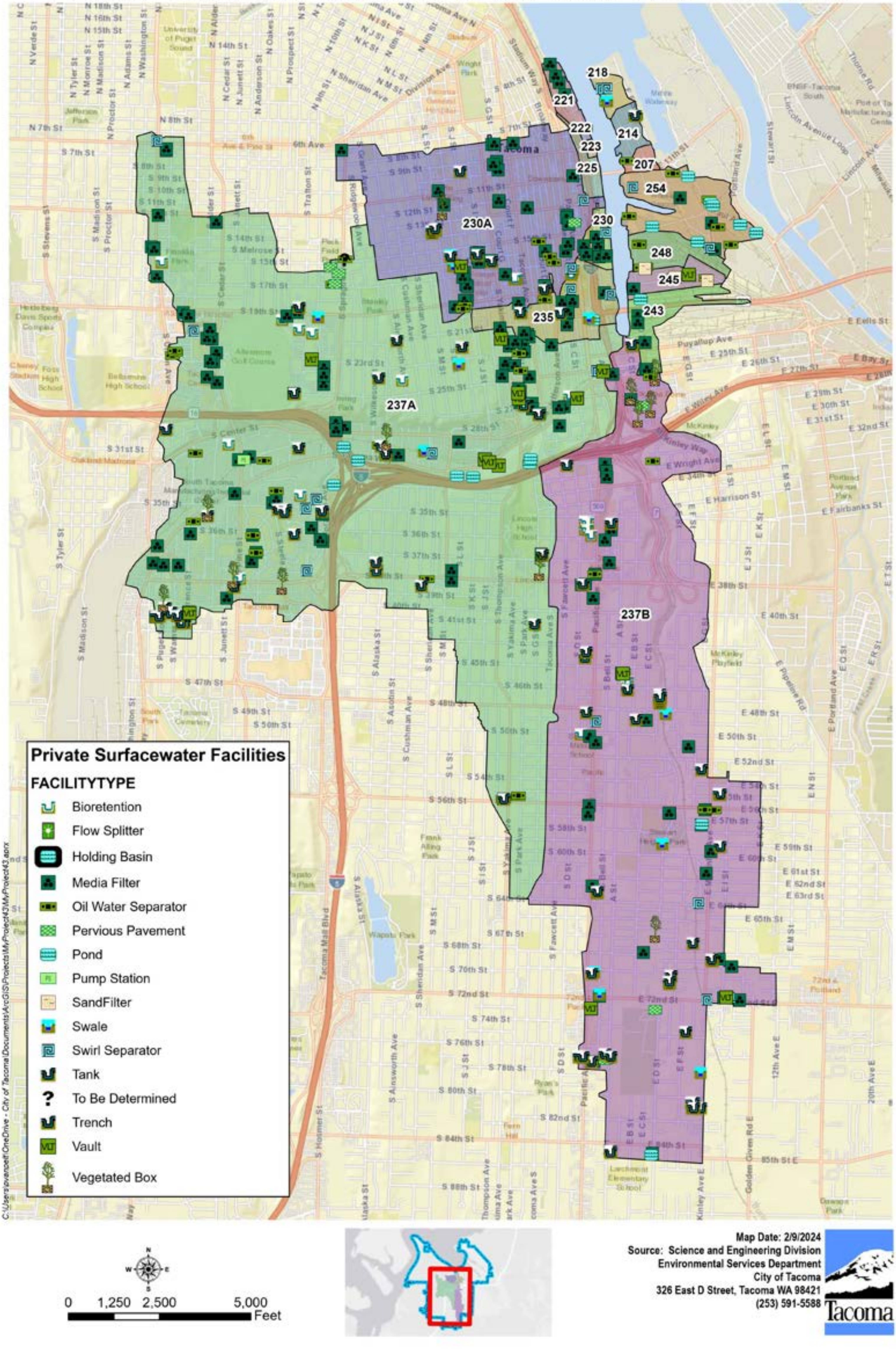
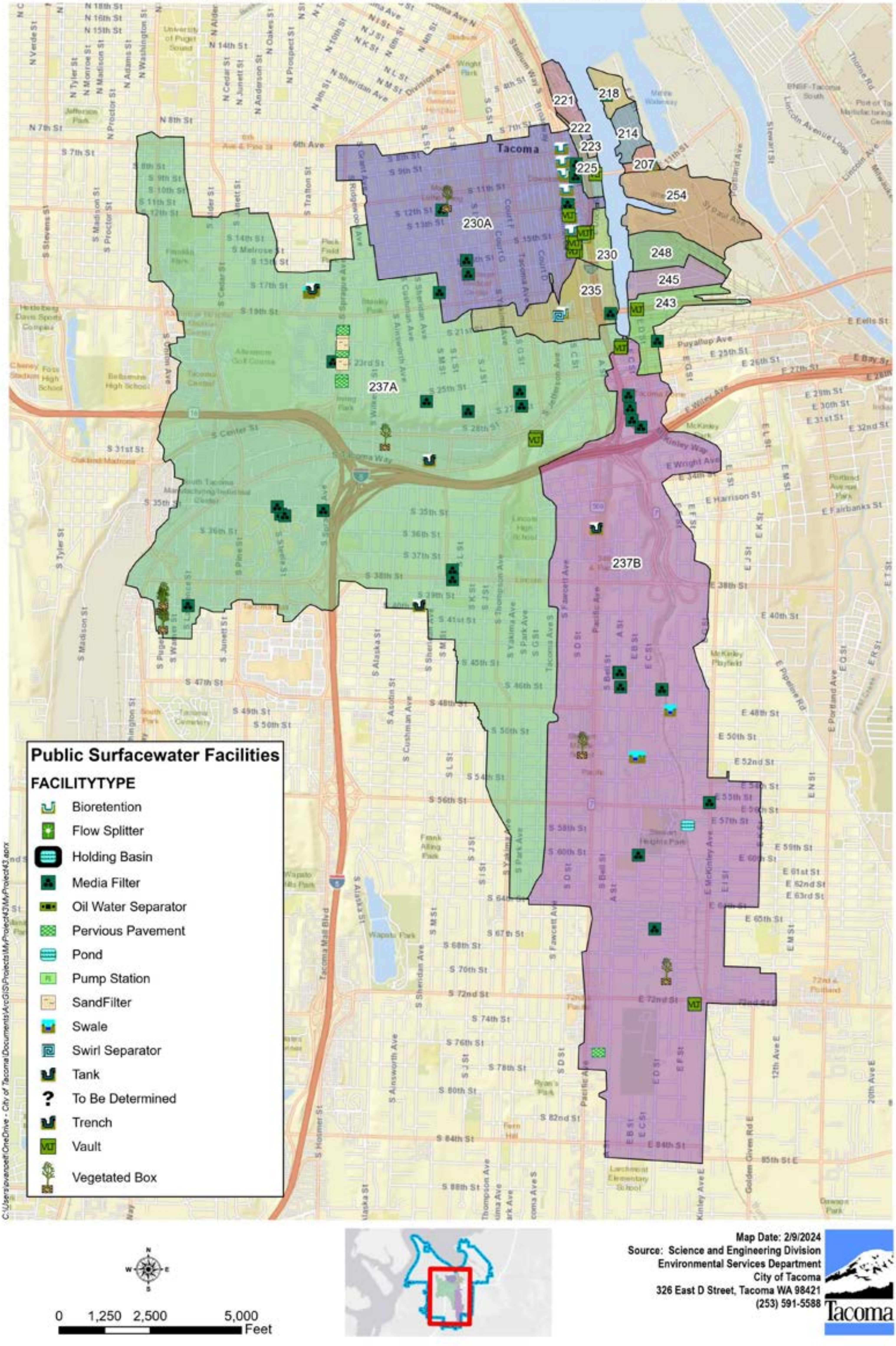


Figure A-1b
Public Treatment Facilities in the Thea Foss Watershed



Memorandum

To: Laura Nokes

From: AMG

Date: January 2024

Re: Foss Business Inspections and Spills/Complaints from 2023

Below are the summary tables for the 2023 Business Inspections and Spills/Complaints that took place in the Thea Foss drainage basin.

	Business inspections	Spills/Complaints
Foss Drainage Basin	177	217
Citywide	475	790

2021 Foss business inspections	
Outfall	**# of inspections**
237A	100
237B	22
207	1
218	7
222	0
223	0
225	0
230	1
230A	22
235	9
241	1
243	4
245	0
248	1
254	9
Total	177

2023 Thea Foss Drainage Area Business Inspections

Outfall	Inspection Date	Company Name	Address
207	8/30/2023	DEGESCH	501 E 11TH ST
218	5/18/2023	CASCADE CAPITAL	202 E F ST
218	9/15/2023	CASCADE CAPITAL	202 E F ST
218	9/25/2023	CASCADE CAPITAL	202 E F ST
218	12/29/2023	CASCADE CAPITAL	202 E F ST
218	6/22/2023	COT SPECIAL PROJECTS GROUP	303 E D ST
218	8/21/2023	JACKSON ENERGY	510 E 3RD ST
218	12/15/2023	JACKSON ENERGY	510 E 3RD ST
230	2023-01-06	COLONIAL FRUIT & PRODUCE	1179 DOCK ST
235	1/6/2023	ESPLANADE PARKING	2101 DOCK ST
235	9/13/2023	GAS LAMP TERRACES HOA	2101 S G ST
235	10/23/2023	SEVEN SEAS BREWERY	2101 JEFFERSON AVE
235	4/24/2023	LIVING TAP ROOM	2101 S C ST
235	6/12/2023	STONEWAY ELECTRIC SUPPLY	1914 MARKET ST
235	3/28/2023	UNION STATION FEDERAL COURTHOUSE	1717 PACIFIC AVE
235	7/20/2023	INCLINE CIDER HOUSE	2115 S C ST
235	3/29/2023	CAMP COLVOS BREWING	2104 COMMERCE ST
235	6/7/2023	BLAZE PLAYS RETRO GAMES	1939 S I ST
243	5/11/2023	BNSF RAILWAY	610 E 21ST ST
243	3/29/2023	FOSS LANDING MARINA & BOAT STORAGE	1940 E D ST
243	7/21/2023	BERG EQUIPMENT SCAFFOLDING CO	2130 E D ST
243	11/3/2023	INDUSTRIAL TIRE SERVICE	423 PUYALLUP AVE
245	3/27/2023	FNS, INC.	495 E 19TH ST
248	9/13/2023	SPINNING HEADS INC	420 E 18TH ST
254	3/31/2023	AIRVAN NORTH AMERICAN	1519 ST PAUL AVE
254	10/30/2023	NORTHWEST PROCESSING CENTER	1623 E J ST
254	10/27/2023	FEED COMMODITIES LLC	2006 E PORTLAND AVE
254	5/4/2023	TACOMA MARINE REPAIR	1100 ST PAUL AVE
254	9/25/2023	TACOMA MARINE REPAIR	1100 ST PAUL AVE
254	9/14/2023	TRI PAK YARD #5	540 E 15TH ST
254	3/28/2023	NESS & CAMPBELL	426 E 11TH ST
254	3/31/2023	ROADTEX	1519 ST PAUL AVE
254	10/26/2023	AQUAGGA, INC	1118 E D ST
230A	9/28/2023	COT BEACON SENIOR CENTER	415 S 13TH ST
230A	3/29/2023	COT POLICE SECTOR ONE - CENTRAL	1524 MARTIN LUTHER KING JR WAY
230A	5/8/2023	FUJIYA JAPANESE RESTAURANT	1120 BROADWAY
230A	3/6/2023	SHELL FOOD MART	1901 MARTIN LUTHER KING JR WAY
230A	11/3/2023	ST. JOSEPH HOSPITAL	1708 S J ST
230A	9/22/2023	TROGER AWNING COMPANY	1722 TACOMA AVE S
230A	9/26/2023	COMMERCE BUILDING	923 COMMERCE ST
230A	5/11/2023	CLIFF STREET LOFTS	1119 A ST
230A	9/12/2023	SPARK PARK	745 COMMERCE ST
230A	9/13/2023	THE PROVIDENT BUILDING AKA THE SECURITY BLDG.	913 TO 919 PACIFIC AVE

230A	3/2/2023	SEA MAR COMMUNITY HEALTH CENTER	1516 S 11TH ST
230A	9/26/2023	PUGET SOUND FAMILY HEALTH AND APOTHECARY	702 A ST
230A	7/31/2023	ODD OTTER BREWING COMPANY	714 TO 716 PACIFIC AVE
230A	9/12/2023	MLK NEW LOOK LLC	1119 S 11TH ST
230A	9/13/2023	THE BROKEN SPOKE	1014 MARTIN LUTHER KING JR WY
230A	3/17/2023	DRIP HOUSE COFFEE	1901 MARTIN LUTHER KING JR WAY
230A	6/1/2023	DRIP HOUSE COFFEE	1901 MARTIN LUTHER KING JR WAY
230A	3/2/2023	SEA MAR COMMUNITY HEALTH CLINIC	1112 S CUSHMAN AVE
230A	3/28/2023	MARRIOT HOTEL	1538 COMMERCE ST
230A	3/2/2023	STAR AUTOMOTIVE SERVICE	1216 MARTIN LUTHER KING FR WAY
230A	7/6/2023	APIZZA LITTLE ITALY	821 TO 823 PACIFIC AVE
230A	7/20/2023	THE VAULT CATERING CO	1316 MARTIN LUTHER KING JR WAY
237A	11/9/2023	COT ASPHALT PLANT	3010 CENTER ST
237A	3/31/2023	COT FLEET SERVICES	3639 S PINE ST
237A	6/14/2023	COT FLEET SERVICES	3639 S PINE ST
237A	11/17/2023	COT POLICE HEADQUARTERS	3639 S PINE ST
237A	3/3/2023	COT PUBLIC WORKS - MATERIALS LAB	2311 S HOLGATE ST
237A	6/27/2023	ADVANCED AUTO PARTS	3735 S PINE
237A	6/28/2023	DAFFODIL STORAGE	3501 S 38TH ST
237A	5/2/2023	MCDONALD'S #4449	2916 S 38TH ST
237A	9/12/2023	MCDONALD'S #4449	2916 S 38TH ST
237A	9/18/2023	PEPSI BOTTLING GROUP	3101 S PINE ST
237A	3/30/2023	PETROCARD - LAWRENCE	3101 S LAWRENCE ST
237A	5/4/2023	U.S. POST OFFICE	3825 S WARNER ST
237A	9/11/2023	VINTAGE AT TACOMA	4023 S LAWRENCE ST
237A	10/2/2023	1550 UNION MEDICAL BUILDING	1550 S UNION AVE
237A	5/10/2023	POOLE'S CORNER COMMERCIAL COMPLEX	3518 6TH AVE
237A	10/16/2023	HAMMONDKNOLL	3320 S G ST
237A	9/13/2023	CITYVIEW TOWNHOMES	2145 S G ST
237A	5/11/2023	CITYSTEPS CONDOS	2100 S YAKIMA
237A	11/14/2023	R&R FOUNDATION SPECIALISTS	2718 PACIFIC AVE
237A	11/3/2023	EAGLE TIRE & AUTOMOTIVE	102 PUYALLUP AVE
237A	4/10/2023	SUPERIOR TANK LINES	1112 CENTER ST
237A	4/20/2023	SUPERIOR TANK LINES	1112 CENTER ST
237A	5/9/2023	SUPERIOR TANK LINES	1112 CENTER ST
237A	8/31/2023	FRANCISCAN EDUCATION & SUPPORT CENTER	2420 S STATE ST
237A	7/17/2023	MCCARVER VILLAGE	2434 YAKIMA CT
237A	11/20/2023	V R ROOFING	2920 S CUSHMAN AVE
237A	9/11/2023	YELLOW CAB COMPANY	3101 S 36TH ST
237A	6/12/2023	NORTHWEST ETCH TECHNOLOGY INC	2601 S HOOD ST
237A	3/22/2023	PERFORMANCE RADIATOR	2667 SOUTH TACOMA WY
237A	3/29/2023	ANTHONY TRUCK REPAIR	3202 S 36TH ST

237A	8/3/2023	MCGUIRE BEARING CO	915 CENTER ST
237A	6/27/2023	VANGARD EVENTS WORKSHOP	2342 JEFFERSON AVE
237A	5/15/2023	TACOMA 35TH STREET, LLC	3303 S 35TH ST
237A	9/28/2023	FRANCO FISH PRODUCTS INC	2544 FAWCETT AVE
237A	9/11/2023	UNION MACHINE	3721 S LAWRENCE ST
237A	7/5/2023	ADVANCED BEHAVIORAL MEDICINE	2013 S 19TH ST
237A	11/3/2023	BUTTON VETERINARY HSP INC	2909 S M ST
237A	9/21/2023	HSUSHI YEH M.D., P.S.	1307 S UNION AVE
237A	9/22/2023	THE MEDICAL PLAZA	2411 S 19TH ST
237A	10/17/2023	THE MEDICAL PLAZA	2411 S 19TH ST
237A	9/22/2023	ARTISTIC PLASTIC SURGERY	3515 S 15TH ST
237A	3/29/2023	CREATIVE ORNAMENTAL IRON INC	3211 S 36TH ST
237A	3/16/2023	7 ELEVEN 38699	2631 S 38TH ST
237A	9/28/2023	CLASSIC MARBLE INTERIORS, INC.	2526 FAWCETT AVE
237A	9/18/2023	NORTHWEST & CAPITAL AUTO SALES	3010 SOUTH TACOMA WY
237A	11/9/2023	CORPORATE CASEWORK	3033 S LAWRENCE ST
237A	11/20/2023	AMB TOOLS & EQUIPMENT	1215 CENTER ST
237A	11/17/2023	SUPER SAW & SUPPLY INC	2712 PACIFIC AVE
237A	11/17/2023	REALITY HOME INC.	2720 S J ST
237A	9/11/2023	SHERWIN WILLIAMS CO #8088	3802 S CEDAR ST
237A	3/29/2023	BAYVIEW RECOVERY	2156 PACIFIC AVE
237A	9/21/2023	ALLENMORE TERRACE OFFICE PARK	3315 S 23RD ST
237A	6/12/2023	OFFICE DEPOT #894	3330 S 23RD ST
237A	7/5/2023	VISITING ANGELS	1401 S UNION AVE
237A	9/22/2023	MULTICULTURAL CHILD AND FAMILY CENTER	2021 S 19TH ST
237A	6/12/2023	EZ FOOD STORE	2728 S 12TH ST
237A	9/14/2023	GLORIA DEI LUTHERAN CHURCH	3315 S 19TH ST
237A	9/14/2023	YORK ENTERPRISES LLC	3517 S 13TH ST
237A	9/18/2023	PPG PAINTS	2719 SOUTH TACOMA WY
237A	3/29/2023	GOODWILL	3121 S 38TH ST
237A	7/10/2023	NORTHWEST AUTOLOAN	3718 SOUTH TACOMA WY
237A	7/18/2023	CRISP GREENS	3602 6TH AVE
237A	9/15/2023	TACOMA RESCUE MISSION/JEFFERSON SQUARE	2336 JEFFERSON AVE
237A	9/12/2023	WIDE AWAKE ESPRESSO & CAFE	1015 CENTER ST
237A	6/28/2023	SOUND HEIGHTS TOWNHOMES	4001 S PUGET SOUND AVE
237A	3/30/2023	TACOMA IRON WORK LLC	3129 S LAWRENCE ST
237A	9/26/2023	HEWITT CABINETS AND INTERIORS	3301 S LAWRENCE ST
237A	10/30/2023	HEWITT CABINETS AND INTERIORS	3301 S LAWRENCE ST
237A	11/9/2023	CATCHALL ENVIRONMENTAL	3221 CENTER ST
237A	10/2/2023	TACOMA ENDODONTIC STUDIO	1550 S UNION AVE
237A	3/29/2023	GIG HARBOR BREWING COMPANY	3120 SOUTH TACOMA WY
237A	5/15/2023	DRAGON CAFE	3715 S G ST
237A	2/14/2023	MCCARVER ELEMENTARY	2111 S J ST
237A	9/18/2023	RAIN TECH INCUBATOR	2304 JEFFERSON AVE
237A	8/3/2023	TACOMA SELF STORAGE	2602 S HOLGATE ST
237A	11/14/2023	MOMMA CHAN	3303 S 35TH ST
237A	3/3/2023	ECONET	2121 S STATE ST

237A	10/16/2023	PACIFIC COAST FARMS - CLOSED	3303 S 35TH ST
237A	4/19/2023	BLACK FLEET BREWING	2302 FAWCETT AVE
237A	5/2/2023	DOMINOS NO. 4618	3735 S PINE
237A	5/15/2023	LINCOLN PHARMACY	821 S 38TH ST
237A	9/18/2023	E9 BREWERY AND TAPROOM	2506 FAWCETT AVE
237A	9/11/2023	ORTHODONTIC CARE OF WASHINGTON	2522 S 38TH ST
237A	7/10/2023	SOUTH SOUND MOTOR SPORTS	3718 SOUTH TACOMA WY
237A	3/14/2023	TWIN KITTEN FARM	4516 S G ST
237A	9/13/2023	APOTHE CARRIES SOAPS	3510 S ALASKA ST
237A	6/7/2023	THE HAPPY FURBABY INN	2347 S M ST
237A	9/11/2023	FIX AUTO TACOMA SOUTH	3843 S WARNER ST
237A	12/12/2023	FIX AUTO TACOMA SOUTH	3843 S WARNER ST
237A	1/3/2023	HOUSE OF CANNABIS	764 S 56TH ST
237A	2/10/2023	PUGET SOUND APARTMENTS	4020 S PUGET SOUND AVE
237A	4/10/2023	SUPER TUNNEL CAR WASH	2501 PACIFIC AVE
237A	10/3/2023	COT PUBLIC WORKS - UPPER STORAGE YARD	XXX JEFFERSON AVE
237A	9/19/2023	COT SEWER TRANSMISSION - DOCK STREET YARD	201 PUYALLUP AVE
237A	6/2/2023	ARCHITECTUAL WOODS INC	2216 CENTER ST
237A	8/10/2023	RSG	2701 S J ST
237A	9/11/2023	NEXT JUMP OUTFITTERS	3721 S LAWRENCE ST
237A	11/9/2023	4EVERGREEN COUNTERTOPS	3033 S LAWRENCE ST
237A	4/25/2023	LEAN ENVIRONMENT, INC.	2340 S HOLGATE ST
237A	11/1/2023	LEAN ENVIRONMENT, INC.	2340 S HOLGATE ST
237B	4/14/2023	LEMAY AMERICA'S CAR MUSEUM	2702 E D ST
237B	1/24/2023	RITE AID #5271	7041 PACIFIC AVE
237B	5/15/2023	WALGREEN'S #5150	3739 PACIFIC AVE
237B	6/8/2023	LA HUERTA #2	5606 PACIFIC AVE
237B	7/11/2023	LA HUERTA #2	5606 PACIFIC AVE
237B	5/15/2023	VALENTINE DENTISTRY	218 S 38TH ST
237B	4/20/2023	EZ FOOD MART	3402 PACIFIC AVE
237B	7/11/2023	PACIFIC AVE RESIDENTIAL CARE	5621 PACIFIC AVE
237B	3/29/2023	THE PROTEIN SPOT	6332 PACIFIC AVE
237B	5/10/2023	O'REILLY AUTO PARTS #3629	5606 PACIFIC AVE
237B	10/10/2023	WSDOT SR-7, VACTOR/DECANT FACILITY	320 E 38TH
237B	6/20/2023	SEQUOIA PARK HOA	7054 E J ST
237B	9/12/2023	26TH STREET HOLDINGS LLC	314 E 26TH ST
237B	9/21/2023	ALFREDO AUTO SERVICES LLC	401 E 68TH ST
237B	3/21/2023	IMPERIAL AUTO SPA	223 E 63RD ST
237B	12/12/2023	JAX AUTO REPAIRS	716 E 64TH ST
237B	3/14/2023	MC SERVICES LLC	204 E 46TH ST
237B	5/10/2023	5520 PACIFIC AVE MARKET	5520 PACIFIC AVE
237B	4/20/2023	PRESTIGE AUTOBODY REPAIR	4006 PACIFIC AVE
237B	6/20/2023	PRESTIGE AUTOBODY REPAIR	4006 PACIFIC AVE
237B	7/11/2023	SEAPEAK INC	7012 PACIFIC AVE
237B	5/10/2023	BRILLIANT BRYANT	716 E 64TH ST

February 26, 2024

Memorandum

To: Laura Nokes

From: AMG

Date: January 2024

Re: 2023 Year end complaints/spills and inspections data for Thea Foss Watershed

In 2020, asset management restructured the Spills and Complaints program to better comply with new permit requirements. The program no longer records the complaint material. Instead, a spill or complaint call is classified as environmental, flooding, or sewer. Below is the breakdown of incident type for 2020-2023 spills documented in the Foss basin.

Incident Type	2020	2021	2022	2023
Environmental Issue	91	129	179	183
Flooding Issue	17	10	12	8
Sewer Issue	40	27	42	26
Total	**148**	**166**	**233**	**217**

City of Tacoma
Environmental Services Department

Memorandum

TO: Laura Nokes

FROM: John Sunich, Kevin Brennan

SUBJECT: 2023 Enforcement Report

DATE: January 29, 2024

Hello Laura,

In 2023 Environmental Compliance issued 27 enforcement actions (14 Warning letters, 1 Illicit Connection letter, 10 Surfacing Effluent letters and 2 Notice of Violations) for violations of Tacoma Municipal Code, Subchapter 12.08D regarding illicit discharges. Of the 27 enforcement actions, 11 were issued for violations within the Thea Foss Waterway drainage basin. Copies of the enforcement letters can be found in: G:\EnviroCompliance\Enforcement\2023 Enforcement Memo

Please note, those enforcement actions issued for violations in the Thea Foss drainage basin are highlighted in yellow below.

Action	Recipient	Date Issued	Address of Incident	Issue
Surfacing Effluent Letter	Resident	2/10/2023	1040 S Macarthur ST	Surfacing Effluent
Illicit Connection Letter	Resident	2/16/2023	7606 A St	Cross Connection
Surfacing Effluent Letter	Resident	3/9/2023	524 S 59th St	Surfacing Effluent
Surfacing Effluent Letter	Wayne & Flitch	3/9/2023	701 E 72nd St	Surfacing Effluent
Surfacing Effluent Letter	Kingston Manor Apartments	3/16/2023	402 N G St	Surfacing Effluent
Warning Letter	Drip House Coffee, LLC	3/22/2023	1901 Martin Luther King Jr Way	Illicit Discharge
Warning Letter	Resident	3/23/2023	3838 E I St	Illicit Discharge
Warning Letter	Jackson Energy	3/29/2023	510 E 3rd St	Illicit Discharge
Warning Letter	Elite Linen	3/29/2023	1115 E 25th St	Illicit Discharge
Surfacing Effluent Letter	Resident	4/7/2023	5918 E I St	Illicit Discharge
NOV	Capital Lumber	4/14/2023	304 E F St	Illicit Discharge
Surfacing Effluent Letter	Resident	4/25/2023	303 S 34th St	Surfacing Effluent
Surfacing Effluent Letter	Resident	5/3/2023	4109 N Stevens St	Surfacing Effluent
Warning Letter	Resident	6/26/2023	3124 N 7th St	Illicit Discharge

Action	Recipient	Date Issued	Address of Incident	Issue
NOV	Tekni-Plex Inc	7/18/2023	3101 South Tacoma Way	Illicit Discharge
Warning Letter	Resident	8/1/2023	3330 Saint Andrews CT NE	Illicit Discharge
Surfacing Effluent Letter	Resident	8/8/2023	8440 6th Ave	Surfacing Effluent
Warning Letter	Trung Do's Goldsmithing Services LLC	8/8/2023	8639 Pacific Ave	Illicit Discharge
Warning Letter	Jackson Energy	8/23/2023	510 E 3rd St	Illicit Discharge
Surfacing Effluent Letter	Resident	8/31/2023	1521 S Walters Rd	Surfacing Effluent
Warning Letter	Resident	9/13/2023	811 East 34th St	Illicit Discharge
Warning Letter	Resident	10/24/2023	6515 Tacoma Ave S	Illicit Discharge
Warning Letter	Alugada LLC	11/17/2023	3569 E Portland Ave	Illicit Discharge
Surfacing Effluent Letter	Resident	12/1/2023	7615 6th Ave	Surfacing Effluent
Warning Letter	Resident	12/8/2023	1641 E 35th St	Surfacing Effluent
Warning Letter	Killy Inc.	12/11/2023	1305 Scenic Dr NE	Illicit Discharge
Warning Letter	Resident	12/13/2023	5918 E I St	Illicit Discharge

2023 UST and LUST List from TPCHD

Business	Site Address	Outfall	Permit Date	Permit Type	Contaminated Soil?	Soil Disposed?	Groundwater Contaminated?	Monitoring Wells?	# Tanks Removed	Removal Date	Closed	Status
56th & Park LLC	5602 S PARK AVE	237A	5/17/2023	R	Y							Open-Active Permit
7-11 Store	4635 S YAKIMA AVE	230	10/4/2023	R	Y							Open-Active Permit
Bradken Inc.	3000 S Alaska ST	237A	3/10/2023	R					1	3/26/1993		Open-Active Permit
Brooks and Jessberger	1201 S UNION AVE	237A	7/14/2023	R	Y	N	Y	Y		10/8/1991		Open-Active Permit
Bryant Montessori School	717 S Grant AVE	230	5/9/2023	R								Open-Active Permit
Former Chevron Service Station No.211579	601 S 38th ST	237A	9/5/2023				Y	Y				Open-Active Permit
Former Foremost Dairy	2413 Pacific AVE S	237A	11/7/2023	R								Open-Active Permit
Former Nalleys Fine Foods / Bird's Eye Site	3403 S 35th ST	237A	8/8/2023	R	Y		Y	Y		10/2/1990		Open-Active Permit
Goodwill of the Olympics and Rainier Region	714 S 27th ST	237A	11/22/2023	R								Open-Active Permit
Heidelberg Brewery	2120 S C ST	235	6/9/2023	R								Open-Active Permit
Hi-Tech Erickson LLC	4006 Pacific AVE	237B	11/30/2022	R					3			Open-Expired Permit
Industrial Tire Service	423 PUYALLUP AVE	243	7/25/2023	R	Y							Open-Active Permit
Olympic Building	1222 Tacoma AVE S	230	4/17/2023	R					1			Open-Active Permit
Parking Garage	1114 Pacific AVE	230	9/8/2023	R					2			Open-Active Permit
RAINIER PLYWOOD CO	624 E 15TH ST	254	10/7/2023	R	Y		Y	Y				Open-Active Permit
Roger Smith	2718 PACIFIC AVE	237A	11/2/2023	R								Open-Active Permit
Shell-405	2631 38th ST S	237A	5/23/2023		Y		Y	Y	3			Open-Active Permit
SUPERIOR LINEN SERVICE	1012 CENTER ST	237A	5/16/2023	R	Y	N	Y	Y				Open-Active Permit
Tacoma CFN	3224 South Tacoma WAY	237A	9/25/2023	R	Y		Y	Y				Open-Active Permit
Tacoma Housing Authority	602 S Wright AVE	237A	3/31/2023	R								Open-Active Permit
WA-4230	1222 S 38TH ST	237A	1/31/2023	R	Y		Y	Y				Open-Active Permit
Time Oil 01-325	1501 UNION S	237A	07/11/2023	LUST	Y							Open-Active Permit

ATTACHMENT A.2 - OF230/OF230A

Table A.2-1
2023 Pipe Maintenance Activities for OF230

Date	Location	Type of Work	Outfall	Sub-Basin
01/17/2023	1001 SOUTH M ST - REPAIR A STYLE CB	REPAIR ASSET	230A	FS_05
02/13/2023	Clean Filterra (tree in box)	CLEAR BRUSH	230A	FS_05
03/20/2023	S 15th St and Tacoma Ave S - CB	CLEAN ASSET	230A	FS_05
03/21/2023	724 S GRANT AVE - SINKHOLE - CLEAN	CLEAN ASSET	230A	FS_05
03/28/2023	724 S GRANT AVE - REPAIR STORM MAIN	REPAIR ASSET	230A	FS_05
04/13/2023	624 S AINSWORTH - TV - 6" PIPE	CLEAN ASSET	230A	FS_05
04/19/2023	INSP & CLN 15 RNGRDN 1 MO, PACIFIC AVE	CLEAR BRUSH	230A	FS_05
05/19/2023	DOCK ST & HOOD - CLEAN FOR TV - 17' 43"	CLEAN ASSET	230A	FS_05
06/21/2023	1320 BROADWAY - INSPECTOR REQ - ROOT CUT	CLEAN ASSET	230A	FS_05
08/07/2023	CLN Flow Splitter MH 1911 On Jefferson	CLEAN ASSET	230A	FS_05
08/07/2023	CLN Flow Splitter MH 1911 On Jefferson	CLEAN ASSET	230A	FS_05
09/08/2023	1502 S SHERIDAN - SINKHOLE - CLEAN	CLEAN ASSET	230A	FS_05
10/04/2023	INSP & CLN 15 RNGRDN 1 MO, PACIFIC AVE	CLEAR BRUSH	230A	FS_05
10/17/2023	S. 11th & Tacoma Ave. - STORM CHECK	CLEAN ASSET	230A	FS_05
10/30/2023	Check CB's 9th and Commerce	CLEAN ASSET	230A	FS_05
12/20/2023	1102 A STREET - SECURE VAULT WITH PLATE	REPAIR ASSET	230A	FS_05
12/20/2023	1130 COMMERCE ST - CLEAN CB	CLEAN ASSET	230A	FS_05
12/29/2023	1209 ALTHEIMER ST - FSS REQ - CLEAN	CLEAN ASSET	230A	FS_05

MEMORANDUM

Date: December 27, 2023

To: Mary Henley and Laura Nokes

cc: Kurt Fremont and Cassandra Moore

From: Tony Miller

Subject: OF230 (FD3A and FD18) 2023 Source Tracing Investigation

INTRODUCTION

The City of Tacoma (City) is tasked with source tracing contaminants of concern identified through annual sediment trap sampling in the Thea Foss Watershed. There has been an ongoing investigation in a portion of the Outfall (OF) 230 drainage basin since 2012 to identify possible sources of PCBs discovered during annual sediment monitoring.

SOURCE CONTROL HISTORY

OF230 was one of the primary outfalls discharging into the Thea Foss Waterway. In December 2022, the majority of stormwater discharges from OF230 were redirected to a new outfall identified as OF230A. The land use for both the OF230 and OF230A drainage basins is primarily commercial downtown with pockets of residential areas. Based on ongoing sediment monitoring now in OF230A, specific sections of this drainage basin were identified as having continuing issues with Thea Foss Waterway contaminants of concern, including PCBs and mercury.

FD3A and FD18 are both sub-basins in the larger OF230A drainage basin. The FD3A sediment trap was replaced in 2023 with FD3C, but represents the same drainage basin in downtown Tacoma from St. Helens to South 14th and Market Streets to A Street (Figure 1). The FD18 sediment trap represents the downtown area from South 11th to South 9th Streets, Market Street to Martin Luther King Jr. Way, the residential area from South 9th Street to South 8th Street, and Martin Luther King Jr. Way to South Sprague Avenue (Figure 2).

For further details of the historic investigations in this basin please review the reports from previous years (Tacoma 2015, 2016, 2017, 2018, 2019, 2020, 202).

SITE SPECIFIC INVESTIGATIONS SUMMARY

<u>PCBs - South 12th & Pacific</u>

Wells Fargo and (Formerly) 1123 Pacific Partners:

During 2023:

Environmental Compliance (EC) staff attempted to sample the catchbasins surrounding the Wells Fargo complex and 1123 Pacific Avenue in March and July of 2023. During both site visits there was insufficient sediment to sample. The 2023 sediment trap results for FD3C (formerly FD3A) showed PCB concentrations of 485 ppb (analysis available upon request), which is lower than in years past but suggests there is still a source of PCBs present within this basin. Additionally, mercury showed an uptick in concentrations to 0.355 ppm. This suggests that there may be a new or ongoing source of mercury contamination.

2024 Plan:

EC staff will attempt to sample the targeted catchbasins surrounding the entire Wells Fargo Complex and in front of 1123 Pacific Avenue early in 2024 to determine if the sources of PCBs are ongoing or if the remediation at these locations were successful. Mercury will be added to this analysis, as well, to try to find where mercury concentrations are more prevalent. If contamination persists, EC will work with these businesses to ensure further remediation takes place.

PCBs - South 13th Street & Commerce Street

During 2023:

On July 31, 2023, EC staff sampled catchbasins 6521525 and 6510859. It was stated in the 2022 report that these locations were not sampled due to insufficient sediment. It appears that there was a mistake made on which locations were checked as these catchbasins were heavily impacted with material. Catchbasin 6521525 had a DEHP concentration of 8,840 ug/Kg and a PCB concentration of 2210 ug/Kg. Catchbasin 6510859 had a DEHP concentration of 6,430 ug/Kg and PCBs were a non-detect (analysis available upon request).

Since it appeared that there was several years' worth of deposition within these catchbasins it is difficult to conclude whether the contamination is historic or not. EC made a request to Sewer Transmission on November 8, 2023, for cleaning. This location is adjacent to light rail lines, so cleaning requires coordination.

2024 Plan:

Once these catchbasins are cleaned, EC will confirm the cleaning and then resample once enough sediment is present to do so. Based on the findings of this next round of sampling site inspections will be scheduled if necessary to look for the sources of contaminants in the adjacent structures.

Please let me know if you have any questions or concerns.

References:

Tacoma 2014. 2013 Stormwater Source Control Report and Water Year 2013 Stormwater Monitoring Report. City of Tacoma. March 31, 2013

Tacoma 2015. 2014 Stormwater Source Control Report and Water Year 2014 Stormwater Monitoring Report. City of Tacoma. March 31, 2014

Tacoma 2016. 2014 Stormwater Source Control Report and Water Year 2015 Stormwater Monitoring Report. City of Tacoma. March 31, 2015

Tacoma 2017. 2016 Stormwater Source Control Report and Water Year 2016 Stormwater Monitoring Report. City of Tacoma. March 31, 2016

Tacoma 2018. 2017 Stormwater Source Control Report and Water Year 2017 Stormwater Monitoring Report. City of Tacoma. March 31, 2017

Tacoma 2019. 2018 Stormwater Source Control Report and Water Year 2018 Stormwater Monitoring Report. City of Tacoma. March 31, 2018

Tacoma 2020. 2019 Stormwater Source Control Report and Water Year 2019 Stormwater Monitoring Report. City of Tacoma. March 31, 2020

Tacoma 2021. 2020 Stormwater Source Control Report and Water Year 2020 Stormwater Monitoring Report. City of Tacoma. March 31, 2021

Tacoma 2022. 2021 Stormwater Source Control Report and Water Year 2020 Stormwater Monitoring Report. City of Tacoma. March 31, 2021

Tacoma 2023. 2022 Stormwater Source Control Report and Water Year 2020 Stormwater Monitoring Report. City of Tacoma. March 31, 2022

MEMORANDUM

Date: December 27, 2023
To: Mary Henley and Laura Nokes
cc: Kurt Fremont and Cassandra Moore
From: Tony Miller
Subject: OF230 (FD18) South 9th Street and Fawcett Avenue 2023 Actions

INTRODUCTION

The City of Tacoma (City) is tasked with source tracing contaminants of concern identified through annual sediment trap sampling in the Thea Foss Watershed. There has been an ongoing investigation in a portion of the Outfall (OF) 230 drainage basin since 2012 to identify possible sources of PCBs discovered during annual sediment monitoring.

SITE SPECIFIC INVESTIGATIONS SUMMARY

The South 9th Street & Fawcett Avenue sampling location is in the FD18 drainage area. This was one of two sites in the FD18 drainage area that were identified with elevated PCB concentrations during initial investigations. Historic investigations at this site are available for review. (Tacoma 2015, 2016, 2017, 2018, 2019, 2020, 2021, 2022).

2023 ACTIONS

Environmental Compliance (EC) staff were planning on sampling the catchbasins at this location in early 2023 but a large fire took place at a neighboring building in March 2023. Due to the debris and runoff from firefighting efforts, these catchbasins and the storm system had to be re-cleaned. A sediment check in October of 2023 showed insufficient sediment to resample.

Additionally, the 2023 FD18 sediment trap sample had non-detectable levels of PCBs (analysis available upon request). It is possible that the curb/gutter/sidewalk construction removed any lingering PCBs that were trapped in the concrete.

2024 PLAN

No investigations are planned in this basin for 2024. The Environmental Programs Group will review the 2024 sediment trap data for FD18 when it becomes available to see if the contamination has returned or remains at reduced on non-detectable levels. Further investigations will be conducted if the contamination returns.

Please contact me if you have any questions or concerns.

References:

Tacoma 2014. 2013 Stormwater Source Control Report and Water Year 2013 Stormwater Monitoring Report. City of Tacoma. March 31, 2013

Tacoma 2015. 2014 Stormwater Source Control Report and Water Year 2014 Stormwater Monitoring Report. City of Tacoma. March 31, 2014

Tacoma 2016. 2015 Stormwater Source Control Report and Water Year 2015 Stormwater Monitoring Report. City of Tacoma. March 31, 2015

Tacoma 2017. 2016 Stormwater Source Control Report and Water Year 2016 Stormwater Monitoring Report. City of Tacoma. March 31, 2016

Tacoma 2018. 2017 Stormwater Source Control Report and Water Year 2017 Stormwater Monitoring Report. City of Tacoma. March 31, 2017

Tacoma 2019. 2018 Stormwater Source Control Report and Water Year 2018 Stormwater Monitoring Report. City of Tacoma. March 31, 2018

Tacoma 2020. 2019 Stormwater Source Control Report and Water Year 2019 Stormwater Monitoring Report. City of Tacoma. March 31, 2019

Tacoma 2021. 2020 Stormwater Source Control Report and Water Year 2020 Stormwater Monitoring Report. City of Tacoma. March 31, 2021

Tacoma 2022. 2021 Stormwater Source Control Report and Water Year 2020 Stormwater Monitoring Report. City of Tacoma. March 31, 2021

Tacoma 2023. 2022 Stormwater Source Control Report and Water Year 2020 Stormwater Monitoring Report. City of Tacoma. March 31, 2022

MEMORANDUM

Date: December 27, 2023
To: Mary Henley and Laura Nokes
cc: Kurt Fremont and Cassandra Moore
From: Tony Miller
Subject: OF230 FD3C/FD3A South 14th Street and Court A

INTRODUCTION

The City of Tacoma (City) is tasked with source tracing contaminants of concern identified through annual sediment trap sampling in the Thea Foss Watershed. There has been an ongoing investigation in a portion of the Outfall (OF) 230 drainage basin since 2012 to identify possible sources of PAHs discovered during annual sediment trap monitoring.

SITE SPECIFIC INVESTIGATIONS SUMMARY

The catchbasin sediments at this location have a history of ongoing issues with relatively elevated PAH concentrations but have shown a drastic decrease in recent years. At this time, the City continues to monitor this location for PAHs to ensure the issues have been resolved. In addition to periodic monitoring, the City required Republic Parking Lot (1320 A Street) to implement quarterly cleanings of their private basins as well as yearly sampling to confirm the removal of PAHs through their onsite source control work. Historic investigations and actions occurring in this basin are available for review in Appendix A of the previous Foss Stormwater Source Control Reports (Tacoma 2014, 2015, 2016, 2017, 2018, 2019, 2020, 2021, 2022).

2023 ACTIONS

Environmental Compliance (EC) attempted to sample sediment at this location on July 13, 2023, and there was no sediment present to sample. In addition, the FD3C sediment trap (formerly FD3A and in a slightly different location but representing the same area) showed PAH concentrations had decreased in 2023 to 64,215 ug/Kg (Table 1) which is significantly lower than what is classified as relative low levels of contamination (<164,000 ug/Kg). EC suspects that the repairs made by Neil Walters and Republic Parking have eliminated the significant sources of PAH contamination within this drainage basin.

2024 PLAN

No PAH investigations are planned in this basin for 2024. The Environmental Programs Group will review the 2024 sediment trap data for FD3C (Formerly FD3A) when it becomes available to see if the PAH contamination has returned or remains at reduced levels. Further investigations will be conducted if the elevated levels of PAH return.

Please contact me if you have any questions or concerns.

Enclosures:

Figure 1: Historical PAH Concentrations

Table 1: FD3C (Formerly FD3A) PAH Concentrations

References:

Tacoma 2014. 2013 Stormwater Source Control Report and Water Year 2013 Stormwater Monitoring Report. City of Tacoma. March 31, 2013

Tacoma 2015. 2014 Stormwater Source Control Report and Water Year 2014 Stormwater Monitoring Report. City of Tacoma. March 31, 2014

Tacoma 2016. 2014 Stormwater Source Control Report and Water Year 2015 Stormwater Monitoring Report. City of Tacoma. March 31, 2015

Tacoma 2017. 2016 Stormwater Source Control Report and Water Year 2016 Stormwater Monitoring Report. City of Tacoma. March 31, 2016

Tacoma 2018. 2017 Stormwater Source Control Report and Water Year 2017 Stormwater Monitoring Report. City of Tacoma. March 31, 2017

Tacoma 2019. 2018 Stormwater Source Control Report and Water Year 2018 Stormwater Monitoring Report. City of Tacoma. March 31, 2018

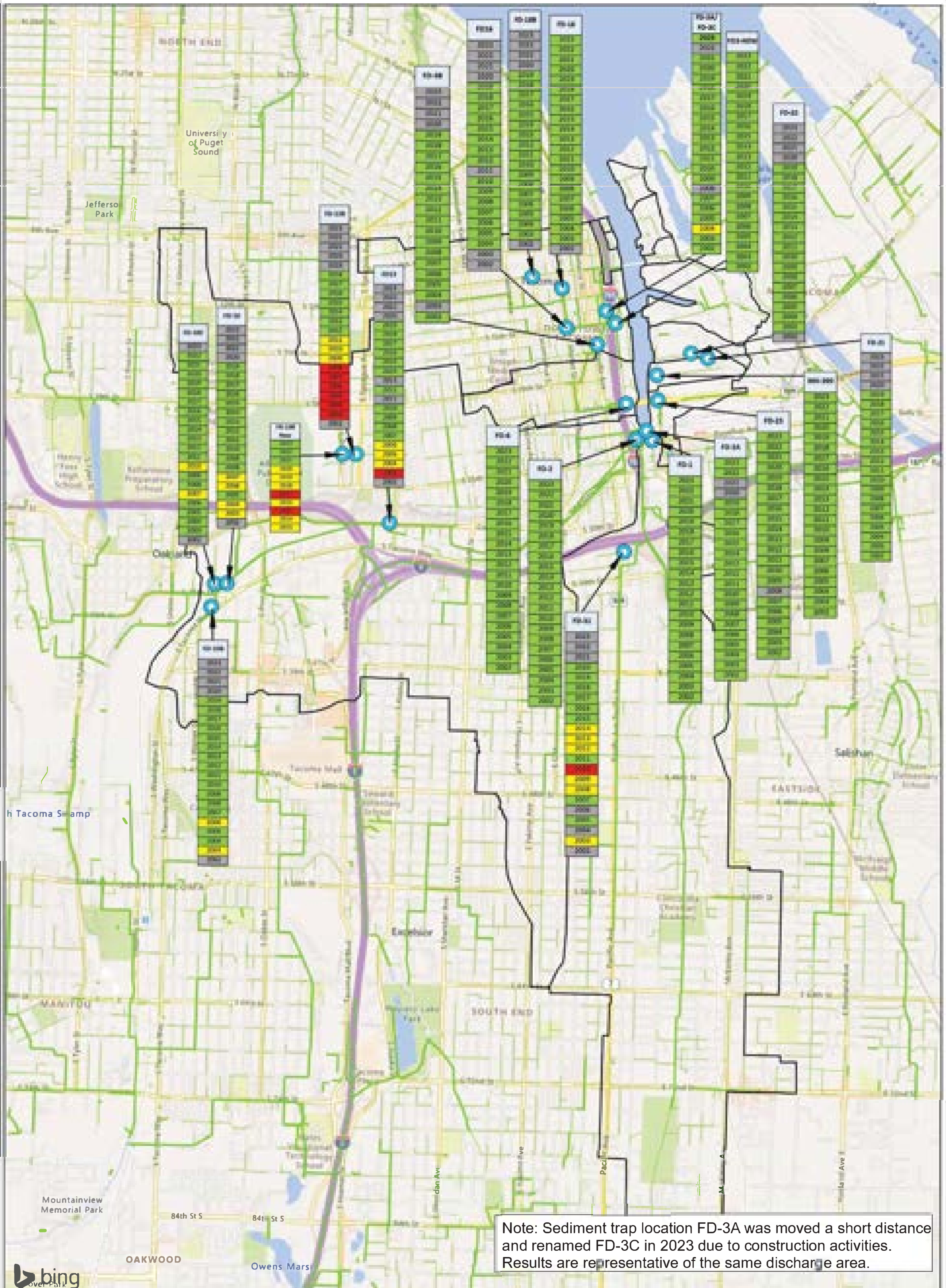
Tacoma 2020. 2019 Stormwater Source Control Report and Water Year 2019 Stormwater Monitoring Report. City of Tacoma. March 31, 2019

Tacoma 2021. 2020 Stormwater Source Control Report and Water Year 2020 Stormwater Monitoring Report. City of Tacoma. March 31, 2021

Tacoma 2022. 2021 Stormwater Source Control Report and Water Year 2021 Stormwater Monitoring Report. City of Tacoma. March 31, 2021

Tacoma 2023. 2022 Stormwater Source Control Report and Water Year 2021 Stormwater Monitoring Report. City of Tacoma. March 31, 2022

Figure 1
Sediment Trap Results - PAHs



Legend

- SAMPLE SITE LOCATIONS
- STORM LINES
- TRUNKLINES 24" AND LARGER
- STORMWATER SUB-BASINS

Map Date: November 29, 2023
Source: Science and Engineering Division, Environmental Services Department City of Tacoma

Environmental Services/ Science & Engineering
326 East D Street, Tacoma WA 98421
(253) 591-5588

N

0 1,000 2,000 4,000 Feet

Symbol Level Key

- NO ANALYSIS
- SMALL LEVELS - < 164,000 ug/Kg
- MEDIUM LEVELS - 164,000 - 300,000 ug/Kg
- LARGE LEVELS - > 300,000 ug/Kg

Tacoma

Projects\2023\P0098_FossFigures2023_PAHs_SedimentTrapResultFigureUpdatesForFossReport

Table 1
FD3C (Formerly FD3A) 2023 Source Tracing Results

Sample Date Collected	FD3C 10/20/2023	
Conventionals		
Total Solids (%)	28.7	
PAHs in ug/kg		
2-Methylnaphthalene	**385**	
Acenaphthene	**457**	
Acenaphthylene	**569**	
Anthracene	**949**	
Benzo(a)anthracene	**4,140**	
Benzo(a)pyrene	**4,380**	
Benzo(b,k)fluoranthenes	**10,900**	
Benzo(g,h,i)perylene	**1,290**	
Chrysene	**5,400**	
Dibenz(a,h)anthracene	**422**	
Fluoranthene	**13,200**	
Flourene	**803**	
Indeno(1,2,3-cd)pyrene	**1,820**	
Napthalene	**1,080**	
Phenanthrene	**7,820**	
Pyrene	**10,600**	
Total PAHs in ug/kg	**64,215**	

KEY & COMMENTS	
PAHs	
Small Levels	**<164,000 ug/kg**
Medium Levels	**164,000 - 300,000 ug/kg**
Large Levels	**> 300,000 ug/Kg**

City of Tacoma
Environmental Services Department

March 22, 2023

SENT VIA CERTIFIED MAIL

Alina Derkach
Drip House Coffee, LLC
11806 8th Street East
Edgewood, WA 98372-1470

Subject: Warning Letter – Illicit Discharge to Private Stormwater System located at 1901 Martin Luther King Jr Way

Dear Alina:

On March 13, 2023, City of Tacoma (City) Environmental Compliance staff observed wash water discharging to a private stormwater catchbasin. The source of the discharge was from a holding tank that collects wash water from the Drip House Coffee business. Wash water is considered a wastewater and cannot be discharged to the stormwater system.

Tacoma Municipal Code (TMC) Chapter 12.08D.110.C *Prohibited Discharges* says, in part, *No person shall throw, drain, spill, or otherwise discharge, cause, or allow others under their control to throw, drain, spill, or otherwise discharge any substance not specifically allowed or conditionally allowed into the municipal stormwater system or receiving waters.*

<u>**Corrective Actions**</u>

Within fifteen (15) days of receipt of this letter, please complete the required maintenance:

- Establish a workplan to ensure the proper disposal of all wastewaters and prevent impact to the stormwater system.
- Clean effected private catchbasin.

Failure to adequately address this concern with City of Tacoma Environmental Services may result in escalating enforcement actions, including, but not limited to, Notices of Violation with Civil Penalties of up to $10,000 per day for each violation of TMC 12.08D.

If you have any questions regarding this matter, please contact Source Control Representative, Mike Sanders at (253) 651-3298 or email at msanders2@cityoftacoma.org.

Sincerely,

DocuSigned by:
Cassandra Moore
F7F79691EFFA489...

Cassandra Moore, MES
Assistant Division Manager
Environmental Compliance

cc: Luke Corporation, Property Owner, 6022 Bayview Dr NE, Tacoma, WA 98422

Enclosures: Photos
Sent by First Class and Certified Mail: 7021 1970 0002 0379 8376


Mar 13, 2023 at 11:38:58
1901 Martin Luther King
Tacoma WA
United States


Mar 13, 2023 at 11:37:57 AM
1901 Martin Luther King Jr Way
Tacoma WA 98405
United States

ATTACHMENT A.3 - OF235

Table A.3-1
2023 Pipe Maintenance Activities for OF235

Date	Location	Type of Work	Outfall	Sub-Basin
04/03/2023	CLN CDS Swirl Separator 1911 Jefferson	CLEAN ASSET	235	FS_06
01/05/2023	CLN CDS Swirl Separator 1911 Jefferson	CLEAN ASSET	235	FS_06
09/12/2023	CLN CDS Swirl Separator 1911 Jefferson	CLEAN ASSET	235	FS_06
11/28/2023	CLN CDS Swirl Separator 1911 Jefferson	CLEAN ASSET	235	FS_06
05/10/2023	CLN CDS Swirl Separator 1911 Jefferson	CLEAN ASSET	235	FS_06

MEMORANDUM

Date: December 27, 2023
To: Mary Henley and Laura Nokes
cc: Kurt Fremont and Cassandra Moore
From: Tony Miller
Subject: OF230/235 2022 Source Tracing Investigation

INTRODUCTION

The City of Tacoma (City) is tasked with source tracing contaminants of concern identified through annual sediment trap and stormwater sampling in the Thea Foss Watershed. Copper was newly identified as a contaminant of concern within Outfalls (OF) 230 and 235 in WY2019 due to some intermittent elevated concentrations in stormwater with other potential outliers starting in 2016. All of these outliers, as well as those detected since that time have been detected in the spring and summer. Due to a large construction project which rerouted the municipal stormwater system in this area, source tracing efforts were focused on business inspections rather than sampling of the municipal storm system until this project was completed.

SOURCE CONTROL HISTORY

OF230 and 235 are two of the primary outfalls discharging into the Thea Foss Waterway. It should be noted that as of December 2022, drainage areas have been revised and stormwater discharges in this area are primarily directed to new OF230A and OF235, with only minor discharges continuing from OF230. The land use for these drainage basins is primarily commercial downtown with pockets of residential areas. Based on ongoing stormwater monitoring, OF230A and 235 were exhibiting elevated copper concentrations in the spring and summer, outside of the normal concentrations seen in the basin.

SITE SPECIFIC INVESTIGATIONS SUMMARY

Due to the seasonal and intermittent nature of the outlier copper concentrations showing up in stormwater samples, it was theorized that it is possible that excess copper is caused by a commercial cleaning or maintenance operation taking place in the drainage basin. Copper is used as a moss killer on roofs and sidewalks as well as being present in some herbicides. The Tacoma Building Improvement Area (BIA) maintains large portions of the downtown area (i.e. pressure washing buildings, sidewalks, etc.). In August of 2022, Environmental Compliance (EC) staff contacted the BIA asking what, if any, products they used to assist with their cleaning activities. No apparent sources were identified during this inquiry.

In addition, City staff identified buildings with copper exteriors as possible contributors. Tacoma's Union Station was identified as a possible source due to its large copper roof.

2023 Actions:

EC exchanged emails with Multi-Air Services Engineers and received confirmation that their catchbasins were cleaned on March 27, 2023. They also confirmed that for roof cleaning they use a "light solution of laundry detergent" and only in moss affected areas. As a federal building they are required to Safer-Choice (EPA) or Biobased (USDA) products (email correspondence attached).

EC staff made a site visit on July 19, 2023, and found that there was insufficient sediment in the catchbasins for sampling.

2024 Plan:

EC staff will inspect the catchbasins at this site in early 2024 and collect catchbasin samples if there is enough sediment present.

EC Staff will also continue to look for other potential sources of copper within the OF230 and 235 drainage basins as needed.

Enclosure:

Appendix A Email Correspondence

References:

Tacoma 2014. 2013 Stormwater Source Control Report and Water Year 2013 Stormwater Monitoring Report. City of Tacoma. March 31, 2013

Tacoma 2015. 2014 Stormwater Source Control Report and Water Year 2014 Stormwater Monitoring Report. City of Tacoma. March 31, 2014

Tacoma 2016. 2014 Stormwater Source Control Report and Water Year 2015 Stormwater Monitoring Report. City of Tacoma. March 31, 2015

Tacoma 2017. 2016 Stormwater Source Control Report and Water Year 2016 Stormwater Monitoring Report. City of Tacoma. March 31, 2016

Tacoma 2018. 2017 Stormwater Source Control Report and Water Year 2017 Stormwater Monitoring Report. City of Tacoma. March 31, 2017

Tacoma 2019. 2018 Stormwater Source Control Report and Water Year 2018 Stormwater Monitoring Report. City of Tacoma. March 31, 2018

Tacoma 2020. 2019 Stormwater Source Control Report and Water Year 2019 Stormwater Monitoring Report. City of Tacoma. March 31, 2020

Tacoma 2021. 2020 Stormwater Source Control Report and Water Year 2020 Stormwater Monitoring Report. City of Tacoma. March 31, 2021

Tacoma 2022. 2021 Stormwater Source Control Report and Water Year 2021 Stormwater Monitoring Report. City of Tacoma. March 31, 2022

Tacoma 2023. 2022 Stormwater Source Control Report and Water Year 2022 Stormwater Monitoring Report. City of Tacoma. March 31, 2023

Appendix A
Email Correspondence

Petty, Cassie

From: Kyle Wyman - 10PMAC <kyle.wyman@gsa.gov>
Sent: Monday, March 27, 2023 1:25 PM
To: Sanders, Michael
Cc: Miller, Tony; Brett Reagan - 10PMAC; Nokes, Laura; Henley, Mary; Brennan, Kevin; Magoon, Stuart; r.tillich@mase-usa.com; s.crespo@masepr.com
Subject: Re: FW: TUS/City Drain Basins - Source Tracing high copper/lead samples at Union Station

Michael,

Drain basin cleaning on this property was completed today!

Sincerely,

Kyle Wyman
Building Services Specialist
Cell- 253-310-6925
Tacoma Union Station
Service Calls: 1-800-806-8145

On Thu, Aug 25, 2022 at 6:56 AM Sanders, Michael <msanders2@cityoftacoma.org> wrote:

Kyle, Thanks for taking my call this morning. As I understand you are waiting on the new fiscal year to address the storm drains.

Additionally as you stated please re-address this matter with the powers to be, as we want to find the contributing factors of high copper/lead effecting our open waters.

Vr

Mike Sanders

From: Sanders, Michael
Sent: Tuesday, June 7, 2022 12:16 PM
To: Kyle Wyman <k.wyman@mase-usa.com>
Cc: Brett Reagan - 10PMAC <brett.reagan@gsa.gov>; r.tillich@mase-usa.com; s.crespo@masepr.com; Miller, Tony <TMiller@cityoftacoma.org>; Nokes, Laura <LNokes@cityoftacoma.org>; Henley, Mary <mhenley@cityoftacoma.org>; Brennan, Kevin <KBRENNAN@cityoftacoma.org>; Magoon, Stuart <SMagoon@cityoftacoma.org>
Subject: RE: TUS/City Drain Basins - Source Tracing high copper/lead samples at Union Station

Kyle, nice to meet you today as per your summary, it is spot on. At this time I would request the cleaning of the private storm drains located at 1717 Pacific Ave as per the map provided. I would recommend to have the private drains pressure washed, sediment removal and jet the leads. Once complete please notify myself and we will continue to sample to see if any changes.

As per our discussion, is it possible to find out what month(s) moss treatment is typically applied on the roof or sidewalks and amounts. Additionally schedule a time where we can dye test your hydroponics discharge point for your cooling towers to confirm connection to wastewater Vs stormwater.

On our attached map the light green indicates private storm system the darker green is City and the red is the wastewater. The squares are the catch basins (storm drains) and the round icon indicate manhole structures. I also attached a contractors list (if needed) and the sample report.

Any questions or concerns please feel free to call me.

Mike Sanders

Source Control Representative

Business Operations/Environmental Services

2201 Portland Ave, P-1, Tacoma, WA 98421

Cell: (253) 651-3298

msanders2@cityoftacoma.org

"If it hits the ground, it hits the Sound."

From: Kyle Wyman <k.wyman@mase-usa.com>
Sent: Tuesday, June 7, 2022 10:42 AM
To: Sanders, Michael <msanders2@cityoftacoma.org>
Cc: Brett Reagan - 10PMAC <brett.reagan@gsa.gov>; r.tillich@mase-usa.com; s.crespo@masepr.com
Subject: TUS/City Drain Basins - High copper/iron samples

Mr. Sanders,

Per our conversation today; City of Tacoma has tested the sediment in/and around the Union Station property and found high copper/iron deposits. The city would like to find the exact source of this problem, and possibly change our current practices to keep these levels down. Your first suggestion is to have these drain basins pumped out and the connecting pipes cleaned. Please send along the diagrams we spoke about, and any pertinent information I left out.

Let's continue dialogue on this subject, and let me know if there is any documentation I can share with you to help us reach a conclusion.

Respectfully,

--

Kyle Wyman

Chief Engineer - Multi Air Services Engineers

Tacoma Union Station

C:253-320-6196/O:253-272-2651

Petty, Cassie

From: Kyle Wyman - 10PMAC <kyle.wyman@gsa.gov>
Sent: Friday, April 14, 2023 8:44 AM
To: Miller, Tony
Cc: Sanders, Michael; Brett Reagan - 10PMAC; Dwayne Smith - 10PMAC
Subject: Re: FW: TUS/City Drain Basins - Source Tracing high copper/lead samples at Union Station

Tony,

Not sure if this was a typo or not. We have Hydronics loops, not Hydroponics. Heating, cooling, and condenser water loops.

As for roof treatment, in the past we've always used a light solution of laundry detergent, and only in moss affected areas. The new contractor may have changed the roof treatment chemical, but they are required in their contract to use Safer-Choice (EPA) or Biobased (USDA) products. As a Federal Facility, it is understood that nothing except rain water should be running into our storm water system. Our contracted partners are following these rules as well.

Let me know if there are any other questions I can answer.

Thank you,

Kyle Wyman
Building Services Specialist
Cell- 253-310-6925
Tacoma Union Station
Service Calls: 1-800-806-8145

On Wed, Apr 12, 2023 at 2:40 PM Miller, Tony <TMiller@cityoftacoma.org> wrote:

> Kyle, thank you for getting these drains cleaned. In the coming months we would like to come out and probe to see if there is any new sediment accumulation and sample accordingly. Additionally, could you elaborate on any cleaning or maintenance processes for you roof or sidewalks? Also the hydroponics system you have onsite (mentioned below), what fertilizers are used where that system discharges to. Any additional information you have on cleaning or maintenance activities that may affect your storm water system would be a huge benefit.
>
> Thank you!
>
> Tony Miller
>
> City of Tacoma
>
> Environmental Services
>
> Desk: (253) 502-2195 Mobile: (253) 355-8955

tmiller@cityoftacoma.org

City of Tacoma STORMWATER SOLIDWASTE WASTEWATER ENVIRONMENTAL SERVICES DEPARTMENT

From: Kyle Wyman - 10PMAC <kyle.wyman@gsa.gov>
Sent: Monday, March 27, 2023 1:25 PM
To: Sanders, Michael <msanders2@cityoftacoma.org>
Cc: Miller, Tony <TMiller@cityoftacoma.org>; Brett Reagan - 10PMAC <brett.reagan@gsa.gov>; Nokes, Laura <LNokes@cityoftacoma.org>; Henley, Mary <mhenley@cityoftacoma.org>; Brennan, Kevin <KBRENNAN@cityoftacoma.org>; Magoon, Stuart <SMagoon@cityoftacoma.org>; r.tillich@mase-usa.com; s.crespo@masepr.com
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To: Kyle Wyman <k.wyman@mase-usa.com>
Cc: Brett Reagan - 10PMAC <brett.reagan@gsa.gov>; r.tillich@mase-usa.com; s.crespo@masepr.com; Miller, Tony <TMiller@cityoftacoma.org>; Nokes, Laura <LNokes@cityoftacoma.org>; Henley, Mary <mhenley@cityoftacoma.org>; Brennan, Kevin <KBRENNAN@cityoftacoma.org>; Magoon, Stuart <SMagoon@cityoftacoma.org>
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Any questions or concerns please feel free to call me.

Mike Sanders

Source Control Representative

Business Operations/Environmental Services

2201 Portland Ave, P-1, Tacoma, WA 98421

Cell: (253) 651-3298

msanders2@cityoftacoma.org

“If it hits the ground, it hits the Sound.”

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Subject: TUS/City Drain Basins - High copper/iron samples

Mr. Sanders,

Per our conversation today; City of Tacoma has tested the sediment in/and around the Union Station property and found high copper/iron deposits. The city would like to find the exact source of this problem, and possibly change our current practices to keep these levels down. Your first suggestion is to have these drain basins pumped out and the connecting pipes cleaned. Please send along the diagrams we spoke about, and any pertinent information I left out.

Let's continue dialogue on this subject, and let me know if there is any documentation I can share with you to help us reach a conclusion.

Respectfully,

--

Kyle Wyman

> > Chief Engineer - Multi Air Services Engineers
> >
> > Tacoma Union Station
> >
> > C:253-320-6196/O:253-272-2651

ATTACHMENT A.4 - OF237A

Table A.4-1
2023 Pipe Maintenance Activities for OF237A

Date	Location	Type of Work	Outfall	Sub-Basin
3/1/2023	3501 S 12TH - CLEAN FOR TV	CLEAN ASSET	237A	FS_01
9/6/2023	3702 6TH AVE - SSO - CLEAN UP	CLEAN ASSET	237A	FS_01
4/12/2023	3010 CENTER ST - ASSIST STREET OPS	CLEAN ASSET	237A	FS_02
2/22/2023	S 43RD & PUGET SOUND - PLUGGED CB	CLEAN ASSET	237A	FS_03
5/19/2023	2912 S WILKESON - CLEAN FOR TV	CLEAN ASSET	237A	FS_03
3/15/2023	1753 S Cushman - Full CB	CLEAN ASSET	237A	FS_04
4/3/2023	BC 2 SEG STORM YEARLY 21ST-23RD & MLK	BACKCUT	237A	FS_04
4/3/2023	BC 2 SEG STORM YEARLY 21ST-23RD & MLK	BACKCUT	237A	FS_04
7/24/2023	STORM BC 2 SEG YEARLY 17-19TH SHERIDAN	BACKCUT	237A	FS_04
7/24/2023	STORM BC 2 SEG YEARLY 17-19TH SHERIDAN	BACKCUT	237A	FS_04
7/24/2023	STORM BC 2 SEG YEARLY 17-19TH SHERIDAN	BACKCUT	237A	FS_04
10/2/2023	6255332 - POST BACKCUT - CLEAN	CLEAN ASSET	237A	FS_04
10/2/2023	6255383 - POST BACKCUT - CLEAN	CLEAN ASSET	237A	FS_04
2/2/2023	2337 YAKIMA CT - PLUGGED CB'S - CLEAN	CLEAN ASSET	237A	FS_07
2/10/2023	2335 S G ST - CLEAN FOR TV	CLEAN ASSET	237A	FS_07
2/10/2023	100 S 25TH ST - CLEAN FOR TV	CLEAN ASSET	237A	FS_07
2/23/2023	2529 S G ST - CLEAN FOR TV	CLEAN ASSET	237A	FS_07
2/23/2023	2529 S G ST - CLEAN FOR TV	CLEAN ASSET	237A	FS_07
7/13/2023	2302 A ST - SINKHOLE	CLEAR BRUSH	237A	FS_07
11/14/2023	102 S 24TH ST - REPLACE R/C	REPAIR ASSET	237A	FS_07
12/6/2023	102 S. 24TH ST.- STREET PATCH	STREET PATCH	237A	FS_07
12/28/2023	2366 TACOMA AVE - CLEAN MAIN	CLEAN ASSET	237A	FS_07
1/26/2023	INSP & CLN 1 SEG 1 YR 730 S TACOMA WAY	CLEAN ASSET	237A	FS_08
5/3/2023	3917 S AINSWORTH - PAVING CLEAN	CLEAN ASSET	237A	FS_08
7/20/2023	3414 S M ST - CLEAN CB	CLEAN ASSET	237A	FS_08
10/3/2023	S 36th St and K St - CLEAN SPILL	CLEAN ASSET	237A	FS_08
11/1/2023	1563 S 35TH - PLUGGED CULVERT	CLEAN ASSET	237A	FS_08
5/2/2023	BC 3 Seg 3 MO S 36th &Thompson	BACKCUT	237A	FS_09
5/2/2023	BC 3 Seg 3 MO S 36th &Thompson	BACKCUT	237A	FS_09
5/2/2023	BC 3 Seg 3 MO S 36th &Thompson	BACKCUT	237A	FS_09
5/2/2023	BC 3 Seg 3 MO S 36th &Thompson	BACKCUT	237A	FS_09
8/11/2023	1122 S 41ST - TREE IN CB	CLEAN ASSET	237A	FS_09
8/24/2023	BC 3 Seg 3 MO S 36th &Thompson	BACKCUT	237A	FS_09
8/24/2023	BC 3 Seg 3 MO S 36th &Thompson	BACKCUT	237A	FS_09
10/24/2023	S 37TH ST AND S THOMPSON ST - SINKHOLE	CLEAN ASSET	237A	FS_09
11/9/2023	BC 1 SEG 1 YR, 1000 S 40TH ST	BACKCUT	237A	FS_09
11/13/2023	BC 3 Seg 3 MO S 36th &Thompson	BACKCUT	237A	FS_09
11/14/2023	BC 3 Seg 3 MO S 36th &Thompson	BACKCUT	237A	FS_09
11/16/2023	6270755 - ROOTS IN MAIN - BACKCUT	BACKCUT	237A	FS_09

MEMORANDUM

Date: December 27, 2023

To: Mary Henley and Laura Nokes

cc: Kurt Fremont and Cassandra Moore

From: Tony Miller

Subject: OF237A Source Tracing Status Update – Polycyclic Aromatic Hydrocarbons (PAH)

INTRODUCTION

The City of Tacoma (City) is tasked with source tracing contaminants of concern identified through annual sediment trap sampling in the Thea Foss Watershed. There has been an ongoing investigation in a portion of the Outfall (OF) 237A drainage basin since 2005 to identify possible sources of polycyclic aromatic hydrocarbons (PAHs) found during upline sediment trap monitoring. Several source control activities have taken place in the area, but the investigation continues as elevated concentrations of PAHs persist in sediment trap samples. The targeted collection system is in the FD13B-New (previously FD13B) sediment monitoring area (Figure 1).

While great strides have been made to identify sources of PAHs and eliminate them during previous investigations, sediment monitoring results in 2017 and 2018 indicated a continued presence of PAHs in at least one private stormwater collection system (Tacoma, 2018). In response, City staff continued the investigation in this area and continued to work with a private property owner to implement source control measures to eliminate a source of PAHs in the FD13B-New basin.

Additionally, short-term sediment traps placed in the south part of this drainage basin exhibited elevated concentrations. These elevated results from ST-C (Figure 1) isolated that the contamination was likely coming from the General Mechanical or CHI Franciscan Health System properties. Ongoing investigations in 2021 isolated it to the southernmost parking lot at the CHI Franciscan property. Reports for historic investigations in this basin are available to review upon request (Tacoma 2015, 2016, 2017, 2018, 2019, 2020, 2021, 2022).

2023 INVESTIGATION

On August 18, 2023, Environmental Compliance (EC) staff received word from Tahni Madden (CHI Franciscan property manager) that all parking lot repairs were completed and that their private stormwater system had been cleaned post-construction (Appendix A). Sediment trap results showed that FD13B-New PAH concentrations had significantly decreased in 2023 to 58,330 ug/Kg (Table 1) which is significantly lower than what is classified as relative low levels of contamination (<164,000 ug/Kg).

2024 PLAN

No investigations are planned in this basin for 2024. Environmental Programs will review the 2024 sediment trap data for FD13B-New when it becomes available to see if the contamination has returned or remains at reduced levels. Further investigations will be conducted if the contamination returns.

Please let me know if you have any questions or concerns.

Enclosures:

Figure 1	Map of 2021 and 2022 sample locations and concentrations
Figure 2	Map of Historical PAH Concentrations
Table 1	Sample data from 2023 sample results
Appendix A	Correspondence with CHI Franciscan

References:

Tacoma 2016. 2015 Stormwater Source Control Report and Water Year 2015 Stormwater Monitoring Report. City of Tacoma. March 31, 2016

Tacoma 2017. 2016 Stormwater Source Control Report and Water Year 2016 Stormwater Monitoring Report. City of Tacoma. March 31, 2017

Tacoma 2018. 2017 Stormwater Source Control Report and Water Year 2017 Stormwater Monitoring Report. City of Tacoma. March 31, 2018

Tacoma 2019. 2018 Stormwater Source Control Report and Water Year 2018 Stormwater Monitoring Report. City of Tacoma. March 31, 2019

Tacoma 2020. 2019 Stormwater Source Control Report and Water Year 2019 Stormwater Monitoring Report. City of Tacoma. March 31, 2020

Tacoma 2021. 2020 Stormwater Source Control Report and Water Year 2020 Stormwater Monitoring Report. City of Tacoma. March 31, 2021

Figure 1

Map of 2021 and 2022 Sample Locations and Concentrations

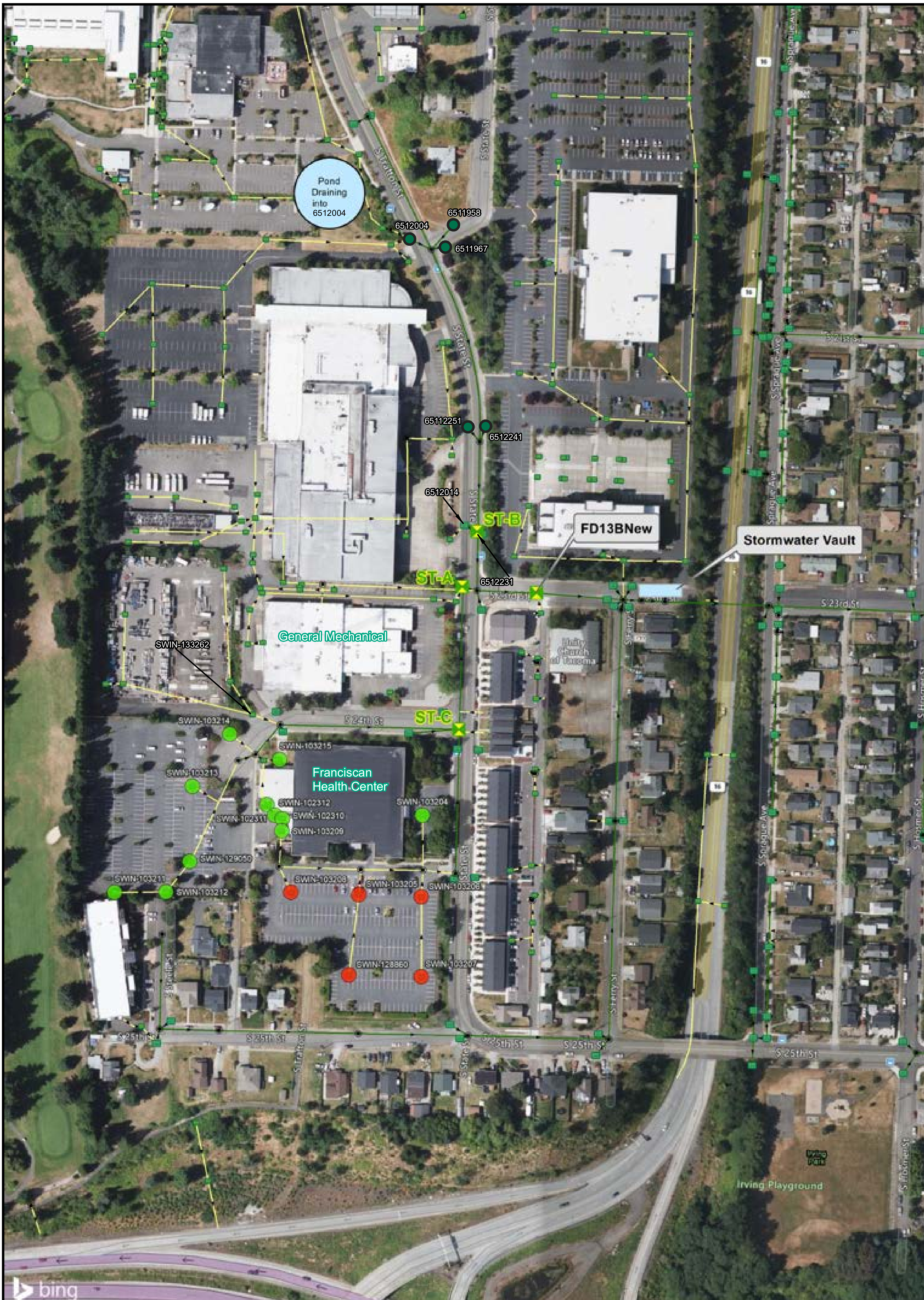


Figure 1 (2021)
FD13BNew (OF 237A)
PAH Source Tracing Investigation

- Pubic CB
- Private CB
- Public Main
- Private Main
- Storm MH
- Sediment Trap

PAHppb
- < 15,000

New sample locations and concentrations
PAH Levels
- High
- Low

N

Feet
0 100 200

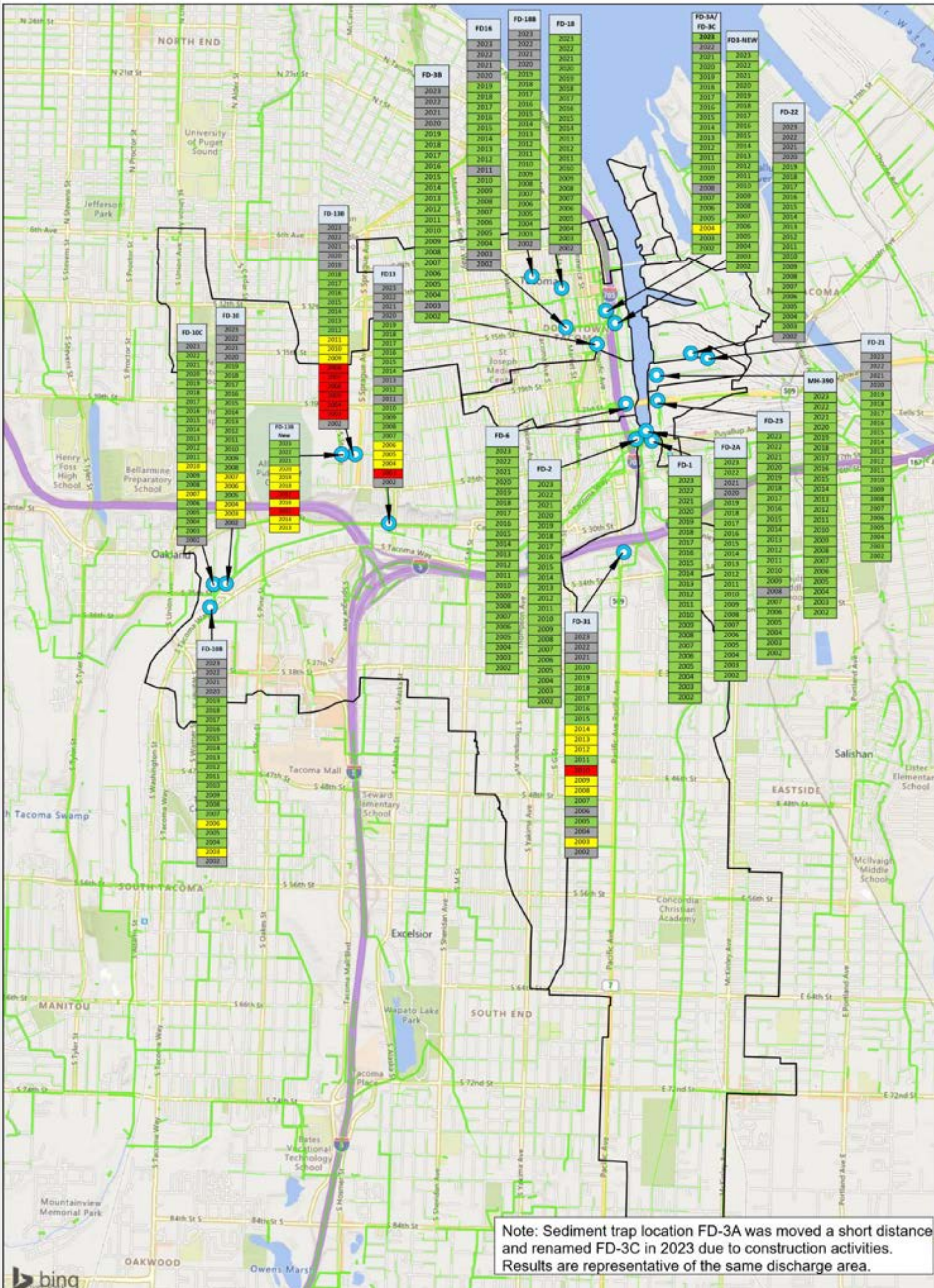
Tacoma

Map Date: January 2022
Source: Science and Engineering Division, Environmental Services Department
City of Tacoma

Center for Urban Waters
326 East D Street , Tacoma WA 98421
(253) 591- 5588

Figure 2
Map of Historical PAH Concentrations

Figure 2-1.2
Sediment Trap Results - PAHs



Note: Sediment trap location FD-3A was moved a short distance and renamed FD-3C in 2023 due to construction activities. Results are representative of the same discharge area.

Legend

- SAMPLE SITE LOCATIONS
- STORM LINES
- TRUNKLINES 24" AND LARGER
- STORMWATER SUB-BASINS

Map Date: November 29, 2023
Source: Science and Engineering Division, Environmental Services Department City of Tacoma

Environmental Services/ Science & Engineering
326 East D Street, Tacoma WA 98421
(253) 591-5588

N

0 1,000 2,000 4,000 Feet

Symbol Level Key

- NO ANALYSIS
- SMALL LEVELS - < 164,000 ug/Kg
- MEDIUM LEVELS - 164,000 - 300,000 ug/Kg
- LARGE LEVELS - > 300,000 ug/Kg

Tacoma

Projects\2023\P0098_FossFigures\2023_PAHs_SedimentTrapResultFigureUpdatesForFossReport

Table 1

Sample Data from 2023 Sample Results

Table 1
FD13B-2023 Source Tracing Results

Sample Date Collected	FD13B 10/20/2023	
Conventionals		
Total Solids (%)	28.7	
PAHs in ug/kg		
2-Methylnaphthalene	**34**	
Acenaphthene	**91**	
Acenaphthylene	**48**	
Anthracene	**765**	
Benzo(a)anthracene	**4,220**	
Benzo(a)pyrene	**4,430**	
Benzo(b,k)fluoranthen	**11,700**	
Benzo(g,h,i)perylene	**1,850**	
Chrysene	**6,360**	
Dibenz(a,h)anthracene	**643**	
Fluoranthene	**11,600**	
Flourene	**198**	
Indeno(1,2,3-cd)pyren	**2,800**	
Napthalene	**91**	**J**
Phenanthrene	**4,460**	
Pyrene	**9,040**	
Total PAHs in ug/kg	**58,330**	

KEY & COMMENTS	
PAHs	
Small Levels	**<164,000 ug/kg**
Medium Levels	**164,000 - 300,000 ug/kg**
Large Levels	**> 300,000 ug/Kg**

Appendix A
Written Correspondence

First Email String

Petty, Cassie

From: Tahni Madden WA-Tacoma <tahni.madden@commonspirit.org>
Sent: Monday, August 14, 2023 8:41 AM
To: Miller, Tony
Subject: Re: 2420 State St.

Tony - Eagle Asphalt completed the parking lot repairs, crack filling and seal and stripe of the main parking lot (where the 5 problem drains are located). Then, this morning we had the drains cleaned by Drain-Pro, Inc. Thanks for your patience! Please feel free to come out and re-test the drains when you are able to make those arrangements - t

Tahni Madden

Property Manager

National Real Estate Services

- Pacific Northwest Division

CommonSpirit Health™

1149 Market Street, 10-06

Tacoma, WA 98402

253-428-8340 (O)

253-310-1205 (M)

Tahni.Madden@commonspirit.org

On Mon, Jul 17, 2023 at 8:59 AM Tahni Madden WA-Tacoma <tahni.madden@commonspirit.org> wrote:

Thank you and will do! - t

Tahni Madden

Property Manager

National Real Estate Services

- Pacific Northwest Division

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On Mon, Jul 17, 2023 at 6:29 AM Miller, Tony <TMiller@cityoftacoma.org> wrote:

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Tony Miller

City of Tacoma

Environmental Services

Desk: (253) 502-2195 Mobile: (253) 355-8955

tmiller@cityoftacoma.org

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Sent: Friday, July 14, 2023 3:11 PM
To: Miller, Tony <TMiller@cityoftacoma.org>
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STORMWATER SOLIDWASTE WASTEWATER
ENVIRONMENTAL SERVICES DEPARTMENT

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CITY OF Tacoma STORMWATER SOLIDWASTE WASTEWATER ENVIRONMENTAL SERVICES DEPARTMENT

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Third Email String

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To: Tahni Madden WA-Tacoma
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MEMORANDUM

Date: December 27, 2023

To: Mary Henley and Laura Nokes

cc: Kurt Fremont and Cassandra Moore

From: Tony Miller

Subject: OF237A Source Tracing Status Update – Polyaromatic Hydrocarbons Investigation and PCBs in FD10c

INTRODUCTION

The City of Tacoma (City) is tasked with source tracing contaminants of concern identified through annual sediment trap monitoring and sampling in the Thea Foss Waterway. Based on sediment monitoring in Outfall 237A (OF237A), the FD10c drainage basin was identified as having moderate PCB contamination and elevated phthalate levels in catchbasin sediments. In addition, past investigations have identified mercury as a potential source of contamination. In previous years, the catchbasins throughout the entire FD10c basin have been sampled, including both public and private sources. The plan for 2023 was to re-sample some of the private locations, which previously held some concentrations of PCBs to determine if these concentrations have increased or decreased. Historic investigations in this basin are available for review in previous annual reports (Tacoma 2015, 2016, 2017, 2018, 2019, 2020, 2021, 2022).

2023 INVESTIGATION

In late 2022, Sewer Transmission cleaned the entire storm system along Lawrence Street and short-term sediment traps were re-installed on February 2, 2023. The short-term sediment traps were retrieved and submitted to the lab on July 11, 2023. Results showed that both sediment traps (6764559 and 6764550) had non-detectable levels of PCBs (Figure 1) (analysis available upon request). The FD10c sediment trap had non-detectable levels of PCBs for 2023. It is possible that the source of PCBs was historical contamination trapped in the stormwater system in Lawrence Street and the system cleaning removed this contamination.

2024 PLAN

No investigations are planned in this basin for 2024. The Environmental Programs Group will review the 2024 FD10c sediment trap data when it becomes available to see if the contamination has returned or if it remains gone. Further investigations will resume if the contamination returns.

Please let me know if you have any questions or concerns.

Enclosure:

Figure 1: FD10C Sampling Map

References:

Tacoma 2015. 2014 Stormwater Source Control Report and Water Year 2013 Stormwater Monitoring Report. City of Tacoma. March 31, 2015

Tacoma 2016. 2015 Stormwater Source Control Report and Water Year 2014 Stormwater Monitoring Report. City of Tacoma. March 31, 2016

Tacoma 2017. 2016 Stormwater Source Control Report and Water Year 2015 Stormwater Monitoring Report. City of Tacoma. March 31, 2017

Tacoma 2018. 2017 Stormwater Source Control Report and Water Year 2016 Stormwater Monitoring Report. City of Tacoma. March 31, 2018

Tacoma 2019. 2018 Stormwater Source Control Report and Water Year 2017 Stormwater Monitoring Report. City of Tacoma. March 31, 2019

Tacoma 2020. 2019 Stormwater Source Control Report and Water Year 2018 Stormwater Monitoring Report. City of Tacoma. March 31, 2020

Tacoma 2021. 2020 Stormwater Source Control Report and Water Year 2020 Stormwater Monitoring Report. City of Tacoma. March 31, 2021

Tacoma 2022. 2021 Stormwater Source Control Report and Water Year 2021 Stormwater Monitoring Report. City of Tacoma. March 31, 2022

Tacoma 2023. 2022 Stormwater Source Control Report and Water Year 2022 Stormwater Monitoring Report. City of Tacoma. March 31, 2023

Figure 1

FD10C Source Tracing 2023 Sampling Locations

Figure 1: FD_10C Source Tracing 2023 Sampling Locations

R:\Projects\2023\P0100_Outfall24 SourceTracingInvestigation\FD_10CSourceTracing2023SampleLocations.mxd

Legend

(Sample Locations

Map Date: 12/1/2023
Source: Science and Engineering Division
Environmental Services Department
City of Tacoma
326 East D Street, Tacoma WA 98421
(253) 591-5588

0 50 100 200
Feet

Tacoma

City of Tacoma
Environmental Services Department

July 18, 2023

SENT VIA CERTIFIED MAIL

Corporation Service Company
Registered Agent for, Tekni-Plex, Inc.
300 Deschutes Way SW, STE 208 MC-CSC1
Tumwater, WA 98501

Subject: Notice of Violation with Monetary Penalties and Corrective Action Order (NOV 2023-005)

Dear Registered Agent:

Under the legal authority granted in Tacoma Municipal Code (TMC) Subchapter 12.08D, the Environmental Services Department hereby issues Tekni-Plex, Inc., located at 3101 South Tacoma Way, Tacoma, WA 98409, the enclosed Notice of Violation with Monetary Penalties and Corrective Action Order in the amount of $2,000 for violations of TMC 12.08D.

This Notice of Violation with Monetary Penalties and Corrective Action Order represents a determination that a violation of TMC 12.08D has occurred and that corrective action is required. This determination is final and conclusive unless you appeal this Notice of Violation with Monetary Penalties and Corrective Action Order to the City of Tacoma's Hearing Examiner and request a hearing as provided in TMC 1.82.050.J and TMC 1.82.060.M. If you decide to file an appeal, you must do so within 10 days from the date of service of this Notice, pursuant to TMC 1.84.020.

The procedures for filing an appeal of a notice of violation are set forth in TMC 1.82.050.J, 1.82.060.M and TMC 1.84.020. Appeals must be directed to:

City of Tacoma
Tacoma Municipal Building
Office of the Hearing Examiner
747 Market Street
Tacoma, WA 98402

Sincerely,

DocuSigned by:
Cassandra Moore
F7F79091EFFA489...

Cassandra Moore, MES
Assistant Division Manager
Environmental Compliance

cc: Brian Quinney, Tekni-Plex, Inc, 3101 South Tacoma Way, Tacoma, WA 98409
Washington State Department of Ecology, Angela Vincent, SWRO
Braden Price, City of Tacoma Environmental Compliance

Enclosures: Notice of Violation, Invoice
Sent via First Class and Certified Mail: 7018 3090 0000 5413 4586

CITY OF TACOMA
Department of Environmental Services

IN THE MATTER OF NOTICE OF VIOLATION with MONETARY PENALTIES and CORRECTIVE ACTION ORDER	))))	No. 2023-005

RESPONSIBLE PERSON
Brian Quinney
Tekni-Plex, Inc
3101 South Tacoma Way
Tacoma, WA 98409

In care of:
Corporation Service Company
Registered Agent for, Tekni-Plex, Inc.
300 Deschutes Way SW, STE 208 MC-CSC1
Tumwater, WA 98501

I. <u>Location of Violations:</u> 3101 South Tacoma Way, Tacoma, WA 98409

II. Legal Authority and Notice of Violation

In accordance with Tacoma Municipal Code (TMC) 12.08D.110, TMC 12.08D.120, TMC 12.08D.400, the City of Tacoma (City), Environmental Services Department (ES), is issuing this Notice of Violation with Monetary Penalties and Corrective Action Order in the amount of $2,000 to Tekni-Plex, Inc, located at 3101 South Tacoma Way, Tacoma, WA 98409, for the following violations of applicable sections of TMC 12.08D occurring on March 29, 2023:

- **<u>Violation 1</u>** Discharging process-associated wastewater into the municipal separate storm sewer system (MS4) which is prohibited under **TMC 12.08D.110.C, Allowable, Conditional, and Prohibited Discharges.**
- **<u>Violation 2</u>** Failure to immediately notify ES of the release of process wastewater to the City's MS4, in violation of **TMC 12.08D.120, Requirement to Report Spills, Releases, or Illicit Discharges**.

Violations of TMC 12.08D are prohibited practices under TMC 12.08D.400 and subject to enforcement and issuance of compliance orders pursuant to and in accordance with the Environmental Services Stormwater Compliance Policy and TMC Ch.1.82.

III. Background

<u>Violation 1</u> During a site visit on March 29, 2023, ES observed evidence of a spill on the Tekni-Plex property leading to a storm drain. The spill originated from a dumpster where waste debris from a pulping tank is collected until it is hauled off site. The City has assessed a $2000 penalty for the violation.

<u>Violation 2</u> TMC 12.08D.120 requires the responsible person to immediately, but no later than twenty-four (24) hours after becoming aware, report to ES any spill, release, illicit discharge, or other incident contributing pollutants to the MS4. The trail of spilled paper pulp was dry when it was discovered, and staff said they did not know when the spill occurred.

IV. Corrective Action Order

Tekni-Plex, Inc is being issued this Notice of Violation with Monetary Penalties and Corrective Action Order to take actions to implement controls to prevent prohibited discharges and to prevent contaminants from coming into contact with stormwater as required by TMC 12.08D.150, and Tacoma's Stormwater Management Manual (SWMM),

No later than fourteen (14) calendar days following the delivering of this Notice, Tekni-Plex shall submit a progress report to ES. The report shall include a statement as to whether Tekni-Plex has completed the corrective action and, if not, the date on which Tekni-Plex expects to comply. Failure to comply with deadlines will result in escalated enforcement.

V. Appeal Process

This Notice of Violation with Monetary Penalties and Corrective Action Order represents a determination that a violation of TMC 12.08D has occurred and that corrective action is required, which determination is final and conclusive unless you appeal this Notice of Violation with Monetary Penalties and Corrective Action Order to the City of Tacoma's Hearing Examiner and request a hearing as provided in TMC 1.82.050.J and TMC 1.82.060.M. If you decide to file an appeal, you must do so within 10 days from the date of service of this Notice, pursuant to TMC 1.84.020.

The procedures for filing an appeal of a notice of violation are set forth in TMC 1.82.050.J, 1.82.060.M and TMC 1.84.020. Appeals must be directed to:

City of Tacoma
Tacoma Municipal Building
Office of the Hearing Examiner
747 Market Street
Tacoma, WA 98402

This notice is a formal document, which requires that future related violations be met with escalated enforcement including compliance schedules, permit revocation/suspension and/or Significant Non-Compliance status.

By Order of the undersigned Environmental Services Department Compliance Officer:

Signed this 18th day of July, 2023 at Tacoma, Washington.

DocuSigned by:
Kurt Fremont

Kurt Fremont
Division Manager, Compliance Officer
Business Operations Division
326 East D Street
Tacoma, WA 98421
253-502-2238

ATTACHMENT A.5 - OF237B

Table A.5-1
2023 Pipe Maintenance Activities for OF237B

Date	Location	Type of Work	Outfall	Sub-Basin
6/1/2023	5602 PACIFIC AVE - SINKING CB	REPAIR ASSET	237B	FS_10
6/15/2023	5010 PACIFIC AVE - OIL SPILL - SWEEPER	STREET SWEEPING	237B	FS_10
6/8/2023	5602 PACIFIC AVE - HOLE CREW REQ - CLEAN	CLEAN ASSET	237B	FS_10
3/16/2023	516 S 38TH ST - CLEAN FOR TV	CLEAN ASSET	237B	FS_10
11/7/2023	BC CB LATERAL 618 E 75TH 1 YR	BACKCUT	237B	FS_11
11/17/2023	HV CB LATERAL 618 E 75TH 1 YR	CLEAN ASSET	237B	FS_11
11/8/2023	618 E 75TH ST - FLOODING - CHECK SYS	CLEAN ASSET	237B	FS_11
2/21/2023	7606 A ST - CLEAN CB'S	CLEAN ASSET	237B	FS_11
11/17/2023	7218 A ST - CB'S NOT DRAINING	CLEAN ASSET	237B	FS_11
3/6/2023	6518914 - SOURCE CONTROL REQ - CLEAN	CLEAN ASSET	237B	FS_11
1/23/2023	311 N Lane - Surface Flooding	CLEAN ASSET	237B	FS_11
9/19/2023	STORM BC 1 SEG YEARLY 68-70TH PAC AVE	BACKCUT	237B	FS_11
2/28/2023	6260406 - ENGINEERING REQ - CLEAN	CLEAN ASSET	237B	FS_11
2/28/2023	6260421 - ENGINEERING REQ - CLEAN	CLEAN ASSET	237B	FS_11
9/6/2023	BC 8 STORMS 1 YR, BLUEBERY FIELDS	BACKCUT	237B	FS_11
9/6/2023	BC 8 STORMS 1 YR, BLUEBERY FIELDS	BACKCUT	237B	FS_11
3/16/2023	7217 PACIFIC - BC	BACKCUT	237B	FS_11
3/27/2023	7217 PACIFIC AVE - CLEAN	CLEAN ASSET	237B	FS_11
9/6/2023	BC 8 STORMS 1 YR, BLUEBERY FIELDS	BACKCUT	237B	FS_11
9/6/2023	BC 8 STORMS 1 YR, BLUEBERY FIELDS	BACKCUT	237B	FS_11
9/6/2023	BC 8 STORMS 1 YR, BLUEBERY FIELDS	BACKCUT	237B	FS_11
9/6/2023	BC 8 STORMS 1 YR, BLUEBERY FIELDS	BACKCUT	237B	FS_11
9/8/2023	BC 8 STORMS 1 YR, BLUEBERY FIELDS	BACKCUT	237B	FS_11
9/7/2023	BC 8 STORMS 1 YR, BLUEBERY FIELDS	BACKCUT	237B	FS_11
12/21/2023	203 E 52ND - CLEAN DRIVEWAY CULVERT	CLEAN ASSET	237B	FS_11
10/25/2023	4301 E C ST - CLEAN CULVERTS	CLEAN ASSET	237B	FS_11
11/14/2023	East C St and Puyallup Ave - CB	CLEAN ASSET	237B	FS_12
10/2/2023	TACOMA DOME - SWEEPING	STREET SWEEPING	237B	FS_12
3/30/2023	INSP & CLN 1 SEG 1 YR 216 PUYALLUP AVE	CLEAN ASSET	237B	FS_12
3/8/2023	301 E 26TH ST - CLEAN CB	CLEAN ASSET	237B	FS_12
3/8/2023	301 E 26TH ST - CLEAN CB	CLEAN ASSET	237B	FS_12
9/8/2022	BC 8 STORMS 1 YR, BLUEBERY FIELDS	BACKCUT	237B	FS_11
9/8/2022	BC 8 STORMS 1 YR, BLUEBERY FIELDS	BACKCUT	237B	FS_11
9/8/2022	BC 8 STORMS 1 YR, BLUEBERY FIELDS	BACKCUT	237B	FS_11
9/8/2022	BC 8 STORMS 1 YR, BLUEBERY FIELDS	BACKCUT	237B	FS_11
8/26/2022	BC 8 STORMS 1 YR, BLUEBERY FIELDS	BACKCUT	237B	FS_11
8/29/2022	BC 8 STORMS 1 YR, BLUEBERY FIELDS	BACKCUT	237B	FS_11
3/22/2022	237 E 66th - CLEAN VAULT	OTHER MAINTENANCE	237B	FS_11
8/5/2022	5712 EAST G ST, CLEAN POND 1 YR	CLEAR BRUSH	237B	FS_11
6/22/2022	CLN SWALE 1 YR, 205 E 52ND ST	CLEAR BRUSH	237B	FS_11
6/22/2022	CLN SWALE 1 YR 211 EAST 52ND ST	CLEAR BRUSH	237B	FS_11
10/6/2022	CLNDI 1 YR, 315 N STADIUM WAY	CLEAR BRUSH	237B	FS_11
6/23/2022	INSP & CLEAN SWALE 4802 EAST E 1YR	CLEAR BRUSH	237B	FS_11
1/28/2022	401 E MORTON ST - SECURE MH RIM/COVER	REPAIR ASSET	237B	FS_11
2/7/2022	1002 E 57TH - PAVING - CLEAN ****	CLEAN ASSET	237B	FS_11
1/3/2022	7002 E E - PAVING - CLEAN FOR TV	CLEAN ASSET	237B	FS_11
2/15/2022	BC CB LATERAL 618 E 75TH 1 YR	BACKCUT	237B	FS_11
1/19/2022	STORM BC 1 SEG YEARLY 68-70TH PAC AVE	BACKCUT	237B	FS_11
2/7/2022	2021 Media Filter Maintenance 6004330	Clean Asset	237B	FS_11
8/25/2022	301 Puyallup Ave - CLEAN CB	CLEAN ASSET	237B	FS_12
8/9/2022	601 UPPPER PARK RD - CLEAN CB'S	CLEAN ASSET	237B	FS_12
8/15/2022	2616 E D ST - CLEAN FOR TV	CLEAN ASSET	237B	FS_12
8/26/2022	723 E 34TH ST - CLEAN FOR TV	CLEAN ASSET	237B	FS_12
8/12/2022	216 E 26TH ST - CLEAN FOR TV	CLEAN ASSET	237B	FS_12
8/29/2022	2750 E D ST - CLEAN FOR TV	CLEAN ASSET	237B	FS_12
8/29/2022	2750 E D ST - CLEAN FOR TV	CLEAN ASSET	237B	FS_12
8/29/2022	2702 E D ST - CLEAN FOR TV	CLEAN ASSET	237B	FS_12
6/27/2022	2702 E D ST - AMG - CLEAN FOR TV	CLEAN ASSET	237B	FS_12

City of Tacoma
Environmental Services Department

December 13, 2023

SENT VIA CERTIFIED MAIL

Teena Quichocho
5918 E I St
Tacoma, WA 98404

Subject: Warning Letter – Illicit Discharge at 5918 East I Street

Dear Ms. Quichocho:

City of Tacoma (City) Environmental Compliance (EC) staff have been notified of an illicit discharge of sanitary sewage wastewater to the ground at the above-referenced property. A recreational vehicle (RV) parked on the property was found to be the source of the discharge. This resulted in an unsanitary public nuisance that is a violation of Tacoma Municipal Code (TMC) 8.30.040.B[1].

Corrective Actions

- **You are required to immediately cease the discharge from the RV until said discharge can be directed into a permitted side sewer connection.**

Failure to adequately address this concern with City of Tacoma Environmental Services may result in escalating enforcement actions, including, but not limited to, Notices of Violation with Civil Penalties of up to $10,000 per day for each violation of TMC 12.08.

If you have any questions regarding this matter, please contact Source Control Representative, Braden Price at (253) 878-8091 or bprice@cityoftacoma.org.

Sincerely,

DocuSigned by:
Jason Yost
8BA765D4218F419...

Jason Yost
Pretreatment Coordinator
Environmental Compliance

cc: Susie Rogers, City of Tacoma, Public Works
Stephanie Seivert Wilson, City of Tacoma, Environmental Services
Mindee Weber, City of Tacoma Planning and Development Services
Cindy Callahan, Tacoma-Pierce County Health Department

Sent by First Class and Certified Mail: 7022 2410 0003 0426 7732

[1] TMC 8.30.040B The discharge of sewage, human excrement, or other wastes in any location or manner, except through systems approved for the conveyance of such, to approved public or private disposal systems and which are constructed and maintained in accordance with the provisions of TMC 2.06, as now or hereafter amended, and all other adopted laws pertaining to such systems.

ATTACHMENT A.6 - OF243

Table A.6-1
2023 Pipe Maintenance Activities for OF243

Date	Location	Type of Work	Outfall	Sub-Basin
2/28/2023	448 E 18TH ST - REPLACE MH RIM AND COVER	CLEAN ASSET	243	FS_13
1/26/2023	ST PAUL CLEAN UP PROJECT - 6509568	CLEAN ASSET	243	FS_13
2/1/2023	ST PAUL CLEAN UP PROJECT - 6509578	CLEAN ASSET	243	FS_13
1/30/2023	ST PAUL CLEAN UP PROJECT - 6510821	CLEAN ASSET	243	FS_13
1/26/2023	ST PAUL CLEAN UP PROJECT - 6511004	CLEAN ASSET	243	FS_13
1/26/2023	ST PAUL CLEAN UP PROJECT - 6511013	CLEAN ASSET	243	FS_13
2/1/2023	ST PAUL CLEAN UP PROJECT - 6258941	CLEAN ASSET	243	FS_13
6/2/2023	ST PAUL CLEAN UP PROJECT - 6259393	CLEAN ASSET	243	FS_13
9/13/2023	1940 E D ST - CLEAN SEGMENT	CLEAN ASSET	243	FS_13
6/2/2023	ST PAUL CLEAN UP PROJECT - 6270004	CLEAN ASSET	243	FS_13
8/3/2023	ST PAUL CLEAN UP PROJECT - 6282784	CLEAN ASSET	243	FS_13
9/13/2023	1940 E D ST - CLEAN SEGMENT	CLEAN ASSET	243	FS_13

MEMORANDUM

Date: December 27, 2023

To: Mary Henley and Laura Nokes

cc: Kurt Fremont and Cassandra Moore

From: Tony Miller

Subject: OF243 Source Tracing Status Update – Mercury Investigation in FD23

INTRODUCTION

The City of Tacoma (City) is tasked with source tracing contaminants of concern identified through annual sediment trap sampling in the Thea Foss Waterway. Based on sediment monitoring in Outfall 243 (OF243), the FD23 drainage area (Figure 1) of this basin was identified as having ongoing issues with mercury sediment contamination. Historic investigations in this basin are available for review in Appendix A of the previous Foss Stormwater Source Control Reports (Tacoma 2015, 2016, 2017, 2018, 2019, 2020, 2021, 2022).

2023 ACTIONS

FD23 sediment trap had insufficient sediment to analyze for mercury. The contaminant prioritization list is going to be updated to have mercury be priority one, as it is the main contaminant of concern in this drainage basin. Catchbasin 6519946 was sampled on May 10, 2023, and the results were 1.46 mg/Kg (data available upon request), which is a slight uptick from 2022 (Figure 1). Environmental Compliance (EC) cannot find any other areas that discharge to this catchbasin for cleaning or remediation. A business inspection of 414 Puyallup Avenue was requested. This business has stated that they have some type of collection system for their roof runoff onsite. It is possible that this collection system has some historical contamination contained within it. During the business inspection, this system needs to be viewed and sampled if possible.

2024 WORK PLAN

During 2024, EC Staff will request to have catchbasin 6519946 re-cleaned and sampled when there is enough new sediment to do so. EC and the Environmental Programs Group will work with the lab to have the contaminant list re-prioritized for FD23. EC staff will also perform a business inspection at 414 Puyallup Avenue and sample their roof water collection system if possible.

Please let me know if you have any questions or concerns.

Enclosures:

Figure 1: OF243 Source Tracing Investigation: FD23 Drainage Area (south)

References:

Tacoma 2015. 2014 Stormwater Source Control Report and Water Year 2013 Stormwater Monitoring Report. City of Tacoma. March 31, 2015

Tacoma 2016. 2015 Stormwater Source Control Report and Water Year 2014 Stormwater Monitoring Report. City of Tacoma. March 31, 2016

Tacoma 2017. 2016 Stormwater Source Control Report and Water Year 2015 Stormwater Monitoring Report. City of Tacoma. March 31, 2017

Tacoma 2018. 2017 Stormwater Source Control Report and Water Year 2016 Stormwater Monitoring Report. City of Tacoma. March 31, 2018

Tacoma 2019. 2018 Stormwater Source Control Report and Water Year 2017 Stormwater Monitoring Report. City of Tacoma. March 31, 2019

Tacoma 2020. 2019 Stormwater Source Control Report and Water Year 2018 Stormwater Monitoring Report. City of Tacoma. March 31, 2020

Tacoma 2021. 2020 Stormwater Source Control Report and Water Year 2020 Stormwater Monitoring Report. City of Tacoma. March 31, 2021

Tacoma 2022. 2021 Stormwater Source Control Report and Water Year 2021 Stormwater Monitoring Report. City of Tacoma. March 31, 2022

Tacoma 2023. 2022 Stormwater Source Control Report and Water Year 2022 Stormwater Monitoring Report. City of Tacoma. March 31, 2023

Figure 1

OF243 Source Tracing Investigation

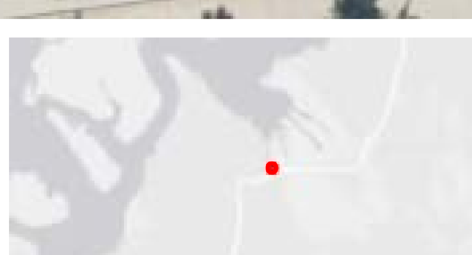
FD23 Drainage Area (south)

Outfall 243 Source Tracing Investigation
FD23 Drainage Area (South)

R:\Projects\2023\P0100_Outfall24 SourceTracingInvestigation\Outfall243Source racingInvestigationFD23DrainageAreaUpdate2023.mxd

Legend

Sample Locations



Map Date: 12/1/2023
Source: Science and Engineering Division
Environmental Services Department
City of Tacoma
326 East D Street, Tacoma WA 98421
(253) 591-5588

0 20 40 80
Feet

Tacoma

ATTACHMENT A.7 - OF245

Table A.7-1
2023 Pipe Maintenance Activities for OF245/OF248

Date	Location	Type of Work	Outfall	Sub-Basin
9/13/2023	1940 E D ST - CLEAN SEGMENT	CLEAN ASSET	243	FS_13
8/3/2023	ST PAUL CLEAN UP PROJECT - 6282784	CLEAN ASSET	243	FS_13
9/13/2023	1940 E D ST - CLEAN SEGMENT	CLEAN ASSET	243	FS_13
9/13/2023	1946 E D ST - CLEAN SUMP	CLEAN ASSET	243	FS_13
9/13/2023	1940 E D ST - CLEAN SUMP	CLEAN ASSET	243	FS_13
9/13/2023	1940 E D ST - CLEAN SUMP	CLEAN ASSET	243	FS_13
1/26/2023	ST PAUL CLEAN UP PROJECT - 6511004	CLEAN ASSET	245	FS_13
1/26/2023	ST PAUL CLEAN UP PROJECT - 6511013	CLEAN ASSET	245	FS_13
6/2/2023	ST PAUL CLEAN UP PROJECT - 6259393	CLEAN ASSET	245	FS_13
6/2/2023	ST PAUL CLEAN UP PROJECT - 6270004	CLEAN ASSET	245	FS_13
6/2/2023	ST PAUL CLEAN UP PROJECT - 6286734	CLEAN ASSET	245	FS_13
6/2/2023	ST PAUL CLEAN UP PROJECT - 6299397	CLEAN ASSET	245	FS_13
6/2/2023	ST PAUL CLEAN UP PROJECT - 6299417	CLEAN ASSET	245	FS_13
9/13/2023	1902 E D ST - CLEAN MH	CLEAN ASSET	245	FS_13
2/28/2023	448 E 18TH ST - REPLACE MH RIM AND COVER	REPAIR ASSET	248	FS_13
1/26/2023	ST PAUL CLEAN UP PROJECT - 6509568	CLEAN ASSET	248	FS_13
2/1/2023	ST PAUL CLEAN UP PROJECT - 6509578	CLEAN ASSET	248	FS_13
2/1/2023	ST PAUL CLEAN UP PROJECT - 6258941	CLEAN ASSET	248	FS_13
3/24/2023	448 E 18th- STREET PATCH	STREET PATCH	248	FS_13

ATTACHMENT A.8 - OF254

Table A.8-1
2023 Pipe Maintenance Activities for OF254

Date	Location	Type of Work	Outfall	Sub-Basin
2/1/2023	ST PAUL CLEAN UP PROJECT - 6510554	CLEAN ASSET	OF254	FS_14
2/1/2023	ST PAUL CLEAN UP PROJECT - 6510562	CLEAN ASSET	OF254	FS_14
2/1/2023	ST PAUL CLEAN UP PROJECT - 6510572	CLEAN ASSET	OF254	FS_14
2/1/2023	ST PAUL CLEAN UP PROJECT - 6510776	CLEAN ASSET	OF254	FS_14
1/26/2023	ST PAUL CLEAN UP PROJECT - 6510786	CLEAN ASSET	OF254	FS_14
1/30/2023	ST PAUL CLEAN UP PROJECT - 6510794	CLEAN ASSET	OF254	FS_14
1/30/2023	ST PAUL CLEAN UP PROJECT - 6510812	CLEAN ASSET	OF254	FS_14
2/1/2023	ST PAUL CLEAN UP PROJECT - 6255795	CLEAN ASSET	OF254	FS_14
11/20/2023	1100 ST PAUL AVE - ASSIST STREET OPS	OTHER MAINTENANCE	OF254	FS_14
1/30/2023	ST PAUL CLEAN UP PROJECT - 6258828	CLEAN ASSET	OF254	FS_14

City of Tacoma
Environmental Services Department

March 29, 2023

SENT VIA CERTIFIED MAIL

Ted Watts
Jackson Energy
510 East 3rd Street
Tacoma WA, 98421

Subject: Warning Letter – Illicit Discharge to City Stormwater System at 510 East 3rd Street

Dear Mr. Watts:

On March 7, 2023, City of Tacoma Environmental Compliance (EC) staff responded to a complaint of turbid water discharging from the subject property into the neighboring parking lot at 303 East D Street. When staff arrived onsite, they discovered recent fill and grade work had been done to manage potholes. This activity caused displaced turbid water to flow off the property and impact the receiving storm system

The illicit discharge was reported to Washington State Department of Ecology (Ecology) in accordance with the City of Tacoma's National Pollutant Discharge Elimination System (NPDES) Permit[1] issued by Ecology.

Tacoma Municipal Code (TMC) Chapter 12.08D.110.C states, in part,

> *no person shall throw, drain, spill, or otherwise discharge, cause, or allow others under their control to throw, drain, spill, or otherwise discharge any substance not specifically allowed or conditionally allowed into the municipal stormwater system.*

Corrective Actions

- **Limit grading and filling activities on the property to periods of dry weather when there is no standing water present.**

Failure to control turbid stormwater runoff may result in escalating enforcement actions, including, but not limited to, Notices of Violation with Civil Penalties of up to $10,000 per day for each violation of TMC 12.08D.

If you have any questions regarding this matter, please contact Source Control Representative, Erik Harrison at (253) 348-1921, or eharrison@cityoftacoma.org.

Sincerely,

Cassandra Moore, MES
Assistant Division Manager
Environmental Compliance

cc: Ray Schuler, Property Owner

Enclosures: Photos
Sent First Class and Certified Mail: 7021 1970 0002 0379 8413

[1] This NPDES Permit requires the City to implement a Source Control Program to protect the municipal stormwater sewer system from pollutants that could discharge to surface waters such as Puget Sound, Commencement Bay, or any of the City's lakes, creeks, streams and ponds.


Mar 7, 2023 at 10:14:41 AM
303 E D St
Tacoma WA 98421
United States


Mar 7, 2023 at 10:14:57 AM
303 E D St
Tacoma WA 98421
United States


Mar 7, 2023 at 10:16:00 AM
303 E D St
Tacoma WA 98421
United States

City of Tacoma
Environmental Services Department

August 23, 2023

SENT VIA CERTIFIED MAIL

Tom White
Jackson Energy
2500 16th Avenue SW
Seattle, WA 98134

Subject: Private Stormwater System Inspection at 510 East 3rd Street, Tacoma, WA 98422

Dear Mr. White:

On June 30, 2023, City of Tacoma Environmental Compliance (EC) staff and Department of Ecology (Ecology) Stormwater Permit Staff conducted an inspection of the City road and right-of-way along East D, East 3rd, and East F Streets. The purpose of the inspection was to observe what source control and erosion and sediment control measures have been installed and to consider what additional measures will be needed to eliminate the sources of turbid water impacting the City's stormwater system.

During the inspection, staff observed that the site access entrance onto 510 East 3rd Street needed maintenance. The quarry spalls present have become filled in with sediment and silt and are no longer able to effectively prevent sediment from being tracked out onto the street.

Discharges to the stormwater system that are contaminated with silt, sediment, concrete, cement, gravel, asphalt, or construction materials including track-out are prohibited.

Tacoma Municipal Code (TMC) Chapter 12.08D.110.C states, in part,

> *no person shall throw, drain, spill, or otherwise discharge, cause, or allow others under their control to throw, drain, spill, or otherwise discharge any substance not specifically allowed or conditionally allowed into the municipal stormwater system.*

<u>**Corrective Actions**</u>

Within thirty (30) days of receipt of this letter, please complete the required maintenance:

- **Site Entrance – remove sediment/silt and reestablish quarry spalls**
- **Property – regularly monitor to ensure track out and turbid water does not impact the municipal stormwater system**

If you have any questions regarding this matter, please contact Source Control Representative, Erik Harrison at (253) 348-1921, or eharrison@cityoftacoma.org.

Sincerely,

DocuSigned by:

Kevin Brennan
Principal Regulatory Compliance Analyst
Environmental Compliance

cc: Ray Schuler, Property Owner

Sent First Class and Certified Mail: 7021 1970 0002 0379 8529

City of Tacoma
Environmental Services Department

April 14, 2023

SENT VIA CERTIFIED MAIL

Capitol Corporate Services, Inc.
Registered agent for, Capital Lumber Company
1780 Barnes Blvd SW
Tumwater, WA 98512

Subject: Notice of Violation 2023-001

Dear Registered Agent:

Under the legal authority granted in Tacoma Municipal Code (TMC), Chapter 12.08D, the Environmental Services Department hereby issues Capital Lumber Company, located at 2525 E Arizona Biltmore Cir Suite A116 in Phoenix AZ, the enclosed Notice of Violation for violations of TMC 12.08D.

The Notice of Violation does not include a monetary penalty or compliance order. Additional prohibited discharges to the City's municipal stormwater system may lead to escalating enforcement.

This Notice of Violation represents a determination by the Environmental Services Department Compliance Officer that a violation of TMC Chapter 12.08D has occurred, which is final unless you appeal this Notice of Violation to the City of Tacoma's Hearing Examiner and request a hearing.

If you decide to file an appeal, you must do so in accordance with procedures set forth in TMC 1.84.020 within ten (10) days of this Notice.

Service shall be deemed complete upon the third day following the day upon which the notice is placed in the mail, unless the third day falls on a Saturday, Sunday, or federal legal holiday, in which event service shall be deemed complete on the first day other than a Saturday, Sunday, or legal holiday following the third day.

Appeals must be directed to:

> City of Tacoma
> Tacoma Municipal Building
> Office of the Hearing Examiner
> 747 Market Street
> Tacoma, WA 98402

If you have any questions, please contact Regulatory Compliance, Kevin Brennan at 253-405-7248 or Kbrennan@cityoftacom.org.

Sincerely,

DocuSigned by:
Kurt Fremont

Kurt Fremont
Division Manager, Compliance Officer
Environmental Compliance, Business Operations Division
2201 Portland Avenue
Tacoma, WA 98421
253-502-2238

cc: Darren Henderson, Capital Lumber Co., 230 East F Street, Tacoma, WA 98421
Ray Schuler, Property Owner, 1201 Pacific Avenue, Suite 1400, Tacoma, WA 98402
Merita Trohimovich, City Environmental Programs

Enclosure: Notice of Violation
Sent by First Class and Certified Mail: 7021 1970 0002 0379 8444

CITY OF TACOMA
Department of Environmental Services

IN THE MATTER OF)
NOTICE OF VIOLATION) No. 2023 - 001

RESPONSIBLE PERSON[1]
Capital Lumber Company
2525 E Arizona Biltmore Cir, Suite A116
Phoenix, AZ 85016

In care of:
Capitol Corporate Services, Inc.
Registered agent for, Capital Lumber Company
1780 Barnes Blvd SW
Tumwater, WA, 98512

I. Location of Violations

304 & 320 E F Street, Tacoma, WA 98421

II. Legal Authority and Notice of Violations

In accordance with Tacoma Municipal Code (TMC) 12.08D.400 and TMC Chapter 1.82, the City of Tacoma (City), Environmental Services Department (ES), is issuing this Notice of Violation to Capital Lumber Company, at 2525 E Arizona Biltmore Cir, Suite A116 Phoenix, AZ 85016 for the following violation:

> The prohibited discharge of silt and sediment laden stormwater to the municipal stormwater system located at 304 & 320 East F Street on April 10, 2023, in violation of **Tacoma Municipal Code (TMC) 12.08D.110.C**[2] and TMC 12.08D.400.D.1.

The Notice of Violation does not include a monetary penalty or compliance order. Additional prohibited discharges to the City's municipal stormwater system may lead to escalating enforcement.

---

[1] ***TMC 1.82.010 Responsible Person,*** *states, in part: A developer, builder, business operator, or owner who is developing, building, or operating a business on the building, premises, structure, or land that is subject to the regulation alleged to have been violated.*

[2] ***TMC 12.08D.110.C Prohibited Discharges,*** *states, in part: No person shall throw, drain, spill, or otherwise discharge, cause, or allow others under their control to throw, drain, spill, or otherwise discharge any substance not specifically allowed or conditionally allowed into the municipal stormwater system or receiving waters. By way of example and not limitation, discharges that are contaminated with the following substances are prohibited: sewage, and any other material that is regulated as a hazardous substance by federal, state, or local laws and regulations.*

III. Background

303 & 320 East F Street collectively make up a 2.67-acre unimproved dirt lot currently occupied by Cascade Capital and owned by Portland at St. Paul LLC. During periods of rain, turbid stormwater runoff has been observed flowing off the east side of the lot and impacting the City of Tacoma's municipal stormwater system located along East F Street and East 3rd Street, which ultimately discharges into the Thea Foss Waterway.

- On April 10, 2023, City of Tacoma Environmental Service (Control Authority) staff observed turbid water discharging into the Thea Foss Waterway from a stormwater outfall located near the NE corner of Pierce County parcel 6375000181 (326 East D Street). The source of the turbid water was found to be stormwater runoff from 304 & 320 East F Street, that was impacting the stormwater collection system located on East 3rd Street.
- On April 11, 2023, Control Authority staff reported the illicit discharge to the Washington State Department of Ecology in accordance with the City of Tacoma's National Pollutant Discharge Elimination System (NPDES) permit.

IV. <u>Appeal Process</u>

This Notice of Violation represents a determination that violations of TMC Chapter 2.08D have occurred, which determination is final unless you appeal this Notice of Violation to the City of Tacoma's Hearing Examiner and request a hearing as provided in TMC 1.82.050.J. If you decide to file an appeal, you must do so within 10 days from the date of service of this Notice, pursuant to TMC 1.84.020.

Be advised that pursuant to TMC 1.84.020.B.2, if the final day to file a notice of appeal is on a weekend or holiday, the appeal will be timely if filed before the close of business on the next business day following the holiday or weekend. For purposes of this section, holiday shall mean those weekdays during which the City offices are closed for established holidays.

The procedures for filing appeal are set forth in TMC 1.82.050.J and TMC 1.84.020. Appeals must be directed to:

City of Tacoma
Tacoma Municipal Building
Office of the Hearing Examiner
747 Market Street
Tacoma, WA 98402

By Order of the Undersigned Environmental Services Department Compliance Officer:

Signed this 13 day of April, 2023, at Tacoma, Washington

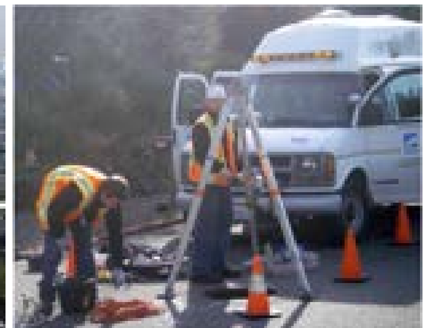
Kurt Fremont
____

Kurt Fremont
Division Manager, Compliance Officer
Business Operations Division
2201 Portland Avenue
Tacoma, WA 98421
253-502-2238

APPENDIX B

Thea Foss and Wheeler-Osgood Waterways
2023 Source Control and Water Year 2023 Stormwater Monitoring Report

Appendix B – Data Validation Report
Water Year 2023



March 2024

Prepared for
Washington State Department of Ecology and
U.S. Environmental Protection Agency

Prepared by
City of Tacoma

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ATTACHMENTS (AVAILABLE UPON REQUEST)

Attachment B.1 – Storm Field Reports
Attachment B.2 – SSPM Field Reports
Attachment B.3 – Storm Lab Reports
Attachment B.4 – SSPM Lab Reports

LIST OF ABBREVIATIONS

2023 Report	2023 Source Control and WY2023 Stormwater Monitoring Report for Thea Foss and Wheeler-Osgood Waterways
2001 SAP	2001 Sampling and Analysis Plan for Thea Foss and Wheeler-Osgood Waterways
BMP	Best Management Practice
BNSF	Burlington Northern Santa Fe
CUW	Center for Urban Waters
CTP	Central Treatment Plant
CD	Consent Decree
City	City of Tacoma
CRM	Certified Reference Material
COC	Contaminants of Concern
CFS	Cubic Feet per Second
DEHP	Bis(2-ethylhexyl) phthalate
DQI	Data Quality Indicator
DQO	Data Quality Objective
DLG	Detection Limit Goal
Ecology	Washington State Department of Ecology
EDL	Estimated Detection Limit
EMPC	Estimated Maximum Possible Concentration
EPA	Environmental Protection Agency
FWDA	Foss Waterway Development Authority
LCS	Laboratory Control Sample
MH	Manhole
MLLW	Mean Lower Low Water
MQO	Measurement Quality Objective
MS	Matrix Spike
MSD	Matrix Spike Duplicate
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NPDES Phase I Permit	NPDES Phase I Municipal Stormwater Permit
NWTPH-Dx	Northwest Total Petroleum Hydrocarbon for Diesel Range Organics
OF	Outfall
PAH	Polycyclic Aromatic Hydrocarbon
PCB	Polychlorinated Biphenyl
PI	Prediction Interval
Permit	State Waste Discharge General Permit for Discharges from Large and Medium Municipal Separate Storm Sewer Systems
pMDL	Performance Method Detection Limit
PBDE	Polybrominated Diphenyl Ether
QAPP	Quality Assurance Project Plan
QA	Quality Assurance
QC	Quality Control
ROW	Right-of-way
RLG	Reporting Limit Goals
RPD	Relative Percent Difference
RSMP	Regional Stormwater Monitoring Program

LIST OF ABBREVIATIONS - CONTINUED

SSPM	Stormwater Suspended Particulate Matter
SOP	Standard Operating Procedure
TOC	Total Organic Carbon
TSS	Total Suspended Solids
UWT	University of Washington-Tacoma
USGS	United States Geological Survey
WY2023	Water Year
WISKI	Water Management Information System, KISTERS Pioneering Technologies

B.1 INTRODUCTION

Stormwater monitoring is required to be conducted under the Thea Foss Waterway Consent Decree (CD) with the Environmental Protection Agency (EPA) and by Section S8.C of the Phase I Municipal Stormwater National Pollutant Discharge Elimination System (NPDES) and State Waste Discharge General Permit for Discharges from Large and Medium Municipal Separate Storm Sewer Systems (Permit).[1] To address these monitoring requirements, stormwater monitoring is conducted at seven outfalls in the Thea Foss Waterway and includes collection of event-based composite and grab samples for chemical analysis as well as annual sediment samples for chemical analysis. Additional details regarding the Thea Foss Waterway CD and NPDES Phase 1 Monitoring Requirements can be found in Section 1.1 through Section 1.3 of the 2023 Source Control and WY2023 Stormwater Monitoring Report for Thea Foss and Wheeler-Osgood Waterways (herein referred to as the 2023 Report) (Tacoma 2024).

The Washington State Department of Ecology (Ecology) issued the most recent NPDES Permit on July 1, 2019, with an effective date of August 1, 2019, and an expiration date of July 31, 2024. This new permit required the City to develop an updated Quality Assurance Project Plan (QAPP) and submit the final plan in August 2020. The 2020 QAPP was approved in August 2020, and in effect October 1, 2021, for the Water Year (WY)2021 monitoring year. Stormwater monitoring discussed in this report was performed under the new NPDES permit and in accordance with the approved 2020 QAPP. Due to the construction of a new 60-inch stormwater outfall (OF230A) discharging to the Thea Foss Waterway, the City revised the existing Thea Foss Watershed Stormwater Work Plan Addendum and 2020 QAPP to reflect the new outfall conditions and monitoring location changes in the Foss Waterway. The Final 2023 QAPP document was submitted in accordance with Section S8.C.2.b of the 2019-2024 Permit. The 2023 QAPP was approved on December 18, 2023 and replaced the 2020 Thea Foss and Wheeler-Osgood Waterways Stormwater Monitoring QAPP, which was currently in effect for stormwater monitoring performed during WY2023.

B.1.1 STORMWATER MONITORING PROGRAM

Monitoring required by the NPDES Phase I Permit and the Stormwater Work Plan Addendum was performed by the City in accordance with the 2020 QAPP and any revisions as outlined in Section B8. The study area and sampling procedures are described in Section B2.0.

The WY2023 sampling period for the Foss Program is October 1, 2022, through September 30, 2023. For reporting purposes, each water year includes the period between October 1st and September 30th, with the wet season defined as October through April and the dry season as May through September. The water year is designated by the calendar year in which it ends. Thus, the year ending September 30, 2023, is called WY2023. Using water years provides consistency with other water quality studies such as those conducted by the United States Geological Survey (USGS).

Stormwater and Stormwater Suspended Particulate Matter (SSPM) were monitored in seven municipal stormwater outfalls. Data collected in WY2023 under the Thea Foss Monitoring Program measured the quality of stormwater and SSPM associated with stormwater discharging to the

[1] The Permit requires that the City either pay into a regional stormwater monitoring fund for effectiveness monitoring or conduct stormwater discharge monitoring at five locations. The City has elected to conduct discharge monitoring to fulfill the Permit requirements.

waterway. Representativeness of the data was assessed using both qualitative and quantitative methods. Qualitative analysis includes review of sampling methods and field data, which is discussed in Sections B.4 (stormwater) and B.5 (SSPM).

Baseflow monitoring was discontinued after WY2011, as sufficient data had been collected to characterize baseflow conditions. After WY2011, new parameters were added for analysis and some analytical methods were being analyzed at lower method detection limits. In order to again characterize the baseflow and to evaluate the effect of the changes, a limited number of baseflow samples were collected in WY2016 at five outfalls and in WY2019 at seven outfalls. Qualitative analysis includes review of sampling methods and field data, which is discussed in Section B.6 (baseflow).

An evaluation of the data relative to continuing source control efforts and a spatial analysis performed for the contaminants of concern are discussed in Sections 3 and 5 of the 2023 Report (Tacoma 2024), respectively.

B.1.1.1 Data Usability and Quality Assessment

The Quality Assurance and Quality Control (QA/QC) approach for the project evaluates the project as a whole and this analysis is presented in Sections B.3 through B.7.

The usability assessment includes assessment of potential outliers, confirmation that the data are comparable and representative, and calculation of the completeness, including:

- identification of outliers from the previous year's data collection efforts;
- confirmation of outliers from previous data collection efforts when sufficient data are available to complete the outlier test;
- confirmation of the comparability of the data;
- confirmation of the representativeness of the data; and
- calculation of the completeness for each dry and wet season for the water year to date.

The data quality assessment process determines whether the sampling and analytical program has fulfilled the project objectives, including the Data Quality Objectives (DQO) established in Section 6.1 of the QAPP, and whether the data can be used to support project management decisions with the desired level of confidence.

Data quality assessment is a professional judgment based on several lines of evidence:

- **Laboratory Data Validation Results**. This metric evaluates laboratory data quality, i.e., the extent to which Measurement Quality Objectives (MQOs) for accuracy, precision, sensitivity, and bias have been met during laboratory analysis, as determined by the data validation process (see Section B.7).
- **Field and Laboratory Completeness**. This metric evaluates data quantity, i.e., the extent to which the QAPP-specified number of valid field and laboratory measurements have been obtained, and whether field and laboratory completeness goals have been achieved.
- **Sample Representativeness**. The degree to which the monitoring program provides a representative sample of the physical-chemical characteristics of baseflow, stormwater, and sediment in space and time will be evaluated. An assessment as to whether the data are suitably representative of the spatial characteristics of the drainage area (i.e., land use, gradient, ground cover, etc.) will be performed, as well as the time-varying characteristics of stormwater within an individual storm event (i.e., adequate sampling of the runoff hydrograph, and time of concentration) and between storm events (i.e., seasonal

changes throughout the monitoring year, and baseflow versus storm flow), and the representativeness of the weather and hydrology during the monitored year(s) compared to an average or “normal” year (see Sections B.3 through B.7).

B.1.1.2 Statistical Evaluation

A discussion of the spatial analysis performed for the constituents of concern are discussed in Section 3 of the WY2023 Report (Tacoma 2024). For each detected chemical at each outfall, the following summary statistics are calculated for baseflow, stormwater, and sediment trap data sets:

Number of samples analyzed

- Number and percentage of samples with detected concentrations
- Arithmetic mean concentration
- Standard deviation of the arithmetic mean
- Percent coefficient of variation
- Minimum and maximum concentrations
- Median concentration (50th percentile)
- 10th and 90th percentile concentrations
- 95th percentile upper and lower confidence limits of the arithmetic mean and the median (N>20; see Gilbert [1987], p.141)

Summary statistics are calculated each year for the current monitoring year, as well as for the entire duration of the monitoring program. In addition, the following hydrologic parameters are tabulated for each sampled storm event:

- Rain depth (inches)
- Average storm intensity (inches/hour)
- Antecedent dry period (hours)
- Event-average and peak flow (cubic feet per second(cfs))
- Total runoff volume (acre-feet)

B.1.2 REPORT ORGANIZATION

The remainder of the report includes the following discussions of the representativeness of monitoring conducted in WY2023 and of the WY2023 results:

- rainfall and flow events
- stormwater sampling events
- SSPM sampling events
- laboratory data review
- recommendations for QAPP revisions

Field reports and summary hydrographs for each event are presented in the following attachments:

- Attachment B.1, Stormwater Field Reports
- Attachment B.2, SSPM Field Reports

Laboratory reports for each event are presented in the following attachments:

- Attachment B.3, Stormwater and Baseflow Lab Reports
- Attachment B.4, SSPM Lab Reports

Summaries of field and laboratory data for each sampling event and summary statistics for WY2023 and the entire monitoring record are presented the following WY2023 Report appendices:

- Appendix C: Supporting Field and Hydrologic Data
- Appendix D: Analytical Data for Baseflow, Stormwater, and Storm Sediment Data

B.2 MONITORING PROGRAM DESCRIPTION

In order to address representativeness of stormwater, the City selected sampling locations, methods, and times so that the data describes various stormwater runoff over the range of land use conditions in the drainage basins, the varying hydrologic conditions within an individual storm event (i.e., rising and falling portions of the hydrograph), and a representative cross-section of storm types during the year. Stormwater and SSPM sampling locations for NPDES and CD compliance are located as near to the end of the seven outfalls as possible to represent the entire drainage basins. Additional SSPM sampling is done upline in the drainage basins for source tracing purposes.

Both end-of-pipe and upline SSPM data are useful tools for source tracing and represent:

- the cumulative effect of sources in that particular drainage basin;
- an extended period of time (up to a year);
- a variety of storms (i.e., a range of volume, duration, and intensity conditions); and
- first flush.

Comparison of results from source tracing sediment traps help to prioritize source control efforts among the sub-basins in the Thea Foss Watershed. It is inappropriate, however, to evaluate SSPM data using sediment quality criteria because the storm drains provide neither habitat nor a point of compliance for aquatic life.

The remainder of this section presents a summary of the monitoring locations and sampling procedures used during WY2023. It also discusses any instances where deviations from the QAPP were required.

B.2.1 SAMPLE LOCATIONS

B.2.1.1 Drainage Basin Description

The Thea Foss and Wheeler-Osgood Waterways are estuarine waterways on the southeastern margin of Commencement Bay. In Commencement Bay and the waterways, average tidal fluctuations vary from zero feet Mean Lower Low Water (MLLW) to 11 feet MLLW. Extreme tides, which generally occur in June and December, range from approximately –4.0 feet MLLW to 14.5 feet MLLW. The Thea Foss Waterway lies north-south along the City's downtown corridor. The Wheeler-Osgood Waterway lies west-east and connects to the east side of the Thea Foss Waterway just south of the 11th Street Bridge. The Thea Foss and Wheeler-Osgood Waterways are commonly referred to as the Thea Foss or Foss Waterway and are referred to herein as the Foss Waterway. The drainage area tributary to the Foss Waterway is referred to herein as the Foss Waterway Watershed.

The Foss Waterway Watershed is one of nine watersheds in the City (Figure B2-1). This watershed covers approximately 5,864 acres and is comprised of drainage basins located in the south-central portion of Tacoma. The area borders the North Tacoma Watershed on the north, Lawrence Street on the west, and East "F" to East "K" Streets on the east. The area extends as far south as 86th Street and includes portions of the Tideflats on the east side of the Foss Waterway (Figure B2-1).

Prior to December 2022, the primary municipal outfalls to the Foss Waterway monitored under the Foss Waterway Monitoring Program were Outfall 237A (OF237A) and OF237B (the twin 96ers), OF230, OF235, OF243, OF245, and OF254. These seven outfalls covered 98 percent of the watershed. There are also several other smaller outfalls that discharge to the waterway. During

2021, the City began construction on a new 60-inch stormwater outfall discharging to the Thea Foss Waterway (OF230A). The existing stormwater system discharging to OF230 and OF235 did not have sufficient capacity to convey runoff generated during significant storm events occurring in the downtown area. The new OF230A was under construction during WY2022 and a portion of WY2023. The upstream drainage area transition to the new outfall was completed in mid-December 2022. OF230A drains approximately 98 percent of the stormwater previously discharging to OF230 and approximately 26 percent of the stormwater previously discharging to OF235.

Due to the re-routing of 98 percent of the stormwater from OF230 to OF230A, there is insufficient stormwater flow at OF230 to collect monitoring samples. Flow and stormwater monitoring continued at OF235 as stated in the revised 2023 QAPP, although the discharge area changed during the water year. The City began monitoring flow and attempted sample collection at the initial sampling location for OF230A on April 12, 2023. Due to insufficient rainfall through the dry season, the City attempted sample collection at this location through November 2023. While the City made every attempt to collect samples at this location, the small tidal windows made sample collection and maintenance of the equipment extremely difficult. The City moved the monitoring location to an upstream location at a higher elevation as shown in Figure B2-5. Due to tidal conditions the baseflow at this location is currently estimated based on historic baseflow data from OF230. Baseflow conditions will be re-evaluated once sufficient data is collected from the new monitoring location.

The City is currently in the process of evaluating the existing flow data and will evaluate sampling data from this monitoring location in the WY2024 Report. This data will be used to determine changes in flow/chemistry in the existing OF235, establish flow/chemistry metrics at the new outfall (OF230A), and continue to evaluate the flow regime at OF230. This annual report includes the new statistical analysis, rainfall to runoff relationships, and flow regime changes associated with this new drainage scheme. Primary land uses in the basins draining to each of the major outfalls and the changes with this new outfall configuration are reflected in the table below:

Outfall	Historic Area (Ac)	Current Area (Ac)	Land Use
230	558	24.2	Commercial
230A	-	583	Residential and Commercial
235	166	109	Commercial
237A	2,813	2,813	Residential and Commercial
237B	1,979	1,979	Residential and Commercial
243	59	59	Industrial and Commercial
245	39	39	Industrial
254	127	127	Industrial

Additional details describing the drainage area changes and the new OF230A drainage area details are discussed in Sections B.2.2.1 and B.2.2.2.

B.2.2 MONITORING LOCATIONS

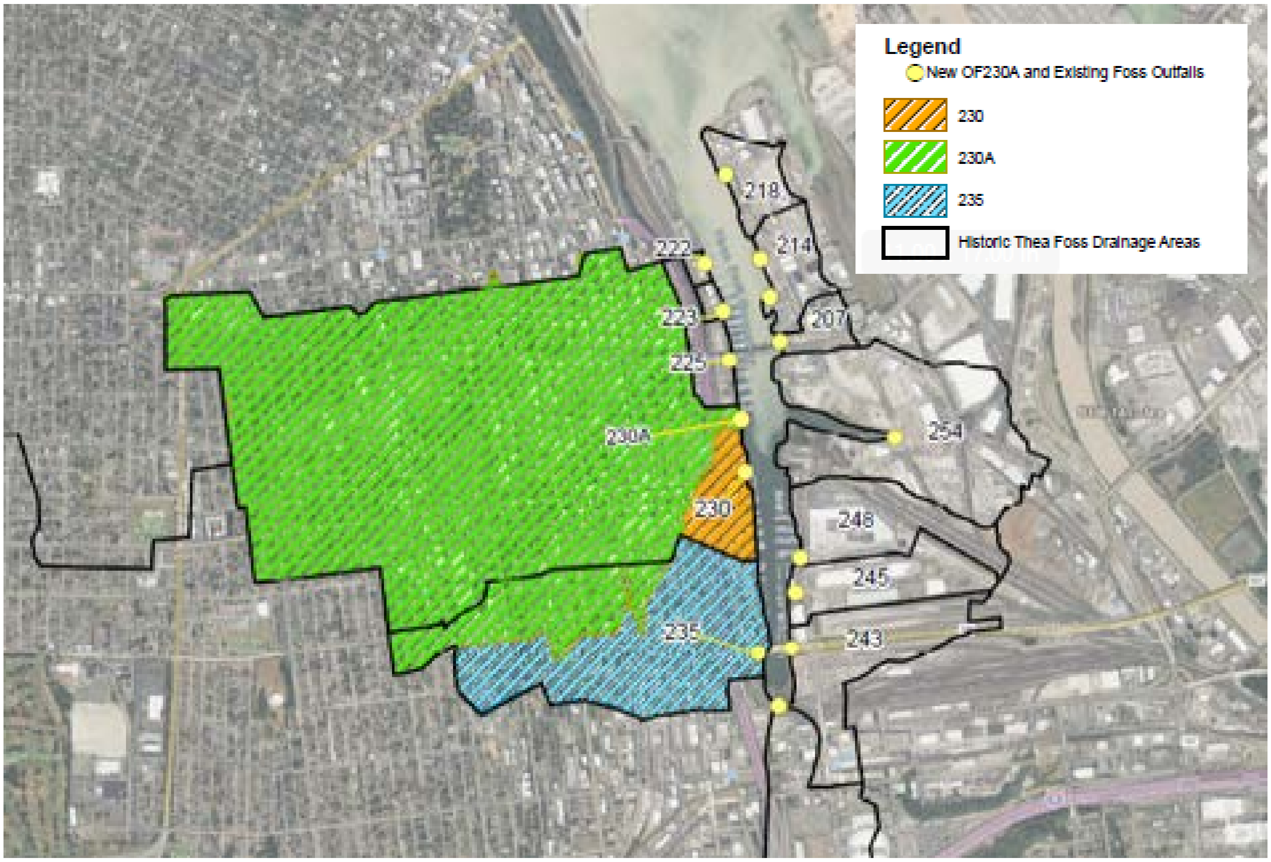
In accordance with Section S8.C of the Permit and the Foss CD, Tacoma is monitoring seven outfalls in the Foss Monitoring Program. All seven outfalls have been monitored for more than 20 years under the Foss Monitoring Program, with three of the outfalls (OF235, OF237B, and OF245) also monitored for three years under Section S8.D of the 2007-2012 NPDES Phase I Permit. The selection of these outfalls is discussed in detail in the QAPP (Tacoma 2023). Due to the construction of OF230A and the re-routing of the stormwater collection system as described in Section 3.1 above, OF230 will no longer be monitored for water quality under this program. OF230A, which now receives the majority of the OF230 flow, will be monitored under the Foss Monitoring Program in lieu of OF230. With this change, Tacoma will still be monitoring the major seven outfalls discharging to the Thea Foss Waterway. Since the locations have already been selected, this section will not go into detail on the selection methodology.

The outfalls selected for this project are the major outfalls discharging into the Foss Waterway and thus represent the bulk of the inputs. The sampling locations for each outfall were selected to be as close to the end-of-pipe as practical. In general, samples are collected at the first manhole upstream from the end of the outfall pipe, which may be tidally influenced, as discussed in more detail below. Details for each site are presented in Table B2-1.

All Foss Waterway outfalls are influenced to a certain degree by tidal inundation and portions of the pipe are inundated with marine water twice a day depending on the pipe elevations and the tide height. Table B2-2 lists each outfall, the invert elevation, whether the pipe is tidally influenced, and baseflow conditions, whether continuous or tidal (including flow rates, if available). Baseflow sources are presented in Figure B2-2 and are described in the outfall-specific sections below.

B.2.2.1 Outfall 230

With construction of the new OF230A, the size of the drainage basin for OF230 was substantially reduced. The new OF230 drainage basin is a small area located on the west side of the Foss Waterway. The drainage area is approximately 24 acres, a fraction of the 582 acres previously draining to this outfall (see figure below). The area discharges to the waterway through a 60-inch outfall pipe (Table B2-2) located at South 15th Street and Dock Street in the right-of-way (ROW) just south of Pacific Seafood (retail). The OF230 drainage basin is now primarily commercial land use and heavily developed. There is minimal baseflow and/or stormwater flow discharging from this outfall location.



Due to the drainage area changes for OF230, sampling stopped at this location in December 2022 and only flow was monitored for the remainder of WY2023. The City will continue to monitor flow at this site during WY2024 in order to study the new flow regime. During heavy, intense flows the new drainage area for OF230A is designed to overflow to OF230. Continued flow monitoring will determine conditions when this overflow may occur. The City will continue to monitor sediment at the historic OF230 sediment trap, for an additional year (WY2024) for statistical purposes and long-term monitoring trends.

The flow monitoring site is located in a job-box at South 15th and Dock Street in a landscaped area next to the City-owned parking lot (Figure B2-4). Confined space entry is needed to maintain the flow sensor. In addition, Figure B2-4 shows the outfall sediment trap sampling site.

B.2.2.2 Outfall 230A

The OF230A drainage basin is located on the mid-portion of the west side of the Foss Waterway. The basin boundaries are shown in Figure B2-3. The area is approximately 583 acres and discharges to the waterway through a 60-inch outfall pipe (Table B2-2). The general basin boundaries are South 8th Street to the north, South 19th Street to the south, South Ainsworth Avenue to the west, and Dock Street to the east. Most of the storm drainage is channeled to South 15th Street via a main trunk line along Market Street and then to the new Jefferson Street Interceptor. Storm lines along Dock Street are susceptible to saltwater intrusion from high tides.

The OF230A drainage basin is heavily developed throughout with primarily commercial land use and some residential use on the west side of the basin (Figure B2-3). The northern portion of the University of Washington–Tacoma (UWT) and the St. Joseph Medical Center Complex discharges to OF230A. The drainage area for UWT is bounded by Pacific Avenue, South 21st Street, Tacoma Avenue, and South 17th Street. Also included in the basin is Tacoma Link light rail, Greater Tacoma

Convention and Trade Center, downtown revitalization (condos and retail), and a portion of Dock Street redevelopment.

OF230A baseflow (estimated as continuous at approximately 0.12 cubic feet per second (cfs) at ½-inch depth) consists of groundwater from footing drains being pumped into several catch basins and potentially non-contact cooling water. The City will continue to evaluate flow data at this location and baseflow conditions will be re-evaluated during WY2024.

Confirmed baseflow sources are (Figure B2-2):

- Since 2004, groundwater from footings for the Greater Tacoma Convention and Trade Center has been pumped to the storm drain (historically OF230, now OF230A).
- During WY2010, investigations led to a discovery of an eight-inch lateral connection on South 11th Street between Commerce Street and Pacific Avenue. This discharge appears to be a continuous flow of clear water at ¼-inch in depth. City staff was unable to locate the source of the discharge due to a collapse in the pipe (historically OF230, now OF230A).

In WY2011, City staff located water discharging into a catch basin (CB# 6502144) at 944 Pacific Avenue. At the time, it was noted that 90 percent of the baseflow in the 11th Street storm line was from this location. It is uncertain whether this discharge is non-contact cooling water or from footing drains (historically OF230, now OF230A).

The whole water monitoring site is located in manhole (MH) #6783605 on “A” Street. Due to turbulent flow conditions in this manhole the City will install the flow sensor and monitoring equipment downstream using an extension cable. While the sampler is currently located in the manhole structure, the City will work towards installing a job-box at this location to store sampling equipment and batteries (Figure B2-5). At that time, the sampling line and sensor would be routed through conduit pipe to the storm system at MH #6783474. Confined space entry is needed to maintain the sample line and flow sensor. The sediment monitoring trap (FD7) is also installed in MH# 6783605 as reflected on Figure B2-5.

A rainfall to runoff relationship has not been developed for OF230A at this time. Due to lack of storm events and tidal influence at this site, the City is unable to provide an estimation for the rainfall to runoff relationship at this time. Due to this outfall receiving most of the flow from OF230 and the similarity in land use and basin size, the City is including the rainfall to runoff relationship developed for OF230 that was based on WY2015-2016 continuous flow data. This relationship is presented in Figure B2-6. The runoff has been normalized to basin size, such that both rainfall and runoff are presented in depth units, and the slope of the regression line is the runoff coefficient (0.3209). The rainfall to runoff relationship for OF230A will be updated once sufficient flow monitoring data is collected at the monitoring site. The rainfall-runoff correlation for the historic OF230 was:

OF230A Estimated Runoff (inches) = 0.3209 X Rainfall (inches).

A minimum of one year of continuous flow data is needed to develop the new rainfall to runoff relationship. The City anticipates that the rainfall to runoff relationship representing the new drainage area will be updated in the WY2024 Annual Report.

B.2.2.3 Outfall 235

The OF235 drainage basin was historically the fourth largest basin in the Foss Waterway Watershed, with 166 acres encompassing a section of downtown between the OF230 and OF237A drainage basins (Figure B2-3). Due to the construction of the new OF230A and the re-routing of a portion of the OF235 drainage area, this heavily developed basin now covers an area of approximately 109 acres which drains through a 42-inch outfall pipe located on the west bank of the Foss Waterway at South 21st and Dock Streets under the State Route (SR)-509 bridge. The historic basin boundaries are South 18th Street to the north, South 23rd Street to the south, South "L" Street to the west, and Dock Street to the east. Due to the construction of the stormwater interceptor along Jefferson Street, a portion of the historic OF235 drainage area now drains to the new OF230A via a new 60-inch pipe (Figure 1-4). The new northern basin boundary is between 19th Street and 21st Street to Jefferson Street where the storm flow is picked up by the new 60-inch pipe. (see Section B.2.2.1).

Commercial land use accounts for the majority of the area in this basin (Figure B2-3). A small portion of freeway right-of-way is in the lower part of this basin, including Interstate 705 (I-705) and the entire I-705 and SR-509 interchange. Most of the stormwater runoff from the freeways discharges to an infiltration pond and not to the City-owned storm drains.

The southern portion of the UWT discharges to OF235. The drainage area for UWT is bounded by Pacific Avenue, South 21st Street, Tacoma Avenue, and South 17th Street. Also included in the basin are portions of the Tacoma Link light rail, downtown revitalization, Dock Street redevelopment, and the Foss Waterway Public Esplanade from South 21st Street to South 17th Street. Most of the OF235 baseflow originates from somewhere on the 19th Street branch above Tacoma Avenue South, with small contributions from Market Street at 19th Street and from Jefferson Avenue and South 21st Street (Figure B2-2). The actual source of the flow on the 19th Street branch has not been located, which leads the City to believe that the baseflow is an accumulation of groundwater springs possibly combined with non-contact cooling water. The Market Street baseflow originates from hillside and is collected in a catch basin at the YMCA building.

In 2015, a source control investigation identified a small groundwater spring on the southwest corner of Jefferson Avenue and South 21st Street, known as the Jefferson Yard. The spring water flows across the pavement to the catch basin on the same corner. During summer months, the flow decreases. There is no baseflow in the South 21st Street branch of OF235 above Jefferson Avenue.

The stormwater sampling site is located at South 21st Street and Dock Street in a private parking lot along the Thea Foss Waterway. The equipment is sited in MH465 (MH# 6767530) (Figure B2-7). The manhole is located in the middle of the parking lot under the SR 509 bridge. The sediment trap sampling device is located in the next upstream manhole, MH463 (MH# 6767511). The property, owned by the City of Tacoma General Government, is a parking area and a park. MH465 is located in the paved area.

A rainfall to runoff relationship that represents the historic outfall drainage area conditions was developed as a part of the 2007-2012 NPDES Phase I Permit S8.D monitoring. This relationship is presented in Figure B2-8. Separate correlations were developed for wet season and dry season conditions. The runoff has been normalized to basin size, such that both rainfall and runoff are presented in depth units, and the slope of the regression line is the runoff coefficient. The rainfall-runoff correlation for OF235 is:

OF235 Wet Season Runoff (inches) = 0.548 X Rainfall (inches).
OF235 Dry Season Runoff (inches) = 0.479 X Rainfall (inches).

A minimum of one year of continuous flow data is needed to develop the new rainfall to runoff relationship. The City anticipates that the rainfall to runoff relationship representing the new drainage area will be updated in the WY2024 Annual Report.

B.2.2.4 Outfall 237A

The OF237A drainage basin is approximately 2,823 acres and drains to the Foss Waterway through the west 96-inch outfall located in the 2300 block of East Dock Street at the head of the waterway. As shown in Figure B2-3, the drainage basin generally extends in the south and west directions from the outfall. The general boundaries are South 19th Street on the north, South 40th Street on the south, Lawrence Street on the west, and Tacoma Avenue on the east.

The OF237A drainage basin contains residential, commercial, and industrial land uses. In addition, freeway ROW for I-5, SR-16, the entire I-5/SR-16 interchange, and a portion of the I-5/I-705 interchange are located within this drainage basin.

Baseflow in OF237A is continuous at approximately 4.4 cfs (Table B2-2) and originates from the following major areas (Figure B2-2):

- An artesian well and seeps in Nalley Valley and near the railroad tracks along South Tacoma Way in Gallagher's Gulch.
- A ditch on Hood Street from South 25th Street to South 23rd Street which collects water from seeps and groundwater from the old Union Pacific railroad tunnel (75 gallons per minute discharging to the 23rd Street Lateral of OF237A).

During periods of increased precipitation, the Leach Creek Holding Basin located to the west of the drainage basin is pumped to the OF237A storm drainage system. The Leach Creek Holding Basin is located within the city limits of Fircrest (west of Tacoma) and has functioned as a stormwater facility since 1961, when a dike was constructed along the southern edge of the current site. Several storm pipelines feed the holding basin draining approximately 2,450 acres of residential, commercial, highways, and other high use developed properties in Tacoma and Fircrest. The primary outflow from the holding basin is a gated 42-inch outlet pipe which conveys stormwater to Leach Creek.

The pump station was constructed in 1991 and consists of four pumps, each with a capacity of 24 cfs and a maximum combined capacity of 96 cfs. During more intense rain events, stormwater from the Leach Creek Holding Basin is pumped through a 42-inch pipe to the Nalley Valley trunk line and discharged into the Foss Waterway through OF237A. The number of pumps operating depends on the intensity of a given storm event, with any number of the four pumps potentially operating at a given time. At low levels of precipitation, no pumps operate and the water discharges to Leach Creek. At increased levels of precipitation[2], pumps sequentially engage up to a maximum of four pumps. The range of flow to the Nalley Valley system from the Leach Creek Holding Basin is from zero to 96 cfs. Emergency overflow from the holding basin is provided by a 40-foot-wide emergency spillway which discharges to Leach Creek.

In 2005, 60 feet of the OF237A outfall pipe was replaced by Burlington Northern Santa Fe (BNSF) Railway as part of their rail track realignment project. Construction included extending the outfall, constructing a new manhole structure, and replacing pipe from the City's sanitary pump station yard (known as Dock Street) to the outfall. The new manhole was constructed downstream of the current stormwater sampling location and FD2 and FD2a. The 23rd Street lateral (FD2a) was rerouted to the new manhole structure in the 237A main trunk line. The new manhole is used as the new end-of-pipe sampling location for OF237A, baseflow and stormwater. The new manhole represents discharge from the entire drainage basin.

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[2] According to the City's best estimation, this occurs when greater than ¾-inch of precipitation falls within a 24-hour period.

The stormwater and sediment trap sampling sites (Figure B2-9) are located in the City's Dock Street Pump Station Yard, in the 2300 block of East "C" Street. The yard is fenced and locked. The equipment is sited within MH# 6777413, which is located in the northwest section of the asphalt-paved yard.

A rainfall to runoff relationship for OF237A was developed based on WY2015 and WY2016 continuous flow data. This relationship is presented in Figure B2-10. Separate correlations were developed for wet season and dry season conditions. The runoff has been normalized to basin size, such that both rainfall and runoff are presented in depth units, and the slope of the regression line is the runoff coefficient. The rainfall-runoff correlation for OF237A is:

OF237A Wet Season Runoff (inches) = 0.301 X Rainfall (inches) + 0.0083
OF237A Dry Season Runoff (inches) = 0.479 X Rainfall (inches) +0.0035

As described below for OF237B, there is a threshold of precipitation of a few hundredths of an inch, below which no runoff occurs. In WY2016, results indicated that this might also be the case for the large, mixed-use basin for OF237A, although it is difficult to discern at this time. Based on the similarities, the threshold was assumed to be the same as the other large basin OF237B. During the dry season, the dry ground has a greater capacity to assimilate incipient rainfall and the basin assimilates some amount of rain before runoff occurs increases (i.e., the threshold is higher during the dry season).

B.2.2.5 Outfall 237B

The OF237B drainage basin encompasses 1,991 acres of south and east Tacoma. This area drains to the Foss Waterway through a 96-inch outfall pipe located on East Dock Street at the head of the waterway. The general basin boundaries are East 23rd Street and East Dock Street to the north, East 84th Street to the south, South Fawcett Avenue to the west, and McKinley Avenue to the east. Most of the storm drainage is channeled to the main trunk line, which flows south to north along East "D" Street.

Primary land use in this drainage basin is residential with some commercial and a very small amount of industrial (Figure B2-3). Commercial areas are mostly linear and spread out in strips along Pacific Avenue and McKinley Avenue with some areas around I-5 to the Foss Waterway. Freeway ROW makes up a small percentage of this basin, and includes a portion of the I-5, I-705, Highway 7 interchange, and Highway 7. This ROW area may increase slightly with the expansion and HOV lanes on I-5. Streets, parks, and open or undeveloped property account for the remaining land use in the basin.

Baseflow from OF237B is continuous at approximately 8.3 cfs and originates from the following major areas (Table B2-2 and Figure B2-2):

- Seeps from the blueberry fields on East 72nd Street.
- A swamp and seeps from along the railroad tracks by Highway 7.

As part of the BNSF Railway railroad realignment project, OF237B was reconstructed between July and September 2005. This work included installation of a new manhole structure downstream of the whole water and SSPM (FD1) sampling location and included extension of the outfall pipe through installation of 60 feet of new concrete pipe. The SSPM and the whole water monitoring station (Figure B2-9) remained at the same location since that location captures contributions from the entire basin.

A rainfall to runoff relationship based on one year of continuous flow data was developed as a part of the 2007-2012 NPDES S8.D monitoring. This relationship is presented in Figure B2-11. Separate correlations were developed for wet season and dry season conditions. The runoff has been normalized to basin size, such that both rainfall and runoff are presented in depth units, and the slope of the regression line is the runoff coefficient. The rainfall-runoff correlation for OF237B is:

OF237B Wet Season Runoff (inches) = 0.4423 X Rainfall (inches) + 0.0145
OF237B Dry Season Runoff (inches) = 0.3025 X Rainfall (inches) + 0.0173

In the large basin for OF237B, there is a threshold of precipitation of a few hundredths of an inch, below which no runoff occurs. This is a large, primarily residential basin (see Figure B2-3) with more vegetated cover and soft shoulders on streets, and thus has more capacity to infiltrate compared to the other basins. The threshold is determined by the intercept of the regression line (see Figure B2-11) and indicates a capacity for the basin to assimilate some amount of rain before runoff occurs. As expected, the threshold is higher during the dry season (i.e., the dry ground has a greater capacity to assimilate incipient rainfall).

The sampling site is located in the City's Dock Street Pump Station Yard, in the 2300 block of East “C” Street. The yard is fenced and locked. The equipment is sited within MH122 (MH# 6762057). MH122 is located in the southeast section of the asphalt-paved yard.

B.2.2.6 Outfall 243

The OF243 drainage basin is 59 acres and discharges to the east side of the waterway at East 21st Street through a 48-inch outfall (Figure B2-3 and Table B2-2). The storm drainage is carried in two main laterals, one south to north on East “D” Street from East 26th Street to East 21st Street, and the second east to west on East 21st Street. The majority of runoff in this basin is from BNSF Railway property and the portion of SR-509 between Portland Avenue and the Foss Waterway. Land uses in the basin are primarily industrial, with some commercial at the west side of the basin and some highway with SR-509.

The outfall has a tide valve which was originally installed in 1999, then reinstalled in 2001 when the outfall pipe was extended. In 2008, “D” Street was raised over the BNSF Railway main line, increasing the drainage area by half an acre. The stormwater runoff from the new half-acre is treated through a VortFilter unit which then discharges to OF243 through a new 15-inch pipe.

OF243 does not have any creeks or other sources that provide constant baseflow but does have tidal backflushing year-round, and during the wet season there is evidence of groundwater infiltration due to the high-water tables in the Tideflats area. The groundwater table is comprised of a bottom layer, which is influenced by tides, and an upper fresher water lens. In the wet season, the upper lens is freshened by rain recharge and salinity effects (e.g., conductivity) are less.

The stormwater sampling site (Figure B2-12) is located at East 21st Street and “D” Street in a private parking lot along the Foss Waterway. The equipment is sited in MH# 6761877. The manhole is located in the middle of the parking lot under the SR-509 bridge. Two sediment trap sampling devices (Figure B2-12) are located within the sump just downstream of the sample location.

A rainfall to runoff relationship based on WY2015 and WY2016 continuous flow data was developed based on rainfall-runoff correlations for OF243. This relationship is presented in Figure B2-13. Separate correlations were developed for wet season and dry season conditions. The runoff has been normalized to basin size, such that both rainfall and runoff are presented in depth units, and the slope of the regression line is the runoff coefficient. The rainfall-runoff correlation for OF243 is:

OF243 Wet Season Runoff (inches) = 0.3357 X Rainfall (inches)
OF243 Dry Season Runoff (inches) = 0.156 X Rainfall (inches)

B.2.2.7 Outfall 245

The OF245 drainage basin is located in the Tideflats of Tacoma on the southern portion of the east side of the waterway. Basin boundaries are shown on Figure B2-3. The outfall is located at East 19th Street, just south of Johnny's Dock Restaurant. The drainage area is approximately 39 acres in size and the main trunkline of the storm drainage system extends east from the Foss Waterway, down East 19th Street to East "I" Street. Because of the low basin elevation, the entire storm system is influenced by saltwater at high tide. Land use in this basin is primarily industrial with the restaurant providing a small commercial area at the west side of the basin. Most facilities in the drainage basin are engaged in storage, transloading and warehousing of materials and products, and manufacturing.

Directly upstream of the outfall is a deep bottom sump manhole known as MH390 (Figure B2-14). MH390 is 60 inches inside diameter and approximately 18 feet in depth with the inlet pipe and outlet pipe at 55.5 inches above the bottom (Table B2-2). A plastic tide gate (swing valve) is located on the inlet pipe. The tide gate does not securely seal, and some tidal water does get into the upper reaches of the system. In fall 2004, the last 24 feet of pipe from MH390 to the waterway was replaced with HPDE pipe. Drainage from MH390 was improved with the new slope of the outfall pipe, which replaced the old line that had a sag in it.

In August 2004, the City replaced a 300-foot segment of the stormwater line and associated laterals in East 19th Street. This action sealed this segment from groundwater, sediment, and product migration from the surrounding contaminated soil that remained in place after an interim action remediation project was completed in this area.

Similar to OF243, OF245 does not have any creeks or other sources that provide constant baseflow but does have tidal backflushing year-round, and during the wet season there is evidence of groundwater infiltration due to the high-water tables in the Tideflats area. The groundwater table is comprised of a bottom layer, which is influenced by tides, and an upper fresher water lens. In the wet season, the upper lens is freshened by rain recharge and salinity effects (e.g., conductivity) are less.

The sampling site is located in the Johnny's Dock Restaurant private parking lot, East 19th Street, and "D" Street. The equipment is sited in MH390. A parking stall is designated for City of Tacoma use only where MH390 is located (Figure B2-15).

A rainfall to runoff relationship based on one year of continuous flow data was developed as a part of the 2007-2012 NPDES S8.D monitoring. This relationship is presented in Figure B2-16. Separate correlations were developed for wet season and dry season conditions. The runoff has been normalized to basin size, such that both rainfall and runoff are presented in depth units, and the slope of the regression line is the runoff coefficient. The rainfall-runoff correlation for OF245 is:

OF245 Wet Season Runoff (inches) = 0.990 X Rainfall (inches)
OF245 Dry Season Runoff (inches) = 0.777 X Rainfall (inches)

B.2.2.8 Outfall 254

The OF254 drainage basin is located on the Tideflats and is the fifth largest basin in the Foss Waterway Watershed (Figure B2-3). It is approximately 119 acres and drains through a 36-inch outfall pipe located at the head of Wheeler-Osgood Waterway on East "F" Street just north of East 15th Street (Table B2-2). The drainage area includes East 15th Street from East "D" Street to St. Paul Avenue, East "J" Street from East 15th Street to the 1600 block, and St. Paul Avenue from East 11th Street to Portland Avenue.

The majority of the OF254 drainage basin is zoned for industrial use, but small commercial areas are present near the shoreline. Similar to OF243 and OF245, OF254 does not have any creeks or other sources that provide constant baseflow but does have tidal backflushing year-round, and during the wet season there is evidence of groundwater infiltration due to the high-water tables in the Tideflats area. The groundwater table is comprised of a bottom layer, which is influenced by tides, and an upper fresher water lens. In the wet season, the upper lens is freshened by rain recharge and salinity effects (e.g., conductivity) are less.

The stormwater sampling site (Figure B2-17) is located near the southwest corner of the property at 625 East 15th Street next to the railroad tracks. The equipment is sited in MH# 6761601. A rainfall to runoff relationship based on WY2015 and WY2016 continuous flow data was used to develop rainfall-runoff correlations for OF254. This relationship is presented in Figure B2-18. Separate correlations were developed for wet season and dry season conditions. The runoff has been normalized to basin size, such that both rainfall and runoff are presented in depth units, and the slope of the regression line is the runoff coefficient:

OF254 Wet Season Runoff (inches) = 0.8442 X Rainfall (inches)
OF254 Dry Season Runoff (inches) = 0.2946 X Rainfall (inches)

B.2.2.9 Upstream Sediment Trap Monitoring

For source control tracing purposes, the City has installed sediment traps upstream of the outfalls in several of the drainage basins. These traps will be used to identify potential problem areas in sub-drainages. The locations of the sediment traps are provided in Table B2-3 and on Figure B2-19. The analytes that these sediment trap samples will be analyzed for are listed in Table B2-3.

B.2.3 Sampling Procedures

City field staff performed all weather tracking, flow monitoring, and stormwater and sediment sampling activities. A summary of the sampling procedures used by field staff to ensure that representative samples were collected throughout the monitoring period is included below.

In order to address representativeness of storm flows, the City selected sampling locations, methods, and times so that the data describes stormwater runoff over the range of land use conditions in the drainage basins, the varying hydrologic conditions within an individual storm event (i.e., rising and falling portions of the hydrograph), various times throughout the year, and a representative cross-section of storm types.

B.2.3.1 Weather Tracking/Storm Criteria

Weather was continuously monitored using multiple forecasts and using radar and satellite imagery to ensure that targeted storms met the precipitation criteria outlined in the QAPP. For this project, the monitoring year is divided into a wet and a dry season, each with specific precipitation criteria. The wet season is defined from October 1st through April 30th during the monitoring year. The following criteria define a qualifying wet season event:

- ≥ 0.20 inches of rainfall
- rainfall duration: No fixed minimum or maximum[3]
- ≤0.05 inches of rainfall in the previous 24-hour antecedent dry period

[3] The QAPP states that the storm event criteria minimum duration sampling period shall be greater than two times the time of concentration for each outfall.

- < 6-hour inter-event dry period

The dry season is defined from May 1st through September 30th during the monitoring year. The following criteria define a qualifying dry season event:

- ≥ 0.20 inches of rainfall
- rainfall duration: No fixed minimum or maximum[3]
- ≤0.02 inches of rainfall in the previous 48-hour antecedent dry period
- < 6-hour inter-event dry period

B.2.3.2 Sampling Equipment

Center for Urban Waters (CUW) and Central Treatment Plant (CTP) rain gauges (Texas Electronics Model TR-525 tipping buckets) are used to represent rainfall in the Thea Foss Basin. Both rain gauges collect five-minute data. The CUW rain gauge is located 0.6 to 1.2 miles north of the Foss stormwater monitoring locations on the CUW building located at 326 East "D" Street. The CTP rain gauge is the backup rain gauge and is located one mile east of the Foss on the roof of the Operations building at the City of Tacoma's CTP (2201 Portland Avenue).

Flow is recorded at five-minute intervals based on measured level and velocity data and site-specific data (i.e., round concrete pipe) using the continuity equation. Specific equipment for each monitoring location is listed below:

Location	Number of Samplers	Flow Module	Additional Sensors
OF230	1	ISCO 750	N/A
OF235	1	ISCO 750	N/A
OF237A	1	ISCO 2150	Telemetry
OF237B	1	ISCO 2150	Telemetry
OF243	1	ISCO 750	Conductivity Probe
OF245	1	ISCO 750	N/A
OF254	1	ISCO 750	Conductivity Probe

Flow- or time-proportional discrete samples were collected using ISCO 6712 samplers with flow monitoring modules, sampler bases, and conductivity probes along with support equipment (battery chargers, data modules, sampler tubs, strainers, glass jars, etc.). Teflon suction tubing, silicon pump tubing, and glass bottles are used in all locations. Sampler probes are attached to a stainless-steel plate. The plate is bolted using stainless steel concrete bolts to the bottom of the pipe. Hoses and electrical cords are attached to the side of the pipe and manhole using concrete bolts and plastic ties. The sampler is placed in a job-box directly adjacent to the monitoring location.

B.2.3.3 Stormwater Monitoring Protocols

Automatic flow-weighted composite samples using ISCO 6712 Samplers were collected at OF230, OF235, OF237A, and OF237B for analytical chemistry. The samplers were programmed to activate once stormwater runoff was detected and to trigger the sampler to collect a sample (aliquot) every time a specified volume passed, based on the predicted storm conditions. These programming protocols are in Table B2-4. These protocols were evaluated and adjusted as necessary to meet the required sample volumes for the Foss and NPDES parameters.

At OF243, OF245, and OF254, sampling was completed using an ISCO 6712 sampler programmed for automatic time-weighted composite samples instead of the flow-weighted composite sample. The sampler was programmed to activate once stormwater runoff was detected and to trigger the sampler to collect an aliquot after a set amount of time (see Table B2-4). Collection of a flow-weighted composite sample is difficult at these sampling locations due to the hydrology of the system (i.e., flat system) and tidal constraints. It is believed that the time-weighted composite sample is representative of the stormwater quality discharged from OF243, OF245, and OF254.

Once enabled, the ISCO 6712 composite sampler utilizes a peristaltic pump to draw stormwater from the strainer installed in the flow. Each time the sampler collects an aliquot, it is deposited into one of 12, one-liter discrete sample containers (Figure B2-20). Each jar contains four stormwater aliquots. This prevents one aliquot from contaminating an entire composite sample with saltwater when the outfall is tidally influenced. It also allows, following a review of the storm hydrograph, for compositing of just those samples that best represent the storm criteria and are most representative of that storm event. As each container is filled, the sampler's distributor arm advances sequentially to the next sample container.

Manual grab samples are collected for total petroleum hydrocarbons and bacteria. Composite samples are not appropriate for these parameters due to their tendency to adhere to sampling equipment (total petroleum hydrocarbon) or change in concentration after a short period (*E. coli* bacteria). Manual grab samples were collected by lowering a decontaminated stainless steel bucket into the flow stream. The sample is then poured into appropriate analyte-specific bottles. Because we expect some storm events to occur in the middle of the night, on weekends, or during holidays (and automatic samplers may begin sampling if enabled), having staff immediately available for grab sampling may be difficult. During these times, it is possible that grab samples may be taken during different storm events when no composite samples are targeted. If the grab sample is collected during storm runoff that meets all qualifying storm event criteria, except for the minimum amount of rainfall, the grab sample will be analyzed and considered a valid sample.

B.2.3.4 Storm Event Sampling Criteria

The sampling frequency as outlined in the QAPP[4] is at least 55 composite samples per year. The number of samples collected per outfall is outlined in Table B2-5. Representative storm event criteria and sampling frequency are defined in Table B2-6. Qualifying storm events must be distributed throughout the year. The goal is to collect 60 to 80 percent of samples during the wet season and 20 to 40 percent of samples during the dry season, representing normal regional rainfall distributions. In addition to the 55 samples per year, all attempts will be made to sample the seasonal first flush event (first significant event that occurs after the summer dry period).

The sample collection criteria defined in the QAPP (outlined below and in Table B2-6) ensure that the composite sample collected is representative of the storm event sampled. For storm events lasting less than 24 hours, samples shall be collected for at least 75 percent of the storm event hydrograph. For storm events lasting longer than 24 hours, samples shall be collected for at least 75 percent of the hydrograph of the first 24 hours of the storm.

[4] Effective October 1, 2012, EPA and Ecology approved a reduction in the number of samples collected per year. The 2001 SAP goal of ten stormwater samples per year for all seven outfalls, was reduced to eight samples per year for OF230, OF235, OF237A, and OF237B, and three samples per year for OF243, OF245, and OF254. To meet the NPDES Permit requirement of 55 samples per year, the approved QAPP requires eight minimum to 11 maximum samples for OF230, OF235, OF237A, OF237B, and OF245, and zero to 11 samples per year for OF243 and OF254.

Storm Event Duration	<24 hours	>24 hours
Minimum storm volume to sample	75% of the storm event hydrograph[c]	75% of the hydrograph of the first 24 hours of the storm[c]
Number of aliquots	≥10: 7-to-9 accepted[b]	≥10: 7-to-9 accepted[b]
Minimum duration to program ISCO for sampling (hours)[a]	2 x time of concentration	2 x time of concentration

a - "Time of Sampling" in Appendix 9 of the Permit requires the sampler to be programmed to continue sampling past the longest estimated time of concentration.
b - Composite samples with seven to nine aliquots are acceptable if they meet the other sampling criteria and help achieve a representative balance of wet season/dry season events and storm sizes.
c - Applies to non-tidally influenced outfalls (OF237B) only. Tidally influenced drains shall be sampled to include only the portion of runoff that is not affected by tides.

The goal is for each composite sample to consist of at least 10 aliquots. Composite samples with seven to nine aliquots are acceptable if they meet the other sampling criteria and help achieve a representative balance of wet season/dry season events and storm sizes.

The sampling of tidally influenced drains (all outfalls except OF237B) is further limited to those periods when the drains are not affected by tides; therefore, they may include only a portion of the runoff hydrograph. Over the course of the monitoring year(s), it is expected that the tidal sampling window will randomly overlap with different portions of the runoff hydrograph, and that a representative range of rising, peak, and falling runoff conditions will be captured during multiple sampling events, if not during a single event.

The parameters analyzed for each stormwater sampling event are listed in Table B2-7[5]. Priority order for analyses for stormwater composite samples is listed in Table B2-8. The Foss Monitoring Program requires the statistical evaluation of parameters over the Foss 20-year monitoring period; results are discussed in Sections 3 and 5 of the WY2023 Report (Tacoma 2024).

B.2.3.5 Sediment Monitoring Protocols

Annual sediment quality is determined through the collection of sediment accumulated at each monitoring location for a period of 12 months[6]. During this monitoring period, collection devices are deployed prior to the seasonal "first flush" on August 27th, based on Tacoma's historical 52-year rainfall record.

In OF230, OF235, OF237A, OF237B, and OF243, sediment samples are collected using sediment traps. In these locations, two sediment traps are placed near the flow monitoring location and mounted onto the wall of the pipe using stainless steel screws. The sediment trap is a stainless steel bracket that holds a wide-mouth Teflon bottle, which is approximately eight inches tall. Traps are designed to passively collect SSPM present in stormwater that passes by the sampling site. The sample bottle is installed in a vertical position so that the mouth of the sample bottle is just above the baseflow level in order to sample only storm flows. A typical installation is shown in Figure B2-21.

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[5] If any chemicals are non-detected for two years, that chemical may be removed from the list of analytes in the QAPP.

[6] Ecology approved the City's request to continue annual sediment monitoring as part of the 2020 QAPP and all subsequent revisions.

WY2023 SSPM sampling was performed in general accordance with the QAPP prepared by Dale Norton of Ecology, 1997. Gloves are worn at all times when collecting samples. The sample bottles were capped in place with a clean Teflon lid, removed from the bracket, stored in a cooler on ice, and transported directly to the analytical laboratory. Clean Teflon bottles were immediately deployed for the next monitoring period. Throughout the monitoring period, traps were inspected regularly and after significant events to evaluate their condition (e.g., damage and sediment volume).

In OF245, sediment is captured in the MH390, which functions similar to a sediment trap or catch basin (Figure B2-14). A representative stormwater sediment sample is collected from the sump using procedures developed during the Foss Monitoring Program. First, the depth of accumulated stormwater sediment is measured and noted in the field notebook. Samples were obtained by conducting a confined space entry into the manhole, delineating, then collecting grabs with a Ponar sampling device. These grabs were composited into a large stainless steel bowl and well mixed into a representative sample. After sampling is completed, the sump is cleaned out to ensure that the accumulated stormwater sediment represents the discrete annual sampling period.

Priority order for analyses for SSPM samples is listed in Table B2-8. The parameters analyzed under the Foss Monitoring Program for SSPM samples are listed in Table B2-9. The Foss Monitoring Program requires the statistical evaluation of parameters over the Foss 20-year monitoring period; results are discussed in Sections 3 and 5 of the WY2023 Report (Tacoma 2024).

B.3 RAINFALL AND FLOW VALIDATION

Representativeness evaluates the field sampling approximation of actual (true) stormwater and SSPM water quality and quantity in the Foss Waterway Watershed. The QA/QC evaluation for rainfall and flow data are summarized in Section 3.1 of the WY2023 Report and discussed in detail herein.

B.3.1 RAINFALL DATA VALIDATION

This section summarizes rainfall and weather conditions during the current monitoring year (WY2023) and provides context relative to the entire monitoring record. Routine rain gauge maintenance visits were performed on a monthly basis or as needed for data review. Each maintenance visit included visual inspection and cleaning of the rain gauge as necessary.

For WY2023, the daily and monthly rainfall and the average daily rainfall for each month are shown in Table B3-1 and Figure B3-1 and Figure B3-2. For Water Years 2002 through 2023, the monthly rainfall and the rainfall summary for each water year are shown in Table B3-1.

B.3.1.1 Year 22: Water Year 2023 (October 2022–September 2023)

The total rainfall for WY2023 amounted to 29.05 inches, presenting a significant deviation from recent historic averages of 38.95 inches. In October, precipitation fell below the monthly average by 1.36 inches, resulting in a total rainfall of 2.03 inches. November's rainfall of 5.64 inches was within the normal range, while December recorded slightly elevated levels with a total of 6.98 inches, surpassing the monthly average by 1.09 inches. The subsequent months of January and February exhibited the most significant variance from normal rainfall conditions, with both months experiencing precipitation below normal by approximately 2.60 inches. March continued in a similar pattern, recording 1.66 inches below the average, accumulating a total of 2.52 inches. April was within normal precipitation levels at 3.46 inches. Conditions returned to drier than average in May (0.62 inches) and June (0.32 inches); collectively, these months experienced 2.65 inches below the average total rainfall. July (0.11 inches) and August (0.26 inches) observed slightly less than normal rainfall. September concluded the water year with slightly elevated rainfall conditions, with 1.07 inches greater than normal, with a total of 2.49 inches (see Table B3.1).

The wet season in WY2023 exhibited drier than normal conditions, recording a total rainfall of 25.25 inches, 7.0 inches below the historical average. Four months (October, January, December, and March) showed significantly lower rainfall compared to historical averages (see Table B3.1).

The dry season in WY2023 was slightly drier than usual, with 2.90 inches less than normal rainfall totals. There was below-average precipitation seen from May through August, returning to close to normal conditions by September, which experienced higher than normal monthly rainfall by 1.07 inches. The increased September rainfall minimized the overall dry conditions during the WY2023 dry season (see Table B3.1).

Total rainfall for WY2023 was 29.05 inches, almost 10 inches below recent averages and 11.25 inches less than the average over the 22-year monitoring record. The rainfall during WY2023 is now the driest year since monitoring began in 2002. Comparable dry years, such as WY2003 and WY2005, had approximately 1.5 inches more total rainfall than WY2023, and this deviation stands significantly below the average over the 21-year monitoring record (see Table B3.1).

The overall rainfall pattern during WY2023 consistently leaned towards drier conditions than typical rainfall patterns. October and January were significantly drier than recent typical rainfall patterns. February, March, May, and June also recorded drier conditions than typical patterns, while the remaining months fell within the range of normal rainfall patterns when compared to the monthly average of the 22-year monitoring period (see Table B3.2).

B.3.1.2 Water Year Seasons: Monitoring Period to Historic Rainfall Comparison (October 2001 to September 2023

The Average annual rainfall for the 22-year monitoring period is 40.30 inches, which is near normal conditions based on the historical average annual rainfall of 38.95 inches. As shown in Figure B3-3, average daily rainfall for October, November, January, March, April, May, and June are above normal and February, July, and August are below normal for the 22-year period relative to the historical monthly means. The average rainfall amounts for both the dry season and wet season precipitation for the 22-year period are near normal; the wet season at 34.01 inches compared to a historical of 32.25 inches and the dry season at 6.30 inches compared to a historical of 6.70 inches (see Table B3-1). The rainfall events sampled during the entire 2001-2023 (22-year) monitoring program are similar to the historical distribution of rainfall in the City, however the number of events greater than 0.9 inches (15.3 percent) is greater than the historical average of 9.1 percent (Figure B4-2 and Table C-16).

Below is a rainfall summary for each water year monitored from October 2001 to present. This summary is provided so that comparisons can be made for a water year's flow or chemistry data relative to the rainfall patterns for that year (e.g., drought conditions, wet conditions). The historic average annual rainfall is 38.95 inches for Tacoma No. 1, Table B3-1.

Year 1: Water Year 2002 (October 2001–September 2002) In Year 1, the wet season was wetter than normal, however, the dry season was considered to be a "drought condition" by the National Weather Service. Overall, the total rainfall for Year 1, 41.65 inches, was above normal. The wet season precipitation was approximately six inches above normal. The dry season was below normal by 3.36 inches.

Year 2: Water Year 2003 (October 2002–September 2003) The total rainfall for Year 2 was 30.56 inches, which is below normal (38.95 inches for Tacoma No. 1) and is one of the lowest annual rainfalls. The wet season was below normal by 2.72 inches. The dry season was also below normal by 4.68 inches and is the driest yet during the monitoring period.

Year 3: Water Year 2004 (October 2003–September 2004) The total rainfall for Year 3 was 41.32 inches, which is near normal. The dry season was above normal by 2.51 inches.

Year 4: Water Year 2005 (October 2004–September 2005) The total rainfall for Year 4 was 30.55 inches, which is below normal (38.95 inches for Tacoma No. 1) and is one of the lowest annual rainfalls. The wet season was below normal by 8.42 inches and is the driest yet during the monitoring period. In fact, February 2005 was one of the driest in recorded history for Puget Sound Lowlands at 32 percent of normal.

Year 5: Water Year 2006 (October 2005–September 2006) The total rainfall for Year 5 was 39.08 inches, which is above average. The wet season precipitation for Year 5 was above normal with a new City record for January 2006 at 11.93 inches. Total precipitation for December 19, 2005, to January 12, 2006, was 12.41 inches at SeaTac Airport, which is the wettest 25-day stretch on record. In contrast, one of the driest seasons was recorded from June 17 to September 14, 2006; 90 days with only four days of measurable rain and only 0.11 inches total. This was only nine days short from setting the record for the driest summer in recorded history.

Year 6: Water Year 2007 (October 2006–September 2007) The total rainfall for Year 6 was 50.75 inches, which is well above average. The wet season precipitation for Year 6 was above normal by 11.33 inches. The Year 6 wet season has the highest precipitation totals (November, wet season and annual) during the monitoring period. In fact, the City set two new records for: 1) the greatest one- and two-day totals for the November 5-7, 2007, storm (5.44 and 6.91 inches, respectively), and 2) November 2007 as the wettest month ever in recorded history for SeaTac Airport at 15.63 inches (256 percent of normal).

Year 7: Water Year 2008 (October 2007–September 2008) The total rainfall for Year 7 was 33.27 inches, which is below normal. Both the dry and wet seasons' precipitation for Year 7 were below normal by 1.46 and 4.22 inches, respectively.

Year 8: Water Year 2009 (October 2008–September 2009) The total rainfall for Year 8 was 37.97 inches, which is near normal. Both the dry and wet seasons' precipitation for Year 8 were near normal. November 2008 had two heavy rain events and flooding on November 7 and 11, 2008. Eighty-four percent (6.38 inches) of the monthly rainfall occurred over only five days out of the first 12 days of November. Another heavy rain event (January 6-8, 2009) brought flooding which was followed by lower than normal precipitation.

Year 9: Water Year 2010 (October 2009–September 2010) The total rainfall for Year 9 was 45.90 inches, which is higher than the historic average. While the wet season was near normal conditions, rainfall during the dry season was almost double average rainfall conditions.

Year 10: Water Year 2011 (October 2010–September 2011) The total rainfall for Year 10 was 44.39 inches, approximately 5.5 inches greater than the historic average. While the wet season was above average conditions (approximately 5 inches greater than normal), rainfall during the dry season was near normal conditions.

Year 11: Water Year 2012 (October 2011–September 2012) The total rainfall for Year 11 was 42.63 inches, approximately 3.7 inches greater than the historic average. While the wet season was above average conditions (approximately 4.6 inches greater than normal), rainfall during the dry season was somewhat below average conditions (approximately 1 inch less than normal).

Year 12: Water Year 2013 (October 2012–September 2013) The total rainfall for Year 12 was 47.39 inches, approximately 8.4 inches greater than the historic average. While the wet season was close to average conditions (approximately 1.1 inches greater than normal), rainfall during the dry season was more than double average conditions (approximately 7.4 inches greater than normal) due primarily to heavy rainfall in September, which resulted in the wettest September on record.

Year 13: Water Year 2014 (October 2013–September 2014) The total rainfall for Year 13 was 40.60 inches, which is near the historic average. While the wet season was close to average conditions (approximately 0.37 inches less than normal), the first four months of the water year (October-January) were well below normal and the second four months (February-May) were well above normal. Rainfall during the dry season was 2.02 inches greater than normal. Four months in WY2014 were in the top ten wettest on record (Sea-Tac Airport) and the wettest February 1st through October 31st (first month of WY2015) on record.

Year 14: Water Year 2015 (October 2014–September 2015) The total rainfall for Year 14 was 36.41 inches, which is near the historic average. While most of the wet season was close to average conditions (overall approximately 0.60 inches less than normal), the first month of the water year, October, was 2.81 inches above normal. Rainfall during the dry season was 1.94 inches less than normal.

Year 15: Water Year 2016 (October 2015–September 2016) The total rainfall for WY2016 was 50.11 inches, which is significantly higher than the recent historic average of 38.95 inches. This was the second wettest year since the beginning of the monitoring program. The third warmest El Nino since 1950 was in place, resulting in lots of active weather including several atmospheric river (i.e., Pineapple Express) events leading to significant flooding in areas. Rainfall during the wet season was more than 14 inches higher than average wet rainfall conditions based on recent history, while during the dry season it was 2.87 inches less than average.

Year 16: Water Year 2017 (October 2016–September 2017) The total rainfall for WY2017 was 51.73 inches, which is significantly higher than the recent historic average of 38.95 inches. This was the wettest year since the beginning of the monitoring program (similar to WY2016). Rainfall in the WY2017 wet season was more than 14 inches higher than average wet rainfall conditions based on recent history, while during the dry season it was 1.94 inches less than average.

Year 17: Water Year 2018 (October 2017–September 2018) The total rainfall for WY2018 was 41.77 inches, which is slightly higher than the recent historic average of 38.95 inches. Overall, the distribution of the rainfall between the wet season and the dry season in WY2018 was fairly similar to that observed in WY2016 and WY2017. Total precipitation for the year, however, was greater than eight inches below WY2016 and WY2017 rainfall, while still being slightly higher than the recent historic average. Rainfall in WY2018 during the wet season was 7.08 inches more than average wet season conditions based on recent history, while during the dry season it was 4.26 inches less than average.

Year 18: Water Year 2019 (October 2018–September 2019) The total rainfall for WY2019 was 32.67 inches, which is lower than the recent historic average of 38.95 inches. Overall, the distribution of the rainfall between the wet season and the dry season was similar to WY2005 and WY2008, with the wet season having below-normal conditions and the dry season proportionally higher based on total rainfall for the year. Total precipitation for the year, however, was approximately 9-to-20 inches less than observed during the three preceding years (WY2016-WY2018).

Year 19: Water Year 2020 (October 2019–September 2020) The total rainfall for WY2020 was 37.90 inches, which was slightly on the drier side of average relative to the other water years in the 19-year monitoring record associated with this project. Overall, the distribution of rainfall between the wet season and dry season in WY2020 was typical with a few more extreme monthly averages in the wet season, and generally more average rainfall each month during the dry season.

Year 20: Water Year 2021 (October 2020-September 2021) The total rainfall for WY2021 was 36.06 inches, which is on the drier side of average relative to water years in the 20 years of monitoring, with only four years having lower total rainfall (see Table B3-1). Overall, the distribution of rainfall between the wet season and dry season was typical with less than average rainfall exhibited during the wet season and a few record-breaking dry months during the summer.

Year 21: Water Year 2022 (October 2021-September 2022) The total rainfall for WY2022 was 44.92 inches, which was almost six inches greater than historic averages and four inches greater than the 21-year monitoring record (see Table B3-1). The wet season was moderately wetter, and the dry season exhibited near-normal conditions. Rainfall for most months during both the wet and dry seasons were variable with one month in the wet season having significantly more rainfall than normal, four months during the year having moderately higher rainfall than normal, and two months during the year having moderately less rainfall than normal. Additionally, this is the first time in the monitoring record that no rain fell in the month of September in the study area.

Year 22: Water Year 2023 (October 2022-September 2023) The total rainfall for WY2023 was 29.05 inches, which is significantly less than the historic average of 38.95 inches and establishing it as the driest year since the initiation of monitoring in 2002. The wet season experienced unusual dryness, exhibiting seven inches below normal conditions when compared to the historical average. While the dry season leaned towards drier conditions with almost three inches less than historic conditions, it remained within the normal range seen during these months (see Table B3.1).

B.3.2 Flow Data Validation Protocols

The continuous flow data from each monitoring location is verified (i.e., does the flow volume look appropriate based on the rainfall total). If necessary, the flow data is edited to account for drift, lost signals, or other anomalies. Routine flow monitoring maintenance visits were performed during the sampling event setup and periodically throughout the year when data review indicated potential equipment issues. Each maintenance visit included visual inspection and cleaning of the sensors, calibration checks and level calibration if necessary. Velocity data, as recorded by the ISCO 750 or 2150 Area Velocity Sensors, can be validated in the field using a portable flow meter (Marsh McBirney).

Data drifts or anomalies are accounted for and corrected using Flowlink Pro 5.1® and proprietary data management software. The City is continuing to develop a rain and flow data management system using solar power, telemetry, and WISKI[7].

B.3.2.1 Water Year 2023 Flow Data

In WY2023, each monitoring location was to be converted from the ISCO 750 to the 2150 Area Velocity Sensors. Both the ISCO 750 and 2150 require manual programming and downloads of all data for sample events. However, the ISCO 2150 has the capability of using telemetry to remotely monitor and program the flow meter and to remotely download data. Some sampling efficiencies are gained using the 2150/telemetry setup and the WISKI data management software. This includes:

- Ability to reprogram samplers when rainfall forecasts change
- Real-time monitoring of all flow meter and sampler functions
- Real-time monitoring of sampling and flow data
- Alerts if meters need maintenance or power

In order to reduce staff time associated with sampler programming and to improve sampling efficiency, the City conducted a pilot telemetry setup using Campbell Scientific telemetry equipment at the OF237B and OF237A NEW monitoring locations. This Campbell Scientific equipment controls the ISCO 6712 sampler and data can be collected via cellular modem as needed. Due to

[7] WISKI – Water Management Information System, KISTERS Pioneering Technologies. This software is used for data validation and correction. The City is continuing to work with KISTERS to develop programs to generate rainfall to runoff curves and to generate annual pollutant loadings for each monitoring location.

programming, equipment, and coding issues at these locations the City is working to clean-up the data from these pilot locations before rolling out the new programming and telemetry setups to other sites. The City will update progress towards this set-up in the WY2024 Annual Report. Emerging technologies may offer new methods and the City is considering all options for moving forward.

All rain and flow data are managed in WISKI. Data dropouts or drifts were corrected using linear interpolation to create an edited dataset used for final flow calculations. Any corrupted flow data is edited or completely removed as warranted using WISKI or Flowlink.

All sampling events have flow data to accompany the chemistry data. The flow volume data for each event is based on the edited dataset (see Appendix C Tables C-1 to C-7 for stormwater and Tables C-8 to C-14 for baseflow). Flow data results for each sampling event are discussed in Section B.4 for stormwater events and in Section B.6 for baseflow events.

B.4 STORMWATER SAMPLING EVENTS

This section presents information about the stormwater sampling events (composite samples and grab samples) and sediment samples collected during WY2023.

B.4.1 STORMWATER COMPOSITE SAMPLING EVENTS

City staff targeted forecasted qualifying storm events during WY2023 (Monitoring Year 22 of the Foss Monitoring Program). The goal is to collect storm events distributed throughout the year with 60 to 80 percent of samples in the wet season and 20 to 40 percent of samples in the dry season.

In WY2023, 19 precipitation events met the NPDES storm event goals. The evaluation of the qualifying events for WY2023 is presented in Table B4-1. Of the 19 potential events, 15 events were forecasted that met the required NPDES storm event goals, 14 occurred during the wet season, and only one during the dry season.

The dates of each storm event sampled in WY2023 are shown in Table B4-2. Summary tables for each storm event, and the field and hydrologic data for each sample taken at each outfall are presented in the WY2023 Report, Appendix C, Tables C-1 through C-7. The following hydrologic parameters are tabulated for each sampled storm event:

- Rain depth (inches)
- Rainfall duration (hours)
- Antecedent dry period (hours)
- Event-average and peak flow (cfs)
- Total runoff volume (cubic feet)

Complete field and laboratory data packets for these events are presented in Attachments B-1 and B-3 of this appendix. The stormwater analytical data for each event is listed in Appendix D and Tables D-1 through D-7. Seventy-one composite samples were submitted to the laboratory for analysis.

30 storm samples had insufficient volumes to analyze for the full list of analytes in Table B2-7. All of the Foss Parameters except for TSS were analyzed in the stormwater samples collected. Total Suspended Solids (TSS) was missing in two samples due to insufficient volumes: OF237A on May 5, 2023, and OF235 on January 13, 2023.

NPDES parameters, metals, polycyclic aromatic hydrocarbon (PAHs), phthalates, and pesticides were analyzed in every stormwater sample collected. The parameters that weren't analyzed due to insufficient volumes are highlighted on Tables D1 through D7.

The field and hydrological data for each event sampled were reviewed to evaluate the representativeness of individual storm events, storm types, and criteria goals. The justification for accepting samples was provided in the field report for that sampling event (see Attachment B-1). Sections B.4.3 and B.4.4 describe the sampling protocols and evaluate the field and hydrologic data and storm event criteria. In addition, these sections provide a discussion about whether these events are believed to be representative of stormwater discharges.

B.4.2 STORMWATER GRAB SAMPLING EVENTS

The goal is to collect grab samples from OF230, OF235, OF237A, OF237B, and OF245 during targeted, qualifying storm events. As discussed in the QAPP, grab samples may not be collected during every qualifying storm event due to logistical and safety issues. These issues include the beginning of the storm event occurring during the night or during a high tidal period when the site is tidally influenced. In these situations, if a sample is not collected during a qualifying storm event then every attempt is made to collect a grab sample from the next qualifying event.

The goal is to collect a minimum of eight manual grab samples from each monitoring location. During WY2023, the City successfully collected two manual grab samples from the OF230, OF235, OF237A, OF237B, OF243, OF245, and OF254 monitoring locations.

The specific dates of each event and location successfully sampled are listed in Table B4-3. The antecedent period for the 10/21/2022 event was greater than 24 hours. The antecedent period for the 11/4/2022 event was 14 hours. The flow had returned to baseline conditions and the samples are considered representative of the storm event. Complete field (including summary graphs) and laboratory data packets for these events are presented in Attachments B-1 and B-3 of this Appendix.

During WY2023, the goal to collect a total of 55 grab samples during storm conditions wasn't met, with only 14 grab samples collected (Table B4-3). The City did not meet the wet/dry season goals at all outfalls with 100 percent of the grab samples collected during the wet season.

City staff sampled whenever conditions presented themselves[8], with a goal of collecting 60-80 percent of the stormwater samples in the wet season and 20-40 percent in the dry season. Of the 99 rain events that occurred in WY2023, only 19 events met QAPP criteria, and 15 of those events were forecasted (see Table B4-1). Grab samples were collected at each location when possible, during WY2023.

Sampling opportunities were limited in the months where no grab samples were collected. The following provides details on the grab sampling attempts during the WY2023 monitoring period:

- October: Grab samples were collected for the October 21, 2022, event. The October 30, 2022, event was missed as it occurred at night. There were no other acceptable storm events for the month of October.
- November: Grab samples were collected for the November 4, 2022, event. One additional sampling event occurred during high tide.
- December: No grab samples were collected during December. Four events had snow on ground or in the forecast and the two other events meeting criteria occurred at night.
- January: No grab samples were collected during January. There were only two acceptable storm events during this month, but a sample was not collected as both events occurred at night.
- February: No grab samples were collected during February. There were only two acceptable storm events during this month, but a sample was not collected as one event occurred at night and the other event had snow in the forecast.
- March: No grab samples were collected during March. There were three events meeting criteria. Two events began at night and one event was missed as it began earlier than predicted on the weekend.

[8] According to the QAPP, grab samples may not be collected in the middle of the night. During WY2023, City staff continued to occasionally have issues with weekend collection due to staffing and laboratory issues.

- April: No grab samples were collected during April. One event was unpredicted, and the other three acceptable events occurred after work hours and/or on the weekend.
- May and June: There was only one qualifying event forecasted during May. The event was missed as it began in the early morning hours.
- June, July, and August: There were no qualifying predicted events during these months and no grab samples were collected.
- September: There were no grab samples collected during September. There was one qualifying event on September 24,2023, but the event had occurred on the weekend and was missed.

The outlined QAPP goal of 55 grab samples wasn't met with a total of 14 grab samples successfully collected in WY2023. The wet/dry season goals were not met during WY2023. The City believes that the overall sampling program was successful in sampling the precipitation events that met storm criteria and every attempt was made to sample and meet the requirements. The City will continue collecting grab samples when practicable in WY2023 in order to meet the goal of 55 grab samples.

B.4.3 SAMPLING CRITERIA AND FREQUENCY

The sampling frequency as outlined in the QAPP[9] is 55 samples per year with a minimum of eight samples at five of the seven outfalls (OF230/230A, OF235, OF237A, OF237B, and OF245). During the WY2023 monitoring period, City staff sampled whenever conditions presented themselves, with a goal of collecting 60-80 percent of the stormwater samples in the wet season and 20-40 percent in the dry season. Attempts were made to evenly distribute the samples throughout the year, but samples were collected in subsequent storms with the goal of obtaining the total number of required samples per year. The storms that were sampled during WY2023 were collected to the extent practicable throughout the year. The storms that were sampled are generally representative of fall, winter, spring, and late summer storms (see Figure B3-1). There was no qualifying, forecasted storm events and no samples collected during the months of June, July, and August.

Rainfall in WY2023 during the wet season was seven inches below the average wet rainfall conditions based on recent history, while during the dry season was almost three inches less (Table 3-1). WY2023 was the driest year on record for the entire monitoring record. There were no events in June, July, or August that were forecasted, or which met storm event criteria (Table B4-1). This resulted in no samples being collected during these months.

At the tidally influenced outfalls (OF230/OF230A, OF235, OF 237A, OF243, OF245, and OF254), the composite sample must contain a minimum of 10 aliquots collected over the tidal window for each event, with no tidally influenced samples composited. Sampler pacing is set to attempt to collect storm samples throughout the entire tidal window to capture as much of the event as possible. Tidal charts are reviewed and conductivity for each container is measured in the laboratory to minimize tidal water contamination. Only containers with a conductivity of

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[9] Effective October 1, 2012, EPA and Ecology approved a reduction in the number of samples collected per year. The 2001 SAP goal of 10 stormwater samples per year for all seven outfalls was reduced to eight samples per year for OF230, OF235, OF237A, and OF237B, and to three samples per year for OF243, OF245, and OF254. To meet the NPDES Permit requirement of 55 samples per year, the approved QAPP requires eight minimum to eleven maximum samples for OF230, OF235, OF237A, OF237B, and OF245, and three to eleven samples per year for OF243 and OF254.

≤ 2,000 µmhos/cm (conductivity ≤ 5,000 µmhos/cm for OF243 and OF254) are composited. The composite samples must be collected for a total duration of at least two times the time of concentration for that outfall.

Each event sampled was evaluated in meeting these goals, but circumstances did arise at times where some of the criteria could not be met. The justification for accepting composite samples that deviated from these criteria is provided in the field reports (Attachment B-1) and in Section B.4.4 below.

B.4.4 Representativeness of WY2023 Stormwater Events

City staff targeted a total of 24 storm events (see Tables B4-2 and B4-4) and up to 20 deployments were made at each monitoring location during WY2023 for a total of 112 individual deployments. Of the 24 storm events where deployments occurred at one or more outfall, the following occurred for the five of seven outfalls (OF230, OF235, OF237A, OF237B, and OF245) that require a minimum of eight samples per year:

- Seven events did not produce sufficient runoff for collection at any sites due to inadequate rainfall
- Up to seven events at the following locations were unsuccessful due to deployment, equipment, forecasting and processing issues: three at OF237A, four at OF235, seven at OF237B, and five at OF245
- The drainage area for OF230 was rerouted to the new OF230A from October to December 2022. During that time there was limited flow discharging to OF230 and monitoring for this outfall ceased in December 2022 after discussions with Ecology. There were eleven deployments at this location from October to December with eight unsuccessful due to low flows.
- OF230A had limited opportunity for sampling during WY2023. The City anticipates increased sampling success during WY2024 at this new monitoring location.
- There were three unpredicted storm events during WY2023 (see Table B4-2).
- The storm events successfully collected during WY2023 are three at OF230, eleven at OF235, nine at OF245; twelve at OF237A; and eight at OF237B.
    - Wet season – Ten storm events were successfully sampled at one or more of the monitoring locations.
    - Dry season – Two storm events were successfully sampled at one or more monitoring locations.

All of the rainfall events were successfully tracked by the City (see Table B4-2).

Of the 24 events, up to 18 events were deployed for the remaining two outfalls, OF243 and OF254, during WY2023. The following occurred at OF243 and OF254, which require a minimum of three samples per year:

- Six events at OF243 were unsuccessful due to deployment, equipment, and forecasting issues. There were four unsuccessful deployments in October 2022 due to a conductivity probe failure. There was supply chain issues and the sensor connection cable was discontinued. These issues caused a delay in fixing the sampler issues at OF254 until June 2023. There was one additional deployment opportunity in September 2023 which was unsuccessful due to a distributor arm equipment issue. These issues have been resolved.
- The storm events successfully collected during WY2023 are seven for OF243 and one for OF254:
  - Wet season – Six storm events at OF243 and one storm event at OF254 were successfully sampled.
  - Dry season – One storm event was successfully sampled at OF243 and there were no successful samples collected at OF254.

The outlined QAPP goal of 55 samples was not met in WY2023 with 51 composite samples accepted. This was largely due to the lack of sampling opportunities at OF230 and OF254 that where beyond the City's control.

- Equipment issues experienced at OF254 and the replacement part was unavailable for most of the sampling year. The additional equipment issues experienced at OF254 limited deployments and sampling success at this site. These issues have been resolved.
- There were eleven deployments at OF230 from October to December 2022 with eight unsuccessful due to low flows, (3 stormwater samples collected).
- As previously discussed in Section B.2.2.1, major changes were made to the OF230 drainage area as most of it was rerouted to OF230A (including some drainage area and flow from OF235) from October to December 2022. This transition resulted in significant changes of storm and baseflows in OF230 and OF230A, very limited flow discharging to OF230. Flow to OF230 was determined to be diminished and monitoring for this outfall ceased in December 2022 after discussions with Ecology.
- Sampling criteria had to be re-established using new flow data monitoring at the new monitoring location for OF230A. The City began monitoring OF230A on April 12, 2023. The City anticipates increased sampling success during WY2024 at this new monitoring location.

The minimum number of samples was met at the majority of the remaining outfalls with the exception of seven samples at OF237B. A minimum of two qualifying events were sampled at OF235, OF237A and OF245 during the dry season. There was one successful dry season sample at both OF237B and 243. The remainder of the samples were collected in the wet season. The following sections describe the composite events that met all QAPP criteria as well as those that did not meet all criteria.

B.4.4.1 Events Meeting all QAPP Criteria

19 of the 24 targeted events met storm criteria. City staff successfully sampled 51 of the 81 sampling opportunities meeting storm event goals, a success rate of 51 percent. The lower success rate exhibited during WY2023 can be attributed to the limited sampling success at OF230 and OF254. The sampling success rate is 68% when looking at the remaining outfalls. The dates and distribution of the sampled events are shown in Table B4-2 and Figure B3-1.

B.4.4.2 Events Not Meeting all NPDES Criteria

Events Not Meeting Antecedent Goals The antecedent dry period during the wet season is 0.05 inches in the previous 24 hours and during the dry season (May to October) is 0.02 inches of rainfall in the previous 48 hours. All but four sampled events met the NPDES antecedent goals set forth in the 2020 QAPP.

The antecedent period for the November 4, 2022, event (0.79 inches) was 14 hours (see Table B4-6). While there was 0.16 inches of rainfall in the previous 24 hours prior to the sampling event, all sampling locations had returned to baseflow conditions prior to the start of the event.

The antecedent period for the December 9, 2022, event (0.58 inches) was 14.58 hours (see Table B4-6). While there was 0.10 inches of rainfall in the previous 24 hours prior to the sampling event, all sampling locations had returned to baseflow conditions prior to the start of the event.

The antecedent period for the April 9, 2023, event (1.11 inches) was 14.33 hours (see Table B4-6). While there was 0.13 inches of rainfall in the previous 24 hours prior to the sampling event, all sampling locations had returned to baseflow conditions prior to the start of the event.

The antecedent period for the September 24, 2023, event (0.91 inches) was 20.75 hours (see Table B4-6). While there was an unpredicted 0.24 inches of rainfall in the previous 24 hours prior to the sampling event, all sampling locations had returned to baseflow conditions prior to the start of the event. This event is considered a first flush event.

The samples were accepted since all sampling locations returned to baseflow conditions:

11/22/2022 – The samplers at OF230, OF235, OF237A, and OF237B were programmed for a 0.31 inch event (actual event was 0.88 inches). The samplers successfully sampled runoff for up to six hours of the nine hour event at each of the outfalls. The OF230 sample represents the rising portion of the storm event due to tidal influence and lack of flow at this site. The OF235, OF237A and OF237B samples represent the rising and peak portions of the storm event and are considered representative of the partial event. The representative duration and rainfall for each outfall are shown in Table B4-6.

Events Not Meeting Spacing Events This criterion sets a goal of a minimum of one week spacing between events to allow some build-up of pollutants during the dry weather intervals, and no more than two samples per month. During WY2023, all samples met this criterion (see Tables B4-2 and B4-4).

Events Not Meeting Composited Aliquots All composite samples included more than 10 aliquots. During WY2023, ten composite samples were collected which had a few aliquots that were considered not representative of that sampling event. If the percentage of the aliquots composited that are considered not representative of that sampling event is relatively low (typically 12 percent or less), the City believes that the analytical results are representative of the stormwater runoff that occurred during that event, and it was included in all calculations. While the following sample contained slightly more than 12 percent of aliquots that were considered to be not representative, this sample was not rejected based on the following:

3/19/2023, OF237A– Due to the sampler triggering early, two aliquots from Jar 1 were collected prior to the start of the storm event and included in the composite sample. Additional due to battery issues, there were limited aliquots for this event. This resulted in two out of 15 aliquots (13 percent) being included in the sample that were not deemed representative as they were collected prior to the event. While this is slightly higher than the goal of <12 percent, samples from this event were accepted and considered representative of the event.

The following samples included aliquots not representative of the sampling event, but samples were not rejected (<12 percent of the total):

- 2/7/2023, OF237A. One aliquot of 12 (8 percent) composited was not representative of the sampling event but was included in the sample composite submitted to the lab.
- 3/12/2023, OF237A. One aliquot of 19 (5 percent) composited was not representative of the sampling event but was included in the sample composite submitted to the lab.
- 11/4/2022, OF237B. One aliquot of 10 (10 percent) composited was not representative of the sampling event but was included in the sample composite submitted to the lab.
- 12/29/2022, OF237B. One aliquot of 14 (7 percent) composited was not representative of the sampling event, but was included in the sample composite submitted to the lab.
- 2/7/2023, OF237B. One aliquot of 16 (6 percent) composited was not representative of the sampling event, but was included in the sample composite submitted to the lab.
- 3/19/2023, OF237B. One aliquot of 21 (5 percent) composited was not representative of the sampling event, but was included in the sample composite submitted to the lab.
- 4/9/2023, OF237B. One aliquot of 18 (6 percent) composited was not representative of the sampling event, but was included in the sample composite submitted to the lab.
- 9/24/2023, OF237B. Two aliquots of 35 (5 percent) composited were not representative of the sampling event, but were included in the sample composite submitted to the lab.
- 3/31/2023, OF243. One aliquot of 21(5 percent) composited was not representative of the sampling event, but was included in the sample composite submitted to the lab.

During WY2023, three composite samples had one to two aliquots that were considered representative of that sampling event and weren't added to the composite of that sampling event. If the percentage of the missing aliquots that are considered not representative of that sampling event is relatively low (less than 12 percent), the City believes that the analytical results are representative of the stormwater runoff that occurred during that event, and it was included in all calculations. The following samples were believed to be representative of that sampling event:

- 11/4/2022, OF237B. One aliquot of 40 (3 percent) was not included in the composite. Most of jar two was collected prior to the event though one aliquot in Jar 2 was considered representative of the storm.
- 10/30/2022, OF245. One aliquot of 32 (3 percent) was excluded but was representative of the storm event. The other aliquot in the jar were taken outside of the event.
- 4/9/2023, OF245. One aliquot of 40 (3 percent) was excluded but was representative of the storm event. The other aliquots in the jar were taken outside of the event.

Events Not Meeting Conductivity Goal To confirm tidal exclusion from the composited samples, aliquots composited from OF243 and OF254 are to be less than 5,000 µmhos/cm and the remainder of the outfalls is to be less than 2,000 µmhos/cm. During WY2023, several samples at OF243, OF245, and OF254 did not meet this criterion. The remaining monitoring locations met the event conductivity goals (Tables D1-D7). The following is a general discussion regarding the samples that did not meet this criterion:

- Conductivity measurements of the aliquots composited for OF243 were greater than 5,000 µmhos/cm for three of the seven composite samples. The composite samples conductivities above 5,000 µmhos/cm ranged from 5,680 to 6,690 µmhos/cm (see WY2023 Report, Appendix C, Table C-5, and Appendix D, Table D-5.1). Although the samples collected were above the 5,000 µS/cm goal, all of the samples were believed to be representative of runoff conditions[10].
- Conductivity measurements of the aliquots composited for OF254 were greater than 5,000 µmhos/cm for the one composite sample collected. The composite sample conductivity was 8,900 µmhos/cm (see WY2023 Report, Appendix C, Table C-7, and Appendix D, Table D-7.1). Although the samples collected were above the 5,000 µmhos /cm goal, the samples were believed to be representative of runoff conditions[11].

B.4.4.3 Representativeness of Individual Storm Events

Stormwater samples were flow-weighted (OF230, OF235, OF237A, and OF237B) or time (OF243, OF245, and OF254) composite samples representing the range of discharge conditions during the sampling event, including, where possible, the rising and falling portions of the runoff hydrograph. The storm events that were successfully flow or time composite sampled during WY2023 included three at OF230, eleven at OF235, Twelve at OF237A, eight at OF237B, seven at OF243, nine at OF245, and one at OF254.

Over the course of the last 22 years, the tidal sampling windows randomly overlapped with different portions of the runoff hydrograph. Table B4-5 identifies the number of storms sampled in each basin over the 22-year monitoring period of the Foss Monitoring Program that fall in each portion of the runoff hydrograph. OF235, OF237A, OF243, and OF245 had 75-100 percent of the events sampled represent the majority of runoff conditions in WY2023. OF230 had 67 percent of the events sampled represent the majority of runoff conditions while none of the events sampled for OF254 represented these conditions. For the remainder of the events sampled, an evenly distributed range of rising, peak, and falling runoff conditions were captured during multiple sampling events. A variety of runoff conditions were sampled in the tidally influenced drains for these individual storm events in an attempt to address the QAPP, which recognizes the fact that storm events are variable by nature.

B.4.4.4 Representativeness of Storm Types

Storm events are highly variable in nature by runoff volume, flow rate, antecedent rainfall, and season. This variability was evaluated by comparing the magnitude and intensity of the runoff hydrographs, where samples were collected on the hydrographs, the time between storm events,

[10] Since the conductivity for non-storm conditions prior to the events were very high, these samples are believed to be representative of storm runoff conditions.

[11] There was snow predicted or on the ground on November 29, 2022, disqualifying a potential events from meeting the sampling criteria. Samplers were not deployed during this time.

and the time of year the samples were collected to determine whether a representative range of storm types was included in the monitoring program. A summary of each of these evaluations is included in the following paragraphs.

B.4.4.4.1 Total Rainfall

A variety of storm types were successfully sampled during WY2023. Figure B4-1.1 shows the variability in the total rainfall sampled for the entire monitoring program. The storm intensity and antecedent dry periods were similar for each monitoring year, however the rainfall depths sampled is generally higher starting in October 2009 to present than in the September 2001 through September 2009 period (see Figure B4-1.2). There are eight events greater than 0.9 inch in September 2001 through September 2009 and 55 events greater than 0.9 inch in October 2009 through September 2023. Many of the highest rainfall depths were sampled in WY2017, WY2021, and WY2022. There were five events during WY2021, four events during WY2022, and two events in WY2023 greater than 0.9 inches (see Figure B4-1.2). The highest rainfall sampled during the monitoring record occurred during WY2022 (4.57 inches).

As shown in Figure B4-2, the majority of the storms accepted in WY2023 were 0.4-0.49 inch (17.6 percent) and 0.5-0.59 inch (23.5 percent). The distribution of WY2023 storm depths sampled varied somewhat from what is typically seen in both the historical average and the monitoring record. The following are the variations seen during the WY2023 monitoring period:

- 0.15-0.29 inch. Historically these storms represent approximately 31 percent of storms sampled and during WY2023 these storm events represented approximately 18 percent of the total.
- 0.3-0.39 inch. Historically these storms represent approximately 21 percent of the storms sampled and during WY2023 there were no storm events represented for this size of storm event.
- 0.4-0.49 inch and 0.5-0.59 inch. Historically these storms represent approximately 24 percent of storms sampled and during WY2023 these storm events represented 42 percent of the storms sampled, or 18 and 24 percent of the total respectively.
- 0.7-0.89 inch. Historically these storms represented a lower percentage of storms sampled (approximately 8 percent). During WY2023, these storm events represented 18 percent of the total.
- >0.9 inch. Sampled storms during WY2023 were fairly consistent with the historical record of 9 percent for these large events with 12 percent of the storms falling in this bracket. The historical monitoring record shows a higher number of these events with 15.4 percent total.

The total rainfall of the sampled storm events in WY2023 varied from 0.20 inch to 1.11 inches (Table B4-6). 59 percent of the storms sampled in WY2023 were less than 0.6 inch in depth.

In WY2023, there were 99 storm events. Table B4-1 lists the total number of the 99 storm events, and further provides analysis to determine those events that met the QAPP criteria for qualifying sampling events. 61 storm events for WY2023 met antecedent conditions, and of these, 19 events had greater than 0.2 inch of rainfall[11]. Only 15 of these 19 events were forecasted. The City sampled four events that did not meet antecedent conditions as described in Section B.4.4.2. Of those sampled events, two were greater than 0.9 inch (12 percent). The storms sampled in

WY2023 were representative of the rainfall events and sampling opportunities for the water year (≥0.2 inch, met antecedent or returned to baseflow conditions and forecasted).

The annual and overall monitoring program's rainfall distribution for the events sampled is compared to the historic distribution of rainfall to determine whether the distribution sampled is representative of the historic distribution. The rainfall events sampled during the entire 2002-2023 monitoring program are similar to the historical distribution of rainfall in the City, however the number of smaller events (less than 0.4 inch) is 8 percent less than historic conditions and the number of events greater than 0.9 inch (15.3 percent) is greater than the historical average of 9 percent (Figure B4-2).

B.4.4.4.1 Storm Duration and Intensity

WY2023 durations ranged from 6.9- to 52-hour storms (see Table B4-6). WY2023 antecedent periods are:

- Four less than 24 hours
- Five between 24 and 49.9 hours
- Two between 50 and 99.9 hours
- Six at 100 hours and greater

Average rainfall intensities (total rainfall/duration) also showed a variety of storm types in WY2023. The average rainfall intensities for WY2023 were 0.01 inches/hour to 0.11 inches per hour (see Table B4-6). The distribution of average rainfall intensities for each year is as follows:

	Average Rainfall Intensities						
Number of events	≤ 0.02"/hr	0.03"/hr	0.04"/hr	0.05"/hr	0.06"/hr	0.07"/hr	≥0.08"/hr
Year 1	6	3	2	2	0	1	1
Year 2	4	3	2	3	1	1	0
Year 3	5	5	2	2	0	0	3
Year 4	5	3	0	0	2	2	2
Year 5	2	1	1	1	2	1	2
Year 6	5	3	4	2	1	1	1
Year 7	6	3	3	3	1	0	1
Year 8	5	5	2	0	2	1	0
Year 9	9	8	7	4	2	1	2
Year 10	9	4	2	0	0	1	2
Year 11	9	5	3	2	2	1	3
Year 12	2	5	1	1	2	1	2
Year 13	4	5	3	0	2	1	1
Year 14	4	4	4	3	1	2	2
Year 15	5	3	6	2	2	1	0
Year 16	2	4	6	0	2	1	0
Year 17	5	4	2	5	2	0	0
Year 18	1	6	3	3	2	1	2
Year 19	2	8	3	7	1	0	3
Year 20	6	5	2	2	2	1	5
Year 21	2	2	5	3	0	2	3
Year 22	5	3	3	1	2	0	3
Totals	106	91	65	48	31	21	38

Figure B4-1.1 shows the variability in the rainfall duration and antecedent for each event sampled in WY2023 and for the entire monitoring program. With the growing monitoring record, it can be seen that a representative cross-section of storm types is being sampled (Figure B4-1.2).

B.4.4.4.2 Seasonal Distribution

In WY2023, the number of precipitation events accepted per season is as follows (see Figure B4-3):

- Fifteen during the wet season (October through April) – 88 percent of the total
- Two during the dry season (May through September) – 12 percent of the total.

The seasonal distribution for WY2023 is similar to the historical average of 84 percent in the wet season and 16 percent in the dry season. The City believes the wet season percentage of accepted events is representative of a drier than normal monitoring year, where the wet season rainfall was:

- 87 percent of the annual precipitation (25.25 inches of the annual 29.05 inches of rainfall) (Table B3-1)
- 87 percent of the number of storm events (86 wet season events of the 99 events) (Table B4-1)

Table B4-7 lists the number of wet and dry season storms sampled per water year and for the entire monitoring record for each monitoring location. For WY2023 and the entire monitoring record, the wet and dry season totals are:

# Storms Sampled per Season by Monitoring Location				
Monitoring Locations	**WY2023**		**Years 1-22**	
	Wet	**Dry**	**Wet**	**Dry**
Total	**15**	**2**	**293**	**86**
OF237A	83%	17%	77%	23%
OF237B	88%	13%	76%	24%
OF230	100%	0%	77%	23%
OF235	82%	18%	77%	23%
OF243	86%	14%	77%	23%
OF245	78%	22%	79%	21%
OF254	100%	0%	78%	22%

Stormwater sampling under the overall monitoring program remains slightly biased toward the dry season, with 23 percent (WY2002-WY2023) of sampled storms occurring during the dry season and77 percent during the wet season (Figure B4-3). This is likely due to the fact that antecedent periods are easier to meet in the dry season as compared to the wet season, which provides more opportunities for sampling.

The yearly and overall monitoring program's seasonal distributions for the events sampled are believed to be representative of the historic seasonal distribution.

Seasonal First Flush There were no qualifying first flush (i.e., first major events after summer dry periods) events sampled in WY2022. There was no significant rainfall during September 2021 and the forecasted first flush event occurred on October 21, 2022. Discussion of the WY2022 first flush event is discussed below. During WY2023, there was one first flush event sampled. WY2023 was significantly drier than the historical average (greater than nine inches) and there were no qualifying events during June, July or August. The summer storm events and seasonal first flush events for WY2022 and WY2023 is shown in Figure B3-1 and were:

- October 2022: No significant rainfall occurred during the month of September 2022. This is the first time in the monitoring record that no rain fell in the month of September in the study area. The first flush event for WY2022 occurred on October 21,2022. There were no rain events prior to this qualifying event with an antecedent dry period of 552 hours (previous rainfall on June 6, 2022). The event was predicted for 0.94 inches and the actual rainfall was 0.42 inches. While samples were successfully collected from OF235 and OF237A samples at the other monitoring locations were unsuccessfully due to programming the samplers for a much larger event.
- July 2022: No qualifying events occurred in July.
- August 2022: No qualifying events occurred in August.
- September 2022: There was one smaller event that occurred on September 18th with 0.07 inches of rainfall. Additionally, there was an unpredicted qualifying event of 0.24 inches of rainfall 21 hours prior to the sampled qualifying first flush event. The City sampled the subsequent event on September 24th with 0.91 inches of rainfall. The first smaller event was not considered a seasonal first flush event due to producing very little runoff. The seasonal first flush events occurred on September 23rd and 24th with 0.24 inches and 0.91 inches respectively. Samples collected at all locations except OF230A due to tidal influence and OF254 due to an equipment error.

There were two qualifying first flush events meeting the QAPP criteria. The first event was the unpredicted event on September 23, 2022, and the second event occurring a day later on September 24th. The September 24th event was 0.91 inches with a 21 hour antecedent dry period. While the antecedent criteria wasn't met for the September 24th event due to a September 23rd storm that occurred, this event was still considered as a first flush event after two months with very little rainfall (2,183 hours with 0.5 inches of rain). Samples were accepted at OF235, OF237A, OF237B, OF243, and OF245 and are considered to be representative of this first flush event. No samples were collected at OF230A and OF254 due to tides and equipment issues.

As shown on Figure B3-1, no qualifying events occurred in July, August, or the first half of September. The City successfully collected a flush event sample from all sites except OF230A and OF254 due to tidal and equipment issues. All attempts were made by the City to collect samples during these first flush events.

B.4.4.4.3 Storm Flow Rates

The ranges of magnitude and intensity of the runoff hydrographs are shown in Table B4-8 for baseflow and Table B4-9 for stormwater. The individual runoff data for each event is listed in Appendix C, Tables C-1 through C-7, as volume of storm runoff and flow rate for each outfall. The total runoff volumes sampled were variable for WY2023 (Year 22) at each outfall (Table B4-9). A variety of average flow rates were also sampled over the course of the year. The WY2023 runoff data was within the ranges of the entire monitoring record.

B.4.4.4.4 Overall Representativeness of Storm Types

During WY2023 monitoring, a wide variety of storm types were sampled. Each storm was defined by the following variables:

- Total rainfall
- Intensity
- Antecedent period
- Season
- Runoff hydrograph

For the most part, WY2023 values were similar to the values reported for Years 1 through 22 (Tables B4-6 and B4-9, and Table C-15). Based on an evaluation of the storm criteria, the City was able to incorporate a large amount of variability in our sampling results and the storm types sampled are considered to be representative.

B.4.4.5 Sampling Success

To evaluate sampling success, precipitation data for each year was reviewed to assess the following:

- The number of precipitation events per year.
- The number of precipitation events that met antecedent criteria and were equal to or greater than 0.2 inches in 24 hours.
- The number of these events that were sampled.
- The number of these events that were not sampled and why they were not sampled.

As shown in Table B4-1, WY2023 had 99 precipitation events, 15 of which were forecasted and met storm criteria of antecedent conditions and minimum rainfall requirements. Of these 15 events, 13 were successfully sampled at one or more outfalls. Four additional events were sampled that did not meet antecedent conditions but was considered representative of storm conditions.

Stormwater sampling is inherently difficult due to several factors: the variability in storm forecasting and subsequent sampler programming verses the actual rainfall total, mechanical failures, and human errors. Sampling in tidally influenced drains is also limited to those periods when the drains are not affected by tides. Despite these inherent difficulties in stormwater sampling, the City made every attempt to meet the goals of this program. Sampling crews reviewed weather forecasts seven days a week, including holidays, so that weekend events would not be missed if the forecast changed after Friday. Almost all of the rainfall events were successfully tracked by the City, with only one possible event missed for a sampling opportunity at OF237B on January 11th.

Due to ongoing issues at OF254 and drainage regime changes at OF230, only fifty-one percent of deployments resulted in successful samples (see Table B4-2). The sampling success at OF235, OF237A, OF237B, OF243 and OF245 was 68 percent. Collection of some samples was prevented due to tidal influences or equipment malfunctions. The most significant challenges in WY2023 included:

- OF254 Conductivity Probe – During much of WY2023 OF254 was either unsuccessfully sampled or not deployed. The conductivity probe malfunctioned, and the City did not have a back-up. Due to supply chain issues and the sensor connection cable being discontinued this caused a delay in fixing the sampler issues at OF254 until June 2023. There was one additional deployment opportunity in September 2023 which was unsuccessful due to a distributor arm equipment issue. These issues have been resolved.

- OF230 Flow change: Due to the flow regime change (flow diverted to OF230A) it was difficult to collect samples at this location, especially during any tidal influence. Sampling was discontinued at this site on January 1, 2023.
- Actual rainfall was much different from the precipitation predictions that the sampler programming was based on
- Tidal influences
- Snow on the ground or in the forecast
- Sensor malfunctions
- A few with pump count errors, battery failure, programming errors, and sample processing errors

The outlined QAPP goal of 55 samples was not met with a total of 51 composite samples successfully collected in WY2023. The wet/dry season goals were not met at OF230, OF235, OF237A, OF237B, OF243 and OF254 (see Table B4-7); however, the City believes this to be representative of the dry season conditions for WY2023[12]. The majority of outfalls did not have a minimum of two qualifying events collected during the dry season, with the exception of OF235, OF237A and OF245. This is due to limited sampling opportunity with only two qualifying forecasted events during the dry season. There was a seasonal first flush sample collected during WY2023 on September 24, 2023. The City believes that the overall sampling program was successful in sampling the precipitation events that met storm criteria and every attempt was made to sample and meet the requirements.

B.4.4.6 Summary

For each sampling event during WY2023, the City reviewed the flow hydrograph, the discrete sampling times relative to tidal stage, rainfall, and the conductivity (salinity) of the samples to determine which of the discrete samples should be composited to best represent the runoff event. The level, velocity, and flow data for every storm event was representative of stormwater runoff conditions. Most of the stormwater criteria were met (conductivity, tidal window, rainfall, and aliquots) and if not, were evaluated and the samples believed to be representative. Field and analytical data for all the samples collected and analyzed are included in Appendices C and D of the WY2023 Report. Rejected data were not included in any of the statistical analyses.

[12] The overall total seasonal distribution of 88 percent of wet season samples aligns with 87 percent of annual precipitation and 87 percent of storm events occurring in the WY2023 wet season.

B.5 STORMWATER SUSPENDED PARTICULATE MATTER (SSPM) MONITORING

The SSPM data are useful tools for source tracing given the following considerations:

- Sample locations are selected at the end of the pipe in an attempt to represent the cumulative effect of sources in that particular drainage basin.
- Sediment traps and the manhole sump collect SSPM for an extended period of time (generally a year) and collect sediment from a variety of storms (i.e., a range of volume, duration, and intensity conditions).
- Sediment traps are generally installed before August 26th each year to include seasonal first flush.
- Comparison of results from source tracing sediment traps help to prioritize source control efforts among Thea Foss sub-basins.

It is inappropriate, however, to evaluate SSPM data using sediment quality criteria because the storm drains provide neither habitat nor a point of compliance for aquatic life.

The following subsections evaluate the field and hydrologic data for WY2023 and discuss whether the samples collected using sediment traps and the MH390 Sump are believed to be representative of SSPM and sediment quality, respectively.

B.5.1 SSPM – SEDIMENT TRAPS

Most WY2023 sediment traps were installed between August 22-23, 2022. The exceptions were as follows:

- FD-3C which replaced FD-3A and represents the same area was installed for this water year on March 23, 2023.
- The FD-10C sediment trap and bracket were installed for WY2023 on August 31, 2022, after a storm line cleaning occurred. Note that there was no rainfall during this one week delay.
- Two bottles at site FD-23 were installed for WY2023 on September 7, 2022, due to cleaning and maintenance of the system. Again, there was no rainfall during this delay.

Consistent with the requirements of the 2020 QAPP and prior years of sampling, the sediment traps were left in place for approximately 12 months. All sediment trap samples were collected August 22-24, 2023, approximately 12 months after deployment.

As shown in Table B5-1, 26.44 inches of rain fell during the Year 22 SSPM sampling period, which is approximately ten inches less than the historic average of 38.95 inches with the majority of the discrepancy occurring during the wet season. During WY2023, the wet season exhibited seven inches less rainfall compared to historic conditions while the dry season exhibited approximately three inches less rainfall. The estimated volume of stormwater runoff during the Year 22 SSPM sampling period is shown in Table B5-2.

SSPM sampling was performed in general accordance with the 2020 QAPP. SSPM sample processing was performed per the laboratory’s revised SOP Foss Waterway Sediment Trap Sample Processing.

B.5.1.1 SSPM Sample Protocols

Between August 22-23, 2022, prior to the September seasonal first flush, sediment traps were deployed at each of the sampling locations shown in Figures B2-5, B2-7, B2-9, and B2-12 and described in Table B2-3. Exceptions to this timing are identified above. The City installed two sediment traps at each outfall location to ensure that sufficient sample volume was collected for analyses.

The traps were installed near the bottom of the junction boxes wherever possible. The sediment traps were inspected quarterly starting in December until the samples were retrieved (see the SSPM Field Report in Attachment B-2). At the end of the deployment period, the collection bottles were capped with screw closures, removed from the mounting brackets, packaged, and placed on ice in coolers for transport to the City's laboratory for processing. The samples were collected and delivered to the City laboratory under chain-of-custody procedures in accordance with the 2020 QAPP.

B.5.1.2 SSPM Sample Processing

Analysis of the SSPM samples was performed on the solids fraction of the collected sample. In order to separate the liquid fraction, the SSPM samples were processed in accordance with the revised August 26,2019, laboratory SOP, Foss Waterway Sediment Trap Sample Handling. The process used was:

1. A portion of the overlying water was decanted and retained.
2. Remaining water and sediment were slurried and then dispensed into Teflon cups. The retained water from step 1 was used to wash out the remaining solids in the sample container.
3. The sample was centrifuged for fifteen minutes at 2000 RPM or until the decanted overlying water was visually clear. The overlying water was then decanted and discarded.
4. The remaining solid portion was dried, cryo-milled to ensure sample homogeneity, and then submitted for analyses.

No part of the sample, in particular the liquid fraction, was discarded during this process without being centrifuged. All particles that could be removed were removed and retained with the solid fraction for analyses. Processing of the samples was accomplished using stainless steel utensils, which were decontaminated prior to use in accordance with the laboratory SOPs.

The SSPM sample analyses were conducted in accordance with the hierarchy listed in Table B2-8 depending on the volume of sediments collected. Once in the laboratory, the laboratory's SOP for sample handling and storage was followed. After analysis, the remaining sample was archived according to the laboratory's SOP. The remaining sample was kept frozen and retained for three months beyond issuance of the Quality Assurance Data Summary Package.

B.5.1.3 Representativeness – SSPM

The sampling plan design, sampling techniques, and sample handling protocols were developed to attempt to get representative samples. There were no deviations from the 2020 QAPP except as noted below:

- Sediment trap FD3A bracket and trap were removed during WY2022 due to construction activity in the area. FD3A was renamed FD3C when it was re-installed at a new monitoring location that captures a similar drainage area. This change is addressed in the updated QAPP approved in 2023.

- The FD10C sediment trap and bracket were reinstalled on August 31, 2022, after a storm line cleaning occurred. No rain fell during this time period when the trap was not in place.
- Two bottles at FD23 were reinstalled for WY2023 on September 7, 2022, following completion of a scheduled cleaning and maintenance of the system. No rain fell during this time period when the trap was not in place.
- No traps were lost during the deployment period from August 2022 to August 2023. Three sediment trap checks were performed quarterly during the 2022 – 2023 sampling year in November/December 2022, March 2023, and May 2023, as per QAPP requirements.

Samples from sediment trap locations FD6, FD2, FD2-A, FD1, FD21, and MH390 were submitted for grain size analysis using the ASTM D422 method (hydrometer/sieve analysis method). Samples from locations FD16, FD18, FD3C, FD3-New, FD13B-New, FD10C, FD23 and FD22 had insufficient sample volume for ADTM D422 analysis and were analyzed with method ASTM D7928. All other required analyses were completed for the sediment trap samples.

All SSPM samples collected and submitted for analysis during the WY2023 monitoring are believed to represent storm sediment conditions, as defined above, for each outfall.

B.5.2 STORMWATER SEDIMENTS – MH390 SUMP

A representative sediment sample is generally taken from the sump (MH390) located upstream of OF245 in August of each year. The MH390 sump is then cleaned following sampling to ensure that the subsequent sampling represents the discrete approximately August to the following August annual sampling period. The depth of accumulated sediment is also measured.

In WY2023, the MH390 sump above OF245 was sampled on September 12, 2023, and results are reported in the WY2023 report. The sample collected September 12, 2023, represents the previous year's sediment accumulation. The accumulated sediment ranged from 0.0 – 3.5 inches in depth with an estimated volume of 0.82 cubic feet of material. Total rainfall for Year 22 SSPM monitoring period is 26.63 inches (see Table B5-1, as measured at NOAA Station Tacoma 1 at the Central Wastewater Treatment Plant). This was significantly less than the historic average of 38.95 inches. Corresponding estimated runoff volumes for each area are presented on Table B5-2. The City believes that the WY2023 MH390 sample is representative of the August 26, 2022, to September 12, 2023, timeframe discussed above and comparable to previous year's data.

B.5.2.1 MH390 Sump Sample Collection and Cleaning Process

The WY2023 sample was collected in accordance with the 2020 QAPP procedure. A confined space entry was performed to measure the sediment depths and samples were collected from the top of the manhole using a Ponar sampling device. Random samples were obtained from the manhole sediment and composited into a large stainless-steel bowl. This sample was then well mixed into a slurry and then distributed in the lab into appropriate containers for analysis.

B.5.2.2 MH390 Sump Sample Process

Once in the laboratory, the laboratory's SOP for sample handling and storage was followed. The analytes tested are listed in Table B2-9. After analysis, the remaining sample was archived according to the laboratory's SOP. The remaining sample was kept frozen and retained for three months beyond issuance of the Quality Assurance Data Summary Package.

B.5.2.3 Representativeness – MH390 Sump Sediments

Material captured by the manhole sump (MH390 sump) above OF245 is representative of SSPM and settleable solids which are transported by stormwater and to a small extent, baseflow. However, it should be noted that a portion of the SSPM and solids present in the sump might represent a source other than stormwater from this basin due to this sample station being tidally influenced. The actual sample was a composite of aliquots randomly taken from the sump (see Section B.5.2.1 and Attachment B-2).

It was the intent of the 2020 QAPP to sample the sump sediment so that the material sampled in the sump and that collected in the sediment traps in the other outfalls can be compared over the same time period. Cleaning and sampling of the sump generally coincided with placement and collection of the sediment traps in the other basins. This ensured that the sampling represents the current time period and included no residuals from previous discharges.

The MH390 sample is believed to be representative of the WY2023 sediments and a representative comparison with WY2023 SSPM samples collected in the sediment traps at other outfalls.

B.6 BASEFLOW MONITORING

Baseflow sampling was discontinued in WY2011. Since that year, detection limits for some analytes have changed and are lower than those in the 2001 Sampling Analysis Plan (SAP). The WY2011 baseflow concentrations, many of which were not detected, biased the baseflow pollutant loadings and overestimated the resulting loads. In order to more accurately estimate the baseflow loadings, baseflow samples were collected in 2016 and in 2019 and analyzed for the stormwater analytes listed in the QAPP.

The determination of whether or not there are baseflow components in OF245, OF243, and OF254 is unclear, as the hydrographs are complicated by tidal inundations. Based on an analysis of the continuous flow record, it was determined that there is no substantive baseflow in OF245, OF243, and OF254. However, baseflow samples were collected at these sites for comparison of the predominately industrial land uses (OF245, OF243, and OF254) to the predominately commercial and residential land uses (OF230, OF235, OF237A, OF237B).

B.6.1 WY2016 BASEFLOW

A total of 25 baseflow samples were collected in WY2016 at OF230, OF235, OF237A, OF237B, and OF243. For each sampling event during WY2016, the City reviewed the flow hydrograph, the discrete sampling times relative to tidal stage, rainfall, and the conductivity (salinity) of the samples to determine which of the discrete samples should be composited to best represent the baseflow event. The level, velocity, and flow data for every baseflow event were representative of baseflow conditions. Most of the baseflow criteria were met (tidal window, no rainfall, and aliquots) and if not, were evaluated and the samples believed to be representative. Field and analytical data for all the samples collected and analyzed are included in Appendices C and D of the WY2016 Report. Rejected data was not included in any of the statistical analyses or pollutant loading calculations.

B.6.2 WY2019 BASEFLOW SAMPLING EVENTS

A total of 19 baseflow samples were collected in WY2019 from all seven locations. For each sampling event during WY2019, the City reviewed the flow hydrograph, the discrete sampling times relative to tidal stage, rainfall, and the conductivity (salinity) of the samples to determine which of the discrete samples should be composited to best represent the baseflow event. The level, velocity, and flow data for every baseflow event were representative of baseflow conditions. Most of the baseflow criteria were met (tidal window, no rainfall, and aliquots) and if not, were evaluated and the samples believed to be representative. Field and analytical data for all the samples collected and analyzed are included in Appendices C and D of the WY2019 Report. Rejected data was not included in any of the statistical analyses or pollutant loading calculations.

B.7 LABORATORY DATA REVIEW

This section describes the procedures used to determine if the MQOs described in Section 6.3 of the 2023 QAPP (Tacoma 2023) are met. The intent is to obtain data of known and documented quality, and of sufficient quality and quantity to meet the use for which they are intended.

The quality of the data is indicated by data qualifier codes, notations used by laboratories and data reviewers to briefly describe data and the systems producing it. Laboratory data qualification generally follows method specific criteria, EPA's National Functional Guidelines for Data Review (EPA 2020a,b) and EPA Contract Laboratory Program Statements of Work (EPA 2019a,b).

During data review, verification and validation results are accepted, rejected, or reported with data qualifiers or flags. Data that meet all QC acceptance limits are usable and are not qualified. Data that fail one or more QC criteria are qualified as estimated (with the J flag) or rejected (with the R flag). The distinction between estimated and rejected data resides in the degree of the QC failure and is highly dependent upon the reviewer's understanding of the objectives of the study. A third term, censoring, applies to QC data that may be used to support qualification or rejection, yet are not conclusive when used alone.

This section discusses the review, verification, and validation of WY2023 monitoring data. Data are reviewed, verified, and validated using a Tier II data review level[13] or higher.

B.7.1 OVERALL DATA QUALITY

Overall, 98 percent of all data in this study met MQOs, including 98 percent of stormwater and 99 percent of SSPM data. All accepted data are representative of the constituent population. Performance is summarized by data quality indicators (DQI): sensitivity, bias, precision, technical consistency, completeness, and representativeness.

- **Sensitivity.** 98 percent of stormwater and 98 percent of SSPM met MQOs. The magnitude of most stormwater exceedances was low, less than twice detection level goals (DLG).
- **Bias.** 99 percent of stormwater and 99 percent of SSPM met MQOs.
- **Precision and Comparability.** 100 percent of stormwater and 100 percent of SSPM are precise and comparable according to MQOs. Precision is measured as duplicate relative percent difference for laboratory, matrix spike, and field duplicates.
- **Technical Consistency.** 87 percent of stormwater samples are technically consistent. That means dissolved metal and orthophosphate concentrations are generally less than their total counterparts. The 13 percent was solely due to MDL for dissolved mercury (0.0111) that were higher than the MDL for total mercury (0.0088). All total mercury detections were greater than dissolved mercury detections or the MDL.
- **Completeness.** 100 percent of data were deemed useable. Nineteen of 7,569 (0.2 percent) quality control data points fell within the rejection region. The WY2023 data set is sufficiently complete for study objectives.

[13] Tier II is equivalent to EPA Stage 2b data validation https://www.epa.gov/clp/staged-electronic-data-deliverable-sedd.

Overall, sample results represent the target populations of interest. An exceedance of an MQO does not automatically lead to rejected data, though a datum is classified by its appropriate data qualifier flag. Data are censored or rejected if performance is within the rejection region, as defined in Figures B7-1 and B7-2, and justified by a weight of evidence approach.

The WY2023 laboratory QA/QC review included 51 stormwater and up to 14 SSPM samples. Overall, 10,361 sample and QA/QC results were analyzed in WY2023. Nineteen of 7,569 QC data points (0.2 percent) are classified as censored or rejected. When possible, failing performance criteria or sample loss is noted and corrected (re-extraction or rerun of samples) within holding time restrictions, limiting the impact of a lost data point.

B.7.2 QUALITY ASSURANCE

Data quality is supported by quality assurance measures, such as standardization of sampling and analysis methods, and quality control is evaluated through performance criteria. Additionally, quality assurance is supported by adhering to guidelines established in the 2023 QAPP (Tacoma 2023), including:

- EPA National Functional Guidelines for Superfund Data Review: Organic (EPA 2020a) and Inorganic (EPA 2020b)
- EPA Contract Laboratory Program (CLP) Statements of Work (SOW) (2019a,b)
- EPA field sampler guidance (EPA 2020c); unfortunately, EPA National Functional Guidelines for High Resolution Gas Chromatography coupled with High Resolution Mass Spectrometry (HRGC/HRMS) data review does not contain PBDEs (EPA 2020d)

MQO and censor or reject criteria[14] are presented in Figure B7-1 and Figure B7-2 for stormwater and SSPM respectively. MQO and censor/reject criteria are modeled from and are generally more restrictive than the EPA Guidelines (EPA 2020a,b) and EPA CLP SOW (EPA 2019a,b). The purpose of more restrictive criteria is to inform project participants of trends in the data and to guide continual performance improvement. Federal guidance for this type of approach is presented in ACOE 2005 and DOD 2017.

Analytical methods and DLG are presented in Table B2-7 for stormwater and Table B2-9 for SSPM. All parameters are accredited and analyzed by the City (Accreditation #G682-22) except *E. coli, Enterococcus* and fecal coliform, particle size distribution/grain size, and PBDEs. Fecal coliform, *E. coli, and Enterococcus* are analyzed by Water Management Laboratories, Inc. (Accreditation C546-24, Tacoma, WA), and particulate size distribution and grain size are analyzed by Materials Testing and Consulting, Inc. (Accreditation #C1041-24). PBDE testing is awaiting an analysis contract with SGS-AXYS (Accreditation #C404-23) [15].

[14] Data are not immediately rejected if performance falls in the rejection region. Weight of evidence of companion QC measures are considered prior to rejection.

[15] PBDE analysis is scheduled with SGS-AXYS. Contracting difficulties have delayed analysis until after the WY2023 reporting season. When analyzed, PBDE 181 and 192 will not be included in the results. PBDE 181 and 192 are rarely analyzed and Ecology approved dropping them from the analysis list in 2022.

B.7.3 Quality Control Performance Review

The goal of quality control performance review is to determine representativeness of sample data through DQIs, including sensitivity, bias, precision, technical consistency, and completeness. MQOs provide the criteria to evaluate performance of quality control samples (duplicates, blanks, etc.) within each DQI and are presented in the section narrative and Figures B7-1 and B7-2. If data provide evidence of a quality concern, corrective actions to be executed in the following water year are described. Where possible, definitions are provided to explain criteria in each section (EPA 2015, EPA 2016).

The type and chemical makeup of a sample may significantly influence quality control performance (i.e., freshwater, marine water, sediment, etc.). Thus, evaluation criteria are divided into two groups: stormwater and SSPM. Generally, SSPM samples are more difficult to analyze as compared to stormwater due to matrix interferences.

This type of performance-based review has occurred for this program since WY2010 and has been utilized by certain federal agencies (ACOE 2005, DOD 2017). Where notable, performance differences between water years are discussed. WY2023 performance data are presented in Table B7-1 for stormwater and Table B7-2 for SSPM. These tables, as well as Figures B7-1 and B7-2, and detection profiles for stormwater (Table B7-3) and SSPM (Table B7-4) are referenced throughout the following sections. WY2023 review evaluates 2,792 sample results and the 7,569 quality control results of the study.

B.7.4 Sensitivity – Reporting Limit Performance

Sensitivity is the capability of a method or instrument to discriminate between measurement responses representing different levels of a variable of interest (EPA 2016). Sensitivity is measured through reporting limit performance (the pMDL). Performance evaluates the variability of reported method detection limits, on a per sample basis, due to background noise, analytical/matrix issues, sample size and procedural changes. A pMDL greater than the reporting limit goal, for non-detect data, represents a loss of information and an MQO exceedance. If a compound is detected and the pMDL is greater than the detection limit goal, then no information is lost. The pMDL is considered a rejected data point if the pMDL (for a non-detect result) is greater than five times the reporting limit goal, recognizing a substantial loss of information. Sample data are not rejected based on the pMDL. Rather, the data are reported with the appropriate pMDL and a 'UJ' classification. MQO and reject criteria constitute a sensitivity evaluation in the QC performance assessment. Reporting limit performance is presented in Table B7-5 for stormwater and Table B7-6 for SSPM.

98 percent of stormwater (2335 of 2391) and 98 percent of SSPM (437 of 444) detection limits (for non-detect tests) met MQOs for sensitivity. No stormwater and SSPM results met rejection criteria.

B.7.4.1 Stormwater

New, lower detection limit goals in this permit cycle led to an increase in MQO exceedances. Additionally, in September 2017 EPA promulgated a new definition of MDL. This included a new procedure for establishing MDLs, which generally raised the confidence in the accuracy of low level detections but also raised the pMDL above DLG for several compounds. Most exceedances were very close to the DLG (Table B7-5).

- The dissolved cadmium DLG is 0.03 µg/L while the pMDL median was 0.04 µg/L, leading to 33 MQO exceedances.

- The orthophosphate DLG is 0.003 µg/L while the pMDL ranged from 0.003 to 0.012 µg/L, leading to two MQO exceedances.
- The NWTPH-Heavy Oil DLG is 0.1 µg/L while the pMDL ranged from 0.19 to 0.2 µg/L, leading to four MQO exceedances.

The remainder (17 of 56) of MQO exceedances are near the current and Tacoma's long-term DLG for PAHs, 0.01 µg/L. All the exceedances are for naphthalene. Naphthalene is a very light compound and difficult to detect at very low levels. As in previous years, naphthalene is the source of many pMDL exceedances. Seventeen naphthalene exceedances ranged from 0.015 to 0.027 µg/L. The DLG is very low and the City will continue to strive to meet this goal. The detection limit for all compounds is very low, affected by the EPA method update rule (EPA 2017), and the City will strive to meet these goals.

B.7.4.2 SSPM

Ninety-eight percent of SSPM met sensitivity goals (437 of 444) and no results exceeded rejection level criteria (Table B7-6). Indeno(1,2,3-cd)pyrene DLG is 70 µg/kg dry while the pMDL ranged from 14.7 to 147 µg/kg dry, leading to 2 MQO exceedances. Di-n-octyl phthalate DLG is 70 µg/kg dry while the nondetection pMDL ranged from 14.1 to 140 µg/kg dry, with five nondetect MQO exceedances.

B.7.5 BIAS

Bias is the systematic or persistent distortion of a measurement process which deprives the result of representativeness (i.e., the expected sample measurement is different from the sample's true value). Bias is evaluated through blanks, laboratory control sample (LCS), matrix spike/spike duplicate (MS/MSD) and CRM recovery. Recovery is the percent sample concentration compared to 'true' concentration. Bias is evaluated for both stormwater (Tables B7-7) and SSPM (Table B7-8).

B.7.5.1 Blanks

Blanks are used to evaluate positive (contamination) bias on sample results resulting from laboratory and field activities (EPA 2015, 2020a,b). Several types of blanks are obtained and discussed in relevant sections. In addition to established laboratory procedure, blanks are evaluated against the reporting limit goal, where an MQO Exceedance indicates a blank detection greater than the reporting limit goal.

A sample rejection occurs where blank detection is greater than DLG and greater than 10 percent of the sample result. The blank result is rejected in this QC analysis and the sample result is relabeled a non-detection (UJ) if exceeding rejection criteria. Sample results are only rejected due to laboratory method blank performance. Elevated blank results represent a loss of information due to positive bias (ACOE 2005, EPA 2020a,b). Laboratory, wash, bottle, trip, filter, ambient air, and rinse blanks are discussed and are a component of the weight of evidence bias evaluation for a set or series of data. This data is used to inform laboratory and field operations.

B.7.5.1.1 Stormwater Blank Results

Laboratory and field blanks were analyzed in WY2023 to evaluate bias (Table B7-1, B7-7). Ninety-nine percent (3,160 of 3,205) of blank results met MQOs and eighteen (0.6 percent) blank results were rejected in the QC performance analysis. Stormwater samples are not significantly biased due to blank contamination.

Laboratory Blanks: Laboratory blanks include wash, bottle, and laboratory method blanks. As presented in prior Data Validation reports (Tacoma 2023), the City lab transitioned from running bottle blanks to a more rigorous City dishwashing/testing process for all equipment (wash blank). The wash blank includes laboratory testing one of every 100 pieces of sampling equipment (including field bottles) for a list of common laboratory contaminants. The results of these tests are compared to the DLG. If no detections result, a green sticker is placed on all equipment and bottles as 'Ready to Use'. This is designed to provide the City greater quality assurance prior to taking bottles and equipment into the field. Bottle washing results with detected concentrations are re-washed and tested a second time.

The laboratory method blank is prepared by lab analysts and run through all preparation, extraction, and analysis procedures as environmental samples. Three to 19 blank results were run per analyte. Ninety-eight percent (749 of 762) laboratory method blank tests met MQOs. Ten blanks met rejection criteria (1.3 percent):

- 11/05/22: 8270E SIM Blank had detections of Di-n-butyl phthalate and Naphthalene. The affected analyte results are qualified as "not detected at or above the associated estimated concentration" (UJ) in associated samples.

- 11/23/22: 8270ESIM Blank had detections of Naphthalene, Pyrene, Chrysene, Benzo(b,j,k)fluoranthenes and Indeno(1,2,3-cd)pyrene. The affected analyte results are qualified as "not detected at or above the associated estimated concentration" (UJ).

- 03/21/22: 8270ESIM Blank had a detection of Naphthalene associated with preparation batch BGC0205. The detected concentration of 0.031ug/L, was greater than the MRL of 0.027 ug/L. Naphthalene was detected in associated samples Outfall 235 (2303048-01) and Outfall 237A New (2303048-02) at concentrations within 5 times the blank detection. Naphthalene is reported as "not detected at or above the estimated concentration" (UJ) in these affected samples

- 04/01/23: Chloride was detected at 0.798mg/L, a concentration greater than the MDL, but less than the RL. Outfall 444 (2303061-07) was the only sample with a detection within 10 times the Blank. As such, the Chloride result for Outfall 444 is qualified as "not detected at the associated estimated concentration" (UJ).

- 04/01/23: Naphthalene was detected in Method Blanks associated with preparation batches BGD0077 and BGD0251 at 0.042ug/L and 0.021 ug/L respectively, concentrations greater than the MDL. Outfalls 237A New, 243, 245 and 444, (2303061-02, 04, 05 and 07), had detections of Naphthalene within 10 times that of their associated Blank. The associated sample detections are reported as "not detected at or above the associated estimated concentration" (UJ).

- 04/17/23: Naphthalene was detected in the Method Blank associated with preparation batch BGD0308 at 0.016 ug/L. The associated sample detections of Naphthalene are reported as "not detected at or above the associated estimated concentration" (UJ).

- 9/14/23: Naphthalene was detected in the Method Blank associated with batch BGI0174 at 0.030 ug/L. There were no associated sample detections. (4 samples)

Field Blanks: Field blanks represent increasing contamination potential due to transport conditions (trip blank), exposure to surroundings during sampling (ambient air blank), and equipment that remains onsite between sample events (rinse blank). Each subsequent blank contains the contamination potential of the preceding blank, and rinse blanks are considered the highest risk assessment of field contamination. Field blanks are evaluated for MQO exceedance and rejection, but do not result in rejection of sample results unless directly relatable to sample event and magnitude of detection. In WY2023, 418 of 450 field blank tests (93 percent) met MQOs, and eight values (0.2 percent) exceeded rejection or censor criteria (Figure B7-1, Table B7-7). Blank performance is discussed in the following sections.

Trip blanks are obtained by pouring clean water into a sample bottle, placing it in the cooler with samples obtained during the field event, and analyzing for contaminants of interest. One to three trip blanks were analyzed per sample. Ninety-eight percent of trip blanks met MQOs (88 of 90) (Table B7-7). One hardness blank was at the DLG of 0.05 mg$CaCO_3$/L. Hardness was detected in 100 percent of samples and the detection profile ranged from 15 to 923 mg$CaCO_3$/L. The lowest hardness blank detection was less than 10x the lowest detection of hardness samples. Similarly, a single blank detection of turbidity (0.74 NTU) was significantly less than the lowest detected concentration of 8.26 NTU. Total nitrogen blank detection (0.09 mg/L) was significantly less than the lowest detected concentration of 0.41 mg/L. Total nitrogen was detected in 100 percent of samples and the detection profile ranged from 0.41 to 2.55 mg/L. None of the blank results were above rejection criteria.

Ambient air (field) blanks are obtained by removing the lids of sample bottles (filled with clean water) and storing the bottle exposed and onsite for the duration of sampling. 86 of 90 tests (96 percent) met MQOs (Table B7-7). As with trip blanks, a hardness exceedance was significantly less than the associated detection profile. One detection of cadmium 0.263 µg/L, was greater than the MQO of 0.2 µg/L. Cadmium was detected in 50 percent of samples and the blank detection exceeds the minimum cadmium result of 0.139 µg/L.

One detection of dissolved lead, 0.092 µg/L, was greater than the MQO of 0.05 µg/L. Dissolved lead was detected in 100 percent of samples and the blank detection was less than the minimum dissolved lead result of 1.45 µg/L. One detection of lead, 0.577 µg/L, was greater than the MQO of 1 µg/L. Lead was detected in 100 percent of samples and the blank detection was less than the minimum lead result of 1.63 µg/L. Ambient blank results will continue to be monitored for performance

Rinse blanks are obtained by running clean water through the entire ISCO or grab sampling system (three system volumes), collecting the final rinsate in a sample jar in the field, and continuing the transport, storage, and analysis process as with any other sample. Rinse blank detections represent the greatest level of potential contamination of the entire field and laboratory sampling process.

Ninety percent (244 of 270) of rinse blanks met MQOs and seven fell within the rejection region (Table 7-7).

All rinse blank exceedances correspond to compounds which were detected in 100 percent of environmental samples. A number of samples exceeded the MQO. Seven samples (2.6 percent) exceeded rejection level criteria of five times the detection level goal (turbidity, total phosphorous, and dissolved copper), only copper and lead result fell within the environmental sample detection profile.

- One of six rinse blank copper results of 6.23 µg/L was greater than the minimum detection profile of 4.09 µg/L and 5th percentile of 5.44 µg/L. This result is larger than 5 of 51 copper detections.
- One of six rinse blank lead result of 3.44 µg/l was greater than the minimum detection profile of 1.63 µg/L and 5th percentile of 2.24 µg/L and 10th percentile of 2.37 µg/L. This result is larger than 11 of 51 lead detections.

Copper is a common contaminant, especially in urban sampling. The majority of rinse blank copper and dissolved copper results were non-detections. Weight of evidence of a single copper and dissolved copper result at the lower end of the detection profile does not indicate positive bias. There is not a preponderance of detections for these two compounds. Cleanliness and standard operating procedures will continue to be improved upon to evaluate performance relative to MQOs, rejection criteria, and relevance to the detection profile.

Overall, 92 percent of rinse blank samples met MQOs, and seven values (2.6 percent) fell within the reject or censor region (Table B7-1, B7-7).

B.7.5.1.2 SSPM Blank Results

One blank was analyzed for each analyte, resulting in 145 blank tests. Blanks were analyzed at the required frequencies of the methods. Analytes were either not detected in the blanks, sample concentrations were greater than 10 times the blank values, or the analytes detected in the blanks were not detected in associated samples, with the exception of Diethyl phthalate, which was detected above the MDL in the Method Blank associated with preparation batch BGI0177. Of the associated samples, only FD23 (2309030-01) had a detection of Diethyl phthalate above the MDL. This value is reported as “not detected at or above the associated estimated value” (UJ) of 40 ug/Kg, and still meets the project DLG.

B.7.5.2 Laboratory Analyses Recovery

Recovery of ‘known’ concentrations of analytes is useful when estimating sample bias. Bias is reported as a percent of the true value. For instance, an analyte which has a low recovery (ideal is 100 percent, low is 25 percent) across most control samples will be classified as ‘biased low’. This means the reported sample result is likely an underestimate of the actual environmental concentration. Underestimation is more common for analyte recoveries than overestimation. Bias control samples take several forms:

- Blanks (discussed in Section B.7.5.1) – ‘pure’ water exposed to laboratory and sampling conditions. If the water becomes contaminated during the process, this infers a positive bias upon sample results.
- A surrogate is a pure substance with properties that mimic the analyte of interest. It is unlikely to be found in environmental samples (e.g., compounds with a tracer hydrogen added (deuterated) such as pyrene-d10) and is added to them for quality control purposes.
- The LCS is an uncontaminated sample matrix spiked with known amounts of analytes from a source independent from the calibration standards.

- The MS is a sample which is spiked with a known amount of an analyte. The difference in MS and LCS recoveries is a function of the sample matrix (chemistry). This is also called the matrix effect.
- A CRM is a type of LCS that has been tested and characterized by several certified laboratories (20 or more). CRMs are primarily run on SSPM for this project.

As part of the organic uptick investigation, the following section contains a multiyear analysis of surrogates, LCS, and MS/MSD in addition to the WY2023 evaluation.

B.7.5.2.1 Stormwater Data

Stormwater bias analysis includes surrogates, LCS, and MS/MSDs. 100 percent (1993 of 1993) of stormwater bias recoveries met MQOs (Table B7-1). Stormwater samples are not biased due to analytical recovery (Table B7-1).

Results with close to 100 percent recovery are desired. Superfund Methods for Organic Data Review (EPA 2020a) generally only recommend rejection of detected compounds when recoveries of surrogate, LCS, or MS/MSD are less than 10 percent (LCS 30 percent), and the reviewer is often given the option not to reject. The City (Tacoma 2010 onward) set MQO criteria tighter than Superfund Methods and review all bias control criteria in combination in order to make an overall bias estimate (see Figure B7-1). This follows previously published protocols used by U.S. Army Corps of Engineers (2005).

Individual data points were evaluated within the laboratory reports and J-qualified (as appropriate) as estimates of concentration due to bias. In WY2023, weight of evidence did not support rejection of data beyond laboratory identified specific bias qualification on a single analytical run. Weight of evidence involves lining up the specific performance for each test – blank bias (positive bias), surrogate (positive or negative bias), LCS (positive or negative bias), and MS/MSD (positive or negative bias) and comparing magnitudes of exceedance.

The individual comparison may be extended to a single compound or class of compounds over the course of the water year. WY2023 stormwater QC performance was excellent.

B.7.5.2.2 Stormwater Sediment Data

SSPM is a difficult matrix to analyze under any condition. To bolster estimates of bias, CRMs are added to the suite of control sample recoveries. SSPM biases are analyzed by a weight of evidence approach, considering results of all bias tests. 100 percent of tests (337 of 337) met MQOs (Table B7-2, CRM presented in Table B7-8).

Weight of evidence for a bias conclusion is evaluated for all control tests and data points may be censored, if appropriate, instead of rejected. SSPM weight of evidence and trends are considered with respect to recoveries of surrogates, laboratory control samples, MS/MSD, CRM, and blank results. Surrogates are given a lower weight when specific analyte recovery data is available.

From a data user standpoint, the intent is to know which chemical results identify the compound correctly and that the magnitude of detection is close to ‘true’. In a general sense, this is done by comparing the percent recovery to a known standard.

Combining surrogate, LCS, MS/MSD, and CRM bias indicators provides the weight of evidence evaluation. A determination of bias is established if a majority of bias indicators are in the same direction for an analysis (such as semi-volatiles), specific chemical performance (e.g., pyrene), or a particular sample. 100 percent of SSPM recovery results met MQOs (Table B7-2, CRM presented in Table B7-8).

B.7.6 Precision and Repeatability

Precision is an evaluation of agreement among replicate measurements of the same property under similar conditions (EPA 2015) and a measure of dispersion of random errors. Precision is measured through duplicates generated in the laboratory and field. Each of the following measures of precision incorporates the variability of the precision measure preceding it:

- Laboratory duplicates that evaluate the sample splitting process, as well as all steps from extraction through analysis internal to the laboratory.
- Matrix duplicates incorporate evaluation of the sample matrix effect.
- Field duplicates incorporate all variability of the system, including laboratory, matrix, preservation, transportation and storage, and the difficulty of obtaining samples under identical conditions.

In this study, precision is calculated as relative percent difference (RPD):

$$\text{RPD} = \left(\frac{(X_1 - X_2)}{(X_1 + X_2) \div 2}\right) \times 100 \text{ where,}$$

X_1 - Original sample
X_2 - Duplicate sample

Stated another way, RPD is the difference between samples divided by their average.

The MQO and rejection criteria for precision are listed in the data validation diagrams Figures B7-1 and B7-2. All detections are evaluated for MQOs. Results are only evaluated for rejection criteria if at least one result is greater than five times the DLG. This rule preserves the understanding that sample results close to the method detection limit have greater inherent variability.

B.7.6.1 Stormwater

Stormwater precision is calculated from laboratory, MS/MSD, and field duplicate samples. The ability to replicate and quantify duplicate samples is increasingly difficult as other sources of variability (e.g., matrix effect, field conditions) are incorporated. These other sources of variability are controlled to the maximum extent practicable using standard operating procedures both in the laboratory and in the field, however, some matrix effects and field conditions are beyond our control. That's why precision is defined as a measurement of dispersion of random errors. Systemic errors are discovered by repeating patterns over the course of a large sample set. The MQO and rejection criteria are appropriately defined based on the ability to control source of variability in laboratory, MS/MSD, and field duplicates.

100 percent of the 692 data pairs met MQOs (Table B7-1). Stormwater met precision MQOs and are representative of the population of interest, as evidenced by meeting 100 percent of MQOs

B.7.6.2 Stormwater Sediments

Precision for SSPM is calculated using field, laboratory, and matrix spike duplicates (Table B7-2). A field duplicate was not collected this year due to insufficient volumes. 100 percent of duplicates met measurement quality objectives (59 of 59). All parameters are sufficiently precise for this study, as evidenced by 100 percent meeting MQOs.

B.7.7 TECHNICAL CONSISTENCY

The last check of data quality is derived from the question, "Do the results make sense?" This program uses the total versus dissolved fraction analysis. The total is the sum of the particulate and dissolved fractions of an analyte. The metals cadmium, copper, lead, mercury, and zinc, as well as the nutrient phosphorus, are analyzed in both their dissolved and total form.

The MQO is met if the dissolved concentration is greater than 120 percent of the total concentration. The performance method detection limit is substituted for non-detect values. The analysis pair is rejected if the dissolved concentration is greater than 120 percent of total and at least one value is greater than five times the reporting limit goal. The magnitude of values considers elevated variability at the level of the detection level goal (MQO) and increasing stability of results as concentrations increase (5x rule for reject review).

51 mercury pairs had all dissolved mercury as nondetect at 0.002 µg/L (9 values) and 0.011 µg/L (42 values) and total mercury nondetect at 0.002-0.008 µg/L (35 values) and detections at 0.002-0.0135 (16 values) 0.073 µg/L. Thirty-eight mercury pairs had dissolved ND values greater than total ND or detected values. None of the mercury results were greater than five times the detection limit goal (i.e., no rejections) (Table B7-1).

87.2 percent (258 of 296) data pairs met the MQOs and associated data are technically consistent for the purposes of this study**.**

B.7.8 COMPLETENESS

As noted in previous sections of this report, sampling and hydrologic results constitute a complete and representative data set for WY2023. Laboratory completeness includes the program elements from sample submission to results produced and may be further refined to include data quality. Deficiencies are noted in a timely manner and samples are re-processed and re-analyzed when possible. Ninety-nine percent of quality control data met measurement project objectives and 0.2 percent fell within a censor or rejection region (Tables B7-1 and B7-2, nineteen censored out of 10,361 data points). The WY2023 data set is sufficiently complete for study objectives.

B.7.9 QUALITY ASSURANCE AND CONTROL SUMMARY

Overall, data quality throughout the Foss/NPDES monitoring project is sufficient and sample results represent the target populations of interest. An exceedance of an MQO does not automatically lead to rejected data, though it is classified by its appropriate data qualifier flag. Data are censored or rejected if performance is within the rejection region, as described above. Only 19 out of 10,361 (0.2 percent) of performance data are classified as censored or rejected (Tables B7-1 and B7-2). Performance is summarized by the DQIs below.

- **Sensitivity.** 98 percent of stormwater and 98 percent of SSPM met MQOs. The magnitude of most stormwater exceedances was low, less than twice detection level goals (DLG).
- **Bias.** 99 percent of stormwater and 99 percent of SSPM met MQOs.

- **Precision and Comparability.** 100 percent of stormwater and 100 percent of SSPM are precise and comparable according to MQOs. Precision is measured as duplicate relative percent difference for laboratory, matrix spike, and field duplicates.
- **Technical Consistency.** 87 percent of stormwater samples are technically consistent. That means dissolved metal and orthophosphate concentrations are generally less than their total counterparts. The 13 percent was solely due to MDL for dissolved mercury (0.0111) that were higher than the MDL for total mercury (0.0088). All total mercury detections were greater than dissolved mercury detections or the MDL.
- **Completeness.** 100 percent of data were deemed useable. Nineteen of 7,569 (0.2 percent) quality control data points fell within the rejection region. The WY2023 data set is sufficiently complete for study objectives.

B.7.9.1 Follow-Up Actions

Field Analysis Recommendations:

- Collect field blank and duplicate samples as per the schedule of the 2020 QAPP (Tacoma 2020). Provide seven rinse blanks for analysis, one from each sample site.
- Collect three or five field replicates for MH390.

Continue clean techniques training, including one event conducted in the field and one in the sample receiving room, including field blank analysis.

B.8 RECOMMENDATIONS FOR QAPP REVISIONS

The new QAPP for this monitoring program was approved by EPA and Ecology in December 2023 and will be effective for WY2024. There have been no significant changes since that time.

This revised 2023 QAPP (V 1.2) includes the following significant changes to the 2020 QAPP:

- Relocating a monitoring station (Section 3.1 and Section 7.1).
- Changes to Project Team Members (Section 5.1)
- Clarification of holding time procedures (Section 8.2.5) and
- Changes in analytical methods (Section 9.1) and data analysis methods (Section 13).

B.9 DISCUSSION OF RESULTS

This section describes the analytical results from the stormwater (composite and grab), sediment and baseflow (composite and grab) samples collected from the Foss monitoring locations.

B.9.1 Annual Flow Data

A compilation of rainfall and runoff statistics for storm events occurring in each of the outfalls in WY2023 is presented in Tables B9-1.1 through B9-1.7. The basis and methods for calculating these statistics is described in Section B1.4.3 Annual Mass Loading Calculations.

Tables B9-1.1 through B9-1.7 include the following statistics:

- Storm event start date, time, and duration (hours), and whether a sample was collected during the event
- Storm event total precipitation (inches) and estimated runoff depth (inches)
- Estimated total discharge volume per event (acre-feet)
- Event mean storm flow and combined flow (gpm); baseflow is assumed to be constant throughout the year
- Fraction of stormwater in the combined (baseflow + storm flow) discharge
- Total wet season, dry season, and annual storm period durations, rain depths, and runoff volumes
- Mean wet season, dry season, and annual storm flow rates

A summary of the estimated seasonal and annual discharge volumes at all outfalls for WY2023 is presented in Table B9-2. These volumes are used in conjunction with chemical analytical results to estimate seasonal and annual pollutant loadings, as presented in Section 6 of the WY2023 Report (Tacoma 2023).

The determination of whether or not there are baseflow components in OF245, OF243, and OF254 is unclear, as the hydrographs are complicated by tidal inundations. Based on an analysis of the continuous flow record, it was determined that there is no substantive baseflow in OF245, OF243, and OF254.

As discussed in Section B.2.2, the drainage area changed for OF230 and OF235 during WY2023 with the addition of the new OF230A. The OF230 drainage changed incrementally from October to December 15, 2022, and the OF235 drainage area changed on December 15, 2022. Storm calculations for both OF230 and OF235 are based on the new drainage area starting with the December 19, 2022, storm event.

B.9.2 Stormwater Sampling

For each sampled event, the following information is discussed in the WY2023 Report (Tacoma 2023), which contains historical sampling data for comparison and statistical inference (Section 3.2 Monitoring Results – WY2002-WY2023, Section 3.3 Spatial Analysis, Section 3.4 Seasonal Analysis, and Section 3.5 Time Trend Analysis):

- A statistical analysis of the event mean concentrations for each parameter (Appendix E of the WY2023 Report) and a narrative description of significant findings from this analysis

- Trend analyses (see Section B1.4.2) for each analyte or indicator compound with three or more years of data
- Any conclusions based on data from this study, including analysis of previously collected data from these discharge monitoring locations
- A description of stormwater management program/source control activities which occurred, are currently taking place, or are planned within the monitoring station's drainage area that may have affected or may potentially affect future monitoring results
- An evaluation of the data as it applies to the Stormwater Management Program (SWMP)
- Any stormwater management activities the Permittee has identified that can be adjusted to respond to the data.

Statistical tests and comparisons between monitoring locations are presented in Section 3.0 of the WY2023 Report. Historical summary statistics and statistical tests for the entire monitoring record, WY2002-2023 for indicator parameters representing constituents of concern under the Foss Monitoring Program, are discussed in Sections 3.3 Spatial Analysis, 3.4 Seasonal Analysis, and 3.5 Time Trend Analysis, as well as in Tables 3-3.1, 3-4, and 3-6 of the WY2023 Report.

Program effectiveness of the Thea Foss Source Control Strategy and SWMP is evaluated by linking source control activities, stormwater and sediment long-term monitoring, post-construction sediment monitoring, and WASP modeling (for the first 10 years post-remediation). The description, evaluation and response to activities and data are discussed in Section 5 of the WY2023 Report.

B.9.2.1 Non-Detected Data

If any chemicals are non-detected for two years, that chemical may be removed from the list of analytes in the QAPP.

Chlorpyrifos and NWTPH-Gasoline were non-detected at all outfalls in WY2018 and WY2019. Removal of these chemicals were discussed with Ecology and analyses are no longer required under the new 2020 QAPP.

B.9.3 SEDIMENT SAMPLING

The results of the stormwater sediment sampling event for WY2023 are presented in the WY2023 Report Appendix D, Table D-8. For each SSPM sample, the following information is discussed in the WY2023 Report, which contains historical sampling data for comparison and statistical inference (Section 3.2 Monitoring Results – WY2002-WY2023 and Section 3.3 Spatial Analysis):

- A narrative analysis of the parameter concentrations
- Any conclusions based on trend data that may result from this study or from previously collected data from these sites
- A description of SWMP activities currently taking place or planned within the monitoring station's drainage area

The WY2023 Report provides a narrative summary of the Foss monitoring parameters. Sediment results for WY2023 are presented in the WY2023 Report Appendix D, Table D-8. Historical summary statistics and statistical tests for the entire monitoring record, WY2002-2023, for indicator parameters representing constituents of concern under the Foss Monitoring Program are discussed in Section 3.2 and in Table 3-3.2 of the WY2023 Report.

Program effectiveness of the Thea Foss Source Control Strategy and SWMP is evaluated by linking source control activities, long-term stormwater and sediment monitoring, post-construction sediment monitoring, and WASP modeling (for the first 10 years post-remediation). The description, evaluation, and response to activities and data are discussed in Section 5 of the WY2023 Report.

B.9.4 Baseflow Sampling

Baseflow sampling was discontinued in WY2011 with the approval of EPA and Ecology, as the baseflow quantity and quality were determined to be well characterized by the 10-year monitoring record. Since that year, detection limits for some analytes have changed and are lower than those in the 2001 SAP. The WY2011 baseflow concentrations, many of which were not detected, biased the baseflow pollutant loadings and overestimated the resulting loads. In order to more accurately estimate the baseflow loadings, baseflow samples were collected in 2016 and 2019 and analyzed for the stormwater analytes listed in the QAPP.

A total of 44 baseflow samples were collected in WY2016 and WY2019 at all seven outfalls. In general, the 2016/2019 baseflow concentrations were similar or less than the 2001-2011 baseflow concentrations, which had 297 samples collected during that time period. The overall arithmetic mean and weighted mean for the two data sets are shown in Table B9-3. OF243, OF245, and OF254 are industrial land use outfalls. The City believes that baseflow quality of these industrial outfalls is similar and as such, the limited number of baseflow data for OF245 and OF254[16] were combined for statistical analyses.

Most of the 2016/2019 data results are similar or less than the 2001-2011 data results. In a few instances the 2016/2019 arithmetic mean results were slightly higher than the 2001-2011 data results; however, in those instances, the maximum 2016/2019 results were within the 2001-2011 data range for that analyte. The 2016/2019 results further support the conclusion that baseflow concentrations in the Foss outfalls have remained fairly consistent or are improving over time.

B.9.5 Rainfall-Runoff Correlations

The City installed flow meters in its three NPDES drainage basins (OF235, OF237B, and OF245) and collected continuous flow data during all of WY2010, as required by the Phase I Permit. During WY2011, the flow records from WY2010 were analyzed to develop rainfall-runoff correlations for the three basins. The rainfall-runoff correlations for these basins are shown on Figures B2-8, B2-11, and B2-16. The runoff has been normalized to basin size, such that both rainfall and runoff are presented in depth units, and the slope of the regression line is the runoff coefficient. Separate correlations were developed for wet season and dry season conditions. The estimated runoff parameters are presented in Tables B9-1.2, B9-1.4, and B9-1.6, and summarized in Table B9-2.

During WY2016, the flow records from WY2015 and WY2016 were analyzed to develop rainfall-runoff correlations for OF230, OF237A, OF243, and OF254. The rainfall-runoff correlations are shown on Figures B2-6, B2-10, B2-13, and B2-18. The runoff has been normalized to basin size, such that both rainfall and runoff are presented in depth units, and the slope of the regression line is the runoff coefficient. Separate correlations were developed for wet season and dry season conditions. The estimated runoff parameters are presented in Tables B9-1.1, B9-1.3, B9-1.5, and B9-1.7, and summarized in Table B9-2. Due to the change in drainage area for OF230 (now OF230A) and OF235, the City will develop new rainfall to runoff correlations once sufficient data is available.

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[16] This is consistent with an April 23, 2013, letter from EPA, which reduced the number of samples required under the Foss CD to three per year for OF243, OF245, and OF254, since these eastsides tidally influenced outfalls were statistically similar for most analytes.

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Tables

Table B2-1
Monitoring Site Basin Characterization Summary

	OF230	OF230A	OF235	OF237A	OF237B	OF243	OF245	OF254
Represented Land Use	N/A	N/A	Commercial	N/A	Residential	N/A	Industrial	N/A
Surface Area Distribution								
Total Area (acres)	24	583	109	2813	1979	59	39	127
Impervious Estimate (%)	78.5	70.1	72.8	59.4	48.0	90.7	93.1	82.2
Land Use Distribution Estimate [1, 2]								
Residential (%)	0%	24%	0%	47%	72%	0%	0%	0%
Industrial (%)	0%	0%	0%	17%	1%	65%	87%	81%
Commercial (%)	100%	76%	99%	25%	19%	35%	12%	16%
Open Space (%)	0%	1%	1%	11%	13%	0%	0%	0%
Hydrologic Information								
Time of Concentration (minutes)[3,4]	N/A	24	11	62	129	16	18	11
Rain Gauge	NOAA Station Tacoma No. 1							
	RG10							
	RG03							
Rain Gauge Location (latitude/longitude)	47.2472/ 122.4122							
	47.5000/ 122.2600							
	47.6481/122.3081							
Mean Annual Precipitation (in)[5]	38.09							
	34.3							
	35.6							

[1] City of Tacoma Zoning, Street, and Parcel Data using ESRI ArcGIS 9 for calculations – September 2019

[2] Land use is generally grouped into four categories: (1) residential which includes one family, two family, and low density multifamily and may include other/NA; (2) commercial which includes residential commercial, community commercial, downtown commercial, hospital medical, schools, government/public facility and may include other/NA; (3) industrial which includes light and heavy industrial and port maritime/industrial and may include vacant; and (4) open which includes parks/open space and may include vacant residential lots.

[3]The times of concentration were estimated using SBUH methodology (Tacoma 2000). This method is described in the City's Surface Water Management Manual (Tacoma 2003). The Time of Concentration, Tc, is defined as:

T c =L¸k×s 1/2

Where:

Tc = time of concentration (minutes)

L = flow length (ft)

k = velocity factor (ft/s) (value for sheet, shallow and channel flow)

s = slope of flow path (ft/ft)

[4] The time of concentration for OF230A is estimated based on the historic evaluation for OF230. There is a slight increase in flow length (514ft or <1%) and a slight descrease in slope (1%). Due to this change the City added 5% to the historic OF230 Tc.

[5] NOAA Station Tacoma No. 1 52-year record: 1948-1998 (2003).

Table B2-2
Mean Lower-Low Water (MLLW) Tidal Elevations

Outfall	Pipe Size	Baseflow	Flow Rate (cfs)	Outfall Pipe Elevation (ft)	Outfall Pipe Elevation (MLLW ft)	Sed Trap Location Elevation	Tidal Influence	Whole Water Location Elevation (MLLW ft.)	Tidal Influence
OF230A (Initial)[1]	60"	Cont.	0.12	-6.76	-0.44	17.3	No	0.2	Yes
OF230A	60"	Cont.	0.12	-6.76	-0.44	17.3	No	17.3	No
OF230	60"	Cont.	0.12		4.3	20+	No	7.0	Yes
OF235	41"	Cont.	0.4	-1.6	4.7	9.9	Minimal	9.8	Minimal
OF237A	72"	Cont.	2.8	0	6.3	15	No	15.0	No
OF237A New	96"	Cont.	4.4	0	6.3	--	--	11.7	Minimal
OF237B	72"	Cont.	8.3	0	6.3	16.5	No	13.6	No
DA-1 Line	--	--	--		--	--	--	14.6	No
OF243[2]	36"	Tidal	0.4	-0.73	5.6	5.0	Yes	5.2	Yes
OF245[2]	18"	Tidal	0.1	-2.7	3.6	3.5 (sump)	Yes	3.2	Yes
OF254	37.5"	Tidal	0.4	-2	4.3	--	--	4.4	Yes

[1] Initial montioring location for OF230A from April 2023 to November 2023. The site moved to new location due to tidal conditions.

[2] OF243 is protected from direct saltwater influence from the waterway by a duckbill valve at the end of the outfall and OF 245 manhole sump has a tidal gate valve.

Notes:

1) All elevations are estimated based on review of plans and visual observations. Baseflow was measured in January and February 2001 for Outfalls 235, 243, 245, and 254. Baseflow for 237A and 237B was measured in October to December 1995 and site is tidally influenced when tide elevation is above the whole water location elevation.

2) 0 feet MLLW tidal Datum is equal to -6.32 feet City of Tacoma Datum.

3) Wholewater is no longer monitored at OF237A, OF230 and DA-1 Line. These are for historic reference.

Table B2-3
Sediment Traps - List of Analytes by Location

Outfall ID	Sediment Trap ID	Location	Grain Size	Total Solids	Total Volatile Solids	Total Organic Carbon	Total Phosphorus	NWTPH-Dx	Bifenthrin and dichlobenil	Copper and Cadmium	Lead	Mercury	Zinc	PAHs	Phthalates	PCBs	Phenols and PBDEs
OF230A	FD7[a]	Between South 15th & South 14th on A Street. MH 6783605 installed in downstream stormline.	Foss/ NPDES	Foss/ NPDES	NPDES	Foss/ NPDES	NPDES	Foss/ NPDES	NPDES	NPDES	Foss/ NPDES	Foss/ NPDES	Foss/ NPDES	Foss/ NPDES	Foss	Foss/ NPDES	NPDES
	FD3a	South 15th & Court "A;" MH 21 ft. east of FD3 in brick plaza, under SR 705 off-ramp															
	FD3	South 15th & Court "A;" MH in brick plaza , under SR 705 off-ramp															
	FD3b	Pacific Avenue & Hood Street; MH on sidewalk															
	FD3C	MH between crest of Hood st. and i705 off ramp in median triangle	Foss	Foss		Foss						Foss		Foss		Foss	
	FD16	South 15th and Market Streets (MH-226)	Foss	Foss		Foss										Foss	
	FD16b	Near 609 So. 15th (MH-422) (above Bates Tech. College)															
	FD18	1100 block of Market Street (MH-144) (downtown, near YMCA)	Foss	Foss		Foss								Foss		Foss	
	FD18b	Tacoma Ave. So. And So. 11th (MH-261) (near County City Bldg and WNG Armory)															
OF230	FD3 New[a,c]	South 15th & "A" Street; MH 262 at crest of bridge (31 ft. deep)	Foss/ NPDES	Foss/ NPDES	NPDES	Foss/ NPDES	NPDES	Foss/ NPDES	NPDES	NPDES	Foss/ NPDES	Foss/ NPDES	Foss/ NPDES	Foss/ NPDES	Foss	Foss/ NPDES	NPDES
OF235	FD6[a]	East 21st & Dock Street; MH on Dock Street under SR 509	Foss/ NPDES	Foss/ NPDES	NPDES	Foss/ NPDES	NPDES	Foss/ NPDES	NPDES	NPDES	Foss/ NPDES	Foss/ NPDES	Foss/ NPDES	Foss/ NPDES	Foss	Foss/ NPDES	NPDES
	FD6a	South 19th and Market; MH in the center of the intersection															
	FD6b	South 21st and Fawcett; MH at NW corner of the intersection															
OF237A	FD2[a]	Dock Street pump station; MH inside pump station yard	Foss/ NPDES	Foss/ NPDES	NPDES	Foss/ NPDES	NPDES	Foss/ NPDES	NPDES	NPDES	Foss/ NPDES	Foss/ NPDES	Foss/ NPDES	Foss/ NPDES	Foss	Foss/ NPDES	NPDES
	FD2a	E. 23rd & Dock Street; MH inside Dock Street Pump Station next to power control station.	Foss	Foss		Foss								Foss		Foss	
	FD13	Off Center Street, alley between Ash and Wilkenson Streets (MH-294)															
	FD13b	So. 23rd and Ferry St. (MH-104) (below major complexes, TNT, AT&T, DSHS)															
	FD13b New	In between So. 23rd and Ferry St. upstream from FD13-B (below major complexes, TNT, AT&T, DSHS	Foss	Foss		Foss								Foss			
	FD5	South 18th & Cedar Street; MH in intersection															
	FD10	BNSF right of way between Cedar and Lawrence Streets (MH-412) (near Nalley's Fine Foods warehouse yard, approximately 500 ft. NE of main office)															
	FD10c	Lawrence Street near Nalley's main Bldg 7, loading dock door (MH-303) (Nalley's processing and shipping yard)	Foss	Foss		Foss										Foss	
	FD10b	Near So. Tacoma way and Lawrence street (MH-022) (above Nalley's and picks up major car lots, dealerships, retail complexes, PSE yard) MH behind 3215 STW.															
OF237B	FD1[a]	Dock Street pump station; MH inside pump station yard	Foss/ NPDES	Foss/ NPDES	NPDES	Foss/ NPDES	NPDES	Foss/ NPDES	NPDES	NPDES	Foss/ NPDES	Foss/ NPDES	Foss/ NPDES	Foss/ NPDES	Foss	Foss/ NPDES	NPDES
	FD30	Tacoma Dome Parking Lot, SW section, (MH459)															
	FD31	East 50 feet at intersection of Pacific and So. 32nd (MH570)															
	FD32	Intersection of So. Wright and Pacific Ave (MH576) (main truck line check point)															
	FD33	In front of 5209 Pacific Ave (MH110)															
	FD34	In front of 402 E. 53rd (MH167)															
	FD35	500 Block of E. 56th (MH244)															
	FD36	E. 72nd and E. D Street (MH234)															
	FD37	7216 E. D street, backyard (MH262)															
	FD38	E. B Street and E. 72nd (MH229)															
OF243	FD23[a]	East 21st & "D" Street; MH in sidewalk on west side of "D" Street (under SR 509)	Foss/ NPDES	Foss/ NPDES	NPDES	Foss/ NPDES	NPDES	Foss/ NPDES	NPDES	NPDES	Foss/ NPDES	Foss/ NPDES	Foss/ NPDES	Foss/ NPDES	Foss	NPDES	NPDES
OF245	FD21	457 East 18th Street; CB on East 18th Street near main office (former MPS, now Quality Transport)	Foss	Foss		Foss					Foss		Foss				
	MH390[a]	SAP #6761877	Foss/ NPDES	Foss/ NPDES	NPDES	Foss/ NPDES	NPDES	Foss/ NPDES	NPDES	NPDES	Foss/ NPDES	Foss/ NPDES	Foss/ NPDES	Foss/ NPDES	Foss	NPDES	NPDES
OF248	FD22[a,b]	East 18th Street; CB downstream of site adjacent to Super Value (West Coast Grocery) warehouse (approximately 510 ft. west of FD21)	Foss	Foss		Foss					Foss		Foss		Foss		

a - Outfall sediment trap
b - Outfall is not a NPDES outfall. Therefore, NPDES analytes do not apply to this outfall trap.
c - The City will evaluate removal of this sediment trap at the end of WY2024.
[shaded box] Not analyzed for this trap. Historical analyses that are no longer required are shown to indicate changes from 2001 Foss SAP. Incorporates changes from EPA April 23, 2013 letter.

Table B2-4
ISCO Site-Specific Settings and Enables

Storm 1.0	
Location	Pacing
OF230A	104,306
OF235	67,518
OF237A New	625,000
OF237B	750,000

Storm 0.5	
Location	Pacing
OF230A	51,786
OF235	32,669
OF237A New	275,000
OF237B	300,000

Storm 0.9	
Location	Pacing
OF230A	93,802
OF235	60,548
OF237A New	550,000
OF237B	650,000

Storm 0.2	
Location	Pacing
OF230A	20,274
OF235	11,759
OF237A New	75,000
OF237B	85,000

Storm 0.6	
Location	Pacing
OF230A	62,290
OF235	39,639
OF237A New	345,000
OF237B	400,000

All Storms	
Location	Pacing
OF243	10 Minutes
OF245	10 Minutes
OF254	10 Minutes

Storm 0.3	
Location	Pacing
OF230A	30,778
OF235	17,729
OF237A New	140,000
OF237B	150,000

Storm 0.7	
Location	Pacing
OF230A	72,794
OF235	46,609
OF237A New	412,000
OF237B	450,000

Storm Enables	
Location	Enable
OF230A	LEV > 0.20, VEL > 1.00
OF235	LEV > 0.70, VEL > 0.30
OF237A New	LEV > 0.5, VEL > 6.2
OF237B	LEV > 0.5
OF243	CON < 10.0
OF245	FLOW > 30
OF254	CON < 10.0

Storm 0.4	
Location	Pacing
OF230A	41,282
OF235	25,699
OF237A New	210,000
OF237B	250,000

Storm 0.8	
Location	Pacing
OF230A	83,298
OF235	53,578
OF237A New	480,000
OF237B	525,000

Note: Pacing and enables may be adjusted at any time based on current site conditions.
Pacing and enbales are identified in the ISCO reports for each sampling event.
ISCO Reports are included in the field report for each event.
2023 Monitoring Update: Pacings and enables have been added for the new OF230A (receiving 98% of flow from OF230 and 26% of flow from OF235). Due to this rerouting these factors were also adjusted for OF235. Due to lack of flow OF230 is no longer sampled, though flow is still monitored.

Table B2-5
Sampling Design Summary

	OF230/OF230A[f]	OF235	OF237A	OF237B	OF243	OF245	OF254	Total
	Composite Stormwater Samples per Year[e]							
# Samples/Year -Required by Foss CD	8[a]	8[a]	8[a]	8[a]	3[a]	3[a]	3[a]	N/A
# Samples/Year - Required by NPDES Permit	8 min 11 max[b]	8 min 11 max[b]	8 min 11 max[b]	8 min 11 max[b]	0 min 11 max[b]	8 min 11 max[b]	0 min 11 max[b]	55[b]
	Grab Samples per Year[e]							
# Samples/Year - Required by Foss CD	0	0	0	0	0	0	0	
# Samples/Year - Required by NPDES Permit	8 min 11 max[c]	8 min 11 max[c]	8 min 11 max[c]	8 min 11 max[c]	0 min 11 max[c]	8 min 11 max[c]	0 min 11 max[c]	55[c]
	Outfall Sediment Trap Samples per Year[e]							
# Samples/Year -Required by Foss CD	1	1	1	1	1	1	0[d]	
# Samples/Year - Required by NPDES Permit	1	1	1	1	0	1	0[d]	
	Upland Sediment Trap Samples per Year[e]							
# Samples/Year -Required by Foss CD	As described in Table B2-3							
# Samples/Year - Required by NPDES Permit	None							

a - Due to the statistical record associated with the Foss program, the number of samples required per outfall under the Foss program shall be increased or decreased based on the procedure outlined in Section 7.2.4 of the QAPP (2014). This increase or decrease in sampling frequency under the Foss CD shall not affect the number of samples required by the NPDES Permit (e.g., the NPDES requirements will not change even if fewer samples are required by the Foss CD).

b - The Permit requires a total of 55 composite samples (5 outfalls, 11 samples each). Since the City is monitoring 7 outfalls required to comply with the Foss CD requirements, the City will meet the NPDES requirements by collecting 55 total samples from all 7 outfalls with a minimum of 8 samples (maximum of 11) from 5 of the outfalls . All of the 55 samples collected will be sampled for the full Foss/NPDES analyte list (Table 3-1 of the QAPP (2014)). Since the City has a strong statistical record for all of the Foss analytes (analytes that have been monitored under the Foss program for over 12 years), the City would likely be able to provide Ecology with a statistical analysis (in accordance with Appendix 9 of the Permit) for all the Foss analytes that demonstrates that the number of samples per year can be reduced for these Foss analytes while still meeting the monitoring goals. For the new NPDES analytes where the City does not have a statistical record, the City feels that providing Ecology with information potentially from more outfalls representing a broader area with slightly fewer samples per outfall is more useful than providing more samples from fewer outfalls. These new NPDES analytes have very limited data available from other stormwater monitoring programs (especially in Washington state). Information about the spatial distribution and the associations with various land uses for these new analytes is more useful than gathering more samples from fewer outfalls since the goal for these new analytes is not necessarily to develop long term trends.

c - The Permit requires a total of 55 grab samples (5 outfalls, 11 samples each). Consistent with the approach for the composite samples, the City will collect 55 total grab samples from all 7 outfalls with a minimum of 8 samples (maximum of 11) from 5 of the outfalls and the remainder coming potentially from the other two Foss outfalls. This will provide Ecology with better information about the spatial distribution (i.e., the variability of these analytes in stormwater outfalls) of these NPDES analytes.

d - Due to tidal conditions, a sediment trap cannot be installed in OF254.

e - These numbers do not include QC samples.

f- Monitoring at OF230 was discontinued during WY2023 and OF230A now represents 98% of the flow previously discharging to OF230.

Table B2-6
Representative Storm Event Criteria and Sampling Frequency

Criteria	Wet season	Dry season
Period	October 1 through April 30	May 1 through September 30
Rainfall volume	0.20” minimum, no fixed maximum	0.20” minimum, no fixed maximum
Rainfall duration	No fixed minimum or maximum	No fixed minimum or maximum
Spacing between Sampling Events	Minimum 1 week spacing between events. No more than 2 samples per month.	Minimum 1 week spacing between events. No more than 2 samples per month.
Antecedent dry period	≤ 0.05” rain in the previous 24 hours	≤ 0.02” rain in the previous 48 hours
Inter-event dry period	6 hours	6 hours
% of samples per season	60% to 80%	20% to 40%

a - See Table B2-5 for total annual sample numbers

Table B2-7
Surface Water Methods and Detection Limit Goals

Analyte	Analysis Method	Detection Limit Goal[1]	Lower Limit of Quantitation[1]	Foss and/or NPDES Parameter[2]
Conventionals				
Anionic Surfactants (MBAS)	SM 5540C		25 µg/L	NPDES
BOD	SM 5210B		2 mg/L	NPDES
Chloride	SM 4500-Cl-E		0.2 mg/L	NPDES
Conductivity	SM 2510B		±1 µS/cm	Foss/NPDES
Hardness	SM 2340B		0.05 mg/L	Foss/NPDES
pH	SM 4500H+ B		0.1 std units	Foss/NPDES
TSS	SM 2540D		1 mg/L	Foss/NPDES
Turbidity	SM 2130B		±0.2 NTU	NPDES
Metals				
Cadmium	EPA 200.8		0.2 µg/L	NPDES
Copper	EPA 200.8		0.5 µg/L	NPDES
Lead	EPA 200.8		0.1 µg/L	Foss/NPDES
Mercury	EPA 245.7		0.1 µg/L	Foss
Zinc	EPA 200.8		5 µg/L	Foss/NPDES
Dissolved Cadmium	EPA 200.8	0.03 µg/L	0.1 µg/L	NPDES
Dissolved Copper	EPA 200.8	0.02 µg/L	0.1 µg/L	NPDES
Dissolved Lead	EPA 200.8	0.05 µg/L	0.1 µg/L	Foss/NPDES
Dissolved Mercury	EPA 245.7		0.1 µg/L	Foss
Dissolved Zinc	EPA 200.8		1 µg/L	Foss/NPDES
PAHs				
2-Methylnaphthalene	EPA 8270E SIM	0.01 µg/L	0.1 µg/L	Foss
Acenaphthene	EPA 8270E SIM	0.01 µg/L	0.1 µg/L	Foss/NPDES
Acenaphthylene	EPA 8270E SIM	0.01 µg/L	0.1 µg/L	Foss/NPDES
Anthracene	EPA 8270E SIM	0.01 µg/L	0.1 µg/L	Foss/NPDES
Benzo(a)anthracene	EPA 8270E SIM	0.01 µg/L	0.1 µg/L	Foss/NPDES
Benzo(a)pyrene	EPA 8270E SIM	0.01 µg/L	0.1 µg/L	Foss/NPDES
Benzo(g,h,i)perylene	EPA 8270E SIM	0.01 µg/L	0.1 µg/L	Foss/NPDES
Benzo(b,j,k)fluoranthenes[3]	EPA 8270E SIM	0.03 µg/L	0.3 µg/L	Foss/NPDES
Chrysene	EPA 8270E SIM	0.01 µg/L	0.1 µg/L	Foss/NPDES
Dibenz(a,h)anthracene	EPA 8270E SIM	0.01 µg/L	0.1 µg/L	Foss/NPDES
Fluoranthene	EPA 8270E SIM	0.01 µg/L	0.1 µg/L	Foss/NPDES
Fluorene	EPA 8270E SIM	0.01 µg/L	0.1 µg/L	Foss/NPDES
Indeno(1,2,3-cd)pyrene	EPA 8270E SIM	0.01 µg/L	0.1 µg/L	Foss/NPDES
Naphthalene	EPA 8270E SIM	0.01 µg/L	0.1 µg/L	Foss/NPDES
Phenanthrene	EPA 8270E SIM	0.01 µg/L	0.1 µg/L	Foss/NPDES
Pyrene	EPA 8270E SIM	0.01 µg/L	0.1 µg/L	Foss/NPDES
Retene	EPA 8270E SIM	0.01 µg/L	0.1 µg/L	NPDES
Phthalates				
Di(2-ethylhexyl)phthalate	EPA 8270E SIM	0.5 µg/L	1 µg/L	Foss/NPDES
Butylbenzylphthalate	EPA 8270E SIM	0.5 µg/L	1 µg/L	Foss/NPDES
Diethylphthalate	EPA 8270E SIM	0.5 µg/L	1 µg/L	Foss/NPDES
Dimethylphthalate	EPA 8270E SIM	0.5 µg/L	1 µg/L	Foss
Di-n-butylphthalate	EPA 8270E SIM	0.5 µg/L	1 µg/L	Foss/NPDES
Di-n-octyl phthalate	EPA 8270E SIM	0.5 µg/L	1 µg/L	Foss/NPDES
Pesticides				
Bifenthrin	EPA 8270E SIM	0.02 µg/L	0.05 µg/L	NPDES
Dichlobenil	EPA 8270E SIM	0.02 µg/L	0.05 µg/L	NPDES
Nutrients				
Total Nitrogen[4]	ATP (WM920550)	0.03 mg/L	0.3 mg/L	NPDES
Nitrate/Nitrite	EPA 353.2	0.007 mg/L	0.1 mg/L	NPDES
Total Phosphorus	SM 4500P-F	0.003 mg/L	0.01 mg/L	NPDES
Orthophosphate	SM 4500P F	0.003 mg/L	0.01 mg/L	NPDES
Total Petroleum Hydrocarbons				
NWTPH-Dx (Diesel)	Ecology97-602	0.1 mg/L	0.25 mg/L	Foss/NPDES
NWTPH-Dx (Heavy Oil)	Ecology97-602	0.1 mg/L	0.5 mg/L	Foss/NPDES
Bacteria[5]				
Fecal Coliform	SM 9221E		2 to 2E6 max	NPDES
E. Coli	SM 9221B+F+C (MPN)		2 to 2E6 max	NPDES
Enterococcus	SM 9230D Enterolert		2 to 2E6 max	NPDES

[1]Appendix 9 of the NPDES permit specified detection limit goals (DLG) as well as lower limits of quantitation (LLOQ). LLOQ is the lowest concentration at which the laboratory has demonstrated target analytes can be reliably measured and reported with a certain degree of confidence. LLOQ is greater than or equal to the lowest standard and results greater than LLOQ are normally reported without qualification. Nitrogen, mercury, and PAH DLGs are lower than NPDES and are City set. The detection limit goal and LLOQ are measures of sensitivity. If a DLG is not presented, the LLOQ is used for measurement quality objective.

[2]Parameter specified under Foss, NPDES, or both programs.

[3]Benzo (b), (-j) and (-k) fluoranthene coelute. All three contain the same 0.1 benzo(a)pyrene Toxicity Equivalence Factor (TEF) under WAC 173-340-708(8)(e), Tables 708 2, 708-3 for assessing human health criteria (Ecology 2015). Benzo(b,j,k)fluoranthene will be reported as it is a more accurate identification, more conservative for purposes of human health, and comparable to Foss stormwater data collected since 2001 (reported as (b,k) combined). Sensitivity has been adjusted to reflect a combined parameter.

[4]Total Kjeldahl Nitrogen (TKN) can be calculated as the difference between Total Nitrogen and Nitrate/Nitrite. Total Nitrogen will be calculated using an Alternative Test Procedure which was approved for use in determining nitrogen in stormwater (Ecology letter dated 9/16/13).

[5]Ecology specified Fecal Coliform Bacteria in Appendix 9 of the NPDES permit. The freshwater state standard will change from fecal coliform to E. coli 12/31/2020 (WAC 173-201A-200). The City will analyze for fecal coliform, E. coli and enterococcus (saltwater criteria) until 9/30/2021, then may revert to E. coli only for the remainder of the permit. Further discussion is provided in Attachment 1.

Table B2-8
Required Sample Analysis Priority Order

Required Whole-Water Composite Sample Analysis Priority Order

Order[a]	All Outfalls
1	Conductivity and pH
2	PAHs, phthalates, phenols, bifenthrin, dichlobenil
3	Mercury
4	Other metals and hardness
5	Dissolved mercury
6	Other dissolved metals
7	TSS
8	Nutrients, nitrogen then phosphorus
9	BOD5
10	Surfactants
11	Turbidity
12	Chloride

a - Order reflects a combination of the Foss CD (Section 8.1 of the 2001 SAP) and Appendix 9 of the Permit.

Required Sediment Sample Analysis Priority Order

Order[a,b]	All Outfalls
1	Total solids, total volatile solids
2	PAHs, phthalates, phenols, bifenthrin and dichlobenil
3	NWTPH-Dx
4	PCBs
5	Grain size
6	Total organic carbon
7	Mercury
8	Other Metals
9	Nutrients
10	PBDE

a - Order reflects Foss CD requirements (Table 6 of the 2001 SAP) plus NPDES analytes in Appendix 9 of the Permit. If an analyte is not required to be analyzed (see Table 3-3 of the QAPP (2020)), that analyte shall be skipped in the order listed above.

b - Order of analyses may be modified based on past sampling results. The goal of modifying the order is to ensure analyses are conducted for contaminants that have historically shown elevated concentrations.

Table B2-9
Sediment Methods and Detection Limit Goals

Analyte	Analysis Method	Lower Limit of Quantitation[1]	Foss and/or NPDES Parameter[2]
Conventionals			
Total Organic Carbon	9060 Mod	0.1%	Foss/NPDES
Grain Size	ASTM D422	NA	Foss/NPDES
Total Solids	SM 2540G	0.1%	Foss/NPDES
Total Volatile Solids	SM 2540G	0.1%	NPDES
Metals			
Total Cadmium	EPA 6020B	0.1 mg/kg	NPDES
Total Copper	EPA 6020B	0.1 mg/kg	NPDES
Total Lead	EPA 6020B	0.1 mg/kg	Foss/NPDES
Total Mercury	EPA 7471B	0.005 mg/kg	Foss
Total Zinc	EPA 6020B	0.5 mg/kg	Foss/NPDES
PAHs			
2-Methylnaphthalene	EPA 8270E	70 µg/kg dry	Foss
Acenaphthene	EPA 8270E	70 µg/kg dry	Foss/NPDES
Acenaphthylene	EPA 8270E	70 µg/kg dry	Foss/NPDES
Anthracene	EPA 8270E	70 µg/kg dry	Foss/NPDES
Benzo(a)anthracene	EPA 8270E	70 µg/kg dry	Foss/NPDES
Benzo(a)pyrene	EPA 8270E	70 µg/kg dry	Foss/NPDES
Benzo(g,h,i)perylene	EPA 8270E	70 µg/kg dry	Foss/NPDES
Benzo(b,j,k)fluoranthenes[3]	EPA 8270E	210 µg/kg dry	Foss/NPDES
Chrysene	EPA 8270E	70 µg/kg dry	Foss/NPDES
Dibenz(a,h)anthracene	EPA 8270E	70 µg/kg dry	Foss/NPDES
Fluoranthene	EPA 8270E	70 µg/kg dry	Foss/NPDES
Fluorene	EPA 8270E	70 µg/kg dry	Foss/NPDES
Indeno(1,2,3-cd)pyrene	EPA 8270E	70 µg/kg dry	Foss/NPDES
Naphthalene	EPA 8270E	70 µg/kg dry	Foss/NPDES
Phenanthrene	EPA 8270E	70 µg/kg dry	Foss/NPDES
Pyrene	EPA 8270E	70 µg/kg dry	Foss/NPDES
Retene	EPA 8270E	70 µg/kg dry	NPDES
Phthalates			
Di(2-ethylhexyl)phthalate	EPA 8270E	70 µg/kg dry	Foss/NPDES
Butylbenzylphthalate	EPA 8270E	70 µg/kg dry	Foss/NPDES
Diethylphthalate	EPA 8270E	70 µg/kg dry	Foss/NPDES
Dimethylphthalate	EPA 8270E	70 µg/kg dry	Foss
Di-n-butylphthalate	EPA 8270E	70 µg/kg dry	Foss/NPDES
Di-n-octyl phthalate	EPA 8270E	70 µg/kg dry	Foss/NPDES
Pesticides			
Bifenthrin	EPA 8270E SIM	1 µg/kg dry	NPDES
Dichlobenil	EPA 8270E SIM	1 µg/kg dry	NPDES
PCBs[4]			
Aroclors 1016, 1221, 1232, 1242, 1248, 1254 and 1260	EPA 8270E SIM	10 µg/kg dry	Foss/NPDES
Phenolics[5]			
Pentachlorophenol	EPA 8270E	270 µg/kg dry	NPDES
m,p-cresol (3,4-methylphenol)	EPA 8270E	70 µg/kg dry	NPDES
o-cresol (2-methylphenol)	EPA 8270E	70 µg/kg dry	NPDES
PBDEs			
PBDE 47, 49, 66, 71, 99, 100, 138, 153, 183, 184, 191	EPA 1614	10 ng/kg dry	NPDES
PBDE 209	EPA 1614	200 ng/kg dry	NPDES
Nutrients			
Total Phosphorus	SM4500P-F	0.01 mg/kg	NPDES
Total Petroleum Hydrocarbons			
NWTPH-Diesel	NWTPH-Dx	25 mg/kg dry	Foss/NPDES
NWTPH-Heavy Oil	NWTPH-Dx	100 mg/kg dry	Foss/NPDES

[1]Appendix 9 of the NPDES permit specified lower limits of quantitation (LLOQ). LLOQ is the lowest concentration at which the laboratory has demonstrated target analytes can be reliably measured and reported with a certain degree of confidence. LLOQ is greater than or equal to the lowest standard and results greater than LLOQ are normally reported without qualification. Mercury, di-n-octylphthalate and phenol values are detection limit goals, and lower than LLOQ set in Appendix 9. The detection limit goal and LLOQ are measures of sensitivity.

[2]Parameter specified under Foss, NPDES or both programs.

[3]Benzo (b), (-j) and (-k) fluoranthene coelute. All three contain the same 0.1 benzo(a)pyrene Toxicity Equivalence Factor (TEF) under WAC 173-340-708(8)(e), Tables 708-2, 708-3 for assessing human health criteria (Ecology 2015). Benzo(b,j,k)fluoranthene will be reported as it is a more accurate identification, more conservative for purposes of human health, and comparable to Foss stormwater data collected since 2001 (reported as (b,k) combined). Sensitivity has been adjusted to reflect a combined parameter.

[4]PCB Lower Limits of Quantitation. Since 2001, the Thea-Foss and NPDES sediment monitoring programs have used a detection limit goal of 80 µg/kg dry. In Appendix 9, Ecology requested a LLOQ of 0.005 to 0.195µg/kg dry. Current LLOQ performance of 10µg/kg meets the needs of the Thea Foss Consent Decree, source control and effectiveness monitoring programs, and this value has been entered as the LLOQ for this QAPP. Further discussion is provided in Attachment 1.

[5]3-and 4-methylphenol ions cannot be separated for quantitation so the combined parameter will be reported (EPA 2018) - https://www.epa.gov/sites/production/files/2019-01/documents/8270e_revised_6_june_2018.pdf, Table 1).

Table B3-1
Total Rain Depth (Inches) During Past and Present Monitoring Years

		WY2002	WY2003	WY2004	WY2005	WY2006	WY2007	WY2008	WY2009	WY2010	WY2011	WY2012	WY2013	WY2014	WY2015	WY2016	WY2017	WY2018	WY2019	WY2020	WY2021	WY2022	WY2023	WY2002 -WY2023 Average	Historical Monthly Mean NCDC 1971-2000	Historical Monthly Mean NCDC 1981 - 2010
WET	October	3.32	0.41	8.88	3.61	3.00	1.28	3.64	2.36	4.18	4.64	3.39	5.97	1.57	6.20	5.92	10.57	5.60	3.89	3.66	3.06	5.03	2.03	4.19	3.39	3.70
WET	November	10.13	2.96	6.15	2.81	6.25	15.81	2.64	7.61	7.74	5.37	5.98	7.12	3.40	6.53	8.22	7.57	9.38	4.15	1.85	5.41	10.54	5.64	6.51	6.10	6.68
WET	December	6.82	6.58	4.65	4.03	6.28	8.05	8.36	4.03	2.67	6.83	6.44	8.33	1.91	4.88	12.22	3.66	5.74	6.93	7.36	5.64	5.55	6.98	6.09	5.89	5.52
WET	January	6.68	8.5	6.79	4.71	11.93	6.92	4.63	7.15	7.40	5.17	7.02	3.31	4.29	3.98	7.20	2.99	7.90	3.70	9.66	8.65	7.28	2.80	6.30	5.38	5.93
WET	February	3.56	1.71	2.55	0.79	2.59	4.09	2.84	1.61	3.95	3.54	3.19	1.58	7.68	4.61	5.55	9.24	2.75	4.19	3.35	4.00	3.56	1.79	3.58	4.44	3.86
WET	March	4.16	5.08	2.18	3.14	1.91	6.09	4.16	4.68	4.91	6.57	7.11	2.50	8.81	3.89	5.80	8.27	2.15	1.86	3.47	2.06	3.10	2.52	4.29	4.18	4.06
WET	April	3.64	3.3	0.91	4.74	2.46	1.34	1.76	3.31	2.90	5.13	3.74	4.52	4.22	1.56	1.37	4.67	5.81	2.65	1.24	0.85	3.34	3.49	3.04	2.87	3.00
DRY	May	1.14	0.55	2.56	3.34	1.56	1.31	1.01	3.03	4.15	3.77	2.33	2.86	3.23	0.74	0.58	2.02	0.09	0.46	2.49	1.29	3.04	0.62	1.92	2.01	2.11
DRY	June	1.36	0.36	0.64	1.26	2.25	1.44	1.26	0.33	3.05	1.40	2.54	1.85	0.94	0.22	1.41	1.54	0.69	0.19	1.90	1.85	2.72	0.32	1.34	1.58	1.57
DRY	July	0.42	0.13	0.00	1.16	0.11	1.30	0.26	0.00	0.78	0.74	0.87	0.01	0.57	0.47	0.61	0.00	0.02	0.77	0.20	0.00	0.19	0.11	0.40	0.86	0.68
DRY	August	0.06	0.29	2.75	0.04	0.00	0.90	2.32	1.04	0.24	0.27	0.00	1.05	1.72	2.21	0.10	0.09	0.10	1.19	0.42	0.05	0.57	0.26	0.71	0.83	0.82
DRY	September	0.36	0.69	3.26	0.92	0.74	2.22	0.39	2.82	3.93	0.96	0.02	8.29	2.26	1.12	1.13	1.11	1.54	2.69	2.30	3.20	0.00	2.49	1.93	1.42	1.29
	Wet Season	38.31	28.54	32.11	23.83	34.42	43.58	28.03	30.75	33.75	37.25	36.87	33.33	31.88	31.65	46.28	46.97	39.33	27.37	30.59	29.67	38.40	25.25	34.01	32.25	32.75
	Dry Season	3.34	2.02	9.21	6.72	4.66	7.17	5.24	7.22	12.15	7.14	5.76	14.06	8.72	4.76	3.83	4.76	2.44	5.30	7.31	6.39	6.52	3.80	6.30	6.70	6.47
	Total	41.65	30.56	41.32	30.55	39.08	50.75	33.27	37.97	45.90	44.39	42.63	47.39	40.60	36.41	50.11	51.73	41.77	32.67	37.90	36.06	44.92	29.05	40.30	38.95	39.22

Key:

	Months	*Seasons/Years*
Dark green	*> 2" above historical monthly average*	*> 8" above historical seasonal/yearly average*
Light green	*> 1" above historical monthly average*	*> 4" above historical seasonal/yearly average*
White	*≤ 1" above/below historical monthly average*	*≤ 4" above/below historical seasonal/yearly average*
Yellow	*> 1" below historical monthly average*	*> 4" below historical seasonal/yearly average*
Orange	*> 2" below historical monthly average*	*> 8" below historical seasonal/yearly average*

Table B4-1
Evaluation of Qualifying Storm Events During WY2023

Storm Event Criteria:	Total	Storms Sampled per Month											
		10/2022	11/2022	12/2022	1/2023	2/2023	3/2023	4/2023	5/2023	6/2023	7/2023	8/2023	9/2023
A: Total Number of Rainfall Events	99	5	12	17	15	14	10	13	1	3	1	2	6
B: Number of A Events Meeting Antecedent Conditions	61	5	6	8	9	10	9	6	1	2	1	2	2
C: Number of **B** Events with >=0.2" Rainfall[a]	19	3	4	1	2	1	3	3	1	0	0	0	1
D: Number of **C** Events Forecasted	15	3	3	1	2	1	3	1	1	0	0	0	0
Number of **D** Events Sampled	13	3	2	1	1	1	3	1	1	0	0	0	0
Number of Outfalls Sampled	--	6	6	6	3	2	5	5	3	--	--	--	5
Number of Outfalls with 2+ Samples per Month	--	1	2	3	--	--	4	--	--	--	--	--	--
Number of Event Sampled that didn't meet antecedent	4	--	1	1	--	--	--	1	--	--	--	--	1

Monitoring Location (Foss Outfalls)	Total	Storms Sampled per Month											
		10/2022	11/2022	12/2022	1/2023	2/2023	3/2023	4/2023	5/2023	6/2023	7/2023	8/2023	9/2023
230/OF230A[b]	3	--	1	2	ND	ND	ND	ND	ND	--	--	--	--
235	11	2	1	2	1	--	2	1	1	--	--	--	1
237A New	12	1	2	2	1	1	2	1	1	--	--	--	1
237B	8	1	2	1	--	1	1	1	--	--	--	--	1
243	7	1	1	1	--	--	2	1	--	--	--	--	1
245	9	1	1	1	1	--	2	1	1	--	--	--	1
254	1	1	--	--	--	--	--	--	--	--	--	--	--

a - There was snow predicted or on the ground several times during WY2023, disqualifying six potential events from meeting the sampling criteria (one event in November, four events in December, one event in February, and one event in March). Samplers were not deployed during this time.

b - Monitoring of OF230 stopped in December 2022 due to lack of flow at this outfall. Flow monitoring at the new OF230A began in April 2023 and sample collection was attempted starting in June 2023. There were very few opportunities during the remainder of the wateryear for sample collection.

Sampling Issues

10/2022 - No sample collected at OF230 due to reduced flow with new outfall. Pacings were reconfigured.
11/2022- No sample collected at OF254 due to conductivity issues. The connection cable was no longer manufactured to work with the conductivity probe from YSI. Due to supply shortage and reconfiguration the City was unable to find a replacement part and didn't recieve until June 2023. No samples were collected at OF254 during that time.
12/2022 - Met sampling goals for the month with the exception of OF254 due to conductivity probe.
1/2023 - No samples collected at OF237B due to sensor issues (cleaned 1/17) and at OF243 due to pumping issues (completed fix on 2/8).
2/2023 - No samples collected at OF235 and OF243 due to pumping issues, and OF245 due to a deployment error.
3/2023 - Met sampling goals for the month with the exception of OF254 due to conductivity probe.
4/2023 - Met sampling goals for the month with the exception of OF254 due to conductivity probe.
5/2023 - Met sampling goals for the month.
4/2023 - No samples were collected at OF243 or OF245 due to storms occurring during higher tides.
5/2023 - No samples were collected at OF237B and OF243 due to deployment errors.
6/2023 - No events met storm requirements
7/2023 - No events met storm requirements
8/2023 - No events met storm requirements
9/2023 - While no events met all storm requirements, samplers were deployed in an attempt to sample the "First Flush" event. The OF230A sampler was not deployed due to vandalism of the site with equipment stolen. No sample was collected at OF254 due to equipment issue with new sampler (Fixed 9/23).

Summary

The minimum sampling requirements were met at outfalls OF235, OF237A New, OF237B, OF245, and OF243. Minimum requirements were not met at OF230/OF230A and OF254 due to limited flow at OF230 (3) and new monitoring site conditions at OF230A (0) and equipment issues at OF254 (1). There were no forecasted rainfall events meeting storm criteria during June, July, August, and September. A first flush event was sampled during September 2023. The 55 events per year requirement was not met due to the limited sampling opportunities at all sites, the new monitoring location for OF230A and major equipment issues at OF254. The cumulative minimum number of events for WY2023 was 51. Four events did not meet antecedent conditions.

Table B4-2
Thea Foss/NPDES Surface Water Sampling Project 2022-2023 (WY2023) - Composite Sampling

Total Deployment	Storm Sampled	Event Type	Date	Rainfall Prediction in/24hours	Actual Rainfall (inches)	Storm Samples Accepted / Issues: Outfall 230[a]	Outfall 230A	Outfall 235	Outfall 237ANEW	Outfall 237B	Outfall 243	Outfall 245	Outfall 254
Wet Season 10/01/2022 - 04/30/2023													
1	1	S	10/21/2022	0.94	0.42	[1] E		[1] 1	[1] 1	[1] F	[1] F	[1] F	[1] F
2		N	10/22/2022	0.5	0.17	[2]		SB	SB	[2]	[2]	[2]	[2]
3	2	S	10/25/2022	0.4	0.43	[3] E		SB	SB	[3] 1	[3] 1	[3] F	[3] F
4		N	10/27/2022	0.31	0.12	[4]		SB	SB	SB	SB	[4]	[4]
5	3	S	10/30/2022	1.52	0.58	[5] E		[2] 2	[2] P	SB	SB	[5] 1	[5] 1
6	4	SA	11/4/2022	1.53	0.79	[6] E		SB	[3] 2	[4] 2	[4] E	SB	SB
7	5	S	11/6/2022	0.62	0.76	[7] E		SB	SB	SB	[5] 2	SB	SB
8	6	S	11/22/2022	0.31	0.88	[8] 1		[3] 3	[4] 3	[5] 3	SB	[6] 2	ND
		S	11/25/2022	N/A	0.61	SB		SB	SB	SB	SB	SB	ND
		SNOW	11/29/2022	During this timeframe there was snow on the ground or forecasted and samplers were not deployed.									
		SNOW	12/2/2022	During this timeframe there was snow on the ground or forecasted and samplers were not deployed.									
		SNOW	12/4/2022	During this timeframe there was snow on the ground or forecasted and samplers were not deployed.									
9		N	12/7/2022	0.59	0.14	[9]		[4]	[5]	[6]	[6]	[7]	ND
10	7	SA	12/9/2022	0.59	0.58	[10] 2		[5] 4	[6] 4	[7]SE	[7] 3	[8] 3	ND
		SNOW	12/20/2022	During this timeframe there was snow on the ground or forecasted and samplers were not deployed.									
		SNOW	12/23/2022	During this timeframe there was snow on the ground or forecasted and samplers were not deployed.									
		A	12/25/2022	N/A	0.99								
		A	12/26/2022	N/A	0.59								
11	8	S	12/29/2022	1	0.54	[11] 3		[6] 5	[7] 5	[8] 4	[8] PE	[9] T	ND
		A	1/6/2023	N/A	0.44								
		A	1/8/2023	N/A	0.26								
12	9	S	1/11/2023	1	0.67	ND		[7] 6	[8] 6	[9] D	[9] PE	[10] 4	ND
		M	1/14/2023	0.22	0.32	ND		SB	SB	Missed	OUT	SB	ND
13	10	S	2/7/2023	0.4	0.21	ND		[8] PE	[9] 7	[10] 5	OUT	[11] D	ND
		SNOW	2/25/2023	During this timeframe there was snow on the ground or forecasted and samplers were not deployed.									
		SNOW	3/3/2023	During this timeframe there was snow on the ground or forecasted and samplers were not deployed.									
14	11	S	3/12/2023	1	0.63	ND		[9] 7	[10] 8	[11] D	[10] 4	[12] 5	ND
15	12	S	3/19/2023	0.24	0.20	ND		[10] 8	[11] 9	[12] 6	[11] D	[13] T	ND
16		N	3/22/2023	0.27	0	ND		SB	SB	SB	[12]	[14]	ND
17	13	S	3/31/2023	0.7	0.25	ND		[11] LV	[12] LV	[13] LV	[13] 5	[15] 6	ND
		U	4/1/2023	N/A	0.2								
18		N	4/6/2023	0.7	0.41			[12] LV	[13] LV	[14] LV			
19	14	SA	4/9/2023	2	1.11	ND		[13] LV	[14] 10	[15] 7	ND	[16] 7	ND
20	15	S	4/16/2023	0.27	0.43	ND	Installed 4/12	[14] 9	SB	SB	[14] 6	SB	ND
		U	4/22/2023	0.14	0.26		ND						
Dry Season 5/01/2022 - 09/30/2023													
21	16	S	5/4/2023	0.7	0.52	ND	ND	[15] 10	[15] 11	[16] D	[15] D	[17] 8	ND
22		N	6/16/2023	0.2	0.02	ND	[1]	[16]	[16]	[17]	[16]	[18]	ND
23		N	8/25/2023	0.5	0	ND	[2]	[17]	[17]	[18]	[17]	[19]	ND
		U	9/23/2023	N/A	0.21	ND	ND	ND	ND	ND	ND	ND	ND
24	17	SA	9/24/2023	1	0.91	ND	ND	[18] 11	[18] 12	[19] 8	[18] 7	[20] 9	[6] D

	Outfall 230[a]	Outfall 230A	Outfall 235	Outfall 237ANEW	Outfall 237B	Outfall 243	Outfall 245	Outfall 254	Totals
Total Storms Deployed	11	2	18	18	19	18	20	6	**112**
Acceptable Storms Deployed	8	0	14	14	14	13	14	4	**81**
Total Samples Submitted for Analysis	3	0	11	12	8	7	9	1	**51**
Total Accepted Samples	3	0	11	12	8	7	9	1	**51**
Accepted Sample/Acceptable Storm Deployed	38%	0%	79%	86%	57%	54%	64%	25%	**50%**
Cumulative Minimum	8		8	8	8	8	8	8	55
Maximum (allowed to contribute to 55)	11		11	11	11	11	11	11	**Met? No, 51**

a - Monitoring of OF230 stopped in December 2022 due to lack of flow at this outfall. Flow monitoring at the new OF230A began in April 2023 and sample collection was attempted starting in June 2023. There were very few opportunities during the remainder of the wateryear for sample collection.

Note: In order to ensure that storm samples are representative throughout the year, a one-week break in sampling is observed once a sample is accepted as denoted by SB (sample break).

KEY
Deployment # **[#]**
Successful sample number **#**
Grabs Collected
Snow

Event Type Description

U	Unpredicted Event: Less than 0.2" of rainfall was predicted and samplers were not deployed. Actual precipitation of 0.2" or greater was achieved.
UA	Unpredicted Antecedent: Rain was predicted within the antecedent period - rain did not fall as expected and antecedent conditions were met.
N	Non-qualifying Event: Greater than 0.2" of rainfall predicted and samplers were deployed. Actual precipitation was less than 0.2".
S	Storm Event: Precipitation met storm criteria - a minimum of 0.2" of rainfall was achieved. (antecedent = Y , Rainfall >= 0.2)
SA	Antecedent conditions were not met, but storm was still accepted.
Snow	Storm event predicted, however there is snow in the forecast and/or snow on the ground.
A	Antecedent conditions were not met, storm was not deployed.

Sampling Issues Description

T	Event occurred during high tide
B	Battery failure occurred
PE	Pumping errors occurred
P	Pacing Issues
E	Enable Issues
SP	Sample processing error
D	Deployment error - programming, tubing, jars, etc.
SE	Problem with sensor - debris, calibration, errors, etc.
ND	Sampler not deployed
OUT	Sampling equipment out due to maintenance, cleaning, replacement, etc.
TB	Issues with Tubing
LV	Low volume collected samples not kept
SB	Sample break due to accepted samples within 7 days.
F	Forecast incorrect

Table B4-3
Grab Sampling Events for WY2023

Grab Sampling Summary WY2023											
Sample Date	Rainfall Prediction	Actual Rainfall	Antecedent Dry (hours)	OF230	OF230A	OF235	OF237A	OF237B	OF243	OF245	OF254
Wet Season											
10/21/2022	0.94	0.4		1	—	1	1	1	1	1	1
11/4/2022	1.53	0.79		1	—	1	1	1	1	1	1
Dry Season											
—	—	—	—	—	—	—	—	—	—	—	—
Number Sampled in Wet Season				2	—	2	2	2	2	2	2
Number Sample in Dry Season				0	—	0	0	0	0	0	0
Total Number of Grab Samples collected for WY2022				2	—	2	2	2	2	2	2
Met 55 Goal?											
WY2023 Minimum				8	—	8	8	8	8	0	0
Cumulative Minimum				55 Samples							
Maximum (allowed to contribute to 55)				11		11	11	11	11	11	11
Wet Season - Goal: 60-80%				100%		100%	100%	100%	100%	100%	100%
Met Wet Season Goal?				No		No	No	No	NA	No	NA

a - Monitoring of OF230 stopped in December 2022 due to lack of flow at this outfall. Flow monitoring at the new OF230A began in April 2023 and sample collection was attempted starting in June 2023. There were very few opportunities during the remainder of the wateryear for sample collection.

Table B4-4
Summary of Sampled Storm Events by Outfall

	Outfalls Sampled							
	237A New	237A	237B	235	230	243	245	254
9/25/01		1	1	-	-	-	-	-
Water Year 2002								
10/10/01	Site Not Active	1	1	1	1	1	1	1
10/24/01		-	-	2	2	2	2	2
11/28/01		-	-	-	3		3	3
12/12/01		2	2	-	4	3	4	-
12/15/01		-	-	3	-	-	-	-
01/06/02		3	3	4	5	-	-	-
01/18/02		4	4	5	6	-	5	4
01/23/02		-	-	-	-	4	-	-
02/20/02		5	-	6	7	5	6	5
03/16/02		6	5	7	8	6	7	6
04/09/02		7	6	8	9	7	8	7
04/26/02		-	7	-	-	-	9	-
05/28/02		8	8	9	10	-	10	8
06/28/02		9	9	10	11	8	11	9
Water Year 2003								
10/03/02	Site Not Active	1	1	1	1	1	1	-
11/06/02		2	2	2	2	-	-	2
11/13/02		-	-	-	-	-	2	-
11/17/02		-	-	-	-	2	-	-
12/10/02		3	3	3	3	-	3	3
01/01/03		4	-	4	4	-	4	4
01/11/03		-	4	-	-	-	-	-
01/21/03		5	5	5	-	3	5	5
01/25/03		-	-	-	5	-	-	-
01/29/03		-	-	-	-	4	-	-
02/15/03		6	6	6		5	6	6
03/11/03		7	7	7	6	6	7	7
04/01/03		8	8	8	7	7	8	8
04/21/03		9	9	9	8	-	9	9
09/16/03		10	10	-	-	-	-	-
Water Year 2004								
10/06/03	Site Not Active	1	1	1	-	-	-	-
10/15/03		-	-	-	1	-	-	1
10/22/03		2	2	2	-	1	1	-
11/15/03		3	3	3	2	-	-	-
12/02/03		4	-	4	-	2	2	2
12/4-5/03		-	4	-	3	-	-	-
12/20/03		-	-	-	-	3	3	-
01/18/04		5	5	-	-	-	-	-
01/22/04		-	-	5	4	4	-	3
02/13/04		6	6	6	5	-	4	-
03/03/04		-	-	7	6	-	5	-
05/10/04		7	7	8	7	5	6	4
05/25/04		8	8		8	6	7	5
06/12/04		9	9	9	9	7	8	6
08/06/04		10	10	10	10	8	9	7
08/21/04		11	11	11	11	9	-	8
09/10/04		12	12	-	-	10	10	9
09/15/04		-	-	12	12	-	-	-
Water Year 2005								
10/05/04	Site Not Active	1	1	1	-	-	1	1
10/08/04		-	-	-	1	1	-	-
11/01/04		2	2	2	2		2	2
11/17/04		3	3	3	3	2	3	3
12/09/04		4	4	4	4	3	4	4
01/15/05		5	5	5	5	4	5	5
02/06/05		6	6	6	-	-	-	-
03/19/05		7	7	7	6	5	6	6
04/10/05		8	8	8	-	-	-	7
05/17/05		-	9	9	-	-	7	-
06/16/05		9	10	10	7	6	8	8
07/08/05		10	11	11	8	-	9	9
09/29/05		11	12	12	9	7	10	10
Water Year 2006								
10/14/05	-	1	1	1	1	1	1	1
01/05/06	-	-	-	-	-	2	2	2
01/16/06	-	-	-	2	2	-	3	3
01/31/06	-	2	2	-	3	3	4	4
02/26/06	1	3	3	3	-	-	5	-
03/08/06	-	-	-	-	4	4	-	5
04/08/06	-	4	4	4	5	-	-	-
04/13/06	2	-	-	-	-	5	6	-
05/21/06	3	5	5	5	6	-	-	6
09/17/06	-	6	-	6	7	6	7	7
Water Year 2007								
10/14/06	-	1	-	1	1	-	1	-
11/02/06	1	2	-	2	-	-	2	1
11/15/06	-	-	-	-	2	-	-	-
11/19/06	-	-	1	3	-	-	3	-
02/17/07	-	-	2	4	-	1	4	2
02/24/07	-	3	-	-	3	-	-	-
03/19/07	-	4	3	5	4	-	5	3
05/02/07	-	5		6	5	-	6	4
06/09/07	2	6	4	-	-	-	-	5
06/28/07	-	-	5	-	-	-	-	-
09/03/07	3	7	6	7	-	-	7	-
09/16/07	4	8	7	8	6	-	-	6
09/27/07	5	9	8	9	7	2	8	7
Water Year 2008								
10/10/07	1	1	1	1	1	-	1	1
11/09/07	2	2	2	-	2	-	2	2
11/26/07	-	-	3	2	3	1	3	3
11/28/07	3	3	-	-	-	-	-	-
12/14/07	4	4	4	3	4		4	4
12/27/07	-	-	-	-	-	2	-	-
01/08/08	5	5	5	4	-	-	5	-
01/14/08	-	-	-	-	5	-	-	5
01/26/08	-	6	-	5	6	3	6	6
02/29/08	6	7	6	6	7	4	7	7
03/23/08	7	8	7	7		5	8	8
05/20/08	8	9	8	8	8	6	9	9
07/31/08	-	-	9	-	9	-	-	-
08/19/08	9	10	10	9	10	7	10	10
Water Year 2009								
10/03/08	1	1	1	1	-	-	1	1
10/20/08	-	-	2	-	1	-	2	-
10/31/08	2	2	-	2	-	-	-	-
11/05/08	-	-	3	-	2	1	3	-
11/10/08	3	-	-	-	-	-	-	2
11/20/08	4	-	-	3	-	-	-	-
12/12/08	5	3	4	4	-	2	4	3
03/14/09	6	4	5	5	3	3	5	4
03/28/09	7	5	6	6	4	-	6	-
04/01/09	-	-	-	-	-	4	-	5
04/17/09	8	6	7	7	5	5	7	6
05/02/09	9	7	8	8	6	6	8	7
05/18/09	-	8	9	9	7	7	-	8
09/05/09	-	9	10	-	8	8	9	-
09/19/09	10	10	11	10	-	-	10	-
Water Year 2010								
10/16/09	1	1	1	1	1	1	-	1
10/22/09	-	-	-	-	-	-	2	-
10/28/09	2	2	2	2	2	-	-	2
10/30/09	-	-	-	-	-	2	-	-
11/05/09	3	3	3	3	-	3	3	3
11/15/09	-	-	-	-	3	-	-	-
11/25/09	4	4	4	4	-	-	4	4
12/31/09	5	5	5	5	4	-	5	-
01/04/10	6	6	-	6	5	-	6	5
01/07/10	-	-	-	7	-	-	7	-
01/10/10	-	-	6	-	-	-	-	-
01/24/10	7	7	7	8	6	-	8	6
02/10/10	-	-	-	-	-	4	-	-
02/15/10	8	8	8	9	7	5	9	7
03/11/10	9	9	9	10	8	-	-	8
03/28/10	10	10	-	11	9	6	-	-
04/02/10	-	-	-	12	-	-	10	9
05/25/10	11	-	10	13	10	-	-	-
05/27/10	-	11	-	-	-	-	11	10
06/03/10	-	-	-	14	-	-	12	-
06/08/10	12	-	11		11	7	13	-
06/19/10	-	-	-	15	-	-	-	11
09/26/10	13	12	12	16	-	-	-	-
Water Year 2011								
10/09/10	1	1	1	1	1	1	-	1
10/30/10	2	-	2	2	2	2	-	2
11/09/10	-	-	-	3	-	-	-	-
11/17/10	-	2	3	-	-	3	1	3
11/30/10	3	-	-	4	-	4	2	4
12/11/10	-	3	4	5	3	-	-	-
01/21/11	4	4	5	6	4	5	3	5
01/29/11	-	-	-	7	-	-	-	-
02/12/11	-	5	6	8	5	-	4	6
03/04/11	-	6	7	9	6	-	-	7
03/12/11	-	-	-	-	-	6	5	-
04/04/11	5	7	8	10	7	-	6	-
04/13/11	6	8	9	11	-	-	7	8
04/26/11	7	9	10	-	-	7	8	9
05/02/11	-	-	-	12	8	-	9	-
05/14/11	-	10	11	-	-	-	-	-
05/25/11	-	11	12	13	9	-	-	-
08/22/11	-	12	13	14	-	-	-	-
Water Year 2012								
10/10/11	-	Site No Longer Active	-	1	1	1	1	1
10/28/11	1		1	2	2	-	2	-
11/02/11	-		-	-	-	-	-	2
11/11/11	-		-	3	-	-	3	-
11/16/11	-		2	-	-	-	-	-
11/21/11	-		-	4	-	-	4	-
11/27/11	-		-	-	3	-	-	-
01/05/12	-		-	5	-	-	5	-
01/09/12	2		3	-	4	-	-	3
01/24/12	-		-	-	-	-	-	4
01/29/12	-		4	-	5	-	-	-
02/01/12	3		-	6	-	-	-	-
02/18/12	-		-	7	-	-	-	-
02/24/12	4		-	-	-	-	-	-
03/05/12	-		5	8	6	-	6	-
03/14/12	-		6	9	-	-	7	-
04/03/12	-		7	10	7	-	8	-
04/19/12	5		8	11	-	2	9	-
04/25/12	6		-	-	-	-	-	-
04/30/12	7		9	-	-	-	10	-
05/03/12	-		-	-	-	3	-	-
05/20/12	8		-	-	-	-	11	-
06/05/12	-		10	12	-	-	12	-
06/07/12	9		-	-	8	4	-	-
06/22/12	-		-	-	9	-	-	-
Water Year 2013								
10/18/12	1	Site No Longer Active	1	1	1	1	-	1
11/11/12	-		-	2	2	2	1	-
11/22/12	2		2	-	-	-	-	2
12/25/12	3		-	3	-	3	2	-
02/22/13	-		-	-	-	-	-	3
02/27/13	4		3	4	3	-	-	-
03/12/13	-		-	5	-	-	-	-
03/19/13	5		4	6	4	-	-	-
04/05/13	6		5	-	-	-	-	-
04/10/13	7		6	7	5	-	-	-
04/12/13	8		7	8	-	-	-	-
04/19/13	9		8	9	6	-	-	-
05/13/13	10		-	10	-	4	3	4
05/21/13	11		9	11	7	-	-	-
08/28/13	12		-	12	8	-	-	-
09/21/13	-		10	-	-	-	-	-
Water Year 2014								
11/01/13	1	Site No Longer Active	1	1	1	1	1	1
11/06/13	2		2	-	2	-	-	-
12/12/13	3		-	-	-	-	-	-
01/06/14	4		-	2	3	-	-	-
01/28/14	5		-	3	-	-	-	-
02/12/14	6		-	4	-	2	2	2
03/08/14	-		3	5	4	-	-	-
03/13/14	-		4	-	-	-	-	-
03/15/14	-		-	6	-	-	-	-
03/28/14	-		5	-	5	-	-	-
04/21/14	7		6	7	6	-	3	3
05/08/14	8		7	8	7	-	-	-
06/12/14	-		8	-	-	-	4	-
07/22/14	-		9	-	8	-	-	4
08/12/14	9		-	-	-	3	-	-
09/23/14	-		10	-	9	4	5	5
Water Year 2015								
10/13/14	-	Site No Longer Active	-	1	1	-	1	-
10/20/14	-		-	2	-	1	2	-
10/22/14	1		-	-	-	-	3	1
10/30/14	2		1	3	2	-	-	-
11/05/14	-		-	-	3	-	-	2
11/21/14	-		-	-	-	2	4	3
11/24/14	3		2	4	4	-	-	-
12/08/14	-		3	5	5	-	5	-
12/23/14	4		4	6	6	3	-	4
01/04/15	5		-	7	7	-	-	5
01/15/15	6		5	8	-	-	6	6
01/17/15	7		6	9	8	-	7	7
03/13/15	-		7	-	9	4	-	-
03/20/15	8		8	10	-	-	8	-
03/23/15	-		-	-	-	5	-	-
04/10/15	9		-	-	-	-	-	-
04/13/15	10		-	11	10	-	-	-
04/23/15	11		-	-	11	6	9	-
07/26/15	-		-	12	-	-	-	-
08/14/15	12		-	13	-	-	-	-
08/29/15	13		-	14	-	-	-	-
09/01/15	-		9	-	-	-	-	-
Water Year 2016								
10/07/15	1	Site No Longer Active	1	1	-	-	-	-
11/08/15	-		-	2	-	-	-	-
11/13/15	-		-	-	-	1	-	-
11/16/15	-		-	3	-	2	-	-
12/01/15	-		-	4	-	3	-	-
12/05/15	2		2	-	-	-	-	-
12/12/15	-		-	-	1	-	-	1
12/21/15	-		-	5	2	-	-	-
12/23/15	-		3	-	-	-	-	-
01/16/16	3		-	6	3	4	1	-
01/19/16	4		4	-	4	-	-	2
02/03/16	5		5	7	-	5	2	-
02/06/16	-		-	-	5	-	-	-
02/12/16	-		6	8	-	-	3	3
02/17/16	6		-	-	6	-	-	-
02/27/16	-		7	-	-	-	4	-
03/21/16	-		8	9	-	-	5	-
03/24/16	7		-	-	7	-	-	4
04/12/16	8		-	10	-	-	6	5
09/06/16	-		-	11	-	6	7	6
09/17/16	9		-	-	8	-	8	7
Water Year 2017								
10/06/16	1	Site No Longer Active	-	-	1	1	1	1
10/12/16	2		1	1	2	-	-	-
10/19/16	-		-	-	-	-	2	-
11/05/16	3		2	-	3	2	3	2
11/13/16	-		-	2	-	-	-	-
11/14/16	4		3	-	4	3	4	3
12/03/16	5		4	3	5	4	5	4
12/19/16	6		-	4	6	5	6	5
01/08/17	-		5	5	7	-	7	6
01/17/17	7		6	6	8	-	8	-
02/03/17	-		7	7	9	6	9	7
02/14/17	-		8	8	-	-	-	-
02/26/17	8		-	-	-	-	-	-
03/17/17	9		9	9	10	7	10	8
04/04/17	10		10	10	11	-	11	-
05/04/17	11		-	-	12	-	12	9
06/07/17	-		-	-	-	-	-	10
06/15/17	12		11	11	13	-	13	-
09/18/17	-		12	12	14	-	-	-
Water Year 2018								
10/12/17	1	Site No Longer Active	1	1	-	1	1	1
11/02/17	-		2	2	-	-	2	-
11/04/17	2		-	-	1	-	-	2
11/12/17	-		3	-	-	2	-	-
11/19/17	3		4	3	2	-	3	-
11/28/17	-		-	-	-	-	4	-
12/01/17	-		5	4	3	-	-	-
01/04/18	-		6	-	4	3	-	3
01/10/18	4		-	5	-	-	5	-
01/17/18	-		7	-	5	4	-	4
01/23/18	5		-	6	-	-	6	-
02/01/18	6		8	7	6	5	7	5
03/13/18	-		-	-	7	6	8	-
03/21/18	7		9	-	8	7	9	-
04/04/18	-		-	-	-	-	-	6
04/07/18	8		10	8	-	8	10	-
06/08/18	-		-	9	9	-	-	7
09/09/18	-		-	-	-	9	11	-
Water Year 2019								
10/05/18	-	Site No Longer Active	1	1	-	1	1	-
10/25/18	1		-	-	-	2	2	1
10/27/18	-		2	2	1	-	-	-
11/21/18	-		-	-	-	-	3	-
11/22/18	2		3	3	-	3	-	-
12/09/18	3		-	4	2	-	4	2
12/11/18	-		4	-	-	-	-	-
12/17/18	4		-	-	3	4	-	3
01/03/19	-		-	5	4	5	-	4
01/18/19	5		5	6	5	6	5	5
02/01/19	6		6	7	6	7	6	6
03/11/19	7		-	8	7	8	7	7
03/25/19	-		7	-	-	-	-	-
07/09/19	-		-	9	8	-	-	-
09/09/19	-		-	10	9	-	-	-
09/12/19	8		8	-	-	-	8	-
09/14/19	-		-	-	-	9	-	-
09/22/19	-		-	11	-	-	-	-
Water Year 2020								
10/16/19	1	Site No Longer Active	-	-	-	-	1	1
10/21/19	-		1	1	-	1	-	-
11/15/19	-		2	2	1	-	-	-
11/17/19	-		-	-	-	-	2	-
11/18/19	-		-	-	-	2	-	2
12/06/19	2		3	3	2	-	3	3
12/18/19	-		-	-	-	3	4	-
12/31/19	-		4	4	3	4	5	-
01/02/20	-		-	-	-	-	-	4
01/17/20	-		5	5	4	5	6	5
01/30/20	-		6	6	-	6	7	6
02/06/20	3		-	-	5	-	-	-
02/23/20	4		7	-	6	-	8	-
03/05/20	5		8	-	7	7	-	7
03/13/20	-		-	7	-	-	-	-
03/28/20	6		9	8	8	-	-	-
04/22/20	7		10	-	9	8	9	8
04/26/20	-		-	9	-	-	-	-
05/02/20	-		11	-	10	-	-	-
05/16/20	-		12	10	11	9	10	9
05/30/20	8		13	11	12	-	11	-
06/08/20	9		14	-	13	10	12	10
09/18/20	-		-	-	14	-	13	-
09/23/20	-		-	-	-	11	-	11
Water Year 2021								
10/09/20	-	Site No Longer Active	-	-	1	1	1	-
10/13/20	-		1	-	-	-	-	-
11/03/20	-		-	-	-	2	2	1
11/04/20	1		2	-	-	-	-	-
11/12/20	2		3	1	2	3	3	2
12/08/20	3		4	-	3	4	4	3
12/15/20	-		-	2	-	-	-	-
12/25/20	-		5	3	-	-	5	-
12/29/20	4		-	-	4	-	-	-
01/11/21	5		6	-	-	5	6	4
01/29/21	6		7	4	5	6	7	-
02/21/21	7		8	5	6	-	8	
03/04/21	8		9	-	7	-	-	5
03/24/21	9		10	6	8	7	9	-
03/28/21	-		-	-	-	-	-	6
04/07/21	10		11	7	9	-	-	7
04/24/21	-		-	-	-	-	-	8
05/27/21	11		12	8	10	-	10	9
06/06/21	-		-	9	-	8	-	-
06/12/21	12		13	10	11	-	11	
09/17/21	-		14	-	12	9	12	10
09/26/21	-		15	-	13	-	-	-
09/29/21	-		-	11	-	-	-	-
Water Year 2022								
10/21/21	-	Site No Longer Active	1	1	1	1	1	1
11/03/21	1		2	2	-	2	2	2
11/08/21	-		-	-	2	-	-	-
11/18/21	-		3	3	3	-	3	-
12/04/21	2		4	4	4	3	4	3
12/17/21	3		5	5	5	-	5	-
01/19/22	-		6	6	6	-	6	4
02/20/22	-		-	-	-	-	-	5
02/26/22	-		7	7	7	-	7	-
03/14/22	4		8	-	8	4	8	6
03/18/22	-		-	8	-	-	-	-
04/03/22	5		9	9	9	5	9	7
04/18/22	6		10	10	10	-	10	-
04/29/22	7		-	-	-	-	-	-
05/05/22	-		-	-	-	6	11	8
05/15/22	8		11	11	11	-	-	-
06/09/22	-		-	12	12	7	12	9
Water Year 2023								
10/21/2022	1	Site No Longer Active	-	1	-	-	-	-
10/25/2022	-		1	-	-	1	-	-
10/30/2022	-		-	2	-	-	1	1
11/4/2022	2		2	-	-	-	-	-
11/6/2022	-		-	-	-	2	-	-
11/22/2022	3		3	3	1	-	2	-
12/9/2022	4		-	4	2	3	3	-
12/29/2022	5		4	5	3	-	-	-
1/11/2023	6		-	6	-	-	4	-
2/7/2023	7		5	-	-	-	-	-
3/12/2023	8		-	7	-	4	5	-
3/19/2023	9		6	8	-	-	-	-
3/31/2023	-		-	-	-	5	6	-
4/9/2023	10		7	-	-	6	7	-
4/16/2023	-		-	9	-	-	-	-
5/4/2023	11		-	10	-	-	8	-
9/24/2023	12		8	11	-	7	9	-

Table B4-5
Portion of Storm Event Sampled in Tidally Influenced Drains

Number of Events Sampled

Portion of storm sampled (Year 1)	230	235	243	245	254	237A New
Rising limb			2		1	Not Sampled
Rising and peak limb	1	1	1	1		
Peak			1	1	1	
Peak and falling limb					2	
Falling limb			3		1	
Most of the storm	10	9		9	3	
Total Number	11	10	7	11	8	

Portion of storm sampled (Year 2)	230	235	243	245	254	237A New
Rising limb			1	1		Not Sampled
Rising and peak limb	1			2		
Peak			1			
Peak and falling limb	3	1	1	1	1	
Falling limb					2	
Most of the storm	4	8	5	5	5	
Total Number	8	9	8	9	8	

Portion of storm sampled (Year 3)	230	235	243	245	254	237A New
Rising limb			1		1	Not Sampled
Rising and peak limb	1	1	1		1	
Peak			1			
Peak and falling limb	2	1	1	3	1	
Falling limb					2	
Most of the storm	8	9	4	6	3	
Total Number	11	11	8	9	8	

Portion of storm sampled (Year 4)	230	235	243	245	254	237A New
Rising limb						Not Sampled
Rising and peak limb	2	1	1	2	1	
Peak	1	2	1	1		
Peak and falling limb			2	2	3	
Falling limb			2		1	
Most of the storm	6	9	1	5	4	
Total Number	9	12	7	10	9	

Portion of storm sampled (Year 5)	230	235	243	245	254	237A New
Rising limb	1					
Rising and peak limb				2	1	
Peak	3		2		2	1
Peak and falling limb	1	1	1	1	3	1
Falling limb			1			
Most of the storm	2	5	1	4	2	1
Total Number	7	6	5	7	8	3

Portion of storm sampled (Year 6)	230	235	243	245	254	237A New
Rising limb	1			1		
Rising and peak limb					1	
Peak					2	
Peak and falling limb	1				1	
Falling limb						
Most of the storm	4	7	2	6	2	2
Total Number	6	7	2	7	6	2

Portion of storm sampled (Year 7)	230	235	243	245	254	237A New
Rising limb		1			1	
Rising and peak limb	2		1	1	2	
Peak	2	2		1	2	
Peak and falling limb	1	1	4	2	3	1
Falling limb			1	1	1	1
Most of the storm	7	8	2	7	3	10
Total Number	12	12	8	12	12	12

Portion of storm sampled (WY2009 (Year 8))	230	235	243	245	254	237A New
Rising limb						
Rising and peak limb						
Peak			2	1	1	
Peak and falling limb			1		1	1
Falling limb					1	
Most of the storm	8	10	5	9	5	9
Total Number	8	10	8	10	8	10

Number of Events Sampled

Portion of storm sampled (WY2010 (Year 9))	230	235	243	245	254	237A New
Rising limb						
Rising and peak limb	2	2		3		1
Peak			2		1	
Peak and falling limb	1				4	1
Falling limb			2		2	
Most of the storm	8	14	3	9	5	11
Total Number	11	16	7	12	12	13

Portion of storm sampled (WY2011 (Year 10))	230	235	243	245	254	237A New
Rising limb	1	1	1	1	1	
Rising and peak limb	1	1	1			
Peak					2	
Peak and falling limb		1		1		2
Falling limb	1		3	1	3	
Most of the storm	6	11	2	6	3	5
Total Number	9	14	7	9	9	7

Portion of storm sampled (WY2012 (Year 11))	230	235	243	245	254	237A New
Rising limb						
Rising and peak limb	2	1		3		
Peak		1			1	
Peak and falling limb	3		1		1	1
Falling limb			3			
Most of the storm	4	10		9	2	8
Total Number	9	12	4	12	4	9

Portion of storm sampled (WY2013 (Year 12))	230	235	243	245	254	237A New
Rising limb						
Rising and peak limb	1				1	
Peak						
Peak and falling limb	1					
Falling limb			2		1	
Most of the storm	6	11	1	3	2	12
Total Number	8	11	3	3	4	12

Portion of storm sampled (WY2014 (Year 13))	230	235	243	245	254	237A New
Rising limb						
Rising and peak limb	2	1		1	1	1
Peak			1			
Peak and falling limb				1	1	1
Falling limb			1			
Most of the storm	7	6	2	3	3	7
Total Number	9	7	4	5	5	9

Portion of storm sampled (WY2015 (Year 14))	230	235	243	245	254	237A New
Rising limb						
Rising and peak limb						1
Peak	2		1	1	2	
Peak and falling limb		1	2	2	2	
Falling limb						
Most of the storm	8	12		4	3	9
Total Number	10	13	3	7	7	10

Portion of storm sampled (WY2016 (Year 15))	230	235	243	245	254	237A New
Rising limb			1			
Rising and peak limb	2		1	1	1	
Peak						
Peak and falling limb			1	1	2	2
Falling limb			1			
Most of the storm	5	10	1	6	4	6
Total Number	7	10	5	8	7	8

Number of Events Sampled

Portion of storm sampled (WY2017 (Year 16))	230	235	243	245	254	237A New
Rising limb		1				
Rising and peak limb	1	3		2	1	1
Peak			1			
Peak and falling limb			1		2	
Falling limb			1		1	
Most of the storm	12	8	4	11	6	11
Total Number	13	12	7	13	10	12

Portion of storm sampled (WY2018 (Year 17))	230	235	243	245	254	237A New
Rising limb						
Rising and peak limb		1	1	3		
Peak						
Peak and falling limb	1					
Falling limb			1			
Most of the storm	8	7	6	8	6	8
Total Number	9	8	8	11	6	8

Portion of storm sampled (WY2019 (Year 18))	230	235	243	245	254	237A New
Rising limb						
Rising and peak limb						
Peak						
Peak and falling limb		1		1	2	1
Falling limb			1			
Most of the storm	8	10	7	7	4	7
Total Number	8	11	8	8	6	8

Portion of storm sampled (WY2020 (Year 19))	230	235	243	245	254	237A New
Rising limb						
Rising and peak limb	1	1	2	1	1	1
Peak					1	
Peak and falling limb					1	
Falling limb				1		
Most of the storm	9	12	6	9	6	11
Total Number	10	13	8	11	9	12

Portion of storm sampled (WY2021 (Year 20))	230	235	243	245	254	237A New
Rising limb			1	1	1	
Rising and peak limb	1			1		
Peak					1	
Peak and falling limb			2	1	2	
Falling limb			1			
Most of the storm	11	14	5	9	6	11
Total Number	12	14	9	12	10	11

Portion of storm sampled (WY2022 (Year 21))	230	235	243	245	254	237A New
Rising limb					1	
Rising and peak limb		1		1	1	2
Peak			1		1	
Peak and falling limb						
Falling limb						
Most of the storm	12	11	6	10	6	6
Total Number	12	12	7	11	9	8

Portion of storm sampled (WY2023 (Year 22))	230	235	243	245	254	237A New
Rising limb	1					
Rising and peak limb		1				1
Peak					1	
Peak and falling limb						1
Falling limb						
Most of the storm	2	10	7	9		10
Total Number	3	11	7	9	1	12

Totals (Years 1-22)	230	235	243	245	254	237A New
Rising limb	4	3	7	4	6	0
Rising and peak limb	20	15	9	24	12	8
Peak	8	5	14	5	18	1
Peak and falling limb	14	7	17	16	32	12
Falling limb	1	0	23	3	15	1
Most of the storm	155	211	70	154	83	144
Total Number	202	241	140	206	166	166
	77%	88%	50%	75%	50%	87%

Table B4-6
Precipitation Summary of Storm Events Sampled

Year	Antecedent (hours)			Precip (in)			Duration (hours)			Avg Intensity (in/hour)		
	Min	Max	Annual Avg	Min	Max	Annual Avg	Min	Max	Annual Avg	Min	Max	Annual Avg
WY2002	11	220	52	0.20	1.40	0.57	7.00	27	18.5	0.01	0.08	0.03
WY2003	22	398	95	0.20	1.22	0.46	3.00	29	14.0	0.01	0.08	0.04
WY2004	26	1277	183	0.20	0.84	0.39	2.75	28	10.9	0.02	0.17	0.05
WY2005	25	440	128	0.20	1.04	0.48	4.00	26	13.3	0.02	0.09	0.04
WY2006	25	2240	276	0.20	1.30	0.51	2.45	27	16.1	0.01	0.11	0.04
WY2007	35	466	176	0.24	0.93	0.43	2.75	22	13.0	0.01	0.32	0.04
WY2008	28	394	99	0.20	0.53	0.30	2.25	18	10.9	0.01	0.09	0.03
WY2009	24	279	95	0.20	0.65	0.35	4.00	36	12.8	0.02	0.07	0.03
WY2010	24	159	50	0.15	1.18	0.53	4.75	39	17.9	0.01	0.08	0.03
WY2011	21	862	124	0.19	1.84	0.51	2.25	42	16.7	0.01	0.13	0.04
WY2012	11	399	82	0.15	1.32	0.49	2.25	48	15.7	0.01	0.09	0.04
WY2013	7	155	48	0.20	0.95	0.48	2.25	38	14.6	0.01	0.10	0.04
WY2014	10	584	175	0.18	1.96	0.71	4.00	59	19.2	0.01	0.09	0.04
WY2015	20	1301	142	0.21	1.33	0.63	1.25	34	16.6	0.01	0.34	0.05
WY2016	23	259	86	0.21	1.69	0.51	3.58	39	16.0	0.01	0.07	0.04
WY2017	16	859	125	0.24	3.94	1.02	5.00	69	21.7	0.01	0.13	0.05
WY2018	10	475	97	0.18	1.49	0.58	3.00	39	15.7	0.02	0.06	0.04
WY2019	9	309	125	0.21	1.19	0.61	2.92	32	15.7	0.01	0.09	0.05
WY2020	12	649	102	0.20	1.90	0.51	5.70	40	15.0	0.01	0.09	0.04
WY2021	24	334	96	0.20	3.22	0.79	4.17	85	19.6	0.01	0.15	0.05
WY2022	20	269	120	0.20	4.57	0.58	5.90	67	17.9	0.01	0.09	0.04
WY2023	14	552	120	0.20	1.11	0.58	6.92	52	19.4	0.01	0.11	0.04
2001-2023												
min	7	155	48	0.15	0.53	0.30	1.25	18	10.9	0.01	0.06	0.03
max	35	2240	276	0.24	4.57	1.02	7.00	85	21.7	0.02	0.34	0.05
average	19	585	118	0.20	1.62	0.55	3.73	41	16.0	0.01	0.12	0.04

	Antecedent (hours)	Precip (in)	Duration (hours)	Avg Intensity (in/hour)
WY2023				
10/21/2022 (3)	552	0.42	14.9	0.04
10/25/2022 (3)	27.0	0.43	9.67	0.06
10/30/2022	60.3	0.58	14.3	0.04
11/4/2022 (2)	14.0	0.79	14.3	0.06
11/6/2022	31.8	0.76	6.92	0.11
11/22/2022	350	0.88	9.00	0.10
Partial	350	0.20	3.92	0.05
Partial	350	0.57	5.50	0.10
Partial	350	0.70	5.92	0.12
Partial	350	0.60	5.58	0.11
12/9/2022 (2)	14.58	0.58	27.5	0.02
12/29/2022 (3)	52.25	0.54	12.5	0.10
1/11/2023	32.7	0.67	51.6	0.01
2/7/2023	37.8	0.21	14.9	0.01
3/12/2023	34.3	0.63	26.7	0.02
3/19/2023	151	0.20	11.0	0.02
3/31/2023 (3)	269	0.25	12.7	0.03
4/9/2023 (2)	14.3	1.11	44.3	0.03
4/16/2023	120	0.43	9.00	0.05
5/4/2023	262	0.52	19.3	0.03
9/24/2023 (2) (3)	20.8	0.91	30.7	0.04

Avg Intensity is total rainfall (in) for the event divided by duration of event (hr)

Minimum value for the monitoring year (yellow)

Maximum value for the monitoring year (blue)

(1) =< 0.05 inches ocurred in the previous 24 hours of event and/or the resulting antecendent is believed to be a better representation of the event.

(2) The antecendent period is <24 hours. The flow at all sites returned to baseflow conditions and the samples collected are believed to be representative of the event.

(3) Most of the precipitation occurred in a shorter amount of time. The resulting Avg Intensity is believed to be a better representation of the event.

Partial - Event sampled represents only a part of the entire event. Rainfall characteristics reflect partial event sampled for that outfall.

Table B4-7
Number of Samples Collected by Season for WY2002-WY2023

	Wet 10/1- 4/30	Dry 5/1 - 9/30	Total
WY2002	**12**	**2**	**14**
OF237A	7	2	9
OF237B	7	2	9
OF230	9	2	11
OF235	8	2	10
OF243	7	1	8
OF245	9	2	11
OF254	7	2	9
WY2003	**14**	**1**	**15**
OF237A	9	1	10
OF237B	9	1	10
OF230	8	0	8
OF235	9	0	9
OF243	7	0	7
OF245	9	0	9
OF254	8	0	8
WY2004	**11**	**7**	**18**
OF237A	6	6	12
OF237B	6	6	12
OF230	6	6	12
OF235	7	5	12
OF243	4	6	10
OF245	5	5	10
OF254	3	6	9
WY2005	**9**	**4**	**13**
OF237A	8	3	11
OF237B	8	4	12
OF230	6	3	9
OF235	8	4	12
OF243	5	2	7
OF245	6	4	10
OF254	7	3	10
WY2006	**8**	**2**	**10**
OF237A	4	2	6
OF237B	4	1	5
OF230	5	2	7
OF235	4	2	6
OF243	5	1	6
OF245	6	1	7
OF254	5	2	7
WY2007	**7**	**6**	**13**
OF237A	4	4	8
OF237B	3	5	8
OF230	4	3	7
OF235	5	4	9
OF243	1	1	2
OF245	5	3	8
OF254	3	4	7
WY2008	**11**	**3**	**14**
OF237A	8	2	10
OF237B	7	3	10
OF230	7	3	10
OF235	7	2	9
OF243	5	2	7
OF245	8	2	10
OF254	8	2	10
WY2009	**11**	**4**	**15**
OF237A	6	4	10
OF237B	7	4	11
OF230	5	3	8
OF235	7	3	10
OF243	5	3	8
OF245	7	3	10
OF254	6	2	8
WY2010	**17**	**6**	**23**
OF237A	10	2	12
OF237B	9	3	12
OF230	9	2	11
OF235	12	4	16
OF243	6	1	7
OF245	9	3	12
OF254	9	2	11
WY2011	**13**	**3**	**16**
OF237A	9	3	12
OF237B	10	3	13
OF230	7	2	9
OF235	11	3	14
OF243	7	0	7
OF245	8	1	9
OF254	9	0	9
WY2012	**20**	**5**	**25**
OF237A New	7	2	9
OF237B	9	1	10
OF230	7	2	9
OF235	11	1	12
OF243	2	2	4
OF245	10	2	12
OF254	4	0	4

	Wet 10/1- 4/30	Dry 5/1 - 9/30	Total
WY2013	**10**	**4**	**14**
OF237A New	7	3	10
OF237B	6	2	8
OF230	6	2	8
OF235	8	3	11
OF243	2	1	3
OF245	2	1	3
OF254	3	1	4
WY2014	**11**	**5**	**16**
OF237A New	7	2	9
OF237B	6	4	10
OF230	6	3	9
OF235	6	1	7
OF243	2	2	4
OF245	3	2	5
OF254	3	2	5
WY2015	**15**	**4**	**19**
OF237A New	9	1	10
OF237B	7	1	8
OF230	10	0	10
OF235	10	3	13
OF243	3	0	3
OF245	7	0	7
OF254	7	0	7
WY2016	**16**	**2**	**18**
OF237A New	7	1	8
OF237B	7	0	7
OF230	6	1	7
OF235	9	1	10
OF243	4	1	5
OF245	6	2	8
OF254	5	2	7
WY2017	**15**	**4**	**19**
OF237A New	10	2	12
OF237B	9	2	11
OF230	10	3	13
OF235	10	2	12
OF243	7	0	7
OF245	11	2	13
OF254	8	2	10
WY2018	**16**	**2**	**18**
OF237A New	8	0	8
OF237B	9	0	9
OF230	8	1	9
OF235	7	1	8
OF243	7	1	8
OF245	10	1	11
OF254	5	1	6
WY2019	**13**	**5**	**18**
OF237A New	7	1	8
OF237B	7	1	8
OF230	6	2	8
OF235	8	3	11
OF243	7	1	8
OF245	7	1	8
OF254	6	0	6
WY2020	**18**	**6**	**24**
OF237A New	9	2	11
OF237B	9	5	14
OF230	7	2	9
OF235	10	4	14
OF243	6	2	8
OF245	9	2	11
OF254	8	2	10
WY2021	**17**	**6**	**23**
OF237A New[a]	7	4	11
OF237B	9	3	12
OF230	10	2	12
OF235	11	3	14
OF243	7	2	9
OF245	9	3	12
OF254	8	2	10
WY2022	**14**	**3**	**17**
OF237A New[a]	7	1	8
OF237B	10	1	11
OF230	10	2	12
OF235	10	2	12
OF243	5	2	7
OF245	10	2	12
OF254	7	2	9
WY2023	**15**	**2**	**17**
OF237A New[a]	10	2	12
OF237B	7	1	8
OF230[b]	3	0	3
OF235	9	2	11
OF243	6	1	7
OF245	7	2	9
OF254	1	0	1
WY2002-2023	**293**	**86**	**379**
OF237A New[a]	166	50	216
OF237B	165	53	218
OF230	155	46	201
OF235	187	55	242
OF243	110	32	142
OF245	163	44	207
OF254	130	37	167

a - OF237A was not sampled after 9/30/11 & location changed to OF237A New . Totals use OF237A New for WY2012 and later.
b - OF230 was not sampled after 12/30/2023 due to the flow being directed to the new OF230A.
Note: Numbers in shaded cells are the number of successful deployments (one or more sample) by season.

	Wet 10/1- 4/30	Dry 5/1 - 9/30	Total
Year 1	**12**	**2**	**14**
OF237A	78%	22%	
OF237B	78%	22%	
OF230	82%	18%	
OF235	80%	20%	
OF243	88%	13%	
OF245	82%	18%	
OF254	78%	22%	
Year 2	**14**	**1**	**15**
OF237A	90%	10%	
OF237B	90%	10%	
OF230	100%	0%	
OF235	100%	0%	
OF243	100%	0%	
OF245	100%	0%	
OF254	100%	0%	
Year 3	**11**	**7**	**18**
OF237A	50%	50%	
OF237B	50%	50%	
OF230	50%	50%	
OF235	58%	42%	
OF243	40%	60%	
OF245	50%	50%	
OF254	33%	67%	
Year 4	**9**	**4**	**13**
OF237A	73%	27%	
OF237B	67%	33%	
OF230	67%	33%	
OF235	67%	33%	
OF243	71%	29%	
OF245	60%	40%	
OF254	70%	30%	
Year 5	**8**	**2**	**10**
OF237A	67%	33%	
OF237B	80%	20%	
OF230	71%	29%	
OF235	67%	33%	
OF243	83%	17%	
OF245	86%	14%	
OF254	71%	29%	
Year 6	**7**	**6**	**13**
OF237A	50%	50%	
OF237B	38%	63%	
OF230	57%	43%	
OF235	56%	44%	
OF243	50%	50%	
OF245	63%	38%	
OF254	43%	57%	
Year 7	**11**	**3**	**14**
OF237A	80%	20%	
OF237B	70%	30%	
OF230	70%	30%	
OF235	78%	22%	
OF243	71%	29%	
OF245	80%	20%	
OF254	80%	20%	
Year 8	**11**	**4**	**15**
OF237A	60%	40%	
OF237B	64%	36%	
OF230	63%	38%	
OF235	70%	30%	
OF243	63%	38%	
OF245	70%	30%	
OF254	75%	25%	
Year 9	**17**	**6**	**23**
OF237A	83%	17%	
OF237B	75%	25%	
OF230	82%	18%	
OF235	75%	25%	
OF243	86%	14%	
OF245	75%	25%	
OF254	82%	18%	
Year 10	**13**	**3**	**16**
OF237A	75%	25%	
OF237B	77%	23%	
OF230	78%	22%	
OF235	79%	21%	
OF243	100%	0%	
OF245	89%	11%	
OF254	100%	0%	
Year 11	**20**	**5**	**25**
OF237A New[a]	78%	22%	
OF237B	90%	10%	
OF230	78%	22%	
OF235	92%	8%	
OF243	50%	50%	
OF245	83%	17%	
OF254	100%	0%	

	Wet 10/1- 4/30	Dry 5/1 - 9/30	Total
Year 12	**10**	**4**	**14**
OF237A New[a]	70%	30%	
OF237B	75%	25%	
OF230	75%	25%	
OF235	73%	27%	
OF243	67%	33%	
OF245	67%	33%	
OF254	75%	25%	
Year 13	**11**	**5**	**16**
OF237A New[a]	78%	22%	
OF237B	60%	40%	
OF230	67%	33%	
OF235	86%	14%	
OF243	50%	50%	
OF245	60%	40%	
OF254	60%	40%	
Year 14	**15**	**4**	**19**
OF237A New[a]	90%	10%	
OF237B	88%	13%	
OF230	100%	0%	
OF235	77%	23%	
OF243	100%	0%	
OF245	100%	0%	
OF254	100%	0%	
Year 15	**16**	**2**	**18**
OF237A New[a]	88%	13%	
OF237B	100%	0%	
OF230	86%	14%	
OF235	90%	10%	
OF243	80%	20%	
OF245	75%	25%	
OF254	71%	29%	
Year 16	**15**	**4**	**19**
OF237A New[a]	83%	17%	
OF237B	82%	18%	
OF230	77%	23%	
OF235	83%	17%	
OF243	100%	0%	
OF245	85%	15%	
OF254	80%	20%	
Year 17	**16**	**2**	**18**
OF237A New[a]	100%	0%	
OF237B	100%	0%	
OF230	89%	11%	
OF235	88%	13%	
OF243	88%	13%	
OF245	91%	9%	
OF254	83%	17%	
Year 18	**13**	**5**	**18**
OF237A New[a]	88%	13%	
OF237B	88%	13%	
OF230	75%	25%	
OF235	73%	27%	
OF243	88%	13%	
OF245	88%	13%	
OF254	100%	0%	
Year 19	**18**	**6**	**24**
OF237A New[a]	82%	18%	
OF237B	64%	36%	
OF230	78%	22%	
OF235	71%	29%	
OF243	75%	25%	
OF245	82%	18%	
OF254	80%	20%	
Year 20	**17**	**6**	**23**
OF237A New[a]	64%	36%	
OF237B	75%	25%	
OF230	83%	17%	
OF235	79%	21%	
OF243	78%	22%	
OF245	75%	25%	
OF254	80%	20%	
Year 21	**14**	**3**	**17**
OF237A New[a]	88%	13%	
OF237B	91%	9%	
OF230	83%	17%	
OF235	83%	17%	
OF243	71%	29%	
OF245	83%	17%	
OF254	78%	22%	
Year 22	**15**	**2**	**17**
OF237A New[a]	83%	17%	
OF237B	88%	13%	
OF230	100%	0%	
OF235	82%	18%	
OF243	86%	14%	
OF245	78%	22%	
OF254	100%	0%	
Years 1-22	**293**	**86**	**379**
OF237A New[a]	77%	23%	
OF237B	76%	24%	
OF230	77%	23%	
OF235	77%	23%	
OF243	77%	23%	
OF245	79%	21%	
OF254	78%	22%	

a - OF237A was not sampled after 9/30/11 & location changed to OF237A New . Totals use OF237A New for WY2012 and later.
b - OF230 was not sampled after 12/30/2023 due to the flow being directed to the new OF230A.
Note: Numbers in shaded cells are the number of successful deployments (one or more sample) by season.

Table B4-8
Ranges of Magnitude and Intensity - Years 1-10, 15, and 18 Baseflow Hydrographs

Year	OF230		OF235		OF237A		OF237A New		OF237B		OF243		OF245		OF254	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Baseflow Volume Samples (cf)																
1	32,620	98,660	8,580	14,750	261,820	326,050	--	--	1,036,410	1,724,400	40,160	40,160	3,080	62,900	28,180	50,100
2	1,740	3,960	102,720	150,140	287,650	344,620	--	--	705,090	1,039,630	34,770	34,770	7,010	17,610	15,580	43,960
3	1,390	3,580	109,290	160,050	181,280	954,660	--	--	594,600	782,500	24,550	24,550	6,750	12,520	4,970	6,170
4	1,590	28,220	82,110	121,740	195,730	261,520	--	--	603,280	856,300	25,840	25,840	21,030	39,840	12,960	39,840
5	21,180	38,420	117,330	225,290	275,600	614,370	459,080	1,376,260	518,020	698,350	33,220	33,220	18,710	34,610	5,500	21,650
6	30,680	84,690	200,020	280,700	93,080	311,870	463,870	1,332,120	574,140	828,980	53,990	53,990	14,370	85,880	6,950	19,860
7	33,264	112,226	63,350	209,190	99,530	264,760	1,083,500	1,339,700	809,200	1,384,460	81,330	81,330	13,240	19,570	12,540	19,720
8	31,740	72,580	40,210	79,800	59,040	2OF2458	361,650	1,656,900	1,143,100	1,524,620	14,660	29,400	6,740	16,000	4,570	40,670
9	51,680	115,300	87,500	144,600	201,900	363,700	225,280	441,000	1,444,300	1,226,020	3,730	13,240	3,130	9,420	15,300	42,120
10	10,307	36,026	66,108	154,606	204,647	389,815	203,646	443,460	1,145,213	1,422,762	9,356	26,735	11,397	17,789	16,097	63,234
11/14	Baseflow No Longer Sampled															
15	15,096	54,980	89,742	117,861	--	--	346,582	449,401	677,609	1,021,464	74,995	126,479	--	--	--	--
18	46,323	57,534	48,399	68,019	--	--	148,968	437,427	646,453	887,602	--	113,610	9,994	130,843	1,604	3,902
Event Average Flow Rate (cfs)																
Year	OF230		OF235		OF237A		OF237A New		OF237B		OF243		OF245		OF254	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
1	0.83	2.81	0.17	0.29	3.03	3.81	--	--	14.21	19.26	1.72	6.61	0.14	2.8	1.74	3.12
2	0.1	0.2	1.9	2.5	3.4	4.4	--	--	8.5	12.8	1.5	1.8	0.5	1.1	0.7	2.0
3	0.1	0.1	2.2	3.0	2.1	12.5	--	--	6.5	8.4	1.4	14.6	0.4	0.6	0.3	0.4
4	0.06	1	1.4	1.8	2.5	2.9	--	--	6.9	9.7	1.4	1.6	1	1.7	0.6	2.8
5	0.8	1.2	3.6	4.8	3.6	7.0	6.3	8.4	6.3	7.7	1.8	46	0.8	2.2	0.2	1.0
6	1.1	2	3.4	3.9	2.3	3.3	5.3	24.4	6.6	9.5	3.7	4.5	0.9	3.5	0.3	0.8
7	0.7	2.6	0.9	3.8	1.1	2.8	14.2	16.3	8.9	15.2	3	7.2	0.8	1.0	0.5	1.3
8	0.9	1.7	0.7	1.2	0.7	2.8	5.2	25.8	13.6	17.6	1.1	1.3	0.6	1.0	0.6	3.0
9	1.7	2.8	1.6	2.5	2.7	5.2	3.2	6.3	13.4	15.8	0.2	1.1	0.2	0.4	1.1	2.9
10	0.4	1.3	1.4	2.7	2.6	4.6	2.7	6	14.1	19.4	0.5	1.2	1	1.2	1.5	3.2
11/14	Baseflow No Longer Sampled															
15	0.6	0.85	0.42	1.76	--	--	6.13	8.26	8.33	11.34	3.73	4.58	--	--	--	--
18	0.72	2.09	1.09	1.26	--	--	3.26	5.73	6.88	8.53	--	3.46	0.48	0.8	0.08	0.1

Maximum Flow Rate (cfs)

Year	OF230	OF235	OF237A	OF237A New	OF237B	OF243	OF245	OF254
1	3.4	0.35	5.7	--	25.3	14.2	3.3	3.2
2	0.2	2.7	6.1	--	15.4	2.8	1.1	4
3	0.2	3.3	16.6	--	10.7	17.1	0.7	0.5
4	0.2	2.7	6.1	--	15.4	2.8	1.1	4
5	1.3	6.3	9.5	10.2	9.4	53	3.3	1.2
6	2.6	5.4	5	29.7	12	15.3	3.6	1.1
7	2.9	14.5	4.3	19	19	8.6	1.3	1.6
8	2.2	2.9	4.1	29.1	20.7	1.3	1.1	3.3
9	5.7	3.6	6.9	7.5	19.3	1.1	0.5	3.1
10	3.3	2.7	8.1	7.3	22.5	1.2	1.2	3.2
11/14	Baseflow No Longer Sampled							
15	1.11	2.23	--	8.67	11.75	8.36	--	--
18	2.49	1.47	--	7.5	8.95	3.68	1.64	0.2

Baseflow event summaries are presented in Appendix B, Attachment B-1.

Table B4-9
Ranges of Magnitude and Intensity - Years 1 to 22 Stormwater Runoff Hydrographs

Year	230		235		237A		237A New		237B		243		245		254	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Storm Volume Sampled (cf)																
1	83,000	3,174,000	15,000	339,300	429,000	3,800,000	--	--	308,000	6,305,000	82,100	678,000	43,200	187,000	4,500	389,000
2	57,654	335,361	43,381	234,063	367,772	1,447,097	--	--	337,514	1,858,007	3,428	25,869	5,654	60,984	6,162	107,162
3	15,467	211,513	32,390	142,119	354,601	1,311,768	--	--	183,431	1,526,854	12,402	113,464	4,641	23,892	3,831	24,393
4	45,187	237,215	37,913	163,159	330,582	1,396,364	--	--	267,243	1,537,388	11,801	14,710	12,185	45,869	7,064	70,355
5	42,203	196,511	52,074	208,197	284,679	760,818	300,853	895,775	259,048	1,069,716	4,158	26,798	16,106	63,754	11,306	54,775
6	98,080	215,920	81,980	176,350	352,880	894,480	792,530	1,157,840	375,780	846,670	8,090	--	11,790	72,630	7,080	36,140
7	53,663	486,483	23,687	177,293	196,531	766,050	158,821	1,389,140	282,139	1,905,083	4,901	13,675	2,179	43,437	4,863	70,208
8	73,381	638,148	34,050	122,187	223,854	712,018	312,758	1,966,758	739,508	2,596,115	3,432	53,066	8,971	29,569	11,010	290,348
9	55,300	395,100	34,800	327,200	283,600	3,137,500	326,300	3,813,500	565,400	5,740,600	1,200	14,100	12,300	84,900	20,740	149,200
10	73,802	679,556	37,465	165,666	242,884	3,474,912	127,205	2,363,333	431,750	7,110,919	6,742	40,419	4,478	51,050	15,434	230,917
11	36,155	619,242	19,399	278,843	--	--	365,849	3,800,000	433,523	3,042,117	17,303	94,952	9,336	47,757	64,625	170,439
12	106,438	425,992	45,904	1,138,041	--	--	362,606	3,755,963	541,595	3,458,605	1,302	26,190	11,901	78,519	12,234	435,757
13	142,893	417,752	82,546	373,687	--	--	463,485	2,009,280	433,240	8,707,213	7,671	56,934	8,872	72,070	47,324	301,032
14	135,672	580,077	34,226	404,943	--	--	945,577	6,278,749	464,989	2,952,441	21,641	66,182	15,192	57,089	91,474	180,014
15	135,104	1,234,257	96,992	337,923	--	--	832,586	1,868,152	550,283	1,790,567	9,599	25,965	5,055	109,416	32,886	321,118
16	103,884	1,297,541	34,491	995,246	--	--	418,425	11,164,382	532,381	4,100,349	2,672	36,516	11,771	135,243	19,045	303,342
17	73,450	550,731	70,416	598,534	--	--	505,195	4,235,736	741,121	2,363,865	573	11,865	12,125	74,387	17,718	163,710
18	110,067	595,276	22,288	508,384	--	--	358,903	2,557,254	330,691	2,029,239	853	49,300	7,793	61,877	50,494	204,708
19	94,541	225,155	34,528	619,941	--	--	591,815	13,205,532	639,758	1,415,164	432	48,414	3,849	145,046	17,134	1,096,250
20	62,225	1,397,760	43,607	935,475	--	--	246,790	4,446,738	359,411	3,179,562	831	53,931	16,946	98,548	5,068	96,212
21	70,840	1,683,393	43,041	1,098,744	--	--	557,522	2,846,109	641,408	11,072,468	263	34,505	6,110	107,270	5,987	155,274
22	1,625	3,791	38,096	201,987	--	--	100,343	3,130,498	754,673	5,200,943	47	20,276	11,737	62,107	3,447	3,447
Event Average Flow Rate (cfs)																
1	7	115	3	12	9	53	--	--	23	87	7	50	1.3	1.3	2	24
2	1.5	8.7	1.4	4	9.4	41	--	--	16	27	0.2	1.4	0.6	2.8	0.5	2.2
3	1.7	7.9	1.6	3.3	8.4	22	--	--	8.2	48	0.7	15.1	1.1	4.4	0.8	3.6
4	3	13.5	1.9	5.2	11.2	28.5	--	--	16.2	51	0.8	1.2	0.5	2	0.5	3.9
5	3.2	10.7	2.0	4.1	10.3	21.8	16.7	34	15.1	36.9	0.9	1.7	1.1	2.7	1.5	3.4
6	3.9	9.7	2.4	6.5	9.1	18	28.6	29.3	14.5	59.6	0.5	0.5	0.9	3.1	0.9	2.6
7	2.9	13	1.5	7.7	5.9	20.9	9.3	38.3	14.5	47.7	0.4	1.8	0.7	3.2	0.5	4.5
8	2.7	16.9	1.4	3.7	7.3	15.6	18.3	42.9	21.9	47.2	0.2	3.3	0.8	2.1	0.9	23.5
9	3.3	17.5	1.1	4.1	9.4	36.5	9.5	63	20	86.6	0.2	0.7	0.7	2.6	1.6	5.0
10	2.8	16.9	1.2	7.1	9.4	45	9.5	39.1	24.4	98.3	0.2	0.6	0.6	2.7	0.9	5.2
11	1.9	12.7	1.8	5.4	--	--	8.9	41.8	25.1	55.2	0.8	1.7	0.5	1.9	2.2	5.1
12	1.9	12.7	1.8	5.4	--	--	14.8	40.5	25.1	55.2	0.8	1.7	0.5	1.9	2.2	5.1
13	2.7	11.6	1.3	4.4	--	--	16.4	62.1	11.5	49.1	1.1	3.8	0.4	2.5	2.9	8.0
14	4.2	19.7	1.1	7.9	--	--	11.6	48.9	12.3	33.1	1.0	2.5	0.4	2.3	1.3	5.3
15	2.4	22.9	2.7	6.9	--	--	18.9	47.4	12.7	46.7	0.5	1.5	0.3	2.5	1.6	7.3
16	1.9	14.8	1.0	10.1	--	--	15.7	77.3	12.3	57.5	0.4	1.9	0.4	4.1	1.3	9.0
17	2.3	9.8	1.1	5.0	--	--	10.1	48.3	17.5	36.0	0.3	1.8	0.2	1.8	0.6	3.7
18	1.8	9.5	0.9	17.8	--	--	15.5	35.9	13.9	30.7	0.4	1.9	0.3	2.0	1.6	8.2
19	3.3	10.8	1.0	5.3	--	--	17.5	88.7	12.3	41.8	0.1	2.4	0.1	1.3	0.8	22.1
20	2.1	19.4	1.4	7.7	--	--	17.0	54.6	12.8	33.8	0.02	2.4	0.2	3.1	0.4	5.4
21	2.3	11.4	1.1	13.8	--	--	13.4	42.4	12.1	40.9	0.01	1.6	0.3	3.2	0.6	5.5
22	0.2	0.5	1.0	9.4	--	--	11.7	80.2	18.2	38.6	0.01	1.2	0.2	1.5	0.4	0.4
Maximum Flow Rate (cfs)																
1	280		52		145		--		186		53		3.4		25	
2	35.5		26.9		83		--		154		3.1		8.1		7.5	
3	22.8		14.2		78		--		187		39.1		7		5.5	
4	37.5		21.7		105		--		172		2.7		6.3		8.6	
5	35.5		29.8		71		63		100		3.3		6.1		5.5	
6	29.9		25.2		37		72		81		0.9		6.9		6.3	
7	119		34.4		78		209		277		3		11		15.3	
8	43.7		11.9		113		178		145		8		4.8		25.3	
9	106		26.7		105		321		264		2.7		8.8		21.9	
10	85.8		19.1		110		152		219		2.4		11.1		20.0	
11	48.1		32.7		--		107		150		4.0		7.4		12.9	
12	60.9		49.0		--		163		148		3.8		5.5		13.6	
13	78.3		24.1		--		176		121		6.1		6.0		42.1	
14	82.4		47.8		--		211		123		3.6		6.4		12.4	
15	109		22.1		--		128		128		2.2		7.1		30.4	
16	136		18.2		--		324		274		4.8		10.5		35.4	
17	56.6		28.2		--		215		91		2.9		9.1		23.6	
18	133		29.0		--		207		98		3.2		8.6		23.4	
19	67.9		38.1		--		363		87		4.7		6.9		15.7	
20	153.4		41.4		--		194		181		6.1		10.4		16.6	
21	57.0		46.7		--		111		173		3.4		16.1		13.4	
22	4.2		17.7		--		199		140		3.9		8.6		2.3	

Storm flow event summaries are presented in Appendix B, Attachment B-1.

Table B5-1
Rainfall for the Stormwater SPM Sampling Periods

Sediment Trap Locations

Month	Average Monthly Rainfall (inches) Tacoma 1[1] 3/1982-12/1999	Average Monthly Rainfall (inches) Tacoma City Hall 6/1948-12/1981	Year 1 8/31/2001-3/26/2002 (inches)	Year 2 8/27/2002-4/28/2003 (inches)	Year 3 8/27/2003-4/8/2004 (inches)	Year 4 8/25/2004-4/8/2004 (inches)	Year 5 8/25/05-4/8/06 (inches)	Year 6 8/21/06-3/14/20/07 (inches)	Year 7 8/22-31/07-4/3/08 (inches)	Year 8 8/28-29/08-4/4-8/09 (inches)	Year 9 8/27/09-8/23/10 (inches)	Year 10 8/23/10-8/24/11 (inches)	Year 11 8/24/11-8/23/12 (inches)	Year 12 8/23/12 - 8/20/13 (inches)	Year 13 8/20/13 - 8/27/14 (inches)	Year 14 8/20/14 - 8/27/15 (inches)	Year 15 8/10-17/15 - 8/15-26/16 (inches)	Year 16 8/15-26/16 - 8/21-23/17 (inches)	Year 17 8/21-23/17 - 8/17-21/18 (inches)	Year 18 8/17-21-23/18-8/19-21/19 (inches)	Year 19 8/19-21/19-8/17-18/20 (inches)	Year 20 8/17-8/20 - 8/24-8/25 (inches)	Year 21 8/24-8/31 - 8/22-8/23 (inches)
Date Deployed - September	1.14	1.42	0.46	0.36	0.69	3.26	0.92	0.74	2.29	0.55	2.41	4.12	0.96	0.02	9.07	2.76	3.33	1.14	1.11	1.54	3.57	2.68	3.25
October	3.49	3.39	3.32	0.41	8.88	3.61	3.00	1.28	3.64	2.36	0.53	4.64	3.39	5.97	1.57	6.20	5.92	10.57	5.60	3.89	3.66	3.06	5.03
November	6.73	6.10	10.13	2.96	6.15	2.81	6.25	15.81	2.64	7.61	7.74	5.37	5.98	7.12	3.40	6.53	8.22	7.57	9.38	4.15	1.85	5.41	10.54
December	5.65	5.89	6.82	6.58	4.65	4.03	6.28	8.05	8.26	4.17	2.67	6.83	6.44	8.33	1.91	4.88	12.22	3.65	5.74	6.93	7.36	5.64	5.55
January	6.01	5.38	6.68	8.50	6.79	4.71	11.93	6.92	4.63	7.13	7.40	5.17	7.02	3.31	4.29	3.98	7.20	2.99	7.90	3.70	9.66	8.65	7.28
February	3.63	4.44	3.56	1.71	2.55	0.79	2.59	4.09	2.79	1.60	3.95	3.54	3.19	1.58	7.68	4.61	5.55	9.24	2.75	4.19	3.35	4.00	3.56
March	4.09	4.18	4.10	5.08	2.18	3.14	1.90	6.09	4.16	4.68	4.91	6.57	7.11	2.50	8.81	3.89	5.80	8.27	2.15	1.86	3.47	2.06	3.10
April	2.96	2.87	--	5.08	0.01	4.74	0.32	1.12	0.00	3.31	2.90	5.13	3.74	4.52	4.22	1.56	1.37	4.67	5.81	2.65	1.24	0.85	3.34
May	1.93	2.01	--	--	--	1.49	--	--	--	0.27/2.05	4.15	3.77	2.33	2.86	3.23	0.74	0.58	2.02	0.09	0.46	2.49	1.29	3.04
June	1.56	1.58	--	--	--	--	--	--	--	--	3.05	1.40	2.54	1.85	0.94	0.22	1.41	1.54	0.69	0.19	1.90	1.85	2.72
July	0.73	0.86	--	--	--	--	--	--	--	--	0.78	0.74	0.87	0.01	0.57	0.47	0.61	0.00	0.02	0.77	0.20	0.00	0.19
August 1 to Date Retreived[2]	0.88	0.83	--	--	--	--	--	--	--	--	0.05	0.27	0.00	0.27	1.22	0.41	0.09	0.09	0.10	0.43	0.04	0.00	0.57
Total	38.80	32.85	35.07	30.68	31.90	28.58	33.19	44.10	28.41	31.64 / 33.42	40.54	47.55	43.57	38.34	46.91	36.25	52.30	51.75	41.34	30.76	38.79	35.49	48.17

Outfall 245 MH390 Sump Locations

Month	Average Monthly Rainfall (inches) Tacoma 1[1] 3/1982-12/1999	Average Monthly Rainfall (inches) Tacoma City Hall 6/1948-12/1981	Year 1 2001-2002 (inches)	Year 2 2002-2003 (inches)	Year 3 2003-2004 (inches)	Year 4 2003-2004 (inches)	Year 5 2005-06 (inches)	Year 6 2006-07 (inches)	Year 7 2007-08 (inches)	Year 8 2008-09 (inches)	Year 9 2009-10 (inches)	Year 10 2010-11 (inches)	Year 11 8/25/11-8/14/12 (inches)	Year 12 8/13/12-8/20/13 (inches)	Year 13 8/20/13-8/27/14 (inches)	Year 14 8/20/14-8/27/15 (inches)	Year 15 10/27/15 - 8/16/16 (inches)	Year 16 8/16/16 - 8/22/17 (inches)	Year 17 8/22/17 - 8/22/18 (inches)	Year 18 8/24/18 - 8/19/19 (inches)	Year 19 9/9/2019 - 8/18/20 (inches)	Year 20 9/3/2020 - 8/25/21 (inches)	Year 21 9/3/2021 - 8/22/22 (inches)
Date Cleaned to August 31	--	--	2.23	0.03	0.00	0.00	0.01	0.07	0.90	1.51	0.38	0.19	0.00	0.00	9.07	0.50	0.00	0.01	0.00	0.00	0.00	0.00	0.00
September	1.14	1.42	0.46	0.36	0.69	3.26	0.92	0.74	2.22	0.39	2.04	3.93	0.96	0.02	1.57	2.26	0.00	1.13	1.11	1.54	2.57	2.30	3.20
October	3.49	3.39	3.32	0.41	8.88	3.61	3.00	1.28	3.64	2.32	0.53	4.64	3.39	5.97	3.40	6.20	3.43	10.57	5.60	3.89	3.66	3.06	5.03
November	6.73	6.10	10.13	2.96	6.15	2.81	6.25	15.81	2.64	7.61	7.74	5.37	5.98	7.12	1.91	6.53	8.22	7.57	9.38	4.15	1.85	5.41	10.54
December	5.65	5.89	6.82	6.58	4.65	4.03	6.28	8.05	8.26	4.17	2.67	6.83	6.44	8.33	4.29	4.88	12.22	3.65	5.74	6.93	7.36	5.64	5.55
January	6.01	5.38	6.68	8.50	6.79	4.71	11.93	6.92	4.63	7.13	7.40	5.17	7.02	3.31	7.68	3.98	7.20	2.99	7.90	3.70	9.66	8.65	7.28
February	3.63	4.44	3.56	1.71	2.55	0.79	2.59	4.09	2.79	1.60	3.95	3.54	3.19	1.58	8.81	4.61	5.55	9.24	2.75	4.19	3.35	4.00	3.56
March	4.09	4.18	4.16	5.08	4.16	3.14	1.90	6.09	4.16	4.68	4.91	6.57	7.11	2.50	4.22	3.89	5.80	8.27	2.15	1.86	3.47	2.06	3.10
April	2.96	2.87	3.64	3.30	0.91	4.74	2.47	1.34	1.75	3.31	2.90	5.13	3.74	4.52	3.23	1.56	1.37	4.67	5.81	2.65	1.24	0.85	3.34
May	1.93	2.01	1.14	0.55	2.56	3.34	1.56	1.31	1.00	3.03	4.15	3.77	2.33	2.86	0.94	0.74	0.58	2.02	0.09	0.46	2.49	1.29	3.04
June	1.56	1.58	1.36	0.36	0.64	1.26	2.25	1.44	1.26	0.33	3.05	1.40	2.54	1.85	0.57	0.22	1.41	1.54	0.69	0.19	1.90	1.85	2.72
July	0.73	0.86	0.42	0.13	0.00	1.16	0.11	1.30	0.26	0.00	0.78	0.74	0.87	0.01	1.22	0.47	0.61	0.00	0.02	0.77	0.20	0.00	0.19
August 1 to Date Cleaned	0.88	0.83	0.03	0.29	2.75	0.03	0.00	0.00	0.55	0.65	0.05	0.27	0.00	0.27	--	0.00	0.09	0.09	0.10	0.31	0.04	0.00	0.57
Total	38.80	32.85	43.95	26.96	40.73	32.88	37.37	47.14	34.06	36.73	40.55	47.55	43.57	35.84	43.51	29.14	33.48	51.75	41.34	26.94	37.79	35.11	48.12

[1] *Rainfall data from Tacoma 1 - NOAA Station at Central Wastewater Treatment Plant, Tacoma, WA*

[2] *During sampling years 1-8 sediment traps were retrieved between March - May. The historic totals (Tacoma 1) for for March/April/May are 30.74/ 33.70/ 35.63.*

Table B5-2
Estimated Runoff Volumes for Stormwater SPM Sampling Periods

				11/1998-8/2001	Year 1		Year 2		Year 3		Year 4		Year 5		Year 6		Year 7		Year 8		Year 9		Year 10		Year 11		Year 12	
					9/2001-3/2002	8/2001-8/2002	9/2002-4/2003	8/2002-8/2003	9/2003-4/2004	8/2003-8/2004	9/2004-5/2005	8/2004-8/2005	9/2005-5/2006	8/2005-8/2006	9/2006-3-4/2006	8/2006-8/2007	8/2007-4/2008	8/2007-8/2008	8/2008-4/2009	8/2008-8/2009	8/2009-8/2010		8/2010-8/2011		8/2011-8/2012		8/2012-8/2013	
Total Precipitation (inches)				199.05	35.07	43.95	28.9	35.07	31.9	38.75	28.54	32.88	33.19	39.27	36.89 / 44.1	48.44	28.41	34.06	31.64 / 33.42	36.73	40.54	40.55	47.55	47.55	43.57	43.57	38.34	38.34
Sampling Location ID No.	**Basin ID No.**	**Contributing Area Acres**	**Factor for Correlating Precip with Runoff Depth***	**Runoff Volume (ac-ft)**																								
FD1	237B	1821	0.4		819		675		745		666		775		1030		663		739		946		1110		1017		895	
FD2	237A	2794	0.4		1256		1035		1143		1022		1189		1580		1018		1133		1452		1703		1561		1373	
FD2A	N/A	129	0.55		80		66		73		65		75		100		65		72		92		108		99		87	
FD3	230	513	0.4		231		190		210		188		218		243		187		208		267		313		287		252	
FD3A	230-7	146	0.55		90		74		82		73		85		95		73		81		104		122		112		99	
FD3B	230-1	82	0.72		66		55		60		54		63		70		54		63		77		90		82		73	
3NEW	230	741	0.4		333		275		303		271		315		350		270		301		385		452		414		364	
FD5	A6	230	0.55		142		117		129		116		135		179		115		128		164		193		177		155	
FD6	235	181	0.55		112		92		102		91		106		118		91		101		129		152		139		122	
FD23	N/A	50	0.72		40		33		37		33		38		51		33		39		47		55		50		44	
MH390	245	38	0.72	175		39		31		34		29		34		42		30		32		36		42		38		34

				11/1998-8/2001	Year 13		Year 14		Year 15		Year 16		Year 17		Year 18		Year 19		Year 20		Year 21		Year 22	
					8/2013-8/2014		8/2014-8/2015		8/2015-8/2016		8/2016-8/2017		8/2017-8/2018		8/2018-8/2019		8/2019-8/2020		8/2020-8/2021		8/2021-9/2022		8/2022-9/2023	
Total Precipitation (inches)				199.05	46.91	46.91	36.25	35.84	52.30	46.48	51.75	51.75	41.34	41.34	30.76	30.64	38.79	37.79	35.49	35.11	48.17	48.12	26.44	26.63
Sampling Location ID No.	**Basin ID No.**	**Contributing Area Acres**	**Factor for Correlating Precip with Runoff Depth***	**Runoff Volume (ac-ft)**																				
FD1	237B	1821	0.4		1095		846		1221		1208		965		718		905.6		829		1125		617	
FD2	237A	2794	0.4		1680		1298		1873		1854		1481		1102		1389		1271		1725		947	
FD2A	N/A	129	0.55		107		82		119		118		94		70		88.21		81		110		60	
FD3	230	513	0.4		309		238		344		340		272		202		255.1		233		317		174	
FD3A	230-7	146	0.55		121		93		135		133		106		79		99.83		91		124		68	
FD3B	230-1	82	0.72		89		69		99		98		78		58		73.4		67		91		50	
3NEW	230	741	0.4		446		344		497		492		393		292		368.5		337		458		251	
FD5	A6	230	0.55		190		147		212		210		168		125		157.3		144		195		107	
FD6	235	181	0.55		150		116		167		165		132		98		123.8		113		154		84	
FD23	N/A	50	0.72		54		42		60		60		48		35		44.76		41		56		31	
MH390	245	38	0.72	175		41		31		41		45		36		27		33		31		42		23

** Refer to September 1999, Stormwater Control Feasibility Study, Appendix B, Table B-3*

Note: Runoff volumes shown are calculated using the formula as described in September 1999, Stormwater Source Control Feasibility Study, Appendix B.

All values shown are estimates.

Table B7-1
Stormwater Quality Control Performance

Data Quality Indicator	Evaluation	Evaluation Points	Measurement Quality Objective: Does not meet Number	Does not meet %	Meets Number	Meets %	Rejection or Censor Number	Rejection or Censor %
Bias	Blank, Laboratory	762	3	0.4%	749	98.3%	10	1.3%
Bias	Blank, Trip	90	2	2.2%	88	97.8%	0	0.0%
Bias	Blank, Ambient Air	90	3	3.3%	86	95.6%	1	1.1%
Bias	Blank, Rinse	270	19	7.0%	244	90.4%	7	2.6%
Bias	Surrogate	228	0	0.0%	228	100.0%	0	0.0%
Bias	Laboratory Control Sample Recovery	834	0	0.0%	834	100.0%	0	0.0%
Bias	Matrix Spike/Duplicate (MS/MSD) Recovery	931	0	0.0%	931	100.0%	0	0.0%
Bias Totals		**3205**	**27**	**0.8%**	**3160**	**98.6%**	**18**	**0.6%**
Comparability	Field Duplicate Relative Percent Difference (RPD)	104	0	0.0%	104	100.0%	0	0.0%
Comparability	Matrix Spike/Duplicate (MS/MSD) RPD	373	0	0.0%	373	100.0%	0	0.0%
Comparability	Lab Duplicate RPD	215	0	0.0%	215	100.0%	0	0.0%
Comparability Totals		**692**	**0**	**0.0%**	**692**	**100.0%**	**0**	**0.0%**
Sensitivity	Reporting limit for non-detect results	2391	56	2.3%	2335	97.7%	0	0.0%
Technical Consistency	Total and subcomponent (dissolved) fraction	296	38	12.8%	258	87.2%	0	0.0%
Detection Profile	Result substituted for 0 value.	2348	0	0.0%	2348	100.0%	0	0.0%
Stormwater Totals		**8932**	**121**	**1.4%**	**8793**	**98.4%**	**18**	**0.2%**

Table B7-2
Stormwater Sediment (SSPM) Quality Control Performance

			Measurement Quality Objective					
		Evaluation	Does not meet		Meets		Rejection or Censor	
Data Quality Indicator	**Evaluation**	**Points**	**Number**	**%**	**Number**	**%**	**Number**	**%**
Bias	Blank, Laboratory	145	0	0.0%	145	100.0%	1	0.7%
Bias	Surrogate	74	0	0.0%	74	100.0%	0	0.0%
Bias	Laboratory Control Sample Recovery	69	0	0.0%	69	100.0%	0	0.0%
Bias	Matrix Spike/Duplicate (MS/MSD) Recovery	149	0	0.0%	149	100.0%	0	0.0%
Bias	Certified Reference Materials	45	0	0.0%	45	100.0%	0	0%
Recovery total		*337*	*0*	*0.0%*	*337*	*100.0%*	*0*	*0%*
Bias		**482**	**0**	0.0%	**482**	100.0%	**1**	0%
Precision	Lab Duplicate RPD	15	0	0.0%	15	100.0%	0	0.0%
Comparability	Matrix Spike/Duplicate (MS/MSD) RPD	44	0	0.0%	44	100.0%	0	0.0%
Precision and Comparability		**59**	**0**	**0.0%**	**59**	**100.0%**	**0**	**0.0%**
Sensitivity	Reporting limit for non-detect results	136	7	5.1%	129	94.9%	0	0.0%
Detection Profile	Result substituted for 0 value.	136	0	0.0%	136	100.0%	0	0.0%
SSPM Quality Control		**813**	**0**	**0.0%**	**806**	**99.1%**	**1**	**0.1%**

Table B7-3

Detection Profile Stormwater - WY2023

Class	Analyte	Detection Limit Goal		Tests			Detection profile, non-detections substituted at full value									Detection profile, non-detections substituted at 1/2 Method Detection Level									Detection profile, non-detections substituted as zero								
		Conc.	Units	Tests	ND	D	Min	5%	10%	25%	Md	75%	90%	95%	Max	Min	5%	10%	25%	Md	75%	90%	95%	Max	Min	5%	10%	25%	Md	75%	90%	95%	Max
Conventionals	Anionic Surfactants - MBAS	25	µg/L	28	0	28	15.	16.2	28.5	43.5	57.1	65.2	112.	132.	138.	15.	16.2	28.5	43.5	57.1	65.2	112.	132.	138.	15.	16.2	28.5	43.5	57.1	65.2	112.	132.	138.
	BOD	2	mg/L	27	6	21	2.	2.	2.	2.	2.4	4.5	9.7	9.7	9.8	1.	1.	1.	2.	2.4	4.5	9.7	9.7	9.8	0.	0.	0.	2.	2.4	4.5	9.7	9.7	9.8
	Chloride	0.2	mg/L	28	0	28	3.82	5.44	5.75	16.9	37.8	196.	924.	1300.	2070.	3.82	5.44	5.75	16.9	37.8	196.	924.	1300.	2070.	3.82	5.44	5.75	16.9	37.8	196.	924.	1300.	2070.
	Conductivity	1.0	µS/cm	51	0	51	65.3	72.4	91.9	110.	172.	554.	3090.	6470.	8900.	65.3	72.4	91.9	110.	172.	554.	3090.	6470.	8900.	65.3	72.4	91.9	110.	172.	554.	3090.	6470.	8900.
	Hardness, Total as CaCO3	0.05	mg CaCO3/L	51	0	51	15.1	21.	23.1	31.7	49.	74.6	322.	679.	923.	15.1	21.	23.1	31.7	49.	74.6	322.	679.	923.	15.1	21.	23.1	31.7	49.	74.6	322.	679.	923.
	pH	0.1	pH Units	51	0	51	6.	6.2	6.4	6.6	6.9	7.2	7.5	7.7	7.9	6.	6.2	6.4	6.6	6.9	7.2	7.5	7.7	7.9	6.	6.2	6.4	6.6	6.9	7.2	7.5	7.7	7.9
	Total Suspended Solids	1.0	mg/L	49	0	49	6.2	10.8	13.	22.2	30.	48.8	68.	76.7	156.	6.2	10.8	13.	22.2	30.	48.8	68.	76.7	156.	6.2	10.8	13.	22.2	30.	48.8	68.	76.7	156.
	Turbidity	0.2	NTU	28	0	28	8.26	9.58	10.	13.6	18.1	29.5	43.6	43.7	44.3	8.26	9.58	10.	13.6	18.1	29.5	43.6	43.7	44.3	8.26	9.58	10.	13.6	18.1	29.5	43.6	43.7	44.3
Nutrients	Nitrate+Nitrite as N	0.007	mg/L	46	0	46	0.058	0.1	0.13	0.214	0.309	0.545	1.4	1.55	1.8	0.058	0.1	0.13	0.214	0.309	0.545	1.4	1.55	1.8	0.058	0.1	0.13	0.214	0.309	0.545	1.4	1.55	1.8
	Phosphate, Ortho	0.003	mg/L	42	1	41	0.012	0.016	0.017	0.024	0.034	0.046	0.069	0.094	0.154	0.006	0.016	0.017	0.024	0.034	0.046	0.069	0.094	0.154	0.	0.016	0.017	0.024	0.034	0.046	0.069	0.094	0.154
	Phosphorus, Total	0.003	mg/L	46	0	46	0.052	0.059	0.065	0.077	0.128	0.202	0.295	0.334	0.416	0.052	0.059	0.065	0.077	0.128	0.202	0.295	0.334	0.416	0.052	0.059	0.065	0.077	0.128	0.202	0.295	0.334	0.416
	Total Nitrogen	0.03	mg/L	46	0	46	0.41	0.54	0.57	0.72	0.83	1.28	2.01	2.12	2.55	0.41	0.54	0.57	0.72	0.83	1.28	2.01	2.12	2.55	0.41	0.54	0.57	0.72	0.83	1.28	2.01	2.12	2.55
Metals	Cadmium	0.2	µg/L	51	26	25	0.1	0.1	0.1	0.1	0.1	0.139	0.241	0.298	0.382	0.05	0.05	0.05	0.05	0.05	0.139	0.241	0.298	0.382	0.	0.	0.	0.	0.	0.139	0.241	0.298	0.382
	Cadmium, Dissolved	0.03	µg/L	51	31	20	0.045	0.045	0.045	0.045	0.045	0.072	0.091	0.133	0.166	0.0225	0.0225	0.0225	0.0225	0.0225	0.072	0.091	0.133	0.166	0.	0.	0.	0.	0.	0.072	0.091	0.133	0.166
	Copper	0.5	µg/L	51	0	51	4.09	5.44	6.32	8.62	13.4	23.6	29.2	41.2	42.8	4.09	5.44	6.32	8.62	13.4	23.6	29.2	41.2	42.8	4.09	5.44	6.32	8.62	13.4	23.6	29.2	41.2	42.8
	Copper, Dissolved	0.02	µg/L	51	0	51	1.45	1.73	2.02	2.46	3.75	7.71	13.1	13.9	23.7	1.45	1.73	2.02	2.46	3.75	7.71	13.1	13.9	23.7	1.45	1.73	2.02	2.46	3.75	7.71	13.1	13.9	23.7
	Lead	0.1	µg/L	51	0	51	1.63	2.24	2.37	3.99	5.79	25.4	45.9	49.7	88.2	1.63	2.24	2.37	3.99	5.79	25.4	45.9	49.7	88.2	1.63	2.24	2.37	3.99	5.79	25.4	45.9	49.7	88.2
	Lead, Dissolved	0.05	µg/L	51	0	51	0.09	0.111	0.14	0.183	0.319	1.02	5.06	6.83	8.68	0.09	0.111	0.14	0.183	0.319	1.02	5.06	6.83	8.68	0.09	0.111	0.14	0.183	0.319	1.02	5.06	6.83	8.68
	Mercury	0.1	µg/L	51	35	16	0.0016	0.002	0.0034	0.008	0.008	0.008	0.0085	0.0115	0.0135	0.0008	0.002	0.0034	0.004	0.004	0.004	0.0085	0.0115	0.0135	0.	0.	0.	0.	0.	0.0034	0.0085	0.0115	0.0135
	Mercury, Dissolved	0.1	µg/L	51	51	0	0.0022	0.0022	0.0022	0.0111	0.0111	0.0111	0.0111	0.0111	0.0111	0.0011	0.0011	0.0011	0.00555	0.00555	0.00555	0.00555	0.00555	0.00555	0.	0.	0.	0.	0.	0.	0.	0.	0.
	Zinc	5	µg/L	51	0	51	23.6	28.5	34.5	50.5	63.6	93.3	132.	158.	170.	23.6	28.5	34.5	50.5	63.6	93.3	132.	158.	170.	23.6	28.5	34.5	50.5	63.6	93.3	132.	158.	170.
	Zinc, Dissolved	1.0	µg/L	51	0	51	8.6	12.7	16.4	22.	26.3	35.2	45.8	59.7	88.3	8.6	12.7	16.4	22.	26.3	35.2	45.8	59.7	88.3	8.6	12.7	16.4	22.	26.3	35.2	45.8	59.7	88.3
Insecticide	Bifenthrin	0.02	µg/L	51	47	4	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.021	0.036	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.021	0.036	0.	0.	0.	0.	0.	0.	0.	0.021	0.036
LPAHs	2-Methylnaphthalene	0.01	µg/L	51	27	24	0.009	0.009	0.009	0.009	0.01	0.02	0.039	0.051	0.059	0.0045	0.0045	0.0045	0.0045	0.005	0.02	0.039	0.051	0.059	0.	0.	0.	0.	0.	0.02	0.039	0.051	0.059
	Acenaphthene	0.01	µg/L	51	42	9	0.009	0.009	0.009	0.01	0.01	0.01	0.015	0.028	0.033	0.0045	0.0045	0.0045	0.005	0.005	0.005	0.015	0.028	0.033	0.	0.	0.	0.	0.	0.	0.015	0.028	0.033
	Acenaphthylene	0.01	µg/L	51	38	13	0.009	0.009	0.009	0.009	0.009	0.01	0.017	0.025	0.028	0.0045	0.0045	0.0045	0.0045	0.0045	0.01	0.017	0.025	0.028	0.	0.	0.	0.	0.	0.01	0.017	0.025	0.028
	Anthracene	0.01	µg/L	51	29	22	0.005	0.005	0.005	0.005	0.005	0.014	0.043	0.06	0.225	0.0025	0.0025	0.0025	0.0025	0.0025	0.014	0.043	0.06	0.225	0.	0.	0.	0.	0.	0.014	0.043	0.06	0.225
	Fluorene	0.01	µg/L	51	39	12	0.009	0.009	0.009	0.009	0.01	0.01	0.013	0.024	0.028	0.0045	0.0045	0.0045	0.0045	0.005	0.005	0.013	0.024	0.028	0.	0.	0.	0.	0.	0.	0.013	0.024	0.028
	Naphthalene	0.01	µg/L	51	17	34	0.015	0.015	0.016	0.016	0.024	0.039	0.063	0.09	0.137	0.0075	0.0075	0.008	0.008	0.024	0.039	0.063	0.09	0.137	0.	0.	0.	0.	0.024	0.039	0.063	0.09	0.137
	Phenanthrene	0.01	µg/L	51	0	51	0.011	0.015	0.017	0.022	0.03	0.051	0.078	0.124	0.199	0.011	0.015	0.017	0.022	0.03	0.051	0.078	0.124	0.199	0.011	0.015	0.017	0.022	0.03	0.051	0.078	0.124	0.199
HPAHs	Benzo(a)anthracene	0.01	µg/L	51	14	37	0.006	0.006	0.006	0.006	0.014	0.031	0.059	0.072	0.183	0.003	0.003	0.003	0.003	0.014	0.031	0.059	0.072	0.183	0.	0.	0.	0.	0.014	0.031	0.059	0.072	0.183
	Benzo(a)pyrene	0.01	µg/L	51	22	29	0.003	0.003	0.003	0.003	0.009	0.029	0.057	0.068	0.258	0.0015	0.0015	0.0015	0.0015	0.009	0.029	0.057	0.068	0.258	0.	0.	0.	0.	0.009	0.029	0.057	0.068	0.258
	Benzo(b,j,k)fluoranthene	0.03	µg/L	51	4	47	0.011	0.011	0.017	0.03	0.048	0.088	0.183	0.286	0.797	0.0055	0.0055	0.017	0.03	0.048	0.088	0.183	0.286	0.797	0.	0.	0.017	0.03	0.048	0.088	0.183	0.286	0.797
	Benzo(g,h,i)perylene	0.01	µg/L	51	1	50	0.005	0.007	0.01	0.013	0.023	0.042	0.05	0.071	0.163	0.0025	0.007	0.01	0.013	0.023	0.042	0.05	0.071	0.163	0.	0.007	0.01	0.013	0.023	0.042	0.05	0.071	0.163
	Chrysene	0.01	µg/L	51	9	42	0.008	0.008	0.008	0.011	0.023	0.045	0.071	0.097	0.347	0.004	0.004	0.004	0.011	0.023	0.045	0.071	0.097	0.347	0.	0.	0.	0.011	0.023	0.045	0.071	0.097	0.347
	Dibenz(a,h)anthracene	0.01	µg/L	51	44	7	0.006	0.006	0.006	0.006	0.006	0.006	0.007	0.012	0.016	0.003	0.003	0.003	0.003	0.003	0.003	0.007	0.012	0.016	0.	0.	0.	0.	0.	0.	0.007	0.012	0.016
	Fluoranthene	0.01	µg/L	51	0	51	0.013	0.017	0.021	0.03	0.052	0.092	0.163	0.195	0.541	0.013	0.017	0.021	0.03	0.052	0.092	0.163	0.195	0.541	0.013	0.017	0.021	0.03	0.052	0.092	0.163	0.195	0.541
	Indeno(1,2,3-cd)pyrene	0.01	µg/L	51	6	45	0.005	0.005	0.005	0.011	0.017	0.034	0.054	0.072	0.183	0.0025	0.0025	0.0025	0.011	0.017	0.034	0.054	0.072	0.183	0.	0.	0.	0.011	0.017	0.034	0.054	0.072	0.183
	Pyrene	0.01	µg/L	51	0	51	0.016	0.023	0.025	0.034	0.063	0.109	0.162	0.19	0.542	0.016	0.023	0.025	0.034	0.063	0.109	0.162	0.19	0.542	0.016	0.023	0.025	0.034	0.063	0.109	0.162	0.19	0.542
	Retene	0.01	µg/L	51	4	47	0.005	0.005	0.006	0.008	0.011	0.017	0.031	0.032	0.053	0.0025	0.0025	0.006	0.008	0.011	0.017	0.031	0.032	0.053	0.	0.	0.006	0.008	0.011	0.017	0.031	0.032	0.053
Phthalates	Bis(2-ethylhexyl) phthalate	0.5	µg/L	51	0	51	0.398	0.421	0.701	0.955	1.35	1.73	2.48	3.04	4.58	0.398	0.421	0.701	0.955	1.35	1.73	2.48	3.04	4.58	0.398	0.421	0.701	0.955	1.35	1.73	2.48	3.04	4.58
	Butyl benzyl phthalate	0.5	µg/L	51	50	1	0.397	0.399	0.401	0.403	0.408	0.413	0.418	0.42	5.57	0.1985	0.1995	0.2005	0.2015	0.204	0.2065	0.209	0.21	5.57	0.	0.	0.	0.	0.	0.	0.	0.	5.57
	Diethyl phthalate	0.5	µg/L	51	42	9	0.307	0.309	0.31	0.314	0.319	0.323	0.342	0.353	0.395	0.1535	0.1545	0.155	0.157	0.1595	0.1615	0.342	0.353	0.395	0.	0.	0.	0.	0.	0.	0.342	0.353	0.395
	Dimethyl phthalate	0.5	µg/L	51	51	0	0.334	0.336	0.338	0.339	0.343	0.348	0.351	0.353	0.354	0.167	0.168	0.169	0.1695	0.1715	0.174	0.1755	0.1765	0.177	0.	0.	0.	0.	0.	0.	0.	0.	0.
	Di-n-butyl phthalate	0.5	µg/L	51	21	30	0.291	0.294	0.296	0.301	0.331	0.471	1.29	1.59	2.36	0.1455	0.147	0.148	0.1505	0.331	0.471	1.29	1.59	2.36	0.	0.	0.	0.	0.331	0.471	1.29	1.59	2.36
	Di-n-octyl phthalate	0.5	µg/L	51	51	0	0.354	0.356	0.358	0.36	0.364	0.369	0.372	0.374	0.375	0.177	0.178	0.179	0.18	0.182	0.1845	0.186	0.187	0.1875	0.	0.	0.	0.	0.	0.	0.	0.	0.
Herbicide	Dichlobenil	0.02	µg/L	51	6	45	0.008	0.008	0.009	0.015	0.024	0.05	0.107	0.338	0.848	0.004	0.004	0.0045	0.015	0.024	0.05	0.107	0.338	0.848	0.	0.	0.	0.015	0.024	0.05	0.107	0.338	0.848
TPH	NWTPH-Diesel	0.1	mg/L	14	13	1	0.09	0.09	0.09	0.1	0.1	0.1	0.1	0.1	0.1	0.045	0.045	0.045	0.05	0.05	0.05	0.05	0.1	0.1	0.	0.	0.	0.	0.	0.	0.	0.1	0.1
	NWTPH-Heavy Oil	0.1	mg/L	14	4	10	0.19	0.19	0.19	0.2	0.29	0.96	1.04	3.52	3.52	0.095	0.095	0.095	0.1	0.29	0.96	1.04	3.52	3.52	0.	0.	0.	0.	0.29	0.96	1.04	3.52	3.52
Bacteria	*E. Coli*	2	CFU/100mL	14	0	14	90.	90.	800.	2200.	3300.	50000.	110000.	280000.	280000.	90.	90.	800.	2200.	3300.	50000.	110000.	280000.	280000.	90.	90.	800.	2200.	3300.	50000.	110000.	280000.	280000.
	Enterococci	2	CFU/100mL	14	0	14	1200.	1200.	6300.	16000.	61500.	85000.	225000.	820000.	820000.	1200.	1200.	6300.	16000.	61500.	85000.	225000.	820000.	820000.	1200.	1200.	6300.	16000.	61500.	85000.	225000.	820000.	820000.
	Fecal coliform	2	CFU/100mL	14	0	14	90.	90.	800.	2400.	22000.	80000.	140000.	800000.	800000.	90.	90.	800.	2400.	22000.	80000.	140000.	800000.	800000.	90.	90.	800.	2400.	22000.	80000.	140000.	800000.	800000.

N = Tests, D = Detections, ND = Non-detections, Md = Median, Min = Minimum, Max = Maximum

Table B7-4

Detection Profile Stormwater Sediment (SSPM) - WY2023

Class	Analyte	Detection Limit Goal		Tests			Detection profile, non-detections substituted at full value									Detection profile, non-detections substituted at 1/2 Method Detection Level									Detection profile, non-detections substituted as zero								
		Conc.	Units	Tests	ND	D	Min	5%	10%	25%	Md	75%	90%	95%	Max	Min	5%	10%	25%	Md	75%	90%	95%	Max	Min	5%	10%	25%	Md	75%	90%	95%	Max
Conventionals	Total Organic Carbon	0.1	%	14	0	14	6700.	6700.	46600.	57900.	119000.	195000.	209000.	216000.	216000.	6700.	6700.	46600.	57900.	119000.	195000.	209000.	216000.	216000.	6700.	6700.	46600.	57900.	119000.	195000.	209000.	216000.	216000.
	Total Solids	0.1	%	15	0	15	21.5	21.5	22.3	25.5	40.7	55.2	63.	63.4	63.4	21.5	21.5	22.3	25.5	40.7	55.2	63.	63.4	63.4	21.5	21.5	22.3	25.5	40.7	55.2	63.	63.4	63.4
	Total Volatile Solids	0.1	%	7	0	7	6.6	6.6	6.6	7.2	13.1	18.7	25.8	25.8	25.8	6.6	6.6	6.6	7.2	13.1	18.7	25.8	25.8	25.8	6.6	6.6	6.6	7.2	13.1	18.7	25.8	25.8	25.8
Nutrients	Phosphorus, Total	0.01	mg/Kg dry	5	0	5	662.	662.	662.	730.	738.	739.	739.	739.	739.	662.	662.	662.	730.	738.	739.	739.	739.	739.	662.	662.	662.	730.	738.	739.	739.	739.	739.
Metals	Cadmium	0.1	mg/Kg dry	6	1	5	0.0184	0.0184	0.0184	0.292	0.434	0.552	0.609	0.609	0.609	0.0092	0.0092	0.0092	0.292	0.434	0.552	0.609	0.609	0.609	0.	0.	0.	0.292	0.434	0.552	0.609	0.609	0.609
	Copper	0.1	mg/Kg dry	6	0	6	50.4	50.4	50.4	78.9	100.	113.	199.	199.	199.	50.4	50.4	50.4	78.9	100.	113.	199.	199.	199.	50.4	50.4	50.4	78.9	100.	113.	199.	199.	199.
	Lead	0.1	mg/Kg dry	8	0	8	28.2	28.2	28.2	29.2	40.	74.5	280.	280.	280.	28.2	28.2	28.2	29.2	40.	74.5	280.	280.	280.	28.2	28.2	28.2	29.2	40.	74.5	280.	280.	280.
	Mercury	0.005	mg/Kg dry	7	0	7	0.0454	0.0454	0.0454	0.05	0.0776	0.112	0.355	0.355	0.355	0.0454	0.0454	0.0454	0.05	0.0776	0.112	0.355	0.355	0.355	0.0454	0.0454	0.0454	0.05	0.0776	0.112	0.355	0.355	0.355
	Zinc	0.5	mg/Kg dry	8	0	8	219.	219.	219.	280.	356.	740.	1770.	1770.	1770.	219.	219.	219.	280.	356.	740.	1770.	1770.	1770.	219.	219.	219.	280.	356.	740.	1770.	1770.	1770.
Insecticide	Bifenthrin	1	µg/Kg dry	7	3	4	0.407	0.407	0.407	0.418	5.96	13.5	15.1	15.1	15.1	0.2035	0.2035	0.2035	0.209	5.96	13.5	15.1	15.1	15.1	0.	0.	0.	0.	5.96	13.5	15.1	15.1	15.1
LPAHs	2-Methylnaphthalene	70	µg/Kg dry	11	0	11	21.6	21.6	21.7	29.6	74.5	380.	385.	2000.	2000.	21.6	21.6	21.7	29.6	74.5	380.	385.	2000.	2000.	21.6	21.6	21.7	29.6	74.5	380.	385.	2000.	2000.
	Acenaphthene	70	µg/Kg dry	11	4	7	13.	13.	13.4	18.	66.8	90.9	133.	457.	457.	6.5	6.5	6.7	18.	33.4	90.9	133.	457.	457.	0.	0.	0.	0.	21.9	90.9	133.	457.	457.
	Acenaphthylene	70	µg/Kg dry	11	2	9	9.23	9.23	10.4	15.2	32.1	62.9	404.	569.	569.	9.23	9.23	10.4	15.2	18.9	62.9	404.	569.	569.	0.	0.	0.	9.23	18.9	62.9	404.	569.	569.
	Anthracene	70	µg/Kg dry	11	0	11	21.4	21.4	22.5	60.1	95.7	591.	765.	949.	949.	21.4	21.4	22.5	60.1	95.7	591.	765.	949.	949.	21.4	21.4	22.5	60.1	95.7	591.	765.	949.	949.
	Fluorene	70	µg/Kg dry	11	1	10	13.8	13.8	15.7	24.2	60.9	198.	450.	803.	803.	13.7	13.7	13.8	15.7	60.9	198.	450.	803.	803.	0.	0.	13.8	15.7	60.9	198.	450.	803.	803.
	Naphthalene	70	µg/Kg dry	11	1	10	48.7	48.7	49.7	66.7	99.2	1080.	1110.	4430.	4430.	34.05	34.05	48.7	49.7	99.2	1080.	1110.	4430.	4430.	0.	0.	48.7	49.7	99.2	1080.	1110.	4430.	4430.
	Phenanthrene	70	µg/Kg dry	11	0	11	91.4	91.4	125.	355.	593.	3260.	4460.	7820.	7820.	91.4	91.4	125.	355.	593.	3260.	4460.	7820.	7820.	91.4	91.4	125.	355.	593.	3260.	4460.	7820.	7820.
HPAHs	Benzo(a)anthracene	70	µg/Kg dry	11	0	11	41.2	41.2	81.2	228.	494.	1460.	4140.	4220.	4220.	41.2	41.2	81.2	228.	494.	1460.	4140.	4220.	4220.	41.2	41.2	81.2	228.	494.	1460.	4140.	4220.	4220.
	Benzo(a)pyrene	70	µg/Kg dry	11	0	11	53.8	53.8	108.	246.	511.	1640.	4380.	4430.	4430.	53.8	53.8	108.	246.	511.	1640.	4380.	4430.	4430.	53.8	53.8	108.	246.	511.	1640.	4380.	4430.	4430.
	Benzo(b,j,k)fluoranthene	210	µg/Kg dry	11	0	11	137.	137.	212.	574.	1100.	4090.	10900.	11700.	11700.	137.	137.	212.	574.	1100.	4090.	10900.	11700.	11700.	137.	137.	212.	574.	1100.	4090.	10900.	11700.	11700.
	Benzo(g,h,i)perylene	70	µg/Kg dry	11	0	11	110.	110.	187.	192.	309.	669.	1290.	1850.	1850.	110.	110.	187.	192.	309.	669.	1290.	1850.	1850.	110.	110.	187.	192.	309.	669.	1290.	1850.	1850.
	Chrysene	70	µg/Kg dry	11	0	11	67.9	67.9	119.	378.	813.	2010.	5400.	6360.	6360.	67.9	67.9	119.	378.	813.	2010.	5400.	6360.	6360.	67.9	67.9	119.	378.	813.	2010.	5400.	6360.	6360.
	Dibenz(a,h)anthracene	70	µg/Kg dry	11	5	6	64.	64.	65.6	65.7	72.3	196.	422.	643.	643.	32.	32.	32.8	32.85	72.3	196.	422.	643.	643.	0.	0.	0.	0.	72.3	196.	422.	643.	643.
	Fluoranthene	70	µg/Kg dry	11	0	11	190.	190.	225.	731.	1210.	3840.	11600.	13200.	13200.	190.	190.	225.	731.	1210.	3840.	11600.	13200.	13200.	190.	190.	225.	731.	1210.	3840.	11600.	13200.	13200.
	Indeno(1,2,3-cd)pyrene	70	µg/Kg dry	11	2	9	71.6	71.6	73.3	95.8	226.	898.	1820.	2800.	2800.	35.8	35.8	36.65	95.8	226.	898.	1820.	2800.	2800.	0.	0.	0.	95.8	226.	898.	1820.	2800.	2800.
	Pyrene	70	µg/Kg dry	11	0	11	334.	334.	337.	665.	1440.	3770.	9040.	10600.	10600.	334.	334.	337.	665.	1440.	3770.	9040.	10600.	10600.	334.	334.	337.	665.	1440.	3770.	9040.	10600.	10600.
	Retene	70	µg/Kg dry	11	0	11	33.4	33.4	38.6	45.2	218.	278.	458.	535.	535.	33.4	33.4	38.6	45.2	218.	278.	458.	535.	535.	33.4	33.4	38.6	45.2	218.	278.	458.	535.	535.
Phthalates	Bis(2-ethylhexyl) phthalate	70	µg/Kg dry	8	0	8	1620.	1620.	1620.	1950.	8030.	8490.	32300.	32300.	32300.	1620.	1620.	1620.	1950.	8030.	8490.	32300.	32300.	32300.	1620.	1620.	1620.	1950.	8030.	8490.	32300.	32300.	32300.
	Butyl benzyl phthalate	70	µg/Kg dry	8	1	7	68.1	68.1	68.1	83.3	504.	1200.	7150.	7150.	7150.	34.05	34.05	34.05	83.3	504.	1200.	7150.	7150.	7150.	0.	0.	0.	83.3	504.	1200.	7150.	7150.	7150.
	Diethyl phthalate	70	µg/Kg dry	8	4	4	34.3	34.3	34.3	35.2	35.2	39.4	65.7	65.7	65.7	17.15	17.15	17.15	17.6	17.6	39.4	65.7	65.7	65.7	0.	0.	0.	0.	0.	39.4	65.7	65.7	65.7
	Dimethyl phthalate	70	µg/Kg dry	8	1	7	5.61	5.61	5.61	8.72	33.9	95.6	493.	493.	493.	2.805	2.805	2.805	8.72	33.9	95.6	493.	493.	493.	0.	0.	0.	8.72	33.9	95.6	493.	493.	493.
	Di-n-butyl phthalate	70	µg/Kg dry	8	0	8	35.1	35.1	35.1	53.	110.	255.	1100.	1100.	1100.	35.1	35.1	35.1	53.	110.	255.	1100.	1100.	1100.	35.1	35.1	35.1	53.	110.	255.	1100.	1100.	1100.
	Di-n-octyl phthalate	70	µg/Kg dry	8	8	0	14.1	14.1	14.1	14.1	70.3	70.7	140.	140.	140.	7.05	7.05	7.05	7.05	35.15	35.35	70.	70.	70.	0.	0.	0.	0.	0.	0.	0.	0.	0.
Herbicide	Dichlobenil	1	µg/Kg dry	7	0	7	6.3	6.3	6.3	6.99	8.45	38.4	75.8	75.8	75.8	6.3	6.3	6.3	6.99	8.45	38.4	75.8	75.8	75.8	6.3	6.3	6.3	6.99	8.45	38.4	75.8	75.8	75.8
TPH	NWTPH-Diesel	25	mg/Kg dry	7	7	0	19.5	19.5	19.5	19.7	20.	20.	20.	20.	20.	9.75	9.75	9.75	9.85	10.	10.	10.	10.	10.	0.	0.	0.	0.	0.	0.	0.	0.	0.
	NWTPH-Heavy Oil	100	mg/Kg dry	7	0	7	757.	757.	757.	1500.	2220.	3260.	4100.	4100.	4100.	757.	757.	757.	1500.	2220.	3260.	4100.	4100.	4100.	757.	757.	757.	1500.	2220.	3260.	4100.	4100.	4100.
PCBs	Aroclor-1016	10	µg/Kg dry	12	12	0	1.76	1.76	1.78	1.8	9.	9.02	9.03	9.03	9.03	0.88	0.88	0.89	0.9	4.5	4.51	4.515	4.515	4.515	0.	0.	0.	0.	0.	0.	0.	0.	0.
	Aroclor-1221	10	µg/Kg dry	12	12	0	1.76	1.76	1.78	1.8	9.	9.02	9.03	9.03	9.03	0.88	0.88	0.89	0.9	4.5	4.51	4.515	4.515	4.515	0.	0.	0.	0.	0.	0.	0.	0.	0.
	Aroclor-1232	10	µg/Kg dry	12	12	0	1.76	1.76	1.78	1.8	9.	9.02	9.03	9.03	9.03	0.88	0.88	0.89	0.9	4.5	4.51	4.515	4.515	4.515	0.	0.	0.	0.	0.	0.	0.	0.	0.
	Aroclor-1242	10	µg/Kg dry	12	12	0	1.76	1.76	1.78	1.8	9.	9.02	9.03	9.03	9.03	0.88	0.88	0.89	0.9	4.5	4.51	4.515	4.515	4.515	0.	0.	0.	0.	0.	0.	0.	0.	0.
	Aroclor-1248	10	µg/Kg dry	12	12	0	1.95	1.95	1.97	2.	9.96	9.98	9.99	9.99	9.99	0.975	0.975	0.985	1.	4.98	4.99	4.995	4.995	4.995	0.	0.	0.	0.	0.	0.	0.	0.	0.
	Aroclor-1254	10	µg/Kg dry	12	11	1	1.95	1.95	1.97	2.	9.96	9.98	9.99	485.	485.	0.975	0.975	0.985	1.	4.98	4.99	4.995	485.	485.	0.	0.	0.	0.	0.	0.	0.	485.	485.
	Aroclor-1260	10	µg/Kg dry	12	12	0	1.95	1.95	1.97	2.	9.96	9.98	9.99	9.99	9.99	0.975	0.975	0.985	1.	4.98	4.99	4.995	4.995	4.995	0.	0.	0.	0.	0.	0.	0.	0.	0.
Phenols	Pentachlorophenol	270	µg/Kg dry	7	5	2	2.11	2.11	2.11	2.17	10.8	193.	326.	326.	326.	1.055	1.055	1.055	1.085	5.4	193.	326.	326.	326.	0.	0.	0.	0.	0.	193.	326.	326.	326.
	2-Methylphenol	70	µg/Kg dry	7	5	2	7.46	7.46	7.46	7.67	11.5	38.2	38.3	38.3	38.3	3.73	3.73	3.73	3.835	11.5	19.15	21.1	21.1	21.1	0.	0.	0.	0.	0.	11.5	21.1	21.1	21.1
	4-Methylphenol	70	µg/Kg dry	7	3	4	4.46	4.46	4.46	4.58	36.4	479.	1430.	1430.	1430.	2.23	2.23	2.23	2.29	36.4	479.	1430.	1430.	1430.	0.	0.	0.	0.	36.4	479.	1430.	1430.	1430.

N = Tests, D = Detections, ND = Non-detections, Md = Median, Min = Minimum, Max = Maximum

Table B7-5
Sensitivity Stormwater - WY2023

Class	Analyte	Detection Limit Goal		Tests			Evaluations			Performance Method Detection Limit (MDL)									Performance Non-Detection MDL									Reporting Level (Lowest Standard = Practical Quantitation Limits)								
		Conc.	Units	Tests	ND	D	DL>DLG	MQO	Rej	Min	5%	10%	25%	Md	75%	90%	95%	Max	Min	5%	10%	25%	Md	75%	90%	95%	Max	Min	5%	10%	25%	Md	75%	90%	95%	Max
Conventionals	Anionic Surfactants - MBAS	25	µg/L	31		31				5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	10.4										25.	25.	25.	25.	25.	25.	25.	25.	50.
	BOD	2	mg/L	30	8	22				2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.
	Chloride	0.2	mg/L	31		31	31			0.73	0.73	0.73	1.46	3.65	73.	73.	365.	365.										1.	1.	1.	2.	5.	100.	100.	500.	500.
	Hardness, Total as CaCO3	0.05	mg CaCO3/L	54		54	2			0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.25										0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.5
	Total Suspended Solids	1	mg/L	52		52	44			1.	1.	1.	1.54	2.	2.	2.38	2.56	3.33										1.	1.	1.	1.54	2.	2.	2.38	2.56	3.33
	Turbidity	0.2	NTU	31		31	31			0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46										1.	1.	1.	1.	1.	1.	1.	1.	1.
Nutrients	Nitrate+Nitrite as N	0.007	mg/L	49		49	49			0.024	0.024	0.024	0.024	0.024	0.024	0.024	0.024	0.048										0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.1
	Phosphate, Ortho	0.003	mg/L	45	2	43	22	2		0.003	0.003	0.003	0.003	0.003	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02
	Phosphorus, Total	0.003	mg/L	49		49	49			0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.025										0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.08
	Total Nitrogen	0.03	mg/L	49		49	49			0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09										0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Metals	Cadmium	0.2	µg/L	54	27	27				0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
	Cadmium, Dissolved	0.03	µg/L	54	33	21	54	33		0.045	0.045	0.045	0.045	0.045	0.045	0.045	0.045	0.045	0.045	0.045	0.045	0.045	0.045	0.045	0.045	0.045	0.045	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
	Copper	0.5	µg/L	54		54	54			0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8										0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
	Copper, Dissolved	0.02	µg/L	54		54	54			0.118	0.118	0.118	0.118	0.118	0.118	0.118	0.118	0.118										0.1	0.1	0.1	0.1	0.118	0.118	0.118	0.118	0.118
	Lead	0.1	µg/L	54		54	54			0.102	0.102	0.102	0.102	0.102	0.102	0.102	0.102	0.102										0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
	Lead, Dissolved	0.05	µg/L	54		54				0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05										0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
	Mercury	0.1	µg/L	54	37	17				0.0016	0.0016	0.0016	0.0016	0.0016	0.008	0.008	0.008	0.008	0.0016	0.0016	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.005	0.005	0.005	0.025	0.025	0.025	0.025	0.025	0.025
	Mercury, Dissolved	0.1	µg/L	54	54														0.0022	0.0022	0.0022	0.0111	0.0111	0.0111	0.0111	0.0111	0.0111	0.005	0.005	0.005	0.025	0.025	0.025	0.025	0.025	0.025
	Zinc	5	µg/L	54		54				1.68	1.68	1.68	1.68	1.68	1.68	1.68	1.68	1.68										5.	5.	5.	5.	5.	5.	5.	5.	5.
	Zinc, Dissolved	1	µg/L	54		54				0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16										1.	1.	1.	1.	1.	1.	1.	1.	1.
Insecticides	Bifenthrin	0.02	µg/L	54	49	5				0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
LPAHs	2-Methylnaphthalene	0.01	µg/L	54	28	26				0.009	0.009	0.009	0.009	0.01	0.01	0.01	0.01	0.01	0.009	0.009	0.009	0.009	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	Acenaphthene	0.01	µg/L	54	44	10				0.009	0.009	0.009	0.009	0.009	0.01	0.01	0.01	0.01	0.009	0.009	0.009	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	Acenaphthylene	0.01	µg/L	54	39	15				0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	Anthracene	0.01	µg/L	54	30	24				0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012
	Fluorene	0.01	µg/L	54	40	14				0.009	0.009	0.009	0.009	0.01	0.01	0.01	0.01	0.01	0.009	0.009	0.009	0.009	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	Naphthalene	0.01	µg/L	54	17	37	54	17		0.015	0.015	0.015	0.016	0.016	0.016	0.016	0.016	0.016	0.015	0.015	0.015	0.016	0.016	0.016	0.016	0.016	0.016	0.025	0.026	0.026	0.026	0.026	0.026	0.027	0.027	0.027
	Phenanthrene	0.01	µg/L	54		54				0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007										0.017	0.017	0.017	0.017	0.017	0.017	0.018	0.018	0.018
HPAHs	Benzo(a)anthracene	0.01	µg/L	54	14	40				0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	Benzo(a)pyrene	0.01	µg/L	54	24	30				0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	Benzo(b,j,k)fluoranthene	0.03	µg/L	54	4	50				0.01	0.01	0.01	0.011	0.011	0.011	0.011	0.011	0.011	0.011	0.011	0.011	0.011	0.011	0.011	0.011	0.011	0.011	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
	Benzo(g,h,i)perylene	0.01	µg/L	54	1	53				0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	Chrysene	0.01	µg/L	54	9	45				0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	Dibenz(a,h)anthracene	0.01	µg/L	54	46	8				0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	Fluoranthene	0.01	µg/L	54		54				0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007										0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	Indeno(1,2,3-cd)pyrene	0.01	µg/L	54	6	48				0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	Pyrene	0.01	µg/L	54		54				0.008	0.008	0.008	0.008	0.008	0.008	0.009	0.009	0.009										0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	Retene	0.01	µg/L	54	4	50				0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Phthalates	Bis(2-ethylhexyl) phthalate	0.5	µg/L	54		54				0.35	0.351	0.352	0.355	0.36	0.364	0.368	0.369	0.37										0.955	0.959	0.962	0.969	0.981	0.994	1.	1.01	1.01
	Butyl benzyl phthalate	0.5	µg/L	54	53	1				0.409	0.409	0.409	0.409	0.409	0.409	0.409	0.409	0.409	0.397	0.398	0.4	0.403	0.408	0.413	0.417	0.419	0.42	0.955	0.959	0.962	0.969	0.981	0.994	1.	1.01	1.01
	Diethyl phthalate	0.5	µg/L	54	45	9				0.31	0.31	0.31	0.312	0.314	0.322	0.324	0.324	0.324	0.307	0.309	0.309	0.314	0.317	0.32	0.322	0.324	0.325	0.955	0.959	0.962	0.969	0.981	0.994	1.	1.01	1.01
	Dimethyl phthalate	0.5	µg/L	54	54														0.334	0.336	0.337	0.339	0.343	0.348	0.351	0.353	0.354	0.955	0.959	0.962	0.969	0.981	0.994	1.	1.01	1.01
	Di-n-butyl phthalate	0.5	µg/L	54	23	31				0.29	0.291	0.292	0.294	0.297	0.3	0.303	0.304	0.305	0.291	0.291	0.291	0.295	0.3	0.303	0.306	0.306	0.306	0.955	0.959	0.962	0.969	0.981	0.994	1.	1.01	1.01
	Di-n-octyl phthalate	0.5	µg/L	54	54														0.354	0.356	0.357	0.36	0.364	0.369	0.372	0.374	0.375	0.955	0.959	0.962	0.969	0.981	0.994	1.	1.01	1.01
Herbicide	Dichlobenil	0.02	µg/L	54	7	47				0.008	0.008	0.008	0.008	0.008	0.009	0.009	0.009	0.009	0.008	0.008	0.008	0.008	0.008	0.009	0.009	0.009	0.009	0.048	0.048	0.048	0.048	0.049	0.05	0.05	0.05	0.051
TPH	NWTPH-Diesel	0.1	mg/L	16	15	1				0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.1	0.1	0.1	0.1	0.1	0.09	0.09	0.09	0.09	0.1	0.1	0.1	0.1	0.1
	NWTPH-Heavy Oil	0.1	mg/L	16	4	12	16	4		0.19	0.19	0.19	0.19	0.19	0.2	0.2	0.2	0.2	0.19	0.19	0.19	0.19	0.19	0.2	0.2	0.2	0.2	0.19	0.19	0.19	0.19	0.19	0.2	0.2	0.2	0.2
Bacteria	E. Coli	2	CFU/100mL	16		16				1.	1.	1.	1.	1.	1.	1.	1.	1.										5.	5.	5.	5.	5.	5.	5.	5.	5.
	Enterococci	2	CFU/100mL	16		16																						1.	1.	1.	1.	1.	1.	1.	1.	1.
	Fecal Coliform	2	CFU/100mL	16		16				1.	1.	1.	1.	1.	1.	1.	1.	1.										1.	1.	1.	1.	1.	1.	1.	1.	1.

D = Detection, ND = Non-detection, Md = Median

Evaluation	Performance detection limit greater than the detection limit goal (DL>DLG).
Method Quality Objective	Performance detection limit greater than the detection limit goal, a result nondetection, and not a rejection. This is an exceedance of the Method Quality Objective.
Rejection	Non-detection greater than five times the method quality objective.

Table B7-6
Sensitivity Stormwater Sediment (SSPM) - WY2023

Class	Analyte	Detection Limit Goal		Tests			Evaluations			Performance Method Detection Limit (MDL)									Performance Non-Detection MDL									Reporting Level (Lowest Standard = Practical Quantitation Limits)								
		Conc.	Units	Tests	ND	D	DL>DLG	MQO	Rej	Min	5%	10%	25%	Md	75%	90%	95%	Max	Min	5%	10%	25%	Md	75%	90%	95%	Max	Min	5%	10%	25%	Md	75%	90%	95%	Max
Phenols	Pentachlorophenol	270	µg/Kg dry	7	5	2				2.18	2.18	2.18	2.18	2.18	10.8	10.8	10.8	10.8	2.11	2.11	2.11	2.17	2.18	10.8	10.8	10.8	10.8	9.69	9.69	9.69	9.96	9.98	49.7	49.7	49.7	49.7
SVOA	2-Methylphenol	70	µg/Kg dry	7	5	2				7.65	7.65	7.65	7.65	7.65	7.69	7.69	7.69	7.69	7.46	7.46	7.46	7.67	7.69	38.2	38.3	38.3	38.3	9.69	9.69	9.69	9.93	9.98	49.6	49.7	49.7	49.7
	4-Methylphenol	70	µg/Kg dry	7	3	4				4.59	4.59	4.59	4.59	4.59	22.8	22.8	22.8	22.8	4.46	4.46	4.46	4.46	4.58	22.9	22.9	22.9	22.9	9.69	9.69	9.69	9.96	9.98	49.7	49.7	49.7	49.7
Conventionals	Total Organic Carbon	0.1	%	14		14	14			8.	8.	8.	8.	8.	8.	8.	8.	8.										200.	200.	200.	200.	200.	200.	200.	200.	200.
	Total Solids	0.1	%	15		15	15			1.	1.	1.	1.	1.	1.	1.	1.	1.										1.	1.	1.	1.	1.	1.	1.	1.	1.
	Total Volatile Solids	0.1	%	7		7	7			1.	1.	1.	1.	1.	1.	1.	1.	1.										1.	1.	1.	1.	1.	1.	1.	1.	1.
Nutrients	Phosphorus, Total	0.01	mg/Kg dry	5		5	5			124.	124.	124.	156.	160.	172.	205.	205.	205.										164.	164.	164.	207.	212.	227.	272.	272.	272.
Metals	Cadmium	0.1	mg/Kg dry	6	1	5				0.0457	0.0457	0.0457	0.0458	0.0459	0.046	0.0758	0.0758	0.0758	0.0184	0.0184	0.0184	0.0184	0.0184	0.0184	0.0184	0.0184	0.0184	0.0999	0.0999	0.0999	0.248	0.249	0.25	0.412	0.412	0.412
	Copper	0.1	mg/Kg dry	6		6	6			0.919	0.919	0.919	0.921	0.924	0.924	1.52	1.52	1.52										2.48	2.48	2.48	2.49	2.5	2.5	4.12	4.12	4.12
	Lead	0.1	mg/Kg dry	8		8	8			0.228	0.228	0.228	0.228	0.23	0.23	0.379	0.379	0.379										0.247	0.247	0.247	0.248	0.25	0.25	0.412	0.412	0.412
	Mercury	0.005	mg/Kg dry	7		7	7			0.0113	0.0113	0.0113	0.0161	0.0193	0.0198	0.0199	0.0199	0.0199										0.0113	0.0113	0.0113	0.0161	0.0193	0.0198	0.0199	0.0199	0.0199
	Zinc	0.5	mg/Kg dry	8		8	8			8.36	8.36	8.36	8.39	8.44	8.44	13.9	13.9	13.9										9.9	9.9	9.9	9.93	9.98	9.99	16.5	16.5	16.5
Insecticides	Bifenthrin	1	µg/Kg dry	7	3	4				0.208	0.208	0.208	0.208	0.21	0.417	0.419	0.419	0.419	0.407	0.407	0.407	0.407	0.418	0.418	0.418	0.418	0.418	0.496	0.496	0.496	0.499	0.993	0.996	0.998	0.998	0.998
LPAHs	2-Methylnaphthalene	70	µg/Kg dry	11		11	1			11.7	11.7	12.	12.	12.	59.7	59.7	119.	119.										11.7	11.7	12.	12.	12.	59.7	59.7	119.	119.
	Acenaphthene	70	µg/Kg dry	11	4	7	1			13.4	13.4	13.4	13.4	13.4	66.9	134.	134.	134.	13.	13.	13.	13.	13.4	66.8	66.9	66.9	66.9	13.	13.	13.4	13.4	13.4	66.9	66.9	134.	134.
	Acenaphthylene	70	µg/Kg dry	11	2	9				6.26	6.26	6.26	6.43	6.45	32.1	64.2	64.2	64.2	32.	32.	32.	32.	32.	32.1	32.1	32.1	32.1	9.69	9.69	9.94	9.96	9.99	49.7	49.7	99.4	99.4
	Anthracene	70	µg/Kg dry	11		11				6.69	6.69	6.86	6.87	6.89	34.3	34.3	68.6	68.6										9.69	9.69	9.94	9.96	9.99	49.7	49.7	99.4	99.4
	Fluorene	70	µg/Kg dry	11	1	10				5.35	5.35	5.35	5.51	5.51	27.4	27.4	54.9	54.9	27.4	27.4	27.4	27.4	27.4	27.4	27.4	27.4	27.4	9.69	9.69	9.96	9.98	49.6	49.7	49.7	99.4	99.4
	Naphthalene	70	µg/Kg dry	11	1	10	1			13.3	13.3	13.3	13.7	68.	68.1	68.4	136.	136.	68.1	68.1	68.1	68.1	68.1	68.1	68.1	68.1	68.1	13.3	13.3	13.6	13.7	68.	68.1	68.4	136.	136.
	Phenanthrene	70	µg/Kg dry	11		11				4.84	4.84	4.97	4.98	24.8	24.8	24.9	49.6	49.6										9.69	9.69	9.96	9.98	49.6	49.7	50.	99.4	99.4
HPAHs	Benzo(a)anthracene	70	µg/Kg dry	11		11				4.76	4.76	4.89	4.9	24.4	24.4	24.5	48.8	48.8										9.69	9.69	9.96	9.98	49.6	49.7	50.	99.4	99.4
	Benzo(a)pyrene	70	µg/Kg dry	11		11	1			10.8	10.8	55.2	55.2	55.3	55.5	55.6	111.	111.										11.6	11.6	59.5	59.6	59.7	59.9	59.9	119.	119.
	Benzo(b,j,k)fluoranthene	210	µg/Kg dry	11		11	1			129.	129.	132.	132.	132.	132.	132.	264.	264.										145.	145.	149.	149.	149.	150.	150.	298.	298.
	Benzo(g,h,i)perylene	70	µg/Kg dry	11		11				32.4	32.4	33.2	33.2	33.3	33.4	33.4	66.5	66.5										48.5	48.5	49.6	49.6	49.7	49.9	50.	99.4	99.4
	Chrysene	70	µg/Kg dry	11		11				5.48	5.48	5.49	5.49	27.3	27.3	27.5	54.7	54.7										9.96	9.96	9.98	9.98	49.6	49.7	50.	99.4	99.4
	Dibenz(a,h)anthracene	70	µg/Kg dry	11	5	6	1			13.1	13.1	13.1	65.5	65.6	66.	131.	131.	131.	64.	64.	64.	65.6	65.7	65.8	65.9	65.9	65.9	19.9	19.9	96.9	99.2	99.4	99.8	99.9	199.	199.
	Fluoranthene	70	µg/Kg dry	11		11				6.37	6.37	6.54	6.56	32.6	32.7	32.8	65.3	65.3										9.69	9.69	9.96	9.98	49.6	49.7	50.	99.4	99.4
	Indeno(1,2,3-cd)pyrene	70	µg/Kg dry	11	2	9	10	2		14.7	14.7	14.7	73.4	73.6	73.8	147.	147.	147.	71.6	71.6	71.6	71.6	71.6	73.3	73.3	73.3	73.3	14.9	14.9	72.7	74.4	74.5	74.9	74.9	149.	149.
	Pyrene	70	µg/Kg dry	11		11				3.62	3.62	3.72	3.72	18.5	18.6	18.6	37.1	37.1										9.69	9.69	9.98	9.98	49.7	49.8	50.	99.4	99.4
	Retene	70	µg/Kg dry	11		11				6.2	6.2	6.39	6.39	31.8	31.8	31.9	63.6	63.6										9.69	9.69	9.98	9.98	49.6	49.7	49.8	99.4	99.4
Phthalates	Bis(2-ethylhexyl) phthalate	70	µg/Kg dry	8		8	8			248.	248.	248.	254.	254.	255.	1020.	1020.	1020.										248.	248.	248.	254.	254.	255.	1020.	1020.	1020.
	Butyl benzyl phthalate	70	µg/Kg dry	8	1	7				13.7	13.7	13.7	13.7	66.4	68.1	68.2	68.2	68.2	68.1	68.1	68.1	68.1	68.1	68.1	68.1	68.1	68.1	13.7	13.7	13.7	13.7	66.4	68.1	68.2	68.2	68.2
	Diethyl phthalate	70	µg/Kg dry	8	4	4				35.1	35.1	35.1	35.1	35.3	35.3	35.4	35.4	35.4	34.3	34.3	34.3	34.3	35.2	35.2	35.2	35.2	35.2	34.3	34.3	34.3	35.1	35.2	35.3	35.4	35.4	35.4
	Dimethyl phthalate	70	µg/Kg dry	8	1	7				5.47	5.47	5.47	5.62	5.63	28.	28.	28.	28.	5.61	5.61	5.61	5.61	5.61	5.61	5.61	5.61	5.61	18.	18.	18.	18.5	18.6	18.6	92.3	92.3	92.3
	Di-n-butyl phthalate	70	µg/Kg dry	8		8	2			30.	30.	30.	30.7	30.8	30.9	153.	153.	153.										30.	30.	30.	30.7	30.8	30.9	153.	153.	153.
	Di-n-octyl phthalate	70	µg/Kg dry	8	8		5	5											14.1	14.1	14.1	14.1	70.3	70.7	140.	140.	140.	14.9	14.9	14.9	15.	74.5	74.9	149.	149.	149.
Herbicide	Dichlobenil	1	µg/Kg dry	7		7	3			0.725	0.725	0.725	0.744	0.747	3.72	3.73	3.73	3.73										0.969	0.969	0.969	0.994	0.998	4.97	4.99	4.99	4.99
TPH	NWTPH-Diesel	25	mg/Kg dry	7	7														19.5	19.5	19.5	19.7	20.	20.	20.	20.	20.	19.5	19.5	19.5	19.7	20.	20.	20.	20.	20.
	NWTPH-Heavy Oil	100	mg/Kg dry	7		7	6			79.7	79.7	79.7	195.	200.	399.	400.	400.	400.										79.7	79.7	79.7	195.	200.	399.	400.	400.	400.
PCBs	Aroclor-1016	10	µg/Kg dry	12	12														1.76	1.76	1.78	1.8	9.	9.02	9.03	9.03	9.03	7.78	7.78	7.89	7.98	39.8	39.9	40.	40.	40.
	Aroclor-1221	10	µg/Kg dry	12	12														1.76	1.76	1.78	1.8	9.	9.02	9.03	9.03	9.03	7.78	7.78	7.89	7.98	39.8	39.9	40.	40.	40.
	Aroclor-1232	10	µg/Kg dry	12	12														1.76	1.76	1.78	1.8	9.	9.02	9.03	9.03	9.03	7.78	7.78	7.89	7.98	39.8	39.9	40.	40.	40.
	Aroclor-1242	10	µg/Kg dry	12	12														1.76	1.76	1.78	1.8	9.	9.02	9.03	9.03	9.03	7.78	7.78	7.89	7.98	39.8	39.9	40.	40.	40.
	Aroclor-1248	10	µg/Kg dry	12	12														1.95	1.95	1.97	2.	9.96	9.98	9.99	9.99	9.99	7.78	7.78	7.89	7.98	39.8	39.9	40.	40.	40.
	Aroclor-1254	10	µg/Kg dry	12	11	1				9.98	9.98	9.98	9.98	9.98	9.98	9.98	9.98	9.98	1.95	1.95	1.97	2.	9.96	9.98	9.99	9.99	9.99	7.78	7.78	7.89	7.98	39.8	39.9	40.	40.	40.
	Aroclor-1260	10	µg/Kg dry	12	12														1.95	1.95	1.97	2.	9.96	9.98	9.99	9.99	9.99	7.78	7.78	7.89	7.98	39.8	39.9	40.	40.	40.

D = Detection, ND = Non-detection, Md = Median

Evaluation	Performance detection limit greater than the detection limit goal (DL>DLG).
Method Quality Objective	Performance detection limit greater than the detection limit goal, a result nondetection, and not a rejection. This is an exceedance of the Method Quality Objective.
Rejection	Non-detection greater than five times the method quality objective.

Table B7-7
Bias - Stormwater Blanks - WY2023

Laboratory Method Blanks

Class	Analyte	Detection Limit Goal Conc.	Units	Tests N	D	ND	Evaluations Detect	MQO	Rej	Min	5%	10%	25%	Md	75%	90%	95%	Max
Conventionals	Anionic Surfactants - MBAS	25	µg/L	16		16				0.	0.	0.	0.	0.	0.	0.	0.	0.
	BOD	2	mg/L	14		14				0.	0.	0.	0.	0.	0.	0.	0.	0.
	Chloride	0.2	mg/L	12	3	9		2	1	0.	0.	0.	0.	0.	0.	0.819	1.84	1.84
	Hardness, Total as CaCO3	0.05	mg CaCO3/L	17		17				0.	0.	0.	0.	0.	0.	0.	0.	0.
	Total Suspended Solids	1	mg/L	1		1				0.	0.	0.	0.	0.	0.	0.	0.	0.
	Turbidity	0.2	NTU	16		16				0.	0.	0.	0.	0.	0.	0.	0.	0.
Nutrients	Nitrate+Nitrite as N	0.007	mg/L	18		18				0.	0.	0.	0.	0.	0.	0.	0.	0.
	Phosphate, Ortho	0.003	mg/L	20		20				0.	0.	0.	0.	0.	0.	0.	0.	0.
	Phosphorus, Total	0.003	mg/L	15		15				0.	0.	0.	0.	0.	0.	0.	0.	0.
	Total Nitrogen	0.03	mg/L	17		17				0.	0.	0.	0.	0.	0.	0.	0.	0.
Metals	Cadmium	0.2	µg/L	17		17				0.	0.	0.	0.	0.	0.	0.	0.	0.
	Cadmium, Dissolved	0.03	µg/L	16		16				0.	0.	0.	0.	0.	0.	0.	0.	0.
	Copper	0.5	µg/L	17		17				0.	0.	0.	0.	0.	0.	0.	0.	0.
	Copper, Dissolved	0.02	µg/L	16		16				0.	0.	0.	0.	0.	0.	0.	0.	0.
	Lead	0.1	µg/L	17		17				0.	0.	0.	0.	0.	0.	0.	0.	0.
	Lead, Dissolved	0.05	µg/L	16		16				0.	0.	0.	0.	0.	0.	0.	0.	0.
	Mercury	0.1	µg/L	14		14				0.	0.	0.	0.	0.	0.	0.	0.	0.
	Mercury, Dissolved	0.1	µg/L	14		14				0.	0.	0.	0.	0.	0.	0.	0.	0.
	Zinc	5	µg/L	17		17				0.	0.	0.	0.	0.	0.	0.	0.	0.
	Zinc, Dissolved	1	µg/L	16	1	15	1			0.	0.	0.	0.	0.	0.	0.	0.33	0.33
Insecticides	Bifenthrin	0.02	µg/L	18		18				0.	0.	0.	0.	0.	0.	0.	0.	0.
LPAHs	2-Methylnaphthalene	0.01	µg/L	18		18				0.	0.	0.	0.	0.	0.	0.	0.	0.
	Acenaphthene	0.01	µg/L	18		18				0.	0.	0.	0.	0.	0.	0.	0.	0.
	Acenaphthylene	0.01	µg/L	18		18				0.	0.	0.	0.	0.	0.	0.	0.	0.
	Anthracene	0.01	µg/L	18		18				0.	0.	0.	0.	0.	0.	0.	0.	0.
	Fluorene	0.01	µg/L	18		18				0.	0.	0.	0.	0.	0.	0.	0.	0.
	Naphthalene	0.01	µg/L	18	8	10		1	7	0.	0.	0.	0.	0.	0.03	0.037	0.042	0.042
	Phenanthrene	0.01	µg/L	18		18				0.	0.	0.	0.	0.	0.	0.	0.	0.
HPAHs	Benzo(a)anthracene	0.01	µg/L	18		18				0.	0.	0.	0.	0.	0.	0.	0.	0.
	Benzo(a)pyrene	0.01	µg/L	18		18				0.	0.	0.	0.	0.	0.	0.	0.	0.
	Benzo(b,j,k)fluoranthene	0.03	µg/L	18	2	16	2			0.	0.	0.	0.	0.	0.	0.012	0.016	0.016
	Benzo(g,h,i)perylene	0.01	µg/L	18		18				0.	0.	0.	0.	0.	0.	0.	0.	0.
	Chrysene	0.01	µg/L	18	1	17			1	0.	0.	0.	0.	0.	0.	0.	0.017	0.017
	Dibenz(a,h)anthracene	0.01	µg/L	18		18				0.	0.	0.	0.	0.	0.	0.	0.	0.
	Fluoranthene	0.01	µg/L	18		18				0.	0.	0.	0.	0.	0.	0.	0.	0.
	Indeno(1,2,3-cd)pyrene	0.01	µg/L	18	1	17	1			0.	0.	0.	0.	0.	0.	0.	0.006	0.006
	Pyrene	0.01	µg/L	18	1	17			1	0.	0.	0.	0.	0.	0.	0.	0.038	0.038
	Retene	0.01	µg/L	18		18				0.	0.	0.	0.	0.	0.	0.	0.	0.
Phthalates	Bis(2-ethylhexyl) phthalate	0.5	µg/L	18		18				0.	0.	0.	0.	0.	0.	0.	0.	0.
	Butyl benzyl phthalate	0.5	µg/L	18		18				0.	0.	0.	0.	0.	0.	0.	0.	0.
	Diethyl phthalate	0.5	µg/L	18		18				0.	0.	0.	0.	0.	0.	0.	0.	0.
	Dimethyl phthalate	0.5	µg/L	18		18				0.	0.	0.	0.	0.	0.	0.	0.	0.
	Di-n-butyl phthalate	0.5	µg/L	18	1	17	1			0.	0.	0.	0.	0.	0.	0.	0.405	0.405
	Di-n-octyl phthalate	0.5	µg/L	18		18				0.	0.	0.	0.	0.	0.	0.	0.	0.
Herbicide	Dichlobenil	0.02	µg/L	18		18				0.	0.	0.	0.	0.	0.	0.	0.	0.
TPH	NWTPH-Diesel	0.1	mg/L	3		3				0.	0.	0.	0.	0.	0.	0.	0.	0.
	NWTPH-Heavy Oil	0.1	mg/L	3		3				0.	0.	0.	0.	0.	0.	0.	0.	0.

Trip Blanks

Class	Analyte	Tests N	D	ND	Evaluations Detect	MQO	Rej	Min	5%	10%	25%	Md	75%	90%	95%	Max
Conventionals	Anionic Surfactants - MBAS	2		2				0.	0.	0.	0.	0.	0.	0.	0.	0.
	BOD	2		2				0.	0.	0.	0.	0.	0.	0.	0.	0.
	Chloride	2		2				0.	0.	0.	0.	0.	0.	0.	0.	0.
	Hardness, Total as CaCO3	2	1	1	1			0.	0.	0.	0.	0.	0.05	0.05	0.05	0.05
	Total Suspended Solids	2		2				0.	0.	0.	0.	0.	0.	0.	0.	0.
	Turbidity	2	1	1		1		0.	0.	0.	0.	0.	0.74	0.74	0.74	0.74
Nutrients	Nitrate+Nitrite as N	2		2				0.	0.	0.	0.	0.	0.	0.	0.	0.
	Phosphate, Ortho	2		2				0.	0.	0.	0.	0.	0.	0.	0.	0.
	Phosphorus, Total	2		2				0.	0.	0.	0.	0.	0.	0.	0.	0.
	Total Nitrogen	2	1	1		1		0.	0.	0.	0.	0.	0.09	0.09	0.09	0.09
Metals	Cadmium	2		2				0.	0.	0.	0.	0.	0.	0.	0.	0.
	Cadmium, Dissolved	2		2				0.	0.	0.	0.	0.	0.	0.	0.	0.
	Copper	2		2				0.	0.	0.	0.	0.	0.	0.	0.	0.
	Copper, Dissolved	2		2				0.	0.	0.	0.	0.	0.	0.	0.	0.
	Lead	2		2				0.	0.	0.	0.	0.	0.	0.	0.	0.
	Lead, Dissolved	2	1	1				0.	0.	0.	0.	0.	0.05	0.05	0.05	0.05
	Mercury	2		2				0.	0.	0.	0.	0.	0.	0.	0.	0.
	Mercury, Dissolved	2		2				0.	0.	0.	0.	0.	0.	0.	0.	0.
	Zinc	2		2				0.	0.	0.	0.	0.	0.	0.	0.	0.
	Zinc, Dissolved	2		2				0.	0.	0.	0.	0.	0.	0.	0.	0.
Insecticides	Bifenthrin	2		2				0.	0.	0.	0.	0.	0.	0.	0.	0.
LPAHs	2-Methylnaphthalene	2		2				0.	0.	0.	0.	0.	0.	0.	0.	0.
	Acenaphthene	2		2				0.	0.	0.	0.	0.	0.	0.	0.	0.
	Acenaphthylene	2		2				0.	0.	0.	0.	0.	0.	0.	0.	0.
	Anthracene	2		2				0.	0.	0.	0.	0.	0.	0.	0.	0.
	Fluorene	2		2				0.	0.	0.	0.	0.	0.	0.	0.	0.
	Naphthalene	2		2				0.	0.	0.	0.	0.	0.	0.	0.	0.
	Phenanthrene	2		2				0.	0.	0.	0.	0.	0.	0.	0.	0.
HPAHs	Benzo(a)anthracene	2		2				0.	0.	0.	0.	0.	0.	0.	0.	0.
	Benzo(a)pyrene	2		2				0.	0.	0.	0.	0.	0.	0.	0.	0.
	Benzo(b,j,k)fluoranthene	2		2				0.	0.	0.	0.	0.	0.	0.	0.	0.
	Benzo(g,h,i)perylene	2		2				0.	0.	0.	0.	0.	0.	0.	0.	0.
	Chrysene	2		2				0.	0.	0.	0.	0.	0.	0.	0.	0.
	Dibenz(a,h)anthracene	2		2				0.	0.	0.	0.	0.	0.	0.	0.	0.
	Fluoranthene	2		2				0.	0.	0.	0.	0.	0.	0.	0.	0.
	Indeno(1,2,3-cd)pyrene	2		2				0.	0.	0.	0.	0.	0.	0.	0.	0.
	Pyrene	2		2				0.	0.	0.	0.	0.	0.	0.	0.	0.
	Retene	2		2				0.	0.	0.	0.	0.	0.	0.	0.	0.
Phthalates	Bis(2-ethylhexyl) phthalate	2		2				0.	0.	0.	0.	0.	0.	0.	0.	0.
	Butyl benzyl phthalate	2		2				0.	0.	0.	0.	0.	0.	0.	0.	0.
	Diethyl phthalate	2		2				0.	0.	0.	0.	0.	0.	0.	0.	0.
	Dimethyl phthalate	2		2				0.	0.	0.	0.	0.	0.	0.	0.	0.
	Di-n-butyl phthalate	2		2				0.	0.	0.	0.	0.	0.	0.	0.	0.
	Di-n-octyl phthalate	2		2				0.	0.	0.	0.	0.	0.	0.	0.	0.
Herbicide	Dichlobenil	2		2				0.	0.	0.	0.	0.	0.	0.	0.	0.
TPH	NWTPH-Diesel															
	NWTPH-Heavy Oil															

Ambient Air Blanks

Class	Analyte	Tests N	D	ND	Evaluations Detect	MQO	Rej	Min	5%	10%	25%	Md	75%	90%	95%	Max
Conventionals	Anionic Surfactants - MBAS	2		2				0.	0.	0.	0.	0.	0.	0.	0.	0.
	BOD	2		2				0.	0.	0.	0.	0.	0.	0.	0.	0.
	Chloride	2		2				0.	0.	0.	0.	0.	1.2	1.2	1.2	1.2
	Hardness, Total as CaCO3	2	1	1		1		0.	0.	0.	0.	0.	0.06	0.06	0.06	0.06
	Total Suspended Solids	2		2				0.	0.	0.	0.	0.	0.	0.	0.	0.
	Turbidity	2		2				0.	0.	0.	0.	0.	0.	0.	0.	0.
Nutrients	Nitrate+Nitrite as N	2		2				0.	0.	0.	0.	0.	0.	0.	0.	0.
	Phosphate, Ortho	2		2				0.	0.	0.	0.	0.	0.	0.	0.	0.
	Phosphorus, Total	2		2				0.	0.	0.	0.	0.	0.	0.	0.	0.
	Total Nitrogen	2		2				0.	0.	0.	0.	0.	0.	0.	0.	0.
Metals	Cadmium	2	1	1		1		0.	0.	0.	0.	0.	0.263	0.263	0.263	0.263
	Cadmium, Dissolved	2		2				0.	0.	0.	0.	0.	0.	0.	0.	0.
	Copper	2		2				0.	0.	0.	0.	0.	0.	0.	0.	0.
	Copper, Dissolved	2		2				0.	0.	0.	0.	0.	0.	0.	0.	0.
	Lead	2	1	1			1	0.	0.	0.	0.	0.	0.577	0.577	0.577	0.577
	Lead, Dissolved	2	1	1		1		0.	0.	0.	0.	0.	0.092	0.092	0.092	0.092
	Mercury	2		2				0.	0.	0.	0.	0.	0.	0.	0.	0.
	Mercury, Dissolved	2		2				0.	0.	0.	0.	0.	0.	0.	0.	0.
	Zinc	2		2				0.	0.	0.	0.	0.	0.	0.	0.	0.
	Zinc, Dissolved	2		2				0.	0.	0.	0.	0.	0.	0.	0.	0.
Insecticides	Bifenthrin	2		2				0.	0.	0.	0.	0.	0.	0.	0.	0.
LPAHs	2-Methylnaphthalene	2		2				0.	0.	0.	0.	0.	0.	0.	0.	0.
	Acenaphthene	2		2				0.	0.	0.	0.	0.	0.	0.	0.	0.
	Acenaphthylene	2		2				0.	0.	0.	0.	0.	0.	0.	0.	0.
	Anthracene	2		2				0.	0.	0.	0.	0.	0.	0.	0.	0.
	Fluorene	2		2				0.	0.	0.	0.	0.	0.	0.	0.	0.
	Naphthalene	2		2				0.	0.	0.	0.	0.	0.028	0.028	0.028	0.028
	Phenanthrene	2		2				0.	0.	0.	0.	0.	0.	0.	0.	0.
HPAHs	Benzo(a)anthracene	2		2				0.	0.	0.	0.	0.	0.	0.	0.	0.
	Benzo(a)pyrene	2		2				0.	0.	0.	0.	0.	0.	0.	0.	0.
	Benzo(b,j,k)fluoranthene	2		2				0.	0.	0.	0.	0.	0.	0.	0.	0.
	Benzo(g,h,i)perylene	2		2				0.	0.	0.	0.	0.	0.	0.	0.	0.
	Chrysene	2		2				0.	0.	0.	0.	0.	0.	0.	0.	0.
	Dibenz(a,h)anthracene	2		2				0.	0.	0.	0.	0.	0.	0.	0.	0.
	Fluoranthene	2		2				0.	0.	0.	0.	0.	0.	0.	0.	0.
	Indeno(1,2,3-cd)pyrene	2		2				0.	0.	0.	0.	0.	0.	0.	0.	0.
	Pyrene	2		2				0.	0.	0.	0.	0.	0.	0.	0.	0.
	Retene	2		2				0.	0.	0.	0.	0.	0.	0.	0.	0.
Phthalates	Bis(2-ethylhexyl) phthalate	2		2				0.	0.	0.	0.	0.	0.	0.	0.	0.
	Butyl benzyl phthalate	2		2				0.	0.	0.	0.	0.	0.	0.	0.	0.
	Diethyl phthalate	2		2				0.	0.	0.	0.	0.	0.	0.	0.	0.
	Dimethyl phthalate	2		2				0.	0.	0.	0.	0.	0.	0.	0.	0.
	Di-n-butyl phthalate	2		2				0.	0.	0.	0.	0.	0.	0.	0.	0.
	Di-n-octyl phthalate	2		2				0.	0.	0.	0.	0.	0.	0.	0.	0.
Herbicide	Dichlobenil	2		2				0.	0.	0.	0.	0.	0.	0.	0.	0.
TPH	NWTPH-Diesel															
	NWTPH-Heavy Oil															

Rinse Blanks

Class	Analyte	Tests N	D	ND	Evaluations Detect	MQO	Rej	Min	5%	10%	25%	Md	75%	90%	95%	Max
Conventionals	Anionic Surfactants - MBAS	6		6				0.	0.	0.	0.	0.	0.	0.	0.	0.
	BOD	6		6				0.	0.	0.	0.	0.	0.	0.	0.	0.
	Chloride	6		6				0.	0.	0.	0.	0.	0.	0.	0.	0.
	Hardness, Total as CaCO3	6	6			6		0.06	0.06	0.06	0.07	0.14	0.18	0.24	0.24	0.24
	Total Suspended Solids	6	2	4		2		0.	0.	0.	0.	0.	1.1	1.5	1.5	1.5
	Turbidity	6	5	1		2	3	0.	0.	0.	0.64	0.67	2.45	2.78	2.78	2.78
Nutrients	Nitrate+Nitrite as N	6		6				0.	0.	0.	0.	0.	0.	0.	0.	0.
	Phosphate, Ortho	6		6				0.	0.	0.	0.	0.	0.	0.	0.	0.
	Phosphorus, Total	6	3	3		2	1	0.	0.	0.	0.	0.	0.01	0.016	0.016	0.016
	Total Nitrogen	6	3	3		3		0.	0.	0.	0.	0.	0.15	0.15	0.15	0.15
Metals	Cadmium	6		6				0.	0.	0.	0.	0.	0.	0.	0.	0.
	Cadmium, Dissolved	6		6				0.	0.	0.	0.	0.	0.	0.	0.	0.
	Copper	6	2	4		1	1	0.	0.	0.	0.	0.	2.08	6.23	6.23	6.23
	Copper, Dissolved	6	1	5			1	0.	0.	0.	0.	0.	0.	0.471	0.471	0.471
	Lead	6	1	5			1	0.	0.	0.	0.	0.	0.	3.44	3.44	3.44
	Lead, Dissolved	6	1	5		1		0.	0.	0.	0.	0.	0.	0.057	0.057	0.057
	Mercury	6		6				0.	0.	0.	0.	0.	0.	0.	0.	0.
	Mercury, Dissolved	6		6				0.	0.	0.	0.	0.	0.	0.	0.	0.
	Zinc	6	2	4	2	1		0.	0.	0.	0.	0.	3.18	12.1	12.1	12.1
	Zinc, Dissolved	6	6		5	1		0.19	0.19	0.19	0.2	0.24	0.51	2.27	2.27	2.27
Insecticides	Bifenthrin	6		6				0.	0.	0.	0.	0.	0.	0.	0.	0.
LPAHs	2-Methylnaphthalene	6		6				0.	0.	0.	0.	0.	0.	0.	0.	0.
	Acenaphthene	6		6				0.	0.	0.	0.	0.	0.	0.	0.	0.
	Acenaphthylene	6		6				0.	0.	0.	0.	0.	0.	0.	0.	0.
	Anthracene	6		6				0.	0.	0.	0.	0.	0.	0.	0.	0.
	Fluorene	6		6				0.	0.	0.	0.	0.	0.	0.	0.	0.
	Naphthalene	6		6				0.	0.	0.	0.	0.	0.	0.	0.	0.
	Phenanthrene	6		6				0.	0.	0.	0.	0.	0.	0.	0.	0.
HPAHs	Benzo(a)anthracene	6		6				0.	0.	0.	0.	0.	0.	0.	0.	0.
	Benzo(a)pyrene	6		6				0.	0.	0.	0.	0.	0.	0.	0.	0.
	Benzo(b,j,k)fluoranthene	6		6				0.	0.	0.	0.	0.	0.	0.	0.	0.
	Benzo(g,h,i)perylene	6		6				0.	0.	0.	0.	0.	0.	0.	0.	0.
	Chrysene	6		6				0.	0.	0.	0.	0.	0.	0.	0.	0.
	Dibenz(a,h)anthracene	6		6				0.	0.	0.	0.	0.	0.	0.	0.	0.
	Fluoranthene	6		6				0.	0.	0.	0.	0.	0.	0.	0.	0.
	Indeno(1,2,3-cd)pyrene	6		6				0.	0.	0.	0.	0.	0.	0.	0.	0.
	Pyrene	6		6				0.	0.	0.	0.	0.	0.	0.	0.	0.
	Retene	6		6				0.	0.	0.	0.	0.	0.	0.	0.	0.
Phthalates	Bis(2-ethylhexyl) phthalate	6		6				0.	0.	0.	0.	0.	0.	0.	0.	0.
	Butyl benzyl phthalate	6		6				0.	0.	0.	0.	0.	0.	0.	0.	0.
	Diethyl phthalate	6		6				0.	0.	0.	0.	0.	0.	0.	0.	0.
	Dimethyl phthalate	6		6				0.	0.	0.	0.	0.	0.	0.	0.	0.
	Di-n-butyl phthalate	6		6				0.	0.	0.	0.	0.	0.	0.	0.	0.
	Di-n-octyl phthalate	6		6				0.	0.	0.	0.	0.	0.	0.	0.	0.
Herbicide	Dichlobenil	6		6				0.	0.	0.	0.	0.	0.	0.	0.	0.
TPH	NWTPH-Diesel															
	NWTPH-Heavy Oil															

N = Tests, D = Detections, ND = Non-detections, Md = Median, Min = Minimum, Max = Maximum

Detect	Detection in blank which does not exceed the reporting limit goal
MQO	Blank detection > reporting limit goal
Rejection	Blank detection > reporting limit goal and > 10% sample result, raise reporting limit and flag "UJ". Rejection of sample data based on blank results only applies to laboratory blanks, unless specific linkages and corroborating evidence are present to reject due to a field blank. Gross contamination is defined as a blank result greater than 5X the detection limit goal.

Table B7-8
Bias SSPM Certified Reference Material - WY2023

Class	Analyte	Detection Limit Goal		Report Value	Ref Value	Recovery of Reference	[1]MQO		Prediction Int.	
		Conc.	Units				<	>	<	>
Nutrients	Phosphorus, Total	0.01	mg/Kg	474	526	90%	75%	125%	44%	156%
Metals	Cadmium	0.1	mg/Kg dry	138	136	102%	75%	125%	75%	125%
	Copper	0.1	mg/Kg dry	59.7	54.5	109%	75%	125%	75%	125%
	Lead	0.1	mg/Kg dry	133	129	103%	75%	125%	72%	128%
	Mercury	0.005	mg/Kg dry	23.5	24.4	96%	75%	125%	63%	137%
	Zinc	0.5	mg/Kg dry	164	157	104%	75%	125%	70%	130%
LPAHs	Acenaphthene	70	µg/Kg dry	2880	3700	78%	60%	140%	51%	149%
	Acenaphthylene	70	µg/Kg dry	1200	1560	77%	60%	140%	49%	151%
	Anthracene	70	µg/Kg dry	2800	3720	75%	60%	140%	44%	156%
	Fluorene	70	µg/Kg dry	4550	5690	80%	60%	140%	32%	168%
	Phenanthrene	70	µg/Kg dry	3210	3940	81%	60%	140%	43%	157%
HPAHs	Benzo(a)anthracene	70	µg/Kg dry	2360	2390	99%	60%	140%	46%	154%
	Benzo(a)pyrene	70	µg/Kg dry	2160	2440	89%	60%	140%	36%	164%
	Benzo(b,j,k)fluoranthene	210	µg/Kg dry	3980	4130	97%	60%	140%	36%	164%
	Benzo(g,h,i)perylene	70	µg/Kg dry	1050	1360	77%	60%	140%	1%	199%
	Chrysene	70	µg/Kg dry	1990	2440	82%	60%	140%	53%	147%
	Dibenz(a,h)anthracene	70	µg/Kg dry	1250	1400	90%	60%	140%	32%	168%
	Fluoranthene	70	µg/Kg dry	3430	3770	91%	60%	140%	35%	165%
	Indeno(1,2,3-cd)pyrene	70	µg/Kg dry	1310	1370	96%	60%	140%	32%	168%
	Pyrene	70	µg/Kg dry	3850	4540	85%	60%	140%	39%	161%
Phthalates	Bis(2-ethylhexyl) phthalate	70	µg/Kg dry	6160	6730	92%	60%	140%	28%	172%
	Butyl benzyl phthalate	70	µg/Kg dry	4780	5140	93%	60%	140%	31%	169%
	Diethyl phthalate	70	µg/Kg dry	2260	3000	75%	60%	140%	51%	149%
	Dimethyl phthalate	70	µg/Kg dry	3070	4190	73%	60%	140%	32%	168%
	Di-n-octyl phthalate	70	µg/Kg dry	1410	1580	89%	60%	140%	43%	157%
PCBs	Aroclor-1254	10	µg/Kg dry	5050	5930	85%	60%	140%	41%	159%
Phenols	Pentachlorophenol	270	µg/Kg dry	3240	4080	79%	60%	140%	1%	199%
	2-Methylphenol	70	µg/Kg dry	1580	2890	55%	60%	140%	19%	181%

[1]A confidence interval was not provided and the MQO for MS/MSD was substituted

V = Value, F = Flag, PI = Prediction Interval - measurements should fall within the PI 19 of 20 times

< PI Recovery less than prediction interval, may be used to reject sample data.

ML Recovery below MQO and above rejection or censor range.

Recovery within Measurement Quality Objective

ML Recovery above MQO and below rejection or censor range.

> PI Recovery greater than prediction interval, may be used to directly reject sample data.

Table B9-1.1
WY2023 Storm Event Hydrology for OF230

Storm Event	Season	Sampled?	Storm Start Date & Time	Storm Duration (hours)	Total Rain (inches)	Estimated Runoff (inches)	Estimated Storm Volume (acre-feet)	Estimated Mean Stormflow (gpm)	Estimated Combined Flow (gpm)	Storm Fraction (unitless)
Wet Season										
1	Wet		10/21/2022 11:10	14.92	0.42	0.13	6.24	2271	2271	1.00
2	Wet		10/24/2022 2:45	5.92	0.17	0.05	2.53	2316	2316	1.00
3	Wet		10/25/2022 11:40	9.67	0.43	0.14	6.39	3587	3587	1.00
4	Wet		10/28/2022 3:30	3.08	0.12	0.04	1.78	3143	3143	1.00
5	Wet		10/30/2022 18:55	14.25	0.58	0.19	8.61	3283	3283	1.00
6	Wet		11/1/2022 21:35	3.58	0.11	0.04	1.63	2479	2479	1.00
7	Wet		11/2/2022 11:40	1.08	0.06	0.02	0.89	4481	4481	1.00
8	Wet		11/3/2022 11:45	6.33	0.16	0.05	2.38	2039	2039	1.00
9	Wet		11/4/2022 2:40	14.25	0.79	0.25	11.73	4472	4472	1.00
10	Wet		11/6/2022 0:40	6.92	0.76	0.24	11.29	8859	8859	1.00
11	Wet		11/6/2022 19:35	6.92	0.11	0.04	1.63	1282	1282	1.00
12	Wet		11/7/2022 8:40	8.33	0.1	0.03	1.49	968	968	1.00
13	Wet	x	11/22/2022 6:40	9.00	0.88	0.28	13.07	7887	7887	1.00
14	Wet		11/25/2022 9:15	7.25	0.61	0.20	9.06	6787	6787	1.00
15	Wet		11/26/2022 22:30	4.67	0.07	0.02	1.04	1209	1209	1.00
16	Wet		11/29/2022 12:25	17.67	1.29	0.41	19.16	5889	5889	1.00
17	Wet		11/30/2022 13:50	5.83	0.12	0.04	1.78	1660	1660	1.00
18	Wet		12/1/2022 5:55	3.33	0.08	0.03	1.19	1938	1938	1.00
19	Wet		12/2/2022 18:55	7.25	0.42	0.13	6.24	4673	4673	1.00
20	Wet		12/4/2022 9:50	8.92	0.49	0.16	7.28	4431	4431	1.00
21	Wet		12/5/2022 18:00	17.08	0.09	0.03	1.34	425	425	1.00
22	Wet		12/8/2022 1:00	6.00	0.14	0.04	2.08	1882	1882	1.00
23	Wet		12/8/2022 19:50	8.42	0.1	0.03	1.49	958	958	1.00
24	Wet	x	12/9/2022 15:30	27.50	0.58	0.19	8.61	1701	1701	1.00
25	Wet		12/11/2022 10:00	4.33	0.04	0.01	0.59	745	745	1.00
26	Wet		12/12/2022 3:10	1.17	0.03	0.01	0.45	2068	2068	1.00
27	Wet		12/19/2022 19:50	4.33	0.04	0.01	0.03	32	32	1.00
28	Wet		12/20/2022 7:00	5.92	0.59	0.19	0.38	346	346	1.00
29	Wet		12/23/2022 11:35	27.25	1.38	0.44	0.88	176	176	1.00
30	Wet		12/25/2022 8:25	23.92	0.99	0.32	0.63	144	144	1.00
31	Wet		12/26/2022 17:50	13.42	0.59	0.19	0.38	153	153	1.00
32	Wet		12/27/2022 13:25	3.17	0.06	0.02	0.04	66	66	1.00
33	Wet	x	12/29/2022 20:50	12.50	0.54	0.17	0.35	150	150	1.00
34	Wet		12/30/2022 20:00	2.92	0.11	0.04	0.07	131	131	1.00
35	Wet		1/3/2023 1:20	3.75	0.05	0.02	0.03	46	46	1.00
36	Wet		1/4/2023 17:15	3.83	0.09	0.03	0.06	82	82	1.00
37	Wet		1/5/2023 22:30	2.42	0.12	0.04	0.08	172	172	1.00
38	Wet		1/6/2023 10:45	31.17	0.44	0.14	0.28	49	49	1.00
39	Wet		1/8/2023 3:45	16.83	0.26	0.08	0.17	54	54	1.00
40	Wet		1/9/2023 12:50	21.58	0.15	0.05	0.10	24	24	1.00
41	Wet		1/11/2023 19:05	51.58	0.67	0.21	0.43	45	45	1.00
42	Wet		1/14/2023 21:20	2.08	0.03	0.01	0.02	50	50	1.00
43	Wet		1/15/2023 6:05	13.00	0.29	0.09	0.19	78	78	1.00
44	Wet		1/17/2023 18:50	2.17	0.07	0.02	0.04	112	112	1.00
45	Wet		1/18/2023 9:00	2.67	0.1	0.03	0.06	130	130	1.00
46	Wet		1/21/2023 10:20	4.92	0.12	0.04	0.08	85	85	1.00
47	Wet		1/22/2023 5:30	1.00	0.03	0.01	0.02	104	104	1.00
48	Wet		1/28/2023 4:20	0.92	0.05	0.02	0.03	189	189	1.00
49	Wet		1/28/2023 18:05	1.33	0.03	0.01	0.02	78	78	1.00
50	Wet		2/3/2023 16:05	12.92	0.16	0.05	0.10	43	43	1.00
51	Wet		2/4/2023 13:50	7.75	0.1	0.03	0.06	45	45	1.00
52	Wet		2/5/2023 5:55	4.75	0.15	0.05	0.10	110	110	1.00
53	Wet		2/6/2023 15:00	0.50	0.03	0.01	0.02	209	209	1.00
54	Wet		2/7/2023 0:55	14.92	0.21	0.07	0.13	49	49	1.00
55	Wet		2/9/2023 22:45	0.75	0.03	0.01	0.02	139	139	1.00
56	Wet		2/12/2023 23:40	6.67	0.09	0.03	0.06	47	47	1.00
57	Wet		2/13/2023 20:45	4.67	0.15	0.05	0.10	112	112	1.00
58	Wet		2/14/2023 8:35	1.75	0.08	0.03	0.05	159	159	1.00
59	Wet		2/17/2023 5:05	4.67	0.07	0.02	0.04	52	52	1.00
60	Wet		2/18/2023 17:05	2.33	0.06	0.02	0.04	90	90	1.00
61	Wet		2/20/2023 17:10	1.92	0.1	0.03	0.06	181	181	1.00
62	Wet		2/25/2023 23:30	5.08	0.2	0.06	0.13	137	137	1.00
63	Wet		2/27/2023 12:30	12.75	0.19	0.06	0.12	52	52	1.00
64	Wet		3/2/2023 0:25	8.08	0.1	0.03	0.06	43	43	1.00
65	Wet		3/3/2023 5:05	27.67	0.57	0.18	0.36	72	72	1.00
66	Wet		3/5/2023 18:45	1.92	0.11	0.04	0.07	199	199	1.00
67	Wet		3/6/2023 21:45	7.25	0.07	0.02	0.04	34	34	1.00
68	Wet		3/8/2023 14:55	1.58	0.09	0.03	0.06	198	198	1.00
69	Wet		3/10/2023 2:10	1.00	0.03	0.01	0.02	104	104	1.00
70	Wet		3/10/2023 17:20	8.75	0.08	0.03	0.05	32	32	1.00
71	Wet		3/12/2023 12:25	26.67	0.63	0.20	0.40	82	82	1.00
72	Wet		3/19/2023 22:25	11.00	0.2	0.06	0.13	63	63	1.00
73	Wet		3/31/2023 14:30	12.67	0.25	0.08	0.16	69	69	1.00
74	Wet		4/1/2023 9:35	5.33	0.06	0.02	0.04	39	39	1.00
75	Wet		4/1/2023 23:05	13.75	0.2	0.06	0.13	51	51	1.00
76	Wet		4/2/2023 20:30	4.67	0.16	0.05	0.10	119	119	1.00
77	Wet		4/6/23 2:20 AM	26.67	0.41	0.13	0.26	53	53	1.00
78	Wet		4/8/23 10:40 AM	4.50	0.13	0.04	0.08	100	100	1.00
79	Wet		4/9/23 2:45 AM	44.25	1.11	0.36	0.71	87	87	1.00
80	Wet		4/11/2023 5:35	2.00	0.1	0.03	0.06	174	174	1.00
81	Wet		4/16/23 7:10 AM	9.00	0.43	0.14	0.28	166	166	1.00
82	Wet		4/17/23 2:30 PM	4.75	0.04	0.01	0.03	29	29	1.00
83	Wet		4/18/23 3:25 AM	5.50	0.05	0.02	0.03	32	32	1.00
84	Wet		4/20/23 12:00 PM	9.42	0.1	0.03	0.06	37	37	1.00
85	Wet		4/22/23 6:20 PM	12.08	0.26	0.08	0.17	75	75	1.00
86	Wet		4/23/23 8:35 PM	4.83	0.09	0.03	0.06	65	65	1.00
			Total Wet Season	**811.12**	**22.44**	**7.18**	**139**			
			Mean Wet Season Flow					**148**		
Dry Season										
87	Dry		5/4/2023 23:50	19.33	0.52	0.17	0.33	94	94	1.00
88	Dry		6/9/2023 3:05	4.75	0.09	0.03	0.06	66	66	1.00
89	Dry		6/9/2023 16:40	16.50	0.09	0.03	0.06	19	19	1.00
90	Dry		6/20/2023 2:35	3.83	0.05	0.02	0.03	45	45	1.00
91	Dry		7/24/2023 18:35	1.58	0.08	0.03	0.05	176	176	1.00
92	Dry		8/22/2023 19:00	5.92	0.16	0.05	0.10	94	94	1.00
93	Dry		8/31/2023 3:10	11.92	0.11	0.04	0.07	32	32	1.00
94	Dry		9/18/2023 5:20	1.67	0.08	0.03	0.05	167	167	1.00
95	Dry		9/20/2023 2:35	9.33	0.07	0.02	0.04	26	26	1.00
96	Dry		9/23/2023 12:10	7.00	0.24	0.08	0.15	119	119	1.00
97	Dry		9/24/2023 13:15	30.67	0.91	0.29	0.58	103	103	1.00
98	Dry		9/26/2023 12:10	6.83	0.29	0.09	0.19	148	148	1.00
99	Dry		9/27/2023 1:35	7.00	0.53	0.17	0.34	263	263	1.00
			Total Dry Season	**126.33**	**3.22**	**1.03**	**2.1**			
			Mean Dry Season Flow					**3**		
			Total Annual	**937.45**	**25.66**	**8.21**	**141**			
			Mean Annual Flow					**87**		

Notes: [1] Mean Annual Baseflow estimated based on rerouting of the drainage system to OF230A.

[2] Stormflow calculations are based on the historical rainfall to runoff relationship for the historic OF230 drainage area.The majority of the drainage area is now discharging to the new OF230A.

A new rainfall to runoff coefficient will be calculated once sufficient flow data is collected at the new monitoring location.

[3] Drainage area was changed 10/1/2022 with incremental changes through 12/15/2022, flow was estimated during this time. Storm flow calculations are based on new drainage area starting with storm number 27.

Due to estimated stormwater pollutant loadings will not be reported WY2023.

Drainage Area Historical:	557	acres
Drainage Area Current:	24	acres[3]
Mean Baseflow:	0	gpm[1]

	Rain Threshold (in)	Runoff Coefficient [2]
Wet Season	0.000	0.32
Dry Season	0.000	0.32

Table B9-1.2.a
WY2023 Storm Event Hydrology for OF235
10/1/2022-12/18/2022

Storm Event	Season	Sampled?	Storm Start Date and Time	Storm Duration (hours)	Total Rain (inches)	Estimated Runoff (inches)	Estimated Storm Volume (acre-feet)	Estimated Mean Stormflow (gpm)	Estimated Combined Flow (gpm)	Storm Fraction (unitless)
Wet Season										
1	Wet	x	10/21/2022 11:10	14.92	0.42	0.23	3.19	1160	1270	0.91
2	Wet		10/24/2022 2:45	5.92	0.17	0.09	1.29	1183	1293	0.91
3	Wet		10/25/2022 11:40	9.67	0.43	0.24	3.26	1832	1942	0.94
4	Wet		10/28/2022 3:30	3.08	0.12	0.07	0.91	1605	1715	0.94
5	Wet	x	10/30/2022 18:55	14.25	0.58	0.32	4.40	1677	1787	0.94
6	Wet		11/1/2022 21:35	3.58	0.11	0.06	0.83	1266	1376	0.92
7	Wet		11/2/2022 11:40	1.08	0.06	0.03	0.46	2288	2398	0.95
8	Wet		11/3/2022 11:45	6.33	0.16	0.09	1.21	1041	1151	0.90
9	Wet		11/4/2022 2:40	14.25	0.79	0.43	5.99	2284	2394	0.95
10	Wet		11/6/2022 0:40	6.92	0.76	0.42	5.76	4524	4634	0.98
11	Wet		11/6/2022 19:35	6.92	0.11	0.06	0.83	655	765	0.86
12	Wet		11/7/2022 8:40	8.33	0.1	0.05	0.76	495	604	0.82
13	Wet	x	11/22/2022 6:40	9.00	0.88	0.48	6.67	4028	4138	0.97
14	Wet		11/25/2022 9:15	7.25	0.61	0.33	4.63	3466	3576	0.97
15	Wet		11/26/2022 22:30	4.67	0.07	0.04	0.53	617	727	0.85
16	Wet		11/29/2022 12:25	17.67	1.29	0.71	9.78	3007	3117	0.96
17	Wet		11/30/2022 13:50	5.83	0.12	0.07	0.91	848	958	0.89
18	Wet		12/1/2022 5:55	3.33	0.08	0.04	0.61	990	1100	0.90
19	Wet		12/2/2022 18:55	7.25	0.42	0.23	3.19	2386	2496	0.96
20	Wet		12/4/2022 9:50	8.92	0.49	0.27	3.72	2263	2373	0.95
21	Wet		12/5/2022 18:00	17.08	0.09	0.05	0.68	217	327	0.66
22	Wet		12/8/2022 1:00	6.00	0.14	0.08	1.06	961	1071	0.90
23	Wet		12/8/2022 19:50	8.42	0.1	0.05	0.76	489	599	0.82
24	Wet	x	12/9/2022 15:30	27.50	0.58	0.32	4.40	869	979	0.89
25	Wet		12/11/2022 10:00	4.33	0.04	0.02	0.30	381	490	0.78
26	Wet		12/12/2022 3:10	1.17	0.03	0.02	0.23	1056	1166	0.91
Total Wet Season				**223.67**	**8.75**	**4.80**	**66**			
Mean Wet Season Flow (10/1-12/18)								**190**		

Note: [1] *Mean Annual Baseflow based on Water Year 2010 Record in Outfall 235*

[2] *Stormflow calculations are based on the historical rainfall to runoff relationship for the historic OF235 drainage area.*

[3] *Effective 12/15/2022, the drainage area for OF235 was modified. Storm flow calculations from 10/1/022 through 12/18/2022 are based on drainage basin area prior to modification. See Table B9-1.2.b.*

Drainage Area: 166 acres

Mean Baseflow: 110 gpm[1]

	Rain Threshold (in)	Runoff Coefficient[2]
Wet Season	0	0.55
Dry Season	0	0.48

Table B9-1.2.b
WY2023 Storm Event Hydrology for OF235

Storm Event	Season	Sampled?	Storm Start Date and Time	Storm Duration (hours)	Total Rain (inches)	Estimated Runoff (inches)	Estimated Storm Volume (acre-feet)	Estimated Mean Stormflow (gpm)	Estimated Combined Flow (gpm)	Storm Fraction (unitless)
Wet Season										
27	Wet		12/19/2022 19:50	4.33	0.04	0.02	0.20	250	360	0.69
28	Wet		12/20/2022 7:00	5.92	0.59	0.32	2.94	2696	2806	0.96
29	Wet		12/23/2022 11:35	27.25	1.38	0.76	6.87	1370	1480	0.93
30	Wet		12/25/2022 8:25	23.92	0.99	0.54	4.93	1119	1229	0.91
31	Wet		12/26/2022 17:50	13.42	0.59	0.32	2.94	1189	1299	0.92
32	Wet		12/27/2022 13:25	3.17	0.06	0.03	0.30	512	622	0.82
33	Wet	x	12/29/2022 20:50	12.50	0.54	0.30	2.69	1168	1278	0.91
34	Wet		12/30/2022 20:00	2.92	0.11	0.06	0.55	1019	1129	0.90
35	Wet		1/3/2023 1:20	3.75	0.05	0.03	0.25	361	471	0.77
36	Wet		1/4/2023 17:15	3.83	0.09	0.05	0.45	636	746	0.85
37	Wet		1/5/2023 22:30	2.42	0.12	0.07	0.60	1341	1451	0.92
38	Wet		1/6/2023 10:45	31.17	0.44	0.24	2.19	382	492	0.78
39	Wet		1/8/2023 3:45	16.83	0.26	0.14	1.29	418	528	0.79
40	Wet		1/9/2023 12:50	21.58	0.15	0.08	0.75	188	298	0.63
41	Wet	x	1/11/2023 19:05	51.58	0.67	0.37	3.34	351	461	0.76
42	Wet		1/14/2023 21:20	2.08	0.03	0.02	0.15	390	500	0.78
43	Wet		1/15/2023 6:05	13.00	0.29	0.16	1.44	603	713	0.85
44	Wet		1/17/2023 18:50	2.17	0.07	0.04	0.35	873	982	0.89
45	Wet		1/18/2023 9:00	2.67	0.1	0.05	0.50	1013	1123	0.90
46	Wet		1/21/2023 10:20	4.92	0.12	0.07	0.60	660	770	0.86
47	Wet		1/22/2023 5:30	1.00	0.03	0.02	0.15	811	921	0.88
48	Wet		1/28/2023 4:20	0.92	0.05	0.03	0.25	1470	1580	0.93
49	Wet		1/28/2023 18:05	1.33	0.03	0.02	0.15	610	720	0.85
50	Wet		2/3/2023 16:05	12.92	0.16	0.09	0.80	335	445	0.75
51	Wet		2/4/2023 13:50	7.75	0.1	0.05	0.50	349	459	0.76
52	Wet		2/5/2023 5:55	4.75	0.15	0.08	0.75	854	964	0.89
53	Wet		2/6/2023 15:00	0.50	0.03	0.02	0.15	1623	1733	0.94
54	Wet		2/7/2023 0:55	14.92	0.21	0.12	1.05	381	491	0.78
55	Wet		2/9/2023 22:45	0.75	0.03	0.02	0.15	1082	1192	0.91
56	Wet		2/12/2023 23:40	6.67	0.09	0.05	0.45	365	475	0.77
57	Wet		2/13/2023 20:45	4.67	0.15	0.08	0.75	869	979	0.89
58	Wet		2/14/2023 8:35	1.75	0.08	0.04	0.40	1236	1346	0.92
59	Wet		2/17/2023 5:05	4.67	0.07	0.04	0.35	405	515	0.79
60	Wet		2/18/2023 17:05	2.33	0.06	0.03	0.30	697	806	0.86
61	Wet		2/20/2023 17:10	1.92	0.1	0.05	0.50	1409	1519	0.93
62	Wet		2/25/2023 23:30	5.08	0.2	0.11	1.00	1065	1175	0.91
63	Wet		2/27/2023 12:30	12.75	0.19	0.10	0.95	403	513	0.79
64	Wet		3/2/2023 0:25	8.08	0.1	0.05	0.50	335	445	0.75
65	Wet		3/3/2023 5:05	27.67	0.57	0.31	2.84	557	667	0.84
66	Wet		3/5/2023 18:45	1.92	0.11	0.06	0.55	1550	1660	0.93
67	Wet		3/6/2023 21:45	7.25	0.07	0.04	0.35	261	371	0.70
68	Wet		3/8/2023 14:55	1.58	0.09	0.05	0.45	1541	1651	0.93
69	Wet		3/10/2023 2:10	1.00	0.03	0.02	0.15	811	921	0.88
70	Wet		3/10/2023 17:20	8.75	0.08	0.04	0.40	247	357	0.69
71	Wet	x	3/12/2023 12:25	26.67	0.63	0.35	3.14	639	749	0.85
72	Wet	x	3/19/2023 22:25	11.00	0.2	0.11	1.00	492	602	0.82
73	Wet		3/31/2023 14:30	12.67	0.25	0.14	1.25	534	644	0.83
74	Wet		4/1/23 9:35 AM	5.33	0.06	0.03	0.30	304	414	0.73
75	Wet		4/1/23 11:05 PM	13.75	0.2	0.11	1.00	393	503	0.78
76	Wet		4/2/23 8:30 PM	4.67	0.16	0.09	0.80	927	1037	0.89
77	Wet		4/6/23 2:20 AM	26.67	0.41	0.22	2.04	416	526	0.79
78	Wet		4/8/23 10:40 AM	4.50	0.13	0.07	0.65	781	891	0.88
79	Wet		4/9/23 2:45 AM	44.25	1.11	0.61	5.53	678	788	0.86
80	Wet		4/11/2023 5:35	2.00	0.1	0.05	0.50	1352	1462	0.92
81	Wet	x	4/16/23 7:10 AM	9.00	0.43	0.24	2.14	1292	1402	0.92
82	Wet		4/17/23 2:30 PM	4.75	0.04	0.02	0.20	228	338	0.67
83	Wet		4/18/23 3:25 AM	5.50	0.05	0.03	0.25	246	356	0.69
84	Wet		4/20/23 12:00 PM	9.42	0.1	0.05	0.50	287	397	0.72
85	Wet		4/22/23 6:20 PM	12.08	0.26	0.14	1.29	582	692	0.84
86	Wet		4/23/23 8:35 PM	4.83	0.09	0.05	0.45	504	614	0.82
Total Wet Season (12/19 - 4/30)				**587.45**	**13.69**	**7.51**	**68**			
Total Wet Season (10/1 - 12/18)[4]				**223.67**	**8.75**	**4.80**	**66**			
Mean Wet Season Flow (12/19 - 4/30)[3]								**116**		
Dry Season										
87	Dry	x	5/4/2023 23:50	19.33	0.52	0.25	2.26	636	746	0.85
88	Dry		6/9/2023 3:05	4.75	0.09	0.04	0.39	448	558	0.80
89	Dry		6/9/2023 16:40	16.50	0.09	0.04	0.39	129	239	0.54
90	Dry		6/20/2023 2:35	3.83	0.05	0.02	0.22	308	418	0.74
91	Dry		7/24/2023 18:35	1.58	0.08	0.04	0.35	1196	1306	0.92
92	Dry		8/22/2023 19:00	5.92	0.16	0.08	0.70	639	749	0.85
93	Dry		8/31/2023 3:10	11.92	0.11	0.05	0.48	218	328	0.66
94	Dry		9/18/2023 5:20	1.67	0.08	0.04	0.35	1132	1242	0.91
95	Dry		9/20/2023 2:35	9.33	0.07	0.03	0.30	177	287	0.62
96	Dry		9/23/2023 12:10	7.00	0.24	0.11	1.04	810	920	0.88
97	Dry	x	9/24/2023 13:15	30.67	0.91	0.44	3.96	701	811	0.86
98	Dry		9/26/2023 12:10	6.83	0.29	0.14	1.26	1003	1113	0.90
99	Dry		9/27/2023 1:35	7.00	0.53	0.25	2.31	1789	1899	0.94
Total Dry Season				**126.33**	**3.22**	**1.54**	**14.0**			
Mean Dry Season Flow								**21**		
Total Annual				**937.45**	**25.66**	**13.85**	**148**			
Mean Annual Flow								**92**		

Note:

1 Mean Annual Baseflow based on Water Year 2010 Record in Outfall 235

2 Stormflow calculations are based on the historical rainfall to runoff relationship for the historic OF235 drainage area.

3 Effective 12/15/2022, the drainage area for OF235 was modified. Storm flow calculations are based on new drainage starting from 12/19/2022.

4 Totals for Wet Season (10/1 - 12/18) are calculated using historical area see Table B9-1.2.a.

Drainage Area Historical:	166 acres
Drainage Area New:	109 acres
Mean Baseflow:	110 gpm[1]

	Rain Threshold (in)	Runoff Coefficient[2]
Wet Season	0	0.55
Dry Season	0	0.48

Table B9-1.3
WY2023 Storm Event Hydrology for OF237A

Storm Event	Season	Sampled?	Storm Start Date & Time	Storm Duration (hours)	Total Rain (inches)	Estimated Runoff (inches)	Estimated Storm Volume (acre-feet)	Estimated Mean Stormflow (gpm)	Estimated Combined Flow (gpm)	Storm Fraction (unitless)
Wet Season										
1	Wet	x	10/21/2022 11:10	14.92	0.42	0.14	31.75	11558	14013	0.82
2	Wet		10/24/2022 2:45	5.92	0.17	0.06	14.11	12946	15401	0.84
3	Wet		10/25/2022 11:40	9.67	0.43	0.14	32.46	18229	20684	0.88
4	Wet		10/28/2022 3:30	3.08	0.12	0.05	10.58	18662	21117	0.88
5	Wet		10/30/2022 18:55	14.25	0.58	0.18	43.04	16404	18859	0.87
6	Wet		11/1/2022 21:35	3.58	0.11	0.04	9.88	14985	17440	0.86
7	Wet		11/2/2022 11:40	1.08	0.06	0.03	6.35	31933	34388	0.93
8	Wet		11/3/2022 11:45	6.33	0.16	0.06	13.41	11502	13957	0.82
9	Wet	x	11/4/2022 2:40	14.25	0.79	0.25	57.86	22051	24506	0.90
10	Wet		11/6/2022 0:40	6.92	0.76	0.24	55.74	43747	46202	0.95
11	Wet		11/6/2022 19:35	6.92	0.11	0.04	9.88	7753	10208	0.76
12	Wet		11/7/2022 8:40	8.33	0.1	0.04	9.17	5980	8435	0.71
13	Wet	x	11/22/2022 6:40	9.00	0.88	0.27	64.21	38746	41201	0.94
14	Wet		11/25/2022 9:15	7.25	0.61	0.19	45.16	33827	36282	0.93
15	Wet		11/26/2022 22:30	4.67	0.07	0.03	7.06	8206	10661	0.77
16	Wet		11/29/2022 12:25	17.67	1.29	0.40	93.14	28626	31081	0.92
17	Wet		11/30/2022 13:50	5.83	0.12	0.05	10.58	9859	12314	0.80
18	Wet		12/1/2022 5:55	3.33	0.08	0.03	7.76	12658	15113	0.84
19	Wet		12/2/2022 18:55	7.25	0.42	0.14	31.75	23785	26240	0.91
20	Wet		12/4/2022 9:50	8.92	0.49	0.16	36.69	22339	24794	0.90
21	Wet		12/5/2022 18:00	17.08	0.09	0.04	8.47	2692	5147	0.52
22	Wet		12/8/2022 1:00	6.00	0.14	0.05	12.00	10857	13312	0.82
23	Wet		12/8/2022 19:50	8.42	0.1	0.04	9.17	5916	8371	0.71
24	Wet	x	12/9/2022 15:30	27.50	0.58	0.18	43.04	8500	10955	0.78
25	Wet		12/11/2022 10:00	4.33	0.04	0.02	4.94	6195	8650	0.72
26	Wet		12/12/2022 3:10	1.17	0.03	0.02	4.23	19651	22106	0.89
27	Wet		12/19/2022 19:50	4.33	0.04	0.02	4.94	6195	8650	0.72
28	Wet		12/20/2022 7:00	5.92	0.59	0.19	43.75	40132	42587	0.94
29	Wet		12/23/2022 11:35	27.25	1.38	0.42	99.49	19828	22283	0.89
30	Wet		12/25/2022 8:25	23.92	0.99	0.31	71.97	16340	18795	0.87
31	Wet		12/26/2022 17:50	13.42	0.59	0.19	43.75	17704	20159	0.88
32	Wet		12/27/2022 13:25	3.17	0.06	0.03	6.35	10879	13334	0.82
33	Wet	x	12/29/2022 20:50	12.50	0.54	0.17	40.22	17474	19929	0.88
34	Wet		12/30/2022 20:00	2.92	0.11	0.04	9.88	18373	20828	0.88
35	Wet		1/3/2023 1:20	3.75	0.05	0.02	5.64	8175	10630	0.77
36	Wet		1/4/2023 17:15	3.83	0.09	0.04	8.47	12006	14461	0.83
37	Wet		1/5/2023 22:30	2.42	0.12	0.05	10.58	23752	26207	0.91
38	Wet		1/6/2023 10:45	31.17	0.44	0.14	33.16	5778	8233	0.70
39	Wet		1/8/2023 3:45	16.83	0.26	0.09	20.46	6603	9058	0.73
40	Wet		1/9/2023 12:50	21.58	0.15	0.05	12.70	3196	5651	0.57
41	Wet	x	1/11/2023 19:05	51.58	0.67	0.21	49.39	5200	7655	0.68
42	Wet		1/14/2023 21:20	2.08	0.03	0.02	4.23	11054	13509	0.82
43	Wet		1/15/2023 6:05	13.00	0.29	0.10	22.58	9433	11888	0.79
44	Wet		1/17/2023 18:50	2.17	0.07	0.03	7.06	17659	20114	0.88
45	Wet		1/18/2023 9:00	2.67	0.1	0.04	9.17	18658	21113	0.88
46	Wet		1/21/2023 10:20	4.92	0.12	0.05	10.58	11683	14138	0.83
47	Wet		1/22/2023 5:30	1.00	0.03	0.02	4.23	22992	25447	0.90
48	Wet		1/28/2023 4:20	0.92	0.05	0.02	5.64	33322	35777	0.93
49	Wet		1/28/2023 18:05	1.33	0.03	0.02	4.23	17287	19742	0.88
50	Wet		2/3/2023 16:05	12.92	0.16	0.06	13.41	5635	8090	0.70
51	Wet		2/4/2023 13:50	7.75	0.1	0.04	9.17	6428	8883	0.72
52	Wet		2/5/2023 5:55	4.75	0.15	0.05	12.70	14521	16976	0.86
53	Wet		2/6/2023 15:00	0.50	0.03	0.02	4.23	45984	48439	0.95
54	Wet	x	2/7/2023 0:55	14.92	0.21	0.07	16.93	6164	8619	0.72
55	Wet		2/9/2023 22:45	0.75	0.03	0.02	4.23	30656	33111	0.93
56	Wet		2/12/2023 23:40	6.67	0.09	0.04	8.47	6894	9349	0.74
57	Wet		2/13/2023 20:45	4.67	0.15	0.05	12.70	14770	17225	0.86
58	Wet		2/14/2023 8:35	1.75	0.08	0.03	7.76	24087	26542	0.91
59	Wet		2/17/2023 5:05	4.67	0.07	0.03	7.06	8206	10661	0.77
60	Wet		2/18/2023 17:05	2.33	0.06	0.03	6.35	14802	17257	0.86
61	Wet		2/20/2023 17:10	1.92	0.1	0.04	9.17	25946	28401	0.91
62	Wet		2/25/2023 23:30	5.08	0.2	0.07	16.23	17350	19805	0.88
63	Wet		2/27/2023 12:30	12.75	0.19	0.07	15.52	6612	9067	0.73
64	Wet		3/2/2023 0:25	8.08	0.1	0.04	9.17	6165	8620	0.72
65	Wet		3/3/2023 5:05	27.67	0.57	0.18	42.34	8309	10764	0.77
66	Wet		3/5/2023 18:45	1.92	0.11	0.04	9.88	27942	30397	0.92
67	Wet		3/6/2023 21:45	7.25	0.07	0.03	7.06	5285	7740	0.68
68	Wet		3/8/2023 14:55	1.58	0.09	0.04	8.47	29104	31559	0.92
69	Wet		3/10/2023 2:10	1.00	0.03	0.02	4.23	22992	25447	0.90
70	Wet		3/10/2023 17:20	8.75	0.08	0.03	7.76	4817	7272	0.66
71	Wet	x	3/12/2023 12:25	26.67	0.63	0.20	46.57	9483	11938	0.79
72	Wet	x	3/19/2023 22:25	11.00	0.2	0.07	16.23	8012	10467	0.77
73	Wet		3/31/2023 14:30	12.67	0.25	0.08	19.76	8468	10923	0.78
74	Wet		4/1/2023 9:35	5.33	0.06	0.03	6.35	6471	8926	0.72
75	Wet		4/1/2023 23:05	13.75	0.2	0.07	16.23	6410	8865	0.72
76	Wet		4/2/23 8:30 PM	4.67	0.16	0.06	13.41	15591	18046	0.86
77	Wet		4/6/23 2:20 AM	26.67	0.41	0.13	31.05	6322	8777	0.72
78	Wet		4/8/23 10:40 AM	4.50	0.13	0.05	11.29	13625	16080	0.85
79	Wet	x	4/9/23 2:45 AM	44.25	1.11	0.34	80.44	9872	12327	0.80
80	Wet		4/11/2023 5:35	2.00	0.1	0.04	9.17	24908	27363	0.91
81	Wet		4/16/23 7:10 AM	9.00	0.43	0.14	32.46	19586	22041	0.89
82	Wet		4/17/23 2:30 PM	4.75	0.04	0.02	4.94	5647	8102	0.70
83	Wet		4/18/23 3:25 AM	5.50	0.05	0.02	5.64	5574	8029	0.69
84	Wet		4/20/23 12:00 PM	9.42	0.1	0.04	9.17	5288	7743	0.68
85	Wet		4/22/23 6:20 PM	12.08	0.26	0.09	20.46	9199	11654	0.79
86	Wet		4/23/2023 20:35	4.83	0.09	0.04	8.47	9520	11975	0.79
			Total Wet Season	**811.12**	**22.44**	**7.53**	**1,765**			
			Mean Wet Season Flow					**1884**		
Dry Season										
87	Dry	x	5/4/2023 23:50	19.33	0.52	0.13	30.12	8461	10916	0.78
88	Dry		6/9/2023 3:05	4.75	0.09	0.03	7.79	8905	11360	0.78
89	Dry		6/9/2023 16:40	16.50	0.09	0.03	7.79	2564	5019	0.51
90	Dry		6/20/2023 2:35	3.83	0.05	0.00	0.00	0	2455	0.00
91	Dry		7/24/2023 18:35	1.58	0.08	0.03	7.27	24986	27441	0.91
92	Dry		8/22/2023 19:00	5.92	0.16	0.05	11.42	10479	12934	0.81
93	Dry		8/31/2023 3:10	11.92	0.11	0.04	8.83	4022	6477	0.62
94	Dry		9/18/2023 5:20	1.67	0.08	0.03	7.27	23640	26095	0.91
95	Dry		9/20/2023 2:35	9.33	0.07	0.03	6.75	3929	6384	0.62
96	Dry		9/23/2023 12:10	7.00	0.24	0.07	15.58	12085	14540	0.83
97	Dry	x	9/24/2023 13:15	30.67	0.91	0.21	50.37	8918	11373	0.78
98	Dry		9/26/2023 12:10	6.83	0.29	0.08	18.17	14450	16905	0.85
99	Dry		9/27/2023 1:35	7.00	0.53	0.13	30.63	23768	26223	0.91
			Total Dry Season	**126.33**	**3.22**	**0.86**	**202**			
			Mean Dry Season Flow					**299**		
			Total Annual	**937.45**	**25.66**	**8.39**	**1,967**			
			Mean Annual Flow					**1220**		

Notes:
[1] *Mean Annual Baseflow based on Water Year 2015 Record in Outfall 237A*

Drainage Area: 2,813 acres
Mean Baseflow: 2,455 gpm[1]

	Rain Threshold (in)	Runoff Coefficient
Wet Season	0.030	0.30
Dry Season	0.060	0.22

Table B9-1.4
WY2023 Storm Event Hydrology for OF237B

Storm Event	Season	Sampled?	Storm Start Date & Time	Storm Duration (hours)	Total Rain (inches)	Estimated Runoff (inches)	Estimated Storm Volume (acre-feet)	Estimated Mean Stormflow (gpm)	Estimated Combined Flow (gpm)	Storm Fraction (unitless)
					Wet Season					
1	Wet		10/21/2022 11:10	14.92	0.42	0.17	28.24	10281	15992	0.64
2	Wet		10/24/2022 2:45	5.92	0.17	0.06	10.01	9182	14892	0.62
3	Wet	x	10/25/2022 11:40	9.67	0.43	0.18	28.97	16272	21983	0.74
4	Wet		10/28/2022 3:30	3.08	0.12	0.04	6.36	11218	16928	0.66
5	Wet		10/30/2022 18:55	14.25	0.58	0.24	39.92	15212	20923	0.73
6	Wet		11/1/2022 21:35	3.58	0.11	0.03	5.63	8544	14255	0.60
7	Wet		11/2/2022 11:40	1.08	0.06	0.01	1.99	9983	15694	0.64
8	Wet		11/3/2022 11:45	6.33	0.16	0.06	9.28	7961	13672	0.58
9	Wet	x	11/4/2022 2:40	14.25	0.79	0.33	55.23	21050	26761	0.79
10	Wet		11/6/2022 0:40	6.92	0.76	0.32	53.05	41630	47341	0.88
11	Wet		11/6/2022 19:35	6.92	0.11	0.03	5.63	4420	10131	0.44
12	Wet		11/7/2022 8:40	8.33	0.1	0.03	4.90	3197	8907	0.36
13	Wet	x	11/22/2022 6:40	9.00	0.88	0.37	61.80	37291	43001	0.87
14	Wet		11/25/2022 9:15	7.25	0.61	0.26	42.10	31539	37250	0.85
15	Wet		11/26/2022 22:30	4.67	0.07	0.02	2.71	3157	8867	0.36
16	Wet		11/29/2022 12:25	17.67	1.29	0.56	91.70	28185	33896	0.83
17	Wet		11/30/2022 13:50	5.83	0.12	0.04	6.36	5926	11637	0.51
18	Wet		12/1/2022 5:55	3.33	0.08	0.02	3.44	5617	11327	0.50
19	Wet		12/2/2022 18:55	7.25	0.42	0.17	28.24	21158	26868	0.79
20	Wet		12/4/2022 9:50	8.92	0.49	0.20	33.35	20305	26016	0.78
21	Wet		12/5/2022 18:00	17.08	0.09	0.03	4.17	1327	7038	0.19
22	Wet		12/8/2022 1:00	6.00	0.14	0.05	7.82	7079	12789	0.55
23	Wet		12/8/2022 19:50	8.42	0.1	0.03	4.90	3162	8873	0.36
24	Wet		12/9/2022 15:30	27.50	0.58	0.24	39.92	7883	13593	0.58
25	Wet		12/11/2022 10:00	4.33	0.04	0.00	0.53	660	6371	0.10
26	Wet		12/12/2022 3:10	1.17	0.03	0.00	0.00	0	5711	0.00
27	Wet		12/19/2022 19:50	4.33	0.04	0.00	0.53	660	6371	0.10
28	Wet		12/20/2022 7:00	5.92	0.59	0.25	40.64	37287	42997	0.87
29	Wet		12/23/2022 11:35	27.25	1.38	0.60	98.27	19585	25295	0.77
30	Wet		12/25/2022 8:25	23.92	0.99	0.42	69.82	15853	21563	0.74
31	Wet		12/26/2022 17:50	13.42	0.59	0.25	40.64	16448	22159	0.74
32	Wet		12/27/2022 13:25	3.17	0.06	0.01	1.99	3401	9112	0.37
33	Wet	x	12/29/2022 20:50	12.50	0.54	0.22	37.00	16074	21785	0.74
34	Wet		12/30/2022 20:00	2.92	0.11	0.03	5.63	10476	16186	0.65
35	Wet		1/3/2023 1:20	3.75	0.05	0.01	1.26	1819	7529	0.24
36	Wet		1/4/2023 17:15	3.83	0.09	0.03	4.17	5918	11629	0.51
37	Wet		1/5/2023 22:30	2.42	0.12	0.04	6.36	14277	19987	0.71
38	Wet		1/6/2023 10:45	31.17	0.44	0.18	29.70	5175	10886	0.48
39	Wet		1/8/2023 3:45	16.83	0.26	0.10	16.57	5348	11059	0.48
40	Wet		1/9/2023 12:50	21.58	0.15	0.05	8.55	2152	7862	0.27
41	Wet		1/11/2023 19:05	51.58	0.67	0.28	46.48	4894	10604	0.46
42	Wet		1/14/2023 21:20	2.08	0.03	0.00	0.00	0	5711	0.00
43	Wet		1/15/2023 6:05	13.00	0.29	0.11	18.76	7838	13549	0.58
44	Wet		1/17/2023 18:50	2.17	0.07	0.02	2.71	6794	12505	0.54
45	Wet		1/18/2023 9:00	2.67	0.1	0.03	4.90	9973	15683	0.64
46	Wet		1/21/2023 10:20	4.92	0.12	0.04	6.36	7022	12733	0.55
47	Wet		1/22/2023 5:30	1.00	0.03	0.00	0.00	0	5711	0.00
48	Wet		1/28/2023 4:20	0.92	0.05	0.01	1.26	7413	13124	0.56
49	Wet		1/28/2023 18:05	1.33	0.03	0.00	0.00	0	5711	0.00
50	Wet		2/3/2023 16:05	12.92	0.16	0.06	9.28	3901	9611	0.41
51	Wet		2/4/2023 13:50	7.75	0.1	0.03	4.90	3436	9146	0.38
52	Wet		2/5/2023 5:55	4.75	0.15	0.05	8.55	9776	15486	0.63
53	Wet		2/6/2023 15:00	0.50	0.03	0.00	0.00	0	5711	0.00
54	Wet	x	2/7/2023 0:55	14.92	0.21	0.08	12.93	4705	10416	0.45
55	Wet		2/9/2023 22:45	0.75	0.03	0.00	0.00	0	5711	0.00
56	Wet		2/12/2023 23:40	6.67	0.09	0.03	4.17	3398	9109	0.37
57	Wet		2/13/2023 20:45	4.67	0.15	0.05	8.55	9943	15654	0.64
58	Wet		2/14/2023 8:35	1.75	0.08	0.02	3.44	10688	16399	0.65
59	Wet		2/17/2023 5:05	4.67	0.07	0.02	2.71	3157	8867	0.36
60	Wet		2/18/2023 17:05	2.33	0.06	0.01	1.99	4627	10338	0.45
61	Wet		2/20/2023 17:10	1.92	0.1	0.03	4.90	13868	19579	0.71
62	Wet		2/25/2023 23:30	5.08	0.2	0.07	12.20	13040	18750	0.70
63	Wet		2/27/2023 12:30	12.75	0.19	0.07	11.47	4885	10595	0.46
64	Wet		3/2/2023 0:25	8.08	0.1	0.03	4.90	3295	9006	0.37
65	Wet		3/3/2023 5:05	27.67	0.57	0.24	39.19	7691	13402	0.57
66	Wet		3/5/2023 18:45	1.92	0.11	0.03	5.63	15932	21642	0.74
67	Wet		3/6/2023 21:45	7.25	0.07	0.02	2.71	2034	7744	0.26
68	Wet		3/8/2023 14:55	1.58	0.09	0.03	4.17	14346	20056	0.72
69	Wet		3/10/2023 2:10	1.00	0.03	0.00	0.00	0	5711	0.00
70	Wet		3/10/2023 17:20	8.75	0.08	0.02	3.44	2138	7848	0.27
71	Wet		3/12/2023 12:25	26.67	0.63	0.26	43.56	8871	14581	0.61
72	Wet	x	3/19/2023 22:25	11.00	0.2	0.07	12.20	6022	11732	0.51
73	Wet		3/31/2023 14:30	12.67	0.25	0.10	15.84	6792	12502	0.54
74	Wet		4/1/2023 9:35	5.33	0.06	0.01	1.99	2023	7733	0.26
75	Wet		4/1/2023 23:05	13.75	0.2	0.07	12.20	4818	10528	0.46
76	Wet		4/2/2023 20:30	4.67	0.16	0.06	9.28	10791	16502	0.65
77	Wet		4/6/2023 2:20	26.67	0.41	0.17	27.52	5603	11313	0.50
78	Wet		4/8/2023 10:40	4.50	0.13	0.04	7.09	8558	14269	0.60
79	Wet	x	4/9/2023 2:45	44.25	1.11	0.48	78.58	9644	15354	0.63
80	Wet		4/11/2023 5:35	2.00	0.1	0.03	4.90	13314	19024	0.70
81	Wet		4/16/2023 7:10	9.00	0.43	0.18	28.97	17484	23194	0.75
82	Wet		4/17/2023 14:30	4.75	0.04	0.00	0.53	602	6312	0.10
83	Wet		4/18/2023 3:25	5.50	0.05	0.01	1.26	1240	6951	0.18
84	Wet		4/20/2023 12:00	9.42	0.1	0.03	4.90	2827	8537	0.33
85	Wet		4/22/2023 18:20	12.08	0.26	0.10	16.57	7451	13162	0.57
86	Wet		4/23/2023 20:35	4.83	0.09	0.03	4.17	4693	10403	0.45
			Total Wet Season	**811.12**	**22.44**	**8.69**	**1,433**			
			Mean Wet Season Flow					**1529**		
					Dry Season					
87	Dry		5/4/2023 23:50	19.33	0.52	0.14	23.09	6487	12197	0.53
88	Dry		6/9/2023 3:05	4.75	0.09	0.01	1.64	1871	7582	0.25
89	Dry		6/9/2023 16:40	16.50	0.09	0.01	1.64	539	6249	0.09
90	Dry		6/20/2023 2:35	3.83	0.05	0.00	0.00	0	5711	0.00
91	Dry		7/24/2023 18:35	1.58	0.08	0.01	1.14	3911	9622	0.41
92	Dry		8/22/2023 19:00	5.92	0.16	0.03	5.13	4705	10416	0.45
93	Dry		8/31/2023 3:10	11.92	0.11	0.02	2.63	1200	6911	0.17
94	Dry		9/18/2023 5:20	1.67	0.08	0.01	1.14	3701	9411	0.39
95	Dry		9/20/2023 2:35	9.33	0.07	0.00	0.64	372	6082	0.06
96	Dry		9/23/2023 12:10	7.00	0.24	0.06	9.12	7076	12786	0.55
97	Dry	x	9/24/2023 13:15	30.67	0.91	0.26	42.54	7533	13244	0.57
98	Dry		9/26/2023 12:10	6.83	0.29	0.07	11.61	9235	14946	0.62
99	Dry		9/27/2023 1:35	7.00	0.53	0.14	23.59	18300	24010	0.76
			Total Dry Season	**126.33**	**3.22**	**0.75**	**124**			
			Mean Dry Season Flow					**183**		
			Total Annual	**937.45**	**25.66**	**9.44**	**1,556.51**			
			Mean Annual Flow					**965**		

Notes:
[1] Mean Annual Baseflow based on Water Year 2010 Record in Outfall 237B

Drainage Area: 1,979 acres
Mean Baseflow: 5,711 gpm[1]

	Rain Threshold (in)	Runoff Coefficient
Wet Season	0.033	0.44
Dry Season	0.057	0.30

Table B9-1.5
WY2023 Storm Event Hydrology for OF243

Storm Event	Season	Sampled?	Storm Start Date and Time	Storm Duration (hours)	Total Rain (inches)	Estimated Runoff (inches)	Estimated Storm Volume (acre-feet)	Estimated Mean Stormflow (gpm)	Estimated Combined Flow (gpm)	Storm Fraction (unitless)
Wet Season										
1	Wet		10/21/2022 11:10	14.92	0.42	0.14	0.69	252	252	1.0
2	Wet		10/24/2022 2:45	5.92	0.17	0.06	0.28	257	257	1.0
3	Wet	x	10/25/2022 11:40	9.67	0.43	0.14	0.71	399	399	1.0
4	Wet		10/28/2022 3:30	3.08	0.12	0.04	0.20	349	349	1.0
5	Wet		10/30/2022 18:55	14.25	0.58	0.19	0.96	365	365	1.0
6	Wet		11/1/2022 21:35	3.58	0.11	0.04	0.18	275	275	1.0
7	Wet		11/2/2022 11:40	1.08	0.06	0.02	0.10	498	498	1.0
8	Wet		11/3/2022 11:45	6.33	0.16	0.05	0.26	227	227	1.0
9	Wet		11/4/2022 2:40	14.25	0.79	0.27	1.30	497	497	1.0
10	Wet	x	11/6/2022 0:40	6.92	0.76	0.26	1.25	984	984	1.0
11	Wet		11/6/2022 19:35	6.92	0.11	0.04	0.18	142	142	1.0
12	Wet		11/7/2022 8:40	8.33	0.1	0.03	0.17	108	108	1.0
13	Wet		11/22/2022 6:40	9.00	0.88	0.30	1.45	876	876	1.0
14	Wet		11/25/2022 9:15	7.25	0.61	0.20	1.01	754	754	1.0
15	Wet		11/26/2022 22:30	4.67	0.07	0.02	0.12	134	134	1.0
16	Wet		11/29/2022 12:25	17.67	1.29	0.43	2.13	654	654	1.0
17	Wet		11/30/2022 13:50	5.83	0.12	0.04	0.20	185	185	1.0
18	Wet		12/1/2022 5:55	3.33	0.08	0.03	0.13	215	215	1.0
19	Wet		12/2/2022 18:55	7.25	0.42	0.14	0.69	519	519	1.0
20	Wet		12/4/2022 9:50	8.92	0.49	0.16	0.81	492	492	1.0
21	Wet		12/5/2022 18:00	17.08	0.09	0.03	0.15	47	47	1.0
22	Wet		12/8/2022 1:00	6.00	0.14	0.05	0.23	209	209	1.0
23	Wet		12/8/2022 19:50	8.42	0.1	0.03	0.17	106	106	1.0
24	Wet	x	12/9/2022 15:30	27.50	0.58	0.19	0.96	189	189	1.0
25	Wet		12/11/2022 10:00	4.33	0.04	0.01	0.07	83	83	1.0
26	Wet		12/12/2022 3:10	1.17	0.03	0.01	0.05	230	230	1.0
27	Wet		12/19/2022 19:50	4.33	0.04	0.01	0.07	83	83	1.0
28	Wet		12/20/2022 7:00	5.92	0.59	0.20	0.97	893	893	1.0
29	Wet		12/23/2022 11:35	27.25	1.38	0.46	2.28	454	454	1.0
30	Wet		12/25/2022 8:25	23.92	0.99	0.33	1.63	371	371	1.0
31	Wet		12/26/2022 17:50	13.42	0.59	0.20	0.97	394	394	1.0
32	Wet		12/27/2022 13:25	3.17	0.06	0.02	0.10	170	170	1.0
33	Wet		12/29/2022 20:50	12.50	0.54	0.18	0.89	387	387	1.0
34	Wet		12/30/2022 20:00	2.92	0.11	0.04	0.18	338	338	1.0
35	Wet		1/3/2023 1:20	3.75	0.05	0.02	0.08	120	120	1.0
36	Wet		1/4/2023 17:15	3.83	0.09	0.03	0.15	211	211	1.0
37	Wet		1/5/2023 22:30	2.42	0.12	0.04	0.20	444	444	1.0
38	Wet		1/6/2023 10:45	31.17	0.44	0.15	0.73	127	127	1.0
39	Wet		1/8/2023 3:45	16.83	0.26	0.09	0.43	138	138	1.0
40	Wet		1/9/2023 12:50	21.58	0.15	0.05	0.25	62	62	1.0
41	Wet		1/11/2023 19:05	51.58	0.67	0.22	1.11	116	116	1.0
42	Wet		1/14/2023 21:20	2.08	0.03	0.01	0.05	129	129	1.0
43	Wet		1/15/2023 6:05	13.00	0.29	0.10	0.48	200	200	1.0
44	Wet		1/17/2023 18:50	2.17	0.07	0.02	0.12	289	289	1.0
45	Wet		1/18/2023 9:00	2.67	0.1	0.03	0.17	336	336	1.0
46	Wet		1/21/2023 10:20	4.92	0.12	0.04	0.20	219	219	1.0
47	Wet		1/22/2023 5:30	1.00	0.03	0.01	0.05	269	269	1.0
48	Wet		1/28/2023 4:20	0.92	0.05	0.02	0.08	487	487	1.0
49	Wet		1/28/2023 18:05	1.33	0.03	0.01	0.05	202	202	1.0
50	Wet		2/3/2023 16:05	12.92	0.16	0.05	0.26	111	111	1.0
51	Wet		2/4/2023 13:50	7.75	0.1	0.03	0.17	116	116	1.0
52	Wet		2/5/2023 5:55	4.75	0.15	0.05	0.25	283	283	1.0
53	Wet		2/6/2023 15:00	0.50	0.03	0.01	0.05	538	538	1.0
54	Wet		2/7/2023 0:55	14.92	0.21	0.07	0.35	126	126	1.0
55	Wet		2/9/2023 22:45	0.75	0.03	0.01	0.05	359	359	1.0
56	Wet		2/12/2023 23:40	6.67	0.09	0.03	0.15	121	121	1.0
57	Wet		2/13/2023 20:45	4.67	0.15	0.05	0.25	288	288	1.0
58	Wet		2/14/2023 8:35	1.75	0.08	0.03	0.13	410	410	1.0
59	Wet		2/17/2023 5:05	4.67	0.07	0.02	0.12	134	134	1.0
60	Wet		2/18/2023 17:05	2.33	0.06	0.02	0.10	231	231	1.0
61	Wet		2/20/2023 17:10	1.92	0.1	0.03	0.17	467	467	1.0
62	Wet		2/25/2023 23:30	5.08	0.2	0.07	0.33	353	353	1.0
63	Wet		2/27/2023 12:30	12.75	0.19	0.06	0.31	134	134	1.0
64	Wet		3/2/2023 0:25	8.08	0.1	0.03	0.17	111	111	1.0
65	Wet		3/3/2023 5:05	27.67	0.57	0.19	0.94	185	185	1.0
66	Wet		3/5/2023 18:45	1.92	0.11	0.04	0.18	514	514	1.0
67	Wet		3/6/2023 21:45	7.25	0.07	0.02	0.12	87	87	1.0
68	Wet		3/8/2023 14:55	1.58	0.09	0.03	0.15	511	511	1.0
69	Wet		3/10/2023 2:10	1.00	0.03	0.01	0.05	269	269	1.0
70	Wet		3/10/2023 17:20	8.75	0.08	0.03	0.13	82	82	1.0
71	Wet	x	3/12/2023 12:25	26.67	0.63	0.21	1.04	212	212	1.0
72	Wet		3/19/2023 22:25	11.00	0.2	0.07	0.33	163	163	1.0
73	Wet	x	3/31/2023 14:30	12.67	0.25	0.08	0.41	177	177	1.0
74	Wet		4/1/2023 9:35	5.33	0.06	0.02	0.10	101	101	1.0
75	Wet		4/1/2023 23:05	13.75	0.2	0.07	0.33	130	130	1.0
76	Wet		4/2/23 8:30 PM	4.67	0.16	0.05	0.26	307	307	1.0
77	Wet		4/6/23 2:20 AM	26.67	0.41	0.14	0.68	138	138	1.0
78	Wet		4/8/23 10:40 AM	4.50	0.13	0.04	0.21	259	259	1.0
79	Wet		4/9/23 2:45 AM	44.25	1.11	0.37	1.83	225	225	1.0
80	Wet		4/11/23 5:35 AM	2.00	0.1	0.03	0.17	448	448	1.0
81	Wet	x	4/16/23 7:10 AM	9.00	0.43	0.14	0.71	428	428	1.0
82	Wet		4/17/23 2:30 PM	4.75	0.04	0.01	0.07	75	75	1.0
83	Wet		4/18/23 3:25 AM	5.50	0.05	0.02	0.08	81	81	1.0
84	Wet		4/20/23 12:00 PM	9.42	0.1	0.03	0.17	95	95	1.0
85	Wet		4/22/23 6:20 PM	12.08	0.26	0.09	0.43	193	193	1.0
86	Wet		4/23/23 8:35 PM	4.83	0.09	0.03	0.15	167	167	1.0
			Total Wet Season	**811.12**	**22.44**	**7.53**	**37.0**			
			Mean Wet Season Flow					**39.5**		
Dry Season										
87	Dry		5/4/2023 23:50	19.33	0.52	0.08	0.40	112	112	1.0
88	Dry		6/9/2023 3:05	4.75	0.09	0.01	0.07	79	79	1.0
89	Dry		6/9/2023 16:40	16.50	0.09	0.01	0.07	23	23	1.0
90	Dry		6/20/2023 2:35	3.83	0.05	0.01	0.04	54	54	1.0
91	Dry		7/24/2023 18:35	1.58	0.08	0.01	0.06	211	211	1.0
92	Dry		8/22/2023 19:00	5.92	0.16	0.02	0.12	113	113	1.0
93	Dry		8/31/2023 3:10	11.92	0.11	0.02	0.08	38	38	1.0
94	Dry		9/18/2023 5:20	1.67	0.08	0.01	0.06	200	200	1.0
95	Dry		9/20/2023 2:35	9.33	0.07	0.01	0.05	31	31	1.0
96	Dry		9/23/2023 12:10	7.00	0.24	0.04	0.18	143	143	1.0
97	Dry	x	9/24/2023 13:15	30.67	0.91	0.14	0.70	124	124	1.0
98	Dry		9/26/2023 12:10	6.83	0.29	0.05	0.22	177	177	1.0
99	Dry		9/27/2023 1:35	7.00	0.53	0.08	0.41	315	315	1.0
			Total Dry Season	**126.33**	**3.22**	**0.50**	**2.5**			
			Mean Dry Season Flow					**3.7**		
			Total Annual	**937.45**	**25.66**	**8.04**	**39.5**			
			Mean Annual Flow					**24.5**		

Note:

1 Mean Annual Baseflow based on Water Year 2010 Record in Outfall 245 HSPF Modeling

Drainage Area: 59 acres

Mean Baseflow: 0 gpm[1]

	Rain Threshold (in)	Runoff Coefficient
Wet Season	0	0.34
Dry Season	0	0.16

Table B9-1.6
WY2023 Storm Event Hydrology for OF245

Storm Event	Season	Sampled?	Storm Start Date and Time	Storm Duration (hours)	Total Rain (inches)	Estimated Runoff (inches)	Estimated Storm Volume (acre-feet)	Estimated Mean Stormflow (gpm)	Estimated Combined Flow (gpm)	Storm Fraction (unitless)
Wet Season										
1	Wet		10/21/2022 11:10	14.92	0.42	0.42	1.35	492	492	1.0
2	Wet		10/24/2022 2:45	5.92	0.17	0.17	0.55	502	502	1.0
3	Wet		10/25/2022 11:40	9.67	0.43	0.43	1.38	777	777	1.0
4	Wet		10/28/2022 3:30	3.08	0.12	0.12	0.39	681	681	1.0
5	Wet	x	10/30/2022 18:55	14.25	0.58	0.57	1.87	711	711	1.0
6	Wet		11/1/2022 21:35	3.58	0.11	0.11	0.35	537	537	1.0
7	Wet		11/2/2022 11:40	1.08	0.06	0.06	0.19	971	971	1.0
8	Wet		11/3/2022 11:45	6.33	0.16	0.16	0.51	442	442	1.0
9	Wet		11/4/2022 2:40	14.25	0.79	0.78	2.54	969	969	1.0
10	Wet		11/6/2022 0:40	6.92	0.76	0.75	2.45	1919	1919	1.0
11	Wet		11/6/2022 19:35	6.92	0.11	0.11	0.35	278	278	1.0
12	Wet		11/7/2022 8:40	8.33	0.1	0.10	0.32	210	210	1.0
13	Wet	x	11/22/2022 6:40	9.00	0.88	0.87	2.83	1709	1709	1.0
14	Wet		11/25/2022 9:15	7.25	0.61	0.60	1.96	1470	1470	1.0
15	Wet		11/26/2022 22:30	4.67	0.07	0.07	0.23	262	262	1.0
16	Wet		11/29/2022 12:25	17.67	1.29	1.28	4.15	1276	1276	1.0
17	Wet		11/30/2022 13:50	5.83	0.12	0.12	0.39	360	360	1.0
18	Wet		12/1/2022 5:55	3.33	0.08	0.08	0.26	420	420	1.0
19	Wet		12/2/2022 18:55	7.25	0.42	0.42	1.35	1012	1012	1.0
20	Wet		12/4/2022 9:50	8.92	0.49	0.49	1.58	960	960	1.0
21	Wet		12/5/2022 18:00	17.08	0.09	0.09	0.29	92	92	1.0
22	Wet		12/8/2022 1:00	6.00	0.14	0.14	0.45	408	408	1.0
23	Wet		12/8/2022 19:50	8.42	0.1	0.10	0.32	208	208	1.0
24	Wet	x	12/9/2022 15:30	27.50	0.58	0.57	1.87	369	369	1.0
25	Wet		12/11/2022 10:00	4.33	0.04	0.04	0.13	161	161	1.0
26	Wet		12/12/2022 3:10	1.17	0.03	0.03	0.10	448	448	1.0
27	Wet		12/19/2022 19:50	4.33	0.04	0.04	0.13	161	161	1.0
28	Wet		12/20/2022 7:00	5.92	0.59	0.58	1.90	1741	1741	1.0
29	Wet		12/23/2022 11:35	27.25	1.38	1.37	4.44	885	885	1.0
30	Wet		12/25/2022 8:25	23.92	0.99	0.98	3.19	723	723	1.0
31	Wet		12/26/2022 17:50	13.42	0.59	0.58	1.90	768	768	1.0
32	Wet		12/27/2022 13:25	3.17	0.06	0.06	0.19	331	331	1.0
33	Wet		12/29/2022 20:50	12.50	0.54	0.53	1.74	755	755	1.0
34	Wet		12/30/2022 20:00	2.92	0.11	0.11	0.35	658	658	1.0
35	Wet		1/3/2023 1:20	3.75	0.05	0.05	0.16	233	233	1.0
36	Wet		1/4/2023 17:15	3.83	0.09	0.09	0.29	411	411	1.0
37	Wet		1/5/2023 22:30	2.42	0.12	0.12	0.39	866	866	1.0
38	Wet		1/6/2023 10:45	31.17	0.44	0.44	1.42	247	247	1.0
39	Wet		1/8/2023 3:45	16.83	0.26	0.26	0.84	270	270	1.0
40	Wet		1/9/2023 12:50	21.58	0.15	0.15	0.48	121	121	1.0
41	Wet	x	1/11/2023 19:05	51.58	0.67	0.66	2.16	227	227	1.0
42	Wet		1/14/2023 21:20	2.08	0.03	0.03	0.10	252	252	1.0
43	Wet		1/15/2023 6:05	13.00	0.29	0.29	0.93	390	390	1.0
44	Wet		1/17/2023 18:50	2.17	0.07	0.07	0.23	564	564	1.0
45	Wet		1/18/2023 9:00	2.67	0.1	0.10	0.32	654	654	1.0
46	Wet		1/21/2023 10:20	4.92	0.12	0.12	0.39	426	426	1.0
47	Wet		1/22/2023 5:30	1.00	0.03	0.03	0.10	524	524	1.0
48	Wet		1/28/2023 4:20	0.92	0.05	0.05	0.16	950	950	1.0
49	Wet		1/28/2023 18:05	1.33	0.03	0.03	0.10	394	394	1.0
50	Wet		2/3/2023 16:05	12.92	0.16	0.16	0.51	216	216	1.0
51	Wet		2/4/2023 13:50	7.75	0.1	0.10	0.32	225	225	1.0
52	Wet		2/5/2023 5:55	4.75	0.15	0.15	0.48	552	552	1.0
53	Wet		2/6/2023 15:00	0.50	0.03	0.03	0.10	1048	1048	1.0
54	Wet		2/7/2023 0:55	14.92	0.21	0.21	0.68	246	246	1.0
55	Wet		2/9/2023 22:45	0.75	0.03	0.03	0.10	699	699	1.0
56	Wet		2/12/2023 23:40	6.67	0.09	0.09	0.29	236	236	1.0
57	Wet		2/13/2023 20:45	4.67	0.15	0.15	0.48	561	561	1.0
58	Wet		2/14/2023 8:35	1.75	0.08	0.08	0.26	799	799	1.0
59	Wet		2/17/2023 5:05	4.67	0.07	0.07	0.23	262	262	1.0
60	Wet		2/18/2023 17:05	2.33	0.06	0.06	0.19	450	450	1.0
61	Wet		2/20/2023 17:10	1.92	0.1	0.10	0.32	910	910	1.0
62	Wet		2/25/2023 23:30	5.08	0.2	0.20	0.64	688	688	1.0
63	Wet		2/27/2023 12:30	12.75	0.19	0.19	0.61	260	260	1.0
64	Wet		3/2/2023 0:25	8.08	0.1	0.10	0.32	216	216	1.0
65	Wet		3/3/2023 5:05	27.67	0.57	0.56	1.83	360	360	1.0
66	Wet		3/5/2023 18:45	1.92	0.11	0.11	0.35	1001	1001	1.0
67	Wet		3/6/2023 21:45	7.25	0.07	0.07	0.23	169	169	1.0
68	Wet		3/8/2023 14:55	1.58	0.09	0.09	0.29	995	995	1.0
69	Wet		3/10/2023 2:10	1.00	0.03	0.03	0.10	524	524	1.0
70	Wet		3/10/2023 17:20	8.75	0.08	0.08	0.26	160	160	1.0
71	Wet	x	3/12/2023 12:25	26.67	0.63	0.62	2.03	413	413	1.0
72	Wet		3/19/2023 22:25	11.00	0.2	0.20	0.64	318	318	1.0
73	Wet	x	3/31/2023 14:30	12.67	0.25	0.25	0.80	345	345	1.0
74	Wet		4/1/2023 9:35	5.33	0.06	0.06	0.19	197	197	1.0
75	Wet		4/1/2023 23:05	13.75	0.2	0.20	0.64	254	254	1.0
76	Wet		4/2/23 8:30 PM	4.67	0.16	0.16	0.51	599	599	1.0
77	Wet		4/6/23 2:20 AM	26.67	0.41	0.41	1.32	269	269	1.0
78	Wet		4/8/23 10:40 AM	4.50	0.13	0.13	0.42	505	505	1.0
79	Wet	x	4/9/23 2:45 AM	44.25	1.11	1.10	3.57	438	438	1.0
80	Wet		4/11/23 5:35 AM	2.00	0.1	0.10	0.32	874	874	1.0
81	Wet		4/16/23 7:10 AM	9.00	0.43	0.43	1.38	835	835	1.0
82	Wet		4/17/23 2:30 PM	4.75	0.04	0.04	0.13	147	147	1.0
83	Wet		4/18/23 3:25 AM	5.50	0.05	0.05	0.16	159	159	1.0
84	Wet		4/20/23 12:00 PM	9.42	0.1	0.10	0.32	185	185	1.0
85	Wet		4/22/23 6:20 PM	12.08	0.26	0.26	0.84	376	376	1.0
86	Wet		4/23/23 8:35 PM	4.83	0.09	0.09	0.29	326	326	1.0
			Total Wet Season	**811.12**	**22.44**	**22.22**	**72.2**			
			Mean Wet Season Flow					**77.1**		
Dry Season										
87	Dry	x	5/4/2023 23:50	19.33	0.52	0.41	1.32	370	370	1.0
88	Dry		6/9/2023 3:05	4.75	0.09	0.07	0.23	261	261	1.0
89	Dry		6/9/2023 16:40	16.50	0.09	0.07	0.23	75	75	1.0
90	Dry		6/20/2023 2:35	3.83	0.05	0.04	0.13	180	180	1.0
91	Dry		7/24/2023 18:35	1.58	0.08	0.06	0.20	697	697	1.0
92	Dry		8/22/2023 19:00	5.92	0.16	0.12	0.41	372	372	1.0
93	Dry		8/31/2023 3:10	11.92	0.11	0.09	0.28	127	127	1.0
94	Dry		9/18/2023 5:20	1.67	0.08	0.06	0.20	660	660	1.0
95	Dry		9/20/2023 2:35	9.33	0.07	0.05	0.18	103	103	1.0
96	Dry		9/23/2023 12:10	7.00	0.24	0.19	0.61	472	472	1.0
97	Dry	x	9/24/2023 13:15	30.67	0.91	0.71	2.31	408	408	1.0
98	Dry		9/26/2023 12:10	6.83	0.29	0.23	0.74	585	585	1.0
99	Dry		9/27/2023 1:35	7.00	0.53	0.41	1.34	1042	1042	1.0
			Total Dry Season	**126.33**	**3.22**	**2.51**	**8.2**			
			Mean Dry Season Flow					**12.1**		
			Total Annual	**937.45**	**25.66**	**24.73**	**80**			
			Mean Annual Flow					**49.8**		

Note:

[1] *Mean Annual Baseflow based on Water Year 2010 Record in Outfall 245 HSPF Modeling*

Drainage Area: 39 acres

Mean Baseflow: 0 gpm[1]

	Rain Threshold (in)	Runoff Coefficient
Wet Season	0	0.99
Dry Season	0	0.78

Table B9-1.7
WY2023 Storm Event Hydrology for OF254

Storm Event	Season	Sampled?	Storm Start Date and Time	Storm Duration (hours)	Total Rain (inches)	Estimated Runoff (inches)	Estimated Storm Volume (acre-feet)	Estimated Mean Stormflow (gpm)	Estimated Combined Flow (gpm)	Storm Fraction (unitless)
					Wet Season					
1	Wet		10/21/2022 11:10	14.92	0.42	0.35	3.75	1366	1366	1.0
2	Wet		10/24/2022 2:45	5.92	0.17	0.14	1.52	1393	1393	1.0
3	Wet		10/25/2022 11:40	9.67	0.43	0.36	3.84	2157	2157	1.0
4	Wet		10/28/2022 3:30	3.08	0.12	0.10	1.07	1890	1890	1.0
5	Wet	x	10/30/2022 18:55	14.25	0.58	0.49	5.18	1974	1974	1.0
6	Wet		11/1/2022 21:35	3.58	0.11	0.09	0.98	1491	1491	1.0
7	Wet		11/2/2022 11:40	1.08	0.06	0.05	0.54	2695	2695	1.0
8	Wet		11/3/2022 11:45	6.33	0.16	0.14	1.43	1226	1226	1.0
9	Wet		11/4/2022 2:40	14.25	0.79	0.67	7.06	2689	2689	1.0
10	Wet		11/6/2022 0:40	6.92	0.76	0.64	6.79	5328	5328	1.0
11	Wet		11/6/2022 19:35	6.92	0.11	0.09	0.98	771	771	1.0
12	Wet		11/7/2022 8:40	8.33	0.1	0.08	0.89	582	582	1.0
13	Wet		11/22/2022 6:40	9.00	0.88	0.74	7.86	4743	4743	1.0
14	Wet		11/25/2022 9:15	7.25	0.61	0.51	5.45	4082	4082	1.0
15	Wet		11/26/2022 22:30	4.67	0.07	0.06	0.63	727	727	1.0
16	Wet		11/29/2022 12:25	17.67	1.29	1.09	11.52	3541	3541	1.0
17	Wet		11/30/2022 13:50	5.83	0.12	0.10	1.07	998	998	1.0
18	Wet		12/1/2022 5:55	3.33	0.08	0.07	0.71	1165	1165	1.0
19	Wet		12/2/2022 18:55	7.25	0.42	0.35	3.75	2810	2810	1.0
20	Wet		12/4/2022 9:50	8.92	0.49	0.41	4.38	2665	2665	1.0
21	Wet		12/5/2022 18:00	17.08	0.09	0.08	0.80	256	256	1.0
22	Wet		12/8/2022 1:00	6.00	0.14	0.12	1.25	1132	1132	1.0
23	Wet		12/8/2022 19:50	8.42	0.1	0.08	0.89	576	576	1.0
24	Wet		12/9/2022 15:30	27.50	0.58	0.49	5.18	1023	1023	1.0
25	Wet		12/11/2022 10:00	4.33	0.04	0.03	0.36	448	448	1.0
26	Wet		12/12/2022 3:10	1.17	0.03	0.03	0.27	1244	1244	1.0
27	Wet		12/19/2022 19:50	4.33	0.04	0.03	0.36	448	448	1.0
28	Wet		12/20/2022 7:00	5.92	0.59	0.50	5.27	4835	4835	1.0
29	Wet		12/23/2022 11:35	27.25	1.38	1.16	12.33	2457	2457	1.0
30	Wet		12/25/2022 8:25	23.92	0.99	0.84	8.84	2008	2008	1.0
31	Wet		12/26/2022 17:50	13.42	0.59	0.50	5.27	2133	2133	1.0
32	Wet		12/27/2022 13:25	3.17	0.06	0.05	0.54	918	918	1.0
33	Wet		12/29/2022 20:50	12.50	0.54	0.46	4.82	2096	2096	1.0
34	Wet		12/30/2022 20:00	2.92	0.11	0.09	0.98	1827	1827	1.0
35	Wet		1/3/2023 1:20	3.75	0.05	0.04	0.45	647	647	1.0
36	Wet		1/4/2023 17:15	3.83	0.09	0.08	0.80	1140	1140	1.0
37	Wet		1/5/2023 22:30	2.42	0.12	0.10	1.07	2405	2405	1.0
38	Wet		1/6/2023 10:45	31.17	0.44	0.37	3.93	685	685	1.0
39	Wet		1/8/2023 3:45	16.83	0.26	0.22	2.32	749	749	1.0
40	Wet		1/9/2023 12:50	21.58	0.15	0.13	1.34	337	337	1.0
41	Wet		1/11/2023 19:05	51.58	0.67	0.57	5.98	630	630	1.0
42	Wet		1/14/2023 21:20	2.08	0.03	0.03	0.27	700	700	1.0
43	Wet		1/15/2023 6:05	13.00	0.29	0.24	2.59	1082	1082	1.0
44	Wet		1/17/2023 18:50	2.17	0.07	0.06	0.63	1565	1565	1.0
45	Wet		1/18/2023 9:00	2.67	0.1	0.08	0.89	1817	1817	1.0
46	Wet		1/21/2023 10:20	4.92	0.12	0.10	1.07	1183	1183	1.0
47	Wet		1/22/2023 5:30	1.00	0.03	0.03	0.27	1455	1455	1.0
48	Wet		1/28/2023 4:20	0.92	0.05	0.04	0.45	2636	2636	1.0
49	Wet		1/28/2023 18:05	1.33	0.03	0.03	0.27	1094	1094	1.0
50	Wet		2/3/2023 16:05	12.92	0.16	0.14	1.43	601	601	1.0
51	Wet		2/4/2023 13:50	7.75	0.1	0.08	0.89	626	626	1.0
52	Wet		2/5/2023 5:55	4.75	0.15	0.13	1.34	1532	1532	1.0
53	Wet		2/6/2023 15:00	0.50	0.03	0.03	0.27	2911	2911	1.0
54	Wet		2/7/2023 0:55	14.92	0.21	0.18	1.88	683	683	1.0
55	Wet		2/9/2023 22:45	0.75	0.03	0.03	0.27	1940	1940	1.0
56	Wet		2/12/2023 23:40	6.67	0.09	0.08	0.80	655	655	1.0
57	Wet		2/13/2023 20:45	4.67	0.15	0.13	1.34	1558	1558	1.0
58	Wet		2/14/2023 8:35	1.75	0.08	0.07	0.71	2218	2218	1.0
59	Wet		2/17/2023 5:05	4.67	0.07	0.06	0.63	727	727	1.0
60	Wet		2/18/2023 17:05	2.33	0.06	0.05	0.54	1249	1249	1.0
61	Wet		2/20/2023 17:10	1.92	0.1	0.08	0.89	2527	2527	1.0
62	Wet		2/25/2023 23:30	5.08	0.2	0.17	1.79	1910	1910	1.0
63	Wet		2/27/2023 12:30	12.75	0.19	0.16	1.70	723	723	1.0
64	Wet		3/2/2023 0:25	8.08	0.1	0.08	0.89	600	600	1.0
65	Wet		3/3/2023 5:05	27.67	0.57	0.48	5.09	999	999	1.0
66	Wet		3/5/2023 18:45	1.92	0.11	0.09	0.98	2779	2779	1.0
67	Wet		3/6/2023 21:45	7.25	0.07	0.06	0.63	468	468	1.0
68	Wet		3/8/2023 14:55	1.58	0.09	0.08	0.80	2763	2763	1.0
69	Wet		3/10/2023 2:10	1.00	0.03	0.03	0.27	1455	1455	1.0
70	Wet		3/10/2023 17:20	8.75	0.08	0.07	0.71	444	444	1.0
71	Wet		3/12/2023 12:25	26.67	0.63	0.53	5.63	1146	1146	1.0
72	Wet		3/19/2023 22:25	11.00	0.2	0.17	1.79	882	882	1.0
73	Wet		3/31/2023 14:30	12.67	0.25	0.21	2.23	957	957	1.0
74	Wet		4/1/2023 9:35	5.33	0.06	0.05	0.54	546	546	1.0
75	Wet		4/1/2023 23:05	13.75	0.2	0.17	1.79	706	706	1.0
76	Wet		4/2/23 8:30 PM	4.67	0.16	0.14	1.43	1662	1662	1.0
77	Wet		4/6/23 2:20 AM	26.67	0.41	0.35	3.66	746	746	1.0
78	Wet		4/8/23 10:40 AM	4.50	0.13	0.11	1.16	1401	1401	1.0
79	Wet		4/9/23 2:45 AM	44.25	1.11	0.94	9.91	1217	1217	1.0
80	Wet		4/11/23 5:35 AM	2.00	0.1	0.08	0.89	2426	2426	1.0
81	Wet		4/16/23 7:10 AM	9.00	0.43	0.36	3.84	2318	2318	1.0
82	Wet		4/17/23 2:30 PM	4.75	0.04	0.03	0.36	409	409	1.0
83	Wet		4/18/23 3:25 AM	5.50	0.05	0.04	0.45	441	441	1.0
84	Wet		4/20/23 12:00 PM	9.42	0.1	0.08	0.89	515	515	1.0
85	Wet		4/22/23 6:20 PM	12.08	0.26	0.22	2.32	1044	1044	1.0
86	Wet		4/23/23 8:35 PM	4.83	0.09	0.08	0.80	904	904	1.0
			Total Wet Season	**811.12**	**22.44**	**18.94**	**200.44**			
			Mean Wet Season Flow					**213.9**		
Dry Season										
87	Dry		5/4/2023 23:50	19.33	0.52	0.15	1.62	455	455	1.0
88	Dry		6/9/2023 3:05	4.75	0.09	0.03	0.28	320	320	1.0
89	Dry		6/9/2023 16:40	16.50	0.09	0.03	0.28	92	92	1.0
90	Dry		6/20/2023 2:35	3.83	0.05	0.01	0.16	221	221	1.0
91	Dry		7/24/2023 18:35	1.58	0.08	0.02	0.25	856	856	1.0
92	Dry		8/22/2023 19:00	5.92	0.16	0.05	0.50	457	457	1.0
93	Dry		8/31/2023 3:10	11.92	0.11	0.03	0.34	156	156	1.0
94	Dry		9/18/2023 5:20	1.67	0.08	0.02	0.25	809	809	1.0
95	Dry		9/20/2023 2:35	9.33	0.07	0.02	0.22	127	127	1.0
96	Dry		9/23/2023 12:10	7.00	0.24	0.07	0.75	579	579	1.0
97	Dry		9/24/2023 13:15	30.67	0.91	0.27	2.83	501	501	1.0
98	Dry		9/26/2023 12:10	6.83	0.29	0.09	0.90	717	717	1.0
99	Dry		9/27/2023 1:35	7.00	0.53	0.16	1.65	1279	1279	1.0
			Total Dry Season	**126.33**	**3.22**	**0.95**	**10.02**			
			Mean Dry Season Flow					**14.8**		
			Total Annual	**937.45**	**25.66**	**19.89**	**210.46**			
			Mean Annual Flow					**130.5**		

Note:
[1] *Mean Annual Baseflow based on Water Year 2010 Record in Outfall 245 HSPF Modeling*
OF254 is not reported for WY2023 due to limited qualifying storm events.

Drainage Area: 127 acres
Mean Baseflow: 0 gpm[1]

	Rain Threshold (in)	Runoff Coefficient
Wet Season	0	0.84
Dry Season	0	0.29

Table B9-2
Annual Flow for All Outfalls

Flow Component	OF237B - Residential											
	WY2010	WY2011	WY2012	WY2015	WY2016	WY2017	WY2018	WY2019	WY2020	WY2021	WY2022	WY2023
Wet Season Baseflow (acre-feet)	5,233	5,354	5,365	5,365	5,365	5,365	5,365	5,365	5,365	5,365	5,365	5,365
Dry Season Baseflow (acre-feet)	3,871	3,864	3,853	3,853	3,853	3,853	3,853	3,853	3,853	3,853	3,853	3,853
Total Baseflow (acre-feet)	**9,104**	**9,218**	**9,218**	**9,218**	**9,218**	**9,218**	**9,218**	**9,218**	**9,218**	**9,218**	**9,218**	**9,218**
Wet Season Storm Flow (acre-feet)	1,870	2,373	1,973	2,279	2,948	2,844	2,314	1,589	1,891	1,869	2,370	1,433
Dry Season Storm Flow (acre-feet)	484	238	186	226	118	158	52	145	245	225	256	124
Total Storm Flow (acre-feet)	**2,354**	**2,611**	**2,159**	**2,505**	**3,066**	**3,002**	**2,366**	**1,733**	**2,136**	**2,094**	**2,626**	**1,557**
Total Combined Flow (acre-feet)	**11,458**	**11,829**	**11,377**	**11,723**	**12,284**	**12,220**	**11,584**	**10,951**	**11,354**	**11,312**	**11,844**	**10,775**
Fraction Baseflow (percent)	79.5%	77.9%	81.0%	78.6%	75.0%	75.4%	79.6%	84.2%	81.2%	81.5%	77.8%	85.5%
Fraction Storm Flow (percent)	20.5%	22.1%	19.0%	21.4%	25.0%	24.6%	20.4%	15.8%	18.8%	18.5%	22.2%	14.5%

Flow Component	OF235 - Commercial											
	WY2010	WY2011	WY2012	WY2015	WY2016	WY2017	WY2018	WY2019	WY2020	WY2021	WY2022	WY2023
Wet Season Baseflow (acre-feet)	98	103	103	103	103	103	103	103	103	103	103	103
Dry Season Baseflow (acre-feet)	79	74	74	74	74	74	74	74	74	74	74	74
Total Baseflow (acre-feet)	**177**	**177**	**177**	**177.5**	**178**	**178**	**178**	**178**	**178**	**178**	**178**	**178**
Wet Season Storm Flow (acre-feet)	225	228	204	222	322	313	255	179	211	208	261	134
Dry Season Storm Flow (acre-feet)	72	34	39	24	26	27	12	28	41	37	36	14
Total Storm Flow (acre-feet)	**297**	**262**	**243**	**273**	**348**	**341**	**268**	**207**	**252**	**244**	**297**	**148**
Total Combined Flow (acre-feet)	**474**	**439**	**420**	**451**	**525**	**518**	**445**	**385**	**429**	**422**	**475**	**326**
Fraction Baseflow (percent)	37.3%	40.3%	42.1%	39.4%	33.8%	34.2%	40%	46%	41%	42%	37%	55%
Fraction Storm Flow (percent)	62.7%	59.7%	57.9%	60.6%	66.2%	65.8%	60%	54%	59%	58%	63%	45%

Flow Component	OF245 - Industrial											
	WY2010	WY2011	WY2012	WY2015	WY2016	WY2017	WY2018	WY2019	WY2020	WY2021	WY2022	WY2023
Wet Season Baseflow (acre-feet)	0	0	0	0	0	0	0	0	0	0	0	0
Dry Season Baseflow (acre-feet)	0	0	0	0	0	0	0	0	0	0	0	0
Total Baseflow (acre-feet)	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Wet Season Storm Flow (acre-feet)	91	96	86	94	139	132	107	76	89	87	110	72
Dry Season Storm Flow (acre-feet)	24	13	15	9	10	10	5	10	16	14	15	8
Total Storm Flow (acre-feet)	**115**	**109**	**101**	**114**	**149**	**142**	**112**	**86**	**104**	**101**	**125**	**80**
Total Combined Flow (acre-feet)	**115**	**109**	**101**	**114**	**149**	**142**	**112**	**86**	**104**	**101**	**125**	**80**
Fraction Baseflow (percent)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Fraction Storm Flow (percent)	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

Flow Component	OF237A - Mixed							
	WY2016	WY2017	WY2018	WY2019	WY2020	WY2021	WY2022	WY2023
Wet Season Baseflow (acre-feet)	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300
Dry Season Baseflow (acre-feet)	1,671	1,671	1,671	1,671	1,671	1,671	1,671	1,671
Total Baseflow (acre-feet)	**3,970**	**3,970**	**3,970**	**3,970**	**3,970**	**3,970**	**3,970**	**3,970**
Wet Season Storm Flow (acre-feet)	3,266	3,197	2,606	1,866	2,165	2,132	2,668	1,765
Dry Season Storm Flow (acre-feet)	269	250	121	278	394	325	364	202
Total Storm Flow (acre-feet)	**3,535**	**3,447**	**2,727**	**2,144**	**2,560**	**2,457**	**3,032**	**1,967**
Total Combined Flow (acre-feet)	**7,505**	**7,417**	**6,698**	**6,114**	**6,530**	**6,428**	**7,002**	**5,937**
Fraction Baseflow (percent)	53%	54%	59%	65%	61%	62%	57%	67%
Fraction Storm Flow (percent)	47%	46%	41%	35%	39%	38%	43%	33%

Flow Component	OF230 - Comm/Res.							
	WY2016	WY2017	WY2018	WY2019	WY2020	WY2021	WY2022	WY2023
Wet Season Baseflow (acre-feet)	148	148	148	148	148	148	148	0
Dry Season Baseflow (acre-feet)	107	107	107	107	107	107	107	0
Total Baseflow (acre-feet)	**255**	**255**	**255**	**255**	**255**	**255**	**255**	**0**
Wet Season Storm Flow (acre-feet)	643	625	509	358	420	414	521	139
Dry Season Storm Flow (acre-feet)	58	63	28	64	94	84	92	2.1
Total Storm Flow (acre-feet)	**701**	**688**	**537**	**422**	**514**	**498**	**614**	**141**
Total Combined Flow (acre-feet)	**956**	**942**	**792**	**676**	**769**	**753**	**868**	**141**
Fraction Baseflow (percent)	27%	27%	32%	38%	33%	34%	29%	0%
Fraction Storm Flow (percent)	73%	73%	68%	62%	67%	66%	71%	100%

Flow Component	OF243 Comm/Ind							
	WY2016	WY2017	WY2018	WY2019	WY2020	WY2021	WY2022	WY2023
Wet Season Baseflow (acre-feet)	0	0	0	0	0	0	0	0
Dry Season Baseflow (acre-feet)	0	0	0	0	0	0	0	0
Total Baseflow (acre-feet)	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Wet Season Storm Flow (acre-feet)	71.4	69.5	56.6	39.8	46.7	46.0	57.9	37.0
Dry Season Storm Flow (acre-feet)	3.0	3.2	1.4	3.3	4.9	4.3	4.8	2.5
Total Storm Flow (acre-feet)	**74**	**72.7**	**58.0**	**43.1**	**51.5**	**50.4**	**63**	**40**
Total Combined Flow (acre-feet)	**74**	**72.7**	**58.0**	**43.1**	**51.5**	**50.4**	**63**	**40**
Fraction Baseflow (percent)	0%	0%	0%	0%	0%	0%	0%	0%
Fraction Storm Flow (percent)	100%	100%	100%	100%	100%	100%	100%	100%

Flow Component	OF254 Industrial							
	WY2016	WY2017	WY2018	WY2019	WY2020	WY2021	WY2022	WY2023
Wet Season Baseflow (acre-feet)	0	0	0	0	0	0	0	0
Dry Season Baseflow (acre-feet)	0	0	0	0	0	0	0	0
Total Baseflow (acre-feet)	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Wet Season Storm Flow (acre-feet)	362	352	287	202	237	233	294	200
Dry Season Storm Flow (acre-feet)	11	12	5	12	19	16.4	18.1	10.0
Total Storm Flow (acre-feet)	**374**	**364.6**	**292.4**	**214**	**255**	**249.9**	**312**	**210**
Total Combined Flow (acre-feet)	**374**	**364.6**	**292.4**	**214**	**255**	**249.9**	**312**	**210**
Fraction Baseflow (percent)	0%	0%	0%	0%	0%	0%	0%	0%
Fraction Storm Flow (percent)	100%	100%	100%	100%	100%	100%	100%	100%

Drain	Rain Threshold (in)		Runoff Coefficient	R^2
237B	Wet	0.03	0.44	0.86
	Dry	0.06	0.30	0.60
235	Wet	0	0.55	0.99
	Dry	0	0.48	0.62
245	Wet	0	0.99	0.90
	Dry	0	0.78	0.63
230	Wet	0	0.32	0.82
	Dry	0	0.32	0.82
237A	Wet	0.03	0.30	0.72
	Dry	0.06	0.22	0.57
243	Wet	0	0.34	0.57
	Dry	0	0.16	-0.75
254	Wet	0	0.84	0.84
	Dry	0	0.29	0.29

Note: New OF230A is not reported for WY2023 due to insufficient number of qualifying storms post installation.

Flow Component	Total Annual Flow acre feet	237A and 237B Annual Flow acre feet	237A and 237B Percent of Total Annual Flow acre feet
Wet Season Baseflow (acre-feet)	7,768	7,664	99%
Dry Season Baseflow (acre-feet)	5,598	5,524	99%
Total Baseflow (acre-feet)	**13,366**	**13,188**	**99%**
Wet Season Storm Flow (acre-feet)	3,781	3,198	85%
Dry Season Storm Flow (acre-feet)	363	326	90%
Total Storm Flow (acre-feet)	**4,143**	**3,524**	**85%**
Total Combined Flow (acre-feet)	**17,509**	**16,712**	**95%**
Fraction Baseflow (percent)	76%	79%	75%
Fraction Storm Flow (percent)	24%	21%	20%

Table B9-3
Comparison of WY2016 and WY2019 and WY2001-2011 Baseflow Data

	Overall WY2016/2019 Data			Overall WY2001-2011 Data			OF230 WY2016/2019		OF230 WY2001-2011		OF235 WY2016/2019		OF235 WY2001-2011	
	% Detections	Arithmetic Mean	Weighted Mean	% Detections	Arithmetic Mean	Weighted Mean	Max	Arithmetic Mean	Max	Arithmetic Mean	Max	Arithmetic Mean	Max	Arithmetic Mean
Conventionals														
TSS (mg/L)	82	4.80	4.2	93	12.29	12.2	12.7	5.3	319	15.8	4.27	2.0	258	25.4
Metals in ug/L														
Lead	84	1.75	1.52	72	5.52	5.53	3.55	1	29.8	5.56	4.79	2	112	14.29
Mercury	27	0.002	0.002	6	0.025	0.025	0.004	0.002	0.003	0.004	0.004	0.003	0.380	0.041
Zinc	100	11.01	9.1	99	46.55	47.5	85.7	29.4	108	46.6	10.5	6.6	355	41.9
Dissolved Lead	59	0.26	0.22	59	2.88	2.86	0.386	0.2	5.5	1.52	2.73	0.7	6.0	1.56
Dissolved Mercury	2	0.003	0.002	3	2.8	2.5	0.0045	0.003	5.9	3.1	*0.005*	*0.003*	*25*	*25*
Dissolved Zinc	100	5.7	4.7	96	25.3	25.9	34.2	14.3	95.0	29.15	5.38	4.3	29.9	10.78
PAHs in ug/L														
2-Methylnaphthalene	16	0.006	0.005	19	0.015	0.015	0.013	0.007	0.122	0.013	0.015	0.006	0.023	0.006
Acenaphthene	25	0.011	0.009	42	0.014	0.014	0.007	0.005	0.013	0.005	*0.01*	*0.005*	0.032	0.011
Acenaphthylene	5	0.005	0.004	2	0.004	0.004	0.005	0.004	*0.005*	*0.004*	*0.005*	*0.005*	*0.005*	*0.004*
Anthracene	30	0.007	0.007	12	0.006	0.006	0.008	0.005	0.012	0.004	0.008	0.005	0.031	0.006
Fluorene	11	0.005	0.004	19	0.006	0.006	0.007	0.006	0.012	0.005	*0.005*	*0.004*	0.060	0.009
Naphthalene	23	0.009	0.007	47	0.023	0.023	0.026	0.015	0.228	0.026	0.021	0.008	0.054	0.011
Phenanthrene	52	0.009	0.008	45	0.013	0.013	0.026	0.017	0.060	0.012	0.020	0.008	0.115	0.014
Total LPAHs[1,2]	64	0.040	0.034	28	0.066	0.011	0.068	0.047	0.270	0.056	0.06	0.027	0.206	0.056
Benzo(a)anthracene	9	0.005	0.004	24	0.012	0.012	0.008	0.005	0.066	0.007	*0.005*	*0.004*	0.114	0.013
Benzo(a)pyrene	14	0.005	0.004	14	0.007	0.007	0.010	0.005	0.057	0.006	*0.005*	*0.004*	0.142	0.013
Benzo(g,h,i)perylene	9	0.009	0.008	18	0.007	0.007	0.026	0.011	0.023	0.007	*0.011*	*0.008*	0.166	0.012
Benzo(b,k)fluoranthenes	20	0.005	0.004	39	0.015	0.015	0.010	0.005	0.113	0.013	*0.005*	*0.004*	0.344	0.026
Chrysene	16	0.005	0.004	26	0.011	0.011	0.007	0.005	0.087	0.010	*0.005*	*0.004*	0.199	0.018
Dibenz(a,h)anthracene	2	0.004	0.004	5	0.005	0.005	0.005	0.004	0.011	0.005	*0.005*	*0.004*	0.028	0.005
Fluoranthene	36	0.007	0.006	60	0.021	0.021	0.015	0.008	0.133	0.017	*0.005*	*0.004*	0.295	0.029
Indeno(1,2,3-c,d)pyrene	5	0.005	0.004	11	0.006	0.006	0.013	0.006	0.019	0.005	*0.005*	*0.005*	0.115	0.009
Pyrene	43	0.008	0.007	79	0.026	0.026	0.016	0.007	0.173	0.021	0.011	0.005	0.253	0.034
Total HPAHs[1]	45	0.037	0.032	30	0.112	0.012	0.107	0.042	0.671	0.091	0.041	0.027	1.639	0.162
Total PAHs[1]	66	0.076	0.066	29	0.178	0.012	0.143	0.089	0.840	0.147	0.090	0.053	1.845	0.217
Phthalates in ug/L														
Bis(2-ethylhexyl)phthalate	18	0.54	0.47	29	1.07	1.06	0.8	0.48	33.00	2.00	0.5	0.37	21.30	1.84
Total Phthalates[3]	23	0.42	0.38	29			2.3	0.72	33.40	4.44	0.5	0.11	22.90	4.06

	OF237A WY2016/2019		OF237A[4] WY2001-2011		OF237B WY2016/2019		OF237B WY2001-2011		OF243 WY2016/2019		OF243 WY2001-2011		OF245/254 WY2016 & WY2019		OF245 WY2001-2011		OF254 WY2001-2011	
	Max	Arithmetic Mean	Max	Arithmetic Mean	Max	Arithmetic Mean	Max	Arithmetic Mean	Max	Arithmetic Mean	Max	Arithmetic Mean	Max	Arithmetic Mean	Max	Arithmetic Mean	Max	Arithmetic Mean
Conventionals																		
TSS (mg/L)	2.94	1.7	16.3	3.08	2.8	1.2	16.9	2.54	21.8	13.7	42.7	13.6	20.8	8.4	78.9	9.6	140	16.1
Metals in ug/L																		
Lead	0.52	0.15	6.11	1.21	0.092	0.04	6.6	0.99	25.4	5	43.9	7.56	2.23	0.85	18.2	3.30	39.0	5.75
Mercury	*0.004*	*0.003*	0.2	0.031	*0.004*	*0.003*	*0.025*	*0.025*	0.004	0.002	0.075	0.029	*0.004*	*0.003*	*0.125*	*0.029*	*0.055*	*0.026*
Zinc	4.1	2.6	27.0	9.5	2.76	1.64	14.2	4.43	30.3	14.8	73.6	21.60	125.0	50.4	1,950	174.1	95.2	27.7
Dissolved Lead	0.08	0.029	*4.5*	*0.81*	0.07	0.031	4.0	0.83	1.81	0.3	35.6	5.38	0.083	0.1	18.9	2.80	47.2	7.26
Dissolved Mercury	*0*	*0.003*	135	31	*0.005*	*0.003*	*25*	*25*	*0*	*0.003*	193	30	*0*	*0.004*	*125*	*29*	114	28
Dissolved Zinc	3.39	1.9	12.6	7.7	1.83	1.3	14.3	4.6	11.9	6.4	45.8	12.3	74.9	28.7	1,220	91.4	54.7	21.3
PAHs in ug/L																		
2-Methylnaphthalene	0.005	0.005	2.100	0.063	0.005	0.005	0.019	0.005	*0.01*	*0.005*	*0.006*	*0.004*	0.029	0.008	0.018	0.005	0.022	0.006
Acenaphthene	*0.01*	*0.005*	0.031	0.005	0.023	0.008	*0.005*	*0.004*	0.132	0.032	0.069	0.030	0.035	0.015	0.103	0.0313	0.096	0.012
Acenaphthylene	*0.005*	*0.005*	0.016	0.004	*0.005*	*0.004*	*0.005*	*0.004*	0.007	0.005	*0.005*	*0.004*	*0.005*	*0.004*	*0.008*	*0.004*	0.019	0.005
Anthracene	*0.005*	*0.004*	*0.005*	*0.004*	*0.005*	*0.004*	*0.005*	*0.004*	0.053	0.019	0.022	0.007	0.017	0.009	0.014	0.006	0.077	0.008
Fluorene	*0.005*	*0.005*	0.086	0.007	*0.005*	*0.004*	*0.005*	*0.004*	0.005	0.005	0.013	0.005	0.013	0.005	0.017	0.006	0.060	0.008
Naphthalene	0.009	0.006	3.00	0.088	*0.009*	*0.007*	0.025	0.007	0.012	0.006	0.017	0.007	0.022	0.010	0.057	0.011	0.034	0.008
Phenanthrene	0.016	0.007	0.149	0.011	*0.013*	*0.006*	*0.008*	*0.004*	0.019	0.008	0.057	0.011	0.037	0.016	0.028	0.011	0.684	0.028
Total LPAHs[1,2]	0.04	0.024	3.276	0.119	0.048	0.028	0.050	0.028	0.22	0.072	0.151	0.065	0.12	0.057	0.181	0.068	0.898	0.068
Benzo(a)anthracene	0.006	0.005	0.022	0.006	*0.005*	*0.004*	0.045	0.005	0.006	0.005	0.055	0.008	*0.004*	*0.003*	0.021	0.006	1.110	0.043
Benzo(a)pyrene	0.006	0.005	0.020	0.006	*0.005*	*0.004*	0.041	0.005	0.007	0.005	0.042	0.007	0.009	0.004	0.048	0.006	0.131	0.010
Benzo(g,h,i)perylene	*0.011*	*0.009*	0.022	0.006	*0.011*	*0.008*	0.044	0.006	0.018	0.011	0.046	0.008	0.019	0.008	0.033	0.006	0.055	0.008
Benzo(b,k)fluoranthenes	0.005	0.004	0.047	0.011	*0.005*	*0.004*	0.107	0.008	0.011	0.006	0.105	0.013	0.008	0.004	0.062	0.009	0.376	0.027
Chrysene	0.006	0.004	0.026	0.006	*0.005*	*0.004*	0.060	0.005	0.014	0.007	0.098	0.011	0.018	0.005	0.063	0.008	0.362	0.020
Dibenz(a,h)anthracene	0.005	0.004	0.010	*0.005*	*0.005*	*0.004*	0.011	*0.005*	*0.005*	*0.005*	0.012	*0.005*	*0.004*	*0.003*	0.013	*0.005*	0.017	0.005
Fluoranthene	0.009	0.005	0.046	0.010	*0.005*	*0.004*	0.088	0.007	0.032	0.013	0.133	0.022	0.020	0.007	0.046	0.013	1.140	0.051
Indeno(1,2,3-c,d)pyrene	*0.005*	*0.005*	0.018	0.005	*0.005*	*0.004*	0.039	0.005	0.008	0.005	0.034	0.006	*0.005*	*0.004*	0.018	0.005	0.053	0.007
Pyrene	0.010	0.005	0.056	0.013	*0.005*	*0.004*	0.078	0.007	0.053	0.018	0.116	0.030	0.038	0.016	0.081	0.024	0.879	0.051
Total HPAHs[1]	0.05	0.029	0.249	0.067	*0.033*	*0.026*	0.513	0.052	0.131	0.060	0.606	0.109	0.11	0.054	0.368	0.081	3.287	0.222
Total PAHs[1]	0.08	0.053	3.464	0.186	0.081	0.054	0.543	0.081	0.353	0.132	0.757	0.174	0.19	0.111	0.436	0.149	4.185	0.290
Phthalates in ug/L																		
Bis(2-ethylhexyl)phthalate	0.5	0.37	1.60	0.56	*0.5*	*0.35*	*0.80*	*0.50*	5.6	1.10	16.00	1.03	2.8	0.63	3.30	0.72	10.00	0.82
Total Phthalates[3]	1.0	0.36	32.00	4.60	0.5	0.08	32.10	5.28	5.8	0.84	22.87	3.14	3.1	0.61	18.70	3.91	13.80	2.21

Italic - zero detected values

Notes:

1 = PAH summations based on 1/2 detection limit for nondetects.

2 = Calculation of Total LPAHs does not include 2-Methylnaphthalene.

3 = Phthalate summations exclude nondetect values.

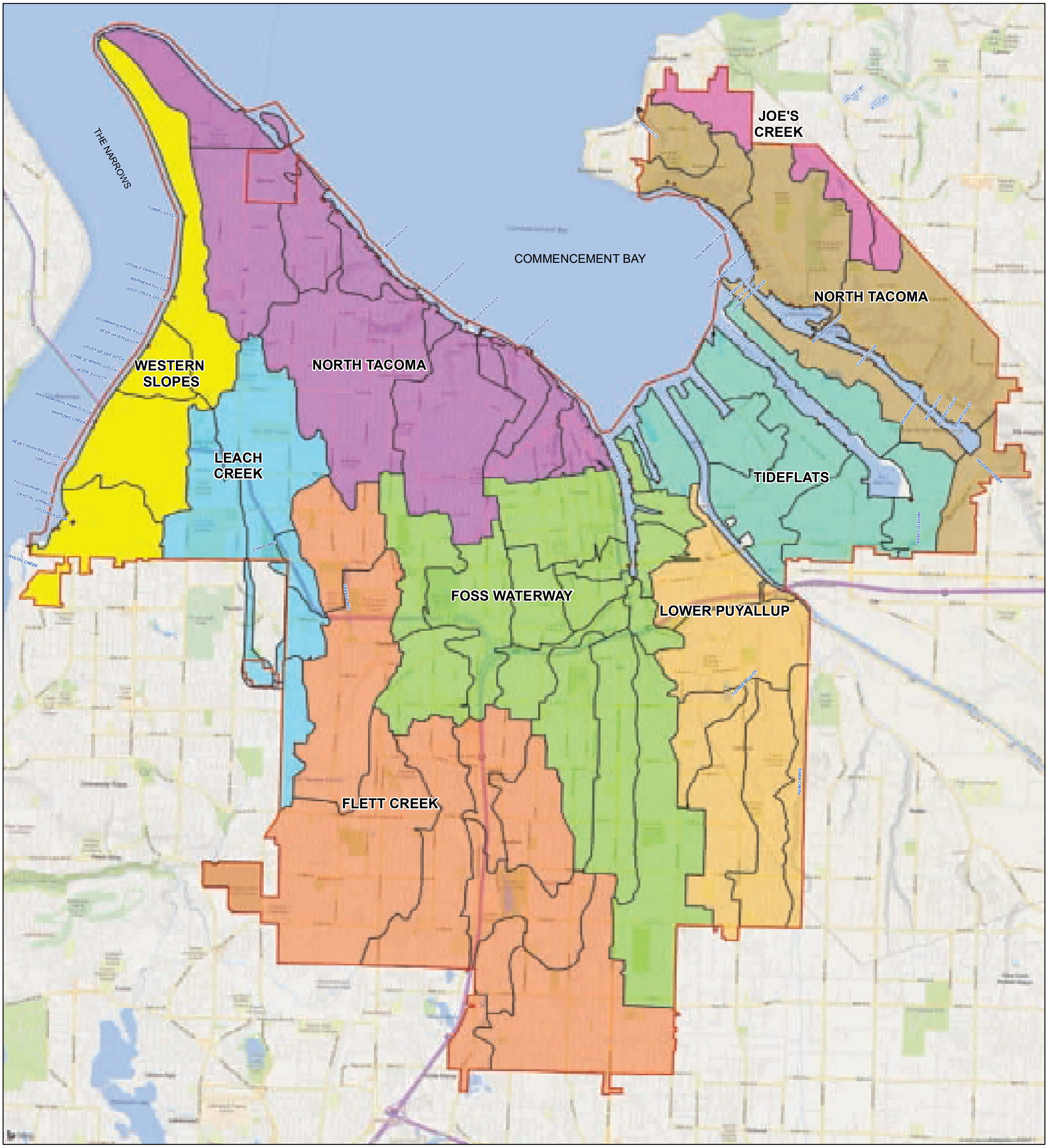
4 = OF237Anew isn't included in the count of samples.

Highest average or highest median concentration detected during monitoring period. (green)

Highest maximum concentration detected during monitoring period. (yellow)

Figures

Figure B2-1
City of Tacoma Watersheds

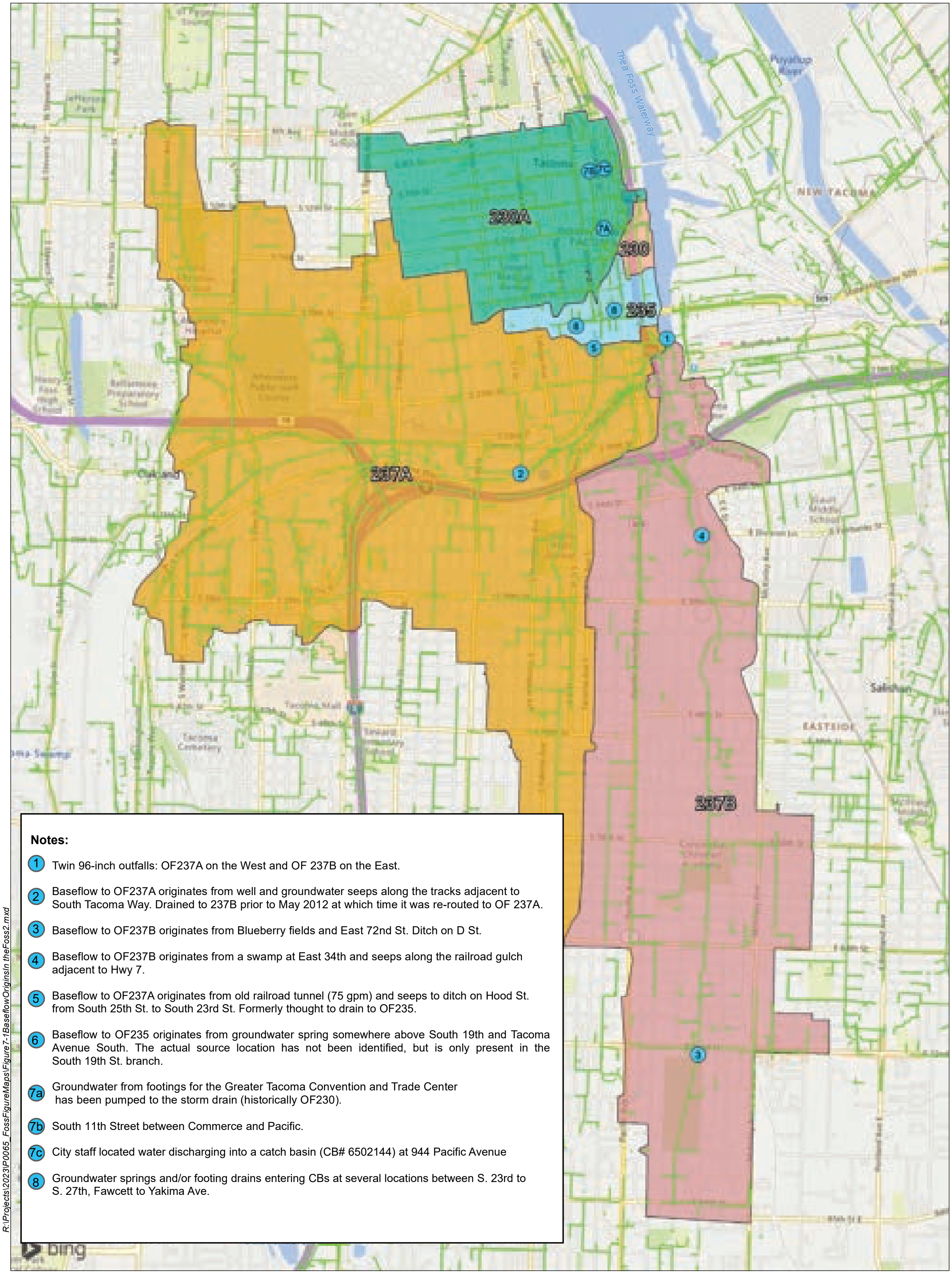


WATERSHEDS

- WESTERN SLOPES
- TIDEFLATS
- NORTH TACOMA
- NE TACOMA
- LOWER PUYALLUP
- LEACH CREEK
- JOE'S CREEK
- FOSS WATERWAY
- FLETT CREEK
- OUTFALLS
- TACOMA CITY LIMITS
- STORMWATER SUBBASINS

Map Date: 11/14/2023
Source: Science and Engineering Division
Environmental Services Department
City of Tacoma
326 East D Street, Tacoma WA 98421
(253) 591-5588

Figure B2-2
Baseflow Origins in Foss Drainage



Notes:

1. Twin 96-inch outfalls: OF237A on the West and OF 237B on the East.
2. Baseflow to OF237A originates from well and groundwater seeps along the tracks adjacent to South Tacoma Way. Drained to 237B prior to May 2012 at which time it was re-routed to OF 237A.
3. Baseflow to OF237B originates from Blueberry fields and East 72nd St. Ditch on D St.
4. Baseflow to OF237B originates from a swamp at East 34th and seeps along the railroad gulch adjacent to Hwy 7.
5. Baseflow to OF237A originates from old railroad tunnel (75 gpm) and seeps to ditch on Hood St. from South 25th St. to South 23rd St. Formerly thought to drain to OF235.
6. Baseflow to OF235 originates from groundwater spring somewhere above South 19th and Tacoma Avenue South. The actual source location has not been identified, but is only present in the South 19th St. branch.

7a. Groundwater from footings for the Greater Tacoma Convention and Trade Center has been pumped to the storm drain (historically OF230).

7b. South 11th Street between Commerce and Pacific.

7c. City staff located water discharging into a catch basin (CB# 6502144) at 944 Pacific Avenue

8. Groundwater springs and/or footing drains entering CBs at several locations between S. 23rd to S. 27th, Fawcett to Yakima Ave.

R:\Projects\2023\P0065_FossFigureMaps\Figure7-1BaseflowOriginsIn theFoss2.mxd

Surfacewater Mains

Foss Basins

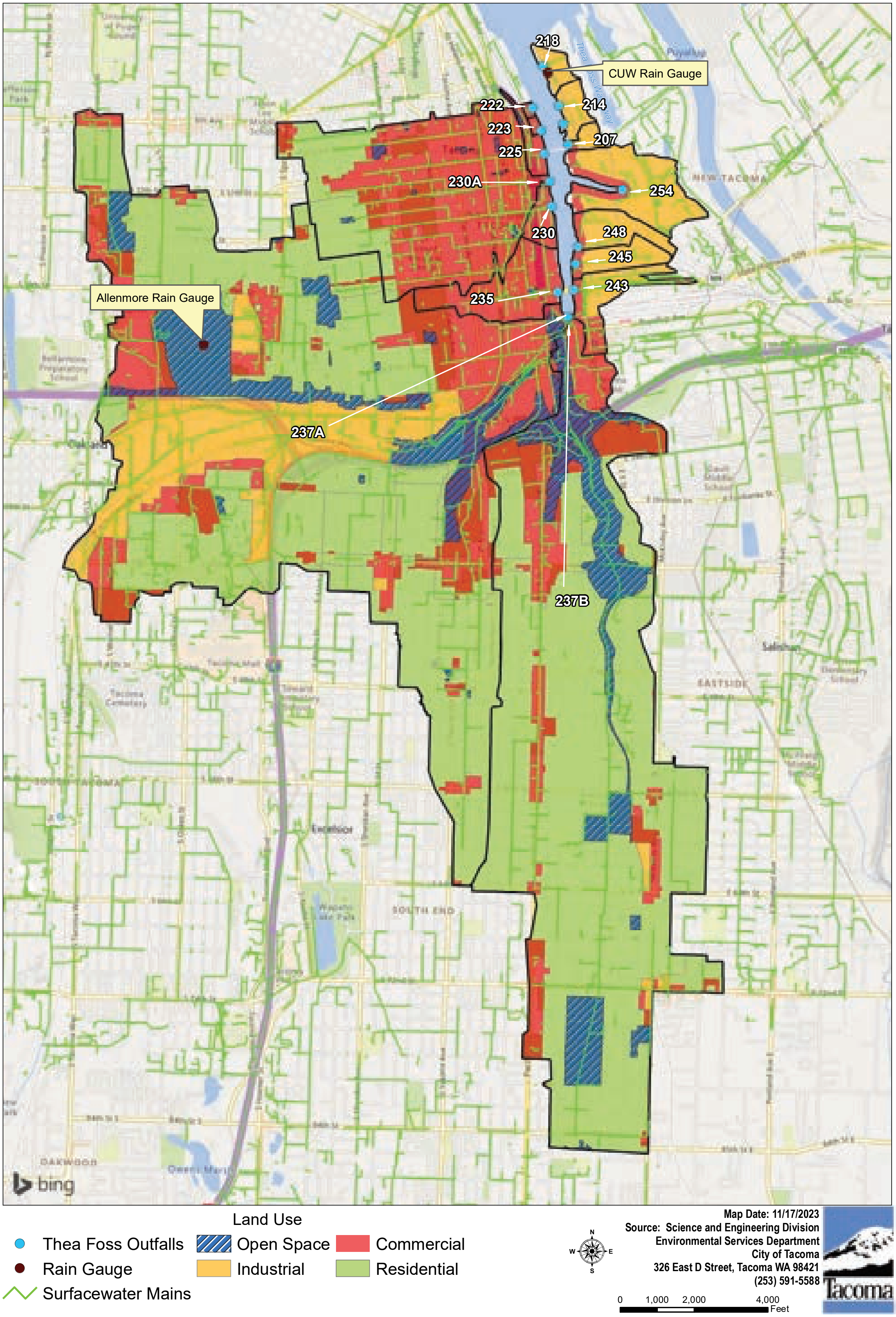
237A | 237B | 230 | 230A | 235

Map Date: 9/20/2023
Source: Science and Engineering Division
Environmental Services Department
City of Tacoma
326 East D Street, Tacoma WA 98421
(253) 591-5588

0 1,000 2,000 4,000 Feet

Tacoma

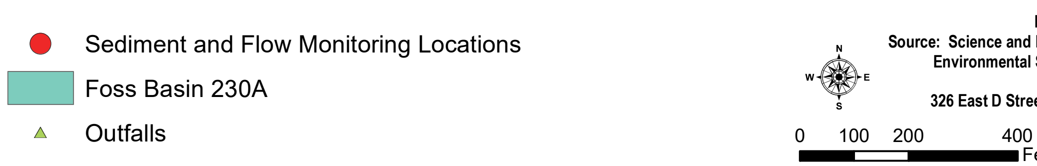
Figure B2-3
Thea Foss Basins Land use



Map Date: 11/17/2023
Source: Science and Engineering Division
Environmental Services Department
City of Tacoma
326 East D Street, Tacoma WA 98421
(253) 591-5588

Figure B2-4
OF230 Sediment and Flow Monitoring Locations

Figure B2-5
Whole-Water Monitoring and Sediment Trap Monitoring Locations - OF230A



Map Date: 11/17/2023
Source: Science and Engineering Division
Environmental Services Department
City of Tacoma
326 East D Street, Tacoma WA 98421
(253) 591-5588

Figure B2-6
Annual Rainfall-Runoff Correlation for OF230

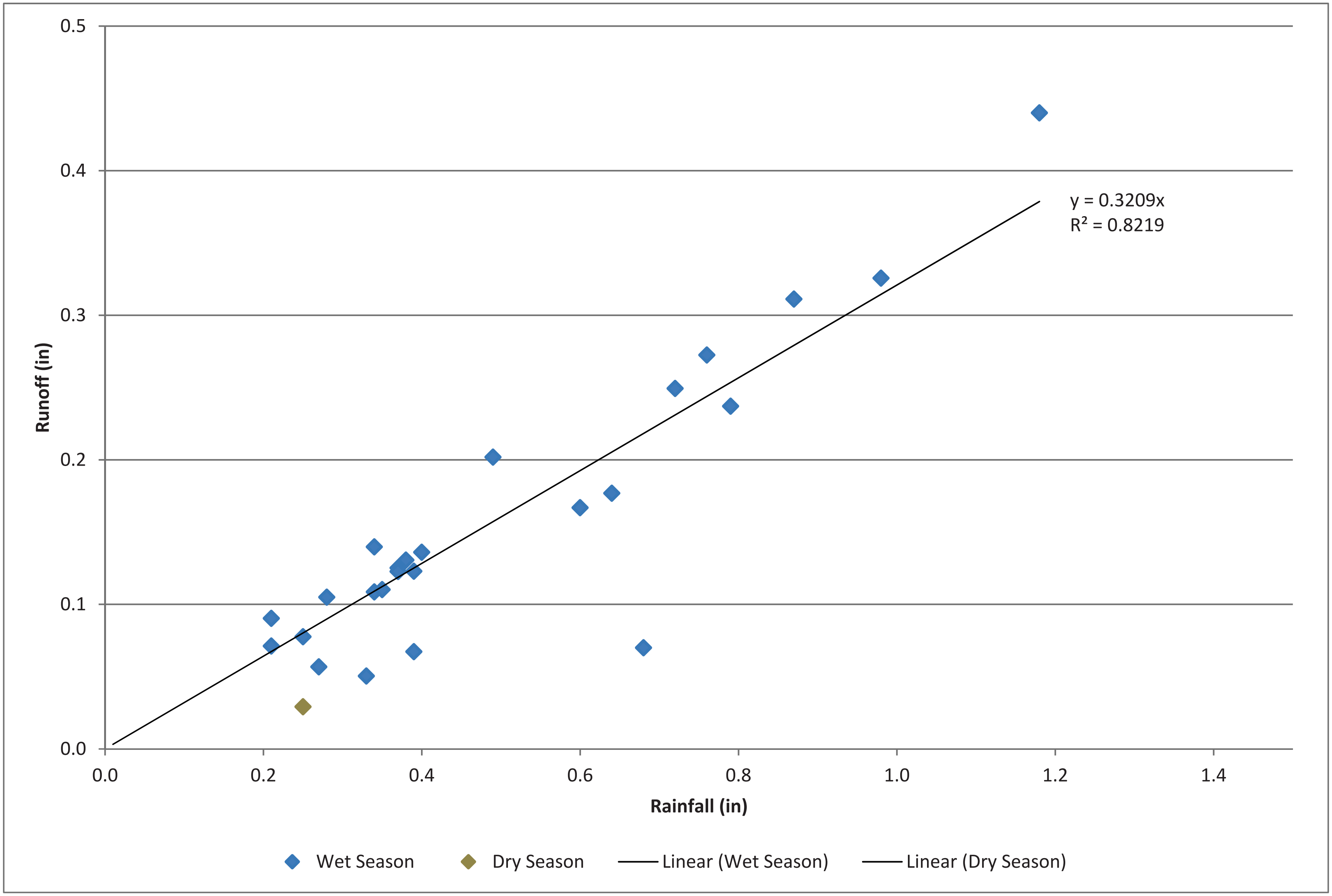


Figure B2-7
Whole-Water Monitoring and
Sediment Trap Monitoring Locations - OF235
6767315
6767341
I 705 RAMP N
PRIVATE DR
OF235
FD6 (6767511)
6767476
6767707
6767520
6767511
SR509 HWY
6767530
6767502
I 705 RAMP S
I705 HWY S
I705 HWY N
I 705 RAMP N
S 21ST ST
DOCK ST
WHOLE WATER
(6767530)
THEA FOSS
WATERWAY
6767741
6752169
S 22ND ST
6765951
N
COURT A
A ST

Figure B2-8
Rainfall-Runoff Correlations for OF235

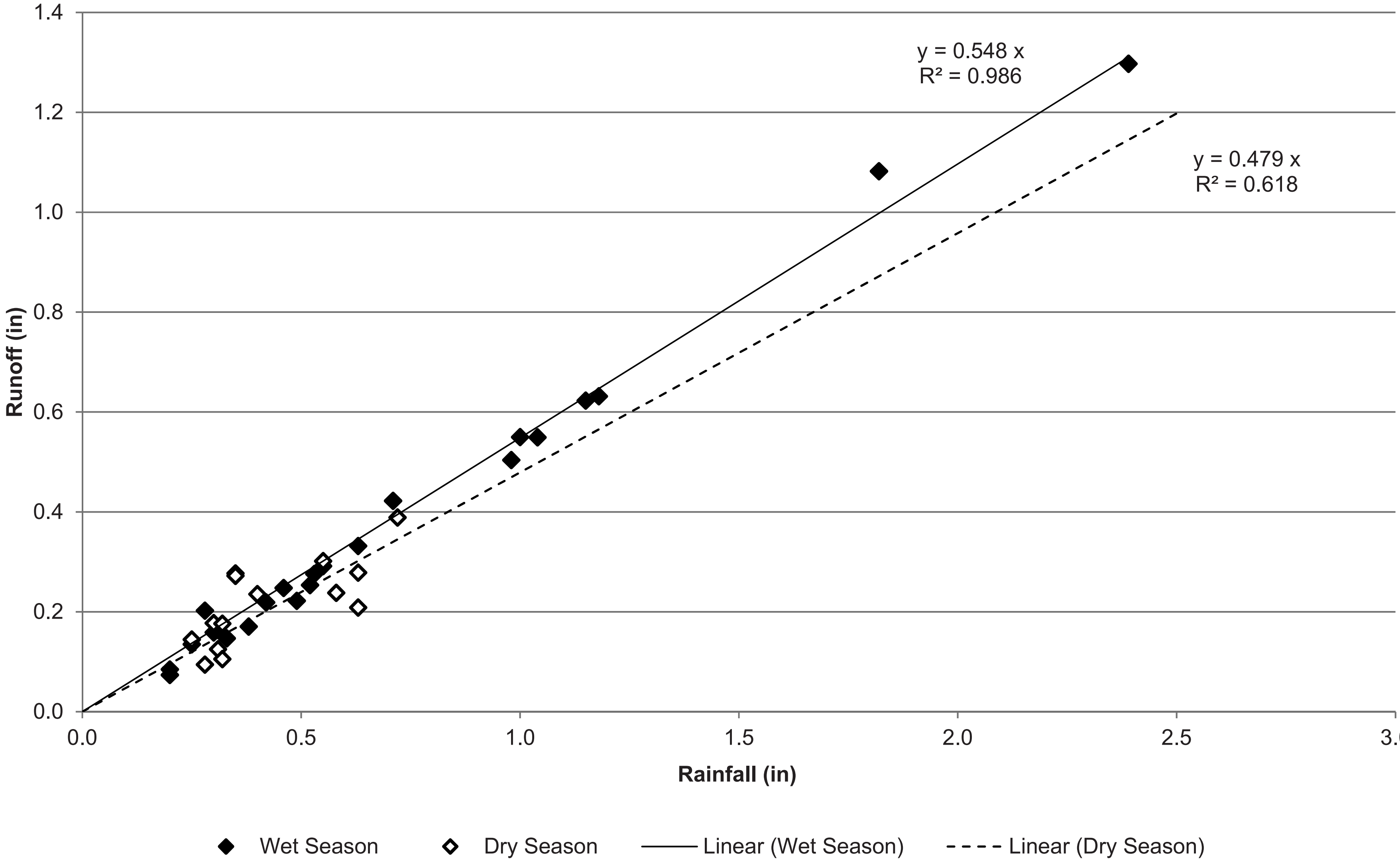


Figure B2-9
Whole-Water Monitoring and
Sediment Trap Monitoring Locations - OF237A and 237B

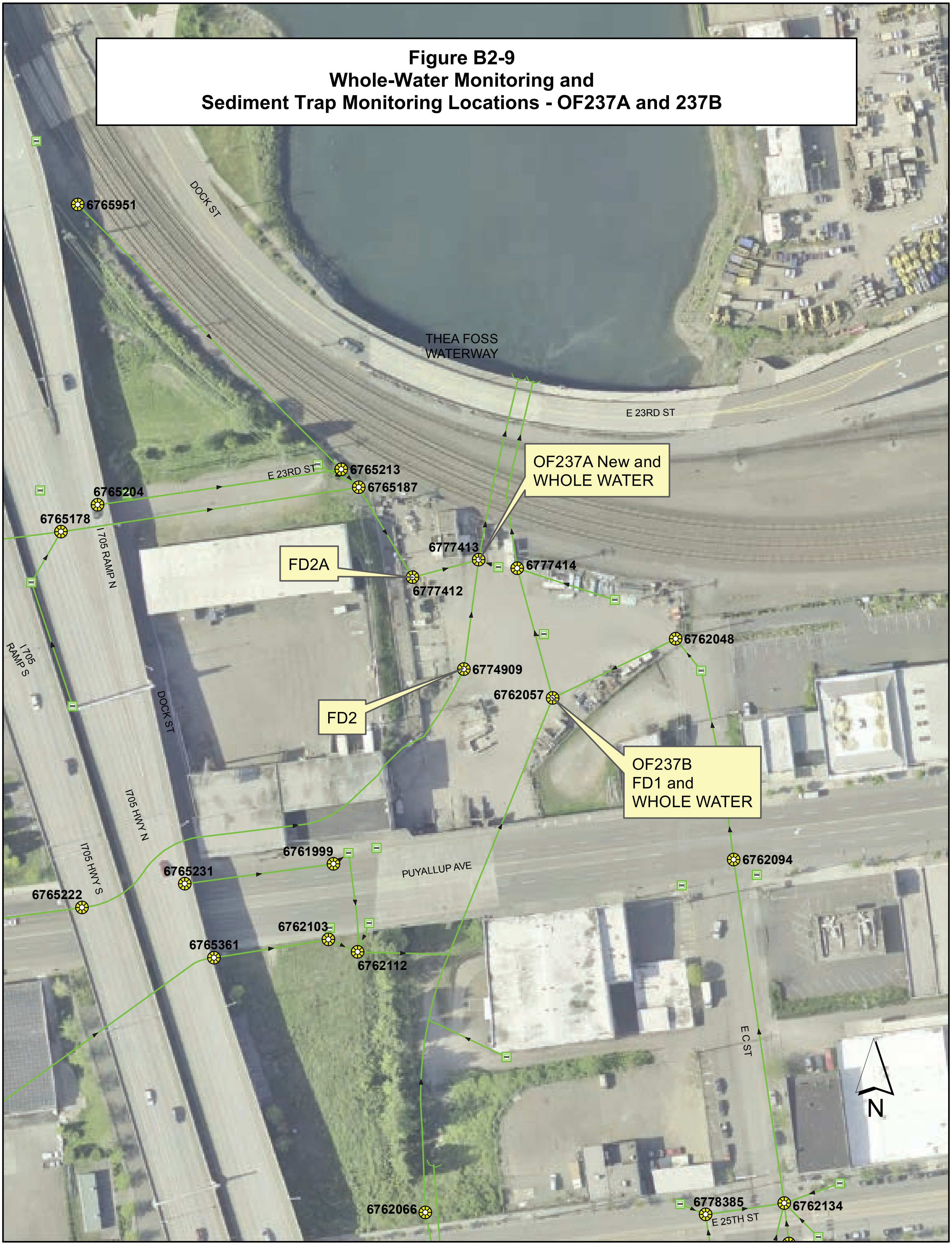
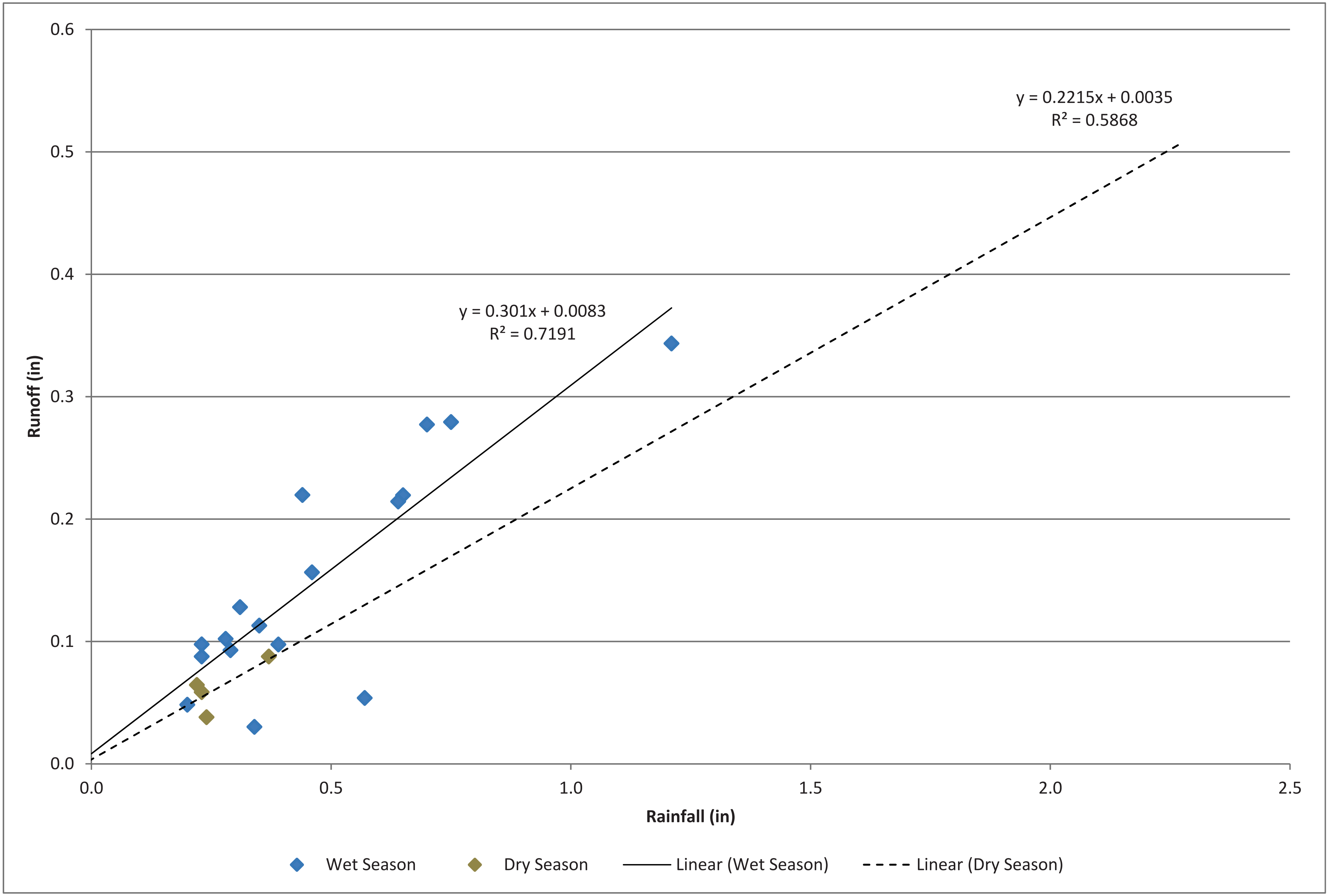


Figure B2-10
Annual Rainfall-Runoff Correlation for OF237A



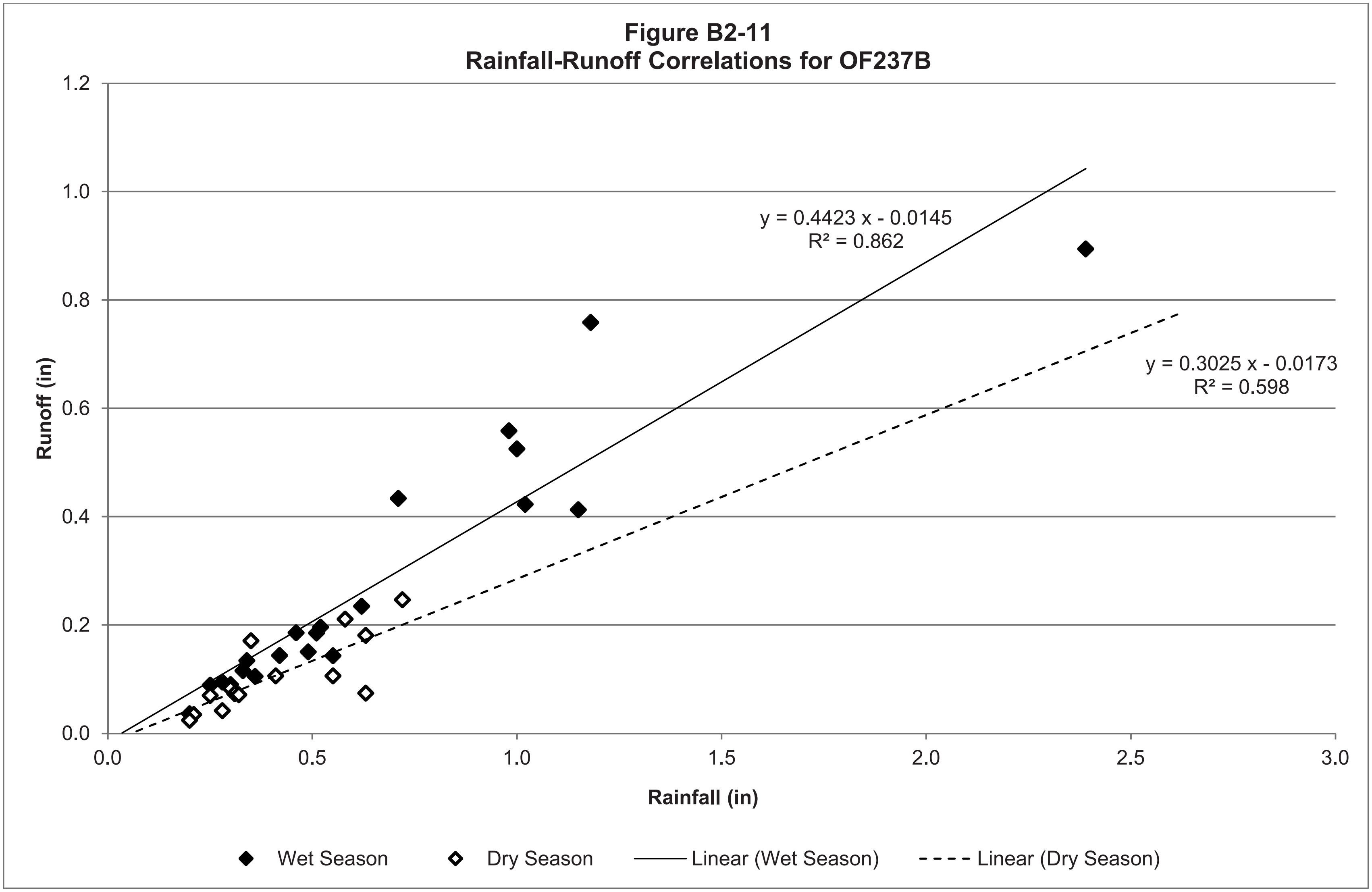


Figure B2-11
Rainfall-Runoff Correlations for OF237B
1.2
1.0
0.8
0.6
0.4
0.2
0.0
Runoff (in)
0.0
0.5
1.0
1.5
2.0
2.5
3.0
Rainfall (in)
y = 0.4423 x - 0.0145
R² = 0.862
y = 0.3025 x - 0.0173
R² = 0.598
Wet Season
Dry Season
Linear (Wet Season)
Linear (Dry Season)

Figure B2-12
Whole-Water Monitoring and Sediment Trap Monitoring Locations - OF243

Figure B2-13
Annual Rainfall-Runoff Correlation for OF243

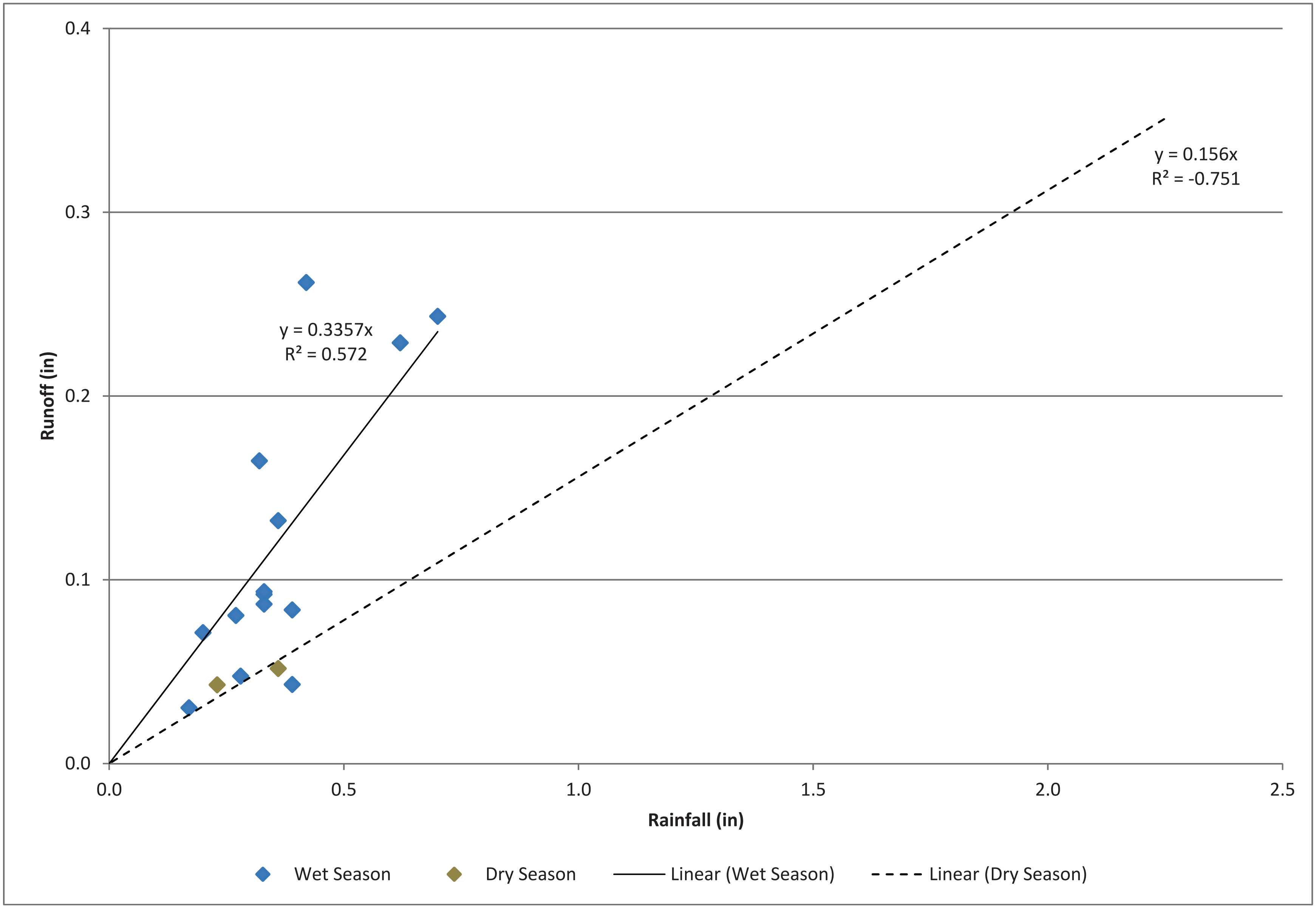


Figure B2-14
Sediment Trap Thea Foss Waterway

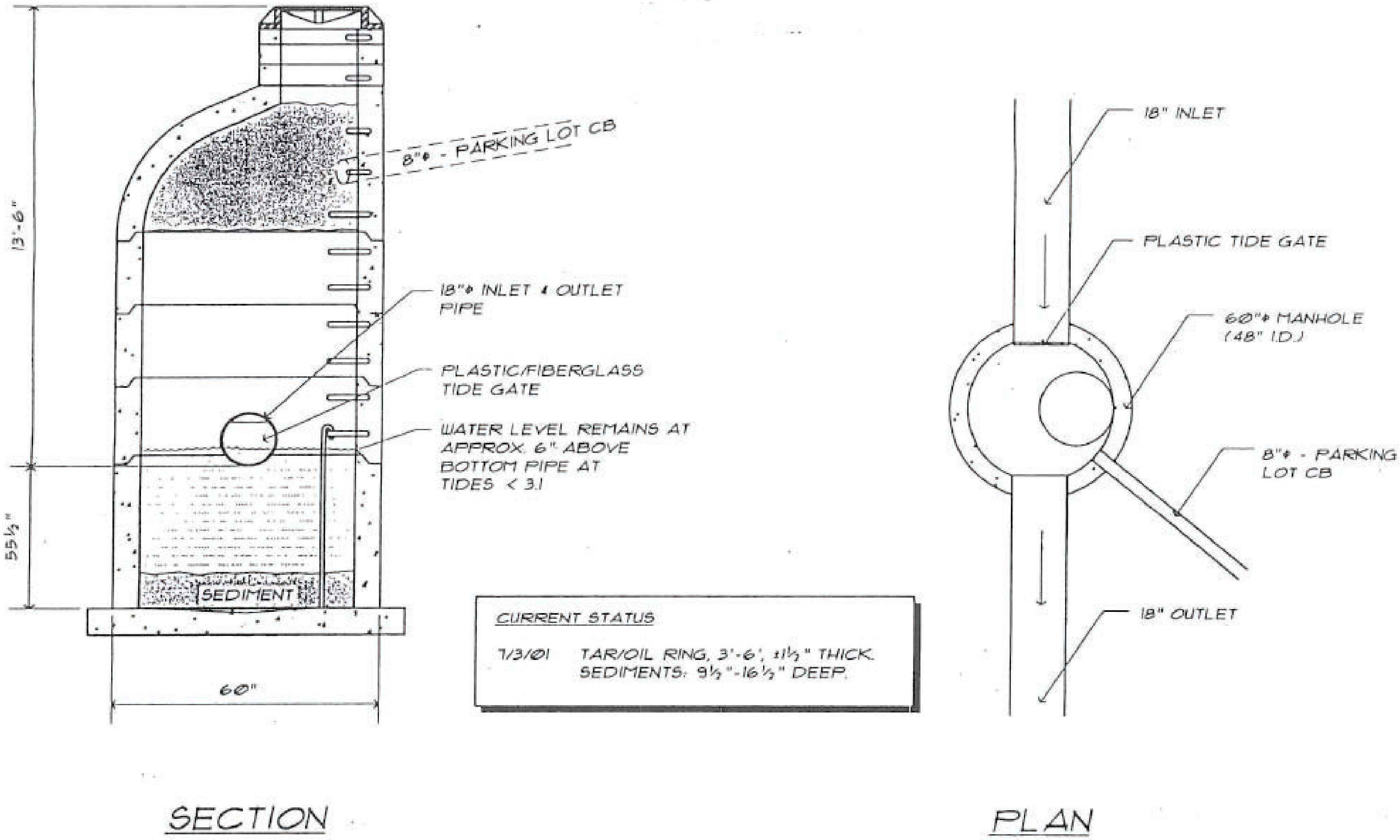


Figure B2-15
Whole-Water Monitoring and Manhole Sump Sample Location - OF245

Figure B2-16
Rainfall-Runoff Correlations for OF245

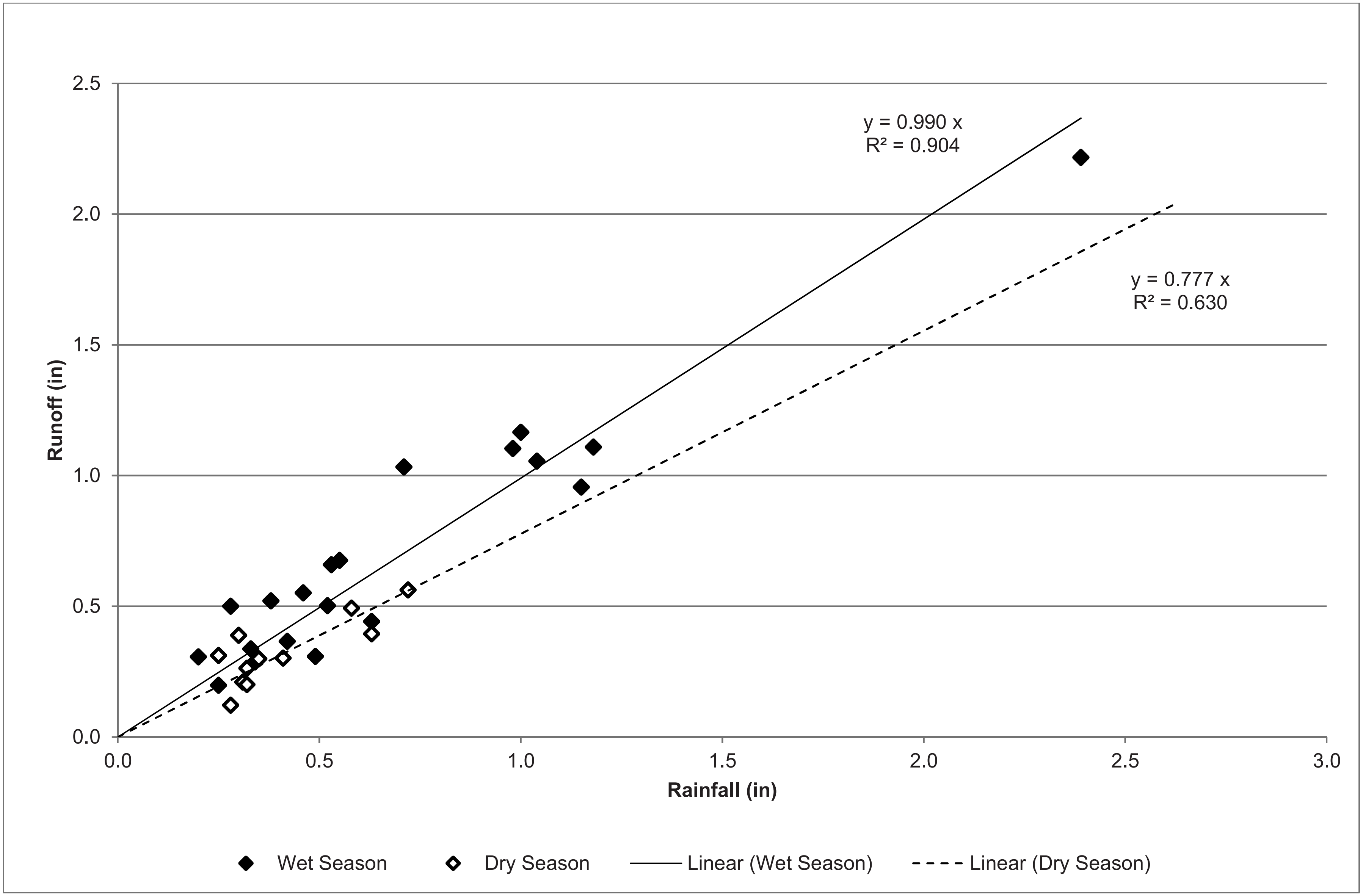


Figure B2-17
Whole-Water Monitoring Location - OF254

Figure B2-18
Annual Rainfall-Runoff Correlation for OF254

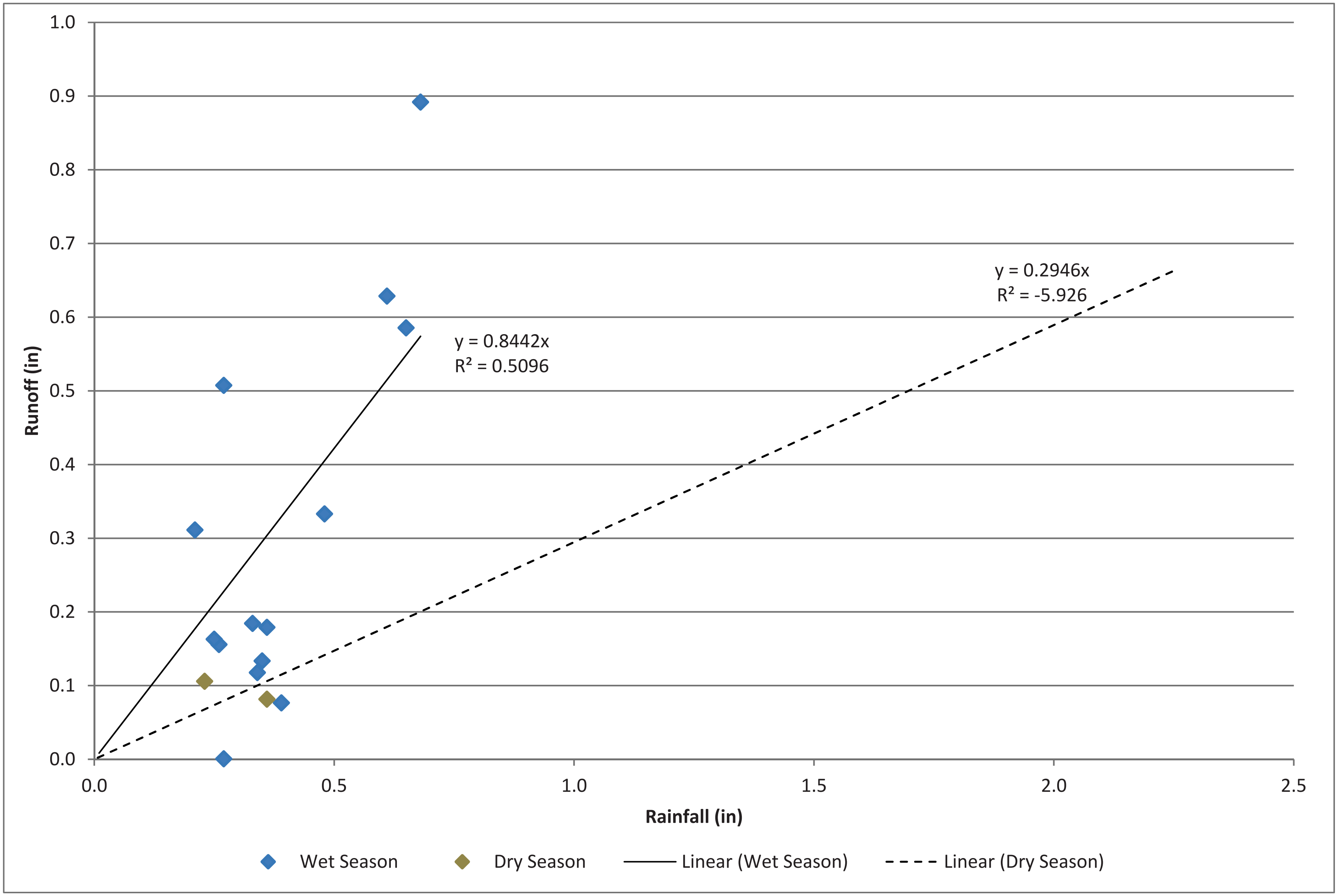
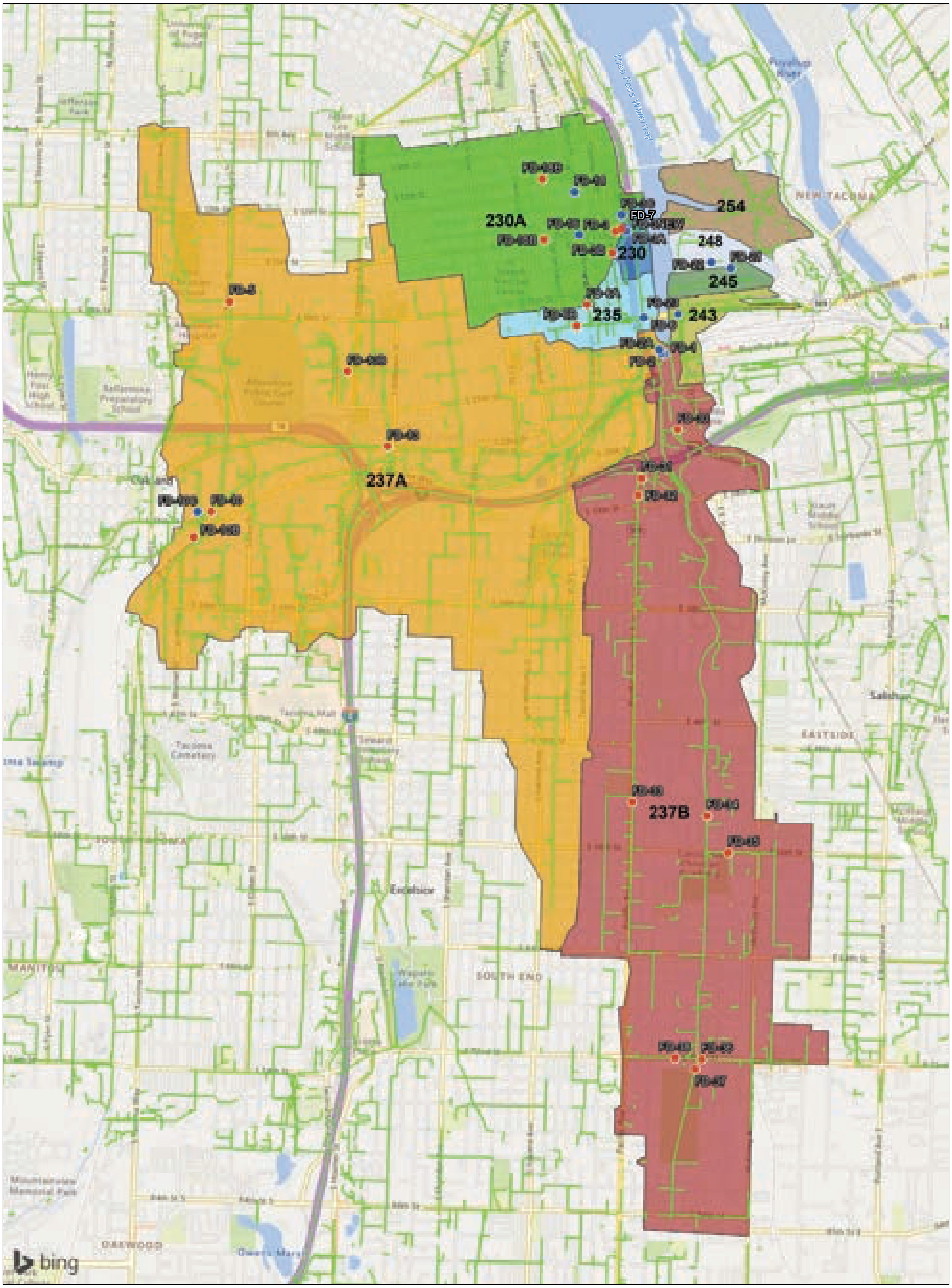


Figure B2-19
Sediment Trap Locations



- Sediment Trap Locations
- Historic Sediment Trap Locations
- Surfacewater Mains

Map Date: 11/14/2023
Source: Science and Engineering Division
Environmental Services Department
City of Tacoma
326 East D Street, Tacoma WA 98421
(253) 591-5588

0 1,000 2,000 4,000 Feet

Tacoma

Figure B2-20 Sequential Sampler Base

Figure B2-21
Stormwater Sediment Traps

Sediment trap mounting bracket.

Typical sediment trap installation – large and medium pipe.

Figure B3-1
WY2023 Daily Rainfall and Average Daily Rainfall, 21-Day Trends Only

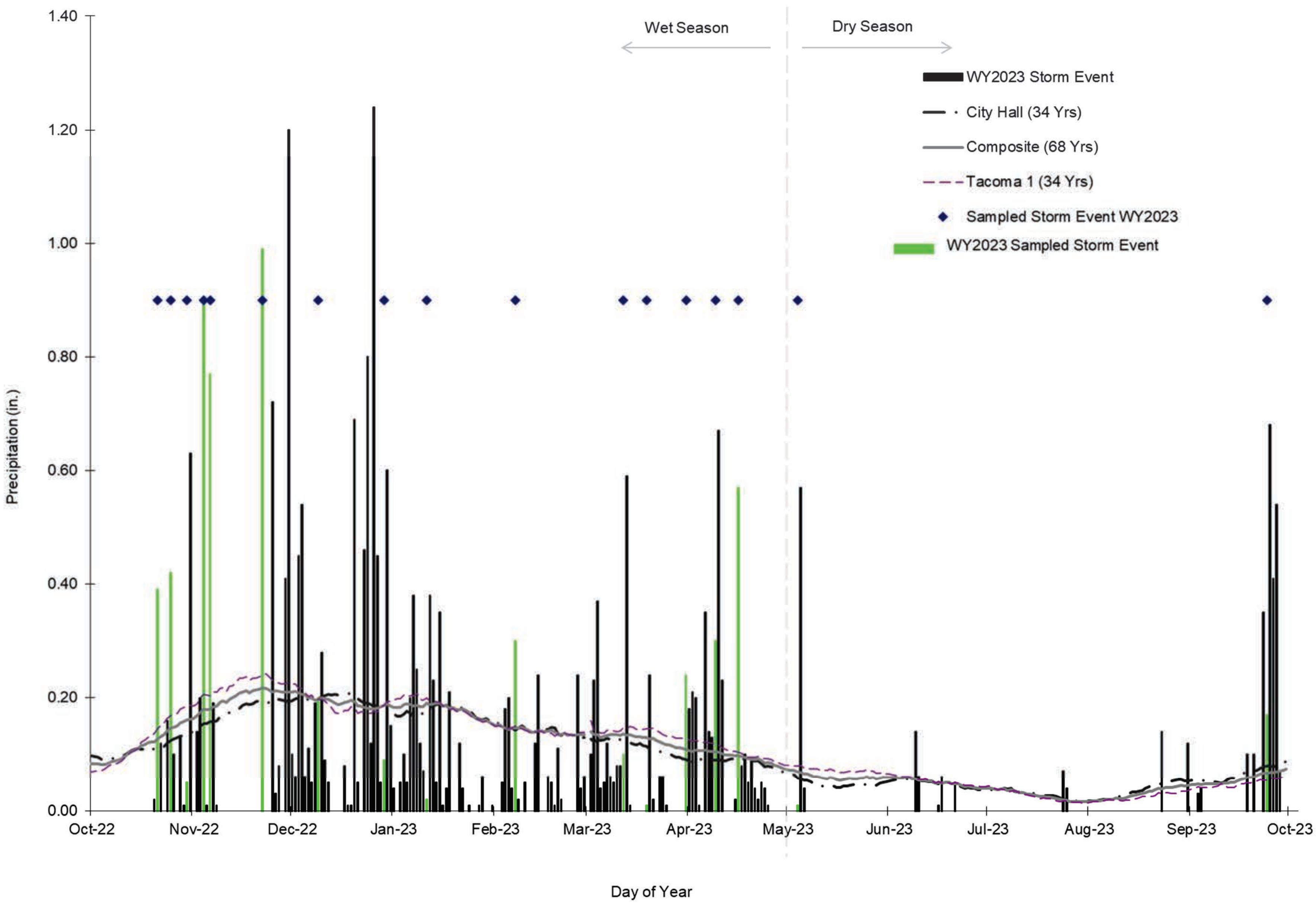


Figure B3-2
Daily Rainfall - Monthly Averages WY2023

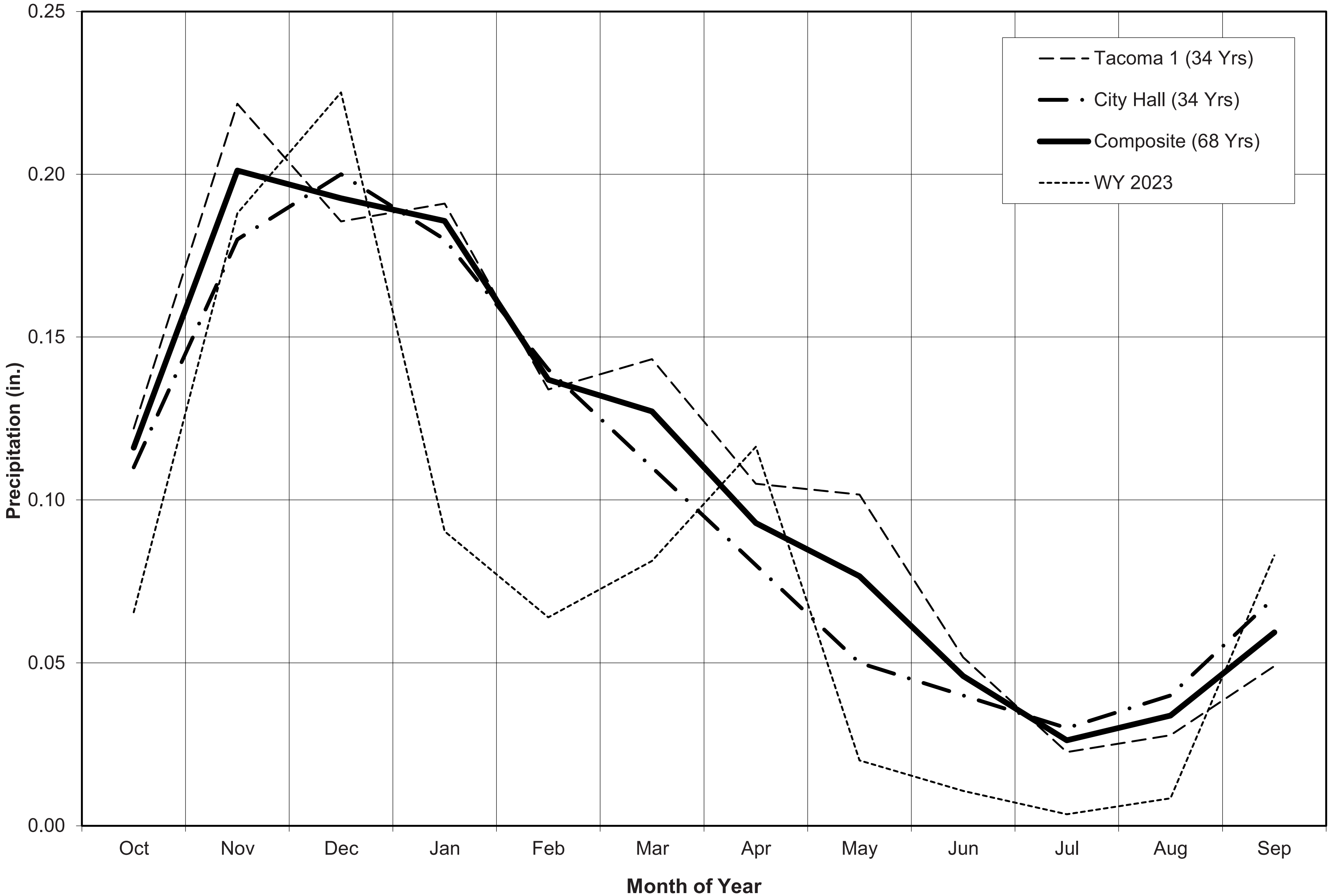


Figure B3-3
Daily Rainfall – Monthly Averages WY2002-2023

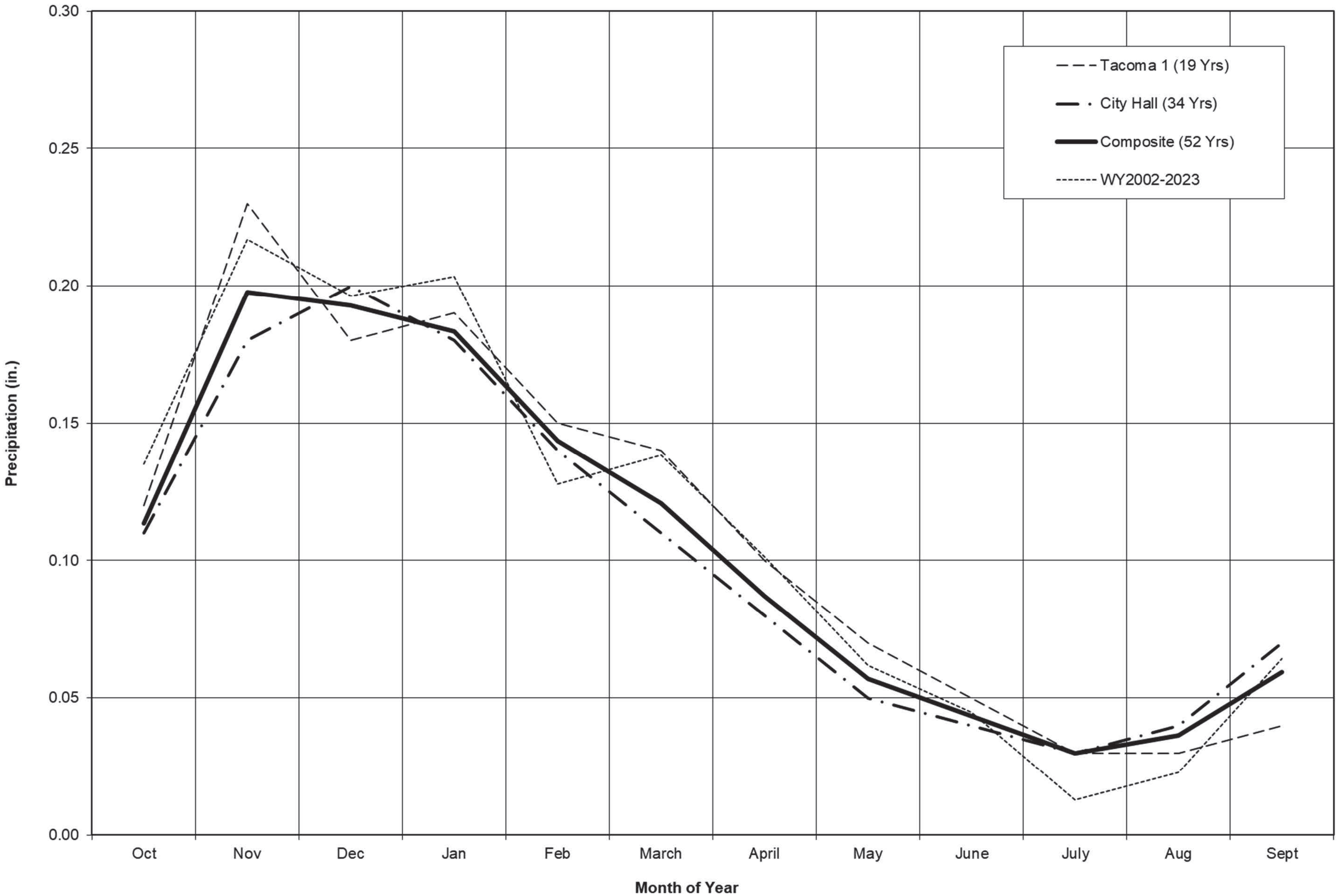
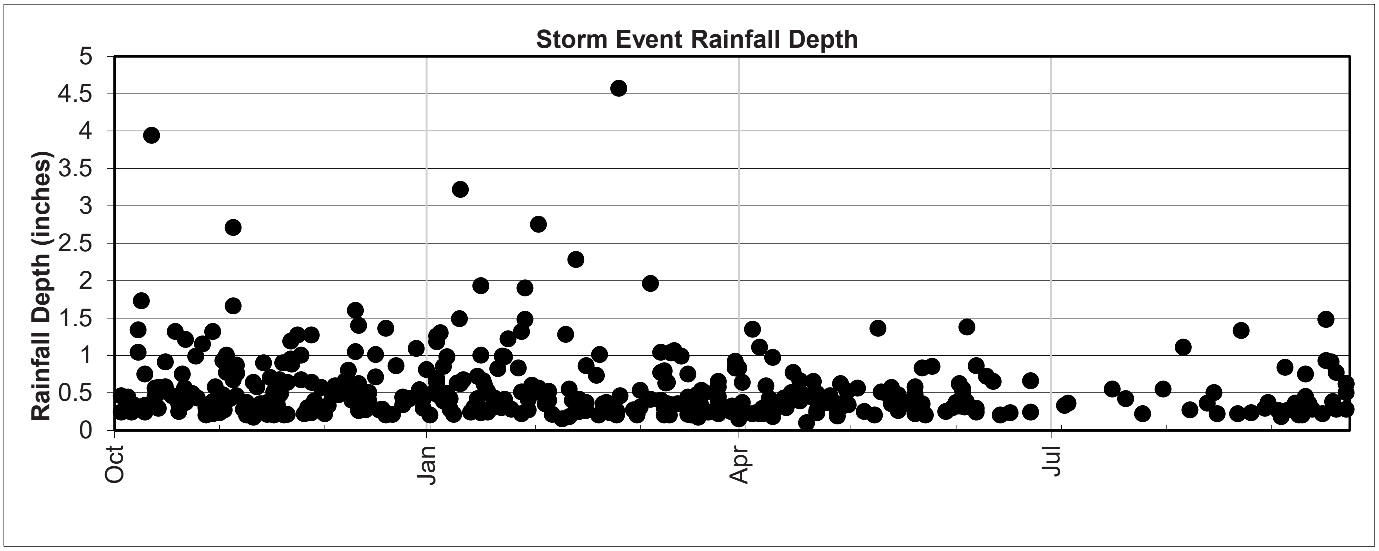
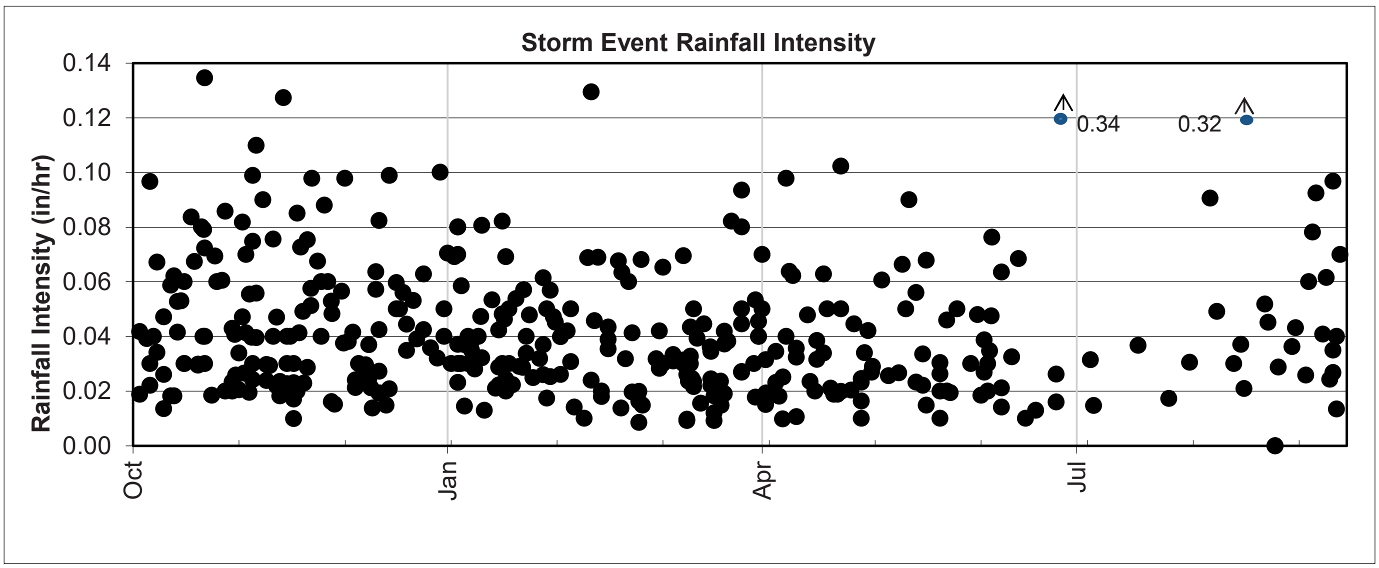


Figure B4-1.1
Storm Event Hydrologic Parameters, October 2001 - September 2023





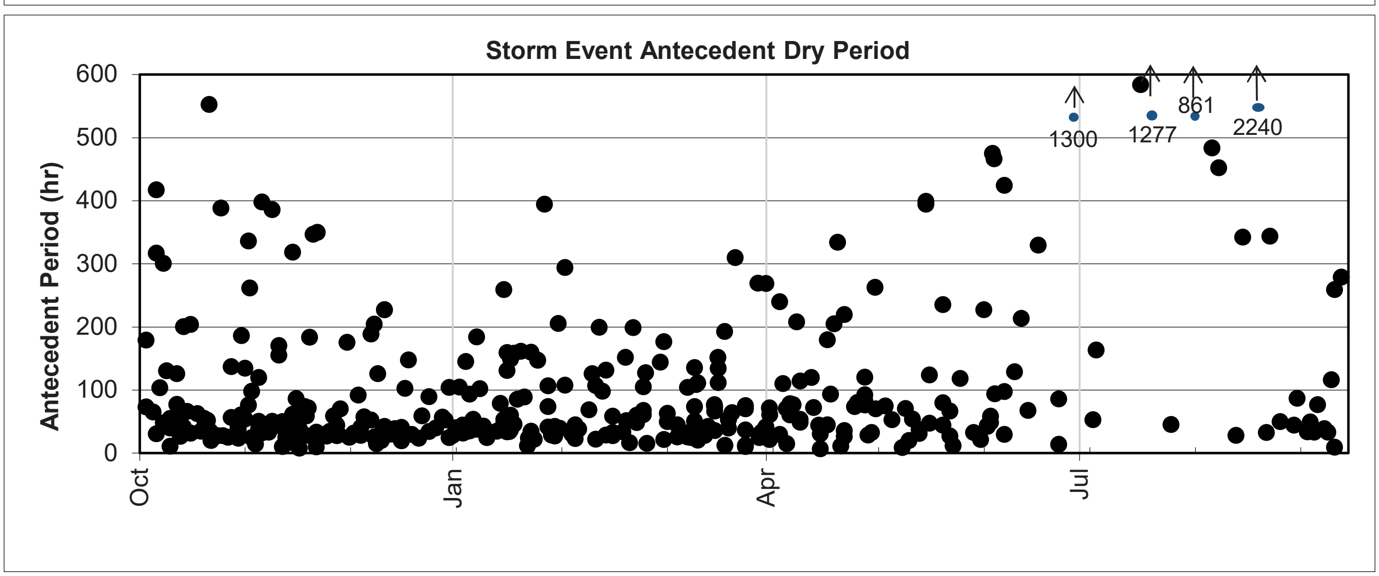


Figure B4-1.2
Storm Event Hydrologic Parameters, October 2001 - September 2023

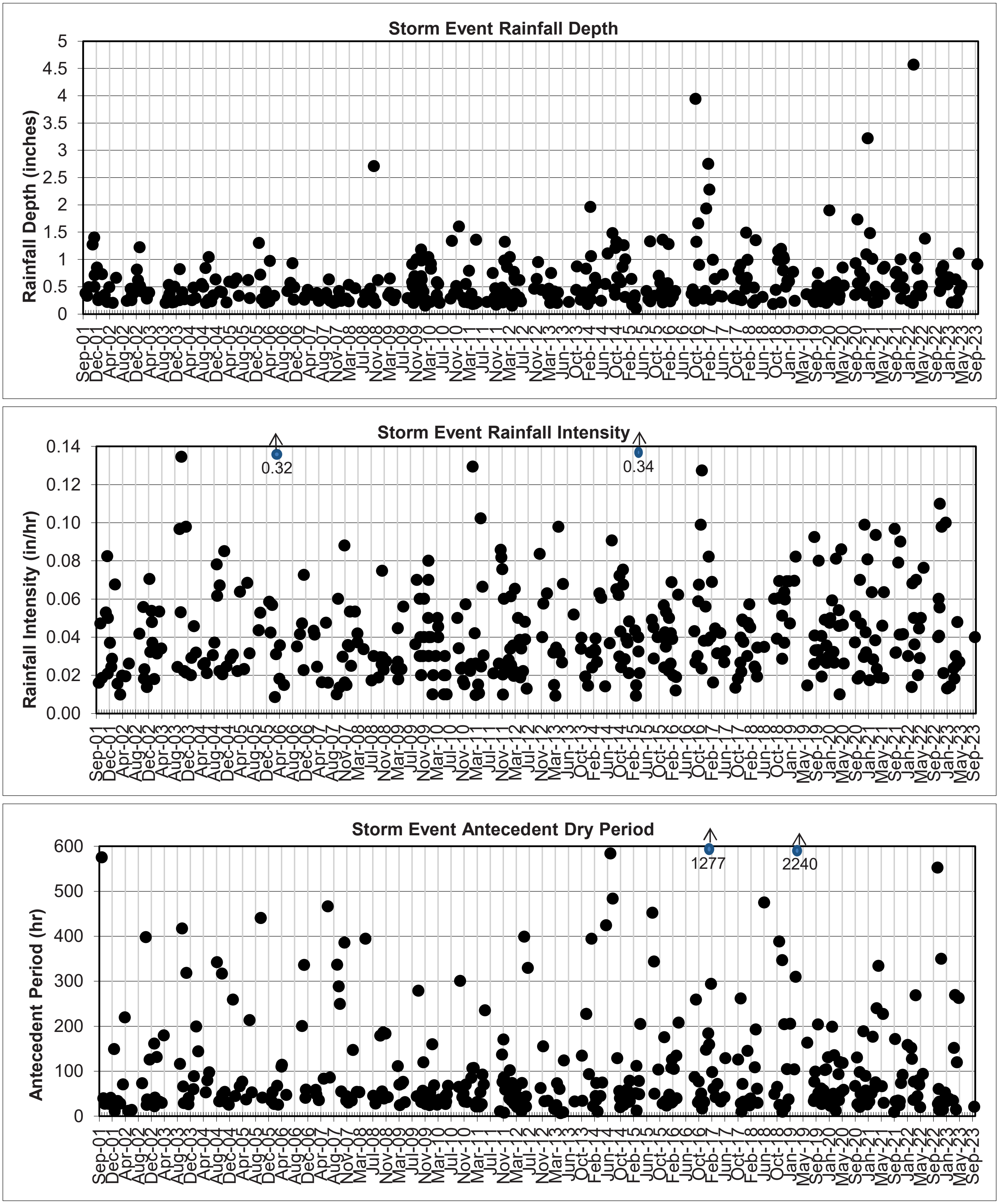
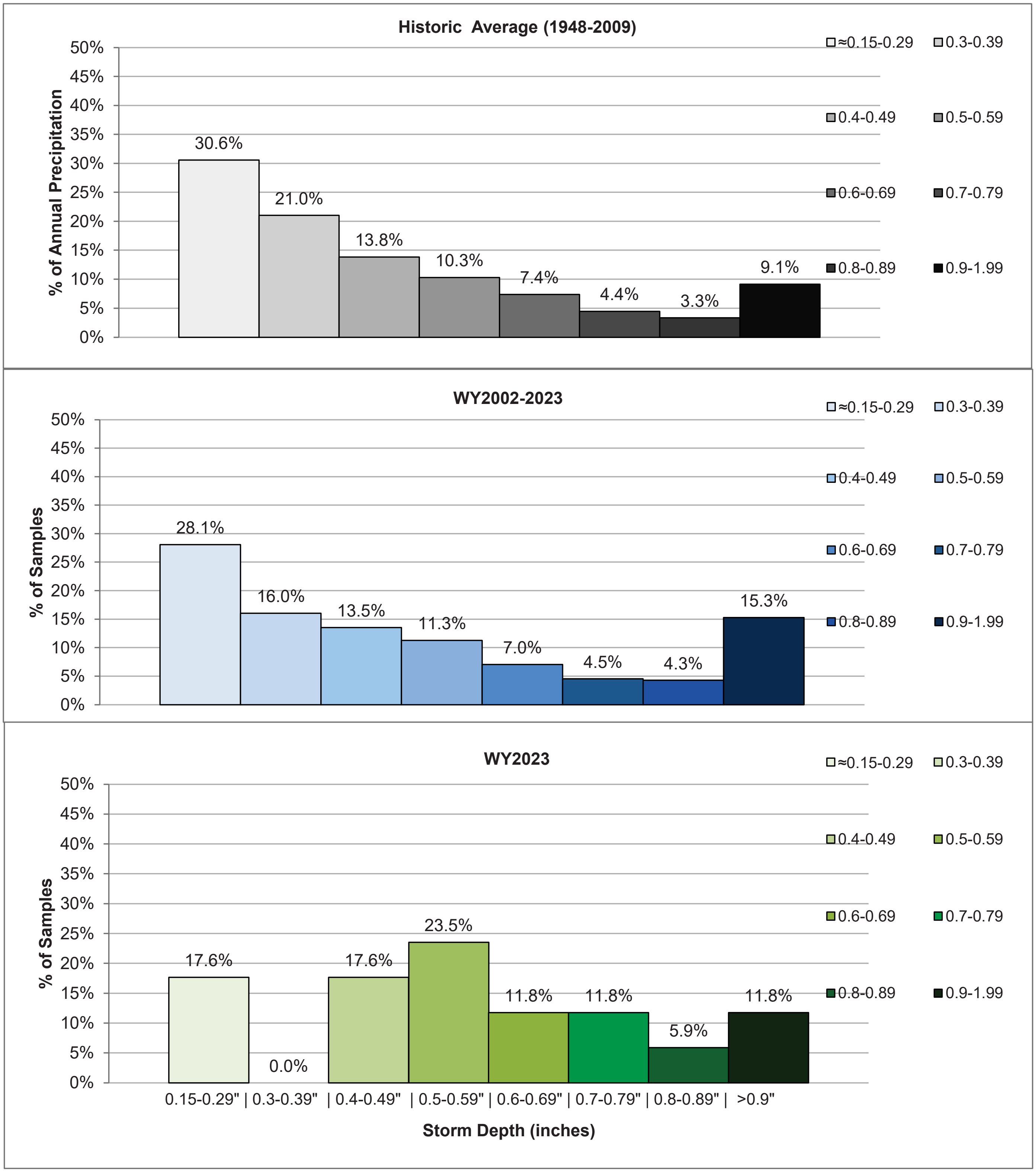


Figure B4-2
Representativeness of Sampled Storm Sizes



Note: Data for 237A is from the original 237A site through WY2011. The 237A New sampling site data was used for WY2012 and later.

Figure B4-3
Representativeness of Seasonal Sampling Distribution

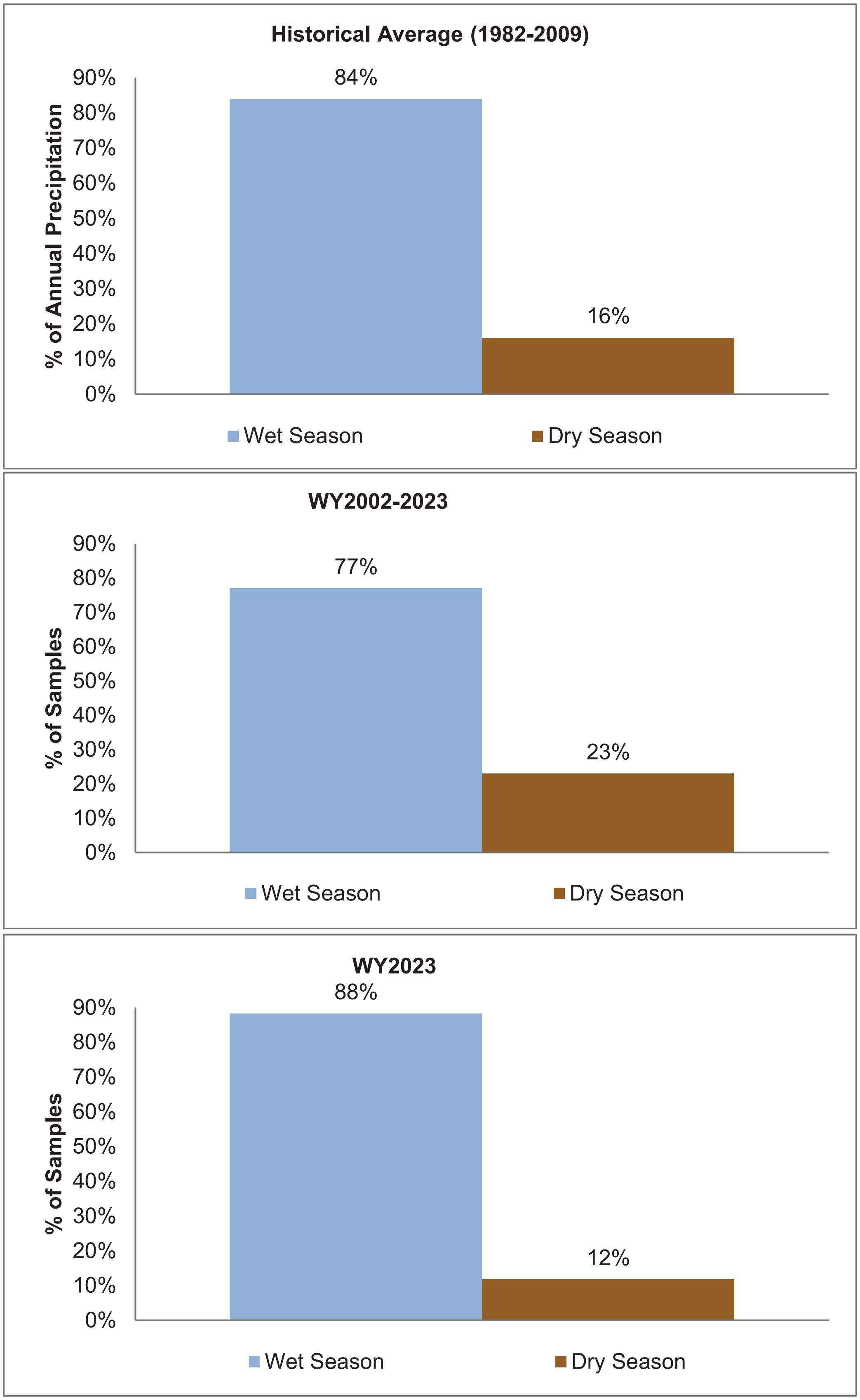


Figure B7-1
Simplified Guidance for Evaluating Performance-Based Chemical Data – Whole-Water

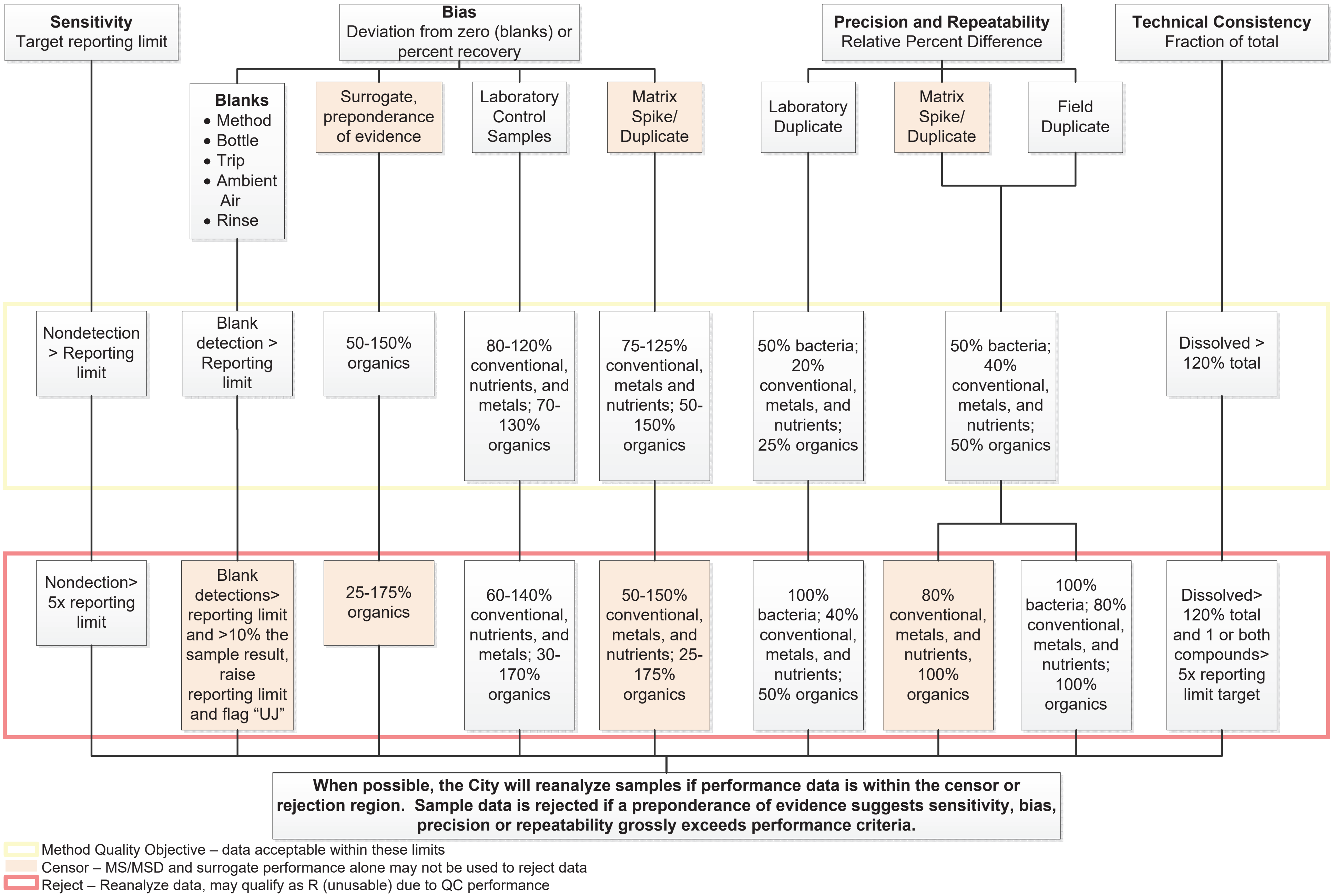


Figure B7-1.vsd

Figure B7-2
Simplified Guidance for Evaluating Performance-Based Chemical Data – Suspended Sediment Particulate Matter

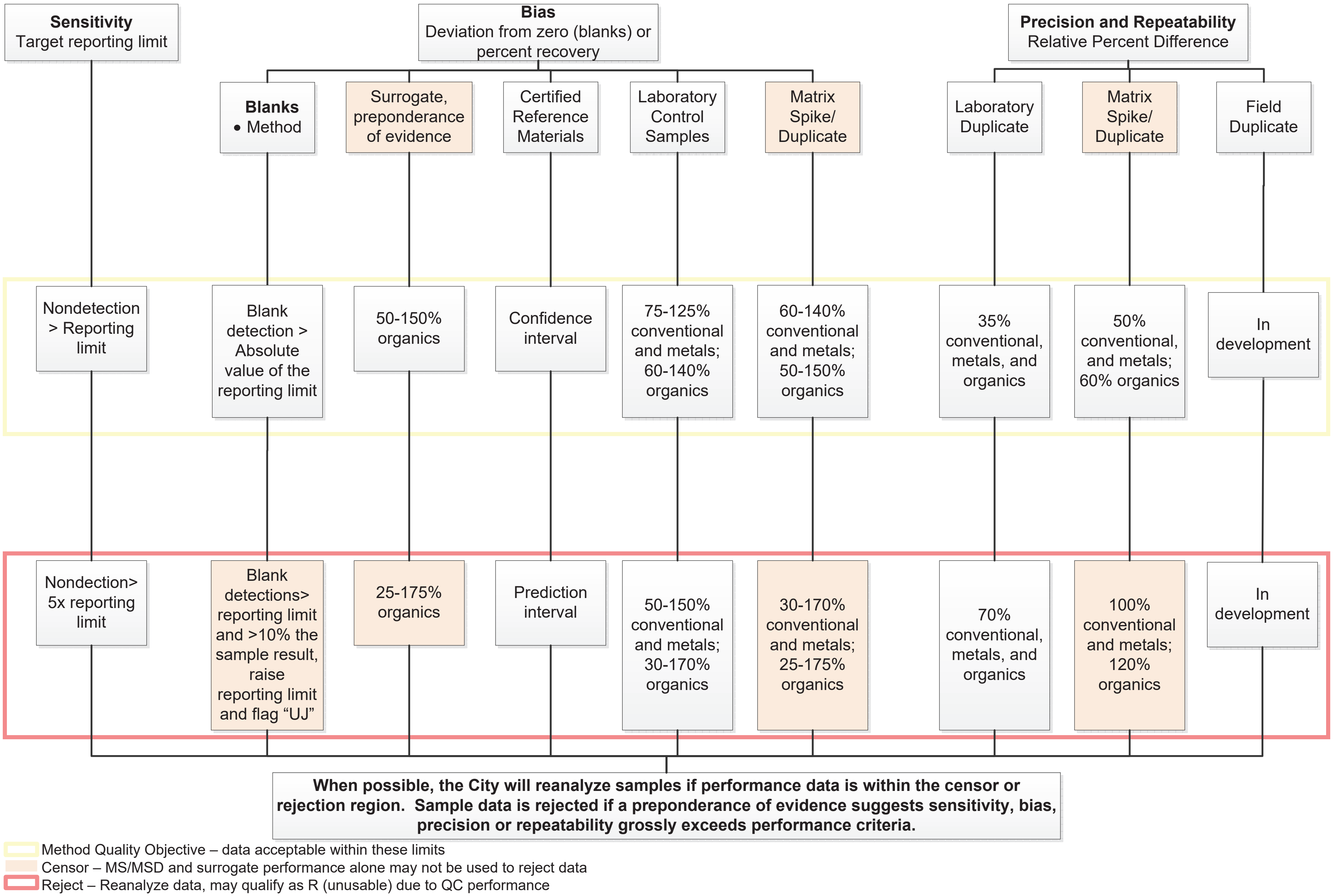


Figure B7-2.vsd

APPENDIX C

Table C-1
Storm Field Summary Report for OF230 WY2023

	Storm Flow Criteria	Sample 1	Sample 1 Partial	Sample 2	Sample 3
Start of Rainfall		11/22/2022	11/22/2022	12/9/2022	12/29/2022
		6:40:00	6:40:00	15:30:00	20:50:00
End of Rainfall		11/22/2022	11/22/2022	12/10/2022	12/30/2022
		15:40:00	10:35:00	19:00:00	9:20:00
Antecedent Dry Period (hours)	<0.02 in 24 hours	349.67	349.67	14.58	52.25
Total Rainfall (inches)	>0.2	0.88	0.2	0.58	0.54
Rainfall Duration (hours)		9.00	3.92	27.50	12.50
Start of Storm Flow		11/22/22 7:50	11/22/22 7:50	12/9/22 19:20	12/29/22 23:05
End of Storm Flow		11/22/22 13:40	11/22/22 10:15	12/10/22 3:30	12/30/22 7:05
Total Volume of Storm Runoff (cf)		4,606	1,969	5,574	14,263
Duration of storm runoff (hours)		5.83	2.42	8.17	8.00
Corrected Duration of storm runoff (hours)		3.00	2.42	7.59	4.17
Flow Calculation (method)	Area*Velocity				
Flow Range (cfs) Avg		0.22	0.23	0.19	0.50
Flow Range (cfs) Max		3.58	0.38	0.57	4.17
Volume Sampled (cf)	>75% of Storm Volume Sampled	1,625	1,625	3,290	3,791
Sample Type (Flow/Time Composite)		Flow	Flow	Flow	Flow
Start of Event		11/22/2022	11/22/2022	12/9/2022	12/30/2022
		8:35:00	8:35:00	19:40:00	0:55:00
End of Event		11/22/2022	11/22/2022	12/9/2022	12/30/2022
		10:13:00	10:13:00	23:20:00	5:41:00
Sampling Duration (hours)	>2*Time of Concentration up to 24 hours	1.63	1.63	3.67	4.77
Corrected Sampling Duration (hours)		1.47	1.47	3.67	2.58
Disable time subracted		0.16	0.16	0.00	2.19
Aliquots Composited	>10	23	23	48	48
Conductivity Range (uS/cm)	<2,000	107.8 - 288.3	107.8 - 288.3	365 - 1030	306 - 1591
Tidal Window		11/22/2022	11/22/2022	12/9/2022	12/29/2022
Time (24:00) Stage (feet)		03:58 10.9	03:58 10.9	16:29 10.5	16:51 4.6
		09:19 5.9	09:19 5.9	23:35 -1.8	21:59 8.5
		14:48 12.2	14:48 12.2	12/10/2022	12/30/2022
		21:45 -1.5	21:45 -1.5	07:17 12.6	03:51 2.9
				12:56 8.0	
				17:07 10.1	
Percent coverage		35.27501205	82.4977405	59.03337561	26.58050168

Table C-2
Storm Field Summary Report for OF235 WY2023

	Storm Flow Criteria	Sample 1	Sample 2	Sample 3	Sample 3 Partial	Sample 4	Sample 5	Sample 6	Sample 7	Sample 8	Sample 9	Sample 10	Sample 11
Start of Rainfall		10/21/2022	10/30/2022	11/22/2022	11/22/2022	12/9/2022	12/29/2022	1/11/2023	3/12/2023	3/19/2023	4/16/2023	5/4/2023	9/24/2023
		11:10:00	18:55:00	6:40:00	6:40:00	15:30:00	20:50:00	19:05:00	12:25:00	22:25:00	7:10:00	23:50:00	13:15:00
End of Rainfall		10/22/2022	10/31/2022	11/22/2022	11/22/2022	12/10/2022	12/30/2022	1/13/2023	3/13/2023	3/20/2023	4/16/2023	5/5/2023	9/25/2023
		2:05:00	9:10:00	15:40:00	12:10:00	19:00:00	9:20:00	22:40:00	15:05:00	9:25:00	16:10:00	19:10:00	19:55:00
Antecedent Dry Period (hours)	<0.02 in 24 hours	551.92	60.33	349.67	349.67	11.25	52.25	32.67	34.33	151.33	119.58	262.42	18.08
Total Rainfall (inches)	>0.2	0.42	0.58	0.88	0.57	0.58	0.54	0.67	0.63	0.2	0.43	0.52	0.91
Rainfall Duration (hours)		14.92	14.25	9.00	5.50	27.50	12.50	51.58	26.67	11.00	9.00	19.33	30.67
Start of Storm Flow		10/21/22 11:35	10/30/22 19:15	11/22/22 8:25	11/22/22 8:25	12/9/22 16:30	12/29/22 21:05	1/11/23 20:55	3/12/23 12:50	3/19/23 23:05	4/16/23 7:15	5/5/23 1:15	9/24/23 16:40
End of Storm Flow		10/22/22 0:00	10/31/22 9:45	11/22/22 15:45	11/22/22 12:15	12/10/22 3:50	12/30/22 9:35	1/14/23 1:05	3/13/23 16:45	3/20/23 11:55	4/16/23 17:15	5/5/23 14:30	9/25/23 20:55
Total Volume of Storm Runoff (cf)		110,324	188,657	129,570	129,570	117,214	167,720	188,983	197,832	62,407	74,593	105,739	242,299
Duration of storm runoff (hours)		12.42	14.50	7.33	3.83	11.33	12.50	52.17	27.92	12.83	10.00	13.25	28.25
Corrected Duration of storm runoff (hours)		11.50	13.67	7.16	3.83	11.33	11.25	48.50	27.92	12.83	10.00	10.67	28.25
Flow Calculation (method)	Area*Velocity												
Flow Range (cfs) Avg		2.47	3.61	4.91	9.39	2.87	3.73	1.01	1.97	1.35	2.07	2.22	2.38
Flow Range (cfs) Max		7.22	10.88	17.65	17.65	7.79	17.18	6.38	11.55	7.19	8.81	7.74	11.59
Volume Sampled (cf)	>75% of Storm Volume Sampled	74,179	168,677	60,697	60,697	115,172	156,615	125,875	154,418	38,096	69,676	95,498	201,987
Sample Type (Flow/Time Composite)		Flow	Flow	Flow	Flow	Flow	Flow	Flow	Flow	Flow	Flow	Flow	Flow
Start of Event		10/21/2022	10/30/2022	11/22/2022	11/22/2022	12/9/2022	12/29/2022	1/11/2023	3/12/2023	3/20/2023	4/16/2023	5/5/2023	9/24/2023
		10:15:00	19:35:00	8:25:00	8:25:00	16:30:00	21:00:00	20:20:00	14:55:00	0:40:00	7:45:00	6:00:00	16:40:00
End of Event		10/21/2022	10/31/2022	11/22/2022	11/22/2022	12/10/2022	12/30/2022	1/13/2023	3/13/2023	3/20/2023	4/16/2023	5/5/2023	9/25/2023
		23:07:00	6:49:00	12:02:00	12:02:00	2:50:00	6:02:00	22:30:00	16:18:00	10:35:00	16:30:00	13:39:00	20:10:00
Sampling Duration (hours)	>2*Time of Concentration up to 24 hours	12.87	11.23	3.62	3.62	10.33	9.03	50.17	25.38	9.92	8.75	7.65	27.50
Corrected Sampling Duration (hours)		7.78	11.23	3.62	3.62	10.33	9.03	23.50	16.73	4.58	6.92	7.65	14.42
Disable time subracted		5.09	0.00	0.00	0.00	0.00	0.00	26.67	8.65	5.34	1.83	0.00	13.08
Aliquots Composited	>10	15	12	28	28	25	12	10	23	15	34	16	22
Conductivity Range (uS/cm)	<2,000	84.2 - 128.3	48.8 - 65.4	58 - 591	58 - 591	74.3 - 280.0	47.3 - 130.7	92 - 181	69.4 - 295.0	94.4 - 206.4	51 - 144	55.5 - 112.6	53.0 - 78.7
Tidal Window		10/21/2022	10/30/2022	11/22/2022	11/22/2022	12/9/2022	12/29/2022	1/11/2023	3/12/2023	3/19/2023	4/16/2023	5/4/2023	9/24/2023
Time (24:00) Stage (feet)		08:41 2.2	15:51 8.1	03:58 10.9	03:58 10.9	16:29 10.5	16:51 4.6	14:18 6.3	08:19 11.7	22:15 -0.8	03:24 11.9	23:13 5.3	06:38 -0.2
		15:35 11.5	20:16 10.2	09:19 5.9	09:19 5.9	23:35 -1.8	21:59 8.5	19:08 9.3	15:10 0.2	3/20/2023	09:33 4.9	5/5/2023	14:50 10.8
		22:00 4.1	10/31/2022	14:48 12.2	14:48 12.2	12/10/2022	12/30/2022	1/12/2023	21:51 10.1	05:19 12.5	14:39 9.5	04:42 11.4	20:28 7.5
		10/22/2022	03:38 -1.4	21:45 -1.5	21:45 -1.5	07:17 12.6	03:51 2.9	01:39 1.0	3/13/2023			11:33 -1.1	9/25/2023
		03:29 9.4	11:34 11.7			12:56 8.0		08:45 12.5	03:09 6.4			18:29 11.2	00:42 9.4
		09:27 2.4				17:07 10.1		15:02 5.5	08:50 11.3				07:48 -0.3
						12/11/2022		20:03 8.8					15:36 11.4
						00:11 -1.4		1/13/2023					
								02:17 2.2					
								09:16 12.4					
								15:50 4.5					
								21:11 8.4					
Percent coverage		67.23715539	89.40941397	46.84501709	46.84501709	98.25813722	93.37898133	66.60649365	78.05515065	61.04478497	93.408028	90.31493828	83.3623876

Table C-3
Storm Field Summary Report for OF237A WY2023

	Storm Flow Criteria	Sample 1	Sample 2	Sample 3	Sample 3 Partial	Sample 4	Sample 5	Sample 6	Sample 7	Sample 8	Sample 9	Sample 10	Sample 11	Sample 12
Start of Rainfall		10/21/2022	11/4/2022	11/22/2022	11/22/2022	12/9/2022	12/29/2022	1/11/2023	2/7/2023	3/12/2023	3/19/2023	4/9/2023	5/4/2023	9/24/2023
		11:10:00	2:40:00	6:40:00	6:40:00	15:30:00	20:50:00	19:05:00	0:55:00	12:25:00	22:25:00	2:45:00	23:50:00	13:15:00
End of Rainfall		10/22/2022	11/4/2022	11/22/2022	11/22/2022	12/10/2022	12/30/2022	1/13/2023	2/7/2023	3/13/2023	3/20/2023	4/10/2023	5/5/2023	9/25/2023
		2:05:00	16:55:00	15:40:00	12:35:00	19:00:00	9:20:00	22:40:00	15:50:00	15:05:00	9:25:00	23:00:00	19:10:00	19:55:00
Antecedent Dry Period (hours)	<0.02 in 24 hours	551.92	8.58	349.67	349.67	11.25	52.25	32.67	9.42	34.33	151.33	11.58	262.42	18.08
Total Rainfall (inches)	>0.2	0.42	0.79	0.88	0.7	0.58	0.54	0.67	0.21	0.63	0.2	1.11	0.52	0.91
Rainfall Duration (hours)		14.92	14.25	9.00	5.92	27.50	12.50	51.58	14.92	26.67	11.00	44.25	19.33	30.67
Start of Storm Flow		10/21/22 11:40	11/4/22 6:10	11/22/22 9:15	11/22/22 9:15	12/9/22 16:05	12/29/22 21:10	1/11/23 19:50	2/7/23 2:10	3/12/23 13:50	3/20/23 0:00	4/9/23 3:35	5/5/23 7:20	9/24/23 18:10
End of Storm Flow		10/22/22 4:31	11/4/22 20:00	11/22/22 16:10	11/22/22 12:35	12/10/22 19:45	12/30/22 8:05	1/14/23 1:45	2/7/23 16:25	3/13/23 16:40	3/20/23 11:35	4/11/23 1:20	5/5/23 19:24	9/25/23 22:10
Total Volume of Storm Runoff (cf)		774,376	2,199,748	1,611,589	962,540	1,870,471	1,400,148	2,568,646	601,809	1,893,815	500,401	3,321,827	799,246	1,648,707
Duration of storm runoff (hours)		16.85	13.83	6.92	3.33	27.67	10.92	53.92	14.25	26.83	11.58	45.75	12.07	28.00
Corrected Duration of storm runoff (hours)		16.85	13.83	6.92	3.33	27.67	10.92	53.92	14.25	26.83	11.58	45.75	12.07	28.00
Flow Calculation (method)	Area*Velocity													
Flow Range (cfs) Avg		12.77	44.17	64.72	80.21	18.78	35.63	13.23	11.73	19.60	12.00	20.17	18.40	16.36
Flow Range (cfs) Max		30.86	86.49	199.29	126.55	61.31	126.32	47.13	62.47	82.19	35.72	67.20	47.95	53.61
Volume Sampled (cf)	>75% of Storm Volume Sampled	100,343	2,081,149	906,749	906,749	1,216,422	1,313,023	1,885,207	403,217	1,732,634	290,533	3,130,498	674,313	1,344,604
Sample Type (Flow/Time Composite)		Flow	Flow	Flow	Flow	Flow	Flow	Flow	Flow	Flow	Flow	Flow	Flow	Flow
Start of Event		10/21/2022	11/4/2022	11/22/2022	11/22/2022	12/9/2022	12/29/2022	1/11/2023	2/7/2023	3/12/2023	3/20/2023	4/9/2023	5/5/2023	9/24/2023
		13:55:00	4:20:00	9:10:00	9:10:00	16:05:00	21:10:00	22:25:00	2:40:00	17:40:00	0:50:00	3:40:00	7:20:00	18:10:00
End of Event		10/22/2022	11/4/2022	11/22/2022	11/22/2022	12/10/2022	12/30/2022	1/14/2023	2/7/2023	3/13/2023	3/20/2023	4/10/2023	5/5/2023	9/25/2023
		4:31:00	18:54:00	12:37:00	12:37:00	13:19:00	6:21:00	1:01:00	14:07:00	15:52:00	10:51:00	21:52:00	19:24:00	22:05:00
Sampling Duration (hours)	>2*Time of Concentration up to 24 hours	14.60	14.57	3.45	3.45	21.23	9.18	50.60	11.45	22.20	10.02	42.20	12.07	27.92
Corrected Sampling Duration (hours)		3.10	10.98	3.45	3.45	15.15	8.60	8.00	7.87	21.78	5.27	36.03	8.07	9.08
Disable time subracted		11.50	3.59	0.00	0.00	6.08	0.58	42.60	3.58	0.42	4.75	6.17	4.00	18.84
Aliquots Composited	>10	10	12	48	48	23	11	14	12	19	14	11	11	14
Conductivity Range (uS/cm)	<2,000	106.5 - 316	49.6 - 128.6	51.0 - 998	51.0 - 998	85.1 - 372	65.7 - 195.7	118 - 366	63.6 - 283.4	85.9 - 307	107.3 - 395	86.4 - 139.2	61.5 - 179.5	62.0 - 310
Tidal Window		10/21/2022	11/4/2022	11/22/2022	11/22/2022	12/9/2022	12/29/2022	1/11/2023	2/6/2023	3/12/2023	3/19/2023	4/9/2023	5/4/2023	9/24/2023
Time (24:00) Stage (feet)		08:41 2.2	02:13 9.0	03:58 10.9	03:58 10.9	16:29 10.5	16:51 4.6	14:18 6.3	23:32 -0.3	08:19 11.7	22:15 -0.8	01:32 5.8	23:13 5.3	06:38 -0.2
		15:35 11.5	08:13 2.1	09:19 5.9	09:19 5.9	23:35 -1.8	21:59 8.5	19:08 9.3	2/7/2023	15:10 0.2	3/20/2023	06:58 11.3	5/5/2023	14:50 10.8
		22:00 4.1	15:09 12.4	14:48 12.2	14:48 12.2	12/10/2022	12/30/2022	1/12/2023	06:38 12.3	21:51 10.1	05:19 12.5	13:53 -1.4	04:42 11.4	20:28 7.5
		10/22/2022	21:40 2.8	21:45 -1.5	21:45 -1.5	07:17 12.6	03:51 2.9	01:39 1.0	12:24 5.9	3/13/2023		20:53 11.2	11:33 -1.1	9/25/2023
		03:29 9.4				12:56 8.0		08:45 12.5		03:09 6.4		4/10/2023	18:29 11.2	00:42 9.4
		09:27 2.4				17:07 10.1		15:02 5.5		08:50 11.3		02:18 6.8		07:48 -0.3
						12/11/2022		20:03 8.8				07:30 11.0		15:36 11.4
						00:11 -1.4		1/13/2023				14:38 -1.6		
								02:17 2.2				21:53 11.1		
								09:16 12.4						
								15:50 4.5						
								21:11 8.4						
Percent coverage		12.95788169	94.60852002	56.26424378	94.20375332	65.03294812	93.77740723	73.39302842	67.00092355	91.48904744	58.05994193	94.24025745	84.36863775	81.55507641

Table C-4
Storm Field Summary Report for OF237B WY2023

	Storm Flow Criteria	Sample 1	Sample 2	Sample 3	Sample 3 Partial	Sample 4	Sample 5	Sample 6	Sample 7	Sample 8
Start of Rainfall		10/25/2022	11/4/2022	11/22/2022	11/22/2022	12/29/2022	2/7/2023	3/19/2023	4/9/2023	9/24/2023
		11:40:00	2:40:00	6:40:00	6:40:00	20:50:00	0:55:00	22:25:00	2:45:00	13:15:00
End of Rainfall		10/25/2022	11/4/2022	11/22/2022	11/22/2022	12/30/2022	2/7/2023	3/20/2023	4/10/2023	9/25/2023
		21:20:00	16:55:00	15:40:00	12:15:00	9:20:00	15:50:00	9:25:00	23:00:00	19:55:00
Antecedent Dry Period (hours)	<0.02 in 24 hours	27	8.58	349.67	349.67	52.25	9.42	151.33	11.58	18.08
Total Rainfall (inches)	>0.2	0.43	0.79	0.88	0.6	0.54	0.21	0.2	1.11	0.91
Rainfall Duration (hours)		9.67	14.25	9.00	5.58	12.50	14.92	11.00	44.25	30.67
Start of Storm Flow		10/25/22 11:40	11/4/22 6:10	11/22/22 6:35	11/22/22 6:35	12/29/22 21:15	2/7/23 2:10	3/20/23 1:30	4/9/23 3:30	9/24/23 14:45
End of Storm Flow		10/26/22 1:37	11/4/22 19:55	11/22/22 16:10	11/22/22 12:20	12/30/22 11:35	2/7/23 16:25	3/20/23 16:10	4/11/23 3:10	9/25/23 23:35
Total Volume of Storm Runoff (cf)		916,084	1,412,652	1,243,773	794,911	1,991,431	1,099,653	1,114,929	5,273,286	3,108,389
Duration of storm runoff (hours)		13.95	13.75	9.58	5.75	14.33	14.25	14.67	47.67	32.83
Corrected Duration of storm runoff (hours)		13.95	13.75	7.50	5.75	14.33	14.25	14.67	47.67	32.83
Flow Calculation (method)	Area*Velocity									
Flow Range (cfs) Avg		18.24	28.54	36.05	38.40	38.59	21.44	21.12	30.73	26.30
Flow Range (cfs) Max		60.26	58.61	139.50	133.67	126.14	53.37	43.54	53.29	55.96
Volume Sampled (cf)	>75% of Storm Volume Sampled	916,084	1,350,547	754,673	754,673	1,970,891	1,084,058	1,026,003	5,200,943	3,078,484
Sample Type (Flow/Time Composite)		Flow	Flow	Flow	Flow	Flow	Flow	Flow	Flow	Flow
Start of Event		10/25/2022	11/4/2022	11/22/2022	11/22/2022	12/29/2022	2/7/2023	3/20/2023	4/9/2023	9/24/2023
		11:40:00	6:40:00	6:35:00	6:35:00	21:15:00	2:10:00	1:30:00	3:30:00	14:55:00
End of Event		10/26/2022	11/4/2022	11/22/2022	11/22/2022	12/30/2022	2/7/2023	3/20/2023	4/11/2023	9/25/2023
		1:37:00	18:52:00	12:19:00	12:19:00	11:23:00	16:12:00	14:49:00	2:22:00	23:18:00
Sampling Duration (hours)	>2*Time of Concentration up to 24 hours	13.95	12.20	5.73	5.73	14.13	14.03	13.32	46.87	32.38
Corrected Sampling Duration (hours)		13.95	12.20	5.73	5.73	14.13	14.03	13.32	46.87	32.38
Disable time subracted		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Aliquots Composited	>10	28	10	40	40	14	16	21	18	39
Conductivity Range (uS/cm)	<2,000	65.6 - 234.7	55.4 - 135.0	39.8 - 500	39.8 - 500	99.9 - 228.6	217.2 - 104.6	130.0 - 242.3	121.2 - 175.7	85.5 - 274.7
Tidal Window		10/25/2022	11/4/2022	11/22/2022	11/22/2022	12/29/2022	2/6/2023	3/19/2023	4/9/2023	9/24/2023
Time (24:00) Stage (feet)		11:28 4.3	02:13 9.0	03:58 10.9	03:58 10.9	16:51 4.6	23:32 -0.3	22:15 -0.8	01:32 5.8	06:38 -0.2
		17:08 12.0	08:13 2.1	09:19 5.9	09:19 5.9	21:59 8.5	44964	45005	06:58 11.3	14:50 10.8
		23:50 -0.9	15:09 12.4	14:48 12.2	14:48 12.2	12/30/2022	06:38 12.3	05:19 12.5	13:53 -1.4	20:28 7.5
				21:45 -1.5	21:45 -1.5	03:51 2.9	12:24 5.9		20:53 11.2	45194
									45026	00:42 9.4
									02:18 6.8	07:48 -0.3
									07:30 11.0	15:36 11.4
									14:38 -1.6	
									21:53 11.1	
Percent coverage		100	95.60364136	60.67615128	94.93809459	98.96857638	98.58176926	92.02405764	98.62811906	99.03793122

Table C-5
Storm Field Summary Report for OF243 WY2023

	Storm Flow Criteria	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Sample 6	Sample 7
Start of Rainfall		10/25/2022	11/6/2022	12/9/2022	3/12/2023	3/31/2023	4/16/2023	9/24/2023
		11:40:00	0:40:00	15:30:00	12:25:00	14:30:00	7:10:00	13:15:00
End of Rainfall		10/25/2022	11/6/2022	12/10/2022	3/13/2023	4/1/2023	4/16/2023	9/25/2023
		21:20:00	7:35:00	19:00:00	15:05:00	3:10:00	16:10:00	19:55:00
Antecedent Dry Period (hours)	<0.02 in 24 hours	27	31.75	11.25	34.33	269.08	119.58	18.08
Total Rainfall (inches)	>0.2	0.43	0.76	0.58	0.63	0.25	0.43	0.91
Rainfall Duration (hours)		9.67	6.92	27.50	26.67	12.67	9.00	30.67
Start of Storm Flow		10/25/22 12:35	11/6/22 4:55	12/9/22 18:50	3/12/23 12:15	3/31/23 16:00	4/16/23 8:30	9/24/23 19:35
End of Storm Flow		10/26/22 2:35	11/6/22 12:40	12/10/22 3:10	3/13/23 16:30	3/31/23 23:10	4/16/23 23:40	9/25/23 20:35
Total Volume of Storm Runoff (cf)		16,099	32,533	9,412	1,668	3,386	307	23,450
Duration of storm runoff (hours)		14.00	7.75	8.33	28.25	7.17	15.17	25.00
Corrected Duration of storm runoff (hours)		3.92	3.92	2.91	1.42	4.50	0.67	9.67
Flow Calculation (method)	Area*Velocity							
Flow Range (cfs) Avg		0.32	1.17	0.31	0.02	0.13	0.01	0.26
Flow Range (cfs) Max		3.53	3.89	1.61	0.69	0.24	0.26	2.54
Volume Sampled (cf)	>75% of Storm Volume Sampled	2,726	20,276	5,547	1,286	1,698	47	6,409
Sample Type (Flow/Time Composite)		Time	Time	Time	Time	Time	Time	Time
Start of Event		10/25/2022	11/6/2022	12/9/2022	3/13/2023	3/31/2023	4/16/2023	9/25/2023
		21:15:00	6:40:00	21:30:00	7:15:00	19:35:00	17:50:00	5:35:00
End of Event		10/26/2022	11/6/2022	12/10/2022	3/13/2023	3/31/2023	4/16/2023	9/25/2023
		1:45:00	12:40:00	3:10:00	15:15:00	23:05:00	23:40:00	10:55:00
Sampling Duration (hours)	>2*Time of Concentration up to 24 hours	4.50	6.00	5.67	8.00	3.50	5.83	5.33
Corrected Sampling Duration (hours)		4.50	6.00	5.67	8.00	3.17	5.83	5.33
Disable time subracted		0.00	0.00	0.00	0.00	0.33	0.00	0.00
Aliquots Composited	>10	27	36	17	48	21	35	32
Conductivity Range (uS/cm)	<2,000	6190 - 8180	4470 - 6180	4860 - 6970	1716 - 5730	4150 - 8250	2896 - 4040	1485 - 14390
Tidal Window		10/25/2022	11/6/2022	12/9/2022	3/12/2023	3/31/2023	4/16/2023	9/24/2023
Time (24:00) Stage (feet)		11:28 4.3	03:29 10.4	16:29 10.5	08:19 11.7	13:41 8.5	03:24 11.9	06:38 -0.2
		17:08 12.0	09:05 3.8	23:35 -1.8	15:10 0.2	20:17 1.5	09:33 4.9	14:50 10.8
		23:50 -0.9		12/10/2022	21:51 10.1		14:39 9.5	20:28 7.5
				07:17 12.6	3/13/2023			9/25/2023
				12:56 8.0	03:09 6.4			00:42 9.4
				17:07 10.1	08:50 11.3			07:48 -0.3
				12/11/2022				15:36 11.4
				00:11 -1.4				
		16.93235864	62.32475562	58.93079309	77.12567598	50.15992274	15.44921875	27.33227321

Table C-6
Storm Field Summary Report for OF245 WY2023

	Storm Flow Criteria	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Sample 6	Sample 7	Sample 8	Sample 9
Start of Rainfall		10/30/2022	11/22/2022	12/9/2022	1/11/2023	3/12/2023	3/31/2023	4/9/2023	5/4/2023	9/24/2023
		18:55:00	6:40:00	15:30:00	19:05:00	12:25:00	14:30:00	2:45:00	23:50:00	13:15:00
End of Rainfall		10/31/2022	11/22/2022	12/10/2022	1/13/2023	3/13/2023	4/1/2023	4/10/2023	5/5/2023	9/25/2023
		9:10:00	15:40:00	19:00:00	22:40:00	15:05:00	3:10:00	23:00:00	19:10:00	19:55:00
Antecedent Dry Period (hours)	<0.02 in 24 hours	60.33	349.67	11.25	32.67	34.33	269.08	11.58	262.42	18.08
Total Rainfall (inches)	>0.2	0.58	0.88	0.58	0.67	0.63	0.25	1.11	0.52	0.91
Rainfall Duration (hours)		14.25	9.00	27.50	51.58	26.67	12.67	44.25	19.33	30.67
Start of Storm Flow		10/30/22 20:40	11/22/22 8:20	12/9/22 17:25	1/11/23 19:35	3/12/23 14:10	3/31/23 17:00	4/9/23 3:50	5/5/23 5:20	9/24/23 14:50
End of Storm Flow		10/31/22 9:15	11/22/22 20:05	12/10/22 3:05	1/14/23 1:05	3/13/23 17:30	3/31/23 23:10	4/10/23 22:10	5/5/23 21:00	9/25/23 20:50
Total Volume of Storm Runoff (cf)		32,619	63,023	18,883	38,268	54,251	14,706	67,019	25,602	64,147
Duration of storm runoff (hours)		12.58	11.75	9.67	53.50	27.33	6.17	42.33	15.67	30.00
Corrected Duration of storm runoff (hours)		11.83	4.92	5.50	24.42	27.25	6.17	27.00	6.00	24.42
Flow Calculation (method)	Area*Velocity									
Flow Range (cfs) Avg		0.72	1.49	0.54	0.20	0.55	0.66	0.44	0.45	0.59
Flow Range (cfs) Max		2.59	8.64	3.29	1.91	5.25	2.04	2.70	2.59	4.21
Volume Sampled (cf)	>75% of Storm Volume Sampled	25,092	62,107	17,177	22,175	24,017	11,737	31,843	32,924	34,476
Sample Type (Flow/Time Composite)		Time	Time	Time	Time	Time	Time	Time	Time	Time
Start of Event		10/30/2022	11/22/2022	12/9/2022	1/11/2023	3/13/2023	3/31/2023	4/9/2023	5/5/2023	9/24/2023
		23:45:00	10:50:00	17:25:00	19:35:00	0:25:00	18:05:00	7:30:00	6:15:00	18:50:00
End of Event		10/31/2022	11/22/2022	12/10/2022	1/13/2023	3/13/2023	3/31/2023	4/10/2023	5/5/2023	9/25/2023
		6:25:00	18:22:00	1:15:00	23:05:00	15:30:00	21:05:00	16:20:00	13:10:00	20:35:00
Sampling Duration (hours)	>2*Time of Concentration up to 24 hours	6.67	7.53	7.83	51.50	15.08	3.00	32.83	6.92	25.75
Corrected Sampling Duration (hours)		6.67	3.87	3.70	5.82	3.55	2.83	6.47	4.88	5.30
Disable time subracted		0.00	3.66	4.13	45.68	11.53	0.17	26.36	2.04	20.45
Aliquots Composited	>10	32	34	11	34	22	17	40	26	32
Conductivity Range (uS/cm)	<2,000	125.3 - 440	30.5 - 347	526 - 597	417 - 2609	41.6 - 477	149.8 - 1327	106.5 - 1239	98.3 - 1982	104.4 - 8740
Tidal Window		10/30/2022	11/22/2022	12/9/2022	1/11/2023	3/12/2023	3/31/2023	4/9/2023	5/4/2023	9/24/2023
Time (24:00) Stage (feet)		15:51 8.1	03:58 10.9	16:29 10.5	14:18 6.3	08:19 11.7	13:41 8.5	01:32 5.8	23:13 5.3	06:38 -0.2
		20:16 10.2	09:19 5.9	23:35 -1.8	19:08 9.3	15:10 0.2	20:17 1.5	06:58 11.3	5/5/2023	14:50 10.8
		10/31/2022	14:48 12.2	12/10/2022	1/12/2023	21:51 10.1		13:53 -1.4	04:42 11.4	20:28 7.5
		03:38 -1.4	21:45 -1.5	07:17 12.6	01:39 1.0	3/13/2023		20:53 11.2	11:33 -1.1	9/25/2023
		11:34 11.7		12:56 8.0	08:45 12.5	03:09 6.4		4/10/2023	18:29 11.2	00:42 9.4
				17:07 10.1	15:02 5.5	08:50 11.3		02:18 6.8		07:48 -0.3
				12/11/2022	20:03 8.8			07:30 11.0		15:36 11.4
				00:11 -1.4	1/13/2023			14:38 -1.6		
					02:17 2.2			21:53 11.1		
					09:16 12.4					
					15:50 4.5					
					21:11 8.4					
Percent coverage		76.92352027	98.54658418	90.96668928	57.94629952	44.27020364	79.81236205	47.51324622	128.5959632	53.7459842

Table C-7
Storm Field Summary Report for OF254 WY2023

	Storm Flow Criteria	Sample 1
Start of Rainfall		10/30/2022
		18:55:00
End of Rainfall		10/31/2022
		9:10:00
Antecedent Dry Period (hours)	<0.02 in 24 hours	60.33
Total Rainfall (inches)	>0.2	0.58
Rainfall Duration (hours)		14.25
Start of Storm Flow		10/30/22 20:40
End of Storm Flow		10/31/22 9:15
Total Volume of Storm Runoff (cf)		19,175
Duration of storm runoff (hours)		12.58
Corrected Duration of storm runoff (hours)		10.16
Flow Calculation (method)	Area*Velocity	
Flow Range (cfs) Avg		0.42
Flow Range (cfs) Max		2.25
Volume Sampled (cf)	>75% of Storm Volume Sampled	3,447
Sample Type (Flow/Time Composite)		Time
Start of Event		10/30/2022
		22:10:00
End of Event		10/31/2022
		1:30:00
Sampling Duration (hours)	>2*Time of Concentration up to 24 hours	3.33
Corrected Sampling Duration (hours)		1.17
Disable time subracted		2.16
Aliquots Composited	>10	12
Conductivity Range (uS/cm)	<2,000	5100 - 17930
Tidal Window		10/30/2022
Time (24:00) Stage (feet)		15:51 8.1
		20:16 10.2
		10/31/2022
		03:38 -1.4
		11:34 11.7
Percent coverage		17.97637959

Table C-8
Field and Hydrologic Data Summary for Outfall 230 Baseflow
Water Year 2019

	Baseflow Criteria[1]	Baseflow 1	Baseflow 2
Start of Event		6/20/2019 8:15	8/13/2019 21:45
End of Event		6/21/2019 3:07	8/14/2019 13:45
Sampling Duration (hours)	>4	18.63	14.40
Duration of Baseflow		10.4	6.90
Total Rainfall (inches)	<0.02	0	0
Last rainfall of0 .01		6/20/2019 1:50	8/10/2019 8:05
Antecedent Dry Period (hours)	<0.02 in 24 hours	344 (0.03", 6/20/19 00:35)	85.4
Flow Calculation (method)		Manning	Manning
Flow Range (cfs)	Avg/Max	0.72/1.13	2.09/2.49
Volume (cf)		29,054	65,587
Sampled Volume (cf)		46,323	57,534
Sample Type (Flow/Time Composite)		Flow	Flow
Sample Start		6/20/2019 8:29	8/13/2019 21:30
Sample Stop		6/21/2019 3:07	8/14/2019 11:54
Aliquots Composited	>10	40	48
Conductivity Range (uhmos)	<2,000	245 - 765	211 - 370
Tidal Window		Yes	Yes
Date		6/20/2019	8/13/2019
Time (24:00) Stage (feet)		02:13 6.85	03:35 10.39
		06:44 9.89	10:29 -1.06
		13:36 -1.54	18:02 11.67
		21:10 12.15	23:33 6.09
		6/21/2019	8/14/2019
		03:03 6.66	04:20 10.37
		07:31 9.35	11:07 -0.98
		14:16 -0.82	18:31 11.68
		21:47 12.03	

Table C-9
Field and Hydrologic Data Summary for Outfall 235 Baseflow
Water Year 2019

	Baseflow Criteria[1]	Baseflow 1	Baseflow 2	Baseflow 3
Start of Event		6/20/2019 11:15	8/13/2019 7:45	10/1/2019 21:00
End of Event		6/21/2019 9:30	8/14/2019 15:00	10/2/2019 10:33
Sampling Duration (hours)	>4	21.92	24.75	26.02
Duration of Baseflow		16.17	21.69	17.26
Total Rainfall (inches)	<0.02	0	0	0
Last rainfall of .01	<0.02	6/20/2019 1:50	8/10/2019 8:05	9/28/2019 6:00
Antecedent Dry Period (hours)	<0.02 in 24 hours	344 (0.03", 6/20/19 00:35)	71.4	74.5
Flow Calculation (method)		Manning	Manning	Manning
Flow Range (cfs)	Avg/Max	1.26/1.46	1.17/1.18	1.09/1.47
Volume (cf)		57,590	48,030	67,994
Sampled Volume (cf)		49,960	48,399	68,019
Sample Type (Flow/Time Composite)		Flow	Flow	Flow
Sample Start		6/20/2019 6:50	8/13/2019 7:31	10/1/2019 8:32
Sample Stop		6/21/2019 4:45	8/14/2019 8:16	10/2/2019 10:33
Aliquots Composited	>10	48	48	44
Conductivity Range (uhmos)	<2,000	318 - 389	307 - 337	378 - 904
Tidal Window		Yes	Yes	Yes
Date		6/20/2019	8/13/2019	10/1/2019
Time (24:00) Stage (feet)		02:13 6.85	03:35 10.39	01:11 -.024
		06:44 9.89	10:29 -1.06	07:37 11.61
		13:36 -1.54	18:02 11.67	13:29 3.25
		21:10 12.15	23:33 6.09	19:20 12.15
		6/21/2019	8/14/2019	10/2/2019
		03:03 6.66	04:20 10.37	01:56 -0.72
		07:31 9.35	11:07 -0.98	08:38 11.39
		14:16 -0.82	18:31 11.68	14:21 4.56
		21:47 12.03		20:00 11.56

[1]Criteria are considered goals.

Table C-10
Field and Hydrologic Data Summary for Outfall 237A New Baseflow
Water Year 2019

	Baseflow Criteria[1]	Baseflow 1	Baseflow 2	Baseflow 3	Baseflow 4
Start of Event		5/8/2019 7:00	6/20/2019 5:00	7/31/2019 4:14	10/1/2019 19:51
End of Event		5/9/2019 7:00	6/21/2019 5:00	8/1/2019 4:14	10/2/2019 19:51
Sampling Duration (hours)	>4	24.90	28.95	21.65	24.12
Duration of Baseflow		21.87	24.95	17.90	21.62
Total Rainfall (inches)	<0.02	0	0	0	0
Last rainfall of 0.01		5/7/2019 6:10	6/20/2019 1:50	7/17/2019 19:45	9/28/2019 6:00
Antecedent Dry Period (hours)	<0.02 in 24 hours	24.8	344 (0.03", 6/20/19 00:35)	320.5	87.8
Flow Calculation (method)		Area*Velocity	Area*Velocity	Area*Velocity	Area*Velocity
Flow Range (cfs)	Avg/Max	5.19 / 5.40	3.26 / 3.59	5.41 / 5.97	5.73 / 7.50
Volume (cf)		392,598	240,707	363,395	399,772
Sampled Volume (cf)		228,903	148,968	353,203	437,427
Sample Type (Flow/Time Composite)		Flow	Flow	Flow	Flow
Sample Start		5/8/2019 7:00	6/20/2019 5:00	7/31/2019 4:14	10/1/2019 21:51
Sample Stop		5/9/2019 7:54	6/21/2019 9:57	8/1/2019 1:53	10/2/2019 21:58
Aliquots Composited	>10	43	29	20	44
Conductivity Range (uhmos)	<2,000	335 - 345	328 - 334	327 - 341	330 - 333
Tidal Window		Yes	Yes	Yes	Yes
Date		5/8/2019	6/20/2019	7/31/2019	10/1/2019
Time (24:00) Stage (feet)		02:02 6.68	02:13 6.85	03:51 11.28	01:11 -.024
		07:01 10.62	06:44 9.89	10:58 -2.91	07:37 11.61
		14:07 -2.08	13:36 -1.54	18:19 12.10	13:29 3.25
		21:21 11.88	21:10 12.15	23:45 6.69	19:20 12.15
		8/9/2019	6/21/2019	8/1/2019	10/2/2019
		02:57 7.06	03:03 6.66	04:42 11.45	01:56 -0.72
		07:45 10.19	07:31 9.35	11:45 -3.11	08:38 11.39
		14:56 -1.78	14:16 -0.82	18:58 12.45	14:21 4.56
		22:18 11.81	21:47 12.03		20:00 11.56

[1]Criteria are considered goals.

Table C-11
Field and Hydrologic Data Summary for Outfall 237B Baseflow
Water Year 2019

	Baseflow Criteria[1]	Baseflow 1	Baseflow 2	Baseflow 3
Start of Event		6/20/2019 7:00	7/31/2019 6:20	10/1/2019 12:04
End of Event		6/21/2019 7:00	8/1/2019 6:22	10/2/2019 13:41
Sampling Duration (hours)	>4	21.40	24.03	25.62
Duration of Baseflow		24.00	24.00	24.00
Total Rainfall (inches)	<0.02	0	0	0
Last rainfall of .01		6/20/2019 1:50	7/17/2019 20:10	9/28/2019 6:00
Antecedent Dry Period (hours)	<0.02 in 24 hours	344 (0.03", 6/20/19 00:35)	322.2	78.1
Flow Calculation (method)		Area*Velocity	Area*Velocity	Area*Velocity
Flow Range (cfs)	Avg/Max	8.38 / 8.71	8.53 / 8.95	6.88 / 6.99
Volume (cf)		726,906	739,817	887,602
Sampled Volume (cf)		646,453	739,817	887,602
Sample Type (Flow/Time Composite)		Flow	Flow	Flow
Sample Start		6/20/2019 7:00	7/31/2019 6:20	10/1/2019 12:04
Sample Stop		6/21/2019 4:24	8/1/2019 6:22	10/2/2019 13:41
Aliquots Composited	>10	48	48	48
Conductivity Range (uhmos)	<2,000	273 - 280	279 - 280	281 - 282
Tidal Window		Yes	Yes	Yes
Date		6/20/2019	7/31/2019	10/1/2019
Time (24:00) Stage (feet)		02:13 6.85	03:51 11.28	01:11 -.024
		06:44 9.89	10:58 -2.91	07:37 11.61
		13:36 -1.54	18:19 12.10	13:29 3.25
		21:10 12.15	23:45 6.69	19:20 12.15
		6/21/2019	04:42 11.45	10/2/2019
		03:03 6.66	11:45 -3.11	01:56 -0.72
		07:31 9.35	18:58 12.45	08:38 11.39
		14:16 -0.82		14:21 4.56
		21:47 12.03		20:00 11.56

[1]Criteria are considered goals.

Table C-12
Field and Hydrologic Data Summary for Outfall 243 Baseflow
Water Year 2019

	Baseflow Criteria[1]	Baseflow 1
Start of Event		10/1/2019 11:15
End of Event		10/2/2019 4:15
Sampling Duration (hours)	>4	16.47
Duration of Baselfow (hours)		9.5
Total Rainfall (inches)	<0.02	0
Last rainfall of .01		9/28/2019 6:00
Antecedent Dry Period (hours)	<0.02 in 24 hours	78.0
Flow Calculation (method)		Manning
Flow Range (cfs)	Avg/Max	3.46 / 3.68
Volume (cf)		121,336
Sampled Volume (cf)		113,610
Sample Type (Flow/Time Composite)		Flow
Sample Start		10/1/2019 12:01
Sample Stop		10/2/2019 4:29
Aliquots Composited	>10	38
Conductivity Range (uhmos)	<2,000	8190 - 20920
Tidal Window		Yes
Date		10/1/2019
Time (24:00) Stage (feet)		01:11 -.024
		07:37 11.61
		13:29 3.25
		19:20 12.15
		10/2/2019
		01:56 -0.72
		08:38 11.39
		14:21 4.56
		20:00 11.56

[1]Criteria are considered goals.

Table C-13
Field and Hydrologic Data Summary for Outfall 245 Baseflow
Water Year 2019

	Baseflow Criteria[1]	Baseflow 1	Baseflow 2	Baseflow 3
Start of Event		5/8/2019 10:15	8/14/2019 7:30	10/1/2019 11:46
End of Event		5/8/2019 15:45	8/14/2019 12:45	10/2/2019 3:30
Sampling Duration (hours)	>4	2.95	4.80	15.75
Duration of Baseflow		5.50	5.25	5.75
Total Rainfall (inches)	<0.02	0	0	0
Last rainfall of .01		5/7/2019 6:10	8/10/2019 8:05	9/28/2019 6:00
Antecedent Dry Period (hours)	<0.02 in 24 hours	29.9	95.0	77.8
Flow Calculation (method)		Manning	Manning	Manning
Flow Range (cfs)	Avg/Max	0.77 / 1.64	0.48 / 0.49	0.77 / 0.86
Volume (cf)		15,061	9,429	17,251
Sampled Volume (cf)		130,843	9,994	18,910
Sample Type (Flow/Time Composite)		Flow	Flow	Flow
Sample Start		5/8/2019 12:01	8/14/2019 7:07	10/1/2019 11:46
Sample Stop		5/8/2019 14:58	8/14/2019 11:55	10/2/2019 3:31
Aliquots Composited	>10	48	48	40
Conductivity Range (uhmos)	<2,000	4000 - 9400	8710 - 20930	5960 - 21770
Tidal Window		Yes	Yes	Yes
Date		5/8/2019	8/14/2019	10/1/2019
Time (24:00) Stage (feet)		02:02 6.68	04:20 10.37	01:11 -.024
		07:01 10.62	11:07 -0.98	07:37 11.61
		14:07 -2.08	18:31 11.68	13:29 3.25
		21:21 11.88	8/15/2019	19:20 12.15
		8/9/2019	00:07 5.77	10/2/2019
		02:57 7.06	05:01 10.36	01:56 -0.72
		07:45 10.19	11:43 -0.77	08:38 11.39
		14:56 -1.78	18:57 11.63	14:21 4.56
		22:18 11.81		20:00 11.56

[1]Criteria are considered goals.

Table C-14
Field and Hydrologic Data Summary for Outfall 254 Baseflow
Water Year 2019

	Baseflow Criteria[1]	Baseflow 1	Baseflow 2	Baseflow 3
Start of Event		5/8/2019 10:00	6/20/2019 9:45	7/31/2019 7:30
End of Event		5/8/2019 16:00	6/20/2019 17:45	7/31/2019 13:15
Sampling Duration (hours)	>4	6.00	6.50	5.13
Duration of Baseflow		5.75	5.75	5.50
Total Rainfall (inches)	<0.02	0	0	0
Last rainfall of .01		5/7/2019 6:10	6/20/2019 1:50	7/17/2019 19:45
Antecedent Dry Period (hours)	<0.02 in 24 hours	28.0	344 (0.03", 6/20/19 00:35)	324.3
Flow Calculation (method)		Manning	Manning	Manning
Flow Range (cfs)	Avg/Max	0.08 / 0.23	0.11 / 0.16	0.12 / 0.24
Volume (cf)		1,564	2,391	2,090
Sampled Volume (cf)		1,604	3,902	2,501
Sample Type (Flow/Time Composite)		Flow	Flow	Flow
Sample Start		5/8/2019 10:08	6/20/2019 9:30	7/31/2019 8:00
Sample Stop		5/8/2019 16:08	6/20/2019 16:00	7/31/2019 13:08
Aliquots Composited	>10	46	20	27
Conductivity Range (uhmos)	<2,000	29750 - 33000	30600 - 35200	36600 - 39300
Tidal Window		Yes	Yes	Yes
Date		5/8/2019	6/20/2019	7/31/2019
Time (24:00) Stage (feet)		02:02 6.68	02:13 6.85	03:51 11.28
		07:01 10.62	06:44 9.89	10:58 -2.91
		14:07 -2.08	13:36 -1.54	18:19 12.10
		21:21 11.88	21:10 12.15	23:45 6.69
		8/9/2019	6/21/2019	8/1/2019
		02:57 7.06	03:03 6.66	04:42 11.45
		07:45 10.19	07:31 9.35	11:45 -3.11
		14:56 -1.78	14:16 -0.82	18:58 12.45
		22:18 11.81	21:47 12.03	

[1]Criteria are considered goals.

Table C-15
Precipitation Summary of Storm Events Sampled

	Antecedent (hours)	Precip (in)	Duration (hours)	Avg Intensity (in/hour)
9/25/2001	575	0.38	23.75	0.02
WY2002				
10/10/2001	39.5	0.33	7	0.05
10/24/2001	27.25	0.49	26.5	0.02
11/28/2001	27.3	1.27	24	0.05
12/12/2001	26.5	1.4	17	0.08
12/15/2001	38.3	0.5	24	0.02
1/6/2002	34.8	0.85	23	0.04
1/18/2002	149	0.25	10.3	0.02
1/23/2002	11.3	0.3	10.5	0.03
2/20/2002	33.5	0.73	10.8	0.07
3/16/2002	27.8	0.35	22.5	0.02
4/9/2002	70.5	0.22	22.5	0.01
4/26/2002	219.5	0.49	24.75	0.02
5/28/2002	11.3	0.2	10.3	0.02
6/28/2002	13.8	0.66	25.25	0.03
Annual Avg	**52.17**	**0.57**	**18.46**	**0.03**
WY2003				
10/3/2002	73	0.24	5.75	0.04
11/6/2002	397.5	0.46	8.25	0.06
11/13/2002	24.5	0.25	13.75	0.02
11/17/2002	37	0.34	14.75	0.02
12/10/2002	125.5	0.4	29	0.01
1/1/2003	27.5	0.81	11.5	0.07
(1)	--	0.97	26.25	0.04
1/11/2003	24.3	0.62	19.3	0.03
1/21/2003	161	0.43	8	0.05
1/25/2003	21.5	1.22	25.5	0.05
1/29/2003	41	0.51	13.8	0.04
(1)	--	0.44	6.75	0.07
2/15/2003	131.25	0.41	22.8	0.02
(1)	--	0.31	7.5	0.04
3/11/2003	31.75	0.4	12.75	0.03
(1)	--	0.36	4.75	0.08
4/1/2003	29.25	0.28	5.25	0.05
(1)	--	0.23	3	0.08
4/21/2003	179	0.39	11.5	0.03
9/16/2003	116	0.2	8.25	0.02
(1)	--	0.19	4	0.05
Annual Avg	**94.67**	**0.46**	**14.01**	**0.04**
WY2004				
10/6/2003	417	0.29	3	0.10
10/15/2003	65.5	0.53	10	0.05
10/22/2003	29	0.37	2.75	0.13
11/15/2003	318	0.21	9.5	0.02
12/2/2003	26	0.22	2.25	0.10
12/4/2003	40.5	0.5	23.5	0.02
(1)	--	0.34	9.5	0.04
12/20/2003		0.2	4.5	0.04
1/18/2004	59.75	0.25	12.5	0.02
(1)	--	0.21	9	0.02
1/22/2004	88.75	0.82	28.25	0.03
2/13/2004	199	0.4	8.75	0.05
3/3/2004	143.8	0.27	8.5	0.03
(1)	--	0.26	5.75	0.05
5/10/2004	52.5	0.25	9.75	0.03
5/25/2004	79.5	0.48	18.25	0.03
(1)	--	0.4	6.5	0.06
6/12/2004	97	0.29	13.75	0.02
8/6/2004	1277	0.55	18	0.03
8/21/2004	341.75	0.5	13.5	0.04
9/10/2004	32.75	0.84	10.75	0.08
(1)	--	0.8	4.75	0.17
9/15/2004	33	0.2	3.25	0.06
Annual Avg	**183.38**	**0.39**	**10.90**	**0.05**
WY2005				
10/5/2004	316.5	0.26	11.75	0.02
(1)	--	0.25	5.45	0.05
10/8/2004	47.25	1.04	15.5	0.07
11/1/2004	53.75	0.23	11.25	0.02
(1)	--	0.22	7.25	0.03
11/17/2004	30.25	0.34	4	0.09
12/9/2004	25	0.63	25.75	0.02
1/15/2005	259	0.41	14.25	0.03
2/6/2005	44.5	0.4	13	0.03
(1)	--	0.33	9.25	0.04
3/19/2005	66.25	0.21	9.5	0.02
(1)	--	0.2	6.75	0.03
4/10/2005	76.5	0.59	9.25	0.06
5/17/2005	37	0.57	24.5	0.02
6/16/2005	213	0.65	9.5	0.07
7/8/2005	52.75	0.33	10.5	0.03
9/29/2005	440.25	0.62	14.25	0.04
Annual Avg	**127.85**	**0.48**	**13.31**	**0.04**
WY2006				
10/14/2005	40.75	0.29	5.5	0.05
1/5/2006	33.75	1.3	22.25	0.06
(1)	--	1.06	12	0.09
1/16/2006	53.25	0.72	17	0.04
(1)	--	0.4	6.75	0.06
1/31/2006	26.75	0.27	4.75	0.06
2/26/2006	67.25	0.2	23.5	0.01
(1)	--	0.11	4.25	0.03
3/8/2006	25	0.41	13.25	0.03
(1)	--	0.28	2.45	0.11
4/8/2006	110	0.23	12.75	0.02
4/13/2006	114	0.97	27.25	0.04
(1)	--	0.65	9.5	0.07
5/21/2006	47	0.33	22.25	0.01
(1)	--	0.31	13.75	0.02
9/17/2006	2240.25	0.42	12	0.04
(1)	--	0.4	6.25	0.06
Annual Avg	**275.80**	**0.51**	**16.05**	**0.04**
WY2007				
10/14/2006	200	0.57	13.75	0.04
Partial	--	0.27	11.25	0.02
11/2/2006	335.75	0.93	19.75	0.05
Partial	--	0.31	11	0.03
Partial	--	0.54	15.75	0.03
Partial	--	0.66	16.5	0.04
11/15/2006	40.25	0.26	11.5	0.02
11/19/2006	58.5	0.49	6.75	0.07
Partial	--	0.28	2.75	0.10
2/17/2007	58	0.26	6	0.04
2/24/2007	48	0.32	7.75	0.04
3/19/2007	35.25	0.44	18	0.02
Partial	--	0.25	7.22	0.03
5/2/2007	83	0.35	21.5	0.02
6/9/2007	466.25	0.38	8	0.05
6/28/2007	85.5	0.24	15	0.02
9/3/2007	336.5	0.38	8.25	0.05
(1)	--	0.24	0.75	0.32
9/16-17/2007	288.25	0.28	22	0.01
9/27-28/2007	249.25	0.63	10.25	0.06
Annual Avg	**175.73**	**0.43**	**12.96**	**0.04**
WY2008				
10/10/2007	54.5	0.24	17.75	0.01
11/9-10/2007	385.5	0.20	6.75	0.03
11/26/2007	34.25	0.22	2.5	0.09
11/28-29/2007	43.75	0.23	14.25	0.02
12/14-15/07	29.75	0.27	18.25	0.01
12/27/2007	39.25	0.42	11.75	0.04
1/8/2008	37.5	0.28	8	0.04
1/14/2008	34.25	0.24	4.5	0.05
(1)	--	0.18	2.25	0.08
1/26/2008	147	0.28	11.25	0.02
(1)	--	0.24	4.5	0.05
2/29/2008	53.5	0.28	5.25	0.05
(1)	--	0.27	3.75	0.07
3/23/2008	53.25	0.53	14.25	0.04
Partial	--	0.23	5.5	0.04
5/20/2008	394	0.47	14	0.03
(1)	--	0.4	7.5	0.05
7/31/2008	45	0.22	12.75	0.02
8/19/2008	27.5	0.36	12	0.03
Annual Avg	**98.50**	**0.30**	**10.95**	**0.03**

	Antecedent (hours)	Precip (in)	Duration (hours)	Avg Intensity (in/hour)
WY2009				
10/3/2008	178.5	0.46	24.5	0.02
(1)	--	0.41	12.5	0.03
10/20/2008	54.75	0.25	8.5	0.03
10/31/2008	185.75	0.29	11.25	0.03
11/5/2008	38.75	2.71	36.25	0.07
Partial	--	0.36	10.25	0.04
11/10/2008	42.75	0.22	7.5	0.03
11/20/2008	183.25	0.2	8.75	0.02
12/12/2008	42	0.62	22.75	0.03
3/14/2009	111	0.34	14.5	0.02
3/28/2009	70	0.65	24	0.03
Partial	--	0.49	11.75	0.04
4/1/2009	24.25	0.32	18	0.02
4/17/2009	71.75	0.3	12.75	0.02
5/2/2009	75.75	0.25	10.75	0.02
5/18/2009	30.75	0.35	6.25	0.06
9/5/2009	44	0.29	8	0.04
(1)	--	0.28	4.75	0.06
9/19/2009	278.5	0.28	4	0.07
Annual Avg	**95.45**	**0.35**	**12.78**	**0.03**
WY2010				
10/16/2009	31.25	0.91	26.25	0.03
Partial	--	0.58	10	0.06
10/22/2009	31	0.52	17.25	0.03
(1)	--	0.51	12.5	0.04
10/28/2009	56.25	0.2	10	0.02
10/30/2009	38.25	0.22	13.75	0.02
11/5/2009	119.5	0.69	21.5	0.03
11/15/2009	42	0.37	11.25	0.03
11/25/2009	26.75	1.00	25.75	0.04
Partial	--	0.67	11	0.06
12/31/2009	24	0.29	5.75	0.05
1/4/2010	43.75	1.18	39.25	0.03
Partial	--	0.64	8.3	0.08
Partial	--	0.69	9	0.08
Partial	--	0.49	7	0.07
1/7/2010	53	0.98	28.25	0.03
Partial	--	0.49	15.5	0.03
1/10/2010	42.25	0.63	15.5	0.04
1/24/2010	159.25	0.41	9.5	0.04
2/10/2010	68.5	0.15	10.75	0.01
2/15/2010	28.25	0.25	11.5	0.02
3/11/2010	25.25	1.04	30.5	0.03
3/28/2010	36.25	0.22	4.75	0.05
4/2/2010	34	0.92	26	0.04
Partial	--	0.83	22.5	0.04
Partial	--	0.62	18.25	0.03
5/25/2010	44	0.58	31	0.02
Partial	--	0.29	20.75	0.01
5/27/2010	26.5	0.35	20	0.02
6/3/2010	32.25	0.25	9.25	0.03
6/8/2010	48.75	0.55	23.5	0.02
6/19/2010	67.25	0.2	14	0.01
9/26/2010	64.5	0.28	6	0.05
Annual Avg	**49.68**	**0.53**	**17.88**	**0.03**
WY2011				
10/8/2010	300.25	1.34	39.25	0.03
10/30/2010	42	0.38	16.25	0.02
11/9/2010	50	0.37	15.5	0.02
11/17/2010	32.5	0.51	30	0.02
11/29/2010	70	0.39	25.75	0.02
12/11/2010	31.25	1.84	42.25	0.04
1/20/2011	84.75	0.29	13	0.02
1/29/2011	106.5	0.22	8.5	0.03
2/12/2011	106.75	0.55	4.25	0.13
3/4/2011	21	0.21	5	0.04
3/12/2011	30.75	0.30	11.5	0.03
4/4/2011	21.25	0.37	24.5	0.02
4/13/2011	53	0.18	17	0.01
4/26/2011	26.25	0.23	2.25	0.10
5/2/2011	92.25	0.19	7.75	0.02
5/14/2011	70.5	1.36	20.5	0.07
5/25/2011	234.75	0.22	7.25	0.03
8/22/2011	861.5	0.22	10.5	0.02
Annual Avg	**124.18**	**0.51**	**16.72**	**0.04**
WY2012				
10/10/2011	10.75	0.75	28.75	0.03
Partial	--	0.54	10.25	0.05
Partial	--	0.56	11.75	0.05
Partial	--	0.66	16.75	0.04
10/28/2011	136.75	0.30	3.5	0.09
11/2/2011	75.75	0.47	5.75	0.08
11/11/2011	170.25	0.17	2.25	0.08
11/16/2011	86.25	0.31	15.25	0.02
Partial	--	0.19	5.5	0.03
11/21/2011	72.75	0.18	3.25	0.06
11/27/2011	58.75	0.30	5	0.06
1/4/2012	39	0.48	20.75	0.02
Partial	--	0.39	10.25	0.04
1/9/2012	101.5	0.21	7.5	0.03
1/24/2012	34.5	0.98	29	0.03
1/29/2012	73.25	1.32	21.5	0.06
1/31/2012	42	0.41	16.25	0.03
2/17/2012	27.25	0.86	24.25	0.04
Partial	--	0.83	24	0.03
2/24/2012	59.75	0.23	11.75	0.02
3/5/2012	62.5	0.31	4.75	0.07
3/14/2012	20.25	1.04	48.25	0.02
Partial	--	0.21	10.3	0.02
Partial	--	0.46	24	0.02
4/3/2012	41.25	0.15	3	0.05
4/19/2012	30.5	0.77	20	0.04
4/25/2012	11	0.65	34.5	0.02
4/29/2012	73.5	0.37	18.25	0.02
5/3/2012	28	0.62	18.25	0.03
5/20/2012	398.75	0.26	11.75	0.02
6/5/2012	21.25	0.30	6.25	0.05
6/7/2012	43.25	0.62	16	0.04
6/22/2012	329	0.23	17.75	0.01
Annual Avg	**81.91**	**0.49**	**15.74**	**0.04**
WY2013				
10/18/2012	62.25	0.46	5.5	0.08
11/11/2012	154.75	0.64	16	0.04
11/22/2012	32.75	0.95	16.5	0.06
12/25/2012	33.75	0.44	7	0.06
2/22/2013	16	0.35	11	0.03
2/27/2013	15	0.46	31	0.01
3/12/2013	24	0.20	21.75	0.01
3/19/2013	72.75	0.75	21.75	0.03
4/10/2013	60	0.22	2.25	0.10
4/19/2013	6.50	0.41	13	0.03
5/13/2013	8.5	0.20	7.5	0.03
5/21/2013	123.75	0.39	5.75	0.07
8/28/2013	32.25	0.22	4.25	0.05
9/21/2013	26.5	0.51	17.5	0.03
(2)	--	1.01	38	0.03
Annual Avg	**47.77**	**0.48**	**14.58**	**0.04**

	Antecedent (hours)	Precip (in)	Duration (hours)	Avg Intensity (in/hour)
WY2014				
11/1/2013	134	0.44	13	0.03
11/6/2013	34	0.87	22	0.04
12/12/2013	227	0.26	13.5	0.02
(1)	--	0.22	4	0.06
1/6/2014	93.25	0.39	27	0.01
1/28/2014	394.25	0.83	26	0.03
Partial	--	0.60	8.5	0.07
2/12/2014	21.75	0.18	7.5	0.02
3/8/2014	44.5	1.96	58.75	0.03
Partial	--	1.12	19.5	0.06
3/13/2014	73.5	0.27	8.25	0.03
3/15/2014	35.75	1.06	27	0.04
3/28/2014	10	0.45	16.75	0.03
4/21/2014	44.25	0.66	10.5	0.06
5/8/2014	74.5	0.56	9.25	0.06
6/12/2014	423.75	0.24	17	0.01
(1)	--	0.18	8.75	0.02
Partial	--	0.18	8.75	0.02
7/22/2014	583.75	0.55	15	0.04
8/12/2014	483.25	1.11	12.25	0.09
9/23/2014	128.75	1.48	22.75	0.07
(1) (3)	--	0.58	7	0.08
Partial	--	1.05	19	0.06
Partial	--	0.58	11	0.05
Annual Avg	**175.39**	**0.71**	**19.16**	**0.04**
WY2015				
10/13/2014	55.75	0.45	7.25	0.06
10/20/2014	40	0.35	11.75	0.03
10/22/2014	19.5	1.21	16.75	0.07
10/30/2014	23.25	1.32	30.75	0.04
Partial	--	0.5	14	0.04
11/5/2014	32.25	0.67	27.75	0.02
11/21/2014	24.5	0.64	12.25	0.05
(1)	24.5	0.64	12.25	0.08
Partial (1)	--	0.42	9.75	0.07
11/24/2014	29.25	1.27	31	0.04
(1)	--	1.27	31	0.07
Partial (1)	--	0.77	16.5	0.08
12/8/2014	52.25	0.58	20.5	0.03
Partial	--	0.27	8.75	0.03
12/23/2014	58.5	0.86	22	0.04
1/4/2015	31.25	1.26	34	0.04
1/15/2015	78.25	0.31	14.75	0.02
1/17/2015	33.25	1	20.75	0.05
3/13/2015	50.5	0.64	14.75	0.04
3/20/2015	111.25	0.21	22.75	0.01
3/22/2015	12.25	0.17	11.5	0.01
4/10/2015	77.75	0.29	7.25	0.04
4/13/2015	48.5	0.34	10.5	0.03
4/23/2015	204.5	0.1	4.75	0.02
7/26/2015	1300.5	0.42	1.25	0.34
8/14/2015	451.75	0.27	5.5	0.05
8/29/2015	343.5	1.33	29.5	0.05
Partial	--	1.06	22	0.05
9/1/2015	49.75	0.23	8	0.03
Annual Avg	**142.19**	**0.63**	**16.6**	**0.05**
WY2016				
10/7/2015	103.2	0.33	8.25	0.04
11/16/2015	27.9	1.69	25.6	0.07
Partial	--	0.31	10.1	0.03
Partial	--	0.70	17.4	0.04
12/1/2015	175.25	0.57	10.1	0.06
12/5/2015	27.5	0.59	24.5	0.02
Partial	--	0.35	11.3	0.03
12/12/2015	33.5	0.41	9.7	0.04
12/20/2015	29.2	1.36	39	0.03
Partial	--	0.29	19.7	0.01
12/22/2015 (3)	23.0	0.21	3.6	0.05
1/16/2016 (3)	47.8	0.42	18.9	0.02
1/19/2016 (3)	45.3	0.52	18.7	0.05
Partial	--	0.43	8.6	0.05
2/3/2016	107.25	0.56	21.5	0.03
Partial	--	0.49	14.9	0.03
2/5/2016	29.8	0.35	8.3	0.04
2/11/2016 (3)	125.7	1.28	26.7	0.07
Partial	--	0.88	19.9	0.04
2/17/2016	32.5	0.37	9.5	0.04
2/26/2016	104.5	0.23	11.6	0.02
3/20/2016	134.3	0.41	34.2	0.01
3/23/2016	39.3	0.32	16.8	0.02
4/12/2016	207.6	0.42	6.75	0.06
9/6/2016	86.5	0.37	8.6	0.04
9/17/2016	258.8	0.45	16.8	0.03
Annual Avg	**86.3**	**0.51**	**16.0**	**0.04**
WY2017				
10/6/2016	30.2	0.24	11.7	0.03
10/12/2016	77.1	3.94	67.1	0.06
10/19/2016	34.2	1.32	19.6	0.07
11/5/2016 (1)	50.1	1.66	25.5	0.10
11/13/2016	24.8	0.79	22.3	0.04
Partial	---	0.35	14.9	0.02
11/14/2016 (1,2)	16.4	0.90	10.0	0.13
12/3/2016	31.3	0.33	8.7	0.04
12/19/2016	147.2	0.28	5.0	0.06
1/8/2017	184.0	0.42	11.0	0.04
1/17/2017 (1)	159.1	1.93	30.7	0.08
2/3/2017	293.6	2.75	69.0	0.04
Partial	---	0.70	18.2	0.04
Partial	---	0.53	15.2	0.03
Partial	---	0.79	22.1	0.04
2/14/2017	97.8	2.28	33.1	0.07
Partial	---	1.26	17.9	0.07
Partial	---	1.44	20.0	0.07
2/26/2017	60.8	0.26	16.1	0.02
3/17/2017	42.1	0.99	22.2	0.04
Partial	---	0.58	11.3	0.05
4/4/2017	71.3	0.64	20.3	0.03
Partial	---	0.42	12.2	0.03
5/4/2017	32.3	0.33	7.8	0.04
6/7/2017	41.8	0.32	11.9	0.03
6/15/2017	128.7	0.72	22.2	0.03
9/18/2017 (3)	858.9	0.29	21.7	0.01
Annual Avg	**125.3**	**1.02**	**21.7**	**0.05**
WY2018				
10/12/2017 (1)	125.3	0.33	18.2	0.02
Partial	---	0.3	15.4	0.02
11/2/2017	261.4	0.27	10.2	0.03
11/4/2017	28.1	0.80	20.2	0.04
11/12/2017 (2)	10.0	0.30	13.8	0.02
11/19/2017	71.3	0.90	18.3	0.05
11/28/2017	31.7	0.64	13.3	0.05
12/1/2017	24.5	0.25	6.7	0.04
1/4/2018	144.6	0.46	15.3	0.03
1/10/2018	35.0	1.49	31.5	0.05
Partial	---	0.36	12.3	0.03
1/17/2018	34.0	0.66	14.3	0.05
1/23/2018	23.9	0.99	17.3	0.06
2/1/2018	38.8	0.50	11.1	0.05
Partial	---	0.44	11.1	0.04
3/13/2018	108.1	0.20	8.2	0.02
3/21/2018	192.3	0.48	20.3	0.02
4/4/2018	60.6	0.25	13.0	0.02
4/7/2018	29.1	1.35	39.2	0.03
Partial	---	0.84	17.2	0.05
6/8/2018	474.8	0.31	8.9	0.03
Partial	---	0.23	5.2	0.04
9/9/2018	49.0	0.18	3.0	0.06
Annual Avg	**96.8**	**0.58**	**15.7**	**0.04**

	Antecedent (hours)	Precip (in)	Duration (hours)	Avg Intensity (in/hour)
WY2019				
10/5/2018	64.8	0.44	11.3	0.04
10/25/2018 (1)	388.0	0.99	31.1	0.07
10/27/2018	24.5	1.15	19.0	0.06
11/21/2018 (3)	346.3	0.21	7.3	0.03
11/22/2018	9.4	1.19	23.3	0.05
Partial		0.76	12.5	0.06
12/9/2018	204.0	0.80	21.7	0.04
12/11/2018 (1)	19.7	1.05	16.5	0.06
12/17/2018 (1)	19.0	1.01	32.0	0.06
1/3/2019 (1)	104.4	0.50	12.3	0.07
1/18/2019	37.0	0.61	11.4	0.07
2/1/2019 (3)	205.0	0.60	17.5	0.05
Partial		0.56	14.7	0.04
3/11/2019 (3)	103.9	0.77	11.1	0.07
3/25/2019	309.4	0.24	9.4	0.08
7/9/2019	162.9	0.36	24.6	0.01
9/9/2019	33.2	0.26	10.1	0.03
9/12/2019	76.4	0.27	2.92	0.09
Partial		0.26	2.42	0.11
9/14/2019 (1)	38.2	0.36	14.3	0.04
9/22/2019 (3)	98.8	0.22	6.7	0.03
Annual Avg	**124.7**	**0.61**	**15.7**	**0.05**
WY2020				
10/16/2019 (1)	203.8	0.52	15.7	0.03
10/21/2019 (3)	51.4	0.75	12.3	0.08
11/15/2019 (1)	61.3	0.23	5.67	0.04
11/17/2019	38.3	0.27	9.6	0.03
11/18/2019	26.8	0.42	21.8	0.02
12/6/2019	57.0	0.47	16.9	0.03
12/18/2019 (1)	102.3	0.27	6.9	0.05
12/31/2019	103.7	0.42	11.8	0.04
1/2/2020 (1)	39.8	0.20	7.6	0.03
1/17/2020 (1)(3)	130.8	0.23	10.4	0.03
1/30/2020	28.1	1.9	40.0	0.05
Partial	--	0.86	21.1	0.04
2/6/2020 (2)	22.9	0.52	10.4	0.05
Partial	--	0.28	4.3	0.06
2/23/2020	198.7	0.37	6.3	0.06
3/5/2020	49.8	0.53	16.5	0.03
3/13/2020 (1)	135.1	0.35	13.17	0.03
3/28/2020 (2)(3)	12.0	0.58	13.7	0.08
4/22/2020 (3)	93.0	0.47	12.50	0.05
4/26/2020	35.3	0.26	5.7	0.05
5/2/2020	119.8	0.34	34.00	0.01
5/16/2020 (3)	53.6	0.50	23.0	0.09
5/30/2020	118.1	0.85	18.33	0.05
6/8/2020	58.2	0.52	19.92	0.03
9/18/2020 (1)	649.1	0.35	9.4	0.04
9/23/2020	66.6	0.93	18.3	0.05
Annual Avg	**102.30**	**0.51**	**15.0**	**0.04**
WY2021				
10/9/2020	130.3	1.73	11.5	0.15
10/13/2020	26.4	0.56	6.3	0.02
11/3/2020 (3)	97.6	0.77	15.42	0.07
11/4/2020 (2)	20.0	0.42	21.5	0.02
Partial	--	0.24	7.7	0.03
11/12/2020	49.7	0.58	12.3	0.05
12/8/2020	188.4	0.66	22.3	0.03
Partial	--	0.31	13.7	0.02
12/15/2020 (1)	35.3	0.39	12.1	0.10
12/25/2020	88.8	0.34	8.0	0.04
12/29/2020 (3)	56.8	1.1	34.1	0.03
1/11/2021	25.9	3.22	39.9	0.08
Partial	--	2.02	22.3	0.09
Partial	--	1.07	14.8	0.07
Partial	--	1.04	12.8	0.08
Partial	--	0.60	6.3	0.10
1/30/2021 (1)	32.3	1.48	85.3	0.02
Partial	--	0.53	43.2	0.01
Partial	--	1.05	56.33	0.01
2/21/2021	51.0	1.01	15.9	0.06
3/4/2021	176.3	0.20	7.08	0.03
3/24/2021	63.8	0.50	13.1	0.04
3/28/2021	74.9	0.39	4.17	0.09
4/7/2021	239.8	0.22	9.50	0.02
4/24/2021	333.8	0.45	23.9	0.02
5/27/2021	66.0	0.83	18.1	0.05
6/6/2021	226.8	0.37	20.1	0.02
6/12/2021 (1) (3)	29.3	0.86	22.9	0.06
9/17/2021¹ (2)	9.1	0.75	7.8	0.10
9/26/2021	171.2	0.77	24.3	0.03
9/29/2021	32.9	0.50	15.7	0.03
Annual Avg	**96.79**	**0.79**	**19.62**	**0.05**
WY2022				
10/21/2021	34.3	0.56	7.1	0.08
11/3/2021 (1)	24.3	1.00	23.0	0.04
11/8/2021 (3)	32.7	0.28	5.9	0.09
11/18/2021	73.6	0.67	16.3	0.04
12/4/2021	91.5	0.46	11.1	0.04
Partial	--	0.32	6.4	0.05
12/17/2021 (3)	40.4	0.71	21.9	0.05
1/19/2022 (3)	158.0	0.24	13.3	0.03
2/20/2022	151.6	0.20	14.5	0.01
2/26/2022	127.2	4.57	67.1	0.07
Partial	--	2.02	39.8	0.05
3/14/2022 (1)	35.8	1.03	29.7	0.05
3/18/2022	76.4	0.34	9.4	0.04
4/3/2022 (3)	269	0.83	21.1	0.07
4/18/2022	43.9	0.50	25.1	0.02
4/29/2022	79.8	0.46	10.3	0.04
5/5/2022	69.8	0.34	11.8	0.03
5/15/2022 (2) (3)	19.5	0.51	19.9	0.05
Partial	--	0.38	10.9	0.03
6/9/2022	93.7	1.38	18.1	0.08
Partial	--	0.71	10.8	0.07
Annual Avg	**83.6**	**0.83**	**19.14**	**0.05**
WY2023				
10/21/2022 (3)	552	0.42	14.9	0.04
10/25/2022 (3)	27.0	0.43	9.67	0.06
10/30/2022	60.3	0.58	14.3	0.04
11/4/2022 (2)	14.0	0.79	14.3	0.06
11/6/2022	31.8	0.76	6.92	0.11
11/22/2022	350	0.88	9.00	0.10
Partial	--	0.20	3.92	0.05
Partial	--	0.57	5.50	0.10
Partial	--	0.70	5.92	0.12
Partial	--	0.60	5.58	0.11
12/9/2022 (2)	14.58	0.58	27.5	0.02
12/29/2022 (3)	52.25	0.54	12.5	0.10
1/11/2023	32.7	0.67	51.6	0.01
2/7/2023	37.8	0.21	14.9	0.01
3/12/2023	34.3	0.63	26.7	0.02
3/19/2023	151	0.20	11.0	0.02
3/31/2023 (3)	269	0.25	12.7	0.03
4/9/2023 (2)	14.3	1.11	44.3	0.03
4/16/2023	120	0.43	9.00	0.05
5/4/2023	262	0.52	19.3	0.03
9/24/2023 (2) (3)	20.8	0.91	30.7	0.04
Annual Avg	**120**	**0.58**	**19.36**	**0.04**

Avg Intensity is total rainfall (in) for the event divided by duration of event (hr)

Minimum value for the monitoring year

Maximum value for the monitoring year

(1) Most of the precipitation occurred in a shorter amount of time. The resulting Avg Intensity is believed to be a better representation of the event.

(2) Event had greater than a six hour break in the middle of the event. Event was validated as one event, rather than two.

(3) =< 0.05 inches occurred in the previous 24 hours of event and/or the resulting antecendent is believed to be a better representation of the event.

Partial - Event sampled represents only a part of the entire event. Rainfall characteristics reflect partial event sampled for that outfall.

TABLE C-16
NUMBER OF STORMS FOR EACH AMOUNT OF PRECIPITATION

Total Rainfall in Inches									
	≈0.15-0.29	0.3-0.39	0.4-0.49	0.5-0.59	0.6-0.69	0.7-0.79	0.8-0.89	0.9-1.99	Total
Water Year 2002									
237A	3	2			1	1	1	1	9
237B	3	2	1		1		1	1	9
230	3	2	1		1	1	1	2	11
235	3	2	1	1	1	1	1		10
243	1	3	1		1	1		1	8
245	3	2	2		1	1		2	11
254	3	2	1		1	1		1	9
Yr 1 Storm	3	3	2	1	1	1	1	2	14
Water Year 2003									
237A	3	1	5				1		10
237B	3	1	5		1				10
230	1	2	3				1	1	8
235	1	2	5				1		9
243	1	2	3	1					7
245	2	2	4				1		9
254	1	1	5				1		8
Yr 2 Storm	4	2	5	1	1	0	1	1	15
Water Year 2004									
237A	6	1	2	2			1		12
237B	5	1	2	3			1		12
230	5	1	2	4			1		13
235	7	1	1	2			1		12
243	4	1	1	2			2		10
245	5	1	2	1			1		10
254	3		1	3			2		9
Yr 3 Storm	9	1	2	4	0	0	2	0	18
Water Year 2005									
237A	3	2	2	1	3				11
237B	3	2	2	2	3				12
230	2	2	1		3			1	9
235	3	2	2	2	3				12
243	1	1	1		3			1	7
245	3	2	1	1	3				10
254	3	2	1	1	3				10
Yr 4 Storm	3	2	2	2	3	0	0	1	13
Water Year 2006									
237A	4	1	1						6
237B	4	1							5
230	3	1	2			1			7
235	3	1	1			1			6
243	2		2					2	6
245	3		1			1		2	7
254	2	1	2			1		1	7
Yr 5 Storm	3	1	2	0	0	1	0	2	9
Water Year 2007									
237A	2	5	1		1				9
237B	5	2			1				8
230	2	2	1	1	1				7
235	2	2	2	1	2				9
243	1				1				2
245	1	2	2	1	1			1	8
254	2	2	1		1			1	7
Yr 6 Storm	7	5	2	2	2	0	0	1	19
Water Year 2008									
237A	7	1	1	1					10
237B	7	1	1	1					10
230	8	1	1						10
235	6	1	1	1					9
243	3	1	2	1					7
245	7	1	1	1					10
254	7	1	1	1					10
Yr 7 Storm	10	1	2	1	0	0	0	0	14
Water Year 2009									
237A	4	3	1		2				10
237B	4	4	1		2				11
230	3	4			1				8
235	4	3	1		2				10
243	2	5			1				8
245	4	3	1		2				10
254	2	4	1		1				8
Yr 8 Storm	7	5	2	0	2	0	0	0	16
Water Year 2010									
237A	5	1	1	1	2			2	12
237B	5		1	1	2			3	12
230	5	1	2	1				2	11
235	8		2		1		1	4	16
243	4			2	1				7
245	3	1	1	2	3			2	12
254	3	1	1	1	2			3	11
Yr 9 Storm	10	2	2	2	3	0	1	4	24
Water Year 2011									
237A	6	1		2				3	12
237B	6	2		2				3	13
230	4	2		1				2	9
235	6	4		2				2	14
243	1	3		1				1	6
245	4	3		2					9
254	4	2		2				1	9
Yr 10 Storm	6	4	0	2	0	0	0	3	15
Water Year 2012									
237A	3	2	1	0	2	1	0	0	9
237B	2	5	0	0	0	1	0	2	10
230	2	3	0	0	1	2	0	1	9
235	3	3	2	0	0	2	1	1	12
243	0	0	0	0	2	2	0	0	4
245	4	4	1	0	0	2	0	1	12
254	1	0	1	0	0	1	0	1	4
Yr 11 Storm	7	6	3	0	3	2	1	3	25

Note: Data for 237A is from the original 237A site through WY2011. The 237A New sampling site data was used for WY2012 and later.

Total Rainfall in Inches									
	≈0.15-0.29	0.3-0.39	0.4-0.49	0.5-0.59	0.6-0.69	0.7-0.79	0.8-0.89	0.9-1.99	Total
Water Year 2013									
237A	3	1	4	0	0	1	0	1	10
237B	1	1	3	1	0	1	0	1	8
230	2	1	3	0	1	1	0	0	8
235	4	1	4	0	1	1	0	0	11
243	1	0	2	0	0	0	0	0	3
245	1	0	1	0	1	0	0	0	3
254	1	1	1	0	0	0	0	1	4
Yr 12 Storm	4	1	4	1	1	1	0	1	13
Water Year 2014									
237A	2	1	1	1	1	0	2	1	9
237B	2	0	2	2	1	0	1	2	10
230	0	1	2	2	1	0	1	2	9
235	1	1	1	1	1	0	1	2	8
243	1	0	1	0	0	0	0	2	4
245	2	0	1	0	1	0	0	1	5
254	1	0	1	1	1	0	0	1	5
Yr 13 Storm	4	1	2	2	1	0	2	4	16
Water Year 2015									
237A	2	2	0	0	0	0	1	5	10
237B	3	1	0	0	1	0	1	2	8
230	0	1	1	2	2	1	1	2	10
235	2	2	2	1	0	0	1	5	13
243	0	0	0	0	2	0	1	0	3
245	2	2	2	0	0	0	0	1	7
254	0	1	0	0	2	0	1	3	7
Yr 14 Storm	3	3	2	1	3	0	1	6	19
Water Year 2016									
237A	0	4	3	1	0	0	0	0	8
237B	2	1	2	1	0	0	1	0	7
230	0	3	2	1	0	0	0	1	7
235	1	3	3	2	0	0	0	1	10
243	0	1	1	2	0	1	0	0	5
245	1	1	4	1	0	0	0	1	8
254	0	2	3	1	0	0	0	1	7
Yr 15 Storm	3	7	7	4	0	1	1	2	25
Water Year 2017									
237A	3	2	0	0	1	1	0	5	12
237B	1	1	1	1	1	1	0	5	11
230	3	2	1	0	1	1	0	5	13
235	2	2	1	0	1	1	0	5	12
243	2	1	0	0	0	1	0	3	7
245	2	2	2	1	0	1	0	5	13
254	2	3	1	1	0	1	0	2	10
Yr 16 Storm	4	4	2	2	1	4	0	10	27
Water Year 2018									
237A	0	1	1	1	0	0	1	4	8
237B	2	1	2	1	1	0	1	1	9
230	3	0	2	1	1	0	1	1	9
235	1	2	0	1	0	0	1	3	8
243	2	2	1	1	1	0	1	0	8
245	3	2	1	1	1	0	1	2	11
254	1	2	0	1	1	0	1	0	6
Yr 17 Storm	5	3	2	1	2	0	1	4	18
Water Year 2019									
237A	1	0	0	0	2	1	1	3	8
237B	2	0	1	1	1	1	0	2	8
230	1	1	0	1	2	0	1	2	8
235	2	1	1	1	2	1	1	2	11
243	1	1	1	0	2	1	0	2	8
245	2	0	1	0	2	1	1	1	8
254	0	0	0	0	2	1	1	2	6
Yr 18 Storm	5	2	1	1	2	1	1	5	18
Water Year 2020									
237A	3	1	2	2	0	1	1	1	11
237B	3	3	3	4	0	0	1	0	14
230	0	1	2	5	0	0	1	0	9
235	2	2	3	4	0	1	1	1	14
243	1	0	3	3	0	0	0	2	9
245	3	2	3	2	0	0	1	1	12
254	2	0	3	3	0	0	1	1	10
Yr 19 Storm	6	4	4	6	0	1	1	2	24
Water Year 2021									
237A	1	3	0	3	0	0	2	2	11
237B	2	1	0	3	0	2	1	3	12
230	2	0	1	2	1	0	2	4	12
235	3	1	0	3	1	2	1	3	14
243	0	1	0	2	1	2	0	3	9
245	0	1	0	2	1	2	2	4	12
254	2	1	1	1	2	2	1	0	10
Yr 20 Storm	3	5	1	5	0	3	2	4	23
Water Year 2022									
237A	0	2	1	1	0	1	1	2	8
237B	1	0	1	3	1	1	1	3	11
230	2	0	1	3	1	1	1	3	12
235	1	1	1	3	1	2	1	2	12
243	0	1	1	1	0	0	1	3	7
245	1	1	0	2	1	1	1	4	11
254	2	1	1	1	1	0	1	2	9
Yr 21 Storm	3	2	2	3	1	1	1	4	17
Water Year 2023									
237A	2	0	2	2	2	2	0	2	12
237B	2	0	1	1	1	1	0	2	8
230	1	0	0	2	0	0	0	0	3
235	1	0	2	5	2	0	0	1	11
243	1	0	2	1	1	1	0	1	7
245	1	0	0	3	2	0	1	2	9
254	0	0	0	1	0	0	0	0	1
Yr 22 Storm	3	0	3	4	2	2	1	2	17
Water Year 2002-2023									
237A	63	37	29	18	17	9	12	32	217
237B	68	30	29	27	17	8	9	30	218
230	52	31	28	26	17	8	11	29	202
235	66	37	36	30	18	12	12	32	243
243	29	23	22	17	16	9	5	21	142
245	57	32	31	20	19	9	9	30	207
254	42	27	26	18	17	7	9	21	167
Yr1-22 Storm	112	64	54	45	28	18	17	61	399
Historic Record									
06/48-12/81	628	402	301	214	155	96	68	177	2041
03/82-12/99	349	269	141	115	81	46	38	115	1154
Historic Total	977	671	442	329	236	142	106	292	3195

PERCENT OF STORM PRECIPITATION RANGES - YEARLY AND HISTORIC									
	≈0.15-0.29	0.3-0.39	0.4-0.49	0.5-0.59	0.6-0.69	0.7-0.79	0.8-0.89	0.9-1.99	Total
Water Year 2002									
237A	33.3%	22.2%	0.0%	0.0%	11.1%	11.1%	11.1%	11.1%	100%
237B	33.3%	22.2%	11.1%	0.0%	11.1%	0.0%	11.1%	11.1%	100%
230	27.3%	18.2%	9.1%	0.0%	9.1%	9.1%	9.1%	18.2%	100%
235	30.0%	20.0%	10.0%	10.0%	10.0%	10.0%	10.0%	0.0%	100%
243	12.5%	37.5%	12.5%	0.0%	12.5%	12.5%	0.0%	12.5%	100%
245	27.3%	18.2%	18.2%	0.0%	9.1%	9.1%	0.0%	18.2%	100%
254	33.3%	22.2%	11.1%	0.0%	11.1%	11.1%	0.0%	11.1%	100%
Yr 1 Storm	21.4%	21.4%	14.3%	7.1%	7.1%	7.1%	7.1%	14.3%	100%
Water Year 2003									
237A	30.0%	10.0%	50.0%	0.0%	0.0%	0.0%	10.0%	0.0%	100%
237B	30.0%	10.0%	50.0%	0.0%	10.0%	0.0%	0.0%	0.0%	100%
230	12.5%	25.0%	37.5%	0.0%	0.0%	0.0%	12.5%	12.5%	100%
235	11.1%	22.2%	55.6%	0.0%	0.0%	0.0%	11.1%	0.0%	100%
243	14.3%	28.6%	42.9%	14.3%	0.0%	0.0%	0.0%	0.0%	100%
245	22.2%	22.2%	44.4%	0.0%	0.0%	0.0%	11.1%	0.0%	100%
254	12.5%	12.5%	62.5%	0.0%	0.0%	0.0%	12.5%	0.0%	100%
Yr 2 Storm	26.7%	13.3%	33.3%	6.7%	6.7%	0.0%	6.7%	6.7%	100%
Water Year 2004									
237A	50.0%	8.3%	16.7%	16.7%	0.0%	0.0%	8.3%	0.0%	100%
237B	41.7%	8.3%	16.7%	25.0%	0.0%	0.0%	8.3%	0.0%	100%
230	38.5%	7.7%	15.4%	30.8%	0.0%	0.0%	7.7%	0.0%	100%
235	58.3%	8.3%	8.3%	16.7%	0.0%	0.0%	8.3%	0.0%	100%
243	40.0%	10.0%	10.0%	20.0%	0.0%	0.0%	20.0%	0.0%	100%
245	50.0%	10.0%	20.0%	10.0%	0.0%	0.0%	10.0%	0.0%	100%
254	33.3%	0.0%	11.1%	33.3%	0.0%	0.0%	22.2%	0.0%	100%
Yr 3 Storm	50.0%	5.6%	11.1%	22.2%	0.0%	0.0%	11.1%	0.0%	100%
Water Year 2005									
237A	27.3%	18.2%	18.2%	9.1%	27.3%	0.0%	0.0%	0.0%	100%
237B	25.0%	16.7%	16.7%	16.7%	25.0%	0.0%	0.0%	0.0%	100%
230	22.2%	22.2%	11.1%	0.0%	33.3%	0.0%	0.0%	11.1%	100%
235	25.0%	16.7%	16.7%	16.7%	25.0%	0.0%	0.0%	0.0%	100%
243	14.3%	14.3%	14.3%	0.0%	42.9%	0.0%	0.0%	14.3%	100%
245	30.0%	20.0%	10.0%	10.0%	30.0%	0.0%	0.0%	0.0%	100%
254	30.0%	20.0%	10.0%	10.0%	30.0%	0.0%	0.0%	0.0%	100%
Yr 4 Storm	23.1%	15.4%	15.4%	15.4%	23.1%	0.0%	0.0%	7.7%	100%
Water Year 2006									
237A	66.7%	16.7%	16.7%	0.0%	0.0%	0.0%	0.0%	0.0%	100%
237B	80.0%	20.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100%
230	42.9%	14.3%	28.6%	0.0%	0.0%	14.3%	0.0%	0.0%	100%
235	50.0%	16.7%	16.7%	0.0%	0.0%	16.7%	0.0%	0.0%	100%
243	33.3%	0.0%	33.3%	0.0%	0.0%	0.0%	0.0%	33.3%	100%
245	42.9%	0.0%	14.3%	0.0%	0.0%	14.3%	0.0%	28.6%	100%
254	28.6%	14.3%	28.6%	0.0%	0.0%	14.3%	0.0%	14.3%	100%
Yr 5 Storm	33.3%	11.1%	22.2%	0.0%	0.0%	11.1%	0.0%	22.2%	100%
Water Year 2007									
237A	22.2%	55.6%	11.1%	0.0%	11.1%	0.0%	0.0%	0.0%	100%
237B	62.5%	25.0%	0.0%	0.0%	12.5%	0.0%	0.0%	0.0%	100%
230	28.6%	28.6%	14.3%	14.3%	14.3%	0.0%	0.0%	0.0%	100%
235	22.2%	22.2%	22.2%	11.1%	22.2%	0.0%	0.0%	0.0%	100%
243	50.0%	0.0%	0.0%	0.0%	50.0%	0.0%	0.0%	0.0%	100%
245	12.5%	25.0%	25.0%	12.5%	12.5%	0.0%	0.0%	12.5%	100%
254	28.6%	28.6%	14.3%	0.0%	14.3%	0.0%	0.0%	14.3%	100%
Yr 6 Storm	36.8%	26.3%	10.5%	10.5%	10.5%	0.0%	0.0%	5.3%	100%
Water Year 2008									
237A	70.0%	10.0%	10.0%	10.0%	0.0%	0.0%	0.0%	0.0%	100%
237B	70.0%	10.0%	10.0%	10.0%	0.0%	0.0%	0.0%	0.0%	100%
230	80.0%	10.0%	10.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100%
235	66.7%	11.1%	11.1%	11.1%	0.0%	0.0%	0.0%	0.0%	100%
243	42.9%	14.3%	28.6%	14.3%	0.0%	0.0%	0.0%	0.0%	100%
245	70.0%	10.0%	10.0%	10.0%	0.0%	0.0%	0.0%	0.0%	100%
254	70.0%	10.0%	10.0%	10.0%	0.0%	0.0%	0.0%	0.0%	100%
Yr 7 Storm	71.4%	7.1%	14.3%	7.1%	0.0%	0.0%	0.0%	0.0%	100%
Water Year 2009									
237A	40.0%	30.0%	10.0%	0.0%	20.0%	0.0%	0.0%	0.0%	100%
237B	36.4%	36.4%	9.1%	0.0%	18.2%	0.0%	0.0%	0.0%	100%
230	37.5%	50.0%	0.0%	0.0%	12.5%	0.0%	0.0%	0.0%	100%
235	40.0%	30.0%	10.0%	0.0%	20.0%	0.0%	0.0%	0.0%	100%
243	25.0%	62.5%	0.0%	0.0%	12.5%	0.0%	0.0%	0.0%	100%
245	40.0%	30.0%	10.0%	0.0%	20.0%	0.0%	0.0%	0.0%	100%
254	25.0%	50.0%	12.5%	0.0%	12.5%	0.0%	0.0%	0.0%	100%
Yr 8 Storm	43.8%	31.3%	12.5%	0.0%	12.5%	0.0%	0.0%	0.0%	100%
Water Year 2010									
237A	41.7%	8.3%	8.3%	8.3%	16.7%	0.0%	0.0%	16.7%	100%
237B	41.7%	0.0%	8.3%	8.3%	16.7%	0.0%	0.0%	25.0%	100%
230	45.5%	9.1%	18.2%	9.1%	0.0%	0.0%	0.0%	18.2%	100%
235	50.0%	0.0%	12.5%	0.0%	6.3%	0.0%	6.3%	25.0%	100%
243	57.1%	0.0%	0.0%	28.6%	14.3%	0.0%	0.0%	0.0%	100%
245	25.0%	8.3%	8.3%	16.7%	25.0%	0.0%	0.0%	16.7%	100%
254	27.3%	9.1%	9.1%	9.1%	18.2%	0.0%	0.0%	27.3%	100%
Yr 9 Storm	41.7%	8.3%	8.3%	8.3%	12.5%	0.0%	4.2%	16.7%	100%
Water Year 2011									
237A	50.0%	8.3%	0.0%	16.7%	0.0%	0.0%	0.0%	25.0%	100%
237B	46.2%	15.4%	0.0%	15.4%	0.0%	0.0%	0.0%	23.1%	100%
230	44.4%	22.2%	0.0%	11.1%	0.0%	0.0%	0.0%	22.2%	100%
235	42.9%	28.6%	0.0%	14.3%	0.0%	0.0%	0.0%	14.3%	100%
243	16.7%	50.0%	0.0%	16.7%	0.0%	0.0%	0.0%	16.7%	100%
245	44.4%	33.3%	0.0%	22.2%	0.0%	0.0%	0.0%	0.0%	100%
254	44.4%	22.2%	0.0%	22.2%	0.0%	0.0%	0.0%	11.1%	100%
Yr 10 Storm	40.0%	26.7%	0.0%	13.3%	0.0%	0.0%	0.0%	20.0%	100%
Water Year 2012									
237A	33.3%	22.2%	11.1%	0.0%	22.2%	11.1%	0.0%	0.0%	100%
237B	20.0%	50.0%	0.0%	0.0%	0.0%	10.0%	0.0%	20.0%	100%
230	22.2%	33.3%	0.0%	0.0%	11.1%	22.2%	0.0%	11.1%	100%
235	25.0%	25.0%	16.7%	0.0%	0.0%	16.7%	8.3%	8.3%	100%
243	0.0%	0.0%	0.0%	0.0%	50.0%	50.0%	0.0%	0.0%	100%
245	33.3%	33.3%	8.3%	0.0%	0.0%	16.7%	0.0%	8.3%	100%
254	25.0%	0.0%	25.0%	0.0%	0.0%	25.0%	0.0%	25.0%	100%
Yr 11 Storm	28.0%	24.0%	12.0%	0.0%	12.0%	8.0%	4.0%	12.0%	100%

Note: Data for 237A is from the original 237A site through WY2011. The 237A New sampling site data was used for WY2012 and later.

PERCENT OF STORM PRECIPITATION RANGES - YEARLY AND HISTORIC									
	≈0.15-0.29	0.3-0.39	0.4-0.49	0.5-0.59	0.6-0.69	0.7-0.79	0.8-0.89	0.9-1.99	Total
Water Year 2013									
237A	30.0%	10.0%	40.0%	0.0%	0.0%	10.0%	0.0%	10.0%	100%
237B	12.5%	12.5%	37.5%	12.5%	0.0%	12.5%	0.0%	12.5%	100%
230	25.0%	12.5%	37.5%	0.0%	12.5%	12.5%	0.0%	0.0%	100%
235	36.4%	9.1%	36.4%	0.0%	9.1%	9.1%	0.0%	0.0%	100%
243	33.3%	0.0%	66.7%	0.0%	0.0%	0.0%	0.0%	0.0%	100%
245	33.3%	0.0%	33.3%	0.0%	33.3%	0.0%	0.0%	0.0%	100%
254	25.0%	25.0%	25.0%	0.0%	0.0%	0.0%	0.0%	25.0%	100%
Yr 12 Storm	30.8%	7.7%	30.8%	7.7%	7.7%	7.7%	0.0%	7.7%	100%
Water Year 2014									
237A	22.2%	11.1%	11.1%	11.1%	11.1%	0.0%	22.2%	11.1%	100%
237B	20.0%	0.0%	20.0%	20.0%	10.0%	0.0%	10.0%	20.0%	100%
230	0.0%	11.1%	22.2%	22.2%	11.1%	0.0%	11.1%	22.2%	100%
235	12.5%	12.5%	12.5%	12.5%	12.5%	0.0%	12.5%	25.0%	100%
243	25.0%	0.0%	25.0%	0.0%	0.0%	0.0%	0.0%	50.0%	100%
245	40.0%	0.0%	20.0%	0.0%	20.0%	0.0%	0.0%	20.0%	100%
254	20.0%	0.0%	20.0%	20.0%	20.0%	0.0%	0.0%	20.0%	100%
Yr 13 Storm	25.0%	6.3%	12.5%	12.5%	6.3%	0.0%	12.5%	25.0%	100%
Water Year 2015									
237A	20.0%	20.0%	0.0%	0.0%	0.0%	0.0%	10.0%	50.0%	100%
237B	37.5%	12.5%	0.0%	0.0%	12.5%	0.0%	12.5%	25.0%	100%
230	0.0%	10.0%	10.0%	20.0%	20.0%	10.0%	10.0%	20.0%	100%
235	15.4%	15.4%	15.4%	7.7%	0.0%	0.0%	7.7%	38.5%	100%
243	0.0%	0.0%	0.0%	0.0%	66.7%	0.0%	33.3%	0.0%	100%
245	28.6%	28.6%	28.6%	0.0%	0.0%	0.0%	0.0%	14.3%	100%
254	0.0%	14.3%	0.0%	0.0%	28.6%	0.0%	14.3%	42.9%	100%
Yr 14 Storm	15.8%	15.8%	10.5%	5.3%	15.8%	0.0%	5.3%	31.6%	100%
Water Year 2016									
237A	0.0%	50.0%	37.5%	12.5%	0.0%	0.0%	0.0%	0.0%	100%
237B	28.6%	14.3%	28.6%	14.3%	0.0%	0.0%	14.3%	0.0%	100%
230	0.0%	42.9%	28.6%	14.3%	0.0%	0.0%	0.0%	14.3%	100%
235	10.0%	30.0%	30.0%	20.0%	0.0%	0.0%	0.0%	10.0%	100%
243	0.0%	20.0%	20.0%	40.0%	0.0%	20.0%	0.0%	0.0%	100%
245	12.5%	12.5%	50.0%	12.5%	0.0%	0.0%	0.0%	12.5%	100%
254	0.0%	28.6%	42.9%	14.3%	0.0%	0.0%	0.0%	14.3%	100%
Yr 15 Storm	12.0%	28.0%	28.0%	16.0%	0.0%	4.0%	4.0%	8.0%	100%
Water Year 2017									
237A	25.0%	16.7%	0.0%	0.0%	8.3%	8.3%	0.0%	41.7%	100%
237B	9.1%	9.1%	9.1%	9.1%	9.1%	9.1%	0.0%	45.5%	100%
230	23.1%	15.4%	7.7%	0.0%	7.7%	7.7%	0.0%	38.5%	100%
235	16.7%	16.7%	8.3%	0.0%	8.3%	8.3%	0.0%	41.7%	100%
243	28.6%	14.3%	0.0%	0.0%	0.0%	14.3%	0.0%	42.9%	100%
245	15.4%	15.4%	15.4%	7.7%	0.0%	7.7%	0.0%	38.5%	100%
254	20.0%	30.0%	10.0%	10.0%	0.0%	10.0%	0.0%	20.0%	100%
Yr 16 Storm	14.8%	14.8%	7.4%	7.4%	3.7%	14.8%	0.0%	37.0%	100%
Water Year 2018									
237A	0.0%	12.5%	12.5%	12.5%	0.0%	0.0%	12.5%	50.0%	100%
237B	22.2%	11.1%	22.2%	11.1%	11.1%	0.0%	11.1%	11.1%	100%
230	33.3%	0.0%	22.2%	11.1%	11.1%	0.0%	11.1%	11.1%	100%
235	12.5%	25.0%	0.0%	12.5%	0.0%	0.0%	12.5%	37.5%	100%
243	25.0%	25.0%	12.5%	12.5%	12.5%	0.0%	12.5%	0.0%	100%
245	27.3%	18.2%	9.1%	9.1%	9.1%	0.0%	9.1%	18.2%	100%
254	16.7%	33.3%	0.0%	16.7%	16.7%	0.0%	16.7%	0.0%	100%
Yr 17 Storm	27.8%	16.7%	11.1%	5.6%	11.1%	0.0%	5.6%	22.2%	100%
Water Year 2019									
237A	12.5%	0.0%	0.0%	0.0%	25.0%	12.5%	12.5%	37.5%	100%
237B	25.0%	0.0%	12.5%	12.5%	12.5%	12.5%	0.0%	25.0%	100%
230	12.5%	12.5%	0.0%	12.5%	25.0%	0.0%	12.5%	25.0%	100%
235	18.2%	9.1%	9.1%	9.1%	18.2%	9.1%	9.1%	18.2%	100%
243	12.5%	12.5%	12.5%	0.0%	25.0%	12.5%	0.0%	25.0%	100%
245	25.0%	0.0%	12.5%	0.0%	25.0%	12.5%	12.5%	12.5%	100%
254	0.0%	0.0%	0.0%	0.0%	33.3%	16.7%	16.7%	33.3%	100%
Yr 18 Storm	27.8%	11.1%	5.6%	5.6%	11.1%	5.6%	5.6%	27.8%	100%
Water Year 2020									
237A	27.3%	9.1%	18.2%	18.2%	0.0%	9.1%	9.1%	9.1%	100%
237B	21.4%	21.4%	21.4%	28.6%	0.0%	0.0%	7.1%	0.0%	100%
230	0.0%	11.1%	22.2%	55.6%	0.0%	0.0%	11.1%	0.0%	100%
235	14.3%	14.3%	21.4%	28.6%	0.0%	7.1%	7.1%	7.1%	100%
243	11.1%	0.0%	33.3%	33.3%	0.0%	0.0%	0.0%	22.2%	100%
245	25.0%	16.7%	25.0%	16.7%	0.0%	0.0%	8.3%	8.3%	100%
254	20.0%	0.0%	30.0%	30.0%	0.0%	0.0%	10.0%	10.0%	100%
Yr 19 Storm	25.0%	16.7%	16.7%	25.0%	0.0%	4.2%	4.2%	8.3%	100%
Water Year 2021									
237A	9.1%	27.3%	0.0%	27.3%	0.0%	0.0%	18.2%	18.2%	100%
237B	16.7%	8.3%	0.0%	25.0%	0.0%	16.7%	8.3%	25.0%	100%
230	16.7%	0.0%	8.3%	16.7%	8.3%	0.0%	16.7%	33.3%	100%
235	21.4%	7.1%	0.0%	21.4%	7.1%	14.3%	7.1%	21.4%	100%
243	0.0%	11.1%	0.0%	22.2%	11.1%	22.2%	0.0%	33.3%	100%
245	0.0%	8.3%	0.0%	16.7%	8.3%	16.7%	16.7%	33.3%	100%
254	20.0%	10.0%	10.0%	10.0%	20.0%	20.0%	10.0%	0.0%	100%
Yr 20 Storm	13.0%	21.7%	4.3%	21.7%	0.0%	13.0%	8.7%	17.4%	100%
Water Year 2022									
237A	0.0%	25.0%	12.5%	12.5%	0.0%	12.5%	12.5%	25.0%	100%
237B	9.1%	0.0%	9.1%	27.3%	9.1%	9.1%	9.1%	27.3%	100%
230	16.7%	0.0%	8.3%	25.0%	8.3%	8.3%	8.3%	25.0%	100%
235	8.3%	8.3%	8.3%	25.0%	8.3%	16.7%	8.3%	16.7%	100%
243	0.0%	14.3%	14.3%	14.3%	0.0%	0.0%	14.3%	42.9%	100%
245	9.1%	9.1%	0.0%	18.2%	9.1%	9.1%	9.1%	36.4%	100%
254	22.2%	11.1%	11.1%	11.1%	11.1%	0.0%	11.1%	22.2%	100%
Yr 21 Storm	17.6%	11.8%	11.8%	17.6%	5.9%	5.9%	5.9%	23.5%	100%
Water Year 2023									
237A	16.7%	0.0%	16.7%	16.7%	16.7%	16.7%	0.0%	16.7%	100%
237B	25.0%	0.0%	12.5%	12.5%	12.5%	12.5%	0.0%	25.0%	100%
230	33.3%	0.0%	0.0%	66.7%	0.0%	0.0%	0.0%	0.0%	100%
235	9.1%	0.0%	18.2%	45.5%	18.2%	0.0%	0.0%	9.1%	100%
243	14.3%	0.0%	28.6%	14.3%	14.3%	14.3%	0.0%	14.3%	100%
245	11.1%	0.0%	0.0%	33.3%	22.2%	0.0%	11.1%	22.2%	100%
254	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	100%
Yr 22 Storm	17.6%	0.0%	17.6%	23.5%	11.8%	11.8%	5.9%	11.8%	100%
Water Year 2002-2023									
237A	29.0%	17.1%	13.4%	8.3%	7.8%	4.1%	5.5%	14.7%	100%
237B	31.2%	13.8%	13.3%	12.4%	7.8%	3.7%	4.1%	13.8%	100%
230	25.7%	15.3%	13.9%	12.9%	8.4%	4.0%	5.4%	14.4%	100%
235	27.2%	15.2%	14.8%	12.3%	7.4%	4.9%	4.9%	13.2%	100%
243	20.4%	16.2%	15.5%	12.0%	11.3%	6.3%	3.5%	14.8%	100%
245	27.5%	15.5%	15.0%	9.7%	9.2%	4.3%	4.3%	14.5%	100%
254	25.1%	16.2%	15.6%	10.8%	10.2%	4.2%	5.4%	12.6%	100%
Yr1-22 Storm	28.1%	16.0%	13.5%	11.3%	7.0%	4.5%	4.3%	15.3%	100%
Historic Record									
06/48-12/81	30.8%	19.7%	14.7%	10.5%	7.6%	4.7%	3.3%	8.7%	100%
03/82-12/99	30.2%	23.3%	12.2%	10.0%	7.0%	4.0%	3.3%	10.0%	100%
Historic Total	30.6%	21.0%	13.8%	10.3%	7.4%	4.4%	3.3%	9.1%	100%

Table C-17
Corrective Actions for WY2023

Date	Outfall	Issue	Explanation	Corrective Action	Date Corrective Action Performed
10/26/2022	230	Programing Issue	Velocity enable set to high for reduced flow	Velocity enable reduced	10/26/22
10/26/2022	245	Programing Issue	Time Pacing set to high	Time Pacing set to 10 min.	10/26/22
10/26/2022	254	Programing Issue	site wont enable on conductivity/ysi is broken	Change enable to flow	10/26/22
11/5/2022	243	Battery Issue	Battery not charging	Battery Replaced	11/05/22
11/23/2022	235	Battery Issue	Battery not charging	Battery Replaced	11/23/22
12/16/2022	237A	Pump Issue	Not pumping correct volume.	New tubing/calibration	12/16/22
12/31/2022	243	Pump Issue	Not pumping correct volume. Strainer may have been out of water at low tid	Strainer Fixed	02/08/22
1/11/2023	237B	Sensor Issue	Sensor not reading correctly	Sensor cleaned	01/17/22
3/23/2023	230	Battery Issue	Low Battery	Battery replaced	03/23/23
4/13/2023	230A	Sensor Issue	Site needed to be set up	Sensor installation/calibration	04/13/23
5/4/2023	243	Vandalism	Site door smashed/ Battery stolen	New lock/Battery replaced	05/04/23
6/16/2023	243	Battery Issue	Battery replacement needed	Battery replaced	6/16/2023
7/19/2023	237A	Rinse Blanks	Rinse Blanks	Rinse Blanks	7/19/2023
7/20/2023	237B	Rinse Blanks	Rinse Blanks	Rinse Blanks	7/20/2023
7/21/2023	235	Rinse Blanks	Rinse Blanks	Rinse Blanks	7/21/2023
9/22/2023	230A	Vandalism	Box drilled open/Battery Stolen	Battery Replaced	9/22/2023

APPENDIX D

Table D-1.1
Stormwater Analytical Data for Outfall 230 WY2023 - Composite Samples

	Sample 1 11/22/2022		Sample 2 12/9/2022		Sample 3 12/30/2022	
Conventionals						
Anionic Surfactants - MBAS (ug/L)	**51.1**		**16.2**	J	**15.0**	J
BOD (mg/L)	**9.7**		2.0	U	2.0	U
Chloride (mg/L)	**30.1**		**129**		**196**	
Conductivity (uS/cm)	**183**		**200**		**881**	
Hardness (mg CaCO3/L)	**37.8**		**75.3**		**113**	
pH (pH Units)	**6.6**		**6.8**		**7.2**	
Total Suspended Solids (mg/L)	**50.2**		**13.0**		**22.2**	
Turbidity (NTU)	**44.3**		**18.5**		**27.4**	
Nutrients						
Nitrate+Nitrite as N (mg/L)	**0.328**		**0.302**	J	**0.436**	
Phosphate, Ortho (mg/L)	**0.094**		**0.034**		**0.034**	
Phosphorus, Total (mg/L)	**0.172**	J	**0.069**		**0.090**	
Total Nitrogen (mg/L)	**1.83**		**0.72**		**0.84**	
Metals						
Cadmium (ug/L)	0.100	U	0.100	U	0.100	U
Cadmium, Dissolved (ug/L)	0.045	U	0.045	U	0.045	U
Copper (ug/L)	**18.2**		**7.39**		**13.4**	
Copper, Dissolved (ug/L)	**7.54**		**2.34**		**2.77**	
Lead (ug/L)	**5.68**		**2.49**		**4.50**	
Lead, Dissolved (ug/L)	**0.283**		**0.214**		**0.141**	
Mercury (ug/L)	**0.0085**	J	0.0080	U	**0.0055**	
Mercury, Dissolved (ug/L)	0.0111	U	0.0111	UJ	0.0022	U
Zinc (ug/L)	**121**		**52.2**		**59.4**	
Zinc, Dissolved (ug/L)	**52.2**		**35.0**		**33.3**	
Insecticides						
Bifenthrin (ug/L)	0.010	U	0.010	U	0.010	U
LPAHs						
2-Methylnaphthalene (ug/L)	**0.043**		**0.011**		0.010	U
Acenaphthene (ug/L)	0.010	U	0.010	U	0.010	U
Acenaphthylene (ug/L)	0.009	U	**0.027**		**0.017**	
Anthracene (ug/L)	0.005	U	**0.057**		**0.060**	
Fluorene (ug/L)	0.010	U	0.010	U	0.010	U
Naphthalene (ug/L)	0.137	UJ	**0.028**		**0.030**	
Phenanthrene (ug/L)	**0.124**		**0.030**		**0.021**	
Total LPAHs	**0.210**		**0.152**		**0.138**	
HPAHs						
Benzo(a)anthracene (ug/L)	**0.027**		**0.072**		**0.055**	
Benzo(a)pyrene (ug/L)	0.003	U	0.003	U	**0.058**	J
Benzo(b,j,k)fluoranthene (ug/L)	0.078	UJ	**0.183**		**0.144**	J
Benzo(g,h,i)perylene (ug/L)	**0.031**		**0.050**		**0.040**	J
Chrysene (ug/L)	0.036	UJ	**0.066**		**0.055**	J
Dibenz(a,h)anthracene (ug/L)	0.006	U	**0.012**		**0.010**	J
Fluoranthene (ug/L)	**0.092**		**0.107**		**0.089**	
Indeno(1,2,3-c,d)pyrene (ug/L)	0.022	UJ	**0.054**		**0.039**	J
Pyrene (ug/L)	0.109	UJ	**0.115**		**0.097**	
Retene (ug/L)	**0.031**		**0.011**		**0.009**	J
Total HPAHs	**0.277**		**0.661**		**0.587**	
Total PAHs	**0.487**		**0.813**		**0.725**	
Phthalates						
Bis(2-ethylhexyl) phthalate (ug/L)	**1.28**		**0.595**	J	**0.410**	J
Butyl benzyl phthalate (ug/L)	0.409	U	0.415	U	0.413	U
Diethyl phthalate (ug/L)	0.317	U	0.321	U	0.320	U
Dimethyl phthalate (ug/L)	0.345	U	0.349	U	0.348	U
Di-n-butyl phthalate (ug/L)	**0.380**	J	0.303	U	**0.412**	J
Di-n-octyl phthalate (ug/L)	0.366	U	0.370	U	0.369	UJ
Total Phthalates	**1.66**		**0.60**		**0.82**	
Herbicides						
Dichlobenil (ug/L)	**0.020**	J	0.009	U	0.009	U

Bold – The analyte was present in the sample.
U – The analyte was not detected at or above the reported value.
UJ – The analyte was not detected at or above the reported estimated value.
J – The analyte was positively identified. The associated value is an estimate.
R – The value is considered unusable.

Insufficient Volume
Laboratory Issue

Table D-1.2
Stormwater Analytical Data for Outfall 230 WY2023 - Grab Samples

	10/21/2022		11/3/2022			
TPH						
NWTPH-Diesel (mg/L)	0.10	U	0.10	U		
NWTPH-Heavy Oil (mg/L)	0.20	U	**0.19**			
Bacteria[1]						
Coliform, Fecal (CFU/100mL)	**140000**		**1300**			
E. Coli (CFU/100mL)	**110000**		**1300**			
Enterococci (CFU/100mL)	**200000**		**40000**			

Bold – The analyte was present in the sample.
U – The analyte was not detected at or above the reported value.
UJ – The analyte was not detected at or above the reported estimated value.
J – The analyte was positively identified. The associated value is an estimate.
R – The value is considered unusable.
E - Exceeds value.

Table D-2.1
Stormwater Analytical Data for Outfall 235 WY2023 - Composite Samples

	Sample 1 10/21/2022	Sample 2 10/31/2022	Sample 3 11/22/2022	Sample 4 12/10/2022	Sample 5 12/30/2022	Sample 6 1/13/2023	Sample 7 3/13/2023	Sample 8 3/20/2023	Sample 9 4/16/2023	Sample 10 5/5/2023	Sample 11 9/25/2023
Conventionals											
Anionic Surfactants - MBAS (ug/L)	**112 J**	–	**61.7**	–	–	–	**41.2**	–	**57.1**	–	**65.2**
BOD (mg/L)	–	–	9.7 **H**	–	–	–	**2.6**	–	**3.2**	–	**4.5**
Chloride (mg/L)	**5.75**	–	**37.8**	–	–	–	**19.6**	–	**5.91**	–	**3.82**
Conductivity (uS/cm)	**98.3**	**65.3**	**174**	**110.0**	**93.4**	**136**	**133**	**134**	**78.5**	**72.4**	**69.3**
Hardness (mg CaCO3/L)	**34.2**	**20.7**	**22.8**	**32.7**	**27.0**	**39.9**	**32.3**	**38.2**	**25.2**	**26.9**	**23.7**
pH (pH Units)	**7.5**	**7.3**	**6.5**	**6.8**	**6.7**	**6.9**	**6.8**	**6.6**	**7.7**	**7.5**	**7.9**
Total Suspended Solids (mg/L)	**54.0**	**17.8**	**56.2**	**45.8**	**52.6**	–	**30.5**	**68.0**	**26.4**	**48.8**	**46.3 J**
Turbidity (NTU)	**29.7 J**	–	**29.5**	–	–	–	**16.5**	–	**12.1**	–	**12.8**
Nutrients											
Nitrate+Nitrite as N (mg/L)	**1.02**	**0.256**	**0.214**	**0.215**	**0.251**	**0.331**	**0.304**	**0.453**	**0.283**	**0.394**	**0.351**
Phosphate, Ortho (mg/L)	**0.143**	**0.046**	**0.069**	**0.030**	–	**0.026**	**0.028**	**0.030**	**0.030**	**0.044**	**0.071**
Phosphorus, Total (mg/L)	**0.295 J**	**0.178**	**0.181**	**0.146**	**0.072**	**0.065**	**0.058**	**0.195**	**0.334**	**0.188**	**0.150**
Total Nitrogen (mg/L)	**2.55**	**0.84**	**1.21**	**0.79**	**0.67**	**0.85**	**0.73**	**1.24**	**0.88**	**1.09**	**0.77**
Metals											
Cadmium (ug/L)	**0.132 J**	0.100 U	**0.131 J**	**0.151 J**	**0.108 J**	**0.101 J**	0.100 U	**0.368 J**	0.100 U	**0.131 J**	0.100 U
Cadmium, Dissolved (ug/L)	0.045 U	0.045 U	0.045 U	0.045 U	**0.102 J**	**0.073 J**	0.045 U	**0.080 J**	0.045 U	0.045 U	0.045 U
Copper (ug/L)	**42.4**	**17.5**	**35.8**	**26.0**	**18.8**	**21**	**24.9**	**42.8**	**29.2**	**38.9**	**27.3**
Copper, Dissolved (ug/L)	**23.7**	**10.6**	**13.1**	**8.34**	**6.18**	**8.63**	**9.00**	**13.9**	**13.2**	**15.6**	**13.6**
Lead (ug/L)	**49.7**	**25.6**	**88.2**	**33.8**	**28.7**	**26.7**	**39.1**	**48.1**	**43.0**	**63.8**	**48.3**
Lead, Dissolved (ug/L)	**7.98**	**6.83**	**6.51**	**5.06**	**2.81**	**4.19**	**4.11**	**4.22**	**5.59**	**4.64**	**8.68**
Mercury (ug/L)	0.0080 U	0.0080 U	0.0080 U	0.0080 U	**0.0035 J**	**0.0034 J**	0.0080 U	**0.0063**	0.0080 U	0.0080 U	0.0080 U
Mercury, Dissolved (ug/L)	0.0111 U	0.0111 U	0.0111 U	0.0111 U	0.0022 U	0.0022 U	0.0111 U	0.0022 U	0.0111 U	0.0111 U	0.0111 U
Zinc (ug/L)	**170**	**62.1**	**139**	**113**	**75.6**	**70.8**	**85.5**	**168**	**78.5**	**120**	**88.5**
Zinc, Dissolved (ug/L)	**88.3**	**37.4**	**45.6**	**34.5**	**25.9**	**31.1**	**30.8**	**43.2**	**30.1**	**35.5**	**35.2**
Insecticides											
Bifenthrin (ug/L)	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
LPAHs											
2-Methylnaphthalene (ug/L)	**0.050**	0.009 U	**0.036**	**0.019**	0.010 U	0.010 U	**0.052**	**0.013**	0.009 U	0.009 U	0.010 U
Acenaphthene (ug/L)	**0.022**	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	**0.023**	0.010 U	0.009 U	0.009 U	0.010 U
Acenaphthylene (ug/L)	0.009 U	**0.015**	0.009 U	**0.018**	0.009 U	0.009 U	**0.013**	0.009 U	**0.009** U	0.009 U	0.009 U
Anthracene (ug/L)	0.005 U	0.005 U	0.005 U	**0.021**	**0.014**	**0.008 J**	**0.030**	0.005 U	0.005 U	0.005 U	0.005 U
Fluorene (ug/L)	**0.012**	0.009 U	**0.024**	**0.011**	0.010 U	0.010 U	**0.028**	**0.011**	0.009 U	0.009 U	0.010 U
Naphthalene (ug/L)	**0.063**	0.016 U	0.071 UJ	**0.027**	**0.018 J**	0.016 U	**0.024 J**	0.039 UJ	**0.035** UJ	0.016 U	0.016 U
Phenanthrene (ug/L)	**0.033**	**0.017**	**0.073**	**0.047**	**0.034**	**0.019**	**0.097**	**0.051**	**0.027**	**0.022**	**0.020**
Total LPAHs	**0.137**	**0.052**	**0.145**	**0.129**	**0.081**	**0.050**	**0.215**	**0.094**	**0.083**	**0.046**	**0.045**
HPAHs											
Benzo(a)anthracene (ug/L)	**0.011**	**0.009 J**	0.006 U	**0.033**	**0.031**	**0.018**	**0.031**	**0.026**	**0.014**	**0.016**	**0.015**
Benzo(a)pyrene (ug/L)	0.003 U	**0.012**	0.003 U	0.003 U	0.003 U	**0.023**	**0.036**	**0.035**	**0.020**	**0.022**	**0.017**
Benzo(b,k)fluoranthene (ug/L)	**0.039**	**0.020 J**	0.078 UJ	**0.094**	**0.081**	**0.052**	**0.086**	**0.087**	**0.048**	**0.047**	**0.031**
Benzo(g,h,i)perylene (ug/L)	**0.020**	**0.014**	**0.036**	**0.037 J**	**0.035**	**0.030**	**0.042**	**0.046**	**0.032**	**0.037**	**0.024**
Chrysene (ug/L)	**0.016**	**0.009 J**	0.046 UJ	**0.050**	**0.043**	**0.025**	**0.043**	**0.042**	**0.021**	**0.026**	**0.009 J**
Dibenz(a,h)anthracene (ug/L)	0.006 U	0.006 U	0.006 U	**0.007 J**	0.006 U	0.006 U	**0.007 J**	0.006 U	0.006 U	0.006 U	0.006 U
Fluoranthene (ug/L)	**0.042**	**0.021**	**0.106**	**0.091**	**0.078**	**0.056**	**0.094**	**0.114**	**0.052**	**0.047**	**0.038**
Indeno(1,2,3-c,d)pyrene (ug/L)	**0.012**	0.005 U	0.020 UJ	**0.026**	**0.023**	**0.018**	**0.029**	**0.027**	**0.021**	**0.022**	**0.016**
Pyrene (ug/L)	**0.052**	**0.031**	0.152 UJ	**0.115**	**0.105**	**0.084**	**0.153**	**0.153**	**0.063**	**0.080**	**0.047**
Retene (ug/L)	**0.016**	**0.008 J**	**0.032**	**0.019**	**0.016**	**0.014**	**0.021**	**0.030**	**0.010**	**0.009 J**	**0.011**
Total HPAHs	**0.197**	**0.122**	**0.298**	**0.4545**	**0.401**	**0.309**	**0.521**	**0.533**	**0.274**	**0.300**	**0.200**
Total PAHs	**0.334**	**0.174**	**0.442**	**0.584**	**0.481**	**0.359**	**0.736**	**0.627**	**0.357**	**0.346**	**0.245**
Phthalates											
Bis(2-ethylhexyl) phthalate (ug/L)	**2.00**	**1.39**	**3.04**	**2.48**	**1.73**	**1.83**	**1.96**	**2.98**	**1.53**	**2.37**	**1.14**
Butyl benzyl phthalate (ug/L)	0.418 U	0.405 U	0.407 U	0.412 U	0.411 U	0.416 U	0.401 U	0.405 U	0.403 U	0.403 U	0.412 U
Diethyl phthalate (ug/L)	**0.395 J**	0.314 U	0.315 U	0.319 U	0.319 U	0.322 U	0.310 U	0.314 U	0.312 U	0.312 U	0.319 U
Dimethyl phthalate (ug/L)	0.352 U	0.341 U	0.343 U	0.347 U	0.347 U	0.350 U	0.338 U	0.341 U	0.339 U	0.339 U	0.347 U
Di-n-butyl phthalate (ug/L)	0.305 U	0.296 U	**0.306 J**	0.301 U	0.300 U	0.303 U	**0.366 J**	**0.351 J**	**0.471 J**	0.294 U	0.301 U
Di-n-octyl phthalate (ug/L)	0.373 U	0.362 U	0.363 U	0.368 U	0.367 U	0.371 U	0.358 U	0.362 U	0.360 U	0.36 U	0.368 U
Total Phthalates	**2.40**	**1.39**	**3.35**	**2.48**	**1.73**	**1.83**	**2.33**	**3.33**	**2.00**	**2.37**	**1.14**
Herbicides											
Dichlobenil (ug/L)	**0.056**	**0.039 J**	**0.848**	**0.050**	0.024 J	**0.023 J**	**0.455**	0.338	**0.196**	**0.107**	**0.026 J**

Bold – The analyte was present in the sample.
U – The analyte was not detected at or above the reported value.
UJ – The analyte was not detected at or above the reported estimated value.
J – The analyte was positively identified. The associated value is an estimate.
R – The value is considered unusable.

Table D-2.2
Stormwater Analytical Data for Outfall 235 WY2023 - Grab Samples

	10/21/2022		11/3/2022			
TPH						
NWTPH-Diesel (mg/L)	0.10	U	**0.10**			
NWTPH-Heavy Oil (mg/L)	**0.99**		**1.0**			
Bacteria						
Coliform, Fecal (CFU/100mL)	**50000**		**3000**			
E. Coli (CFU/100mL)	**50000**		**2300**			
Enterococci (CFU/100mL)	**225000**		**44000**			

Bold – The analyte was present in the sample.
U – The analyte was not detected at or above the reported value.
UJ – The analyte was not detected at or above the reported estimated value.
J – The analyte was positively identified. The associated value is an estimate.
R – The value is considered unusable.
E - Exceeds value.

Table D-3.1
Stormwater Analytical Data for Outfall 237A WY2023 - Composite Samples

	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Sample 6	Sample 7	Sample 8	Sample 9	Sample 10	Sample 11	Sample 12
	10/22/2022	11/4/2022	11/22/2022	12/10/2022	12/30/2022	1/14/2023	2/8/2023	3/14/2023	3/20/2023	4/10/2023	5/5/2023	9/26/2023
Conventionals												
Anionic Surfactants - MBAS (ug/L)	–	–	63.3	43.5	–	36.8	–	44.3	–	–	–	–
BOD (mg/L)	–	–	9.2 H	2.4	–	–	–	2.0 U	–	–	–	–
Chloride (mg/L)	–	–	40.6	33.6	–	31.1	–	31.1	–	–	–	–
Conductivity (uS/cm)	161	118	172	188	103	213	198	178	204	106	85.3	110
Hardness (mg CaCO3/L)	49.0	26.6	21.0	42.5	23.1	58.1	55.4	38.9	52.3	25.9	23.1	36.7
pH (pH Units)	7.3	6.9	6.2	6.4	6.7	7.1	6.2	6.7	6.7	6.4	7.0	7.8
Total Suspended Solids (mg/L)	23.3	32.9	59.6	33.2	43.0	10.8	156	30.0	36.4	28.7	–	40.0
Turbidity (NTU)	–	–	34.2	26.4	–	9.58	–	17.1	–	–	–	–
Nutrients												
Nitrate+Nitrite as N (mg/L)	–	–	0.165	0.478	0.297	0.845	0.675	0.392	0.678	–	0.331	0.300
Phosphate, Ortho (mg/L)	–	0.030	0.069	0.021	–	0.024	–	0.017	0.026	–	–	0.034
Phosphorus, Total (mg/L)	–	–	0.178	0.077	0.091	0.052	0.233	0.059	0.095	–	0.124	0.117
Total Nitrogen (mg/L)	–	–	0.83	0.83	0.63	1.36	1.05	0.75	1.30	–	0.76	0.71
Metals												
Cadmium (ug/L)	0.100 U	0.100 U	0.128 J	0.100 U	0.100 U	0.114 J	0.206 J	0.100 U	0.100 U	0.100 U	0.131 J	0.100 U
Cadmium, Dissolved (ug/L)	0.045 U	0.045 U	0.045 U	0.056 J	0.045 U	0.098 J	0.045 U	0.045 U	0.045 U	0.045 J	0.045 U	0.045 U
Copper (ug/L)	13.5	8.68	16.3	8.71	10.1	4.09	26.3	7.09	9.52	7.90	14.8	8.64
Copper, Dissolved (ug/L)	8.21	3.22	4.21	2.34	2.96	1.94	2.51	2.17	3.64	2.75	4.17	3.64
Lead (ug/L)	5.37	4.37	11.1	6.33	8.48	2.24	25.4	5.6	5.86	5.52	10.2	4.77
Lead, Dissolved (ug/L)	1.02	0.346	0.564	0.292	1.21	0.268	0.309	0.183	0.315	0.269	0.329	0.319
Mercury (ug/L)	0.0080 U	0.0080 U	0.0080 U	0.0080 U	0.0039 J	0.0016 U	0.0120 J	0.0080 U	0.0032 J	0.0080 U	0.0135 J	0.0080 U
Mercury, Dissolved (ug/L)	0.0111 U	0.0111 U	0.0111 U	0.0111 U	0.0022 U	0.0022 U	0.0111 U	0.0111 U	0.0022 U	0.0111 U	0.0111 U	0.0111 U
Zinc (ug/L)	92.7	52.6	132	58.0	66.1	63.6	158	50.5	62.6	51.4	93.1	59.5
Zinc, Dissolved (ug/L)	60.0	25.2	59.7	24.4	27.6	45.8	21.6	22.0	26.3	21.5	25.7	27.6
Insecticides												
Bifenthrin (ug/L)	0.010 U	0.010 U	0.023	0.010 U	0.010 U	0.010 U	0.021	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
LPAHs												
2-Methylnaphthalene (ug/L)	0.011	0.021	0.036	0.023	0.016	0.039	0.035	0.059	0.011	0.051	0.009 U	0.011
Acenaphthene (ug/L)	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.009 U	0.009 U	0.010 U	0.009 U	0.010 U
Acenaphthylene (ug/L)	0.009 U	0.009 U	0.009 U	0.009 U	0.009 U	0.009 U	0.009 U	0.009 U	0.009 U	0.009 U	0.009 U	0.009 U
Anthracene (ug/L)	0.005 U	0.005 U	0.005 U	0.011 J	0.011 J	0.005 U	0.225	0.006 J	0.005 U	0.005 U	0.007 J	0.005 U
Fluorene (ug/L)	0.010 U	0.010 U	0.010 U	0.009 U	0.010 U	0.011	0.011	0.009 U	0.009 U	0.012	0.009 U	0.009 U
Naphthalene (ug/L)	0.018 J	0.054 UJ	0.083 UJ	0.038	0.038	0.028	0.046	0.090	0.047 UJ	0.041 UJ	0.015 U	0.016 U
Phenanthrene (ug/L)	0.022	0.037	0.139	0.062	0.074	0.028	0.199	0.052	0.041	0.033	0.042	0.021
Total LPAHs	0.057	0.081	0.198	0.125	0.138	0.079	0.491	0.162	0.081	0.078	0.070	0.046
HPAHs												
Benzo(a)anthracene (ug/L)	0.014	0.022	0.094 J	0.062	0.066	0.011	0.183	0.035	0.024	0.019	0.040	0.019
Benzo(a)pyrene (ug/L)	0.003 U	0.034	0.003 U	0.003 U	0.003 U	0.023	0.258	0.057	0.038	0.029	0.058	0.030
Benzo(b,k)fluoranthene (ug/L)	0.054	0.088	0.421	0.244	0.286	0.045	0.797	0.152	0.111	0.080	0.164	0.069
Benzo(g,h,i)perylene (ug/L)	0.019	0.039	0.086 J	0.071	0.070	0.020	0.163	0.050	0.036	0.043	0.063	0.042
Chrysene (ug/L)	0.023	0.035	0.223 J	0.095	0.097	0.019	0.347	0.056	0.045	0.030	0.071	0.023
Dibenz(a,h)anthracene (ug/L)	0.006 U	0.006 U	0.006 U	0.016	0.006 U	0.006 U	0.006 U	0.011	0.006 U	0.006 U	0.012	0.006 U
Fluoranthene (ug/L)	0.039	0.084	0.327 J	0.169	0.195	0.036	0.541	0.108	0.086	0.055	0.116	0.055
Indeno(1,2,3-c,d)pyrene (ug/L)	0.017	0.034	0.088 J	0.072	0.072	0.018	0.183	0.052	0.032	0.040	0.059	0.041
Pyrene (ug/L)	0.045	0.078	0.299 UJ	0.162	0.188	0.045	0.542	0.104	0.095	0.063	0.128	0.056
Retene	0.013	0.010	0.053	0.017	0.017	0.006 J	0.034	0.011	0.032	0.006 J	0.010	0.031
Total HPAHs	0.216	0.417	1.393	0.910	0.979	0.220	3.017	0.625	0.470	0.362	0.711	0.338
TOTAL PAHs	0.273	0.498	1.591	1.035	1.116	0.299	3.508	0.787	0.551	0.440	0.781	0.384
Phthalates												
Bis(2-ethylhexyl) phthalate (ug/L)	1.35	1.42	2.62	1.53	1.69	0.902 J	3.73	1.37	1.67	1.17	1.65	1.4
Butyl benzyl phthalate (ug/L)	0.420 U	5.57	0.412 U	0.405 U	0.417 U	0.413 U	0.416 U	0.401 U	0.400 U	0.412 U	0.401 U	0.406 U
Diethyl phthalate (ug/L)	0.325 U	0.317 U	0.319 U	0.335 J	0.323 U	0.32 U	0.327 J	0.347 J	0.310 U	0.319 U	0.311 U	0.314 U
Dimethyl phthalate (ug/L)	0.354 U	0.345 U	0.347 U	0.341 U	0.351 U	0.348 U	0.350 U	0.338 U	0.337 U	0.347 U	0.338 U	0.342 U
Di-n-butyl phthalate (ug/L)	0.306 U	0.385 UJ	0.456 J	0.296 U	0.35 J	0.36 J	0.574 J	0.353 J	0.510 J	0.318 J	0.312 J	0.312 J
Di-n-octyl phthalate (ug/L)	0.375 U	0.366 U	0.368 U	0.362 U	0.372 U	0.369 U	0.371 U	0.358 U	0.357 U	0.368 U	0.359 U	0.362 U
Total Phthalates	1.35	6.99	3.08	1.87	2.04	1.26	4.63	2.07	2.18	1.49	1.96	1.71
Herbicides												
Dichlobenil (ug/L)	0.051	0.027 J	0.041 J	0.011 J	0.011 J	0.024 J	0.057	0.121	0.087	0.056	0.044 J	0.034 J

Bold – The analyte was present in the sample.
U – The analyte was not detected at or above the reported value.
UJ – The analyte was not detected at or above the reported estimated value.
J – The analyte was positively identified. The associated value is an estimate.
R – The value is considered unusable.
E - Exceeds value.

Insufficient Volume
Laboratory Issue

Table D-3.2
Stormwater Analytical Data for Outfall 237A WY2023 - Grab Samples

	10/21/2022	11/3/2022		
TPH				
NWTPH-Diesel (mg/L)	0.10 U	0.10 U		
NWTPH-Heavy Oil (mg/L)	**0.29**	**0.28**		
Bacteria				
Coliform, Fecal (CFU/100mL)	**80000**	**11000**		
E. Coli (CFU/100mL)	**2200**	**3300**		
Enterococci (CFU/100mL)	**73500**	**10000**		

Bold – The analyte was present in the sample.
U – The analyte was not detected at or above the reported value.
UJ – The analyte was not detected at or above the reported estimated value.
J – The analyte was positively identified. The associated value is an estimate.
R – The value is considered unusable.
E - Exceeds value.

Table D-4.1
Stormwater Analytical Data for Outfall 237B WY2023 - Composite Samples

	Sample 1 10/26/2022	Sample 2 11/4/2022	Sample 3 11/22/2022	Sample 4 12/30/2022	Sample 5 2/7/2023	Sample 6 3/20/2023	Sample 7 4/11/2023	Sample 8 9/26/2023
Conventionals								
Anionic Surfactants - MBAS (ug/L)	**63.0**	–	**68.0**	**47.7**	–	–	–	**62.6**
BOD (mg/L)	**4.1**	–	**9.8** H	–	–	–	**2.2**	**2.5**
Chloride (mg/L)	**5.44**	–	**23.7**	**10.6**	–	–	–	**5.80**
Conductivity (uS/cm)	**142**	**91.9**	**155**	**151**	**103**	**134**	**143**	**167**
Hardness (mg CaCO3/L)	**63.1**	**36.4**	**34.5**	**55.8**	**69.7**	**74.6**	**56.5**	**66.9**
pH (pH Units)	**7.3**	**7.3**	**6.2**	**6.5**	**6.6**	**6.6**	**6.5**	**7.7**
Total Suspended Solids (mg/L)	**27.7**	**27.3**	**45.8**	**23.0**	**75.9**	**20.0**	**13.8**	**15.2**
Turbidity (NTU)	**13.6**	–	**25.8**	**15.4**	–	–	–	**8.26**
Nutrients								
Nitrate+Nitrite as N (mg/L)	**1.48**	–	**0.712**	**1.55**	**1.40**	**1.80**	**1.38**	**1.72**
Phosphate, Ortho (mg/L)	**0.043**	–	**0.063**	**0.019**	**0.021**	–	**0.020**	**0.040**
Phosphorus, Total (mg/L)	**0.092**	–	**0.128**	**0.075**	**0.23**	**0.096**	**0.064**	**0.066**
Total Nitrogen (mg/L)	**1.94**	–	**1.50**	**2.12**	**2.07**	**2.27**	**2.01**	**1.79**
Metals								
Cadmium (ug/L)	0.100 U	0.100 U	0.100 U	0.100 U	**0.133** J	0.100 U	0.100 U	0.100 U
Cadmium, Dissolved (ug/L)	0.045 U	0.045 U	0.045 U	**0.065** J	0.045 U	0.045 U	0.045 U	0.045 U
Copper (ug/L)	**7.75**	**6.32**	**10.4**	**5.61**	**16.8**	**5.67**	**4.41**	**5.44**
Copper, Dissolved (ug/L)	**3.20**	**2.4**	**3.74**	**2.02**	**1.69**	**2.15**	**1.88**	**2.70**
Lead (ug/L)	**3.92**	**4.14**	**6.96**	**4.03**	**16.5**	**4.08**	**2.60**	**2.37**
Lead, Dissolved (ug/L)	**0.433**	**0.419**	**0.450**	**0.225**	**0.187**	**0.153**	**0.154**	**0.181**
Mercury (ug/L)	0.0080 U	0.0080 U	**0.0090** J	**0.0058**	**0.0115** J	**0.0020** J	0.0080 U	0.0080 U
Mercury, Dissolved (ug/L)	0.0111 U	0.0111 U	0.0111 U	0.0022 U	0.0111 U	0.0022 U	0.0111 U	0.0111 U
Zinc (ug/L)	**43.2**	**35.3**	**78.8**	**31.4**	**96.5**	**34.5**	**23.6**	**24.9**
Zinc, Dissolved (ug/L)	**19.2**	**16.4**	**36.8**	**13.6**	**12.7**	**12.8**	**8.60**	**11.4**
Insecticides								
Bifenthrin (ug/L)	**0.036**	0.010 U	0.010 U	0.010 U	**0.013** J	0.010 U	0.010 U	0.010 U
LPAHs								
2-Methylnaphthalene (ug/L)	0.010 U	0.009 U	0.010 U	0.010 U	**0.013**	0.009 U	0.010 U	0.009 U
Acenaphthene (ug/L)	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.009 U	0.010 U	0.010 U
Acenaphthylene (ug/L)	0.009 U	**0.011**	0.009 U	0.009 U	0.009 U	0.009 U	0.009 U	0.009 U
Anthracene (ug/L)	0.005 U	0.005 U	0.005 U	0.005 U	**0.010** J	0.005 U	0.005 U	0.005 U
Fluorene (ug/L)	0.010 U	0.009 U	0.010 U	0.010 U	0.010 U	0.009 U	0.010 U	0.009 U
Naphthalene (ug/L)	0.016 U	0.036 UJ	0.061 UJ	0.016 U	**0.023** J	0.015 U	0.016 U	0.016 U
Phenanthrene (ug/L)	**0.019**	**0.021**	**0.046**	**0.022**	**0.078**	**0.017**	**0.011** J	**0.012** J
Total LPAHs	**0.044**	**0.062**	**0.0935**	**0.047**	**0.126**	**0.041**	**0.036**	**0.0365**
HPAHs								
Benzo(a)anthracene (ug/L)	**0.022**	**0.009** J	**0.018**	**0.013**	**0.046**	0.006 U	0.006 U	0.006 U
Benzo(a)pyrene (ug/L)	0.003 U	**0.016**	0.003 U	0.003 U	**0.073**	**0.011**	**0.009** J	**0.014**
Benzo(b,k)fluoranthene (ug/L)	**0.030**	**0.035**	0.067 UJ	**0.057**	**0.194**	**0.029** J	**0.021** J	**0.025** J
Benzo(g,h,i)perylene (ug/L)	**0.013**	**0.019**	**0.023** J	**0.016**	**0.046**	**0.012**	**0.013**	**0.018**
Chrysene (ug/L)	**0.011**	**0.015**	0.029 UJ	**0.020**	**0.071**	**0.012**	0.008 U	0.008 U
Dibenz(a,h)anthracene (ug/L)	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U
Fluoranthene (ug/L)	**0.023**	**0.035**	**0.064**	**0.045**	**0.163**	**0.025**	**0.021**	**0.020**
Indeno(1,2,3-c,d)pyrene (ug/L)	**0.011**	**0.013**	0.016 UJ	**0.014**	**0.040**	**0.009** J	**0.010**	**0.016**
Pyrene (ug/L)	**0.030**	**0.042**	0.077 UJ	**0.054**	**0.190**	**0.034**	**0.025**	**0.023**
Retene (ug/L)	**0.007** J	**0.010**	**0.022**	**0.009** J	**0.029**	**0.009** J	0.005 U	0.005 U
Total HPAHs	**0.145**	**0.187**	**0.204**	**0.224**	**0.826**	**0.138**	**0.109**	**0.123**
Total PAHs	**0.189**	**0.249**	**0.298**	**0.271**	**0.952**	**0.179**	**0.145**	**0.160**
Phthalates								
Bis(2-ethylhexyl) phthalate (ug/L)	**0.905** J	**1.22**	**1.43**	**1.03**	**2.39**	**0.955** J	0.701 UJ	**0.767** J
Butyl benzyl phthalate (ug/L)	0.413 U	0.405 U	0.408 U	0.416 U	0.416 U	0.399 U	0.420 U	0.406 U
Diethyl phthalate (ug/L)	0.320 U	0.314 U	0.316 U	0.322 U	0.322 U	0.309 U	0.325 U	0.315 U
Dimethyl phthalate (ug/L)	0.348 U	0.341 U	0.344 U	0.350 U	0.350 U	0.336 U	0.354 U	0.342 U
Di-n-butyl phthalate (ug/L)	0.301 U	0.370 UJ	0.298 U	0.303 U	**0.369** J	0.291 U	0.306 U	0.296 U
Di-n-octyl phthalate (ug/L)	0.369 U	0.362 U	0.365 U	0.371 U	0.371 U	0.356 U	0.375 U	0.363 U
Total Phthalates	**0.905**	**1.220**	**1.43**	**1.030**	**2.759**	**0.955**		**0.767**
Herbicides								
Dichlobenil (ug/L)	**0.031** J	**0.025** J	**0.028** J	**0.012** J	**0.037** J	**0.026** J	**0.097**	**0.021** J

Bold – The analyte was present in the sample.
U – The analyte was not detected at or above the reported value.
UJ – The analyte was not detected at or above the reported estimated value.
J – The analyte was positively identified. The associated value is an estimate.
R – The value is considered unusable.
E - Exceeds value.

Insufficient Volume
Laboratory Issue

Table D-4.2
Stormwater Analytical Data for Outfall 237B WY2023 - Grab Samples

	10/21/2022		11/3/2022			
TPH						
NWTPH-Diesel (mg/L)	0.10	U	0.10	U		
NWTPH-Heavy Oil (mg/L)	**0.78**		**0.34**			
Bacteria						
Coliform, Fecal (CFU/100mL)	**Unusable**	**R**	**2300**			
E. Coli (CFU/100mL)	**3900**		**2300**			
Enterococci (CFU/100mL)	**66000**		**6300**			

Bold – The analyte was present in the sample.
U – The analyte was not detected at or above the reported value.
UJ – The analyte was not detected at or above the reported estimated value.
J – The analyte was positively identified. The associated value is an estimate.
R – The value is considered unusable.
E - Exceeds value.

Table D-5.1
Stormwater Analytical Data for Outfall 243 WY2023 - Composite Samples

	Sample 1 10/26/2022	Sample 2 11/6/2022	Sample 3 12/10/2022	Sample 4 3/13/2023	Sample 5 3/31/2023	Sample 6 4/16/2023	Sample 7 9/25/2023
Conventionals							
Anionic Surfactants - MBAS (ug/L)	**138**	**28.5**	–	**44.4**	–	**58.1**	**85.8**
BOD (mg/L)	**2.2**	2.0 U	2.0 U	**2.4**	–	**2.0**	2.0 U
Chloride (mg/L)	**2070**	**1300**	–	**924**	–	**844**	**534**
Conductivity (uS/cm)	**6690**	**4640**	**5680**	**3090**	**6470**	**3090**	**1980**
Hardness (mg CaCO3/L)	**729**	**449**	**561**	**300**	**679**	**322**	**210**
pH (pH Units)	**6.9**	**7.1**	**7.1**	**7.2**	**7.3**	**7.7**	**7.0**
Total Suspended Solids (mg/L)	**12.5**	**28.3**	**16.8**	**76.7**	**26.2**	**9.10**	**6.20**
Turbidity (NTU)	**16.1**	**18.1**	–	**43.7**	–	**11.5**	**10.0**
Nutrients							
Nitrate+Nitrite as N (mg/L)	**0.545**	**0.243**	**0.139**	**0.130**	**0.222**	**0.181**	**0.445**
Phosphate, Ortho (mg/L)	**0.042**	**0.048**	**0.037**	0.012 U	**0.050**	**0.032**	**0.066**
Phosphorus, Total (mg/L)	**0.148**	**0.214**	**0.158**	**0.244**	**0.202**	**0.068**	**0.165**
Total Nitrogen (mg/L)	**1.28**	**0.59**	**0.66**	**0.57**	**0.98**	**0.78**	**0.77**
Metals							
Cadmium (ug/L)	**0.139 J**	**0.241 J**	**0.245 J**	**0.382 J**	**0.188 J**	0.100 U	0.100 U
Cadmium, Dissolved (ug/L)	**0.056 J**	**0.141 J**	**0.166 J**	**0.090 J**	**0.077 J**	0.045 U	**0.072 J**
Copper (ug/L)	**18.0**	**12.9**	**19.8**	**41.2**	**23.6**	**8.71**	**11.9**
Copper, Dissolved (ug/L)	**9.19**	**3.94**	**3.75**	**5.95**	**4.42**	**3.63**	**7.71**
Lead (ug/L)	**6.34**	**6.98**	**4.52**	**45.9**	**14.9**	**2.27**	**2.29**
Lead, Dissolved (ug/L)	**0.676**	**0.360**	**0.284**	**0.958**	**0.321**	0.225	**0.349**
Mercury (ug/L)	0.0080 U	0.0080 U	0.0080 U	**0.0090 J**	**0.0059**	0.0080 U	0.0080 U
Mercury, Dissolved (ug/L)	0.0111 U	0.0111 U	0.0111 U	0.0111 U	0.0022 U	0.0111 U	0.0111 U
Zinc (ug/L)	**58.0**	**46.1**	**48.1**	**91.1**	**47.9**	**28.5**	**31.1**
Zinc, Dissolved (ug/L)	**38.8**	**27.9**	**30.5**	**23.0**	**18.7**	**17.9**	**23.8**
Insecticides							
Bifenthrin (ug/L)	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
LPAHs							
2-Methylnaphthalene (ug/L)	0.010 U	0.009 U	0.010 U	**0.020**	0.009 U	0.009 U	0.010 U
Acenaphthene (ug/L)	0.010 U	**0.012**	0.010 U	**0.015**	**0.029**	**0.033**	**0.028**
Acenaphthylene (ug/L)	0.009 U	**0.013**	**0.014**	**0.025**	**0.022**	**0.028**	0.009 U
Anthracene (ug/L)	**0.032**	**0.028**	**0.043**	**0.066**	**0.031**	**0.038**	**0.044**
Fluorene (ug/L)	0.010 U	0.009 U	0.010 U	**0.023**	**0.020**	0.009 U	0.010 U
Naphthalene (ug/L)	0.016 U	0.035 UJ	**0.021 J**	**0.029**	0.038 UJ	0.034 UJ	0.016 U
Phenanthrene (ug/L)	**0.028**	**0.022**	**0.030**	**0.113**	**0.045**	**0.016 J**	**0.015 J**
Total LPAHs	**0.083**	**0.097**	**0.118**	**0.271**	**0.166**	**0.1365**	**0.105**
HPAHs							
Benzo(a)anthracene (ug/L)	0.006 U	**0.011**	**0.012**	**0.059**	**0.023**	0.006 U	0.006 U
Benzo(a)pyrene (ug/L)	0.003 U	**0.015**	0.003 U	**0.068**	**0.029**	**0.006 J**	0.003 U
Benzo(b,k)fluoranthene (ug/L)	**0.026 J**	**0.034**	**0.036**	**0.173**	**0.076**	**0.016 J**	0.011 U
Benzo(g,h,i)perylene (ug/L)	**0.008 J**	**0.012**	**0.013**	**0.043 J**	**0.028**	**0.007 J**	0.005 U
Chrysene (ug/L)	0.008 U	**0.013**	**0.013**	**0.073**	**0.034**	0.008 U	0.008 U
Dibenz(a,h)anthracene (ug/L)	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U
Fluoranthene (ug/L)	**0.027**	**0.030**	**0.041**	**0.168**	**0.077**	**0.017**	**0.013**
Indeno(1,2,3-c,d)pyrene (ug/L)	**0.008 J**	**0.014**	**0.012**	**0.048**	**0.029**	**0.006 J**	0.005 U
Pyrene (ug/L)	**0.033**	**0.031**	**0.047**	**0.187**	**0.081**	**0.025**	**0.016**
Retene (ug/L)	**0.010**	**0.006 J**	**0.008 J**	**0.023**	**0.014**	**0.006 J**	0.005 U
Total HPAHs	**0.114**	**0.163**	**0.179**	**0.822**	**0.380**	**0.087**	**0.051**
Total PAHs	**0.196**	**0.260**	**0.297**	**1.093**	**0.546**	**0.224**	**0.156**
Phthalates							
Bis(2-ethylhexyl) phthalate (ug/L)	**1.17**	**0.398 J**	**0.930 J**	**1.29**	4.58 UJ	**0.543 J**	**0.421 J**
Butyl benzyl phthalate (ug/L)	0.419 U	0.405 U	0.408 U	0.398 U	0.407 U	0.403 U	0.409 U
Diethyl phthalate (ug/L)	**0.342 J**	**0.327 J**	**0.353 J**	0.309 U	0.315 U	0.312 U	0.317 U
Dimethyl phthalate (ug/L)	0.353 U	0.341 U	0.343 U	0.336 U	0.342 U	0.339 U	0.344 U
Di-n-butyl phthalate (ug/L)	0.306 U	0.295 U	**0.331 J**	0.291 U	**0.489 J**	0.294 U	0.298 U
Di-n-octyl phthalate (ug/L)	0.374 U	0.361 U	0.364 U	0.356 U	0.363 U	0.360 U	0.365 U
Total Phthalates	**1.51**	**0.725**	**1.61**	**1.29**	**0.489**	**0.543**	**0.421**
Herbicides							
Dichlobenil (ug/L)	**0.015 J**	0.008 U	0.008 U	**0.019 J**	**0.021 J**	**0.021 J**	**0.017 J**

Bold – The analyte was present in the sample.
U – The analyte was not detected at or above the reported value.
UJ – The analyte was not detected at or above the reported estimated value.
J – The analyte was positively identified. The associated value is an estimate.
R – The value is considered unusable.
E - Exceeds value.

Insufficient Volume
Laboratory Issue

Table D-5.2
Stormwater Analytical Data for Outfall 243 WY2023 - Grab Samples

	10/21/2022		11/3/2022			
TPH						
NWTPH-Diesel (mg/L)	0.10	U	0.09	U		
NWTPH-Heavy Oil (mg/L)	**0.96**		0.19	U		
Bacteria						
Coliform, Fecal (CFU/100mL)	**80000**		**800**			
E. Coli (CFU/100mL)	**50000**		**800**			
Enterococci (CFU/100mL)	**85000**		**16000**			

Bold – The analyte was present in the sample.
U – The analyte was not detected at or above the reported value.
UJ – The analyte was not detected at or above the reported estimated value.
J – The analyte was positively identified. The associated value is an estimate.
R – The value is considered unusable.
E - Exceeds value.

Table D-6.1
Stormwater Analytical Data for Outfall 245 WY2023 - Composite Samples

	Sample 1 10/31/2022	Sample 2 11/22/2022	Sample 3 12/10/2022	Sample 4 1/13/2023	Sample 5 3/13/2023	Sample 6 3/31/2023	Sample 7 4/10/2023	Sample 8 5/5/2023	Sample 9 9/25/2023
Conventionals									
Anionic Surfactants - MBAS (ug/L)	**67.2**	**56.5**	–	**48.1**	**61.1**	**132**	**39.4**	–	**87.1**
BOD (mg/L)	**3.4**	**5.4**	–	**2.3**	**2.1**	–	**2.3**	**5.1**	**2.4**
Chloride (mg/L)	**75.1** J	**16.9**	–	**322**	**87.5** J	**127**	**132.0**	–	**561**
Conductivity (uS/cm)	**225**	**102**	**578**	**1100**	**223**	**544**	**554**	**458**	**1930**
Hardness (mg CaCO3/L)	**31.7**	**15.1**	**66.7**	**133**	**37.2**	**65.8**	**65.0**	**60.6**	**192**
pH (pH Units)	**6.3**	**6.0**	**7.1**	**6.8**	**6.6**	**6.7**	**6.9**	**7.2**	**6.9**
Total Suspended Solids (mg/L)	**17.9**	**48.8**	**21.8**	**28.4**	**77.0**	**37.6**	**25.5**	**67.5**	**27.0**
Turbidity (NTU)	**17.5**	**40.4**	–	**25.3**	**43.6**	**41.8**	**26.5**	–	**18.1**
Nutrients									
Nitrate+Nitrite as N (mg/L)	**0.163**	**0.100**	–	**0.078**	**0.058**	**0.152**	**0.120**	**0.309**	**0.418**
Phosphate, Ortho (mg/L)	**0.039**	**0.039**	–	**0.154**	**0.015**	**0.018**	**0.017**	**0.016** J	**0.044**
Phosphorus, Total (mg/L)	**0.087**	**0.208**	–	**0.217**	**0.092**	**0.295**	**0.072**	**0.362**	**0.102**
Total Nitrogen (mg/L)	**0.72**	**0.72**	–	**0.57**	**0.41**	**0.98**	**0.46**	**0.75**	**0.54**
Metals									
Cadmium (ug/L)	0.100 U	**0.162** J	**0.126** J	**0.194** J	**0.185** J	**0.298** J	0.100 U	**0.241** J	**0.135** J
Cadmium, Dissolved (ug/L)	0.045 U	0.045 U	**0.060** J	**0.091** J	**0.062** J	**0.133** J	0.045 U	**0.081** J	**0.085** J
Copper (ug/L)	**8.62**	**13.3**	**6.50**	**7.55**	**14.1**	**14.9**	**8.74**	**23.9**	**9.82**
Copper, Dissolved (ug/L)	**3.84**	**3.29**	**1.45**	**1.73**	**2.26**	**6.43**	**2.46**	**4.88**	**3.96**
Lead (ug/L)	**1.63**	**4.76**	**2.16**	**2.50**	**5.79**	**3.99**	**2.56**	**7.86**	**2.91**
Lead, Dissolved (ug/L)	**0.170**	**0.149**	**0.102**	**0.090** J	**0.131**	**0.319**	**0.131**	**0.447**	**0.111**
Mercury (ug/L)	0.0080 U	0.0080 U	0.0080 U	0.0016 U	0.0080 U	**0.0031** J	0.0080 U	0.0080 U	0.0080 U
Mercury, Dissolved (ug/L)	0.0111 U	0.0111 U	0.0111 U	0.0022 U	0.0111 U	0.0022 U	0.0111 U	0.0111 U	0.0111 U
Zinc (ug/L)	**47.3**	**93.3**	**56.1**	**60.3**	**110**	**120**	**52.5**	**133**	**64.1**
Zinc, Dissolved (ug/L)	**26.2**	**26.0**	**25.1**	**23.9**	**23.2**	**57.4**	**18.1**	**29.6**	**28.6**
Insecticides									
Bifenthrin (ug/L)	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
LPAHs									
2-Methylnaphthalene (ug/L)	0.009 U	**0.027**	**0.010**	0.010 U	**0.011**	0.009 U	0.010 U	0.009 U	0.010 U
Acenaphthene (ug/L)	0.010 U	0.010 U	0.010 U	0.010 U	**0.012**	0.009 U	0.010 U	0.009 U	0.010 U
Acenaphthylene (ug/L)	**0.010**	0.009 U	0.009 U	0.009 U	0.009 U	0.009 U	0.009 U	0.009 U	0.009 U
Anthracene (ug/L)	0.005 U	0.005 U	0.005 U	0.005 U	**0.006** J	**0.008** J	0.005 U	**0.006** J	0.005 U
Fluorene (ug/L)	0.009 U	**0.025**	**0.013**	0.010 U	0.009 U	0.009 U	0.010 U	0.009 U	0.010 U
Naphthalene (ug/L)	0.016 U	0.091 UJ	**0.023** J	**0.024** J	**0.021** J	0.041 UJ	0.016 U	0.015 U	0.016 U
Phenanthrene (ug/L)	**0.025**	**0.075**	**0.037**	**0.026**	**0.051**	**0.037**	**0.023**	**0.030**	**0.028**
Total LPAHs	**0.055**	**0.158**	**0.085**	**0.0670**	**0.099**	**0.079**	**0.048**	**0.057**	**0.053**
HPAHs									
Benzo(a)anthracene (ug/L)	0.006 U	0.006 U	0.006 U	0.006 U	**0.011**	0.006 U	0.006 U	**0.009** J	0.006 U
Benzo(a)pyrene (ug/L)	**0.007** J	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	**0.008** J	**0.014**	0.003 U
Benzo(b,k)fluoranthene (ug/L)	0.011 U	0.037 UJ	**0.021** J	0.011 U	**0.048**	**0.032**	**0.017** J	**0.041**	0.011 U
Benzo(g,h,i)perylene (ug/L)	**0.007** J	**0.019**	**0.010**	**0.010**	**0.020**	**0.016**	**0.011**	**0.021** J	**0.012**
Chrysene (ug/L)	0.008 U	0.024 UJ	**0.010**	0.008 U	**0.026**	**0.016**	0.008 U	**0.020**	0.008 U
Dibenz(a,h)anthracene (ug/L)	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U
Fluoranthene (ug/L)	**0.014**	**0.052**	**0.030**	**0.023**	**0.056**	**0.038**	**0.021**	**0.040**	**0.022**
Indeno(1,2,3-c,d)pyrene (ug/L)	0.005 U	0.010 UJ	0.005 U	0.005 U	**0.011**	**0.011**	**0.007** J	**0.012**	0.005 U
Pyrene (ug/L)	**0.022**	0.066 UJ	**0.039**	**0.031**	**0.075**	**0.050**	**0.028**	**0.059**	**0.024**
Retene (ug/L)	**0.009** J	**0.017**	**0.010**	**0.007** J	**0.015**	**0.017**	**0.007** J	**0.012**	**0.013**
Total HPAHs	**0.068**	**0.147**	**0.120**	**0.084**	**0.252**	**0.171**	**0.102**	**0.219**	**0.078**
TOTAL PAHs	**0.123**	**0.305**	**0.205**	**0.151**	**0.351**	**0.250**	**0.150**	**0.276**	**0.131**
Phthalates									
Bis(2-ethylhexyl) phthalate (ug/L)	**1.00**	**1.32**	**0.966** J	**0.840** J	**1.69**	2.01 UJ	**1.02**	**1.45**	**0.873** J
Butyl benzyl phthalate (ug/L)	0.406 U	0.411 U	0.407 U	0.407 U	0.397 U	0.401 U	0.412 U	0.399 U	0.418 U
Diethyl phthalate (ug/L)	0.315 U	0.319 U	0.315 U	0.316 U	0.307 U	**0.342** J	0.319 U	0.309 U	0.324 U
Dimethyl phthalate (ug/L)	0.342 U	0.347 U	0.342 U	0.343 U	0.334 U	0.338 U	0.347 U	0.336 U	0.352 U
Di-n-butyl phthalate (ug/L)	**1.32**	**1.19**	**1.84**	**1.17**	**1.59**	**2.36**	**1.29**	**1.39**	**0.385** J
Di-n-octyl phthalate (ug/L)	0.363 U	0.367 U	0.363 U	0.364 U	0.354 U	0.358 U	0.368 U	0.356 U	0.373 U
Total Phthalates	**2.32**	**2.51**	**2.81**	**2.01**	**3.28**	**2.70**	**2.31**	**2.84**	**1.26**
Herbicides									
Dichlobenil (ug/L)	**0.014** J	**0.013** J	0.008 U	0.008 U	**0.020** J	**0.018** J	**0.020** J	**0.012** J	**0.015** J

Bold – The analyte was present in the sample.
U – The analyte was not detected at or above the reported value.
UJ – The analyte was not detected at or above the reported estimated value.
J – The analyte was positively identified. The associated value is an estimate.
R – The value is considered unusable.
E - Exceeds value.

Insufficient Volume
Laboratory Issue

Table D-6.2
Stormwater Analytical Data for Outfall 245 WY2023 - Grab Samples

	10/21/2022		11/3/2022			
TPH						
NWTPH-Diesel (mg/L)	0.10	U	0.09	U		
NWTPH-Heavy Oil (mg/L)	0.20	U	0.19	U		
Bacteria						
Coliform, Fecal (CFU/100mL)	**70000**		**90**			
E. Coli (CFU/100mL)	**17000**		**90**			
Enterococci (CFU/100mL)	**61500**		**1200**			

Bold – The analyte was present in the sample.
U – The analyte was not detected at or above the reported value.
UJ – The analyte was not detected at or above the reported estimated value.
J – The analyte was positively identified. The associated value is an estimate.
R – The value is considered unusable.
E - Exceeds value.

Table D-7.1
StormwaterAnalytical Data for Outfall 254 WY2023 - Composite Samples

	Sample 1 10/31/2022	
Conventionals		
Anionic Surfactants - MBAS (ug/L)	–	
BOD (mg/L)	–	
Chloride (mg/L)	–	
Conductivity (uS/cm)	**8900**	
Hardness (mg CaCO3/L)	**923**	
pH (pH Units)	**7.2**	
Total Suspended Solids (mg/L)	**52.4**	
Turbidity (NTU)	-	
Nutrients		
Nitrate+Nitrite as N (mg/L)	**0.167**	
Phosphate, Ortho (mg/L)	**0.036**	
Phosphorus, Total (mg/L)	**0.416**	
Total Nitrogen (mg/L)	**0.78**	
Metals		
Cadmium (ug/L)	**0.124**	**J**
Cadmium, Dissolved (ug/L)	**0.057**	**J**
Copper (ug/L)	**27.0**	
Copper, Dissolved (ug/L)	**4.12**	
Lead (ug/L)	**7.31**	
Lead, Dissolved (ug/L)	**0.140**	
Mercury (ug/L)	0.0080	U
Mercury, Dissolved (ug/L)	0.0111	U
Zinc (ug/L)	**63.6**	
Zinc, Dissolved (ug/L)	**26.2**	
Insecticides		
Bifenthrin (ug/L)	0.010	U
LPAHs		
2-Methylnaphthalene (ug/L)	**0.017**	
Acenaphthene (ug/L)	**0.012**	
Acenaphthylene (ug/L)	**0.017**	
Anthracene (ug/L)	0.005	U
Fluorene (ug/L)	0.009	U
Naphthalene (ug/L)	**0.022**	**J**
Phenanthrene (ug/L)	**0.038**	
Total LPAHs	**0.096**	
HPAHs		
Benzo(a)anthracene (ug/L)	**0.012**	
Benzo(a)pyrene (ug/L)	**0.016**	
Benzo(b,k)fluoranthene (ug/L)	**0.043**	
Benzo(g,h,i)perylene (ug/L)	**0.015**	
Chrysene (ug/L)	**0.016**	
Dibenz(a,h)anthracene (ug/L)	0.006	U
Fluoranthene (ug/L)	**0.036**	
Indeno(1,2,3-c,d)pyrene (ug/L)	**0.015**	
Pyrene (ug/L)	**0.045**	
Retene (ug/L)	0.005	U
Total HPAHs	**0.201**	
Total PAHs	**0.297**	
Phthalates		
Bis(2-ethylhexyl) phthalate (ug/L)	**1.09**	
Butyl benzyl phthalate (ug/L)	0.403	U
Diethyl phthalate (ug/L)	**0.382**	**J**
Dimethyl phthalate (ug/L)	0.339	U
Di-n-butyl phthalate (ug/L)	**0.579**	**J**
Di-n-octyl phthalate (ug/L)	0.360	U
Total Phthalates	**2.05**	
Herbicides		
Dichlobenil (ug/L)	**0.015**	**J**

U – The analyte was not detected at or above the reported value.
UJ – The analyte was not detected at or above the reported estimated value.
J – The analyte was positively identified. The associated value is an estimate.
R – The value is considered unusable.

Insufficient Volume
Laboratory Issue

Table D-7.2
Stormwater and Baseflow Analytical Data for Outfall 254 WY2023 - Grab Samples

	10/21/2022		11/3/2022			
TPH						
NWTPH-Diesel (mg/L)	0.10	U	0.09	U		
NWTPH-Heavy Oil (mg/L)	**3.5**		**0.84**			
Bacteria						
Coliform, Fecal (CFU/100mL)	**800000**		**Unusable**	**R**		
E. Coli (CFU/100mL)	**280000**		**24000**	**J**		
Enterococci (CFU/100mL)	**820000**		**70000**			

Bold – The analyte was present in the sample.
U – The analyte was not detected at or above the reported value.
UJ – The analyte was not detected at or above the reported estimated value.
J – The analyte was positively identified. The associated value is an estimate.
R – The value is considered unusable.
E - Exceeds value.

Table D-8
Sediment Trap Analytical Data WY2023

Outfall	OF230				OF235	OF237A				OF237B	OF243	OF245		OF248
ID#	FD16	FD18	FD3-C[6]	FD3-New	FD6	FD10-C	FD13-B New	FD2	FD2-A	FD1	FD23	FD21	MH-390	FD22
	2308045-03	2308045-04	2308045-16	2308045-01	2308045-05	2308045-10	2308045-08	2308045-06	2308045-07	2308045-10	2309030-01	2308045-12	2309030-02	2308045-15
Date Collected	8/22/2023	8/22/2023	8/23/2023	8/22/2023	8/23/2023	8/23/2023	8/22/2023	8/24/2023	8/24/2023	8/24/2023	9/12/2023	8/24/2023	9/12/2023	8/24/2023
Conventionals														
Particle/Grain Size, Clay (%)	--	--	--	--	**5.3**	--	--	**3.5**	**5.1**	**19.6**	--	**17.9**	**5.4**	--
Particle/Grain Size, Sand (%)	--	--	--	--	**69.1**	--	--	**73.2**	**73.9**	**56.8**	--	**43.6**	**76.4**	--
Particle/Grain Size, Silt (%)	--	--	--	--	**25.6**	--	--	**23.4**	**21.0**	**23.6**	--	**38.5**	**17.8**	--
Total Organic Carbon (mg/Kg)	**195000**	**209000**	**216000**	**6700**	**99300**	**178000**	**133000**	**119000**	**149000**	**53500**	--	**78700**	**57900**	**196000**
Total Solids (%)	**25.5**	**22.9**	**28.7**	**55.2**	**57.0**	**30.3**	**27.2**	**54.0**	**40.7**	**54.5**	**22.3**	**49.8**	**63.4**	**21.5**
Total Volatile Solids (%)	--	--	--	**6.6**	**13.1**	--	--	**18.7**	--	**15.2**	**25.8**	--	**7.2**	--
Nutrients														
Phosphorus, Total (mg/Kg)	--	--	--	--	**738**	--	--	**739**	--	**662**	--	--	**739**	--
Metals														
Cadmium (mg/Kg dry)	--	--	--	**0.534**	**0.0184** U	--	--	**0.434**	--	**0.292**	--	--	**0.552**	--
Copper (mg/Kg dry)	--	--	--	**78.9**	**199**	--	--	**100.0**	--	**50.4**	--	--	**113**	--
Lead (mg/Kg dry)	--	--	--	**28.2**	**280**	--	--	**74.5**	--	**38.8**	--	**44.3**	**40.0**	**182**
Mercury (mg/Kg dry)	--	--	**0.355**	**0.112**	**0.0830**	--	--	**0.0776**	--	**0.0500**	--	--	**0.0683**	--
Zinc (mg/Kg dry)	--	--	--	**219**	**740**	--	--	**540**	--	**280**	--	**799**	**356**	**1770**
LPAHs														
2-Methylnaphthalene (ug/Kg)	--	**380**	**385**	**60**	**75**	--	**34**	**81**	**2000**	**22**	**114**	--	**30**	--
Acenaphthene (ug/Kg)	--	**133**	**457**	**22**	67 U	--	**91**	67 U	**86**	**18**	**30**	--	13 U	--
Acenaphthylene (ug/Kg)	--	**404**	**569**	**15**	32 U	--	**48**	32 U	**41** J	**9** J	**63**	--	**19**	--
Anthracene (ug/Kg)	--	**591**	**949**	**71**	**61**	--	**765**	**242**	**96**	**60**	**178**	--	**21**	--
Fluorene (ug/Kg)	--	**450**	**803**	27 U	**45** J	--	**198**	**93**	**104**	**24**	**61**	--	**16**	--
Naphthalene (ug/Kg)	--	**1110** J	**1080** J	68 UJ	**125** J	--	**91** J	**99** J	**4430** J	**50** J	**217** J	--	**67** J	--
Phenanthrene (ug/Kg)	--	**3260**	**7820**	**355**	**447**	--	**4460**	**1500**	**958**	**394**	**593**	--	**125**	--
Total LPAHs		**5948**	**11678**	**511**	**728**		**5653**	**1984**	**5715**	**555**	**1142**		**255**	
HPAHs														
Benzo(a)anthracene (ug/Kg)	--	**1150**	**4140**	**530**	**228**	--	**4220**	**1460**	**494**	**301**	**397**	--	**81**	--
Benzo(a)pyrene (ug/Kg)	--	**1360**	**4380**	**511**	**246**	--	**4430**	**1640**	**563**	**379**	**429**	--	**108**	--
Benzo(b,j,k)fluoranthenes (ug/Kg)	--	**3060**	**10900**	**885**	**574**	--	**11700**	**4090**	**1390**	**848**	**1100**	--	**212**	--
Benzo(g,h,i)perylene (ug/Kg)	--	**622**	**1290**	**309**	**200**	--	**1850**	**669** J	**256**	**192**	**402**	--	**187** J	--
Chrysene (ug/Kg)	--	**1720**	**5400**	**548**	**378**	--	**6360**	**2010**	**819**	**440**	**813**	--	**119**	--
Dibenz(a,h)anthracene (ug/Kg)	--	**138**	**422**	**72**	66 U	--	**643**	**196** J	66 U	66 U	**75** J	--	66 U	--
Fluoranthene (ug/Kg)	--	**3840**	**13200**	**771**	**731**	--	**11600**	**3560**	**1610**	**795**	**1210**	--	**225**	--
Indeno(1,2,3-c,d)pyrene (ug/Kg)	--	73 U	**1820**	**204**	**153**	--	**2800**	**898** J	**267**	**226**	**317**	--	**96**	--
Pyrene (ug/Kg)	--	**3770**	**10600**	**665**	**791**	--	**9040**	**3010**	**1440**	**960**	**1720**	--	**334**	--
Retene (ug/Kg)	--	**535**	**278**	**218**	**196**	--	**158**	**458**	**225**	**45**	**240**	--	**39** J	--
Total HPAHs		**15697**	**52152**	**4495**	**3334**		**52643**	**17533**	**6872**	**4174**	**6463**		**1395**	
Total PAHs		**21645**	**63830**	**5006**	**4062**		**58296**	**19517**	**12587**	**4729**	**7605**		**1650**	
Phthalates														
bis(2-Ethylhexyl)phthalate (ug/Kg)	--	--	--	**32300**	**8290**	--	--	**8030** J	--	**3350**	**8490**	--	**1950**	**8770**
Butyl benzyl phthalate (ug/Kg)	--	--	--	**83**	68 U	--	--	**1200**	--	**139**	**504**	--	**7150**	**1050**
Diethylphthalate (ug/Kg)	--	--	--	35 U	35 U	--	--	**39**	--	**39**	40 UJ	--	35 U	**66**
Dimethyl phthalate (ug/Kg)	--	--	--	6 U	**493**	--	--	**150**	--	**96**	**34**	--	**14** J	**45**
Di-n-butylphthalate (ug/Kg)	--	--	--	**53**	**353**	--	--	**1100**	--	**110**	**127**	--	**93**	**255**
Di-n-Octyl phthalate (ug/Kg)	--	--	--	14 U	70 U	--	--	140 U	--	14 U	71 U	--	70 U	71 U
Total Phthalates				**32436**	**9136**			**10519**		**3734**	**9155**		**9207**	**10186**
PCBs														
Aroclor-1016 (ug/Kg)	8.99 U	9 U	9.02 U	9.00 U	9.02 UJ	9.03 U	--	9.03 U	9.03 U	1.80 U	1.80 U	--	1.78 U	--
Aroclor-1221 (ug/Kg)	8.99 U	9 U	9.02 U	9.00 U	9.02 UJ	9.03 U	--	9.03 U	9.03 U	1.80 U	1.80 U	--	1.78 U	--
Aroclor-1232 (ug/Kg)	8.99 U	9 U	9.02 U	9.00 U	9.02 UJ	9.03 U	--	9.03 U	9.03 U	1.80 U	1.80 U	--	1.78 U	--
Aroclor-1242 (ug/Kg)	8.99 U	9 U	9.02 U	9.00 U	9.02 UJ	9.03 U	--	9.03 U	9.03 U	1.80 U	1.80 U	--	1.78 U	--
Aroclor-1248 (ug/Kg)	9.95 U	9.96 U	9.98 U	9.96 U	9.98 UJ	9.99 U	--	9.99 U	9.98 U	2.00 U	2.00 U	--	1.97 U	--
Aroclor-1254 (ug/Kg)	9.95 U	9.96 U	**485**	9.96 U	9.98 UJ	9.99 U	--	9.99 U	9.98 U	2.00 U	2.00 U	--	1.97 U	--
Aroclor-1260 (ug/Kg)	9.95 U	9.96 U	9.98 U	9.96 U	9.98 UJ	9.99 U	--	9.99 U	9.98 U	2.00 U	2.00 U	--	1.97 U	--
TOTAL PCBs			**485**											
TPH														
NWTPH-Diesel (mg/Kg)	--	--	--	20 U	20 UJ	--	--	20 U	--	20 U	20 U	--	20 U	--
NWTPH-Heavy Oil (mg/Kg)	--	--	--	**760**	**2200** J	--	--	**4100**	--	**1500**	**3300**	--	**2800**	--
Insecticides														
Bifenthrin (ug/Kg)	--	--	--	0.4 U	**6**	--	--	**15**	--	**7**	**13**	--	0.4 U	--
Herbicides														
Dichlobenil (ug/L)	--	--	--	**8**	**76**	--	--	**38**	--	**7**	**7**	--	**8**	--
Phenolics														
2-Methylphenol (ug/Kg dry)	--	--	--	38 UJ	**21** J	--	--	Unusable R	--	8 UJ	**11** J	--	8 UJ	--
4-Methylphenol (ug/Kg dry)	--	--	--	23 UJ	**248** J	--	--	**479** J	--	**36** J	**1430** J	--	5 UJ	--
Pentachlorophenol (ug/Kg dry)	--	--	--	11 UJ	11 UJ	--	--	**326** J	--	2 UJ	**193** J	--	2 UJ	--

Notes

1 - Total LPAHs is the sum of the concentration or non-detected calculated value of the following compounds: Naphthalene, acenaphthene, acenaphthylene, anthracene, fluorene, and phenanthrene.

2 - Total HPAHs is the sum of the concentration of non-detected calculated value of the following compounds: Fluoranthene, pyrene, benzo(a)anthracene, chrysene, benzo(b,k)fluoranthene, benzo(b,k)fluoranthene, benzo(a)pyrene, indeno(1,2,3-c,d)pyrene, dibenz(a,h)anthracene, benzo(g,h,i)perylene.

3 - Total PAHs is the sum of the LPAHs and HPAHs.

4 - Total value for PCBs is the sum of detected values only.

5 - Total phthalates is the sum of detected values only.

6 - The upline FD3A sediment trap was removed due to the construction of the new OF230A on 12/17/2021 and no sediment was analyzed for WY2022. FD3C was installed upstream and represents the previous FD3A drainage area.

7- Due to insufficient sample size the silt and clay percentage is reported as combined.

8 - PBDE's were not anlayzed for WY2023 due to laboratory issues.

Bold – The analyte was present in the sample.
U – The analyte was not detected at or above the reported value.
UJ – The analyte was not detected at or above the reported estimated value.
J – The analyte was positively identified. The associated value is an estimate.
NJ - There is evidence the analyte is present. The associated value is an estimate.
E - Estimated above the calibration curve.

APPENDIX E

TABLE E-1
SUMMARY STATISTICS FOR
BASEFLOW AT OUTFALL 237A
Water Years 2002-2011

	Minimum	Maximum	Arithmetic Mean	Median	# of Detects	Count	% Detects	10th Per	90th Per	Standard Deviation	Coefficient of Variation	Standard Error	95% UCL	95% LCL
Conventionals														
Hardness (mg/L as CaCO3)	85.4	126.0		102.0	39	39	100%							
pH (pH units)	6.8	7.8		7.40	39	39	100%							
TSS (mg/L)	0.26	16.30	3.33	2.20	34	39	87%	0.26	7.56	3.47	1.04	0.56	4.45	2.20
Metals in ug/L														
Lead	*0.23*	6.11	1.43	0.91	16	38	42%	0.34	3.10	1.35	0.94	0.22	1.88	0.99
Mercury	*0.025*	0.196	0.031	*0.025*	3	38	8%	0.025	0.025	0.028	0.911	0.005	0.041	0.022
Zinc	1.6	27.0	9.7	9.4	36	37	97%	5.26	14.06	4.58	0.47	0.75	11.24	8.19
Dissolved Lead	*0.08*	*4.50*	*0.96*	*0.68*	8	38	21%	0.13	1.90	0.92	0.95	0.15	1.27	0.66
Dissolved Mercury	*0.025*	0.135	0.029	*0.025*	2	37	5%	0.025	0.025	0.019	0.645	0.003	0.035	0.023
Dissolved Zinc	2.30	12.2	7.88	7.51	36	37	97%	4.30	11.60	2.84	0.36	0.47	8.82	6.93
PAH in ug/L														
LPAHs														
2-Methylnaphthalene	*0.002*	2.100	0.069	*0.005*	10	39	26%	0.002	0.021	0.338	4.872	0.054	0.179	-0.040
Acenaphthene	*0.002*	0.031	0.005	*0.005*	2	39	5%	0.002	0.005	0.005	0.938	0.001	0.007	0.003
Acenaphthylene	*0.002*	0.016	0.004	*0.005*	1	39	3%	0.002	0.005	0.002	0.544	0.000	0.005	0.004
Anthracene	*0.002*	*0.005*	*0.004*	*0.005*	0	39	0%	0.002	0.005	0.001	0.310	0.000	0.005	0.004
Fluorene	*0.002*	0.086	0.007	*0.005*	5	39	13%	0.002	0.005	0.013	1.912	0.002	0.011	0.003
Naphthalene	*0.002*	3.000	0.097	0.011	22	39	56%	0.005	0.038	0.479	4.946	0.077	0.252	-0.058
Phenanthrene	*0.002*	0.149	0.012	*0.005*	15	39	38%	0.004	0.016	0.024	1.992	0.004	0.020	0.004
*Total LPAHs[1]	*0.010*	3.276	0.130	0.035				0.015	0.078	0.520	4.007			
HPAHs														
Benzo(a)anthracene	*0.001*	0.022	0.006	*0.005*	10	39	26%	0.002	0.014	0.005	0.723	0.001	0.008	0.005
Benzo(a)pyrene	*0.001*	0.020	0.006	*0.005*	7	39	18%	0.002	0.011	0.004	0.753	0.001	0.007	0.004
Benzo(g,h,i)perylene	*0.002*	0.022	0.007	*0.005*	8	39	21%	0.004	0.014	0.005	0.706	0.001	0.008	0.005
Benzo(b,k)fluoranthene	*0.002*	0.047	0.011	*0.005*	17	39	44%	0.003	0.028	0.012	1.021	0.002	0.015	0.008
Chrysene	*0.002*	0.026	0.007	*0.005*	10	39	26%	0.002	0.016	0.006	0.918	0.001	0.009	0.005
Dibenz(a,h)anthracene	*0.003*	0.010	*0.005*	*0.005*	1	39	3%	0.004	0.005	0.001	0.229	0.000	0.005	0.004
Fluoranthene	*0.003*	0.046	0.011	0.005	16	39	41%	0.003	0.028	0.011	0.997	0.002	0.015	0.007
Indeno(1,2,3-c,d)pyrene	*0.003*	0.018	0.006	*0.005*	6	39	15%	0.004	0.011	0.004	0.616	0.001	0.007	0.005
Pyrene	*0.002*	0.056	0.014	0.006	23	39	59%	0.003	0.033	0.014	0.981	0.002	0.018	0.009
*Total HPAHs[2]	*0.012*	0.249	0.071	0.048				0.021	0.172	0.058	0.825			
*Total PAHs[3]	*0.023*	3.464	0.201	0.094				0.041	0.274	0.543	2.707			
Phenols in ug/L														
4-Methylphenol	*0.005*	0.163	0.022	0.010	5	16	31%	0.005	0.047	0.040	1.801	0.010	0.044	0.001
Phthalates in ug/L														
Bis(2-ethylhexyl) phthalate	*0.2*	1.6	0.6	*0.5*	12	38	32%	0.5	1.1	0.3	0.5	0.0	0.7	0.5
Butylbenzyl phthalate	0.05	*0.5*	*0.4*	*0.5*	3	39	8%	0.1	0.5	0.2	0.5	0.0	0.4	0.3
Diethyl phthalate	0.035	32.0	2.2	*0.5*	12	39	31%	0.1	1.3	6.3	2.9	1.0	4.2	0.1
Dimethyl phthalate	*0.016*	*0.5*	*0.4*	*0.5*	0	39	0%	0.0	0.5	0.2	0.6	0.0	0.4	0.3
Di-n-butyl phthalate	*0.05*	*0.5*	*0.4*	*0.5*	6	39	15%	0.2	0.5	0.1	0.3	0.0	0.5	0.4
Di-n-octyl phthalate	*0.042*	*0.5*	*0.4*	*0.5*	0	39	0%	0.0	0.5	0.2	0.5	0.0	0.4	0.3
*Total Phthalates[4]		32.0												

TABLE E-1 (Cont'd)
SUMMARY STATISTICS FOR
BASEFLOW AT OUTFALL 237ANew
Water Years 2006-2010

	Minimum	Maximum	Arithmetic Mean	Median	# of Detects	Count	% Detects	10th Per	90th Per	Standard Deviation	Coefficient of Variation	Standard Error	95% UCL	95% LCL
Conventionals														
Hardness (mg/L as CaCO3)	95.3	116.0		110.0	21	21	100%							
pH (pH units)	6.5	7.7		7.30	21	21	100%							
TSS (mg/L)	0.26	26.80	3.41	1.80	18	21	86%	0.26	5.41	5.78	1.69	1.26	6.04	0.78
Metals in ug/L														
Lead	0.14	4.60	1.46	1.30	7	18	39%	0.30	3.10	1.21	0.83	0.28	2.06	0.86
Mercury	0.025	0.025	0.025	0.025	0	21	0%	0.025	0.025	0.000	0.000	0.000	0.025	0.025
Zinc	3.24	26.60	10.24	9.70	19	19	100%	4.17	16.48	5.63	0.55	1.29	12.95	7.52
Dissolved Lead	0.01	3.20	0.98	0.75	5	18	28%	0.10	2.83	0.99	1.01	0.23	1.47	0.49
Dissolved Mercury	0.025	0.078	0.028	0.025	1	20	5%	0.025	0.025	0.012	0.429	0.003	0.033	0.022
Dissolved Zinc	3.14	31.20	8.87	7.60	19	19	100%	3.93	14.52	6.38	0.72	1.46	11.95	5.80
PAH in ug/L														
LPAHs														
2-Methylnaphthalene	0.002	0.022	0.005	0.005	5	21	24%	0.002	0.005	0.004	0.869	0.001	0.007	0.003
Acenaphthene	0.002	0.005	0.004	0.005	1	21	5%	0.002	0.005	0.002	0.478	0.000	0.004	0.003
Acenaphthylene	0.002	0.005	0.003	0.004	0	21	0%	0.002	0.005	0.002	0.504	0.000	0.004	0.003
Anthracene	0.002	0.005	0.004	0.005	1	21	5%	0.002	0.005	0.001	0.401	0.000	0.004	0.003
Fluorene	0.002	0.005	0.004	0.005	2	21	10%	0.002	0.005	0.002	0.446	0.000	0.004	0.003
Naphthalene	0.002	0.017	0.007	0.005	9	21	43%	0.003	0.014	0.004	0.605	0.001	0.009	0.005
Phenanthrene	0.002	0.031	0.006	0.005	8	21	38%	0.002	0.011	0.006	0.980	0.001	0.009	0.004
*Total LPAHs[1]	0.010	0.065	0.028	0.030				0.011	0.042	0.013	0.479			
HPAHs														
Benzo(a)anthracene	0.001	0.019	0.005	0.005	2	21	10%	0.001	0.005	0.004	0.864	0.001	0.006	0.003
Benzo(a)pyrene	0.002	0.036	0.006	0.005	4	21	19%	0.002	0.009	0.008	1.277	0.002	0.010	0.003
Benzo(g,h,i)perylene	0.003	0.024	0.006	0.005	3	21	14%	0.004	0.008	0.005	0.776	0.001	0.008	0.004
Benzo(b,k)fluoranthene	0.002	0.058	0.009	0.005	7	21	33%	0.002	0.017	0.012	1.343	0.003	0.015	0.004
Chrysene	0.002	0.029	0.005	0.005	4	21	19%	0.002	0.009	0.006	1.124	0.001	0.008	0.003
Dibenz(a,h)anthracene	0.003	0.008	0.005	0.005	1	21	5%	0.004	0.005	0.001	0.243	0.000	0.005	0.004
Fluoranthene	0.002	0.043	0.008	0.005	6	21	29%	0.003	0.019	0.010	1.167	0.002	0.013	0.004
Indeno(1,2,3-c,d)pyrene	0.003	0.035	0.006	0.005	3	21	14%	0.003	0.010	0.007	1.150	0.002	0.010	0.003
Pyrene	0.002	0.163	0.014	0.005	9	21	43%	0.002	0.017	0.034	2.398	0.008	0.030	-0.001
*Total HPAHs[2]	0.022	0.383	0.065	0.045				0.022	0.089	0.079	1.217			
*Total PAHs[3]	0.032	0.448	0.093	0.075				0.033	0.121	0.090	0.966			
Phenols in ug/L														
4-Methylphenol														
Phthalates in ug/L														
Bis(2-ethylhexyl) phthalate	0.3	0.7	0.5	0.5	6	21	29%	0.4	0.5	0.1	0.2	0.0	0.5	0.4
Butylbenzyl phthalate	0.045	0.5	0.3	0.2	2	21	10%	0.1	0.5	0.2	0.7	0.0	0.4	0.2
Diethyl phthalate	0.04	1.9	0.4	0.5	4	21	19%	0.1	0.5	0.5	1.1	0.1	0.7	0.2
Dimethyl phthalate	0.016	0.5	0.3	0.1	0	21	0%	0.0	0.5	0.2	1.0	0.1	0.4	0.1
Di-n-butyl phthalate	0.05	0.5	0.3	0.5	5	21	24%	0.1	0.5	0.2	0.5	0.0	0.4	0.3
Di-n-octyl phthalate	0.042	1.0	0.3	0.3	0	21	0%	0.0	0.5	0.3	0.9	0.1	0.4	0.2
*Total Phthalates[4]		1.8												

TABLE E-2
SUMMARY STATISTICS FOR
BASEFLOW AT OUTFALL 237B
Water Years 2002-2011

	Minimum	Maximum	Arithmetic Mean	Median	# of Detects	Count	% Detects	10th Per	90th Per	Standard Deviation	Coefficient of Variation	Standard Error	95% UCL	95% LCL
Conventionals														
Hardness (mg/L as CaCO3)	61.0	129		113.0	39	39								
pH (pH units)	5.9	7.8		7.2	39	39								
TSS (mg/L)	0.26	16.90	2.52	1.28	36	39	92%	0.55	3.86	3.68	1.46	0.59	3.71	1.32
Metals in ug/L														
Lead	*0.07*	6.60	0.99	0.63	10	38	26%	0.15	1.65	1.23	1.24	0.20	1.40	0.59
Mercury	*0.025*	*0.025*	*0.025*	*0.025*	5	38	13%	0.025	0.025	0.000	0.000	0.000	0.025	0.025
Zinc	1.05	14.20	4.47	3.90	24	39	62%	2.07	6.96	2.47	0.55	0.40	5.27	3.67
Dissolved Lead	*0.02*	4.00	0.96	*0.65*	14	38	37%	0.12	1.93	0.95	0.99	0.15	1.28	0.65
Dissolved Mercury	*0.025*	*0.025*	*0.025*	*0.025*	0	38	0%	0.025	0.025	0.000	0.000	0.000	0.025	0.025
Dissolved Zinc	*0.60*	14.30	4.71	3.79	26	39	67%	1.89	8.59	3.07	0.65	0.49	5.71	3.71
PAH in ug/L														
LPAHs														
2-Methylnaphthalene	*0.002*	0.019	0.005	*0.005*	4	39	10%	0.002	0.005	0.003	0.639	0.001	0.006	0.004
Acenaphthene	*0.002*	*0.005*	*0.004*	*0.005*	2	39	5%	0.002	0.005	0.001	0.324	0.000	0.005	0.004
Acenaphthylene	*0.002*	*0.005*	*0.004*	*0.005*	0	39	0%	0.002	0.005	0.001	0.358	0.000	0.005	0.004
Anthracene	*0.002*	*0.005*	*0.004*	*0.005*	0	39	0%	0.002	0.005	0.001	0.310	0.000	0.005	0.004
Fluorene	*0.002*	*0.005*	*0.004*	*0.005*	0	39	0%	0.002	0.005	0.001	0.356	0.000	0.005	0.004
Naphthalene	*0.002*	0.025	0.008	*0.005*	13	39	33%	0.004	0.013	0.005	0.611	0.001	0.009	0.006
Phenanthrene	*0.002*	*0.005*	*0.004*	*0.005*	3	39	8%	0.002	0.005	0.001	0.291	0.000	0.005	0.004
*Total LPAHs[1]	*0.008*	0.050	0.028	*0.030*				0.013	0.037	0.010	0.342			
HPAHs														
Benzo(a)anthracene	*0.001*	0.045	0.005	*0.005*	4	39	10%	0.001	0.005	0.007	1.229	0.001	0.008	0.003
Benzo(a)pyrene	*0.002*	0.041	0.005	*0.005*	2	39	5%	0.002	0.005	0.006	1.154	0.001	0.007	0.003
Benzo(g,h,i)perylene	*0.003*	0.044	0.006	*0.005*	2	39	5%	0.004	0.005	0.006	1.095	0.001	0.008	0.004
Benzo(b,k)fluoranthene	*0.002*	0.107	0.008	*0.005*	7	39	18%	0.002	0.011	0.017	2.068	0.003	0.013	0.003
Chrysene	*0.002*	0.060	0.006	*0.005*	2	39	5%	0.002	0.005	0.009	1.628	0.001	0.009	0.003
Dibenz(a,h)anthracene	*0.003*	0.011	*0.005*	*0.005*	1	39	3%	0.004	0.005	0.001	0.255	0.000	0.005	0.004
Fluoranthene	*0.003*	0.088	0.007	*0.005*	4	39	10%	0.003	0.005	0.014	1.943	0.002	0.011	0.003
Indeno(1,2,3-c,d)pyrene	*0.003*	0.039	0.005	*0.005*	1	39	3%	0.004	0.005	0.006	1.041	0.001	0.007	0.004
Pyrene	*0.002*	0.078	0.008	*0.005*	11	39	28%	0.003	0.011	0.012	1.577	0.002	0.011	0.004
*Total HPAHs[2]	*0.011*	0.513	0.054	*0.045*				0.024	0.056	0.076	1.421			
*Total PAHs[3]	*0.020*	0.543	0.082	0.075				0.035	0.093	0.079	0.956			
Phenols in ug/L														
4-Methylphenol	*0.005*	0.104	0.012	*0.005*	2	16	13%	0.005	0.008	0.025	2.148	0.006	0.025	-0.002
Phthalates in ug/L														
Bis(2-ethylhexyl) phthalate	*0.3*	*0.8*	*0.5*	*0.5*	6	38	16%	0.4	0.5	0.1	0.2	0.0	0.5	0.5
Butylbenzyl phthalate	*0.05*	*0.5*	*0.4*	*0.5*	1	39	3%	0.1	0.5	0.2	0.5	0.0	0.4	0.3
Diethyl phthalate	*0.04*	17.0	1.1	*0.5*	9	39	23%	0.1	1.3	2.8	2.6	0.4	2.0	0.2
Dimethyl phthalate	*0.016*	*0.5*	*0.4*	*0.5*	0	39	0%	0.0	0.5	0.2	0.6	0.0	0.4	0.3
Di-n-butyl phthalate	*0.05*	*0.5*	*0.4*	*0.5*	6	39	15%	0.1	0.5	0.2	0.4	0.0	0.5	0.4
Di-n-octyl phthalate	*0.042*	*0.5*	*0.4*	*0.5*	0	39	0%	0.0	0.5	0.2	0.5	0.0	0.4	0.3
*Total Phthalates[4]		17.0												

TABLE E-3
SUMMARY STATISTICS FOR
BASEFLOW AT OUTFALL 230
Water Years 2002-2011

	Minimum	Maximum	Arithmetic Mean	Median	# of Detects	Count	% Detects	10th Per	90th Per	Standard Deviation	Coefficient of Variation	Standard Error	95% UCL	95% LCL
Conventionals														
Hardness (mg/L as CaCO3)	27.9	249		142.0	38	38	100%							
pH (pH units)	7.1	9.0		7.7	38	38	100%							
TSS (mg/L)	0.90	319.00	16.44	5.95	38	38	100%	1.52	20.21	51.07	3.11	8.28	33.23	-0.34
Metals in ug/L														
Lead	0.99	29.80	5.81	4.36	28	38	74%	1.61	10.31	5.85	1.01	0.95	7.73	3.89
Mercury	0.025	0.083	0.031	0.025	6	38	16%	0.025	0.056	0.015	0.477	0.002	0.036	0.026
Zinc	19.3	101.0	46.0	34.0	37	37	100%	22.70	82.20	24.16	0.52	3.97	54.08	37.97
Dissolved Lead	0.14	5.50	1.72	1.40	16	38	42%	0.46	3.20	1.27	0.74	0.21	2.14	1.30
Dissolved Mercury	0.025	0.059	0.026	0.025	1	38	3%	0.025	0.025	0.006	0.213	0.001	0.028	0.024
Dissolved Zinc	6.4	95.0	28.8	23.7	37	37	100%	10.70	46.52	19.33	0.67	3.18	35.27	22.38
PAH in ug/L														
LPAHs														
2-Methylnaphthalene	0.002	0.122	0.015	0.005	19	38	50%	0.003	0.032	0.023	1.534	0.004	0.022	0.007
Acenaphthene	0.002	0.013	0.005	0.005	5	38	13%	0.002	0.006	0.003	0.506	0.000	0.006	0.004
Acenaphthylene	0.002	0.005	0.004	0.005	0	38	0%	0.002	0.005	0.001	0.341	0.000	0.005	0.004
Anthracene	0.002	0.012	0.004	0.005	1	38	3%	0.002	0.005	0.002	0.400	0.000	0.005	0.004
Fluorene	0.002	0.012	0.005	0.005	5	38	13%	0.003	0.005	0.002	0.358	0.000	0.005	0.004
Naphthalene	0.005	0.228	0.027	0.013	27	38	71%	0.005	0.073	0.042	1.555	0.007	0.040	0.013
Phenanthrene	0.002	0.084	0.014	0.011	25	38	66%	0.005	0.022	0.015	1.118	0.003	0.019	0.009
*Total LPAHs[1]	0.016	0.270	0.059	0.045				0.025	0.111	0.052	0.869			
HPAHs														
Benzo(a)anthracene	0.001	0.066	0.008	0.005	8	38	21%	0.001	0.013	0.011	1.407	0.002	0.011	0.004
Benzo(a)pyrene	0.002	0.057	0.007	0.005	6	38	16%	0.002	0.012	0.009	1.340	0.001	0.010	0.004
Benzo(g,h,i)perylene	0.004	0.036	0.008	0.005	12	38	32%	0.004	0.015	0.007	0.828	0.001	0.010	0.006
Benzo(b,k)fluoranthene	0.002	0.113	0.014	0.008	19	38	50%	0.002	0.025	0.019	1.365	0.003	0.020	0.008
Chrysene	0.002	0.087	0.010	0.005	17	38	45%	0.002	0.018	0.014	1.374	0.002	0.015	0.006
Dibenz(a,h)anthracene	0.003	0.014	0.005	0.005	5	38	13%	0.004	0.007	0.002	0.419	0.000	0.006	0.005
Fluoranthene	0.003	0.133	0.017	0.012	26	38	68%	0.005	0.028	0.022	1.295	0.004	0.025	0.010
Indeno(1,2,3-c,d)pyrene	0.003	0.033	0.006	0.005	4	38	11%	0.004	0.007	0.006	0.908	0.001	0.008	0.004
Pyrene	0.004	0.173	0.022	0.015	35	38	92%	0.005	0.032	0.027	1.266	0.004	0.031	0.013
*Total HPAHs[2]	0.025	0.712	0.097	0.061				0.034	0.146	0.113	1.170			
*Total PAHs[3]	0.041	0.923	0.157	0.135				0.062	0.232	0.144	0.920			
Phenols in ug/L														
4-Methylphenol	0.005	0.115	0.024	0.008	1	16	6%	0.005	0.058	0.031	1.276	0.008	0.040	0.008
Phthalates in ug/L														
Bis(2-ethylhexyl) phthalate	0.3	33.0	1.6	0.5	14	37	38%	0.4	1.7	5.3	3.3	0.9	3.4	-0.2
Butylbenzyl phthalate	0.09	0.7	0.4	0.5	3	38	8%	0.1	0.5	0.2	0.4	0.0	0.5	0.4
Diethyl phthalate	0.070	8.4	0.7	0.5	8	38	21%	0.2	0.5	1.4	1.9	0.2	1.2	0.3
Dimethyl phthalate	0.016	0.5	0.4	0.5	0	38	0%	0.0	0.5	0.2	0.6	0.0	0.4	0.3
Di-n-butyl phthalate	0.1	0.5	0.4	0.5	6	38	16%	0.1	0.5	0.1	0.3	0.0	0.5	0.4
Di-n-octyl phthalate	0.042	2.0	0.4	0.5	2	38	5%	0.0	0.5	0.3	0.7	0.1	0.5	0.3
*Total Phthalates[4]		33.0												

TABLE E-4
SUMMARY STATISTICS FOR
BASEFLOW AT OUTFALL 235
Water Years 2002-2011

	Minimum	Maximum	Arithmetic Mean	Median	# of Detects	Count	% Detects	10th Per	90th Per	Standard Deviation	Coefficient of Variation	Standard Error	95% UCL	95% LCL
Conventionals														
Hardness (mg/L as CaCO3)	123.0	199.0		148.0	38	38	100%							
pH (pH units)	7.1	8.0		7.7	38	38	100%							
TSS (mg/L)	1.00	258	27.81	7.37	38	38	100%	1.49	79.03	58.43	2.10	9.48	47.01	8.60
Metals in ug/L														
Lead	1.64	112	15.04	6.85	32	38	84%	3.15	30.38	24.37	1.62	3.95	23.05	7.03
Mercury	*0.025*	0.380	0.043	*0.025*	4	37	11%	0.025	0.080	0.062	1.454	0.010	0.064	0.022
Zinc	7.40	355.0	44.67	17.20	35	35	100%	10.48	73.60	80.96	1.81	13.69	72.48	16.85
Dissolved Lead	*0.24*	6.00	1.64	1.23	16	38	42%	0.54	3.53	1.37	0.83	0.22	2.09	1.19
Dissolved Mercury	*0.025*	*0.025*	*0.025*	*0.025*	3	36	8%	0.025	0.025	0.000	0.000	0.000	0.025	0.025
Dissolved Zinc	3.80	28.50	10.65	9.60	35	35	100%	6.35	15.60	5.15	0.48	0.87	12.42	8.88
PAH in ug/L														
LPAHs														
2-Methylnaphthalene	*0.002*	0.040	0.007	*0.005*	7	38	18%	0.002	0.011	0.007	1.083	0.001	0.009	0.004
Acenaphthene	*0.002*	0.032	0.011	0.012	28	38	74%	0.005	0.018	0.006	0.569	0.001	0.013	0.009
Acenaphthylene	*0.002*	*0.005*	*0.004*	*0.005*	0	38	0%	0.002	0.005	0.001	0.341	0.000	0.005	0.004
Anthracene	*0.002*	0.031	0.006	*0.005*	5	38	13%	0.002	0.009	0.005	0.872	0.001	0.008	0.004
Fluorene	*0.002*	0.043	0.008	*0.005*	14	38	37%	0.002	0.014	0.007	0.939	0.001	0.010	0.005
Naphthalene	*0.003*	0.056	0.013	0.011	23	38	61%	0.004	0.021	0.012	0.936	0.002	0.017	0.009
Phenanthrene	*0.002*	0.115	0.015	0.005	15	38	39%	0.002	0.031	0.025	1.608	0.004	0.024	0.007
*Total LPAHs[1]	*0.013*	0.240	0.058	0.0465				0.022	0.096	0.048	0.829			
HPAHs														
Benzo(a)anthracene	*0.001*	0.114	0.014	*0.005*	11	38	29%	0.001	0.022	0.024	1.766	0.004	0.022	0.006
Benzo(a)pyrene	*0.002*	0.142	0.014	*0.005*	8	38	21%	0.002	0.023	0.030	2.127	0.005	0.024	0.004
Benzo(g,h,i)perylene	*0.002*	0.166	0.013	*0.005*	11	38	29%	0.004	0.027	0.027	2.101	0.004	0.022	0.004
Benzo(b,k)fluoranthene	*0.002*	0.344	0.029	0.008	21	38	55%	0.004	0.055	0.070	2.402	0.011	0.052	0.006
Chrysene	*0.002*	0.199	0.020	*0.005*	11	38	29%	0.002	0.036	0.044	2.234	0.007	0.035	0.005
Dibenz(a,h)anthracene	*0.003*	0.028	0.006	*0.005*	4	38	11%	0.004	0.006	0.004	0.716	0.001	0.007	0.004
Fluoranthene	*0.003*	0.295	0.031	0.012	29	38	76%	0.005	0.054	0.060	1.926	0.010	0.051	0.011
Indeno(1,2,3-c,d)pyrene	*0.003*	0.115	0.009	*0.005*	8	38	21%	0.004	0.018	0.018	1.959	0.003	0.015	0.003
Pyrene	*0.004*	0.253	0.036	0.018	34	38	89%	0.005	0.067	0.057	1.575	0.009	0.055	0.017
*Total HPAHs[2]	*0.025*	1.639	0.173	0.0705				0.041	0.299	0.320	1.854			
*Total PAHs[3]	*0.038*	1.845	0.231	0.124				0.062	0.383	0.358	1.554			
Phenols in ug/L														
4-Methylphenol	*0.005*	0.055	0.016	*0.005*	4	16	25%	0.005	0.045	0.018	1.178	0.005	0.025	0.006
Phthalates in ug/L														
Bis(2-ethylhexyl) phthalate	*0.4*	21.3	2.1	1.2	22	37	59%	0.5	3.3	3.6	1.7	0.6	3.3	0.9
Butylbenzyl phthalate	0.09	1.6	*0.4*	*0.5*	5	38	13%	0.1	0.5	0.3	0.6	0.0	0.5	0.3
Diethyl phthalate	*0.04*	15.0	1.0	*0.5*	9	38	24%	0.1	1.7	2.4	2.4	0.4	1.8	0.2
Dimethyl phthalate	*0.016*	*0.5*	*0.4*	*0.5*	0	38	0%	0.0	0.5	0.2	0.6	0.0	0.4	0.3
Di-n-butyl phthalate	*0.05*	*0.5*	*0.4*	*0.5*	4	38	11%	0.2	0.5	0.1	0.3	0.0	0.5	0.4
Di-n-octyl phthalate	*0.042*	3.9	0.5	*0.5*	1	38	3%	0.0	0.5	0.6	1.2	0.1	0.7	0.3
*Total Phthalates[4]		22.9												

TABLE E-5
SUMMARY STATISTICS FOR
BASEFLOW AT OUTFALL 243
Water Years 2002-2011

	Minimum	Maximum	Arithmetic Mean	Median	# of Detects	Count	% Detects	10th Per	90th Per	Standard Deviation	Coefficient of Variation	Standard Error	95% UCL	95% LCL
Conventionals														
Hardness (mg/L as CaCO3)	463	2,310		1,325	38	38	100%							
pH (pH units)	6.6	7.8		7.0	37	37	100%							
TSS (mg/L)	1.5	42.7	14.2	10.8	37	37	100%	3.36	32.88	11.60	0.82	1.91	18.04	10.30
Metals in ug/L					15									
Lead	*0.39*	43.9	7.9	4.5	22	36	61%	1.90	24.00	9.61	1.22	1.60	11.16	4.65
Mercury	*0.025*	0.065	0.028	*0.025*	0	38	0%	0.025	0.025	0.010	0.352	0.002	0.031	0.025
Zinc	5.3	73.6	22.4	15.4	34	36	94%	8.84	37.55	16.24	0.73	2.71	27.85	16.86
Dissolved Lead	0.01	35.60	5.78	2.88	18	36	50%	0.10	15.25	8.06	1.40	1.34	8.51	3.05
Dissolved Mercury	*0.025*	0.193	0.030	*0.025*	0	38	0%	0.025	0.025	0.027	0.912	0.004	0.039	0.021
Dissolved Zinc	*0.13*	45.80	12.29	8.90	29	36	81%	4.10	23.55	9.34	0.76	1.56	15.45	9.13
PAH in ug/L														
LPAHs														
2-Methylnaphthalene	*0.002*	*0.006*	*0.004*	*0.005*	3	38	8%	0.002	0.005	0.001	0.291	0.000	0.005	0.004
Acenaphthene	*0.005*	0.069	0.031	0.031	37	38	97%	0.012	0.054	0.017	0.533	0.003	0.036	0.026
Acenaphthylene	*0.002*	*0.005*	*0.004*	*0.005*	4	38	11%	0.002	0.005	0.001	0.302	0.000	0.005	0.004
Anthracene	*0.002*	0.022	0.007	*0.005*	11	38	29%	0.003	0.013	0.005	0.697	0.001	0.008	0.005
Fluorene	*0.002*	0.013	0.005	*0.005*	11	38	29%	0.003	0.010	0.003	0.501	0.000	0.006	0.004
Naphthalene	*0.001*	0.017	0.008	*0.005*	17	38	45%	0.005	0.015	0.004	0.527	0.001	0.009	0.007
Phenanthrene	0.002	0.057	0.011	*0.005*	19	38	50%	0.004	0.023	0.013	1.197	0.002	0.015	0.007
*Total LPAHs[1]	*0.025*	0.151	0.066	0.061				0.038	0.103	0.028	0.426			
HPAHs														
Benzo(a)anthracene	*0.001*	0.055	0.009	*0.005*	12	38	32%	0.001	0.015	0.010	1.179	0.002	0.012	0.005
Benzo(a)pyrene	*0.002*	0.042	0.007	*0.005*	4	38	11%	0.002	0.010	0.008	1.204	0.001	0.009	0.004
Benzo(g,h,i)perylene	*0.004*	0.046	0.008	*0.005*	7	38	18%	0.004	0.013	0.009	1.108	0.001	0.011	0.005
Benzo(b,k)fluoranthene	0.002	0.105	0.014	*0.005*	16	38	42%	0.005	0.025	0.023	1.636	0.004	0.022	0.007
Chrysene	*0.002*	0.098	0.012	*0.005*	11	38	29%	0.003	0.028	0.021	1.728	0.003	0.019	0.005
Dibenz(a,h)anthracene	*0.003*	0.012	*0.005*	*0.005*	0	38	0%	0.004	0.005	0.001	0.281	0.000	0.005	0.004
Fluoranthene	*0.003*	0.133	0.023	0.016	32	38	84%	0.005	0.044	0.025	1.093	0.004	0.031	0.015
Indeno(1,2,3-c,d)pyrene	*0.003*	0.034	0.006	*0.005*	3	38	8%	0.004	0.005	0.006	1.022	0.001	0.008	0.004
Pyrene	*0.005*	0.116	0.032	0.022	37	38	97%	0.014	0.063	0.027	0.846	0.004	0.041	0.023
*Total HPAHs[2]	0.031	0.606	0.115	0.074				0.053	0.199	0.123	1.068			
*Total PAHs[3]	0.055	0.757	0.182	0.133				0.092	0.298	0.143	0.789			
Phenols in ug/L														
4-Methylphenol	*0.005*	0.099	0.014	*0.005*	6	16	38%	0.005	0.017	0.023	1.695	0.006	0.026	0.001
Phthalates in ug/L														
Bis(2-ethylhexyl) phthalate	*0.4*	16.0	1.1	*0.5*	9	37	24%	0.5	1.0	2.6	2.4	0.4	2.0	0.2
Butylbenzyl phthalate	*0.085*	*1.8*	*0.4*	*0.5*	3	38	8%	0.1	0.5	0.3	0.6	0.0	0.5	0.4
Diethyl phthalate	*0.05*	10.0	0.8	*0.5*	9	38	24%	0.1	1.1	1.6	2.1	0.3	1.3	0.2
Dimethyl phthalate	*0.016*	*0.5*	*0.4*	*0.5*	1	38	3%	0.0	0.5	0.2	0.5	0.0	0.5	0.3
Di-n-butyl phthalate	*0.05*	4.3	*0.6*	*0.5*	8	38	21%	0.3	0.5	0.6	1.1	0.1	0.8	0.4
Di-n-octyl phthalate	*0.042*	*0.5*	*0.4*	*0.5*	2	38	5%	0.0	0.5	0.2	0.5	0.0	0.5	0.3
*Total Phthalates[4]		22.9												

TABLE E-6
SUMMARY STATISTICS FOR
BASEFLOW AT OUTFALL 245
Water Years 2002-2011

	Minimum	Maximum	Arithmetic Mean	Median	# of Detects	Count	% Detects	10th Per	90th Per	Standard Deviation	Coefficient of Variation	Standard Error	95% UCL	95% LCL
Conventionals														
Hardness (mg/L as CaCO3)	136	2,880	909.23	891.00	39	39	100%	382.40	1468.00	524.51	0.58	83.99	1079.26	739.20
pH (pH units)	7.1	8.0		7.3	39	39	100%							
TSS (mg/L)	0.26	78.90	9.89	6.90	38	39	97%	2.16	19.60	13.16	1.33	2.11	14.16	5.63
Metals in ug/L														
Lead	*0.14*	18.20	4.08	2.58	18	37	49%	0.38	11.94	4.63	1.13	0.76	5.63	2.54
Mercury	*0.025*	*0.125*	*0.030*	*0.025*	5	38	13%	0.025	0.025	0.020	0.671	0.003	0.036	0.023
Zinc	11.8	1950	180	52	39	39	100%	16.80	235.40	386.46	2.15	61.88	305.28	54.73
Dissolved Lead	*0.02*	18.90	3.15	1.60	19	37	51%	0.05	6.99	3.97	1.26	0.65	4.47	1.82
Dissolved Mercury	*0.025*	*0.125*	*0.029*	*0.025*	3	37	8%	0.025	0.025	0.018	0.619	0.003	0.035	0.023
Dissolved Zinc	0.60	1220.00	94.43	24.10	37	39	95%	4.85	113.92	237.53	2.52	38.03	171.42	17.43
PAH in ug/L														
LPAHs														
2-Methylnaphthalene	*0.002*	0.018	0.006	*0.005*	9	39	23%	0.002	0.011	0.004	0.636	0.001	0.007	0.005
Acenaphthene	*0.002*	0.103	0.033	0.026	34	39	87%	0.005	0.068	0.023	0.698	0.004	0.040	0.025
Acenaphthylene	*0.002*	*0.008*	*0.004*	*0.005*	1	39	3%	0.002	0.005	0.002	0.358	0.000	0.005	0.004
Anthracene	*0.002*	0.014	0.006	*0.005*	9	39	23%	0.002	0.011	0.003	0.527	0.000	0.007	0.005
Fluorene	*0.002*	0.017	0.006	*0.005*	14	39	36%	0.003	0.012	0.004	0.613	0.001	0.008	0.005
Naphthalene	*0.004*	0.057	0.011	0.010	22	39	56%	0.005	0.019	0.010	0.842	0.002	0.014	0.008
Phenanthrene	*0.002*	0.027	0.011	0.008	23	39	59%	0.005	0.022	0.007	0.682	0.001	0.013	0.008
*Total LPAHs[1]	0.013	0.181	0.072	0.066				0.030	0.123	0.037	0.522			
HPAHs														
Benzo(a)anthracene	*0.001*	0.021	0.006	*0.005*	8	39	21%	0.001	0.012	0.004	0.658	0.001	0.008	0.005
Benzo(a)pyrene	*0.002*	0.048	0.006	*0.005*	4	39	10%	0.002	0.005	0.007	1.239	0.001	0.008	0.003
Benzo(g,h,i)perylene	*0.003*	0.033	0.006	*0.005*	3	39	8%	0.004	0.006	0.005	0.824	0.001	0.008	0.004
Benzo(b,k)fluoranthene	*0.002*	0.062	0.010	*0.005*	17	39	44%	0.005	0.015	0.010	1.061	0.002	0.013	0.006
Chrysene	*0.002*	0.063	0.008	*0.005*	12	39	31%	0.003	0.017	0.010	1.236	0.002	0.012	0.005
Dibenz(a,h)anthracene	*0.003*	0.013	*0.005*	*0.005*	1	39	3%	0.004	0.005	0.002	0.332	0.000	0.005	0.004
Fluoranthene	*0.003*	0.046	0.014	0.012	27	39	69%	0.005	0.033	0.011	0.775	0.002	0.018	0.011
Indeno(1,2,3-c,d)pyrene	*0.003*	0.018	0.005	*0.005*	3	39	8%	0.004	0.005	0.003	0.526	0.000	0.006	0.004
Pyrene	0.004	0.081	0.025	0.024	37	39	95%	0.010	0.041	0.015	0.594	0.002	0.030	0.020
*Total HPAHs[2]	0.029	0.368	0.086	0.074				0.045	0.126	0.056	0.654			
*Total PAHs[3]	0.042	0.436	0.157	0.144				0.082	0.237	0.074	0.468			
Phenols in ug/L														
4-Methylphenol	*0.005*	0.093	0.028	0.015	10	16	63%	0.005	0.062	0.028	0.972	0.007	0.043	0.014
Phthalates in ug/L														
Bis(2-ethylhexyl) phthalate	*0.4*	3.3	0.7	*0.5*	9	38	24%	0.5	1.2	0.6	0.8	0.1	0.9	0.5
Butylbenzyl phthalate	*0.09*	16.0	1.6	*0.5*	10	39	26%	0.1	3.3	3.4	2.1	0.5	2.7	0.5
Diethyl phthalate	0.04	4.4	0.7	*0.5*	11	39	28%	0.1	1.4	1.0	1.3	0.2	1.1	0.4
Dimethyl phthalate	*0.016*	*0.5*	*0.4*	*0.5*	0	39	0%	0.0	0.5	0.2	0.6	0.0	0.4	0.3
Di-n-butyl phthalate	0.16	*1.3*	*0.5*	*0.5*	10	39	26%	0.3	0.5	0.2	0.4	0.0	0.5	0.4
Di-n-octyl phthalate	*0.042*	*0.5*	*0.4*	*0.5*	0	39	0%	0.0	0.5	0.2	0.5	0.0	0.5	0.3
*Total Phthalates[4]	0.44	18.7												

TABLE E-7
SUMMARY STATISTICS FOR
BASEFLOW AT OUTFALL 254
Water Years 2002-2011

	Minimum	Maximum	Arithmetic Mean	Median	# of Detects	Count	% Detects	10th Per	90th Per	Standard Deviation	Coefficient of Variation	Standard Error	95% UCL	95% LCL
Conventionals														
Hardness (mg/L as CaCO3)	386	4,410		3,020	38	38	100%							
pH (pH units)	6.7	7.6		7.2	38	38	100%							
TSS (mg/L)	1.8	140.0	17.2	9.2	38	38	100%	3.16	30.80	23.41	1.36	3.80	24.89	9.50
Metals in ug/L														
Lead	*0.06*	39.00	6.48	3.10	18	37	49%	0.44	16.82	8.73	1.35	1.43	9.39	3.57
Mercury	*0.025*	*0.055*	*0.026*	*0.025*	0	38	0%	0.025	0.025	0.006	0.236	0.001	0.029	0.024
Zinc	7.24	95.20	28.78	23.90	36	36	100%	11.45	52.35	19.33	0.67	3.22	35.32	22.24
Dissolved Lead	*0.01*	47.20	8.07	2.65	20	37	54%	0.23	19.14	10.65	1.32	1.75	11.62	4.52
Dissolved Mercury	*0.025*	0.114	0.028	*0.025*	1	37	3%	0.025	0.025	0.015	0.537	0.002	0.033	0.023
Dissolved Zinc	*0.33*	54.70	22.08	19.45	30	36	83%	2.10	45.90	15.82	0.72	2.64	27.43	16.73
PAH in ug/L														
LPAHs														
2-Methylnaphthalene	0.002	0.034	0.006	*0.005*	8	38	21%	0.003	0.012	0.006	0.942	0.001	0.008	0.004
Acenaphthene	*0.002*	0.096	0.014	*0.005*	10	38	26%	0.002	0.039	0.020	1.477	0.003	0.020	0.007
Acenaphthylene	*0.002*	0.019	0.005	*0.005*	3	38	8%	0.002	0.005	0.003	0.646	0.001	0.006	0.004
Anthracene	*0.002*	0.077	0.008	*0.005*	7	38	18%	0.002	0.016	0.013	1.564	0.002	0.013	0.004
Fluorene	*0.002*	0.060	0.009	*0.005*	9	38	24%	0.002	0.025	0.012	1.323	0.002	0.013	0.005
Naphthalene	*0.002*	0.029	0.008	*0.005*	10	38	26%	0.004	0.020	0.007	0.856	0.001	0.011	0.006
Phenanthrene	*0.002*	0.684	0.030	0.007	20	38	53%	0.002	0.033	0.110	3.613	0.018	0.067	-0.006
*Total LPAHs[1]	0.010	0.898	0.075	0.033				0.014	0.143	0.148	1.965			
HPAHs														
Benzo(a)anthracene	*0.001*	1.110	0.047	0.005	16	38	42%	0.001	0.037	0.183	3.873	0.030	0.107	-0.013
Benzo(a)pyrene	*0.002*	0.131	0.011	*0.005*	10	38	26%	0.002	0.020	0.022	1.929	0.004	0.018	0.004
Benzo(g,h,i)perylene	*0.003*	0.055	0.008	*0.005*	10	38	26%	0.004	0.014	0.009	1.116	0.002	0.011	0.005
Benzo(b,k)fluoranthene	*0.002*	0.376	0.029	0.014	23	38	61%	0.002	0.043	0.063	2.169	0.010	0.050	0.008
Chrysene	*0.002*	0.362	0.023	0.005	16	38	42%	0.002	0.033	0.060	2.636	0.010	0.042	0.003
Dibenz(a,h)anthracene	*0.003*	0.017	0.005	*0.005*	3	38	8%	0.004	0.005	0.003	0.507	0.000	0.006	0.004
Fluoranthene	*0.003*	1.140	0.065	0.019	30	38	79%	0.003	0.093	0.188	2.875	0.030	0.127	0.004
Indeno(1,2,3-c,d)pyrene	*0.003*	0.053	0.008	*0.005*	8	38	21%	0.004	0.012	0.009	1.187	0.001	0.010	0.005
Pyrene	0.002	0.879	0.057	0.025	35	38	92%	0.006	0.066	0.144	2.519	0.023	0.104	0.010
*Total HPAHs[2]	0.024	3.287	0.254	0.093				0.029	0.422	0.559	2.204			
*Total PAHs[3]	0.034	4.185	0.329	0.131				0.043	0.547	0.697	2.118			
Phenols in ug/L														
4-Methylphenol	*0.005*	0.103	0.015	*0.005*	7	16	44%	0.005	0.017	0.024	1.582	0.006	0.028	0.002
Phthalates in ug/L														
Bis(2-ethylhexyl) phthalate	*0.1*	2.9	0.6	*0.5*	8	37	22%	0.5	0.8	0.5	0.8	0.1	0.8	0.5
Butylbenzyl phthalate	0.09	1.4	*0.4*	*0.5*	4	38	11%	0.1	0.5	0.2	0.5	0.0	0.5	0.4
Diethyl phthalate	0.04	3.8	0.5	*0.5*	9	38	24%	0.1	0.5	0.6	1.2	0.1	0.7	0.3
Dimethyl phthalate	*0.016*	*0.5*	*0.4*	*0.5*	2	38	5%	0.0	0.5	0.2	0.6	0.0	0.4	0.3
Di-n-butyl phthalate	0.05	*0.5*	*0.4*	*0.5*	9	38	24%	0.2	0.5	0.1	0.3	0.0	0.5	0.4
Di-n-octyl phthalate	*0.042*	*0.5*	*0.4*	*0.5*	0	38	0%	0.0	0.5	0.2	0.5	0.0	0.5	0.3
*Total Phthalates[4]		3.9												

Table E-8
Summary Statistics for Stormwater at OF230 Water Years 2002-2023

	Minimum	Maximum	Arithmetic Mean	Median	Detects	Count	Percent Detects	10th Per	90th Per	Standard Deviation	Coefficient of Variation	Standard Error	95% UCL	95% LCL
Conventionals														
Anionic Surfactants - MBAS (mg/L)	0.001	0.199	0.043	0.036	51	54	94%	0.017	0.065	0.031	0.73	0.004	0.052	0.036
BOD (mg/L)	0.2	9.7	3.8	3.2	49	56	87%	1.9	7.9	2.3	0.61	0.3	4.4	3.2
Chloride (mg/L)	0.51	551	22.9	4.54	56	57	98%	1.37	24.80	77.5	3.38	10.3	45.6	8.0
Conductivity (uS/cm)	14.9	2260	124	57.5	138	138	100%	32.1	185	295	2.39	25.1	178	80.5
Hardness (mg CaCO3/L)	8.7	206	21.4	16.1	202	202	100%	11.4	27.2	24.0	1.12	1.7	25.0	18.5
pH (pH units)	5.0	10.6	6.9	7.0	202	202	100%	6.3	7.4	0.6	0.08	0.0	7.0	6.9
TSS (mg/L)	4.8	322	48.7	30.8	196	196	100%	12.9	101	51.5	1.06	3.7	56.4	41.8
Turbidity (NTU)	5.5	85.2	19.1	14.1	55	55	100%	8.2	35.3	15.9	0.84	2.2	23.6	15.3
Nutrients														
Nitrate+Nitrite as N (mg/L)	0.062	0.436	0.157	0.129	71	71	100%	0.082	0.265	0.086	0.55	0.010	0.177	0.138
Phosphorus, Total (mg/L)	0.042	0.688	0.124	0.085	71	71	100%	0.055	0.251	0.115	0.93	0.014	0.153	0.100
Phosphate, Ortho (mg/L)	0.004	0.098	0.029	0.023	77	77	100%	0.014	0.049	0.018	0.61	0.002	0.033	0.025
Total Nitrogen (mg/L)	0.13	2.10	0.57	0.46	71	71	100%	0.27	1.05	0.39	0.69	0.05	0.66	0.48
Metals														
Cadmium (ug/L)	7.00E-04	0.466	0.082	0.065	49	85	57%	0.019	0.160	0.079	0.96	0.009	0.100	0.067
Cadmium, Dissolved (ug/L)	0.001	0.125	0.029	0.028	24	84	28%	0.009	0.048	0.018	0.64	0.002	0.033	0.025
Copper (ug/L)	3.72	66.40	11.30	8.30	85	85	100%	5.15	20.40	10.20	0.90	1.11	13.70	9.37
Copper, Dissolved (ug/L)	0.84	18.10	4.13	3.19	84	84	100%	1.83	7.67	2.93	0.71	0.32	4.80	3.55
Lead (ug/L)	2.09	229	18.10	11.30	202	202	100%	4.41	37.90	22.10	1.22	1.56	21.40	15.30
Lead, Dissolved (ug/L)	0.018	9.05	0.907	0.500	161	201	80%	0.221	1.880	1.210	1.33	0.085	1.090	0.753
Mercury (ug/L)	3.000E-07	0.1300	0.0220	0.0100	81	204	39%	0.0020	0.0520	0.0260	1.17	0.0020	0.0260	0.0190
Mercury, Dissolved (ug/L)	2.000E-07	0.1670	0.0150	0.0070	26	203	12%	0.0010	0.0410	0.0190	1.23	0.0010	0.0180	0.0130
Zinc (ug/L)	31.8	721	108.0	80.7	202	202	100%	49.9	176.0	86.8	0.80	6.1	121.0	96.9
Zinc, Dissolved (ug/L)	11.5	543	55.0	42.4	201	201	100%	26.6	86.2	53.7	0.98	3.8	63.2	48.4
Insecticides														
2,4-D (ug/L)	0.002	1.700	0.181	0.060	28	44	63%	0.014	0.512	0.301	1.66	0.045	0.281	0.105
Carbaryl (ug/L	0.002	0.50	0.13	0.04	0	26	0%	0.01	0.33	0.15	1.19	0.03	0.19	0.07
Chlorpyrifos (ug/L)	1.00E-04	1.420	0.041	0.009	2	71	2%	0.002	0.056	0.168	4.12	0.020	0.083	0.016
Bifenthrin (ug/L)	1.00E-04	0.009	0.004	0.004	0	28	0%	0.001	0.008	0.003	0.64	0.001	0.005	0.003
PAHs														
LPAHs														
2-Methylnaphthalene (ug/L)	3.00E-04	0.469	0.025	0.013	154	202	76%	0.004	0.040	0.050	2.04	0.004	0.032	0.018
Acenaphthene (ug/L)	5.00E-05	0.080	0.007	0.004	42	202	20%	0.001	0.012	0.010	1.46	0.001	0.008	0.005
Acenaphthylene (ug/L)	2.00E-04	0.060	0.006	0.005	47	202	23%	0.001	0.010	0.006	1.01	0.000	0.007	0.005
Anthracene (ug/L)	4.00E-06	0.122	0.011	0.006	76	202	37%	0.001	0.022	0.015	1.40	0.001	0.013	0.009
Fluorene (ug/L)	1.00E-04	0.246	0.011	0.007	98	202	48%	0.002	0.023	0.021	1.81	0.001	0.015	0.009
Naphthalene (ug/L)	2.00E-04	0.528	0.032	0.020	154	201	76%	0.008	0.051	0.052	1.62	0.004	0.040	0.026
Phenanthrene (ug/L)	5.00E-05	0.653	0.076	0.036	194	202	96%	0.013	0.195	0.103	1.35	0.007	0.091	0.063
Total LPAHs[1]	0.008	0.923	0.138	0.080	201	201	100%	0.033	0.298	0.157	1.14	0.011	0.161	0.117
HPAHs														
Benzo(a)anthracene (ug/L)	8.00E-05	0.439	0.046	0.017	153	202	75%	0.002	0.117	0.069	1.49	0.005	0.056	0.037
Benzo(a)pyrene (ug/L)	1.00E-05	0.563	0.055	0.021	147	202	72%	0.002	0.152	0.084	1.53	0.006	0.067	0.044
Benzo(b,k)fluoranthene (ug/L)	2.00E-03	1.400	0.152	0.053	170	202	84%	0.008	0.415	0.224	1.48	0.016	0.185	0.122
Benzo(g,h,i)perylene (ug/L)	8.00E-05	0.457	0.062	0.028	181	202	89%	0.006	0.155	0.080	1.29	0.006	0.074	0.052
Chrysene (ug/L)	3.00E-04	0.860	0.100	0.032	182	202	90%	0.005	0.270	0.151	1.51	0.011	0.122	0.080
Dibenz(a,h)anthracene (ug/L)	3.00E-04	0.088	0.013	0.007	102	202	50%	0.001	0.034	0.016	1.24	0.001	0.016	0.011
Fluoranthene (ug/L)	4.00E-04	1.690	0.156	0.054	199	202	98%	0.014	0.415	0.242	1.55	0.017	0.190	0.125
Indeno(1,2,3-cd)pyrene (ug/L)	2.00E-04	0.346	0.048	0.021	160	202	79%	0.002	0.130	0.063	1.32	0.004	0.057	0.039
Pyrene (ug/L)	2.00E-04	1.200	0.145	0.056	195	202	96%	0.016	0.380	0.202	1.39	0.014	0.174	0.119
Retene (ug/L)	6.00E-04	0.031	0.010	0.009	21	27	77%	0.003	0.021	0.007	0.73	0.001	0.013	0.008
Total HPAHs[2]	0.025	6.680	0.774	0.294	202	202	100%	0.054	2.180	1.120	1.45	0.079	0.941	0.624
TOTAL PAHs[3]	0.037	7.490	0.911	0.380	202	202	100%	0.092	2.460	1.260	1.38	0.088	1.090	0.750
Phthalates														
bis(2-Ethylhexyl) phthalate (ug/L)	0.05	44.10	3.21	1.95	182	201	90%	0.74	6.80	4.17	1.30	0.29	3.83	2.69
Butyl benzyl phthalate (ug/L)	0.005	8.400	0.468	0.292	43	202	21%	0.057	0.854	0.859	1.84	0.060	0.596	0.363
Diethyl phthalate (ug/L)	0.002	9.300	0.553	0.269	62	202	30%	0.071	1.000	1.060	1.93	0.075	0.712	0.422
Dimethyl phthalate (ug/L)	4.00E-04	4.700	0.316	0.182	16	202	7%	0.024	0.742	0.504	1.59	0.035	0.390	0.253
Di-n-butyl phthalate (ug/L)	0.013	1.600	0.399	0.378	88	202	43%	0.114	0.715	0.244	0.61	0.017	0.433	0.367
Di-n-Octyl phthalate (ug/L)	0.001	3.200	0.475	0.322	78	200	39%	0.059	1.000	0.508	1.07	0.036	0.547	0.410
***Total Phthalates[4]**	0.00	44.10	4.22	2.68	194	202	96%	0.84	8.79	5.15	1.22	0.36	4.99	3.56
Herbicides														
Dichlobenil (ug/L)	0.003	0.730	0.072	0.052	76	96	79%	0.012	0.155	0.090	1.25	0.009	0.092	0.056
TPH														
NWTPH-Diesel (mg/L)	1.0E-04	0.13	0.05	0.05	6	53	11%	0.02	0.11	0.03	0.68	0.01	0.06	0.04
NWTPH-Gasoline (mg/L)	3.E-02	48.0	20.6	18.6	0	46	0%	1.6	44.5	17.5	0.85	2.6	25.7	15.7
NWTPH-Heavy Oil (mg/L)	0.04	1.90	0.61	0.53	50	53	94%	0.28	1.10	0.36	0.59	0.05	0.71	0.52
Bacteria														
Coliform, Fecal (CFU/100 ml)	80	1300000	39100	4250	52	52	100%	851	29400	181000	4.63	25100	93200	8510
E.coli (CFU/100 ml)	90	110000	20900	11000	9	9	100%	1060	48400	34900	1.67	11600	45500	5180
Enterococci (CFU/100 ml)	6200	210000	58200	16000	9	9	100%	7400	202000	84000	1.44	28000	118000	13400
BTEX														
Benzene (ug/L)	3.E-03	1.2	0.1	0.1	1	46	2%	0.0	0.2	0.2	1.26	0.0	0.2	0.1
Ethylbenzene (ug/L)	2.E-04	0.4	0.1	0.1	2	46	4%	0.0	0.2	0.1	0.76	0.0	0.1	0.1
m,p-Xylene (ug/L)	1.E-02	1.1	0.2	0.1	4	46	8%	0.0	0.4	0.2	1.08	0.0	0.3	0.1
o-Xylene (ug/L)	6.E-03	0.5	0.1	0.1	4	46	8%	0.0	0.2	0.1	0.82	0.0	0.1	0.1
Toluene (ug/L)	1.E-02	1.2	0.2	0.1	9	46	19%	0.1	0.3	0.2	1.17	0.0	0.3	0.1

[1] *Total LPAHs is the sum of the concentration or non-detected calculated value of the following compounds: Naphthalene, acenaphthene, acenaphthylene, anthracene, fluorene, and phenanthrene.*

[2] *Total HPAHs is the sum of the concentration of non-detected calculated value of the following compounds: Fluoranthene, pyrene, benzo(a)anthracene, chrysene, benzo(b,k)fluoranthene, benzo(b,k)fluoranthene, benzo(a)pyrene, indeno(1,2,3-c,d)pyrene, dibenz(a,h)anthracene, benzo(g,h,i)perylene.*

[3] *Total PAHs is the sum of the LPAHs and HPAHs.*

[4] *Total phthalates is the sum of detected values only.*

Table E-8 (Cont'd)
Summary Statistics for Stormwater at OF230 WY2023

	Minimum	Maximum	Arithmetic Mean	Median	Detects	Count	Percent Detects	10th Per	90th Per	Standard Deviation	Coefficient of Variation	Standard Error	95% UCL	95% LCL
Conventionals														
Anionic Surfactants - MBAS (mg/L)	0.015	0.051	0.027	0.016	3	3	100%	0.015	0.044	0.021	0.75	0.012	0.051	0.015
BOD (mg/L)	1.0	9.7	3.9	1.0	1	3	33%	1.0	8.0	5.0	1.29	2.9	9.7	1.0
Chloride (mg/L)	30.10	196.00	118.37	129.00	3	3	100%	49.88	182.60	83.46	0.71	48.19	196.00	30.10
Conductivity (uS/cm)	183.0	881.0	421.3	200.0	3	3	100%	186.4	744.8	398.2	0.95	229.9	881.0	183.0
Hardness (mg CaCO3/L)	37.8	113.0	75.4	75.3	3	3	100%	45.3	105.5	37.6	0.50	21.7	113.0	37.8
pH (pH units)	6.6	7.2	6.9	6.8	3	3	100%	6.6	7.1	0.3	0.04	0.2	7.2	6.6
TSS (mg/L)	13.0	50.2	28.5	22.2	3	3	100%	14.8	44.6	19.4	0.68	11.2	50.2	13.0
Turbidity (NTU)	18.5	44.3	30.1	27.4	3	3	100%	20.3	40.9	13.1	0.44	7.6	44.3	18.5
Nutrients														
Nitrate+Nitrite as N (mg/L)	0.302	0.436	0.355	0.328	3	3	100%	0.307	0.414	0.071	0.20	0.041	0.436	0.302
Phosphorus, Total (mg/L)	0.069	0.172	0.110	0.090	3	3	100%	0.073	0.156	0.054	0.49	0.031	0.172	0.069
Phosphate, Ortho (mg/L)	0.034	0.094	0.054	0.034	3	3	100%	0.034	0.082	0.035	0.64	0.020	0.094	0.034
Total Nitrogen (mg/L)	0.72	1.83	1.13	0.84	3	3	100%	0.74	1.63	0.61	0.54	0.35	1.83	0.72
Metals														
Cadmium (ug/L)	0.050	0.050	0.050	0.050	0	3	0%	0.050	0.050	0.000	0.00	0.000	0.050	0.050
Cadmium, Dissolved (ug/L)	0.023	0.023	0.023	0.023	0	3	0%	0.023	0.023	0.000	0.00	0.000	0.023	0.023
Copper (ug/L)	7.39	18.20	13.00	13.40	3	3	100%	8.59	17.24	5.42	0.42	3.13	18.20	7.39
Copper, Dissolved (ug/L)	2.34	7.54	4.22	2.77	3	3	100%	2.43	6.59	2.89	0.68	1.67	7.54	2.34
Lead (ug/L)	2.49	5.68	4.22	4.50	3	3	100%	2.89	5.44	1.61	0.38	0.93	5.68	2.49
Lead, Dissolved (ug/L)	0.141	0.283	0.213	0.214	3	3	100%	0.156	0.269	0.071	0.33	0.041	0.283	0.141
Mercury (ug/L)	0.0055	0.0085	0.0065	0.0055	2	3	67%	0.0055	0.0079	0.0017	0.27	0.0010	0.0085	0.0055
Mercury, Dissolved (ug/L)	0.0011	0.0056	0.0041	0.0056	0	3	0%	0.0020	0.0056	0.0026	0.63	0.0015	0.0056	0.0011
Zinc (ug/L)	52.2	121.0	77.5	59.4	3	3	100%	53.6	108.7	37.8	0.49	21.8	121.0	52.2
Zinc, Dissolved (ug/L)	33.3	52.2	40.2	35.0	3	3	100%	33.6	48.8	10.5	0.26	6.0	52.2	33.3
Insecticides														
Bifenthrin (ug/L)	0.005	0.005	0.005	0.005	0	3	0%	0.005	0.005	0.000	0.00	0.000	0.005	0.005
PAHs														
LPAHs														
2-Methylnaphthalene (ug/L)	0.001	0.043	0.018	0.011	2	3	67%	0.003	0.037	0.022	1.20	0.013	0.043	0.001
Acenaphthene (ug/L)	0.005	0.005	0.005	0.005	0	3	0%	0.005	0.005	0.000	0.00	0.000	0.005	0.005
Acenaphthylene (ug/L)	0.007	0.027	0.017	0.017	2	3	67%	0.009	0.025	0.010	0.57	0.006	0.027	0.007
Anthracene (ug/L)	0.052	0.060	0.056	0.057	2	3	67%	0.053	0.059	0.004	0.07	0.002	0.060	0.052
Fluorene (ug/L)	0.005	0.005	0.005	0.005	0	3	0%	0.005	0.005	0.000	0.00	0.000	0.005	0.005
Naphthalene (ug/L)	0.028	0.030	0.029	0.029	2	2	100%	0.028	0.030	0.001	0.05	0.001	0.030	0.028
Phenanthrene (ug/L)	0.021	0.124	0.058	0.030	3	3	100%	0.023	0.105	0.057	0.98	0.033	0.124	0.021
Total LPAHs[1]	0.138	0.210	0.167	0.152	3	3	100%	0.141	0.198	0.038	0.23	0.022	0.210	0.138
HPAHs														
Benzo(a)anthracene (ug/L)	0.027	0.072	0.051	0.055	3	3	100%	0.033	0.069	0.023	0.44	0.013	0.072	0.027
Benzo(a)pyrene (ug/L)	0.002	0.058	0.020	0.002	1	3	33%	0.002	0.047	0.033	1.60	0.019	0.058	0.002
Benzo(b,k)fluoranthene (ug/L)	0.094	0.183	0.140	0.144	2	3	67%	0.104	0.175	0.045	0.32	0.026	0.183	0.094
Benzo(g,h,i)perylene (ug/L)	0.031	0.050	0.040	0.040	3	3	100%	0.033	0.048	0.010	0.24	0.005	0.050	0.031
Chrysene (ug/L)	0.040	0.066	0.054	0.055	2	3	67%	0.043	0.064	0.013	0.25	0.008	0.066	0.040
Dibenz(a,h)anthracene (ug/L)	0.007	0.012	0.010	0.010	2	3	67%	0.008	0.012	0.002	0.25	0.001	0.012	0.007
Fluoranthene (ug/L)	0.089	0.107	0.096	0.092	3	3	100%	0.090	0.104	0.010	0.10	0.006	0.107	0.089
Indeno(1,2,3-cd)pyrene (ug/L)	0.022	0.054	0.038	0.039	2	3	67%	0.025	0.051	0.016	0.42	0.009	0.054	0.022
Pyrene (ug/L)	0.097	0.115	0.103	0.097	2	3	67%	0.097	0.111	0.010	0.10	0.006	0.115	0.097
Retene (ug/L)	0.009	0.031	0.017	0.011	3	3	100%	0.009	0.027	0.012	0.72	0.007	0.031	0.009
Total HPAHs[2]	0.277	0.661	0.508	0.587	3	3	100%	0.339	0.646	0.204	0.40	0.118	0.661	0.277
TOTAL PAHs	0.487	0.813	0.675	0.725	3	3	100%	0.534	0.795	0.169	0.25	0.097	0.813	0.487
Phthalates														
bis(2-Ethylhexyl) phthalate (ug/L)	0.41	1.28	0.76	0.60	3	3	100%	0.45	1.14	0.46	0.60	0.26	1.28	0.41
Butyl benzyl phthalate (ug/L)	0.205	0.208	0.206	0.207	0	3	0%	0.205	0.207	0.002	0.01	0.001	0.208	0.205
Diethyl phthalate (ug/L)	0.159	0.161	0.160	0.160	0	3	0%	0.159	0.160	0.001	0.01	0.001	0.161	0.159
Dimethyl phthalate (ug/L)	0.173	0.175	0.174	0.174	0	3	0%	0.173	0.174	0.001	0.01	0.001	0.175	0.173
Di-n-butyl phthalate (ug/L)	0.329	0.412	0.374	0.380	2	3	67%	0.339	0.406	0.042	0.11	0.024	0.412	0.329
Di-n-Octyl phthalate (ug/L)	0.183	0.185	0.184	0.185	0	3	0%	0.183	0.185	0.001	0.01	0.001	0.185	0.183
***Total Phthalates[4]**	0.60	1.66	1.03	0.82	3	3	100%	0.64	1.49	0.56	0.55	0.32	1.66	0.60
Herbicides														
Dichlobenil (ug/L)	0.005	0.020	0.010	0.005	1	3	33%	0.005	0.017	0.009	0.93	0.005	0.020	0.005
TPH														
NWTPH-Diesel (mg/L)	0.05	0.05	0.05	0.05	0	2	0%	0.05	0.05	0.00	0.00	0.00	0.05	0.05
NWTPH-Heavy Oil (mg/L)	0.10	0.19	0.15	0.15	1	2	50%	0.11	0.18	0.06	0.44	0.05	0.19	0.10
Bacteria														
Coliform, Fecal (CFU/100 ml)	2400	140000	71200	71200	2	2	100%	16160	126240	97298	1.37	68800	140000	2400
E.coli (CFU/100 ml)	1300	110000	55650	55650	2	2	100%	12170	99130	76863	1.38	54350	110000	1300
Enterococci (CFU/100 ml)	40000	200000	120000	120000	2	2	100%	56000	184000	113137	0.94	80000	200000	40000

Table E-9
Summary Statistics for Stormwater at OF235 Water Years 2002-2023

	Minimum	Maximum	Arithmetic Mean	Median	Detects	Count	Percent Detects	10th Per	90th Per	Standard Deviation	Coefficient of Variation	Standard Error	95% UCL	95% LCL
Conventionals														
Anionic Surfactants - MBAS (mg/L)	0.004	0.665	0.062	0.047	90	96	93%	0.022	0.105	0.075	1.21	0.008	0.079	0.050
BOD (mg/L)	0.1	9.7	3.6	3.2	63	79	79%	1.1	6.9	2.1	0.58	0.2	4.1	3.2
Chloride (mg/L)	3.E-03	114	10.30	4.49	88	89	98%	0.50	27.70	17.60	1.71	1.87	14.10	7.04
Conductivity (uS/cm)	7.2	1590	127.0	82.9	175	175	100%	52.0	191.0	164.0	1.29	12.4	154.0	105.0
Hardness (mg CaCO3/L)	9.8	63.9	30.0	28.0	241	241	100%	19.5	42.4	9.8	0.33	0.6	31.2	28.8
pH (pH units)	5.4	8.6	7.0	7.1	241	241	100%	6.4	7.5	0.5	0.07	0.0	7.1	7.0
TSS (mg/L)	5.6	441	55.7	40.8	235	235	100%	14.9	108.0	53.3	0.96	3.5	62.8	49.4
Turbidity (NTU)	5.1	79.5	19.0	16.2	66	66	100%	9.1	30.8	11.5	0.61	1.4	21.9	16.4
Nutrients														
Nitrate+Nitrite as N (mg/L)	0.028	1.650	0.337	0.244	121	121	100%	0.163	0.666	0.267	0.79	0.024	0.387	0.293
Phosphorus, Total (mg/L)	0.019	0.532	0.124	0.097	119	119	100%	0.058	0.223	0.091	0.73	0.008	0.141	0.109
Phosphate, Ortho (mg/L)	1.00E-05	0.143	0.027	0.024	120	120	100%	0.004	0.046	0.020	0.75	0.002	0.031	0.024
Total Nitrogen (mg/L)	2.0E-03	3.28	0.80	0.65	118	121	97%	0.36	1.32	0.55	0.69	0.05	0.90	0.71
Metals														
Cadmium (ug/L)	3.00E-03	0.960	0.131	0.093	105	156	67%	0.017	0.271	0.143	1.09	0.011	0.154	0.110
Cadmium, Dissolved (ug/L)	1.00E-04	0.379	0.050	0.036	68	157	43%	0.009	0.107	0.049	0.99	0.004	0.058	0.043
Copper (ug/L)	3.45	162	28.10	22.70	156	156	100%	14.40	43.50	20.50	0.73	1.64	31.60	25.20
Copper, Dissolved (ug/L)	1.79	79.10	11.80	9.81	156	157	99%	5.92	18.80	8.99	0.76	0.72	13.40	10.60
Lead (ug/L)	2.46	368	53.80	41.20	241	241	100%	22.00	97.60	41.80	0.78	2.69	59.30	48.70
Lead, Dissolved (ug/L)	0.156	28.00	6.10	4.590	238	242	98%	2.110	12.300	4.880	0.80	0.314	6.730	5.500
Mercury (ug/L)	2.000E-08	0.1900	0.0230	0.0095	91	245	37%	0.0020	0.0550	0.0320	1.37	0.0020	0.0270	0.0190
Mercury, Dissolved (ug/L)	4.000E-07	0.0500	0.0150	0.0068	24	245	9%	0.0007	0.0420	0.0160	1.06	0.0010	0.0170	0.0130
Zinc (ug/L)	34.3	598	110.0	86.5	240	240	100%	47.3	180.0	77.3	0.70	5.0	121.0	101.0
Zinc, Dissolved (ug/L)	9.7	347	42.4	33.5	240	240	100%	22.4	68.9	32.4	0.76	2.1	46.8	38.7
Insecticides														
2,4-D (ug/L)	0.001	12.0	0.587	0.133	52	84	61%	0.023	1.250	1.500	2.56	0.164	0.948	0.325
Carbaryl (ug/L	3.0E-03	0.49	0.11	0.03	0	33	0%	0.01	0.35	0.14	1.30	0.02	0.16	0.07
Chlorpyrifos (ug/L)	6.00E-05	0.707	0.026	0.010	2	114	1%	0.002	0.058	0.068	2.66	0.006	0.040	0.017
Bifenthrin (ug/L)	9.00E-05	0.010	0.005	0.005	0	39	0%	0.001	0.008	0.003	0.63	0.001	0.006	0.004
PAHs														
LPAHs														
2-Methylnaphthalene (ug/L)	2.00E-04	4.130	0.033	0.010	159	242	65%	0.002	0.036	0.265	7.97	0.017	0.069	0.014
Acenaphthene (ug/L)	8.00E-05	0.086	0.009	0.005	87	242	35%	0.001	0.019	0.010	1.18	0.001	0.010	0.008
Acenaphthylene (ug/L)	5.00E-06	0.060	0.006	0.005	65	242	26%	0.001	0.013	0.007	1.10	0.000	0.007	0.005
Anthracene (ug/L)	4.00E-05	0.138	0.013	0.008	121	242	50%	0.001	0.030	0.017	1.26	0.001	0.015	0.011
Fluorene (ug/L)	1.00E-05	0.083	0.011	0.006	114	242	47%	0.001	0.025	0.014	1.24	0.001	0.013	0.009
Naphthalene (ug/L)	1.00E-05	4.430	0.042	0.016	155	239	64%	0.004	0.054	0.286	6.75	0.018	0.081	0.022
Phenanthrene (ug/L)	6.00E-04	0.776	0.070	0.029	220	242	90%	0.010	0.184	0.102	1.45	0.007	0.083	0.058
Total LPAHs[1]	0.009	4.93	0.148	0.071	242	242	100%	0.026	0.310	0.344	2.33	0.022	0.197	0.114
HPAHs														
Benzo(a)anthracene (ug/L)	2.00E-04	0.555	0.042	0.018	201	242	83%	0.002	0.118	0.065	1.55	0.004	0.050	0.034
Benzo(a)pyrene (ug/L)	2.00E-04	0.498	0.044	0.020	187	242	77%	0.003	0.118	0.066	1.50	0.004	0.053	0.036
Benzo(b,k)fluoranthene (ug/L)	1.00E-04	1.200	0.111	0.052	215	242	88%	0.012	0.322	0.155	1.40	0.010	0.131	0.092
Benzo(g,h,i)perylene (ug/L)	7.00E-05	0.410	0.052	0.028	220	242	90%	0.006	0.139	0.062	1.20	0.004	0.060	0.044
Chrysene (ug/L)	4.00E-04	0.678	0.083	0.034	229	242	94%	0.009	0.236	0.115	1.39	0.007	0.097	0.069
Dibenz(a,h)anthracene (ug/L)	4.00E-05	0.154	0.010	0.005	101	242	41%	0.001	0.025	0.015	1.50	0.001	0.012	0.008
Fluoranthene (ug/L)	0.002	1.550	0.140	0.055	239	242	98%	0.024	0.386	0.193	1.38	0.012	0.165	0.117
Indeno(1,2,3-cd)pyrene (ug/L)	2.00E-04	0.338	0.035	0.019	196	242	80%	0.003	0.088	0.045	1.31	0.003	0.041	0.029
Pyrene (ug/L)	0.003	1.160	0.143	0.066	239	242	98%	0.026	0.376	0.180	1.26	0.012	0.166	0.121
Retene (ug/L)	4.00E-04	0.115	0.015	0.010	34	37	91%	0.007	0.020	0.018	1.21	0.003	0.022	0.011
Total HPAHs[2]	0.027	6.50	0.657	0.307	241	241	100%	0.091	1.840	0.884	1.35	0.057	0.771	0.549
TOTAL PAHs[3]	0.045	7.55	0.802	0.368	242	242	100%	0.123	2.220	1.090	1.36	0.070	0.948	0.672
Phthalates														
bis(2-Ethylhexyl) phthalate (ug/L)	0.31	97.0	3.95	1.96	230	241	95%	0.83	8.40	7.28	1.84	0.47	4.95	3.18
Butyl benzyl phthalate (ug/L)	0.001	7.93	0.895	0.511	128	242	52%	0.104	1.900	1.180	1.32	0.076	1.050	0.754
Diethyl phthalate (ug/L)	0.004	590	2.880	0.258	85	242	35%	0.057	0.963	37.900	13.20	2.440	7.800	0.374
Dimethyl phthalate (ug/L)	0.002	2.4	0.228	0.137	17	240	7%	0.028	0.546	0.278	1.22	0.018	0.265	0.196
Di-n-butyl phthalate (ug/L)	0.001	1.6	0.354	0.304	91	242	37%	0.061	0.763	0.259	0.73	0.017	0.386	0.322
Di-n-Octyl phthalate (ug/L)	0.001	3.2	0.432	0.271	63	241	26%	0.028	0.995	0.514	1.19	0.033	0.501	0.370
***Total Phthalates[4]**	0.0	596.00	7.70	2.98	237	242	97%	0.95	11.50	38.90	5.06	2.50	13.50	4.46
Herbicides														
Dichlobenil (ug/L)	1.00E-03	3.390	0.099	0.034	92	145	63%	0.005	0.165	0.308	3.10	0.026	0.156	0.060
TPH														
NWTPH-Diesel (mg/L)	3.0E-05	0.31	0.05	0.04	7	75	9%	0.01	0.11	0.05	0.89	0.01	0.07	0.04
NWTPH-Gasoline (mg/L)	2.E-02	50.0	16.2	13.0	13	67	19%	1.1	41.0	14.9	0.92	1.8	19.7	12.7
NWTPH-Heavy Oil (mg/L)	4.0E-03	1.70	0.62	0.54	69	75	92%	0.20	1.16	0.38	0.61	0.04	0.70	0.54
Bacteria														
Coliform, Fecal (CFU/100 ml)	80	160000	11700	3500	69	69	100%	732	17600	23200	1.98	2790	17900	7110
E.coli (CFU/100 ml)	1300	50000	10700	4900	7	7	100%	1900	24700	17500	1.64	6600	24100	2960
Enterococci (CFU/100 ml)	3700	350000	92500	35000	8	8	100%	4120	262000	127000	1.37	44800	182000	22200
BTEX														
Benzene (ug/L)	2.E-03	1.2	0.3	0.2	17	46	36%	0.0	0.7	0.3	1.10	0.0	0.3	0.2
Ethylbenzene (ug/L)	2.E-03	0.4	0.1	0.1	7	46	15%	0.0	0.2	0.1	0.84	0.0	0.2	0.1
m,p-Xylene (ug/L)	4.E-03	0.6	0.2	0.2	4	46	8%	0.0	0.4	0.1	0.74	0.0	0.2	0.2
o-Xylene (ug/L)	8.E-04	0.2	0.1	0.1	0	46	0%	0.0	0.2	0.1	0.55	0.0	0.1	0.1
Toluene (ug/L)	1.E-03	1.2	0.2	0.1	13	46	28%	0.0	0.3	0.2	1.15	0.0	0.3	0.1

[1] Total LPAHs is the sum of the concentration or non-detected calculated value of the following compounds: Naphthalene, acenaphthene, acenaphthylene, anthracene, fluorene, and phenanthrene.

[2] Total HPAHs is the sum of the concentration of non-detected calculated value of the following compounds: Fluoranthene, pyrene, benzo(a)anthracene, chrysene, benzo(b,k)fluoranthene, benzo(b,k)fluoranthene, benzo(a)pyrene, indeno(1,2,3-c,d)pyrene, dibenz(a,h)anthracene, benzo(g,h,i)perylene.

[3] Total PAHs is the sum of the LPAHs and HPAHs.

[4] Total phthalates is the sum of detected values only.

Table E-9 (Cont'd)
Summary Statistics for Stormwater at OF235 WY2023

	Minimum	Maximum	Arithmetic Mean	Median	Detects	Count	Percent Detects	10th Per	90th Per	Standard Deviation	Coefficient of Variation	Standard Error	95% UCL	95% LCL
Conventionals														
Anionic Surfactants - MBAS (mg/L)	0.041	0.112	0.067	0.062	5	5	100%	0.048	0.093	0.027	0.39	0.012	0.092	0.050
BOD (mg/L)	2.6	9.7	5.0	3.9	4	4	100%	2.8	8.1	3.2	0.65	1.6	8.1	2.9
Chloride (mg/L)	3.82	37.80	14.58	5.91	5	5	100%	4.59	30.52	14.43	0.99	6.45	27.36	5.01
Conductivity (uS/cm)	65.3	174.0	105.8	98.3	11	11	100%	69.3	136.0	34.9	0.33	10.5	125.9	87.1
Hardness (mg CaCO3/L)	20.7	39.9	29.4	27.0	11	11	100%	22.8	38.2	6.4	0.22	1.9	33.0	25.9
pH (pH units)	6.5	7.9	7.1	6.9	11	11	100%	6.6	7.7	0.5	0.07	0.1	7.4	6.8
TSS (mg/L)	17.8	68.0	44.6	47.6	10	10	100%	25.5	57.4	15.3	0.34	4.8	53.3	35.6
Turbidity (NTU)	12.1	29.7	20.1	16.5	5	5	100%	12.4	29.6	8.8	0.44	3.9	27.0	13.3
Nutrients														
Nitrate+Nitrite as N (mg/L)	0.214	1.020	0.370	0.304	11	11	100%	0.215	0.453	0.228	0.62	0.069	0.513	0.273
Phosphorus, Total (mg/L)	0.058	0.334	0.169	0.178	11	11	100%	0.065	0.295	0.088	0.52	0.027	0.220	0.121
Phosphate, Ortho (mg/L)	0.026	0.143	0.052	0.037	10	10	100%	0.028	0.078	0.036	0.70	0.011	0.075	0.034
Total Nitrogen (mg/L)	0.67	2.55	1.06	0.85	11	11	100%	0.73	1.24	0.53	0.50	0.16	1.39	0.82
Metals														
Cadmium (ug/L)	0.036	0.368	0.121	0.108	7	11	64%	0.048	0.151	0.091	0.75	0.027	0.179	0.079
Cadmium, Dissolved (ug/L)	0.023	0.102	0.052	0.046	3	11	27%	0.028	0.080	0.024	0.47	0.007	0.066	0.039
Copper (ug/L)	17.50	42.80	29.51	27.30	11	11	100%	18.80	42.40	9.17	0.31	2.76	34.75	24.56
Copper, Dissolved (ug/L)	6.18	23.70	12.35	13.10	11	11	100%	8.34	15.60	4.76	0.39	1.44	15.31	9.89
Lead (ug/L)	25.60	88.20	45.00	43.00	11	11	100%	26.70	63.80	18.45	0.41	5.56	56.05	35.80
Lead, Dissolved (ug/L)	2.810	8.680	5.511	5.060	11	11	100%	4.110	7.980	1.803	0.33	0.544	6.554	4.536
Mercury (ug/L)	0.0034	0.0063	0.0044	0.0035	3	3	100%	0.0034	0.0057	0.0016	0.37	0.0010	0.0063	0.0034
Mercury, Dissolved (ug/L)	0.0011	0.0056	0.0043	0.0056	0	11	0%	0.0011	0.0056	0.0021	0.48	0.0006	0.0056	0.0031
Zinc (ug/L)	62.1	170.0	106.5	88.5	11	11	100%	70.8	168.0	38.5	0.36	11.6	128.9	85.7
Zinc, Dissolved (ug/L)	25.9	88.3	39.8	35.2	11	11	100%	30.1	45.6	17.1	0.43	5.1	50.6	32.5
Insecticides														
Bifenthrin (ug/L)	0.005	0.005	0.005	0.005	0	11	0%	0.005	0.005	0.000	0.00	0.000	0.005	0.005
PAHs														
LPAHs														
2-Methylnaphthalene (ug/L)	0.003	0.052	0.018	0.008	5	11	45%	0.003	0.050	0.019	1.03	0.006	0.030	0.008
Acenaphthene (ug/L)	0.005	0.023	0.008	0.005	2	11	18%	0.005	0.022	0.007	0.88	0.002	0.013	0.005
Acenaphthylene (ug/L)	0.004	0.018	0.010	0.009	3	11	27%	0.005	0.015	0.004	0.44	0.001	0.012	0.007
Anthracene (ug/L)	0.001	0.030	0.008	0.004	4	11	36%	0.001	0.021	0.010	1.17	0.003	0.014	0.003
Fluorene (ug/L)	0.003	0.028	0.010	0.006	5	11	45%	0.003	0.024	0.009	0.86	0.003	0.015	0.006
Naphthalene (ug/L)	0.004	0.063	0.019	0.012	4	10	40%	0.006	0.031	0.017	0.91	0.005	0.030	0.011
Phenanthrene (ug/L)	0.017	0.097	0.040	0.033	11	11	100%	0.019	0.073	0.025	0.64	0.008	0.055	0.027
Total LPAHs[1]	0.045	0.215	0.098	0.083	11	11	100%	0.046	0.145	0.054	0.55	0.016	0.130	0.069
HPAHs														
Benzo(a)anthracene (ug/L)	0.006	0.033	0.019	0.016	10	11	91%	0.009	0.031	0.010	0.50	0.003	0.025	0.014
Benzo(a)pyrene (ug/L)	0.006	0.036	0.018	0.017	7	11	64%	0.007	0.035	0.010	0.58	0.003	0.024	0.012
Benzo(b,k)fluoranthene (ug/L)	0.020	0.094	0.057	0.048	10	11	91%	0.031	0.087	0.026	0.45	0.008	0.071	0.043
Benzo(g,h,i)perylene (ug/L)	0.014	0.046	0.032	0.035	11	11	100%	0.020	0.042	0.010	0.30	0.003	0.037	0.027
Chrysene (ug/L)	0.009	0.050	0.028	0.025	10	11	91%	0.009	0.043	0.014	0.52	0.004	0.036	0.020
Dibenz(a,h)anthracene (ug/L)	0.003	0.007	0.004	0.003	2	11	18%	0.003	0.007	0.002	0.43	0.000	0.005	0.003
Fluoranthene (ug/L)	0.021	0.114	0.067	0.056	11	11	100%	0.038	0.106	0.031	0.46	0.009	0.085	0.050
Indeno(1,2,3-cd)pyrene (ug/L)	0.011	0.029	0.020	0.021	9	11	82%	0.012	0.027	0.006	0.31	0.002	0.023	0.016
Pyrene (ug/L)	0.031	0.153	0.086	0.080	10	11	91%	0.047	0.153	0.041	0.47	0.012	0.111	0.065
Retene (ug/L)	0.008	0.032	0.017	0.016	11	11	100%	0.009	0.030	0.008	0.48	0.002	0.022	0.013
Total HPAHs[2]	0.122	0.533	0.328	0.300	11	11	100%	0.197	0.521	0.135	0.41	0.041	0.406	0.255
TOTAL PAHs	0.174	0.736	0.426	0.359	11	11	100%	0.245	0.627	0.169	0.40	0.051	0.524	0.333
Phthalates														
bis(2-Ethylhexyl) phthalate (ug/L)	1.14	3.04	2.04	1.96	11	11	100%	1.39	2.98	0.62	0.30	0.19	2.39	1.71
Butyl benzyl phthalate (ug/L)	0.201	0.209	0.204	0.204	0	11	0%	0.202	0.208	0.003	0.01	0.001	0.206	0.203
Diethyl phthalate (ug/L)	0.155	0.395	0.179	0.158	1	11	9%	0.156	0.161	0.072	0.40	0.022	0.223	0.157
Dimethyl phthalate (ug/L)	0.169	0.176	0.172	0.172	0	11	0%	0.170	0.175	0.002	0.01	0.001	0.173	0.171
Di-n-butyl phthalate (ug/L)	0.167	0.471	0.259	0.193	4	11	36%	0.193	0.366	0.099	0.38	0.030	0.318	0.207
Di-n-Octyl phthalate (ug/L)	0.179	0.187	0.182	0.182	0	11	0%	0.180	0.186	0.002	0.01	0.001	0.184	0.181
***Total Phthalates[4]**	1.14	3.35	2.21	2.33	11	11	100%	1.39	3.33	0.70	0.32	0.21	2.62	1.83
Herbicides														
Dichlobenil (ug/L)	0.023	0.848	0.197	0.056	11	11	100%	0.024	0.455	0.260	1.32	0.078	0.360	0.071
TPH														
NWTPH-Diesel (mg/L)	0.05	0.10	0.08	0.08	1	2	50%	0.06	0.10	0.04	0.47	0.03	0.10	0.05
NWTPH-Heavy Oil (mg/L)	0.99	1.04	1.02	1.02	2	2	100%	1.00	1.04	0.04	0.03	0.03	1.04	0.99
Bacteria														
Coliform, Fecal (CFU/100 ml)	3000	50000	26500	26500	2	2	100%	7700	45300	33234	1.25	23500	50000	3000
E.coli (CFU/100 ml)	2300	50000	26150	26150	2	2	100%	7070	45230	33729	1.29	23850	50000	2300
Enterococci (CFU/100 ml)	44000	225000	134500	134500	2	2	100%	62100	206900	127986	0.95	90500	225000	44000

Table E-10
Summary Statistics for Stormwater at OF237A New Water Years 2002-2023

	Minimum	Maximum	Arithmetic Mean	Median	Detects	Count	Percent Detects	10th Per	90th Per	Standard Deviation	Coefficient of Variation	Standard Error	95% UCL	95% LCL
Conventionals														
Anionic Surfactants - MBAS (mg/L)	0.008	0.096	0.043	0.040	61	64	95%	0.023	0.069	0.019	0.45	0.002	0.048	0.038
BOD (mg/L)	0.3	9.2	3.1	2.7	47	59	79%	0.9	5.2	1.8	0.57	0.2	3.6	2.7
Chloride (mg/L)	0.36	154	13.90	7.22	62	64	96%	3.47	31.10	20.50	1.48	2.57	19.50	9.76
Conductivity (uS/cm)	7.5	1190	117	91.3	147	147	100%	55.0	177.0	117.0	1.00	9.6	138.0	101.0
Hardness (mg CaCO3/L)	14.5	68.8	30.6	28.3	210	210	100%	20.6	42.6	10.0	0.33	0.7	31.9	29.2
pH (pH units)	5.3	8.3	6.9	6.9	209	209	100%	6.3	7.4	0.5	0.07	0.0	6.9	6.8
TSS (mg/L)	3.5	668	48.8	33.6	208	208	100%	16.3	85.7	61.6	1.26	4.3	58.0	41.5
Turbidity (NTU)	6.1	57.1	19.8	17.9	65	65	100%	11.7	32.7	9.7	0.49	1.2	22.3	17.6
Nutrients														
Nitrate+Nitrite as N (mg/L)	0.161	1.090	0.413	0.383	81	81	100%	0.228	0.662	0.179	0.43	0.020	0.454	0.376
Phosphorus, Total (mg/L)	0.041	1.150	0.110	0.086	81	81	100%	0.055	0.165	0.127	1.15	0.014	0.143	0.089
Phosphate, Ortho (mg/L)	0.009	0.069	0.024	0.021	79	79	100%	0.013	0.040	0.011	0.48	0.001	0.026	0.021
Total Nitrogen (mg/L)	0.36	2.03	0.72	0.64	81	81	100%	0.43	1.05	0.29	0.40	0.03	0.78	0.66
Metals														
Cadmium (ug/L)	0.001	0.615	0.078	0.067	49	91	53%	0.010	0.131	0.080	1.03	0.008	0.096	0.063
Cadmium, Dissolved (ug/L)	1.00E-04	0.098	0.024	0.023	16	91	17%	0.002	0.047	0.019	0.78	0.002	0.028	0.021
Copper (ug/L)	4.09	69.10	10.40	8.06	91	91	100%	5.51	16.30	8.65	0.84	0.91	12.30	8.80
Copper, Dissolved (ug/L)	1.51	12.10	3.33	2.82	91	91	100%	1.94	4.53	1.73	0.52	0.18	3.71	3.00
Lead (ug/L)	1.40	80.60	11.30	8.11	209	210	99%	3.86	24.10	10.60	0.94	0.73	12.80	9.99
Lead, Dissolved (ug/L)	0.009	3.460	0.532	0.309	154	210	73%	0.167	1.200	0.538	1.01	0.037	0.607	0.462
Mercury (ug/L)	5.000E-07	0.174	0.0180	0.0079	69	214	32%	0.0020	0.0450	0.0210	1.15	0.0010	0.0210	0.0150
Mercury, Dissolved (ug/L)	2.000E-07	0.067	0.0150	0.0073	23	213	10%	0.0003	0.0400	0.0160	1.08	0.0010	0.0170	0.0130
Zinc (ug/L)	30.6	361.0	91.0	72.1	210	210	100%	45.2	158.0	57.0	0.63	3.9	98.9	83.6
Zinc, Dissolved (ug/L)	16.9	289.0	45.7	34.0	210	210	100%	22.2	76.4	35.8	0.78	2.5	50.9	41.2
Insecticides														
2,4-D (ug/L)	9.00E-04	2.500	0.299	0.135	42	50	84%	0.039	0.676	0.449	1.50	0.063	0.434	0.190
Carbaryl (ug/L	1.2E-02	0.47	0.13	0.08	0	31	0%	0.02	0.33	0.13	0.98	0.02	0.18	0.09
Chlorpyrifos (ug/L)	3.00E-04	0.365	0.028	0.012	2	72	2%	0.002	0.058	0.047	1.68	0.006	0.040	0.019
Bifenthrin (ug/L)	3.00E-04	0.054	0.008	0.006	7	32	21%	0.000	0.020	0.010	1.25	0.002	0.012	0.005
PAHs														
LPAHs														
2-Methylnaphthalene (ug/L)	2.00E-05	0.104	0.015	0.011	144	209	68%	0.002	0.035	0.015	1.00	0.001	0.017	0.013
Acenaphthene (ug/L)	2.00E-04	0.532	0.009	0.004	42	209	20%	0.001	0.013	0.038	4.20	0.003	0.015	0.006
Acenaphthylene (ug/L)	2.00E-05	0.061	0.005	0.004	37	209	17%	0.001	0.010	0.006	1.09	0.000	0.006	0.005
Anthracene (ug/L)	8.00E-05	0.225	0.012	0.006	82	209	39%	0.001	0.022	0.024	2.06	0.002	0.015	0.009
Fluorene (ug/L)	2.00E-04	0.110	0.010	0.007	93	209	44%	0.002	0.021	0.011	1.13	0.001	0.011	0.008
Naphthalene (ug/L)	3.00E-04	0.150	0.024	0.019	141	208	67%	0.004	0.048	0.021	0.87	0.001	0.027	0.021
Phenanthrene (ug/L)	4.00E-04	0.893	0.081	0.038	197	209	94%	0.010	0.193	0.124	1.53	0.009	0.099	0.065
Total LPAHs[1]	0.003	1.090	0.136	0.081	208	208	100%	0.024	0.294	0.169	1.25	0.012	0.160	0.114
HPAHs														
Benzo(a)anthracene (ug/L)	1.00E-04	0.902	0.062	0.022	178	209	85%	0.004	0.144	0.114	1.84	0.008	0.078	0.048
Benzo(a)pyrene (ug/L)	2.00E-05	0.865	0.069	0.029	163	209	77%	0.003	0.171	0.113	1.62	0.008	0.086	0.055
Benzo(b,k)fluoranthene (ug/L)	1.00E-04	2.430	0.216	0.088	192	209	91%	0.013	0.479	0.335	1.55	0.023	0.264	0.174
Benzo(g,h,i)perylene (ug/L)	1.00E-03	0.794	0.078	0.041	194	209	92%	0.007	0.184	0.104	1.32	0.007	0.093	0.065
Chrysene (ug/L)	2.00E-04	1.490	0.131	0.052	199	209	95%	0.010	0.341	0.195	1.49	0.013	0.158	0.106
Dibenz(a,h)anthracene (ug/L)	4.00E-05	0.305	0.017	0.007	104	209	49%	0.001	0.041	0.032	1.81	0.002	0.022	0.014
Fluoranthene (ug/L)	0.008	2.640	0.214	0.082	208	209	99%	0.020	0.545	0.354	1.66	0.025	0.264	0.170
Indeno(1,2,3-cd)pyrene (ug/L)	8.00E-05	0.680	0.069	0.034	184	209	88%	0.004	0.175	0.098	1.43	0.007	0.083	0.056
Pyrene (ug/L)	0.006	2.930	0.195	0.085	206	209	98%	0.022	0.491	0.319	1.63	0.022	0.241	0.156
Retene (ug/L)	0.001	0.222	0.024	0.013	29	31	93%	0.006	0.034	0.039	1.65	0.007	0.039	0.014
Total HPAHs[2]	0.029	12.300	1.050	0.458	209	209	100%	0.080	2.570	1.620	1.54	0.112	1.290	0.847
TOTAL PAHs[3]	0.033	13.300	1.190	0.520	209	209	100%	0.114	2.880	1.770	1.50	0.123	1.440	0.961
Phthalates														
bis(2-Ethylhexyl) phthalate (ug/L)	0.01	13.70	2.01	1.42	172	208	82%	0.56	4.40	1.77	0.88	0.12	2.26	1.78
Butyl benzyl phthalate (ug/L)	0.001	5.570	0.379	0.254	39	209	18%	0.050	0.802	0.519	1.37	0.036	0.457	0.317
Diethyl phthalate (ug/L)	0.008	230	1.810	0.252	68	209	32%	0.058	1.100	16.000	8.85	1.110	4.260	0.487
Dimethyl phthalate (ug/L)	0.001	0.998	0.241	0.179	11	208	5%	0.013	0.630	0.249	1.03	0.017	0.274	0.207
Di-n-butyl phthalate (ug/L)	0.002	4.800	0.386	0.322	87	209	41%	0.086	0.699	0.392	1.01	0.027	0.446	0.339
Di-n-Octyl phthalate (ug/L)	0.005	2.500	0.330	0.216	48	207	23%	0.037	0.866	0.339	1.03	0.024	0.378	0.286
***Total Phthalates[4]**	0.00	230	3.95	1.96	186	209	88%	0.00	5.92	16.10	4.07	1.11	6.42	2.52
Herbicides														
Dichlobenil (ug/L)	7.00E-05	1.080	0.067	0.046	75	101	74%	0.011	0.113	0.112	1.67	0.011	0.093	0.050
TPH														
NWTPH-Diesel (mg/L)	1.0E-03	0.32	0.05	0.03	3	54	5%	0.01	0.10	0.05	1.06	0.01	0.06	0.04
NWTPH-Gasoline (mg/L)	0.5	47.1	16.3	10.0	0	46	0%	2.1	37.9	15.0	0.92	2.2	20.6	12.2
NWTPH-Heavy Oil (mg/L)	0.01	2.10	0.57	0.54	49	54	90%	0.24	0.89	0.34	0.59	0.05	0.66	0.49
Bacteria														
Coliform, Fecal (CFU/100 ml)	230	80000	7090	2200	52	52	100%	520	15800	15600	2.19	2160	11900	3520
E.coli (CFU/100 ml)	1100	14000	3890	2800	9	9	100%	1340	6720	3950	1.02	1320	6620	2120
Enterococci (CFU/100 ml)	3400	110000	25400	9200	9	9	100%	3880	80800	38800	1.53	12900	52000	5820
BTEX														
Benzene (ug/L)	5.E-03	0.2	0.1	0.1	0	46	0%	0.0	0.2	0.1	0.51	0.0	0.1	0.1
Ethylbenzene (ug/L)	6.E-04	0.2	0.1	0.1	0	46	0%	0.0	0.2	0.1	0.61	0.0	0.1	0.1
m,p-Xylene (ug/L)	7.E-03	0.4	0.2	0.2	0	46	0%	0.0	0.4	0.1	0.62	0.0	0.2	0.2
o-Xylene (ug/L)	1.E-02	0.2	0.1	0.1	0	46	0%	0.0	0.2	0.1	0.46	0.0	0.1	0.1
Toluene (ug/L)	3.E-03	0.8	0.1	0.2	4	46	8%	0.0	0.2	0.1	0.83	0.0	0.2	0.1

[1] Total LPAHs is the sum of the concentration or non-detected calculated value of the following compounds: Naphthalene, acenaphthene, acenaphthylene, anthracene, fluorene, and phenanthrene.

[2] Total HPAHs is the sum of the concentration of non-detected calculated value of the following compounds: Fluoranthene, pyrene, benzo(a)anthracene, chrysene, benzo(b,k)fluoranthene, benzo(b,k)fluoranthene, benzo(a)pyrene, indeno(1,2,3-c,d)pyrene, dibenz(a,h)anthracene, benzo(g,h,i)perylene.

[3] Total PAHs is the sum of the LPAHs and HPAHs.

[4] Total phthalates is the sum of detected values only.

Table E-10 (Cont'd)
Summary Statistics for Stormwater at OF237A WY2023

	Minimum	Maximum	Arithmetic Mean	Median	Detects	Count	Percent Detects	10th Per	90th Per	Standard Deviation	Coefficient of Variation	Standard Error	95% UCL	95% LCL
Conventionals														
Anionic Surfactants - MBAS (mg/L)	0.037	0.063	0.047	0.044	4	4	100%	0.039	0.058	0.011	0.24	0.006	0.058	0.039
BOD (mg/L)	0.2	9.2	3.9	2.4	2	3	67%	0.7	7.8	4.7	1.19	2.7	9.2	0.2
Chloride (mg/L)	31.10	40.60	34.10	32.35	4	4	100%	31.10	38.50	4.49	0.13	2.25	38.23	31.10
Conductivity (uS/cm)	85.3	213.0	153.0	166.5	12	12	100%	103.3	203.4	45.6	0.30	13.2	176.9	128.5
Hardness (mg CaCO3/L)	21.0	58.1	37.7	37.8	12	12	100%	23.1	55.1	13.7	0.36	4.0	45.2	30.3
pH (pH units)	6.2	7.8	6.8	6.7	12	12	100%	6.2	7.3	0.5	0.07	0.1	7.1	6.5
TSS (mg/L)	10.8	156.0	44.9	33.2	11	11	100%	23.3	59.6	38.8	0.86	11.7	69.6	28.3
Turbidity (NTU)	9.6	34.2	21.8	21.8	4	4	100%	11.8	31.9	10.7	0.49	5.4	30.3	13.3
Nutrients														
Nitrate+Nitrite as N (mg/L)	0.165	0.845	0.462	0.392	9	9	100%	0.271	0.711	0.224	0.49	0.075	0.603	0.330
Phosphorus, Total (mg/L)	0.052	0.233	0.114	0.095	9	9	100%	0.058	0.189	0.059	0.51	0.020	0.152	0.081
Phosphate, Ortho (mg/L)	0.017	0.069	0.032	0.026	7	7	100%	0.019	0.048	0.017	0.55	0.007	0.045	0.022
Total Nitrogen (mg/L)	0.63	1.36	0.91	0.83	9	9	100%	0.69	1.31	0.26	0.29	0.09	1.08	0.76
Metals														
Cadmium (ug/L)	0.029	0.206	0.086	0.071	4	12	33%	0.038	0.131	0.051	0.60	0.015	0.115	0.060
Cadmium, Dissolved (ug/L)	0.003	0.098	0.025	0.014	3	12	25%	0.004	0.055	0.028	1.12	0.008	0.043	0.012
Copper (ug/L)	4.09	26.30	11.30	9.12	12	12	100%	7.17	16.15	5.83	0.52	1.68	14.74	8.55
Copper, Dissolved (ug/L)	1.94	8.21	3.48	3.09	12	12	100%	2.19	4.21	1.67	0.48	0.48	4.51	2.73
Lead (ug/L)	2.24	25.40	7.94	5.73	12	12	100%	4.41	11.01	6.03	0.76	1.74	11.55	5.33
Lead, Dissolved (ug/L)	0.183	1.210	0.452	0.317	12	12	100%	0.268	0.974	0.325	0.72	0.094	0.647	0.299
Mercury (ug/L)	0.0010	0.0135	0.0045	0.0033	4	12	33%	0.0012	0.0114	0.0041	0.91	0.0012	0.0070	0.0026
Mercury, Dissolved (ug/L)	0.0011	0.0056	0.0044	0.0056	0	12	0%	0.0011	0.0056	0.0020	0.45	0.0006	0.0056	0.0033
Zinc (ug/L)	50.5	158.0	78.3	63.1	12	12	100%	51.5	128.1	34.6	0.44	10.0	98.6	61.8
Zinc, Dissolved (ug/L)	21.5	60.0	32.3	26.0	12	12	100%	21.6	58.3	14.4	0.45	4.2	40.9	25.1
Insecticides														
Bifenthrin (ug/L)	0.005	0.023	0.008	0.005	2	12	17%	0.005	0.019	0.007	0.85	0.002	0.012	0.005
PAHs														
LPAHs														
2-Methylnaphthalene (ug/L)	0.005	0.059	0.027	0.022	11	12	92%	0.011	0.050	0.017	0.65	0.005	0.036	0.018
Acenaphthene (ug/L)	0.005	0.005	0.005	0.005	0	12	0%	0.005	0.005	0.000	0.05	0.000	0.005	0.005
Acenaphthylene (ug/L)	0.005	0.005	0.005	0.005	0	12	0%	0.005	0.005	0.000	0.00	0.000	0.005	0.005
Anthracene (ug/L)	0.000	0.225	0.022	0.001	5	12	42%	0.000	0.011	0.064	2.93	0.019	0.060	0.002
Fluorene (ug/L)	0.008	0.012	0.010	0.009	3	12	25%	0.008	0.011	0.001	0.12	0.000	0.010	0.009
Naphthalene (ug/L)	0.013	0.090	0.032	0.025	6	12	50%	0.013	0.045	0.021	0.66	0.006	0.044	0.022
Phenanthrene (ug/L)	0.021	0.199	0.063	0.042	12	12	100%	0.023	0.133	0.054	0.86	0.015	0.095	0.038
Total LPAHs	0.046	0.491	0.134	0.081	12	12	100%	0.058	0.194	0.121	0.91	0.035	0.210	0.083
HPAHs														
Benzo(a)anthracene (ug/L)	0.011	0.183	0.049	0.030	12	12	100%	0.015	0.091	0.049	1.00	0.014	0.079	0.027
Benzo(a)pyrene (ug/L)	0.004	0.258	0.047	0.030	8	12	67%	0.007	0.058	0.069	1.48	0.020	0.089	0.020
Benzo(b,k)fluoranthene (ug/L)	0.045	0.797	0.209	0.132	12	12	100%	0.056	0.408	0.216	1.03	0.062	0.340	0.110
Benzo(g,h,i)perylene (ug/L)	0.019	0.163	0.059	0.047	12	12	100%	0.022	0.085	0.039	0.66	0.011	0.081	0.040
Chrysene (ug/L)	0.019	0.347	0.089	0.051	12	12	100%	0.023	0.210	0.099	1.12	0.029	0.149	0.043
Dibenz(a,h)anthracene (ug/L)	0.003	0.016	0.007	0.006	3	12	25%	0.003	0.012	0.004	0.54	0.001	0.010	0.005
Fluoranthene (ug/L)	0.036	0.541	0.151	0.097	12	12	100%	0.041	0.314	0.148	0.98	0.043	0.239	0.082
Indeno(1,2,3-cd)pyrene (ug/L)	0.017	0.183	0.059	0.047	12	12	100%	0.019	0.086	0.045	0.76	0.013	0.087	0.039
Pyrene (ug/L)	0.045	0.542	0.133	0.093	11	12	92%	0.046	0.185	0.136	1.02	0.039	0.217	0.078
Retene (ug/L)	0.006	0.053	0.020	0.015	12	12	100%	0.006	0.034	0.014	0.72	0.004	0.028	0.013
Total HPAHs	0.216	3.017	0.805	0.548	12	12	100%	0.232	1.352	0.780	0.97	0.225	1.300	0.464
TOTAL PAHs	0.273	3.508	0.938	0.666	12	12	100%	0.307	1.543	0.898	0.96	0.259	1.509	0.547
Phthalates														
bis(2-Ethylhexyl) phthalate (ug/L)	0.90	3.73	1.71	1.48	12	12	100%	1.19	2.53	0.76	0.44	0.22	2.16	1.37
Butyl benzyl phthalate (ug/L)	0.200	5.570	0.652	0.206	1	12	8%	0.201	0.210	1.549	2.38	0.447	1.547	0.203
Diethyl phthalate (ug/L)	0.283	0.347	0.304	0.293	3	12	25%	0.293	0.334	0.021	0.07	0.006	0.315	0.293
Dimethyl phthalate (ug/L)	0.169	0.177	0.172	0.173	0	12	0%	0.169	0.175	0.003	0.02	0.001	0.174	0.171
Di-n-butyl phthalate (ug/L)	0.232	0.574	0.360	0.334	9	12	75%	0.240	0.505	0.104	0.29	0.030	0.419	0.308
Di-n-Octyl phthalate (ug/L)	0.179	0.188	0.183	0.184	0	12	0%	0.179	0.186	0.003	0.02	0.001	0.184	0.181
***Total Phthalates**	1.26	6.99	2.55	2.00	12	12	100%	1.36	4.48	1.67	0.65	0.48	3.56	1.78
Herbicides														
Dichlobenil (ug/L)	0.011	0.121	0.047	0.043	12	12	100%	0.012	0.084	0.032	0.67	0.009	0.065	0.031
TPH														
NWTPH-Diesel (mg/L)	0.05	0.05	0.05	0.05	0	2	0%	0.05	0.05	0.00	0.00	0.00	0.05	0.05
NWTPH-Heavy Oil (mg/L)	0.28	0.29	0.29	0.29	2	2	100%	0.28	0.29	0.01	0.02	0.00	0.29	0.28
Bacteria														
Coliform, Fecal (CFU/100 ml)	11000	80000	45500	45500	2	2	100%	17900	73100	48790	1.07	34500	80000	11000
E.coli (CFU/100 ml)	2200	3300	2750	2750	2	2	100%	2310	3190	778	0.28	550	3300	2200
Enterococci (CFU/100 ml)	10000	73500	41750	41750	2	2	100%	16350	67150	44901	1.08	31750	73500	10000

Table E-11
Summary Statistics for Stormwater at OF237B Water Years 2002-2023

	Minimum	Maximum	Arithmetic Mean	Median	Detects	Count	Percent Detects	10th Per	90th Per	Standard Deviation	Coefficient of Variation	Standard Error	95% UCL	95% LCL
Conventionals														
Anionic Surfactants - MBAS (mg/L)	0.002	0.357	0.051	0.042	80	89	89%	0.019	0.073	0.049	0.96	0.005	0.062	0.042
BOD (mg/L)	0.4	9.8	3.1	2.7	59	74	79%	1.3	5.4	1.9	0.59	0.2	3.6	2.7
Chloride (mg/L)	3.0E-03	68.60	5.90	4.59	85	86	98%	0.01	9.41	7.83	1.33	0.84	7.80	4.57
Conductivity (uS/cm)	39.5	708	133	123	153	153	100%	82.3	181.0	66.2	0.50	5.4	145.0	124.0
Hardness (mg CaCO3/L)	20.7	1220	54.6	48.3	219	219	100%	32.6	69.7	80.3	1.47	5.4	66.3	47.9
pH (pH units)	5.7	8.8	6.9	7.0	220	220	100%	6.4	7.3	0.4	0.06	0.0	7.0	6.9
TSS (mg/L)	3.6	278	48.3	35.0	208	208	100%	13.7	97.2	43.1	0.89	3.0	54.3	42.7
Turbidity (NTU)	7.2	50.2	19.6	18.2	61	61	100%	10.8	30.3	9.3	0.47	1.2	21.9	17.4
Nutrients														
Nitrate+Nitrite as N (mg/L)	0.190	2.720	1.190	1.130	114	114	100%	0.727	1.770	0.417	0.35	0.039	1.270	1.120
Phosphorus, Total (mg/L)	0.017	0.564	0.105	0.088	112	113	99%	0.053	0.173	0.065	0.62	0.006	0.117	0.094
Phosphate, Ortho (mg/L)	2.00E-05	0.128	0.022	0.020	112	112	100%	0.000	0.037	0.016	0.76	0.002	0.025	0.019
Total Nitrogen (mg/L)	0.02	3.19	1.32	1.26	113	114	99%	0.72	2.00	0.54	0.41	0.05	1.42	1.22
Metals														
Cadmium (ug/L)	0.002	0.455	0.085	0.068	73	130	56%	0.013	0.169	0.075	0.87	0.007	0.099	0.073
Cadmium, Dissolved (ug/L)	9.00E-04	0.153	0.034	0.030	43	131	32%	0.007	0.067	0.028	0.81	0.002	0.039	0.030
Copper (ug/L)	2.93	27.90	7.89	6.35	128	128	100%	4.07	12.80	4.34	0.55	0.38	8.67	7.17
Copper, Dissolved (ug/L)	0.75	8.06	2.60	2.22	124	125	99%	1.62	3.81	1.19	0.46	0.11	2.81	2.40
Lead (ug/L)	1.40	64.20	9.94	6.65	216	218	99%	2.44	22.60	9.68	0.97	0.66	11.30	8.72
Lead, Dissolved (ug/L)	0.002	11.400	0.518	0.245	149	220	67%	0.151	1.100	0.994	1.92	0.067	0.663	0.405
Mercury (ug/L)	1.000E-07	0.2160	0.0180	0.0077	65	223	29%	0.0010	0.0430	0.0280	1.52	0.0020	0.0220	0.0150
Mercury, Dissolved (ug/L)	2.000E-07	0.1820	0.0160	0.0069	19	223	8%	0.0006	0.0420	0.0200	1.26	0.0010	0.0190	0.0130
Zinc (ug/L)	15.0	285.0	60.7	45.0	219	219	100%	25.0	116.0	44.3	0.73	3.0	66.8	55.1
Zinc, Dissolved (ug/L)	6.8	260.0	24.4	18.8	219	220	99%	12.4	39.8	23.2	0.95	1.6	27.7	21.7
Insecticides														
2,4-D (ug/L)	0.001	2.100	0.363	0.165	45	72	62%	0.028	0.918	0.472	1.30	0.056	0.475	0.259
Carbaryl (ug/L	2.0E-04	0.45	0.12	0.06	0	26	0%	0.01	0.33	0.14	1.11	0.03	0.18	0.08
Chlorpyrifos (ug/L)	3.00E-05	0.106	0.019	0.009	1	94	1%	0.001	0.050	0.023	1.18	0.002	0.024	0.015
Bifenthrin (ug/L)	3.00E-04	0.036	0.007	0.007	3	33	9%	0.001	0.010	0.006	0.96	0.001	0.009	0.005
PAHs														
LPAHs														
2-Methylnaphthalene (ug/L)	1.00E-04	0.250	0.012	0.008	123	220	55%	0.002	0.021	0.020	1.71	0.001	0.015	0.010
Acenaphthene (ug/L)	8.00E-06	0.063	0.005	0.004	37	220	16%	0.001	0.011	0.006	1.12	0.000	0.006	0.005
Acenaphthylene (ug/L)	2.00E-06	0.064	0.005	0.004	31	220	14%	0.001	0.009	0.006	1.12	0.000	0.006	0.004
Anthracene (ug/L)	2.00E-04	0.097	0.007	0.004	48	220	21%	0.001	0.014	0.010	1.40	0.001	0.008	0.006
Fluorene (ug/L)	2.00E-05	0.078	0.007	0.005	73	220	33%	0.001	0.014	0.009	1.18	0.001	0.009	0.006
Naphthalene (ug/L)	4.00E-05	0.130	0.017	0.014	135	218	61%	0.003	0.031	0.014	0.85	0.001	0.018	0.015
Phenanthrene (ug/L)	0.001	0.838	0.045	0.021	194	220	88%	0.008	0.112	0.074	1.66	0.005	0.056	0.036
Total LPAHs[1]	0.006	1.130	0.080	0.054	218	218	100%	0.019	0.180	0.101	1.25	0.007	0.095	0.068
HPAHs														
Benzo(a)anthracene (ug/L)	6.00E-05	0.685	0.029	0.010	158	220	71%	0.001	0.076	0.059	2.03	0.004	0.038	0.022
Benzo(a)pyrene (ug/L)	1.00E-04	0.690	0.034	0.013	158	220	71%	0.002	0.090	0.065	1.90	0.004	0.043	0.027
Benzo(b,k)fluoranthene (ug/L)	1.00E-05	1.760	0.095	0.036	178	220	80%	0.006	0.245	0.173	1.82	0.012	0.120	0.074
Benzo(g,h,i)perylene (ug/L)	3.00E-05	0.614	0.042	0.019	189	220	85%	0.004	0.106	0.064	1.54	0.004	0.051	0.034
Chrysene (ug/L)	1.00E-04	0.965	0.061	0.021	183	220	83%	0.003	0.172	0.105	1.72	0.007	0.076	0.048
Dibenz(a,h)anthracene (ug/L)	4.00E-05	0.143	0.008	0.004	75	220	34%	0.001	0.021	0.013	1.57	0.001	0.010	0.007
Fluoranthene (ug/L)	0.001	1.830	0.094	0.035	216	220	98%	0.011	0.227	0.172	1.84	0.012	0.118	0.073
Indeno(1,2,3-cd)pyrene (ug/L)	8.00E-05	0.546	0.030	0.014	166	220	75%	0.002	0.071	0.051	1.70	0.003	0.037	0.024
Pyrene (ug/L)	0.000	1.490	0.096	0.041	210	220	95%	0.013	0.272	0.154	1.60	0.010	0.119	0.077
Retene (ug/L)	4.00E-04	0.029	0.008	0.007	21	31	67%	0.002	0.013	0.006	0.79	0.001	0.010	0.006
Total HPAHs[2]	0.019	8.730	0.488	0.193	219	219	100%	0.039	1.340	0.852	1.75	0.058	0.610	0.385
TOTAL PAHs[3]	0.028	9.870	0.568	0.255	219	219	100%	0.073	1.540	0.947	1.67	0.064	0.702	0.456
Phthalates														
bis(2-Ethylhexyl) phthalate (ug/L)	0.01	12.00	1.89	1.12	183	219	83%	0.46	4.70	2.04	1.08	0.14	2.17	1.63
Butyl benzyl phthalate (ug/L)	0.001	2.80	0.322	0.233	28	220	12%	0.048	0.736	0.352	1.09	0.024	0.370	0.278
Diethyl phthalate (ug/L)	0.002	52.00	0.962	0.241	57	220	25%	0.044	0.997	4.650	4.83	0.313	1.660	0.467
Dimethyl phthalate (ug/L)	4.00E-04	0.956	0.227	0.175	6	219	2%	0.025	0.591	0.232	1.02	0.016	0.259	0.197
Di-n-butyl phthalate (ug/L)	2.00E-04	1.000	0.336	0.300	82	220	37%	0.059	0.693	0.233	0.69	0.016	0.367	0.306
Di-n-Octyl phthalate (ug/L)	0.002	2.300	0.316	0.217	42	219	19%	0.031	0.806	0.350	1.11	0.024	0.364	0.271
***Total Phthalates[4]**	0.00	66.20	2.84	1.42	199	219	90%	0.18	5.59	5.74	2.03	0.39	3.69	2.18
Herbicides														
Dichlobenil (ug/L)	0.001	1.380	0.067	0.037	87	123	70%	0.010	0.117	0.135	2.02	0.012	0.094	0.048
TPH														
NWTPH-Diesel (mg/L)	2.0E-04	0.34	0.05	0.04	9	77	11%	0.01	0.10	0.05	0.99	0.01	0.06	0.04
NWTPH-Gasoline (mg/L)	0.4	395.0	23.6	15.7	14	70	20%	1.4	40.6	47.4	2.01	5.7	36.8	15.7
NWTPH-Heavy Oil (mg/L)	0.01	1.30	0.48	0.42	68	77	88%	0.09	0.90	0.29	0.61	0.03	0.54	0.41
Bacteria														
Coliform, Fecal (CFU/100 ml)	130	280000	8720	2400	72	72	100%	300	16000	32900	3.77	3870	17100	3950
E.coli (CFU/100 ml)	790	140000	19900	3100	8	8	100%	1010	45500	48500	2.44	17200	54600	1880
Enterococci (CFU/100 ml)	3100	220000	36400	6700	9	9	100%	3420	96800	71700	1.97	23900	84500	5260
BTEX														
Benzene (ug/L)	1.E-02	0.3	0.1	0.1	1	48	2%	0.0	0.2	0.1	0.58	0.0	0.1	0.1
Ethylbenzene (ug/L)	3.E-03	0.8	0.1	0.1	1	48	2%	0.0	0.2	0.1	1.00	0.0	0.2	0.1
m,p-Xylene (ug/L)	1.E-03	3.5	0.3	0.2	1	48	2%	0.0	0.4	0.5	1.82	0.1	0.4	0.2
o-Xylene (ug/L)	2.E-03	1.6	0.1	0.1	1	48	2%	0.0	0.2	0.2	1.86	0.0	0.2	0.1
Toluene (ug/L)	2.E-02	4.0	0.2	0.1	2	48	4%	0.1	0.2	0.6	2.65	0.1	0.4	0.1

[1] Total LPAHs is the sum of the concentration or non-detected calculated value of the following compounds: Naphthalene, acenaphthene, acenaphthylene, anthracene, fluorene, and phenanthrene.

[2] Total HPAHs is the sum of the concentration of non-detected calculated value of the following compounds: Fluoranthene, pyrene, benzo(a)anthracene, chrysene, benzo(b,k)fluoranthene, benzo(b,k)fluoranthene, benzo(a)pyrene, indeno(1,2,3-c,d)pyrene, dibenz(a,h)anthracene, benzo(g,h,i)perylene.

[3] Total PAHs is the sum of the LPAHs and HPAHs.

[4] Total phthalates is the sum of detected values only.

Table E-11 (Cont'd)
Summary Statistics for Stormwater at OF237B WY2023

	Minimum	Maximum	Arithmetic Mean	Median	Detects	Count	Percent Detects	10th Per	90th Per	Standard Deviation	Coefficient of Variation	Standard Error	95% UCL	95% LCL
Conventionals														
Anionic Surfactants - MBAS (mg/L)	0.048	0.068	0.060	0.063	4	4	100%	0.052	0.067	0.009	0.15	0.004	0.067	0.052
BOD (mg/L)	2.2	9.8	4.7	3.3	4	4	100%	2.3	8.1	3.5	0.76	1.8	8.0	2.4
Chloride (mg/L)	5.44	23.70	11.39	8.20	4	4	100%	5.55	19.77	8.54	0.75	4.27	19.23	5.62
Conductivity (uS/cm)	91.9	167.0	135.9	142.5	8	8	100%	99.7	158.6	25.8	0.19	9.1	151.5	118.1
Hardness (mg CaCO3/L)	34.5	74.6	57.2	59.8	8	8	100%	35.8	71.2	14.8	0.26	5.2	66.3	47.1
pH (pH units)	6.2	7.7	6.8	6.6	8	8	100%	6.4	7.4	0.5	0.08	0.2	7.2	6.5
TSS (mg/L)	13.8	75.9	31.1	25.2	8	8	100%	14.8	54.8	20.7	0.66	7.3	45.5	19.7
Turbidity (NTU)	8.3	25.8	15.8	14.5	4	4	100%	9.9	22.7	7.3	0.47	3.7	22.8	10.0
Nutrients														
Nitrate+Nitrite as N (mg/L)	0.712	1.800	1.435	1.480	7	7	100%	1.113	1.752	0.355	0.25	0.134	1.647	1.169
Phosphorus, Total (mg/L)	0.064	0.230	0.107	0.092	7	7	100%	0.065	0.169	0.058	0.54	0.022	0.152	0.075
Phosphate, Ortho (mg/L)	0.019	0.063	0.034	0.031	6	6	100%	0.020	0.053	0.018	0.51	0.007	0.048	0.023
Total Nitrogen (mg/L)	1.50	2.27	1.96	2.01	7	7	100%	1.67	2.18	0.25	0.13	0.09	2.11	1.78
Metals														
Cadmium (ug/L)	0.050	0.133	0.060	0.050	1	8	13%	0.050	0.075	0.029	0.49	0.010	0.081	0.050
Cadmium, Dissolved (ug/L)	0.023	0.065	0.028	0.023	1	8	13%	0.023	0.035	0.015	0.54	0.005	0.038	0.023
Copper (ug/L)	4.41	16.80	7.80	6.00	8	8	100%	5.13	12.32	4.08	0.52	1.44	10.67	5.60
Copper, Dissolved (ug/L)	1.69	3.74	2.47	2.28	8	8	100%	1.82	3.36	0.70	0.28	0.25	2.95	2.05
Lead (ug/L)	2.37	16.50	5.58	4.06	8	8	100%	2.53	9.82	4.63	0.83	1.64	8.92	3.31
Lead, Dissolved (ug/L)	0.153	0.450	0.275	0.206	8	8	100%	0.154	0.438	0.134	0.49	0.047	0.368	0.195
Mercury (ug/L)	0.0019	0.0115	0.0052	0.0045	4	8	50%	0.0020	0.0098	0.0035	0.66	0.0012	0.0076	0.0032
Mercury, Dissolved (ug/L)	0.0011	0.0056	0.0044	0.0056	0	8	0%	0.0011	0.0056	0.0021	0.46	0.0007	0.0056	0.0028
Zinc (ug/L)	23.6	96.5	46.0	34.9	8	8	100%	24.5	84.1	26.8	0.58	9.5	64.4	30.6
Zinc, Dissolved (ug/L)	8.6	36.8	16.4	13.2	8	8	100%	10.6	24.5	8.8	0.54	3.1	23.0	11.9
Insecticides														
Bifenthrin (ug/L)	0.000	0.036	0.007	0.001	2	8	25%	0.000	0.020	0.013	1.83	0.004	0.016	0.001
PAHs														
LPAHs														
2-Methylnaphthalene (ug/L)	0.005	0.013	0.006	0.005	1	8	13%	0.005	0.007	0.003	0.50	0.001	0.008	0.005
Acenaphthene (ug/L)	0.005	0.005	0.005	0.005	0	8	0%	0.005	0.005	0.000	0.04	0.000	0.005	0.005
Acenaphthylene (ug/L)	0.005	0.011	0.005	0.005	1	8	13%	0.005	0.006	0.002	0.43	0.001	0.007	0.005
Anthracene (ug/L)	0.003	0.010	0.003	0.003	1	8	13%	0.003	0.005	0.003	0.77	0.001	0.005	0.003
Fluorene (ug/L)	0.005	0.005	0.005	0.005	0	8	0%	0.005	0.005	0.000	0.05	0.000	0.005	0.005
Naphthalene (ug/L)	0.008	0.031	0.014	0.008	1	8	13%	0.008	0.025	0.009	0.64	0.003	0.020	0.009
Phenanthrene (ug/L)	0.011	0.078	0.028	0.020	8	8	100%	0.012	0.056	0.023	0.81	0.008	0.045	0.016
Total LPAHs	0.036	0.126	0.061	0.046	8	8	100%	0.036	0.103	0.032	0.53	0.011	0.084	0.042
HPAHs														
Benzo(a)anthracene (ug/L)	0.002	0.046	0.015	0.011	5	8	63%	0.003	0.029	0.014	0.98	0.005	0.025	0.007
Benzo(a)pyrene (ug/L)	0.001	0.073	0.016	0.010	5	8	63%	0.002	0.033	0.024	1.46	0.008	0.033	0.005
Benzo(b,k)fluoranthene (ug/L)	0.021	0.194	0.053	0.032	7	8	88%	0.024	0.098	0.058	1.09	0.020	0.095	0.028
Benzo(g,h,i)perylene (ug/L)	0.012	0.046	0.020	0.017	8	8	100%	0.013	0.030	0.011	0.56	0.004	0.028	0.015
Chrysene (ug/L)	0.003	0.071	0.018	0.012	5	8	63%	0.004	0.035	0.022	1.20	0.008	0.034	0.008
Dibenz(a,h)anthracene (ug/L)	0.003	0.003	0.003	0.003	0	8	0%	0.003	0.003	0.000	0.00	0.000	0.003	0.003
Fluoranthene (ug/L)	0.020	0.163	0.050	0.030	8	8	100%	0.021	0.094	0.048	0.98	0.017	0.085	0.026
Indeno(1,2,3-cd)pyrene (ug/L)	0.009	0.040	0.016	0.012	7	8	88%	0.010	0.023	0.010	0.65	0.004	0.023	0.011
Pyrene (ug/L)	0.023	0.190	0.054	0.035	7	8	88%	0.024	0.095	0.056	1.03	0.020	0.095	0.030
Retene (ug/L)	0.002	0.029	0.012	0.009	6	8	75%	0.003	0.024	0.009	0.80	0.003	0.018	0.006
Total HPAHs	0.109	0.826	0.244	0.166	8	8	100%	0.119	0.404	0.238	0.98	0.084	0.418	0.141
TOTAL PAHs	0.145	0.952	0.305	0.219	8	8	100%	0.155	0.494	0.267	0.88	0.094	0.501	0.185
Phthalates														
bis(2-Ethylhexyl) phthalate (ug/L)	0.46	2.39	1.14	0.99	7	8	88%	0.68	1.72	0.58	0.51	0.20	1.56	0.82
Butyl benzyl phthalate (ug/L)	0.200	0.210	0.205	0.205	0	8	0%	0.202	0.209	0.004	0.02	0.001	0.207	0.203
Diethyl phthalate (ug/L)	0.155	0.163	0.159	0.159	0	8	0%	0.156	0.161	0.003	0.02	0.001	0.161	0.157
Dimethyl phthalate (ug/L)	0.168	0.177	0.173	0.173	0	8	0%	0.170	0.176	0.003	0.02	0.001	0.175	0.171
Di-n-butyl phthalate (ug/L)	0.146	0.369	0.181	0.151	1	8	13%	0.147	0.240	0.077	0.42	0.027	0.237	0.149
Di-n-Octyl phthalate (ug/L)	0.178	0.188	0.183	0.184	0	8	0%	0.180	0.186	0.003	0.02	0.001	0.185	0.181
***Total Phthalates**	0.00	2.76	1.13	0.99	8	8	100%	0.54	1.83	0.78	0.69	0.28	1.68	0.68
Herbicides														
Dichlobenil (ug/L)	0.012	0.097	0.035	0.027	8	8	100%	0.018	0.055	0.026	0.76	0.009	0.054	0.022
TPH														
NWTPH-Diesel (mg/L)	0.05	0.05	0.05	0.05	0	2	0%	0.05	0.05	0.00	0.00	0.00	0.05	0.05
NWTPH-Heavy Oil (mg/L)	0.34	0.78	0.56	0.56	2	2	100%	0.38	0.74	0.31	0.56	0.22	0.78	0.34
Bacteria														
Coliform, Fecal (CFU/100 ml)	2300	2300	2300	2300	1	1	100%	2300	2300				2300	2300
E.Coli (CFU/100 ml)	2300	3900	3100	3100	2	2	100%	2460	3740	1131	0.36	800	3900	2300
Enterococci (CFU/100 ml)	6300	66000	36150	36150	2	2	100%	12270	60030	42214	1.17	29850	66000	6300

Table E-12
Summary Statistics for Stormwater at OF243 Water Years 2002-2023

	Minimum	Maximum	Arithmetic Mean	Median	Detects	Count	Percent Detects	10th Per	90th Per	Standard Deviation	Coefficient of Variation	Standard Error	95% UCL	95% LCL
Conventionals														
Anionic Surfactants - MBAS (mg/L)	1.20E-02	0.158	0.049	0.044	52	53	98%	0.026	0.086	0.027	0.56	0.004	0.057	0.042
BOD (mg/L)	0.2	8.5	3.0	2.4	37	53	69%	0.9	4.8	2.0	0.67	0.3	3.5	2.4
Chloride (mg/L)	261	25400	1890	1180	54	54	100%	727	2570	3360	1.78	457	2910	1280
Conductivity (uS/cm)	942	13300	5080	4220	98	98	100%	2680	8380	2550	0.50	258	5610	4590
Hardness (mg CaCO3/L)	59.3	3150	515	432	144	144	100%	229	863	352	0.68	29.3	576	461
pH (pH units)	6.1	7.8	7.1	7.1	144	144	100%	6.7	7.3	0.3	0.04	0.0	7.1	7.0
TSS (mg/L)	4.4	300	62.2	40.6	141	141	100%	14.8	148.0	58.3	0.94	4.9	72.0	52.8
Turbidity (NTU)	0.2	169	45.6	33.3	53	53	100%	14.3	103.0	38.2	0.84	5.2	56.2	36.3
Nutrients														
Nitrate+Nitrite as N (mg/L)	0.089	0.799	0.253	0.217	60	60	100%	0.128	0.446	0.135	0.53	0.017	0.288	0.221
Phosphorus, Total (mg/L)	0.043	3.680	0.419	0.211	60	60	100%	0.107	0.828	0.595	1.42	0.077	0.585	0.288
Phosphate, Ortho (mg/L)	0.007	0.138	0.034	0.032	59	60	98%	0.016	0.048	0.021	0.61	0.003	0.040	0.030
Total Nitrogen (mg/L)	0.26	2.11	0.75	0.74	60	60	100%	0.41	1.08	0.31	0.41	0.04	0.83	0.68
Metals														
Cadmium (ug/L)	0.008	1.250	0.231	0.188	54	65	83%	0.056	0.423	0.191	0.83	0.024	0.280	0.189
Cadmium, Dissolved (ug/L)	0.001	0.173	0.079	0.080	52	65	80%	0.019	0.139	0.042	0.53	0.005	0.090	0.070
Copper (ug/L)	3.22	110.00	20.90	17.20	65	65	100%	9.37	37.10	16.00	0.76	1.98	25.20	17.50
Copper, Dissolved (ug/L)	0.95	9.19	4.01	3.75	65	65	100%	1.99	6.21	1.78	0.44	0.22	4.46	3.58
Lead (ug/L)	0.12	379	32.60	15.40	144	144	100%	4.34	66.50	50.50	1.55	4.21	41.50	25.20
Lead, Dissolved (ug/L)	0.002	145.0	2.540	0.311	109	144	75%	0.023	4.110	12.500	4.91	1.040	4.940	1.120
Mercury (ug/L)	1.000E-06	0.1880	0.0240	0.0110	52	145	35%	0.0010	0.0550	0.0320	1.36	0.0030	0.0290	0.0190
Mercury, Dissolved (ug/L)	3.000E-07	0.5520	0.0170	0.0075	5	145	3%	0.0005	0.0420	0.0470	2.71	0.0040	0.0260	0.0120
Zinc (ug/L)	12.3	1170	90.4	64.8	144	144	100%	38.1	141.0	106.0	1.18	8.9	110.0	76.0
Zinc, Dissolved (ug/L)	5.6	910	33.8	22.9	144	144	100%	13.1	47.0	75.7	2.24	6.3	48.3	25.5
Insecticides														
2,4-D (ug/L)	2.00E-03	0.190	0.047	0.034	19	33	57%	0.010	0.102	0.043	0.91	0.008	0.063	0.034
Carbaryl (ug/L	0.01	0.48	0.20	0.15	0	18	0%	0.04	0.40	0.15	0.76	0.04	0.27	0.14
Chlorpyrifos (ug/L)	0.000	0.443	0.030	0.012	1	50	2%	0.001	0.053	0.064	2.13	0.009	0.051	0.017
Bifenthrin (ug/L)	1.00E-03	0.010	0.006	0.006	0	24	0%	0.002	0.010	0.003	0.47	0.001	0.007	0.005
PAHs														
LPAHs														
2-Methylnaphthalene (ug/L)	4.00E-05	0.136	0.012	0.009	91	144	63%	0.001	0.024	0.015	1.24	0.001	0.015	0.010
Acenaphthene (ug/L)	2.00E-04	0.105	0.021	0.018	124	144	86%	0.006	0.037	0.015	0.71	0.001	0.023	0.018
Acenaphthylene (ug/L)	2.00E-04	0.064	0.009	0.007	68	144	47%	0.001	0.021	0.008	0.95	0.001	0.010	0.008
Anthracene (ug/L)	9.00E-04	0.079	0.029	0.028	136	144	94%	0.008	0.051	0.017	0.58	0.001	0.032	0.026
Fluorene (ug/L)	2.00E-04	0.098	0.014	0.010	103	144	71%	0.003	0.027	0.013	0.96	0.001	0.016	0.012
Naphthalene (ug/L)	1.00E-03	0.135	0.022	0.018	99	143	69%	0.004	0.037	0.019	0.86	0.002	0.025	0.019
Phenanthrene (ug/L)	0.002	0.221	0.049	0.032	140	144	97%	0.013	0.121	0.045	0.91	0.004	0.056	0.042
Total LPAHs[1]	0.030	0.473	0.140	0.121	143	143	100%	0.054	0.265	0.083	0.59	0.007	0.154	0.127
HPAHs														
Benzo(a)anthracene (ug/L)	2.00E-04	0.615	0.033	0.015	112	144	77%	0.003	0.076	0.064	1.96	0.005	0.045	0.024
Benzo(a)pyrene (ug/L)	2.00E-04	0.654	0.033	0.015	108	144	75%	0.002	0.078	0.064	1.91	0.005	0.045	0.025
Benzo(b,k)fluoranthene (ug/L)	4.00E-04	1.430	0.088	0.041	127	144	88%	0.011	0.201	0.152	1.72	0.013	0.116	0.067
Benzo(g,h,i)perylene (ug/L)	1.00E-04	0.503	0.035	0.019	122	144	84%	0.004	0.088	0.053	1.51	0.004	0.045	0.028
Chrysene (ug/L)	8.00E-04	0.788	0.062	0.026	130	144	90%	0.005	0.152	0.101	1.64	0.008	0.079	0.047
Dibenz(a,h)anthracene (ug/L)	3.00E-05	0.684	0.012	0.005	45	144	31%	0.001	0.017	0.057	4.83	0.005	0.022	0.006
Fluoranthene (ug/L)	0.013	0.444	0.088	0.052	144	144	100%	0.020	0.226	0.089	1.01	0.007	0.103	0.074
Indeno(1,2,3-cd)pyrene (ug/L)	6.00E-05	0.620	0.028	0.016	111	144	77%	0.002	0.060	0.056	2.03	0.005	0.038	0.021
Pyrene (ug/L)	0.012	0.620	0.093	0.054	144	144	100%	0.019	0.230	0.099	1.06	0.008	0.110	0.077
Retene (ug/L)	0.002	0.023	0.009	0.009	20	23	86%	0.005	0.016	0.005	0.49	0.001	0.011	0.008
Total HPAHs[2]	0.031	5.840	0.466	0.246	144	144	100%	0.072	1.180	0.674	1.45	0.056	0.583	0.367
TOTAL PAHs[3]	0.065	6.050	0.606	0.373	144	144	100%	0.136	1.410	0.728	1.20	0.061	0.737	0.497
Phthalates														
bis(2-Ethylhexyl) phthalate (ug/L)	8.7E-03	41.00	1.83	0.93	117	143	81%	0.35	4.07	3.67	2.00	0.31	2.54	1.36
Butyl benzyl phthalate (ug/L)	0.004	9.200	0.776	0.243	32	144	22%	0.050	1.800	1.560	2.01	0.130	1.040	0.544
Diethyl phthalate (ug/L)	0.018	7.600	0.464	0.312	45	144	31%	0.058	0.948	0.733	1.58	0.061	0.599	0.362
Dimethyl phthalate (ug/L)	1.00E-03	1.730	0.260	0.174	1	143	0%	0.018	0.722	0.283	1.09	0.024	0.309	0.215
Di-n-butyl phthalate (ug/L)	0.006	1.270	0.319	0.258	43	144	29%	0.039	0.722	0.261	0.82	0.022	0.361	0.278
Di-n-Octyl phthalate (ug/L)	6.90E-03	1.490	0.292	0.211	14	142	9%	0.019	0.758	0.292	1.00	0.024	0.342	0.247
***Total Phthalates[4]**	0.00	41.00	2.69	1.37	130	144	90%	0.04	6.58	4.36	1.62	0.36	3.45	2.06
Herbicides														
Dichlobenil (ug/L)	6.00E-04	0.088	0.017	0.013	22	72	30%	0.004	0.035	0.015	0.84	0.002	0.021	0.014
TPH														
NWTPH-Diesel (mg/L)	3.0E-04	0.19	0.05	0.05	3	42	7%	0.01	0.09	0.04	0.86	0.01	0.06	0.04
NWTPH-Gasoline (mg/L)	6.E-03	43.4	14.8	6.7	0	35	0%	1.0	38.0	15.0	1.01	2.5	19.8	10.1
NWTPH-Heavy Oil (mg/L)	4.0E-04	0.96	0.33	0.33	33	42	78%	0.02	0.57	0.23	0.69	0.04	0.40	0.27
Bacteria														
Coliform, Fecal (CFU/100 ml)	170	80000	8370	2400	41	41	100%	310	16000	14900	1.78	2320	13500	4460
E.coli (CFU/100 ml)	130	50000	7490	1300	9	9	100%	226	16400	16100	2.15	5380	18800	1100
Enterococci (CFU/100 ml)	3000	110000	29500	12000	9	9	100%	4280	90000	39400	1.34	13100	56400	8640
BTEX														
Benzene (ug/L)	1.E-03	0.2	0.1	0.1	0	35	0%	0.0	0.2	0.1	0.68	0.0	0.1	0.1
Ethylbenzene (ug/L)	3.E-03	0.2	0.1	0.1	0	35	0%	0.0	0.2	0.1	0.55	0.0	0.1	0.1
m,p-Xylene (ug/L)	1.E-02	0.6	0.2	0.2	1	35	2%	0.1	0.4	0.1	0.64	0.0	0.3	0.2
o-Xylene (ug/L)	1.E-02	0.2	0.1	0.1	0	35	0%	0.0	0.1	0.0	0.50	0.0	0.1	0.1
Toluene (ug/L)	3.E-02	0.5	0.1	0.1	4	35	11%	0.0	0.3	0.1	0.79	0.0	0.2	0.1

[1] *Total LPAHs is the sum of the concentration or non-detected calculated value of the following compounds: Naphthalene, acenaphthene, acenaphthylene, anthracene, fluorene, and phenanthrene.*

[2] *Total HPAHs is the sum of the concentration of non-detected calculated value of the following compounds: Fluoranthene, pyrene, benzo(a)anthracene, chrysene, benzo(b,k)fluoranthene, benzo(b,k)fluoranthene, benzo(a)pyrene, indeno(1,2,3-c,d)pyrene, dibenz(a,h)anthracene, benzo(g,h,i)perylene.*

[3] *Total PAHs is the sum of the LPAHs and HPAHs.*

[4] *Total phthalates is the sum of detected values only.*

Table E-12 (Cont'd)
Summary Statistics for Stormwater at OF243 WY2023

	Minimum	Maximum	Arithmetic Mean	Median	Detects	Count	Percent Detects	10th Per	90th Per	Standard Deviation	Coefficient of Variation	Standard Error	95% UCL	95% LCL
Conventionals														
Anionic Surfactants - MBAS (mg/L)	0.029	0.138	0.071	0.058	5	5	100%	0.035	0.117	0.043	0.61	0.019	0.109	0.041
BOD (mg/L)	1.5	2.4	1.9	1.9	3	6	50%	1.5	2.3	0.4	0.19	0.1	2.2	1.6
Chloride (mg/L)	534.00	2070.00	1134.40	924.00	5	5	100%	658.00	1762.00	589.88	0.52	263.80	1611.60	736.00
Conductivity (uS/cm)	1980.0	6690.0	4520.0	4640.0	7	7	100%	2646.0	6558.0	1844.5	0.41	697.2	5757.1	3255.7
Hardness (mg CaCO3/L)	210.0	729.0	464.3	449.0	7	7	100%	264.0	699.0	199.0	0.43	75.2	603.6	331.1
pH (pH units)	6.9	7.7	7.2	7.1	7	7	100%	7.0	7.5	0.3	0.04	0.1	7.4	7.0
TSS (mg/L)	6.2	76.7	25.1	16.8	7	7	100%	7.9	47.7	24.2	0.96	9.1	43.7	12.0
Turbidity (NTU)	10.0	43.7	19.9	16.1	5	5	100%	10.6	33.5	13.7	0.69	6.1	32.1	11.8
Nutrients														
Nitrate+Nitrite as N (mg/L)	0.130	0.545	0.272	0.222	7	7	100%	0.135	0.485	0.160	0.59	0.061	0.392	0.171
Phosphorus, Total (mg/L)	0.068	0.244	0.171	0.165	7	7	100%	0.116	0.226	0.057	0.33	0.022	0.208	0.129
Phosphate, Ortho (mg/L)	0.023	0.066	0.043	0.042	6	7	86%	0.029	0.056	0.014	0.32	0.005	0.052	0.034
Total Nitrogen (mg/L)	0.57	1.28	0.80	0.77	7	7	100%	0.58	1.10	0.25	0.31	0.10	0.99	0.65
Metals														
Cadmium (ug/L)	0.073	0.382	0.195	0.188	5	7	71%	0.087	0.300	0.106	0.54	0.040	0.272	0.127
Cadmium, Dissolved (ug/L)	0.033	0.166	0.091	0.077	6	7	86%	0.047	0.151	0.047	0.52	0.018	0.125	0.060
Copper (ug/L)	8.71	41.20	19.44	18.00	7	7	100%	10.62	30.64	10.86	0.56	4.11	27.67	13.02
Copper, Dissolved (ug/L)	3.63	9.19	5.51	4.42	7	7	100%	3.70	8.30	2.19	0.40	0.83	7.09	4.14
Lead (ug/L)	2.27	45.90	11.89	6.34	7	7	100%	2.28	27.30	15.60	1.31	5.90	24.03	4.02
Lead, Dissolved (ug/L)	0.225	0.958	0.453	0.349	7	7	100%	0.260	0.789	0.265	0.59	0.100	0.654	0.297
Mercury (ug/L)	0.0047	0.0090	0.0064	0.0059	2	7	29%	0.0051	0.0079	0.0014	0.22	0.0005	0.0074	0.0055
Mercury, Dissolved (ug/L)	0.0011	0.0056	0.0049	0.0056	0	7	0%	0.0038	0.0056	0.0017	0.34	0.0006	0.0056	0.0036
Zinc (ug/L)	28.5	91.1	50.1	47.9	7	7	100%	30.1	71.2	20.8	0.42	7.9	66.2	37.4
Zinc, Dissolved (ug/L)	17.9	38.8	25.8	23.8	7	7	100%	18.4	33.8	7.3	0.28	2.8	31.0	21.0
Insecticides														
Bifenthrin (ug/L)	0.005	0.005	0.005	0.005	0	7	0%	0.005	0.005	0.000	0.00	0.000	0.005	0.005
PAHs														
LPAHs														
2-Methylnaphthalene (ug/L)	0.005	0.020	0.007	0.005	1	7	14%	0.005	0.011	0.006	0.83	0.002	0.011	0.005
Acenaphthene (ug/L)	0.006	0.033	0.019	0.015	5	7	71%	0.007	0.031	0.011	0.59	0.004	0.026	0.011
Acenaphthylene (ug/L)	0.007	0.028	0.017	0.014	5	7	71%	0.008	0.026	0.008	0.48	0.003	0.022	0.011
Anthracene (ug/L)	0.028	0.066	0.040	0.038	7	7	100%	0.030	0.053	0.013	0.32	0.005	0.050	0.033
Fluorene (ug/L)	0.011	0.023	0.016	0.015	2	7	29%	0.012	0.021	0.004	0.28	0.002	0.019	0.013
Naphthalene (ug/L)	0.009	0.029	0.018	0.017	2	4	50%	0.010	0.027	0.009	0.50	0.004	0.025	0.011
Phenanthrene (ug/L)	0.015	0.113	0.038	0.028	7	7	100%	0.016	0.072	0.034	0.90	0.013	0.065	0.021
Total LPAHs	0.083	0.271	0.139	0.118	7	7	100%	0.091	0.208	0.064	0.46	0.024	0.187	0.103
HPAHs														
Benzo(a)anthracene (ug/L)	0.001	0.059	0.016	0.011	4	7	57%	0.002	0.037	0.020	1.28	0.008	0.031	0.005
Benzo(a)pyrene (ug/L)	0.000	0.068	0.017	0.006	4	7	57%	0.001	0.045	0.025	1.42	0.009	0.036	0.003
Benzo(b,k)fluoranthene (ug/L)	0.005	0.173	0.052	0.034	6	7	86%	0.012	0.115	0.058	1.10	0.022	0.096	0.021
Benzo(g,h,i)perylene (ug/L)	0.002	0.043	0.016	0.012	6	7	86%	0.005	0.034	0.014	0.88	0.005	0.027	0.007
Chrysene (ug/L)	0.001	0.073	0.020	0.013	4	7	57%	0.002	0.050	0.026	1.29	0.010	0.040	0.005
Dibenz(a,h)anthracene (ug/L)	0.003	0.003	0.003	0.003	0	7	0%	0.003	0.003	0.000	0.00	0.000	0.003	0.003
Fluoranthene (ug/L)	0.013	0.168	0.053	0.030	7	7	100%	0.015	0.113	0.055	1.03	0.021	0.095	0.023
Indeno(1,2,3-cd)pyrene (ug/L)	0.002	0.048	0.017	0.012	6	7	86%	0.004	0.037	0.016	0.95	0.006	0.029	0.007
Pyrene (ug/L)	0.016	0.187	0.060	0.033	7	7	100%	0.021	0.123	0.060	1.00	0.023	0.105	0.028
Retene (ug/L)	0.003	0.023	0.010	0.008	6	7	86%	0.005	0.018	0.007	0.68	0.003	0.015	0.006
Total HPAHs	0.051	0.822	0.256	0.163	7	7	100%	0.073	0.557	0.271	1.06	0.103	0.463	0.106
TOTAL PAHs	0.156	1.093	0.396	0.260	7	7	100%	0.180	0.765	0.333	0.84	0.126	0.647	0.212
Phthalates														
bis(2-Ethylhexyl) phthalate (ug/L)	0.40	1.29	0.79	0.74	6	6	100%	0.41	1.23	0.39	0.49	0.16	1.09	0.52
Butyl benzyl phthalate (ug/L)	0.199	0.210	0.204	0.204	0	7	0%	0.201	0.207	0.003	0.02	0.001	0.206	0.201
Diethyl phthalate (ug/L)	0.297	0.353	0.316	0.297	3	7	43%	0.297	0.346	0.024	0.08	0.009	0.333	0.302
Dimethyl phthalate (ug/L)	0.168	0.177	0.171	0.171	0	7	0%	0.169	0.174	0.003	0.02	0.001	0.173	0.170
Di-n-butyl phthalate (ug/L)	0.108	0.489	0.194	0.108	2	7	29%	0.108	0.394	0.154	0.79	0.058	0.312	0.108
Di-n-Octyl phthalate (ug/L)	0.178	0.187	0.182	0.182	0	7	0%	0.179	0.184	0.003	0.02	0.001	0.184	0.180
***Total Phthalates**	0.42	1.61	0.94	0.73	7	7	100%	0.46	1.55	0.51	0.54	0.19	1.30	0.61
Herbicides														
Dichlobenil (ug/L)	0.012	0.021	0.017	0.017	5	7	71%	0.013	0.021	0.004	0.21	0.001	0.019	0.014
TPH														
NWTPH-Diesel (mg/L)	0.05	0.05	0.05	0.05	0	2	0%	0.05	0.05	0.00	0.07	0.00	0.05	0.05
NWTPH-Heavy Oil (mg/L)	0.10	0.96	0.53	0.53	1	2	50%	0.18	0.87	0.61	1.16	0.43	0.96	0.10
Bacteria														
Coliform, Fecal (CFU/100 ml)	800	80000	40400	40400	2	2	100%	8720	72080	56003	1.39	39600	80000	800
E.coli (CFU/100 ml)	800	50000	25400	25400	2	2	100%	5720	45080	34790	1.37	24600	50000	800
Enterococci (CFU/100 ml)	16000	85000	50500	50500	2	2	100%	22900	78100	48790	0.97	34500	85000	16000

Table E-13
Summary Statistics for Stormwater at OF245 Water Years 2002-2023

	Minimum	Maximum	Arithmetic Mean	Median	Detects	Count	Percent Detects	10th Per	90th Per	Standard Deviation	Coefficient of Variation	Standard Error	95% UCL	95% LCL
Conventionals														
Anionic Surfactants - MBAS (mg/L)	0.001	0.434	0.069	0.057	86	88	97%	0.027	0.116	0.057	0.83	0.006	0.081	0.058
BOD (mg/L)	6.E-02	8.1	3.1	2.7	66	78	84%	1.4	5.7	1.7	0.54	0.2	3.5	2.8
Chloride (mg/L)	0.01	1260	143.0	74.2	86	86	100%	0.42	316	224	1.56	24.10	194	99.5
Conductivity (uS/cm)	46.8	6360	579	331	144	144	100%	103.0	1250	787	1.36	65.6	717	461
Hardness (mg CaCO3/L)	14.0	626	73.9	52.0	208	208	100%	26.2	145.0	72.5	0.98	5.0	84.0	64.6
pH (pH units)	5.6	8.4	7.0	7.0	208	208	100%	6.4	7.4	0.4	0.06	0.0	7.0	6.9
TSS (mg/L)	6.2	296	59.8	50.3	201	201	100%	18.1	107.0	43.8	0.73	3.1	66.0	54.0
Turbidity (NTU)	11.1	139.0	44.4	37.4	66	66	100%	17.4	80.2	27.5	0.62	3.4	51.4	38.2
Nutrients														
Nitrate+Nitrite as N (mg/L)	0.034	1.010	0.201	0.142	100	100	100%	0.078	0.419	0.170	0.84	0.017	0.234	0.169
Phosphorus, Total (mg/L)	0.054	1.510	0.184	0.140	98	98	100%	0.072	0.320	0.169	0.92	0.017	0.221	0.155
Phosphate, Ortho (mg/L)	6.00E-06	0.689	0.039	0.025	101	105	96%	0.000	0.069	0.071	1.82	0.007	0.055	0.028
Total Nitrogen (mg/L)	0.03	2.90	0.74	0.61	99	100	99%	0.30	1.41	0.47	0.64	0.05	0.83	0.65
Metals														
Cadmium (ug/L)	0.007	2.410	0.293	0.204	114	128	89%	0.076	0.514	0.335	1.14	0.030	0.355	0.240
Cadmium, Dissolved (ug/L)	2.00E-04	1.850	0.130	0.074	99	128	77%	0.025	0.224	0.222	1.71	0.020	0.171	0.096
Copper (ug/L)	3.00	42.60	13.70	12.20	128	128	100%	6.21	23.80	7.42	0.54	0.66	15.00	12.40
Copper, Dissolved (ug/L)	0.02	26.10	3.73	3.13	125	127	98%	1.55	6.09	2.88	0.77	0.26	4.26	3.28
Lead (ug/L)	0.03	60.00	9.54	7.41	206	208	99%	2.48	18.80	8.50	0.89	0.59	10.70	8.44
Lead, Dissolved (ug/L)	0.007	6.270	0.470	0.230	129	208	62%	0.071	1.180	0.685	1.46	0.047	0.567	0.384
Mercury (ug/L)	9.000E-08	0.8700	0.0210	0.0077	56	209	26%	0.0010	0.0400	0.0640	3.10	0.0040	0.0310	0.0140
Mercury, Dissolved (ug/L)	3.000E-07	0.1450	0.0170	0.0072	10	209	4%	0.0006	0.0410	0.0190	1.16	0.0010	0.0190	0.0140
Zinc (ug/L)	27.7	585	131.0	103.0	207	207	100%	48.5	230	95.9	0.73	6.7	144.0	118.0
Zinc, Dissolved (ug/L)	0.8	335	53.6	36.5	206	207	99%	20.9	107.0	46.8	0.87	3.3	60.4	47.6
Insecticides														
2,4-D (ug/L)	0.001	1.500	0.156	0.039	17	72	23%	0.005	0.621	0.290	1.86	0.034	0.227	0.094
Carbaryl	0.01	0.47	0.13	0.05	0	27	0%	0.02	0.41	0.16	1.17	0.03	0.19	0.08
Chlorpyrifos (ug/L)	8.00E-05	0.754	0.025	0.009	3	92	3%	0.002	0.041	0.079	3.19	0.008	0.044	0.014
Bifenthrin (ug/L)	4.00E-04	0.009	0.006	0.005	0	33	0%	0.003	0.009	0.003	0.44	0.000	0.007	0.005
PAHs														
LPAHs														
2-Methylnaphthalene (ug/L)	4.00E-05	1.140	0.030	0.010	138	206	66%	0.002	0.038	0.109	3.64	0.008	0.047	0.017
Acenaphthene (ug/L)	4.00E-05	0.855	0.016	0.009	125	206	60%	0.002	0.026	0.060	3.69	0.004	0.025	0.011
Acenaphthylene (ug/L)	3.00E-06	0.095	0.008	0.005	75	206	36%	0.001	0.014	0.012	1.47	0.001	0.010	0.007
Anthracene (ug/L)	5.00E-05	0.289	0.011	0.007	82	206	39%	0.001	0.017	0.025	2.24	0.002	0.015	0.008
Fluorene (ug/L)	8.00E-05	0.928	0.021	0.009	124	206	60%	0.002	0.030	0.075	3.57	0.005	0.032	0.013
Naphthalene (ug/L)	3.00E-05	0.795	0.037	0.021	150	204	73%	0.006	0.062	0.077	2.10	0.005	0.048	0.028
Phenanthrene (ug/L)	0.001	1.650	0.060	0.034	197	206	95%	0.013	0.117	0.128	2.13	0.009	0.080	0.046
Total LPAHs[1]	0.007	4.610	0.149	0.084	205	205	100%	0.035	0.256	0.350	2.35	0.024	0.204	0.112
HPAHs														
Benzo(a)anthracene (ug/L)	2.00E-06	0.247	0.017	0.008	120	206	58%	0.001	0.048	0.026	1.50	0.002	0.021	0.014
Benzo(a)pyrene (ug/L)	3.00E-05	0.133	0.018	0.010	136	206	66%	0.002	0.043	0.021	1.19	0.001	0.020	0.015
Benzo(b,k)fluoranthene (ug/L)	3.00E-04	0.414	0.045	0.025	153	206	74%	0.003	0.117	0.055	1.22	0.004	0.053	0.038
Benzo(g,h,i)perylene (ug/L)	2.00E-04	0.112	0.025	0.018	169	206	82%	0.004	0.057	0.023	0.92	0.002	0.028	0.022
Chrysene (ug/L)	7.00E-06	0.420	0.039	0.017	164	206	79%	0.002	0.113	0.055	1.40	0.004	0.047	0.032
Dibenz(a,h)anthracene (ug/L)	4.00E-05	0.028	0.005	0.003	46	206	22%	0.001	0.013	0.005	0.99	0.000	0.006	0.004
Fluoranthene (ug/L)	0.001	1.720	0.064	0.033	200	206	97%	0.012	0.142	0.129	2.00	0.009	0.085	0.051
Indeno(1,2,3-cd)pyrene (ug/L)	3.00E-06	0.058	0.013	0.009	129	206	62%	0.002	0.032	0.013	0.98	0.001	0.015	0.012
Pyrene (ug/L)	0.003	1.310	0.081	0.048	203	206	98%	0.015	0.187	0.116	1.43	0.008	0.099	0.067
Retene (ug/L)	0.004	0.021	0.011	0.011	31	32	96%	0.007	0.019	0.005	0.41	0.001	0.013	0.010
Total HPAHs[2]	0.011	4.390	0.302	0.167	206	206	100%	0.043	0.736	0.413	1.37	0.029	0.363	0.251
TOTAL PAHs[3]	0.020	9.000	0.450	0.264	206	206	100%	0.093	1.000	0.729	1.62	0.051	0.563	0.367
Phthalates														
bis(2-Ethylhexyl) phthalate (ug/L)	0.01	31.00	2.28	1.31	177	204	86%	0.62	4.37	3.45	1.52	0.24	2.79	1.86
Butyl benzyl phthalate (ug/L)	0.013	290	8.790	0.307	83	206	40%	0.06	17.60	30.90	3.52	2.150	13.50	5.040
Diethyl phthalate (ug/L)	4.00E-04	430	2.440	0.238	51	206	24%	0.055	0.781	29.9	12.30	2.090	6.650	0.311
Dimethyl phthalate (ug/L)	2.00E-04	1.100	0.259	0.165	13	205	6%	0.025	0.667	0.262	1.01	0.018	0.296	0.225
Di-n-butyl phthalate (ug/L)	0.002	2.360	0.514	0.406	106	206	51%	0.136	1.060	0.406	0.79	0.028	0.570	0.459
Di-n-Octyl phthalate (ug/L)	2.00E-04	4.100	0.297	0.193	15	206	7%	0.023	0.792	0.409	1.38	0.028	0.357	0.245
***Total Phthalates[4]**	0.00	593	13.40	2.12	199	206	96%	0.65	21.60	51.70	3.84	3.60	21.60	7.52
Herbicides														
Dichlobenil (ug/L)	7.00E-04	0.167	0.027	0.019	61	122	50%	0.004	0.049	0.026	0.97	0.002	0.031	0.022
Total Petroleum Hydrocarbons														
NWTPH-Diesel (mg/L)	3.0E-03	0.33	0.06	0.06	10	70	14%	0.01	0.12	0.06	0.91	0.01	0.08	0.05
NWTPH-Gasoline (mg/L)	0.1	62.3	20.0	15.2	13	63	20%	3.1	42.6	15.5	0.78	2.0	23.8	16.3
NWTPH-Heavy Oil (mg/L)	0.01	1.10	0.35	0.34	58	70	82%	0.03	0.68	0.22	0.63	0.03	0.40	0.30
Bacteria														
Coliform, Fecal (CFU/100 ml)	50	240000	15400	2300	66	66	100%	245	26000	37700	2.45	4640	25500	7590
E.coli (CFU/100 ml)	5	240000	31900	3500	9	9	100%	32	61600	78300	2.45	26100	85200	2770
Enterococci (CFU/100 ml)	1200	820000	141000	48000	9	9	100%	1440	364000	266000	1.89	88700	322000	22000
BTEX														
Benzene (ug/L)	1.E-03	0.2	0.1	0.1	0	42	0%	0.0	0.2	0.1	0.70	0.0	0.1	0.1
Ethylbenzene (ug/L)	3.E-03	0.2	0.1	0.1	0	42	0%	0.0	0.2	0.1	0.54	0.0	0.1	0.1
m,p-Xylene (ug/L)	2.E-02	0.4	0.2	0.2	0	42	0%	0.0	0.3	0.1	0.62	0.0	0.2	0.1
o-Xylene (ug/L)	2.E-04	0.2	0.1	0.1	0	42	0%	0.0	0.2	0.1	0.78	0.0	0.1	0.1
Toluene (ug/L)	9.E-03	0.5	0.1	0.1	3	42	7%	0.0	0.2	0.1	0.85	0.0	0.1	0.1

[1] *Total LPAHs is the sum of the concentration or non-detected calculated value of the following compounds: Naphthalene, acenaphthene, acenaphthylene, anthracene, fluorene, and phenanthrene.*

[2] *Total HPAHs is the sum of the concentration of non-detected calculated value of the following compounds: Fluoranthene, pyrene, benzo(a)anthracene, chrysene, benzo(b,k)fluoranthene, benzo(b,k)fluoranthene, benzo(a)pyrene, indeno(1,2,3-c,d)pyrene, dibenz(a,h)anthracene, benzo(g,h,i)perylene.*

[3] *Total PAHs is the sum of the LPAHs and HPAHs.*

[4] *Total phthalates is the sum of detected values only.*

Table E-13 (Cont'd)
Summary Statistics for Stormwater at OF245 WY2023

	Minimum	Maximum	Arithmetic Mean	Median	Detects	Count	Percent Detects	10th Per	90th Per	Standard Deviation	Coefficient of Variation	Standard Error	95% UCL	95% LCL
Conventionals														
Anionic Surfactants - MBAS (mg/L)	0.039	0.132	0.070	0.061	7	7	100%	0.045	0.105	0.031	0.44	0.012	0.094	0.052
BOD (mg/L)	2.1	5.4	3.3	2.4	7	7	100%	2.2	5.2	1.4	0.43	0.5	4.3	2.4
Chloride (mg/L)	16.90	561.00	188.79	127.00	7	7	100%	51.82	417.60	189.76	1.01	71.72	330.29	77.56
Conductivity (uS/cm)	102.0	1930.0	634.9	544.0	9	9	100%	198.8	1266.0	566.2	0.89	188.7	1023.2	338.3
Hardness (mg CaCO3/L)	15.1	192.0	74.1	65.0	9	9	100%	28.4	144.8	55.2	0.75	18.4	111.3	44.0
pH (pH units)	6.0	7.2	6.7	6.8	9	9	100%	6.2	7.1	0.4	0.06	0.1	6.9	6.5
TSS (mg/L)	17.9	77.0	39.1	28.4	9	9	100%	21.0	69.4	21.0	0.54	7.0	52.5	27.1
Turbidity (NTU)	17.5	43.6	30.5	26.5	7	7	100%	17.9	42.5	11.3	0.37	4.3	38.3	22.7
Nutrients														
Nitrate+Nitrite as N (mg/L)	0.058	0.418	0.175	0.136	8	8	100%	0.072	0.342	0.125	0.72	0.044	0.261	0.104
Phosphorus, Total (mg/L)	0.072	0.362	0.179	0.155	8	8	100%	0.083	0.315	0.109	0.61	0.038	0.251	0.114
Phosphate, Ortho (mg/L)	0.015	0.154	0.043	0.029	8	8	100%	0.016	0.077	0.047	1.09	0.016	0.077	0.022
Total Nitrogen (mg/L)	0.41	0.98	0.64	0.65	8	8	100%	0.45	0.82	0.19	0.29	0.07	0.77	0.53
Metals														
Cadmium (ug/L)	0.076	0.298	0.168	0.162	7	9	78%	0.090	0.252	0.071	0.42	0.024	0.213	0.127
Cadmium, Dissolved (ug/L)	0.031	0.133	0.070	0.062	6	9	67%	0.037	0.099	0.032	0.45	0.011	0.090	0.051
Copper (ug/L)	6.50	23.90	11.94	9.82	9	9	100%	7.34	16.70	5.40	0.45	1.80	15.57	8.96
Copper, Dissolved (ug/L)	1.45	6.43	3.37	3.29	9	9	100%	1.67	5.19	1.61	0.48	0.54	4.40	2.41
Lead (ug/L)	1.63	7.86	3.80	2.91	9	9	100%	2.05	6.20	2.03	0.53	0.68	5.11	2.64
Lead, Dissolved (ug/L)	0.090	0.447	0.183	0.131	9	9	100%	0.100	0.345	0.120	0.65	0.040	0.266	0.121
Mercury (ug/L)	0.0008	0.0040	0.0035	0.0040	1	9	11%	0.0026	0.0040	0.0011	0.30	0.0004	0.0040	0.0028
Mercury, Dissolved (ug/L)	0.0011	0.0056	0.0046	0.0056	0	9	0%	0.0011	0.0056	0.0020	0.43	0.0007	0.0056	0.0031
Zinc (ug/L)	47.3	133.0	81.8	64.1	9	9	100%	51.5	122.6	32.6	0.40	10.9	102.5	62.5
Zinc, Dissolved (ug/L)	18.1	57.4	28.7	26.0	9	9	100%	22.2	35.2	11.3	0.39	3.8	36.5	23.4
Insecticides														
Bifenthrin (ug/L)	0.005	0.005	0.005	0.005	0	9	0%	0.005	0.005	0.000	0.00	0.000	0.005	0.005
PAHs														
LPAHs														
2-Methylnaphthalene (ug/L)	0.001	0.027	0.007	0.003	3	9	33%	0.001	0.014	0.009	1.28	0.003	0.012	0.002
Acenaphthene (ug/L)	0.005	0.012	0.006	0.005	1	9	11%	0.005	0.006	0.002	0.42	0.001	0.007	0.005
Acenaphthylene (ug/L)	0.005	0.010	0.005	0.005	1	9	11%	0.005	0.006	0.002	0.36	0.001	0.006	0.005
Anthracene (ug/L)	0.002	0.008	0.005	0.004	3	9	33%	0.003	0.006	0.002	0.38	0.001	0.006	0.004
Fluorene (ug/L)	0.000	0.025	0.006	0.002	2	9	22%	0.001	0.015	0.008	1.45	0.003	0.011	0.002
Naphthalene (ug/L)	0.016	0.024	0.020	0.019	3	7	43%	0.017	0.023	0.003	0.14	0.001	0.022	0.018
Phenanthrene (ug/L)	0.023	0.075	0.037	0.030	9	9	100%	0.025	0.056	0.017	0.45	0.006	0.048	0.028
Total LPAHs	0.048	0.158	0.078	0.067	9	9	100%	0.052	0.111	0.034	0.44	0.011	0.101	0.060
HPAHs														
Benzo(a)anthracene (ug/L)	0.003	0.011	0.006	0.005	2	9	22%	0.003	0.009	0.003	0.46	0.001	0.008	0.004
Benzo(a)pyrene (ug/L)	0.001	0.014	0.005	0.003	3	9	33%	0.001	0.009	0.004	0.89	0.001	0.008	0.002
Benzo(b,k)fluoranthene (ug/L)	0.008	0.048	0.023	0.017	5	9	56%	0.010	0.042	0.014	0.62	0.005	0.032	0.015
Benzo(g,h,i)perylene (ug/L)	0.007	0.021	0.014	0.012	9	9	100%	0.009	0.020	0.005	0.36	0.002	0.017	0.011
Chrysene (ug/L)	0.004	0.026	0.012	0.009	4	9	44%	0.006	0.021	0.007	0.60	0.002	0.017	0.008
Dibenz(a,h)anthracene (ug/L)	0.003	0.003	0.003	0.003	0	9	0%	0.003	0.003	0.000	0.00	0.000	0.003	0.003
Fluoranthene (ug/L)	0.014	0.056	0.033	0.030	9	9	100%	0.020	0.053	0.015	0.44	0.005	0.042	0.024
Indeno(1,2,3-cd)pyrene (ug/L)	0.004	0.012	0.008	0.006	4	9	44%	0.005	0.011	0.003	0.40	0.001	0.009	0.006
Pyrene (ug/L)	0.022	0.075	0.040	0.034	8	9	89%	0.024	0.062	0.018	0.44	0.006	0.052	0.030
Retene (ug/L)	0.007	0.017	0.012	0.012	9	9	100%	0.007	0.017	0.004	0.33	0.001	0.014	0.010
Total HPAHs	0.068	0.252	0.138	0.120	9	9	100%	0.076	0.226	0.065	0.47	0.022	0.180	0.100
TOTAL PAHs	0.123	0.351	0.216	0.205	9	9	100%	0.129	0.314	0.083	0.39	0.028	0.266	0.167
Phthalates														
bis(2-Ethylhexyl) phthalate (ug/L)	0.84	1.69	1.14	1.01	8	8	100%	0.86	1.52	0.31	0.27	0.11	1.35	0.96
Butyl benzyl phthalate (ug/L)	0.199	0.209	0.203	0.204	0	9	0%	0.199	0.207	0.003	0.02	0.001	0.205	0.201
Diethyl phthalate (ug/L)	0.154	0.342	0.178	0.158	1	9	11%	0.154	0.198	0.061	0.34	0.020	0.220	0.157
Dimethyl phthalate (ug/L)	0.167	0.176	0.171	0.171	0	9	0%	0.168	0.174	0.003	0.02	0.001	0.173	0.169
Di-n-butyl phthalate (ug/L)	0.385	2.360	1.393	1.320	9	9	100%	1.013	1.944	0.536	0.38	0.179	1.716	1.065
Di-n-Octyl phthalate (ug/L)	0.177	0.187	0.181	0.182	0	9	0%	0.178	0.185	0.003	0.02	0.001	0.183	0.180
***Total Phthalates**	1.26	3.28	2.45	2.51	9	9	100%	1.86	2.93	0.58	0.24	0.19	2.77	2.06
Herbicides														
Dichlobenil (ug/L)	0.009	0.020	0.015	0.014	7	9	78%	0.010	0.020	0.004	0.28	0.001	0.017	0.012
TPH														
NWTPH-Diesel (mg/L)	0.05	0.05	0.05	0.05	0	2	0%	0.05	0.05	0.00	0.07	0.00	0.05	0.05
NWTPH-Heavy Oil (mg/L)	0.10	0.10	0.10	0.10	0	2	0%	0.10	0.10	0.00	0.04	0.00	0.10	0.10
Bacteria														
Coliform, Fecal (CFU/100 ml)	90	70000	35045	35045	2	2	100%	7081	63009	49434	1.41	34955	70000	90
E.coli (CFU/100 ml)	90	17000	8545	8545	2	2	100%	1781	15309	11957	1.40	8455	17000	90
Enterococci (CFU/100 ml)	1200	61500	31350	31350	2	2	100%	7230	55470	42639	1.36	30150	61500	1200

Table E-14
Summary Statistics for Stormwater at OF254 Water Years 2002-2023

	Minimum	Maximum	Arithmetic Mean	Median	Detects	Count	Percent Detects	10th Per	90th Per	Standard Deviation	Coefficient of Variation	Standard Error	95% UCL	95% LCL
Conventionals														
Anionic Surfactants - MBAS (mg/L)	0.008	0.175	0.066	0.054	53	54	98%	0.031	0.120	0.038	0.57	0.005	0.077	0.057
BOD (mg/L)	0.1	69.0	3.7	2.4	34	48	70%	0.6	4.1	9.7	2.61	1.4	6.7	2.0
Chloride (mg/L)	493	8000	2340	2220	55	55	100%	941	3720	1360	0.58	183.0	2700	2010
Conductivity (uS/cm)	4.9	23000	6250	5530	107	107	100%	2180	10700	3770	0.60	365.0	6980	5560
Hardness (mg CaCO3/L)	49.5	2380	589	496	166	166	100%	216.0	1080	371	0.63	28.8	647	535
pH (pH units)	6.2	8.1	7.1	7.1	166	166	100%	6.6	7.5	0.4	0.05	0.0	7.1	7.0
TSS (mg/L)	5.2	354	90.4	68.9	163	163	100%	29.6	183.0	68.2	0.76	5.3	101.0	80.4
Turbidity (NTU)	0.5	216	70.8	57.0	54	54	100%	21.4	135.0	49.9	0.70	6.8	84.2	58.3
Nutrients														
Nitrate+Nitrite as N (mg/L)	0.036	0.287	0.142	0.136	62	62	100%	0.078	0.223	0.061	0.43	0.008	0.158	0.127
Phosphorus, Total (mg/L)	0.068	1.090	0.171	0.120	62	62	100%	0.085	0.293	0.157	0.92	0.020	0.215	0.137
Phosphate, Ortho (mg/L)	0.007	0.097	0.028	0.024	64	64	100%	0.012	0.042	0.017	0.61	0.002	0.032	0.024
Total Nitrogen (mg/L)	0.05	1.95	0.59	0.49	61	62	98%	0.30	1.06	0.33	0.56	0.04	0.68	0.51
Metals														
Cadmium (ug/L)	0.003	0.543	0.185	0.166	54	66	81%	0.072	0.311	0.108	0.58	0.013	0.212	0.161
Cadmium, Dissolved (ug/L)	0.021	0.273	0.097	0.089	56	65	86%	0.045	0.161	0.047	0.49	0.006	0.109	0.085
Copper (ug/L)	5.81	56.30	16.40	13.20	66	66	100%	7.98	29.20	10.10	0.62	1.25	19.00	14.10
Copper, Dissolved (ug/L)	0.53	11.30	2.97	2.25	66	66	100%	0.99	5.80	2.18	0.74	0.27	3.51	2.46
Lead (ug/L)	1.21	68.0	14.90	10.70	162	166	97%	4.00	32.50	12.50	0.84	0.97	16.90	13.10
Lead, Dissolved (ug/L)	0.009	12.20	1.020	0.229	111	165	67%	0.034	2.490	2.020	1.99	0.157	1.340	0.732
Mercury (ug/L)	7.000E-07	0.3070	0.0260	0.0150	69	168	41%	0.0020	0.0600	0.0350	1.34	0.0030	0.0310	0.0210
Mercury, Dissolved (ug/L)	5.000E-07	0.2110	0.0180	0.0087	5	168	2%	0.0007	0.0440	0.0240	1.34	0.0020	0.0220	0.0150
Zinc (ug/L)	27.6	427	121.0	95.2	166	166	100%	50.0	219.0	74.8	0.62	5.8	132.0	110.0
Zinc, Dissolved (ug/L)	5.1	239	44.4	31.6	166	166	100%	22.1	85.8	33.4	0.75	2.6	49.7	39.6
Insecticides														
2,4-D (ug/L)	0.001	1.000	0.088	0.028	20	40	50%	0.003	0.174	0.185	2.12	0.029	0.152	0.041
Carbaryl (ug/L	1.0E-03	0.49	0.21	0.16	0	23	0%	0.02	0.48	0.18	0.83	0.04	0.28	0.14
Chlorpyrifos (ug/L)	0.001	0.320	0.026	0.010	2	53	3%	0.002	0.056	0.047	1.82	0.006	0.040	0.016
Bifenthrin (ug/L)	0.002	0.010	0.006	0.007	0	21	0%	0.003	0.009	0.003	0.47	0.001	0.007	0.005
PAHs														
LPAHs														
2-Methylnaphthalene (ug/L)	4.00E-04	0.435	0.022	0.012	129	165	78%	0.003	0.037	0.044	2.03	0.003	0.029	0.016
Acenaphthene (ug/L)	2.00E-04	0.352	0.016	0.009	97	165	58%	0.002	0.029	0.033	2.04	0.003	0.022	0.012
Acenaphthylene (ug/L)	3.00E-06	0.070	0.010	0.007	72	165	43%	0.001	0.023	0.012	1.12	0.001	0.012	0.009
Anthracene (ug/L)	3.00E-04	0.389	0.031	0.009	104	165	63%	0.003	0.076	0.055	1.78	0.004	0.039	0.023
Fluorene (ug/L)	2.00E-04	0.159	0.019	0.010	110	165	66%	0.002	0.045	0.026	1.33	0.002	0.023	0.016
Naphthalene (ug/L)	4.00E-04	0.126	0.025	0.021	121	164	73%	0.006	0.048	0.020	0.80	0.002	0.028	0.022
Phenanthrene (ug/L)	0.001	0.657	0.078	0.044	160	165	96%	0.017	0.182	0.093	1.19	0.007	0.094	0.065
Total LPAHs[1]	0.005	1.240	0.176	0.102	164	164	100%	0.043	0.393	0.198	1.13	0.015	0.208	0.148
HPAHs														
Benzo(a)anthracene (ug/L)	2.00E-04	0.915	0.059	0.019	138	165	83%	0.003	0.166	0.098	1.66	0.008	0.075	0.046
Benzo(a)pyrene (ug/L)	1.00E-04	0.428	0.052	0.025	142	165	86%	0.005	0.140	0.065	1.26	0.005	0.062	0.042
Benzo(b,k)fluoranthene (ug/L)	1.00E-03	1.660	0.139	0.064	146	165	88%	0.009	0.385	0.193	1.39	0.015	0.169	0.111
Benzo(g,h,i)perylene (ug/L)	2.00E-04	0.253	0.046	0.030	148	165	89%	0.007	0.121	0.045	0.98	0.004	0.053	0.039
Chrysene (ug/L)	5.00E-04	1.910	0.123	0.045	154	165	93%	0.009	0.323	0.199	1.62	0.015	0.156	0.095
Dibenz(a,h)anthracene (ug/L)	6.00E-07	0.071	0.010	0.006	76	165	46%	0.001	0.028	0.011	1.09	0.001	0.012	0.009
Fluoranthene (ug/L)	4.00E-04	3.960	0.211	0.078	162	165	98%	0.019	0.531	0.388	1.84	0.030	0.277	0.160
Indeno(1,2,3-cd)pyrene (ug/L)	7.00E-05	0.239	0.031	0.019	136	165	82%	0.003	0.077	0.035	1.12	0.003	0.037	0.026
Pyrene (ug/L)	0.001	4.120	0.215	0.084	162	165	98%	0.025	0.557	0.385	1.79	0.030	0.280	0.164
Retene (ug/L)	0.002	0.027	0.015	0.013	19	20	95%	0.008	0.025	0.007	0.46	0.001	0.018	0.012
Total HPAHs[2]	0.027	13.600	0.884	0.374	165	165	100%	0.086	2.360	1.390	1.57	0.108	1.120	0.697
TOTAL PAHs[3]	0.040	14.700	1.060	0.475	165	165	100%	0.129	2.670	1.550	1.46	0.121	1.320	0.848
Phthalates														
bis(2-Ethylhexyl) phthalate (ug/L)	0.03	10.20	2.11	1.42	136	165	82%	0.40	5.33	1.93	0.92	0.15	2.41	1.83
Butyl benzyl phthalate (ug/L)	0.002	6.10	0.416	0.268	32	165	19%	0.056	0.799	0.595	1.43	0.046	0.519	0.336
Diethyl phthalate (ug/L)	9.00E-04	120.0	1.220	0.211	36	165	21%	0.049	0.844	9.430	7.72	0.734	2.820	0.343
Dimethyl phthalate (ug/L)	0.004	3.200	0.314	0.164	25	165	15%	0.032	0.803	0.425	1.35	0.033	0.384	0.252
Di-n-butyl phthalate (ug/L)	2.00E-04	1.300	0.400	0.378	74	165	44%	0.088	0.737	0.243	0.61	0.019	0.437	0.364
Di-n-Octyl phthalate (ug/L)	0.004	4.500	0.361	0.219	29	163	17%	0.035	0.840	0.487	1.35	0.038	0.441	0.293
***Total Phthalates[4]**	0.00	123.00	3.58	1.88	156	164	95%	0.32	7.36	9.82	2.74	0.77	5.40	2.53
Herbicides														
Dichlobenil (ug/L)	5.00E-04	0.263	0.030	0.017	23	72	31%	0.004	0.052	0.043	1.40	0.005	0.041	0.022
TPH														
NWTPH-Diesel (mg/L)	2.0E-03	0.16	0.07	0.07	19	51	37%	0.01	0.14	0.05	0.74	0.01	0.08	0.06
NWTPH-Gasoline (mg/L)	0.3	48.2	15.5	13.7	0	44	0%	0.7	37.8	14.8	0.96	2.2	19.9	11.3
NWTPH-Heavy Oil (mg/L)	4.0E-03	4.20	0.81	0.56	48	51	94%	0.32	1.30	0.79	0.98	0.11	1.04	0.62
Bacteria														
Coliform, Fecal (CFU/100 ml)	220	800000	28100	3300	49	49	100%	330	19400	116000	4.13	16500	64700	6700
E.coli (CFU/100 ml)	1.65	280000	54700	10200	7	8	87%	1190	161000	98100	1.79	34700	125000	5910
Enterococci (CFU/100 ml)	2200	820000	158000	26000	9	9	100%	3640	492000	280000	1.77	93300	343000	20400
BTEX														
Benzene (ug/L)	4.E-03	0.2	0.1	0.1	0	44	0%	0.0	0.2	0.1	0.68	0.0	0.1	0.1
Ethylbenzene (ug/L)	3.E-03	0.2	0.1	0.1	0	44	0%	0.0	0.2	0.1	0.59	0.0	0.1	0.1
m,p-Xylene (ug/L)	4.E-03	0.4	0.2	0.2	0	44	0%	0.1	0.4	0.1	0.59	0.0	0.2	0.2
o-Xylene (ug/L)	4.E-03	0.2	0.1	0.1	0	44	0%	0.0	0.2	0.1	0.62	0.0	0.1	0.1
Toluene (ug/L)	1.E-02	1.0	0.2	0.1	7	44	15%	0.0	0.4	0.2	1.32	0.0	0.2	0.1

[1] *Total LPAHs is the sum of the concentration or non-detected calculated value of the following compounds: Naphthalene, acenaphthene, acenaphthylene, anthracene, fluorene, and phenanthrene.*

[2] *Total HPAHs is the sum of the concentration of non-detected calculated value of the following compounds: Fluoranthene, pyrene, benzo(a)anthracene, chrysene, benzo(b,k)fluoranthene, benzo(b,k)fluoranthene, benzo(a)pyrene, indeno(1,2,3-c,d)pyrene, dibenz(a,h)anthracene, benzo(g,h,i)perylene.*

[3] *Total PAHs is the sum of the LPAHs and HPAHs.*

[4] *Total phthalates is the sum of detected values only.*

Table E-14 (Cont'd)
Summary Statistics for Stormwater at OF254 WY2023

	Minimum	Maximum	Arithmetic Mean	Median	Detects	Count	Percent Detects	10th Per	90th Per	Standard Deviation	Coefficient of Variation	Standard Error	95% UCL	95% LCL
Conventionals														
Anionic Surfactants - MBAS (mg/L)	–	–	–	–	–	–	–	–	–	–	–	–	–	–
BOD (mg/L)	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Chloride (mg/L)	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Conductivity (uS/cm)	8900.0	8900.0	8900.0	8900.0	1	1	100%	8900.0	8900.0	–	–	–	8900.0	8900.0
Hardness (mg CaCO3/L)	923.0	923.0	923.0	923.0	1	1	100%	923.0	923.0	–	–	–	923.0	923.0
pH (pH units)	7.2	7.2	7.2	7.2	1	1	100%	7.2	7.2	–	–	–	7.2	7.2
TSS (mg/L)	52.4	52.4	52.4	52.4	1	1	100%	52.4	52.4	–	–	–	52.4	52.4
Turbidity (NTU)	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Nutrients														
Nitrate+Nitrite as N (mg/L)	0.167	0.167	0.167	0.167	1	1	100%	0.167	0.167	–	–	–	0.167	0.167
Phosphorus, Total (mg/L)	0.416	0.416	0.416	0.416	1	1	100%	0.416	0.416	–	–	–	0.416	0.416
Phosphate, Ortho (mg/L)	0.036	0.036	0.036	0.036	1	1	100%	0.036	0.036	–	–	–	0.036	0.036
Total Nitrogen (mg/L)	0.78	0.78	0.78	0.78	1	1	100%	0.78	0.78	–	–	–	0.78	0.78
Metals														
Cadmium (ug/L)	0.124	0.124	0.124	0.124	1	1	100%	0.124	0.124	–	–	–	0.124	0.124
Cadmium, Dissolved (ug/L)	0.057	0.057	0.057	0.057	1	1	100%	0.057	0.057	–	–	–	0.057	0.057
Copper (ug/L)	27.00	27.00	27.00	27.00	1	1	100%	27.00	27.00	–	–	–	27.00	27.00
Copper, Dissolved (ug/L)	4.12	4.12	4.12	4.12	1	1	100%	4.12	4.12	–	–	–	4.12	4.12
Lead (ug/L)	7.31	7.31	7.31	7.31	1	1	100%	7.31	7.31	–	–	–	7.31	7.31
Lead, Dissolved (ug/L)	0.140	0.140	0.140	0.140	1	1	100%	0.140	0.140	–	–	–	0.140	0.140
Mercury (ug/L)	0.0040	0.0040	0.0040	0.0040	0	1	0%	0.0040	0.0040	–	–	–	0.0040	0.0040
Mercury, Dissolved (ug/L)	0.0056	0.0056	0.0056	0.0056	0	1	0%	0.0056	0.0056	–	–	–	0.0056	0.0056
Zinc (ug/L)	63.6	63.6	63.6	63.6	1	1	100%	63.6	63.6	–	–	–	63.6	63.6
Zinc, Dissolved (ug/L)	26.2	26.2	26.2	26.2	1	1	100%	26.2	26.2	–	–	–	26.2	26.2
Insecticides														
Bifenthrin (ug/L)	0.005	0.005	0.005	0.005	0	1	0%	0.005	0.005	–	–	–	0.005	0.005
PAHs														
LPAHs														
2-Methylnaphthalene (ug/L)	0.017	0.017	0.017	0.017	1	1	100%	0.017	0.017	–	–	–	0.017	0.017
Acenaphthene (ug/L)	0.012	0.012	0.012	0.012	1	1	100%	0.012	0.012	–	–	–	0.012	0.012
Acenaphthylene (ug/L)	0.017	0.017	0.017	0.017	1	1	100%	0.017	0.017	–	–	–	0.017	0.017
Anthracene (ug/L)	0.003	0.003	0.003	0.003	0	1	0%	0.003	0.003	–	–	–	0.003	0.003
Fluorene (ug/L)	0.005	0.005	0.005	0.005	0	1	0%	0.005	0.005	–	–	–	0.005	0.005
Naphthalene (ug/L)	0.022	0.022	0.022	0.022	1	1	100%	0.022	0.022	–	–	–	0.022	0.022
Phenanthrene (ug/L)	0.038	0.038	0.038	0.038	1	1	100%	0.038	0.038	–	–	–	0.038	0.038
Total LPAHs	0.096	0.096	0.096	0.096	1	1	100%	0.096	0.096				0.096	0.096
HPAHs														
Benzo(a)anthracene (ug/L)	0.012	0.012	0.012	0.012	1	1	100%	0.012	0.012	–	–	–	0.012	0.012
Benzo(a)pyrene (ug/L)	0.016	0.016	0.016	0.016	1	1	100%	0.016	0.016	–	–	–	0.016	0.016
Benzo(b,k)fluoranthene (ug/L)	0.043	0.043	0.043	0.043	1	1	100%	0.043	0.043	–	–	–	0.043	0.043
Benzo(g,h,i)perylene (ug/L)	0.015	0.015	0.015	0.015	1	1	100%	0.015	0.015	–	–	–	0.015	0.015
Chrysene (ug/L)	0.016	0.016	0.016	0.016	1	1	100%	0.016	0.016	–	–	–	0.016	0.016
Dibenz(a,h)anthracene (ug/L)	0.003	0.003	0.003	0.003	0	1	0%	0.003	0.003	–	–	–	0.003	0.003
Fluoranthene (ug/L)	0.036	0.036	0.036	0.036	1	1	100%	0.036	0.036	–	–	–	0.036	0.036
Indeno(1,2,3-cd)pyrene (ug/L)	0.015	0.015	0.015	0.015	1	1	100%	0.015	0.015	–	–	–	0.015	0.015
Pyrene (ug/L)	0.045	0.045	0.045	0.045	1	1	100%	0.045	0.045	–	–	–	0.045	0.045
Retene (ug/L)	0.003	0.003	0.003	0.003	0	1	0%	0.003	0.003	–	–	–	0.003	0.003
Total HPAHs	0.201	0.201	0.201	0.201	1	1	100%	0.201	0.201	–	–	–	0.201	0.201
TOTAL PAHs	0.297	0.297	0.297	0.297	1	1	100%	0.297	0.297	–	–	–	0.297	0.297
Phthalates														
bis(2-Ethylhexyl) phthalate (ug/L)	1.09	1.09	1.09	1.09	1	1	100%	1.09	1.09	–	–	–	1.09	1.09
Butyl benzyl phthalate (ug/L)	0.202	0.202	0.202	0.202	0	1	0%	0.202	0.202	–	–	–	0.202	0.202
Diethyl phthalate (ug/L)	0.382	0.382	0.382	0.382	1	1	100%	0.382	0.382	–	–	–	0.382	0.382
Dimethyl phthalate (ug/L)	0.170	0.170	0.170	0.170	0	1	0%	0.170	0.170	–	–	–	0.170	0.170
Di-n-butyl phthalate (ug/L)	0.579	0.579	0.579	0.579	1	1	100%	0.579	0.579	–	–	–	0.579	0.579
Di-n-Octyl phthalate (ug/L)	0.180	0.180	0.180	0.180	0	1	0%	0.180	0.180	–	–	–	0.180	0.180
***Total Phthalates**	2.05	2.05	2.05	2.05	1	1	100%	2.05	2.05	–	–	–	2.05	2.05
Herbicides														
Dichlobenil (ug/L)	0.015	0.015	0.015	0.015	1	1	100%	0.015	0.015	–	–	–	0.015	0.015
TPH														
NWTPH-Diesel (mg/L)	0.05	0.05	0.05	0.05	0	2	0%	0.05	0.05	0.00	0.07	0.00	0.05	0.05
NWTPH-Heavy Oil (mg/L)	0.84	3.52	2.18	2.18	2	2	100%	1.11	3.25	1.90	0.87	1.34	3.52	0.84
Bacteria														
Coliform, Fecal (CFU/100 ml)	800000	800000	800000	800000	1	1	100%	800000	800000	–	–	–	800000	800000
E.coli (CFU/100 ml)	24000	280000	152000	152000	2	2	100%	49600	254400	181019	1.19	128000	280000	24000
Enterococci (CFU/100 ml)	70000	820000	445000	445000	2	2	100%	145000	745000	530330	1.19	375000	820000	70000

Table E-15
Summary Statistics for Stormwater Sediment at OF230 FD3New WY2002-WY2023

	Minimum	Maximum	Arithmetic Mean	Median	Detects	Count	Percent Detects	10th Per	90th Per	Standard Deviation	Coefficient of Variation	Standard Error	95% UCL	95% LCL
Conventionals														
Total Organic Carbon (mg/Kg)	0.67	14	6	6	22	22	100%	3	11	3	0.51	1	8	5
Total Solids (%)	30.1	65	51	53	22	22	100%	41	63	10	0.19	2	55	47
Total Volatile Solids (%)	6.1	22	12	10	9	9	100%	7	22	6	0.50	2	16	9
Nutrients														
Phosphorus, Total (mg/Kg)	543	1560	1030	1110	7	7	100%	622	1510	402	0.39	152	1310	762
Metals														
Cadmium (mg/Kg dry)	0.286	0.926	0.535	0.518	8	8	100%	0.367	0.701	0.188	0.35	0.067	0.666	0.423
Copper (mg/Kg dry)	48.2	132	79	80	8	8	100%	55	100	25.6	0.32	9	97	64
Lead (mg/Kg dry)	28.2	1420.0	200.0	141.0	21	21	100%	73.3	235	286	1.43	62.4	332.0	120.0
Mercury (mg/Kg dry)	0.0330	0.827	0.176	0.122	21	21	100%	0.051	0.304	0.198	1.13	0.043	0.263	0.105
Zinc (mg/Kg dry)	219	3200	612	438	21	21	100%	288	828	621	1.01	136	905	426
TPH														
NWTPH-Diesel (mg/Kg)	1.6	960	162	123	17	22	77%	13.0	254	203	1.25	43	255	94
NWTPH-Heavy Oil (mg/Kg)	25	8300	3500	3250	22	22	100%	983	6080	2150	0.61	457	4390	2630
PAHs														
LPAHs														
2-Methylnaphthalene (ug/Kg)	4.4	310	90	66	17	22	77%	22	182	77	0.86	16	123	60
Acenaphthene (ug/Kg)	3.2	350	123	124	19	22	86%	24	257	90	0.73	19	161	88
Acenaphthylene (ug/Kg)	1	93	43	37	12	22	54%	9	90	29	0.68	6	55	31
Anthracene (ug/Kg)	38	640	288	302	21	22	95%	60	448	165	0.57	35	356	221
Fluorene (ug/Kg)	6	577	171	160	20	22	90%	39	300	128	0.75	27	226	123
Naphthalene (ug/Kg)	45	480	134	115	21	22	95%	59	198	99	0.74	21	180	99
Phenanthrene (ug/Kg)	238	5400	2290	2400	22	22	100%	381	4240	1370	0.60	292	2850	1740
Total LPAHs[1]	382	5990	2230	1720	10	22	45%	483	4770	1690	0.76	360	2950	1560
HPAHs														
Benzo(a)anthracene (ug/Kg)	128	3400	1530	1650	22	22	100%	282	2580	910	0.59	194	1900	1170
Benzo(a)pyrene (ug/Kg)	253	5870	1740	1580	22	22	100%	315	2770	1260	0.72	268	2300	1260
Benzo(b,k)fluoranthene (ug/Kg)	641	17900	4630	4280	22	22	100%	902	7200	3770	0.81	804	6310	3250
Benzo(g,h,i)perylene (ug/Kg)	78	3000	1380	1190	22	22	100%	305	2990	975	0.71	208	1790	991
Chrysene (ug/Kg)	283	5000	2220	2220	22	22	100%	390	3550	1260	0.57	269	2740	1720
Dibenz(a,h)anthracene (ug/Kg)	22	2700	430	332	19	22	86%	46	755	570	1.32	121	693	241
Fluoranthene (ug/Kg)	368	6800	3490	3640	22	22	100%	767	5860	1960	0.56	417	4280	2690
Indeno(1,2,3-c,d)pyrene (ug/Kg)	122	4260	1340	1300	22	22	100%	267	2490	1030	0.77	219	1790	947
Pyrene (ug/Kg)	388	9400	4010	4250	22	22	100%	587	7170	2570	0.64	547	5070	3010
Retene (ug/L)	31	218	97	42	3	3	100%	33	183	105	1	61	218	31
Total HPAHs[2]	1270	45700	15900	11200	10	22	45%	2690	34700	13300	0.83	2830	21500	10800
Total PAHs[3]	2200	49100	18200	14300	10	22	45%	3550	35500	13900	0.76	2950	24000	12600
Phthalates														
bis(2-Ethylhexyl) phthalate (ug/Kg)	3530	43000	17400	15600	22	22	100%	4740	31400	11700	0.67	2500	22300	12700
Butyl benzyl phthalate (ug/Kg)	42	4700	976	617	21	22	95%	111	1490	1010	1.04	216	1440	626
Diethyl phthalate (ug/Kg)	4	170	49	44	6	22	27%	11	90	38	0.78	8	65	35
Dimethyl phthalate (ug/Kg)	4	1200	130	51	12	22	54%	5	198	255	1.96	54	249	52
Di-n-butyl phthalate (ug/Kg)	4	2400	420	236	20	22	90%	58	981	540	1.28	115	673	230
Di-n-Octyl phthalate (ug/Kg)	5	9290	1620	948	16	22	72%	11	3710	2100	1.30	447	2580	901
Total Phthalates[4]	3600	48800	20500	18600	22	22	100%	5690	36000	13900	0.68	2950	26400	15000
Insecticides														
Bifenthrin (ug/Kg)	0	142	28	17	8	9	88%	4	48	44	1.55	15	58	10
PCBs														
Aroclor-1016 (ug/Kg)	0.05	45	8.2	3.09	0	22	0%	0	31	13	1.59	3	14	3
Aroclor-1221 (ug/Kg)	0.17	49	8.5	2.73	1	22	4%	0	16	13	1.50	3	14	4
Aroclor-1232 (ug/Kg)	0.07	74	10.7	2.07	1	22	4%	0	38	20	1.87	4	20	4
Aroclor-1242 (ug/Kg)	0.00	65	9.9	2.85	0	22	0%	0	28	17	1.72	4	18	4
Aroclor-1248 (ug/Kg)	0.02	31	8.0	5.95	0	22	0%	0	18	8	1.07	2	12	5
Aroclor-1254 (ug/Kg)	0.13	581	185	108	13	22	59%	1	496	197	1.06	42	268	110
Aroclor-1260 (ug/Kg)	0.10	910	86	9	5	22	22%	0	211	203	2.38	43	180	21
TOTAL PCBs[5]	0	910	264	190	15	22	68%	0	576	270	1.02	58	377	159
Herbicides														
Dichlobenil (ug/L)	8	33	21	21	3	3	100%	11	31	13	0.61	7	33	8
Phenolics														
2-Methylphenol (ug/Kg dry)	0.08	30	20.1	30.10	0	3	0%	6	30	17	0.86	10	30	0
4-Methylphenol (ug/Kg dry)	26.00	2300	694.0	121.00	4	5	80%	50	1760	973	1.40	435	1570	69
Pentachlorophenol (ug/Kg dry)	18.70	830	333.0	149.00	2	3	66%	45	694	436	1.31	252	830	19

[1] *Total LPAHs is the sum of the concentration or non-detected calculated value of the following compounds: Naphthalene, acenaphthene, acenaphthylene, anthracene, fluorene, and phenanthrene.*

[2] *Total HPAHs is the sum of the concentration of non-detected calculated value of the following compounds: Fluoranthene, pyrene, benzo(a)anthracene, chrysene, benzo(b,k)fluoranthene, benzo(b,k)fluoranthene, benzo(a)pyrene, indeno(1,2,3-c,d)pyrene, dibenz(a,h)anthracene, benzo(g,h,i)perylene.*

[3] *Total PAHs is the sum of the LPAHs and HPAHs.*

[4] *Total phthalates is the sum of detected values only.*

[5] *Total value for PCBs is the sum of detected values only.*

Bold – The analyte was present in the sample.
U – The analyte was not detected at or above the reported value.
UJ – The analyte was not detected at or above the reported estimated value.
J – The analyte was positively identified. The associated value is an estimate.
NJ - There is evidence the analyte is present. The associated value is an estimate.
E - Estimated above the calibration curve.

Table E-16
Summary Statistics for Stormwater Sediment at OF235 FD6 WY2002-WY2023

	Minimum	Maximum	Arithmetic Mean	Median	Detects	Count	Percent Detects	10th Per	90th Per	Standard Deviation	Coefficient of Variation	Standard Error	95% UCL	95% LCL
Conventionals														
Total Organic Carbon (mg/Kg)	3.45	9.93	5.83	5.62	22	22	100%	4.05	8.08	1.62	0.28	0.35	6.51	5.19
Total Solids (%)	54.5	72.8	63.2	62.5	22	22	100%	56.5	70.6	5.5	0.09	1.2	65.5	61.0
Total Volatile Solids (%)	10.4	14.7	12.7	12.7	9	9	100%	11.1	14.5	1.4	0.11	0.5	13.5	11.8
Nutrients														
Phosphorus, Total (mg/Kg)	549	1180	867	884	9	9	100%	619	1170	228	0.26	76	1010	729
Metals														
Cadmium (mg/Kg dry)	0.000	0.819	0.425	0.557	9	11	81%	0.057	0.723	0.300	0.71	0.090	0.589	0.255
Copper (mg/Kg dry)	84.4	199	134	137	11	11	100%	91	173	33	0.25	10	153	116
Lead (mg/Kg dry)	88.2	286.0	157.0	146.0	22	22	100%	96.7	205.0	51.4	0.33	11.0	180.0	138.0
Mercury (mg/Kg dry)	0.0480	1.350	0.139	0.080	22	22	100%	0.052	0.108	0.273	1.96	0.058	0.262	0.071
Zinc (mg/Kg dry)	219	789	447	386	22	22	100%	297	666	160	0.36	34	514	386
TPH														
NWTPH-Diesel (mg/Kg)	1	1000	161	125	17	22	77%	32	229	199	1.23	42	256	101
NWTPH-Heavy Oil (mg/Kg)	1600	4700	3000	2600	22	22	100%	2100	4490	959	0.32	204	3390	2620
PAHs														
LPAHs														
2-Methylnaphthalene (ug/Kg)	6	150	72	75	16	22	72%	17	118	40	0.55	8.5	88	56
Acenaphthene (ug/Kg)	2	270	59	45	15	22	68%	11	119	61	1.04	13.0	86	37
Acenaphthylene (ug/Kg)	0.7	179	37	24	6	22	27%	2	82	41	1.11	8.7	55	22
Anthracene (ug/Kg)	35	430	177	170	22	22	100%	51	348	115	0.65	24.4	226	131
Fluorene (ug/Kg)	16	270	87	66	17	22	77%	23	164	64	0.74	13.6	115	62
Naphthalene (ug/Kg)	14	251	88	83	16	22	72%	27	130	53	0.60	11.3	111	68
Phenanthrene (ug/Kg)	263	2400	1030	963	22	22	100%	332	1640	549	0.53	117.0	1260	816
Total LPAHs[1]	3	2030	934	895	10	22	45%	78	2000	714	0.76	152	1230	645
HPAHs														
Benzo(a)anthracene (ug/Kg)	120	1300	588	535	22	22	100%	217	1030	322	0.55	69	724	460
Benzo(a)pyrene (ug/Kg)	184	1100	582	550	22	22	100%	252	956	276	0.47	59	698	472
Benzo(b,k)fluoranthene (ug/Kg)	439	2700	1320	1280	22	22	100%	570	2340	671	0.51	143	1600	1050
Benzo(g,h,i)perylene (ug/Kg)	176	1600	500	340	22	22	100%	200	971	372	0.75	79	665	363
Chrysene (ug/Kg)	297	1800	922	935	22	22	100%	352	1630	460	0.50	98	1110	737
Dibenz(a,h)anthracene (ug/Kg)	2.0	900	121	73	15	22	68%	26	196	184	1.52	39	206	66
Fluoranthene (ug/Kg)	432	2650	1330	1150	22	22	100%	623	2310	638	0.48	136	1600	1080
Indeno(1,2,3-c,d)pyrene (ug/Kg)	24	930	348	300	21	22	95%	165	617	206	0.59	44	435	271
Pyrene (ug/Kg)	560	4200	1810	1840	22	22	100%	658	2890	1020	0.57	218	2230	1420
Retene (ug/L)	73	196	129	119	3	3	100%	82	181	62	0.48	36	196	73
Total HPAHs[2]	520	11500	5040	3670	10	22	45%	1790	9900	3220	0.64	686	6380	3790
Total PAHs[3]	586	13500	5980	4640	10	22	45%	2870	10800	3520	0.59	750	7470	4570
Phthalates														
bis(2-Ethylhexyl) phthalate (ug/Kg)	1600	22000	12500	12800	22	22	100%	6620	18900	5090	0.41	1080	14500	10500
Butyl benzyl phthalate (ug/Kg)	18	3800	1180	1180	21	22	95%	523	2000	805	0.68	172	1530	878
Diethyl phthalate (ug/Kg)	2	89	34	28	4	22	18%	12	74	25	0.74	5	45	24
Dimethyl phthalate (ug/Kg)	17	493	120	87	18	22	81%	32	235	110	0.92	24	170	81
Di-n-butyl phthalate (ug/Kg)	41	370	195	180	21	22	95%	60	342	102	0.52	22	237	155
Di-n-Octyl phthalate (ug/Kg)	7.3	2800	839	848	13	22	59%	18	1860	866	1.03	185	1200	500
Total Phthalates[4]	2960	28900	14800	15800	22	22	100%	7390	20900	6000	0.41	1280	17300	12400
Insecticides														
Bifenthrin (ug/Kg)	6	24	13	13	9	9	100%	7	22	7	0.49	2	17	9
PCBs														
Aroclor-1016 (ug/Kg)	0.14	55	9.9	2.38	0	22	0%	1	26	16	1.59	3	17	4
Aroclor-1221 (ug/Kg)	0.20	54	10.4	5.24	0	22	0%	1	25	14	1.32	3	17	6
Aroclor-1232 (ug/Kg)	0.13	45	10.5	5.90	0	22	0%	1	27	13	1.26	3	16	6
Aroclor-1242 (ug/Kg)	0.18	420	27.7	3.10	1	22	4%	0	27	89	3.20	19	68	5
Aroclor-1248 (ug/Kg)	0.18	55	7.7	2.39	0	22	0%	0	19	13	1.67	3	14	3
Aroclor-1254 (ug/Kg)	0.34	280	34	17	8	22	36%	1	53	61	1.77	13	63	15
Aroclor-1260 (ug/Kg)	0.05	44	10	5	2	22	9%	1	21	13	1.26	3	16	5
TOTAL PCBs[5]	0	420	52	0	9	22	40%	0	107	104	2.02	22	99	15
Herbicides														
Dichlobenil (ug/L)	6	76	41	41	3	3	100%	13	69	35	0.85	20	76	6
Phenolics														
2-Methylphenol (ug/Kg dry)	2.51	67	28.4	25.50	2	6	33%	9	51	22	0.78	9	46	14
4-Methylphenol (ug/Kg dry)	44.00	440	219.0	210.00	9	9	100%	89	382	136	0.62	45	303	138
Pentachlorophenol (ug/Kg dry)	4.69	17800	3600.0	39.40	2	5	40%	6	10700	7940	2.20	3550	10700	13

[1] Total LPAHs is the sum of the concentration or non-detected calculated value of the following compounds: Naphthalene, acenaphthene, acenaphthylene, anthracene, fluorene, and phenanthrene.

[2] Total HPAHs is the sum of the concentration of non-detected calculated value of the following compounds: Fluoranthene, pyrene, benzo(a)anthracene, chrysene, benzo(b,k)fluoranthene, benzo(b,k)fluoranthene, benzo(a)pyrene, indeno(1,2,3-c,d)pyrene, dibenz(a,h)anthracene, benzo(g,h,i)perylene.

[3] Total PAHs is the sum of the LPAHs and HPAHs.

[4] Total phthalates is the sum of detected values only.

[5] Total value for PCBs is the sum of detected values only.

Bold – The analyte was present in the sample.
U – The analyte was not detected at or above the reported value.
UJ – The analyte was not detected at or above the reported estimated value.
J – The analyte was positively identified. The associated value is an estimate.
NJ - There is evidence the analyte is present. The associated value is an estimate.
E - Estimated above the calibration curve.

Table E-17
Summary Statistics for Stormwater Sediment at OF237A FD2 WY2002-WY2023

	Minimum	Maximum	Arithmetic Mean	Median	Detects	Count	Percent Detects	10th Per	90th Per	Standard Deviation	Coefficient of Variation	Standard Error	95% UCL	95% LCL
Conventionals														
Total Organic Carbon (mg/Kg)	2.86	17.0	7.1	6.1	22	22	100%	4.1	11.9	3.6	0.50	0.8	8.6	5.7
Total Solids (%)	48.6	91.7	61.2	61.0	22	22	100%	54.0	66.3	8.5	0.14	1.8	65.1	58.1
Total Volatile Solids (%)	8.8	18.7	14.1	14.5	9	9	100%	10.6	18.7	3.3	0.23	1.1	16.0	12.1
Nutrients														
Phosphorus, Total (mg/Kg)	584	1880	985	808	9	9	100%	650	1410	410	0.42	137	1250	765
Metals														
Cadmium (mg/Kg dry)	0.399	0.853	0.562	0.519	10	10	100%	0.406	0.762	0.159	0.283	0.050	0.661	0.474
Copper (mg/Kg dry)	57.7	100	81	79	10	10	100%	64	100	17	0.20	5	91	71
Lead (mg/Kg dry)	50.9	114.0	83.0	80.4	22	22	100%	64.9	104.0	17.7	0.21	3.8	90.3	75.9
Mercury (mg/Kg dry)	0.029	0.129	0.067	0.066	22	22	100%	0.046	0.088	0.023	0.34	0.005	0.077	0.058
Zinc (mg/Kg dry)	220	540	356	336	22	22	100%	268	473	87	0.24	18	393	322
TPH														
NWTPH-Diesel (mg/Kg)	0.6	780	137	125	18	22	81%	22	169	153	1.12	33	209	90
NWTPH-Heavy Oil (mg/Kg)	1400	4300	2840	2550	22	22	100%	2000	4080	886	0.31	189	3210	2490
PAHs														
LPAHs														
2-Methylnaphthalene (ug/Kg)	0.0	184	68	62	15	22	68%	5	138	49	0.72	11	88	48
Acenaphthene (ug/Kg)	7	300	91	66	19	22	86%	19	188	73	0.80	16	122	63
Acenaphthylene (ug/Kg)	0.9	29	15	16	8	22	36%	3	28	10	0.62	2	19	12
Anthracene (ug/Kg)	43	890	330	312	22	22	100%	117	603	210	0.64	45	418	248
Fluorene (ug/Kg)	18	270	137	125	22	22	100%	46	247	76	0.55	16	169	107
Naphthalene (ug/Kg)	13	220	101	109	19	22	86%	36	140	48	0.48	10	121	82
Phenanthrene (ug/Kg)	247	4600	2210	2140	22	22	100%	858	4010	1240	0.56	265	2740	1720
Total LPAHs[1]	43	16500	3200	2120	10	22	45%	414	5930	3630	1.14	775	4830	1940
HPAHs														
Benzo(a)anthracene (ug/Kg)	194	3700	1750	1590	22	22	100%	477	2960	975	0.56	208	2140	1360
Benzo(a)pyrene (ug/Kg)	260	3300	1730	1700	22	22	100%	412	2960	860	0.50	183	2070	1380
Benzo(b,k)fluoranthene (ug/Kg)	721	8500	4330	4220	22	22	100%	885	7740	2320	0.54	494	5290	3390
Benzo(g,h,i)perylene (ug/Kg)	180	9300	1660	1300	22	22	100%	311	2670	1900	1.14	404	2540	1040
Chrysene (ug/Kg)	305	6900	2630	2350	22	22	100%	718	4270	1570	0.60	335	3320	2010
Dibenz(a,h)anthracene (ug/Kg)	6	2800	466	328	21	22	95%	77	717	583	1.25	124	733	277
Fluoranthene (ug/Kg)	671	7700	3630	3720	22	22	100%	1340	5370	1670	0.46	357	4340	2940
Indeno(1,2,3-c,d)pyrene (ug/Kg)	205	2800	1280	1240	22	22	100%	288	2090	675	0.53	144	1550	1020
Pyrene (ug/Kg)	551	9500	4160	4080	22	22	100%	1440	6280	2390	0.58	510	5170	3200
Retene (ug/L)	138	475	357	458	3	3	100%	202	472	190	0.53	110	475	138
Total HPAHs[2]	44	24000	11900	11400	10	22	45%	3420	20900	7320	0.61	1560	14900	8990
Total PAHs[3]	978	27700	15100	13500	10	22	45%	5120	26900	8500	0.56	1810	18600	11800
Phthalates														
bis(2-Ethylhexyl) phthalate (ug/Kg)	1300	24000	9510	7460	22	22	100%	4030	15900	5760	0.61	1230	12000	7320
Butyl benzyl phthalate (ug/Kg)	140	2200	808	658	22	22	100%	280	1740	574	0.71	122	1060	588
Diethyl phthalate (ug/Kg)	3	250	54	35	6	22	27%	13	94	57	1.04	12	80	35
Dimethyl phthalate (ug/Kg)	10	2200	226	110	17	22	77%	24	420	458	2.02	98	439	96
Di-n-butyl phthalate (ug/Kg)	29	1100	304	234	18	22	81%	71	616	270	0.89	58	421	202
Di-n-Octyl phthalate (ug/Kg)	4	4800	925	845	15	22	68%	28	1810	1090	1.17	231	1410	531
Total Phthalates[4]	1660	31200	11800	10300	22	22	100%	4810	18900	7170	0.61	1530	14800	9060
Insecticides														
Bifenthrin (ug/Kg)	12	44	30	31	9	9	100%	14	43	12	0.40	4	37	23
PCBs														
Aroclor-1016 (ug/Kg)	0.5	45	6.7	3.74	0	22	0%	1.0	12.8	9.5	1.42	2.0	11.3	3.6
Aroclor-1221 (ug/Kg)	0.0	22	6.3	3.29	0	22	0%	0.8	16.7	6.4	1.02	1.4	9.1	3.8
Aroclor-1232 (ug/Kg)	0.0	65	10.8	3.61	0	22	0%	0.7	34.9	17.4	1.60	3.7	18.5	4.6
Aroclor-1242 (ug/Kg)	0.3	68	11.3	3.62	0	22	0%	0.9	37.8	18.5	1.64	3.9	19.5	4.7
Aroclor-1248 (ug/Kg)	0.4	47	8.4	2.31	0	22	0%	0.5	28.8	12.9	1.53	2.7	14.1	3.7
Aroclor-1254 (ug/Kg)	0.0	390	47	6	7	22	31%	0.5	109.0	89.8	1.92	19.1	88.9	16.6
Aroclor-1260 (ug/Kg)	1.0	150	44	26	8	22	36%	1.9	109.0	45.2	1.02	9.6	63.1	26.8
TOTAL PCBs[5]	0	390	77	64	13	22	59%	0	177	94	1.22	20	120	42
Herbicides														
Dichlobenil (ug/L)	19	38	27	25	3	3	100%	20	35	10	0.36	6	38	19
Phenolics														
2-Methylphenol (ug/Kg dry)	2.48	22	12.0	12.00	0	2	0%	4	20	14	1.12	10	22	2
4-Methylphenol (ug/Kg dry)	56.00	4700	1240.0	585.00	6	6	100%	133	3000	1750	1.41	715	2660	293
Pentachlorophenol (ug/Kg dry)	158.00	326	225.0	190.00	3	3	100%	164	299	89	0.40	52	326	158

[1] *Total LPAHs is the sum of the concentration or non-detected calculated value of the following compounds: Naphthalene, acenaphthene, acenaphthylene, anthracene, fluorene, and phenanthrene.*

[2] *Total HPAHs is the sum of the concentration of non-detected calculated value of the following compounds: Fluoranthene, pyrene, benzo(a)anthracene, chrysene, benzo(b,k)fluoranthene, benzo(b,k)fluoranthene, benzo(a)pyrene, indeno(1,2,3-c,d)pyrene, dibenz(a,h)anthracene, benzo(g,h,i)perylene.*

[3] *Total PAHs is the sum of the LPAHs and HPAHs.*

[4] *Total phthalates is the sum of detected values only.*

[5] *Total value for PCBs is the sum of detected values only.*

Bold – The analyte was present in the sample.

U – The analyte was not detected at or above the reported value.

UJ – The analyte was not detected at or above the reported estimated value.

J – The analyte was positively identified. The associated value is an estimate.

NJ - There is evidence the analyte is present. The associated value is an estimate.

E - Estimated above the calibration curve.

Table E-18
Summary Statistics for Stormwater Sediment at OF237B FD1 WY2002-WY2023

	Minimum	Maximum	Arithmetic Mean	Median	Detects	Count	Percent Detects	10th Per	90th Per	Standard Deviation	Coefficient of Variation	Standard Error	95% UCL	95% LCL
Conventionals														
Total Organic Carbon (mg/Kg)	0.572	11	3.1	2.3	22	22	100%	1.4	5.2	2.3	0.76	0.5	4.1	2.3
Total Solids (%)	54.5	82.8	69.9	69.7	22	22	100%	62.9	77.3	6.9	0.10	1.5	72.7	67.1
Total Volatile Solids (%)	3.1	15.2	5.8	4.9	9	9	100%	3.6	8.1	3.7	0.63	1.2	8.3	4.2
Nutrients														
Phosphorus, Total (mg/Kg)	375	662	540	529	9	9	100%	440	659	98	0.18	33	598	478
Metals														
Cadmium (mg/Kg dry)	0.034	2.030	0.497	0.362	11	11	100%	0.230	0.649	0.534	1.07	0.161	0.842	0.274
Copper (mg/Kg dry)	30.9	64	44	41	11	11	100%	33	64	11	0.25	3	51	38
Lead (mg/Kg dry)	20.6	129.0	47.3	40.6	22	22	100%	27.6	71.7	23.6	0.50	5.0	57.8	38.5
Mercury (mg/Kg dry)	0.0073	0.162	0.046	0.040	21	22	95%	0.018	0.069	0.033	0.71	0.007	0.060	0.034
Zinc (mg/Kg dry)	123	280	199	195	22	22	100%	146	260	40	0.20	8	216	184
TPH														
NWTPH-Diesel (mg/Kg)	0.76	780	76.4	39	14	22	63%	5	127	162	2.12	35	151	32
NWTPH-Heavy Oil (mg/Kg)	520	3000	1310	1300	22	22	100%	755	1790	617	0.47	131	1570	1070
PAHs														
LPAHs														
2-Methylnaphthalene (ug/Kg)	1.5	120	33	23	7	22	31%	3.7	73	31	0.93	6.6	47	22
Acenaphthene (ug/Kg)	0.2	170	47	18	9	22	40%	6.4	129	53	1.13	11.3	69	26
Acenaphthylene (ug/Kg)	1.4	32	13	9	4	22	18%	3.5	24	9	0.68	1.9	17	10
Anthracene (ug/Kg)	2.0	500	120	50	16	22	72%	3.6	357	144	1.20	30.7	185	65
Fluorene (ug/Kg)	0	240	63	29	11	22	50%	3.4	183	71	1.12	15.0	94	37
Naphthalene (ug/Kg)	2	160	36	29	7	22	31%	2.6	72	37	1.01	7.8	53	23
Phenanthrene (ug/Kg)	36	3500	902	476	22	22	100%	108	2410	951	1.05	203	1310	559
Total LPAHs[1]	4	555	296	263	10	22	45%	120	495	157	0.53	33	361	233
HPAHs														
Benzo(a)anthracene (ug/Kg)	52	2200	566	329	22	22	100%	82	1200	554	0.98	118	805	361
Benzo(a)pyrene (ug/Kg)	62	2200	553	344	22	22	100%	106	1200	526	0.95	112	786	357
Benzo(b,k)fluoranthene (ug/Kg)	147	7300	1660	874	22	22	100%	356	3870	1820	1.10	388	2480	994
Benzo(g,h,i)perylene (ug/Kg)	47	2900	674	256	22	22	100%	119	1780	829	1.23	177	1050	364
Chrysene (ug/Kg)	68	3000	818	487	22	22	100%	150	1700	768	0.94	164	1160	520
Dibenz(a,h)anthracene (ug/Kg)	8.9	410	125	61	18	22	81%	26	227	114	0.91	24	172	81
Fluoranthene (ug/Kg)	77	4700	1370	902	22	22	100%	239	2680	1230	0.90	263	1890	901
Indeno(1,2,3-c,d)pyrene (ug/Kg)	65	1600	426	242	22	22	100%	125	851	412	0.97	88	612	271
Pyrene (ug/Kg)	73	7400	1550	851	22	22	100%	234	3290	1720	1.11	366	2320	920
Retene (ug/L)	22	45	32	30	2	3	66%	24	42	12	0.36	7	45	22
Total HPAHs[2]	25	4170	1940	1610	10	22	45%	642	3640	1200	0.62	257	2450	1460
Total PAHs[3]	30	4730	2230	1860	10	22	45%	816	4100	1280	0.58	274	2770	1720
Phthalates														
bis(2-Ethylhexyl) phthalate (ug/Kg)	1360	17000	4160	3200	22	22	100%	1560	6570	3450	0.83	735	5720	2940
Butyl benzyl phthalate (ug/Kg)	17	1700	289	145	21	22	95%	45	706	375	1.30	80	462	163
Diethyl phthalate (ug/Kg)	0	190	37	29	5	22	22%	2	67	40	1.09	9	55	23
Dimethyl phthalate (ug/Kg)	1	7200	374	25	6	22	27%	5	94	1530	4.09	326	1040	26
Di-n-butyl phthalate (ug/Kg)	4	490	106	59	13	22	59%	18	205	118	1.12	25	159	63
Di-n-Octyl phthalate (ug/Kg)	2	2000	498	502	13	22	59%	7	879	511	1.03	109	722	302
Total Phthalates[4]	1570	21100	5400	3720	22	22	100%	1650	7820	5010	0.93	1070	7650	3600
Insecticides														
Bifenthrin (ug/Kg)	2	21	9	7	9	9	100%	4	18	6	0.69	2	13	6
PCBs														
Aroclor-1016 (ug/Kg)	0.1	60	7.0	2	0	22	0%	0.5	19.6	13.4	1.92	2.9	13.4	2.5
Aroclor-1221 (ug/Kg)	0.0	36	6.1	1.7	0	22	0%	0.3	10.0	9.8	1.61	2.1	10.7	2.7
Aroclor-1232 (ug/Kg)	0.3	32	6.7	2	0	22	0%	0.6	15.8	8.9	1.33	1.9	10.6	3.4
Aroclor-1242 (ug/Kg)	0.0	52	9.3	2	0	22	0%	0.3	41.9	16.4	1.76	3.5	16.7	3.2
Aroclor-1248 (ug/Kg)	0.0	21	3.5	2	0	22	0%	0.4	7.7	4.7	1.35	1.0	5.6	1.8
Aroclor-1254 (ug/Kg)	0.0	43	7.4	2	2	22	9%	0.3	13.8	11.5	1.56	2.4	12.4	3.3
Aroclor-1260 (ug/Kg)	0.0	45	11.9	7.5	4	22	18%	0.3	33.7	13.9	1.17	3.0	18.0	6.6
TOTAL PCBs[5]	0	88	8	0	4	21	19%	0.0	30.0	21.0	2.58	4.6	18.2	0.9
Herbicides														
Dichlobenil (ug/L)	2	7	4	2	3	3	100%	2	6	3	0.79	2	7	2
Phenolics														
2-Methylphenol (ug/Kg dry)	4.40	34	16.0	14.4	0	6	0%	5	29	12	0.75	5	25	8
4-Methylphenol (ug/Kg dry)	19.00	900	311.0	263.0	8	9	88%	29	828	333	1.07	111	533	126
Pentachlorophenol (ug/Kg dry)	0.54	204	49.6	9.0	1	5	20%	1	135	87	1.76	39	129	3

[1] *Total LPAHs is the sum of the concentration or non-detected calculated value of the following compounds: Naphthalene, acenaphthene, acenaphthylene, anthracene, fluorene, and phenanthrene*

[2] *Total HPAHs is the sum of the concentration of non-detected calculated value of the following compounds: Fluoranthene, pyrene, benzo(a)anthracene, chrysene, benzo(b,k)fluoranthene, benzo(b,k)fluoranthene, benzo(a)pyrene, indeno(1,2,3-c,d)pyrene, dibenz(a,h)anthracene, benzo(g,h,i)perylene.*

[3] *Total PAHs is the sum of the LPAHs and HPAHs.*

[4] *Total phthalates is the sum of detected values only.*

[5] *Total value for PCBs is the sum of detected values only.*

Bold – The analyte was present in the sample.
U – The analyte was not detected at or above the reported value.
UJ – The analyte was not detected at or above the reported estimated value.
J – The analyte was positively identified. The associated value is an estimate.
NJ - There is evidence the analyte is present. The associated value is an estimate.
E - Estimated above the calibration curve.

Table E-19
Summary Statistics for Stormwater Sediment at OF243 FD23 WY2002-WY2023

	Minimum	Maximum	Arithmetic Mean	Median	Detects	Count	Percent Detects	10th Per	90th Per	Standard Deviation	Coefficient of Variation	Standard Error	95% UCL	95% LCL
Conventionals														
Total Organic Carbon (mg/Kg)	3.71	14	8	8	17	17	100%	5.3	10.7	2.4	0.29	0.6	9.3	7.1
Total Solids (%)	18.6	47	31	31	22	22	100%	22.5	40.2	7.1	0.23	1.5	34.3	28.5
Total Volatile Solids (%)	17.0	25.8	21.2	21.0	9	9	100%	18.7	25.1	2.8	0.13	0.9	23.0	19.6
Nutrients														
Phosphorus, Total (mg/Kg)	1900	13700	8890	9570	6	6	100%	3600	13500	4610	0.52	1880	12100	5520
Metals														
Cadmium (mg/Kg dry)	1.79	5.55	3.27	2.87	9	9	100%	1.90	4.66	1.25	0.38	0.42	4.06	2.52
Copper (mg/Kg dry)	174	288	225	224	9	9	100%	192	254	33	0.14	11	246	205
Lead (mg/Kg dry)	343	913	516	433	17	17	100%	377	755	172	0.33	42	600	442
Mercury (mg/Kg dry)	0.206	0.972	0.419	0.316	18	18	100%	0.229	0.750	0.236	0.56	0.056	0.530	0.322
Zinc (mg/Kg dry)	440	936	759	764	17	17	100%	648	909	127	0.17	31	815	697
TPH														
NWTPH-Diesel (mg/Kg)	8	670	219	190	17	21	80%	14	400	178	0.82	39	300	148
NWTPH-Heavy Oil (mg/Kg)	1700	7400	4300	4100	21	21	100%	2500	6600	1640	0.38	357	4990	3620
PAHs														
LPAHs														
2-Methylnaphthalene (ug/Kg)	12	260	113	110	20	21	95%	52	150	57	0.50	12	137	90
Acenaphthene (ug/Kg)	1	211	55	38	14	21	66%	17	82	54	0.98	12	79	35
Acenaphthylene (ug/Kg)	14	130	63	56	14	21	66%	30	130	34	0.54	7	78	49
Anthracene (ug/Kg)	40	1000	302	290	21	21	100%	127	460	203	0.67	44	395	227
Fluorene (ug/Kg)	1	330	105	88	19	21	90%	15	200	88	0.84	19	144	71
Naphthalene (ug/Kg)	52	393	184	170	21	21	100%	106	280	84	0.45	18	221	151
Phenanthrene (ug/Kg)	134	2900	950	710	21	21	100%	422	2000	717	0.76	157	1270	679
Total LPAHs[1]	264	1930	937	1050	10	21	47%	328	1580	480	0.51	105	1140	741
HPAHs														
Benzo(a)anthracene (ug/Kg)	91	1700	714	710	20	21	95%	235	1110	389	0.55	85	881	559
Benzo(a)pyrene (ug/Kg)	112	1200	701	660	20	21	95%	267	1100	313	0.45	68	829	571
Benzo(b,k)fluoranthene (ug/Kg)	287	4200	1820	1780	21	21	100%	639	2750	937	0.51	204	2230	1440
Benzo(g,h,i)perylene (ug/Kg)	157	2100	670	510	20	21	95%	228	1300	492	0.73	107	889	480
Chrysene (ug/Kg)	184	2400	1320	1200	21	21	100%	508	2100	633	0.48	138	1590	1070
Dibenz(a,h)anthracene (ug/Kg)	11	1700	182	95	17	21	80%	23	266	355	1.95	78	347	84
Fluoranthene (ug/Kg)	186	3770	1510	1400	21	21	100%	688	2530	826	0.55	180	1870	1170
Indeno(1,2,3-c,d)pyrene (ug/Kg)	59	950	421	380	19	21	90%	138	700	229	0.54	50	519	326
Pyrene (ug/Kg)	316	5700	2260	1780	21	21	100%	861	3700	1410	0.63	308	2860	1700
Retene (ug/L)	70	240	155	154	3	3	100%	87	223	85	0.55	49	240	70
Total HPAHs[2]	224	13100	7220	7790	10	21	47%	2030	12300	3770	0.52	822	8760	5600
Total PAHs[3]	666	15000	8160	8240	10	21	47%	2800	13200	4070	0.50	887	9810	6450
Phthalates														
bis(2-Ethylhexyl) phthalate (ug/Kg)	1830	41000	15200	12800	21	21	100%	5270	29000	11200	0.74	2450	20100	10900
Butyl benzyl phthalate (ug/Kg)	150	51000	7940	2700	21	21	100%	504	20000	13200	1.67	2890	14000	3170
Diethyl phthalate (ug/Kg)	0.9	180	42	22	6	21	28%	5	110	48	1.13	10	64	24
Dimethyl phthalate (ug/Kg)	3	390	98	42	16	21	76%	22	210	108	1.10	24	147	57
Di-n-butyl phthalate (ug/Kg)	19	725	225	181	19	21	90%	40	440	184	0.81	40	308	154
Di-n-Octyl phthalate (ug/Kg)	1	4000	1050	684	14	21	66%	21	3400	1220	1.16	265	1600	583
Total Phthalates[4]	1990	96400	24500	18800	21	21	100%	7070	48500	22700	0.93	4960	34900	16100
Insecticides														
Bifenthrin (ug/Kg)	2	29	14	14	9	9	100%	5	25	9	0.63	3	19	9
PCBs														
Aroclor-1016 (ug/Kg)	0.0	99	12	2	0	17	0%	0	28	24	1.96	6	26	3.6
Aroclor-1221 (ug/Kg)	0.2	28	6	2	0	17	0%	0	18	8	1.50	2	10	2.2
Aroclor-1232 (ug/Kg)	0.1	121	13	3	0	17	0%	0	22	29	2.21	7	28	3.6
Aroclor-1242 (ug/Kg)	0.1	127	11	1	0	17	0%	0	19	30	2.70	7	27	2.1
Aroclor-1248 (ug/Kg)	0.0	147	18	1	0	17	0%	0	42	37	2.06	9	37	4.4
Aroclor-1254 (ug/Kg)	0.0	220	44	2	4	17	23%	0	154	70	1.59	17	78	14.6
Aroclor-1260 (ug/Kg)	0.1	96	17	3	1	17	5%	0	54	30	1.80	7	32	4.8
TOTAL PCBs[5]	0	220	46	0	4	16	25%	0	183	84	1.82	21	89	10.0
Herbicides														
Dichlobenil (ug/L)	2	7	5	6	3	3	100%	3	7	3	0.53	2	7	2
Phenolics														
2-Methylphenol (ug/Kg dry)	0.84	11	5.7	5.26	1	3	33%	2	10	5	0.89	3	11	1
4-Methylphenol (ug/Kg dry)	14.00	5400	1190.0	146.00	5	6	83%	24	3420	2130	1.78	870	2960	66
Pentachlorophenol (ug/Kg dry)	106.00	193	154.0	162.00	3	3	100%	117	187	44	0.29	26	193	106

[1] *Total LPAHs is the sum of the concentration or non-detected calculated value of the following compounds: Naphthalene, acenaphthene, acenaphthylene, anthracene, fluorene, and phenanthrene.*

[2] *Total HPAHs is the sum of the concentration of non-detected calculated value of the following compounds: Fluoranthene, pyrene, benzo(a)anthracene, chrysene, benzo(b,k)fluoranthene, benzo(b,k)fluoranthene, benzo(a)pyrene, indeno(1,2,3-c,d)pyrene, dibenz(a,h)anthracene, benzo(g,h,i)perylene.*

[3] *Total PAHs is the sum of the LPAHs and HPAHs.*

[4] *Total phthalates is the sum of detected values only.*

[5] *Total value for PCBs is the sum of detected values only.*

Bold – The analyte was present in the sample.
U – The analyte was not detected at or above the reported value.
UJ – The analyte was not detected at or above the reported estimated value.
J – The analyte was positively identified. The associated value is an estimate.
NJ - There is evidence the analyte is present. The associated value is an estimate.
E - Estimated above the calibration curve.

Table E-20
Summary Statistics for Stormwater Sediment at OF245 MH390 WY2002-WY2023

	Minimum	Maximum	Arithmetic Mean	Median	Detects	Count	Percent Detects	10th Per	90th Per	Standard Deviation	Coefficient of Variation	Standard Error	95% UCL	95% LCL
Conventionals														
Total Organic Carbon (mg/Kg)	0.933	13	4.5	4.1	22	22	100%	1.2	7.8	3.0	0.67	0.6	5.9	3.4
Total Solids (%)	43.8	81	67.2	68.9	22	22	100%	50.0	79.0	11.2	0.17	2.4	71.6	62.6
Total Volatile Solids (%)	3	30.9	12.9	9.9	9	9	100%	5.2	26.4	9.4	0.73	3.1	19.1	7.5
Nutrients														
Phosphorus, Total (mg/Kg)	587	3290	1220	944	9	9	100%	615	2110	870	0.71	290	1820	773
Metals														
Cadmium (mg/Kg dry)	0.541	1.800	1.010	0.791	11	11	100%	0.552	1.770	0.504	0.498	0.152	1.310	0.751
Copper (mg/Kg dry)	45.2	276	121	114	12	12	100%	71	168	60	0.50	17	156	91.5
Lead (mg/Kg dry)	8.3	85.7	46.1	42.4	22	22	100%	22.0	74.4	22.2	0.48	4.7	55.0	37.0
Mercury (mg/Kg dry)	0.0003	0.2110	0.0650	0.0535	21	22	95%	0.025	0.145	0.052	0.792	0.011	0.087	0.046
Zinc (mg/Kg dry)	80.9	679	409	394	22	22	100%	174	602	171	0.42	37	476	338
TPH														
NWTPH-Diesel (mg/Kg)	1.03	1100	240	117	13	22	59%	3	555	289	1.20	62	365	129
NWTPH-Heavy Oil (mg/Kg)	230	6900	2850	2800	22	22	100%	830	4860	1662	0.58	354	3549	2188
PAHs														
LPAHs														
2-Methylnaphthalene (ug/Kg)	11.3	86	43	37	11	22	50%	26	73	21	0.48	4.4	52	34.7
Acenaphthene (ug/Kg)	1	97	31	24	6	22	27%	4	64	27	0.88	5.8	42	20.2
Acenaphthylene (ug/Kg)	0	29	16	16	7	22	31%	7	26	8	0.51	1.7	19	12.3
Anthracene (ug/Kg)	4.0	530	71	34	14	22	63%	8.5	108	116	1.64	24.7	124	33.0
Fluorene (ug/Kg)	0.9	260	35	17	9	22	40%	3	77	56	1.60	11.9	61	16.8
Naphthalene (ug/Kg)	3.3	124	52	52	11	22	50%	9	95	32	0.62	6.8	65	38.9
Phenanthrene (ug/Kg)	13.5	810	209	135	20	22	90%	59	319	194	0.93	41.4	293	138
Total LPAHs	17	1050	379	299	10	22	45%	96	695	264	0.70	56	493	276
HPAHs														
Benzo(a)anthracene (ug/Kg)	1.6	740	144	84	18	22	81%	27	384	175	1.21	37	225	82
Benzo(a)pyrene (ug/Kg)	21	490	130	100	17	22	77%	29	317	121	0.93	26	184	85
Benzo(b,k)fluoranthene (ug/Kg)	9	824	268	190	18	22	81%	60	695	237	0.89	51	371	178
Benzo(g,h,i)perylene (ug/Kg)	5	300	134	116	21	22	95%	58	244	80	0.60	17	167	102
Chrysene (ug/Kg)	24.5	1000	242	160	21	22	95%	55	499	232	0.96	50	344	157
Dibenz(a,h)anthracene (ug/Kg)	2.7	168	37	32	6	22	27%	13	55	34	0.91	7	53	26
Fluoranthene (ug/Kg)	24.9	1040	275	210	21	22	95%	96	477	238	0.86	51	381	189
Indeno(1,2,3-c,d)pyrene (ug/Kg)	2.6	220	63	51	13	22	59%	10	127	50	0.80	11	85	45
Pyrene (ug/Kg)	47.3	1200	444	332	21	22	95%	118	931	338	0.76	72	591	314
Retene	22	39	32	34	3	3	100%	24	38	9	0.28	5	39	22
Total HPAHs	97	4700	1560	1320	10	22	45%	430	2960	1120	0.72	239	2050	1140
TOTAL PAHs	406	5750	1940	1490	10	22	45%	729	3400	1310	0.67	279	2520	1450
Phthalates														
bis(2-Ethylhexyl) phthalate (ug/Kg)	780	34000	9140	4460	21	22	95%	1320	32000	11600	1.27	2480	14200	4810
Butyl benzyl phthalate (ug/Kg)	2500	160000	23900	9400	22	22	100%	3500	47900	35100	1.47	7480	40100	12200
Diethyl phthalate (ug/Kg)	0.8	128	38	31	3	22	13%	5	80	32	0.85	7	52	26
Dimethyl phthalate (ug/Kg)	3.4	211	64	49	11	22	50%	9	164	59	0.92	13	90	42
Di-n-butyl phthalate (ug/Kg)	25.1	15000	1060	202	19	22	86%	47	1450	3160	2.98	673	2500	240
Di-n-Octyl phthalate (ug/Kg)	9.7	4250	422	82	12	22	54%	14	943	910	2.16	194	859	147
Total Phthalates	5330	207000	34500	14000	22	22	100%	5830	79000	46200	1.34	9860	55500	18700
Insecticides														
Bifenthrin (ug/Kg)	0	9	4	3	7	9	77%	0	7	3	0.87	1	6	2
PCBs														
Aroclor-1016 (ug/Kg)	0.0	29	3.8	2.2	0	20	0%	0.8	6.6	6.3	1.65	1.4	6.9	2
Aroclor-1221 (ug/Kg)	0.3	14	4.5	2.1	0	20	0%	0.6	11.0	4.4	0.98	1.0	6.5	3
Aroclor-1232 (ug/Kg)	0.0	12	3.8	3.4	0	20	0%	0.3	9.2	3.7	0.97	0.8	5.4	2
Aroclor-1242 (ug/Kg)	0.2	25	4.2	1.9	0	20	0%	0.4	7.3	5.6	1.33	1.3	6.8	2
Aroclor-1248 (ug/Kg)	0.2	19	4.2	1.6	0	20	0%	0.3	11.6	5.2	1.25	1.2	6.6	2
Aroclor-1254 (ug/Kg)	0.4	70	12	2.7	5	20	25%	0.9	36.1	20.7	1.70	4.6	22.0	5
Aroclor-1260 (ug/Kg)	0.0	130	11	3.7	1	19	5%	0.3	14.0	29.1	2.57	6.7	25.5	3
TOTAL PCBs	0	130	18	0	6	19	31%	0	65	35	1.99	8	35	4
Herbicides														
Dichlobenil (ug/L)	8	18	12	10	3	3	100%	8	16	5	0.44	3	18	8
Phenolics														
2-Methylphenol (ug/Kg dry)	2.40	119	31.1	10.60	1	6	16%	3	80	45	1.46	19	68	6
4-Methylphenol (ug/Kg dry)	1.29	100	42.8	35.20	2	9	22%	7	90	38	0.88	13	67	20
Pentachlorophenol (ug/Kg dry)	0.26	111	35.8	9.84	2	5	40%	3	87	46	1.29	21	77	5

[1] *Total LPAHs is the sum of the concentration or non-detected calculated value of the following compounds: Naphthalene, acenaphthene, acenaphthylene, anthracene, fluorene, and phenanthrene.*

[2] *Total HPAHs is the sum of the concentration of non-detected calculated value of the following compounds: Fluoranthene, pyrene, benzo(a)anthracene, chrysene, benzo(b,k)fluoranthene, benzo(b,k)fluoranthene, benzo(a)pyrene, indeno(1,2,3-c,d)pyrene, dibenz(a,h)anthracene, benzo(g,h,i)perylene.*

[3] *Total PAHs is the sum of the LPAHs and HPAHs.*

[4] *Total phthalates is the sum of detected values only.*

[5] *Total value for PCBs is the sum of detected values only.*

Bold – The analyte was present in the sample.
U – The analyte was not detected at or above the reported value.
UJ – The analyte was not detected at or above the reported estimated value.
J – The analyte was positively identified. The associated value is an estimate.
NJ - There is evidence the analyte is present. The associated value is an estimate.
E - Estimated above the calibration curve.

Table E-21
Baseflow Data at Outfall 230 for WY2016 and WY2019

	Minimum	Maximum	Arithmetic Mean	Median	# of Detects	Count	% Detects	10th Per	90th Per	Standard Deviation	Coefficient of Variation	Standard Error	95% UCL	95% LCL
Conventionals														
Anionic Surfactants - MBAS (ug/L)	0.013	0.0464	0.0	0.0327	4	5	80%	0.0161	0.0429	0.0	0.443	0.006	0.0	0.0
BOD (mg/L)	1.0	4.9	1.8	1.0	1	5	20%	1.0	3.3	1.7	0.980	0.780	3.9	-0.4
Chloride (mg/L)	13.3	44.4	21.6	17.2	5	5	100%	13.3	34.5	13.0	0.604	5.828	37.8	5.4
Conductivity (uS/cm)	126	20900	3201.9	248	7	7	100%	154	8609	7805	2.438	2949.91	10420.0	-4016.3
Hardness (mg CaCO3/L)	67	150	103.2	97.1	7	7	100%	71.9	147	32.3	0.313	12.22	133.1	73.3
pH (pH units)	7.0	8.1	7.7	7.9	7	7	100%	7.0	8.04	0.5	0.061	0.18	8.1	7.2
TSS (mg/L)	1.70	12.7	5.34	2.70	7	7	100%	2.00	12.46	4.92	0.922	1.86	9.9	0.8
Turbidity (NTU)	1.84	15.5	6.51	5.39	5	5	100%	2.26	12.076	5.41	0.831	2.42	13.2	-0.2
Nutrients														
Nitrate+Nitrite as N (mg/L)	0.513	1.570	0.998	0.934	6	6	100%	0.659	1.400	0.365	0.37	0.149	1.381	0.614
Phosphate, Ortho (mg/L)	0.057	0.165	0.116	0.113	6	6	100%	0.076	0.159	0.040	0.35	0.016	0.157	0.074
Phosphorus, Total (mg/L)	0.070	0.184	0.128	0.126	6	6	100%	0.083	0.176	0.045	0.35	0.018	0.175	0.081
Total Nitrogen (mg/L)	0.600	2.000	1.093	1.060	6	6	100%	0.605	1.615	0.522	0.48	0.213	1.642	0.545
Metals														
Cadmium (ug/L)	0.017	0.062	0.036	0.031	2	7	29%	0.019	0.058	0.017	0.472	0.006	0.052	0.020
Cadmium, Dissolved (ug/L)	0.013	0.040	0.024	0.025	2	7	29%	0.013	0.032	0.009	0.386	0.003	0.032	0.015
Copper (ug/L)	2.89	10.100	5.003	4.04	7	7	100%	3.232	7.622	2.445	0.489	0.924	7.264	2.741
Copper, Dissolved (ug/L)	1.78	7.06	3.19	2.68	7	7	100%	2.07	4.67	1.77	0.554	0.668	4.825	1.555
Lead (ug/L)	0.380	3.55	1.25	0.748	7	7	100%	0.46	2.39	1.11	0.888	0.420	2.280	0.224
Lead, Dissolved (ug/L)	0.010	0.386	0.202	0.232	6	7	86%	0.068	0.324	0.128	0.632	0.048	0.321	0.084
Mercury (ng/L)	0.0008	0.004	0.002	0.001	5	7	71%	0.00092	0.004	0.0014	0.705	0.0005	0.0033	0.0007
Mercury, Dissolved (ng/L)	0.0009	0.0045	0.0026	0.0025	1	7	14%	0.0019	0.0034	0.0010	0.406	0.0004	0.0035	0.0016
Zinc (ug/L)	10.3	85.7	29.4	15.0	7	7	100%	12.46	62.06	27.596	0.938	10.430	54.936	3.892
Zinc, Dissolved (ug/L)	6.47	34.2	14.3	11.3	7	7	100%	7.73	23.3	9.28	0.646	3.51	22.9	5.77
Insecticides														
Carbaryl (ug/L)	0.030	0.030	0.030	0.030	0	4	0%	0.030	0.030	0	0	0	0.030	0.030
Chlorpyrifos (ug/L)	0.0255	0.0295	0.0268	0.0260	0	7	0%	0.0255	0.0295	0.002	0.070	0.001	0.029	0.025
PAHs														
LPAHs														
2-Methylnaphthalene (ug/L)	0.005	0.013	0.007	0.005	2	7	29%	0.005	0.012	0.003	0.49	0.001	0.010	0.004
Acenaphthene (ug/L)	0.0025	0.007	0.005	0.005	1	7	14%	0.004	0.006	0.001	0.26	0.000	0.006	0.004
Acenaphthylene (ug/L)	0.0015	0.005	0.004	0.005	1	7	14%	0.003	0.005	0.001	0.30	0.000	0.006	0.003
Anthracene (ug/L)	0.003	0.008	0.005	0.005	1	7	14%	0.003	0.006	0.002	0.35	0.001	0.006	0.003
Fluorene (ug/L)	0.004	0.007	0.006	0.005	3	7	43%	0.005	0.007	0.001	0.20	0.000	0.007	0.005
Naphthalene (ug/L)	0.005	0.03	0.015	0.015	6	7	86%	0.009	0.023	0.007	0.44	0.003	0.022	0.009
Phenanthrene (ug/L)	0.008	0.026	0.017	0.017	7	7	100%	0.012	0.022	0.006	0.33	0.002	0.022	0.012
Total LPAHs	0.035	0.07	0.047	0.046	7	7	100%	0.036	0.061	0.012	0.25	0.005	0.058	0.036
HPAHs in ug/L														
Benzo(a)anthracene (ug/L)	0.003	0.008	0.005	0.005	1	7	14%	0.003	0.006	0.002	0.35	0.001	0.006	0.003
Benzo(a)pyrene (ug/L)	0.002	0.010	0.005	0.005	2	7	29%	0.003	0.007	0.002	0.51	0.001	0.007	0.003
Benzo(b,k)fluoranthenes (ug/L)	0.005	0.026	0.011	0.010	1	7	14%	0.005	0.017	0.007	0.63	0.003	0.018	0.005
Benzo(g,h,i)perylene (ug/L)	0.003	0.010	0.005	0.004	3	7	43%	0.003	0.007	0.002	0.50	0.001	0.007	0.003
Chrysene (ug/L)	0.002	0.007	0.005	0.005	2	7	29%	0.004	0.006	0.001	0.30	0.001	0.006	0.004
Dibenz(a,h)anthracene (ug/L)	0.002	0.005	0.004	0.005	1	7	14%	0.003	0.005	0.001	0.27	0.000	0.005	0.003
Fluoranthene (ug/L)	0.004	0.015	0.008	0.007	5	7	71%	0.004	0.013	0.004	0.49	0.002	0.012	0.005
Indeno(1,2,3-cd)pyrene (ug/L)	0.003	0.013	0.006	0.005	1	7	14%	0.004	0.008	0.003	0.58	0.001	0.009	0.003
Pyrene (ug/L)	0.004	0.016	0.007	0.005	2	7	29%	0.004	0.012	0.004	0.63	0.002	0.011	0.003
Total HPAHs	0.023	0.11	0.042	0.034	4	7	57%	0.025	0.070	0.030	0.70	0.011	0.069	0.015
Total PAHs	0.061	0.14	0.089	0.084	7	7	100%	0.062	0.118	0.029	0.33	0.011	0.116	0.062
Phthalates														
bis(2-Ethylhexyl)phthalate (ug/L)	0.188	0.8	0.48	0.52	2	7	29%	0.190	0.71	0.229	0.473	0.087	0.696	0.272
Butyl benzyl phthalate (ug/L)	0.213	0.52	0.429	0.510	0	7	0%	0.224	0.517	0.142	0.330	0.054	0.560	0.298
Diethylphthalate (ug/L)	0.139	1.20	0.600	0.520	3	7	43%	0.162	1.140	0.412	0.69	0.156	0.981	0.219
Dimethyl phthalate (ug/L)	0.134	0.52	0.414	0.510	0	7	0%	0.174	0.517	0.169	0.409	0.064	0.570	0.257
Di-n-butylphthalate (ug/L)	0.138	0.52	0.359	0.510	2	7	29%	0.141	0.520	0.196	0.546	0.074	0.541	0.178
Di-n-Octyl phthalate (ug/L)	0.174	0.52	0.421	0.510	0	7	0%	0.199	0.517	0.155	0.368	0.059	0.565	0.278
Total Phthalates	--	2.3	0.72	--	3	7	43%	0.000	2.218	1.052	1.47	0.40	1.69	-0.26
Herbicides														
2,4-D (ug/L)	0.044	0.970	0.211	0.050	3	6	50%	0.047	0.535	0.373	1.77	0.152	0.602	-0.180
Dichlobenil (ug/L)	0.020	0.052	0.043	0.051	1	7	14%	0.027	0.052	0.012	0.288	0.005	0.055	0.032
TPH														
NWTPH-Diesel (mg/L)	0.015	0.050	0.022	0.015	0	5	0%	0.015	0.036	0.016	0.71	0.007	0.041	0.003
NWTPH-Gasoline (ug/L)	2.34	25.0	6.9	2.3	0	5	0%	2.3	15.9	10.1	1.47	4.5	19.5	-5.7
NWTPH-Heavy Oil (mg/L)	0.100	0.105	0.102	0.100	0	5	0%	0.100	0.105	0.003	0.03	0.001	0.105	0.099
Bacteria														
Coliform, Fecal (CFU/100 ml)	10	2,400	669	110	4	5	80%	19	1,756	1,020	1.53	456	1,935	-598
BTEX														
Benzene (ug/L)	0.100	0.250	0.220	0.250	0	5	0%	0.160	0.250	0.067	0.30	0.030	0.303	0.137
Ethylbenzene (ug/L)	0.100	0.250	0.220	0.250	0	5	0%	0.160	0.250	0.067	0.30	0.030	0.303	0.137
m,p-Xylene (ug/L)	0.200	1.000	0.840	1.000	0	5	0%	0.520	1.000	0.358	0.43	0.160	1.284	0.396
o-Xylene (ug/L)	0.100	0.250	0.220	0.250	0	5	0%	0.160	0.250	0.067	0.30	0.030	0.303	0.137
Toluene (ug/L)	0.100	0.250	0.220	0.250	0	5	0%	0.160	0.250	0.067	0.30	0.030	0.303	0.137

Table E-22
Baseflow Data at Outfall 235 for WY2016 and WY2019

	Minimum	Maximum	Arithmetic Mean	Median	# of Detects	Count	% Detects	10th Per	90th Per	Standard Deviation	Coefficient of Variation	Standard Error	95% UCL	95% LCL
Conventionals														
Anionic Surfactants - MBAS (ug/L)	0.0048	0.054	0.0	0.029	6	7	86%	0.01378	0.0507	0.0	0.545	0.006	0.0	0.0
BOD (mg/L)	1	1	1.0	1	0	7	0%	1	1	0.0	0.000	0.000	1.0	1.0
Chloride (mg/L)	15.8	50.4	27.3	22.25	6	6	100%	16.65	43.05	13.3	0.487	5.429	41.3	13.4
Conductivity (uS/cm)	323	714	419.1	337	7	7	100%	327.8	567	141.6	0.338	53.52	550.1	288.2
Hardness (mg CaCO3/L)	129	155	138.9	136	7	7	100%	131.4	151.4	9.5	0.068	3.59	147.6	130.1
pH (pH units)	6.9	8.1	7.7	7.8	7	7	100%	7.32	8.04	0.4	0.052	0.15	8.1	7.4
TSS (mg/L)	0.5	4.27	2.0	1.8	6	7	86%	0.62	3.4	1.4	0.686	0.51	3.2	0.7
Turbidity (NTU)	0.8	9.53	3.2	1.74	7	7	100%	1.04	7.034	3.2	1.007	1.21	6.1	0.2
Nutrients														
Nitrate+Nitrite as N (mg/L)	0.980	1.280	1.160	1.210	7	7	100%	0.998	1.280	0.129	0.11	0.049	1.279	1.041
Phosphate, Ortho (mg/L)	0.980	1.280	1.160	1.210	7	7	100%	0.998	1.280	0.129	0.11	0.049	1.279	1.041
Phosphorus, Total (mg/L)	0.093	0.143	0.119	0.125	6	6	100%	0.098	0.136	0.018	0.15	0.007	0.139	0.100
Total Nitrogen (mg/L)	1.080	1.630	1.337	1.350	7	7	100%	1.176	1.516	0.172	0.13	0.065	1.496	1.178
Metals														
Cadmium (ug/L)	0.0085	0.25	0.1	0.03	1	7	14%	0.0	0	0.1	1.601	0.03	0.1	0.0
Cadmium, Dissolved (ug/L)	0.0	0.25	0.1	0.0	0	7	0%	0.0	0	0.1	1.025	0.05	0.2	0.0
Copper (ug/L)	1.34	6.000	3.200	2.6	7	7	100%	1.454	5.772	1.867	0.583	0.706	4.927	1.473
Copper, Dissolved (ug/L)	1.0	4.5	2.0	1.7	7	7	100%	1.1	3	1.2	0.568	0.44	3.1	1.0
Lead (ug/L)	0.51	4.79	2	1.65	7	7	100%	0.5	3	1.4	0.765	0.54	3.2	0.5
Lead, Dissolved (ug/L)	0.1	2.73	0.7	0.4	7	7	100%	0.1	2	0.9	1.271	0.35	1.6	-0.1
Mercury (ng/L)	0.0008	0.0	0.00	0.00	1	7	14%	0.00182	0.004	0.00	0.403	0.000	0.00	0.00
Mercury, Dissolved (ng/L)	0.0	0.0045	0.0	0.0	0	7	0%	0.0	0	0.0	0.448	0.00	0.0	0.0
Zinc (ug/L)	5	10.500	6.600	5.93	7	7	100%	5.186	8.7	1.917	0.290	0.724	8.373	4.827
Zinc, Dissolved (ug/L)	3.6	5.38	4.3	4.1	7	7	100%	3.7	5	0.7	0.157	0.25	4.9	3.7
Insecticides														
Carbaryl (ug/L)	0.030	0.030	0.030	0.030	0	4	0%	0.030	0.030	0.000	0.00	0.000	0.030	0.030
Chlorpyrifos (ug/L)	0.026	0.030	0.027	0.026	0	7	0%	0.026	0.030	0.002	0.08	0.001	0.029	0.025
PAHs														
LPAHs														
2-Methylnaphthalene (ug/L)	0.0015	0.015	0.006	0.005	1	7	14%	0.004	0.009	0.004	0.71	0.002	0.010	0.002
Acenaphthene (ug/L)	0.0025	0.005	0.005	0.005	0	7	0%	0.004	0.005	0.001	0.20	0.000	0.006	0.004
Acenaphthylene (ug/L)	0.0015	0.005	0.005	0.005	0	7	0%	0.004	0.005	0.001	0.29	0.001	0.006	0.003
Anthracene (ug/L)	0.003	0.008	0.005	0.005	1	7	14%	0.003	0.006	0.002	0.35	0.001	0.006	0.003
Fluorene (ug/L)	0.003	0.005	0.004	0.005	0	7	0%	0.003	0.005	0.001	0.22	0.000	0.005	0.003
Naphthalene (ug/L)	0.005	0.02	0.008	0.005	1	7	14%	0.005	0.014	0.006	0.74	0.002	0.013	0.003
Phenanthrene (ug/L)	0.005	0.020	0.008	0.005	2	7	29%	0.005	0.014	0.006	0.73	0.002	0.013	0.003
Total LPAHs	0.012	0.06	0.027	0.019	2	7	29%	0.016	0.048	0.017	0.62	0.006	0.042	0.011
HPAHs in ug/L														
Benzo(a)anthracene (ug/L)	0.003	0.005	0.004	0.005	0	7	0%	0.003	0.005	0.001	0.25	0.000	0.005	0.003
Benzo(a)pyrene (ug/L)	0.002	0.005	0.004	0.005	0	7	0%	0.003	0.005	0.001	0.28	0.000	0.005	0.003
Benzo(b,k)fluoranthenes (ug/L)	0.005	0.011	0.008	0.010	0	7	0%	0.005	0.011	0.003	0.32	0.001	0.011	0.006
Benzo(g,h,i)perylene (ug/L)	0.003	0.005	0.004	0.005	0	7	0%	0.003	0.005	0.001	0.26	0.000	0.005	0.003
Chrysene (ug/L)	0.002	0.005	0.004	0.005	0	7	0%	0.002	0.005	0.002	0.43	0.001	0.005	0.002
Dibenz(a,h)anthracene (ug/L)	0.002	0.005	0.004	0.005	0	7	0%	0.003	0.005	0.001	0.28	0.000	0.005	0.003
Fluoranthene (ug/L)	0.003	0.005	0.004	0.005	0	7	0%	0.003	0.005	0.001	0.21	0.000	0.005	0.003
Indeno(1,2,3-cd)pyrene (ug/L)	0.003	0.005	0.005	0.005	0	7	0%	0.004	0.005	0.001	0.20	0.000	0.005	0.004
Pyrene (ug/L)	0.003	0.011	0.005	0.005	1	7	14%	0.003	0.007	0.003	0.49	0.001	0.008	0.003
Total HPAHs	0.022	0.04	0.027	0.024	1	7	14%	0.022	0.035	0.007	0.27	0.003	0.033	0.020
Total PAHs	0.036	0.09	0.05	0.041	2	7	29%	0.038	0.085	0.022	0.42	0.008	0.074	0.033
Phthalates														
bis(2-Ethylhexyl)phthalate (ug/L)	0.188	0.5	0.37	0.48	1	7	14%	0.190	0.51	0.167	0.452	0.063	0.524	0.215
Butyl benzyl phthalate (ug/L)	0.213	0.52	0.390	0.505	0	7	0%	0.223	0.517	0.153	0.394	0.058	0.532	0.248
Diethylphthalate (ug/L)	0.139	1	0.364	0.505	0	7	0%	0.161	0.517	0.186	0.51	0.070	0.536	0.191
Dimethyl phthalate (ug/L)	0.134	0.52	0.370	0.505	0	7	0%	0.174	0.517	0.179	0.485	0.068	0.536	0.204
Di-n-butylphthalate (ug/L)	0.140	0.52	0.374	0.505	1	7	14%	0.142	0.517	0.179	0.480	0.068	0.540	0.208
Di-n-Octyl phthalate (ug/L)	0.174	0.52	0.380	0.505	0	7	0%	0.199	0.517	0.166	0.438	0.063	0.534	0.226
Total Phthalates	0.000	0.5	0.11	0.000	2	7	29%	0.000	0.363	0.196	1.79	0.07	0.29	-0.07
Herbicides														
2,4-D (ug/L)	0.017	0.061	0.044	0.050	3	7	43%	0.023	0.054	0.016	0.36	0.006	0.058	0.029
Dichlobenil (ug/L)	0.010	0.052	0.039	0.046	1	7	14%	0.016	0.051	0.017	0.43	0.006	0.055	0.023
TPH														
NWTPH-Diesel (mg/L)	0.015	0.050	0.022	0.015	0	5	0%	0.015	0.036	0.016	0.71	0.007	0.041	0.003
NWTPH-Gasoline (ug/L)	2.3	25.0	6.9	2.3	0	5	0%	2.3	15.9	10.1	1.47	4.5	19.5	-5.7
NWTPH-Heavy Oil (mg/L)	0.100	0.105	0.102	0.100	0	5	0%	0.100	0.105	0.003	0.03	0.001	0.105	0.099
Bacteria														
Coliform, Fecal (CFU/100 ml)	110	16,000	5,062	2,400	5	5	100%	626	11,760	6,418	1.27	2,870	13,031	-2,907
BTEX														
Benzene (ug/L)	0.500	1.000	0.740	0.700	5	5	100%	0.580	0.920	0.182	0.25	0.081	0.966	0.514
Ethylbenzene (ug/L)	0.100	0.250	0.190	0.200	3	5	60%	0.140	0.230	0.055	0.29	0.024	0.258	0.122
m,p-Xylene (ug/L)	0.200	1.000	0.720	1.000	1	5	20%	0.280	1.000	0.390	0.54	0.174	1.204	0.236
o-Xylene (ug/L)	0.100	0.250	0.220	0.250	0	5	0%	0.160	0.250	0.067	0.30	0.030	0.303	0.137
Toluene (ug/L)	0.100	0.250	0.190	0.200	3	5	60%	0.140	0.230	0.055	0.29	0.024	0.258	0.122

Table E-23
Baseflow Data at Outfall 237A for WY2016 and WY2019

	Minimum	Maximum	Arithmetic Mean	Median	# of Detects	Count	% Detects	10th Per	90th Per	Standard Deviation	Coefficient of Variation	Standard Error	95% UCL	95% LCL
Conventionals														
Anionic Surfactants - MBAS (ug/L)	0.00475	0.0466	0.0	0.0125	4	10	40%	0.011725	0.03445	0.0	0.685	0.004	0.0	0.0
BOD (mg/L)	1	1	1.0	1	0	9	0%	1	1	0.0	0.000	0.000	1.0	1.0
Chloride (mg/L)	11.5	21.3	16.3	15.95	10	10	100%	12.04	19.95	3.4	0.206	1.062	18.7	13.9
Conductivity (uS/cm)	304	423	347.6	334.5	10	10	100%	306.7	414.9	40.4	0.116	12.79	376.5	318.7
Hardness (mg CaCO3/L)	126	141	130.8	131	10	10	100%	126.9	134.7	4.5	0.035	1.44	134.0	127.6
pH (pH units)	7.1	8.1	7.7	7.9	10	10	100%	7.28	8.01	0.3	0.045	0.11	8.0	7.5
TSS (mg/L)	0.5	2.94	1.7	1.68	7	10	70%	0.95	2.634	0.8	0.447	0.24	2.3	1.2
Turbidity (NTU)	0.53	2	1.1	1.01	10	10	100%	0.548	1.649	0.5	0.452	0.15	1.4	0.7
Nutrients														
Nitrate+Nitrite as N (mg/L)	2.160	2.560	2.369	2.395	10	10	100%	2.178	2.524	0.139	0.06	0.044	2.468	2.270
Phosphate, Ortho (mg/L)	0.028	0.042	0.034	0.034	10	10	100%	0.028	0.039	0.005	0.15	0.002	0.038	0.030
Phosphorus, Total (mg/L)	0.023	0.037	0.029	0.030	10	10	100%	0.026	0.033	0.004	0.14	0.001	0.032	0.027
Total Nitrogen (mg/L)	2.180	2.450	2.299	2.270	10	10	100%	2.189	2.450	0.108	0.05	0.034	2.377	2.221
Metals														
Cadmium (ug/L)	0.0105	0.25	0.1	0.03	0	10	0%	0.0	0	0.1	1.008	0.04	0.2	0.0
Cadmium, Dissolved (ug/L)	0.025	0.25	0.2	0.3	0	10	0%	0.0	0	0.1	0.726	0.04	0.2	0.1
Copper (ug/L)	0.184	1.060	0.466	0.4455	7	10	70%	0.2033	0.702	0.264	0.566	0.084	0.655	0.277
Copper, Dissolved (ug/L)	0.213	0.538	0.3	0.3	10	10	100%	0.2	0	0.1	0.319	0.03	0.4	0.2
Lead (ug/L)	0.037	0.52	0	0.079	7	10	70%	0.1	0	0.1	0.976	0.05	0.3	0.0
Lead, Dissolved (ug/L)	0.007	0.08	0.0	0.0	6	10	60%	0.0	0	0.0	0.801	0.01	0.0	0.0
Mercury (ng/L)	0.0008	0.0	0.00	0.00	0	10	0%	0.00233	0.004	0.00	0.357	0.000	0.00	0.00
Mercury, Dissolved (ng/L)	0.0	0.0045	0.0	0.0	0	10	0%	0.0	0	0.0	0.403	0.00	0.0	0.0
Zinc (ug/L)	0.99	4.090	2.585	2.775	10	10	100%	1.557	3.703	0.991	0.384	0.314	3.294	1.876
Zinc, Dissolved (ug/L)	0.72	3.39	1.9	2.0	10	10	100%	1.2	2	0.7	0.374	0.23	2.5	1.4
Insecticides														
Carbaryl (ug/L)	0.030	0.030	0.030	0.030	0	6	0%	0.030	0.030	0.000	0.00	0.000	0.030	0.030
Chlorpyrifos (ug/L)	0.026	0.030	0.027	0.026	0	10	0%	0.026	0.030	0.002	0.08	0.001	0.029	0.026
PAHs														
LPAHs														
2-Methylnaphthalene (ug/L)	0.004	0.005	0.005	0.005	1	10	10%	0.005	0.005	0.000	0.06	0.000	0.005	0.005
Acenaphthene (ug/L)	0.0025	0.005	0.005	0.005	0	10	0%	0.005	0.005	0.001	0.17	0.000	0.005	0.004
Acenaphthylene (ug/L)	0.0015	0.005	0.005	0.005	0	10	0%	0.005	0.005	0.001	0.24	0.000	0.005	0.004
Anthracene (ug/L)	0.003	0.005	0.004	0.005	0	10	0%	0.003	0.005	0.001	0.25	0.000	0.005	0.003
Fluorene (ug/L)	0.003	0.005	0.005	0.005	0	10	0%	0.004	0.005	0.001	0.18	0.000	0.005	0.004
Naphthalene (ug/L)	0.004	0.01	0.006	0.006	1	10	10%	0.005	0.009	0.002	0.32	0.001	0.008	0.005
Phenanthrene (ug/L)	0.004	0.016	0.007	0.005	4	10	40%	0.004	0.012	0.004	0.60	0.001	0.009	0.004
Total LPAHs	0.019	0.04	0.024	0.020	3	10	30%	0.019	0.032	0.008	0.32	0.002	0.030	0.019
HPAHs in ug/L														
Benzo(a)anthracene (ug/L)	0.004	0.006	0.005	0.005	1	10	10%	0.004	0.005	0.001	0.18	0.000	0.005	0.004
Benzo(a)pyrene (ug/L)	0.004	0.006	0.005	0.005	1	10	10%	0.004	0.005	0.001	0.18	0.000	0.005	0.004
Benzo(b,k)fluoranthenes (ug/L)	0.006	0.011	0.009	0.010	1	10	10%	0.006	0.011	0.002	0.23	0.001	0.010	0.007
Benzo(g,h,i)perylene (ug/L)	0.003	0.005	0.004	0.005	0	10	0%	0.003	0.005	0.001	0.25	0.000	0.005	0.003
Chrysene (ug/L)	0.002	0.006	0.004	0.005	1	10	10%	0.002	0.005	0.002	0.37	0.000	0.005	0.003
Dibenz(a,h)anthracene (ug/L)	0.002	0.005	0.004	0.005	0	10	0%	0.003	0.005	0.001	0.23	0.000	0.005	0.004
Fluoranthene (ug/L)	0.004	0.009	0.005	0.005	1	10	10%	0.004	0.005	0.002	0.32	0.001	0.006	0.004
Indeno(1,2,3-cd)pyrene (ug/L)	0.003	0.005	0.005	0.005	0	10	0%	0.004	0.005	0.001	0.17	0.000	0.005	0.004
Pyrene (ug/L)	0.003	0.010	0.005	0.005	2	10	20%	0.003	0.006	0.002	0.43	0.001	0.006	0.003
Total HPAHs	0.022	0.05	0.029	0.025	2	10	20%	0.022	0.035	0.010	0.36	0.003	0.036	0.022
Total PAHs	0.040	0.08	0.05	0.045	3	10	30%	0.040	0.075	0.016	0.30	0.005	0.065	0.042
Phthalates														
bis(2-Ethylhexyl)phthalate (ug/L)	0.189	0.5	0.37	0.47	2	10	20%	0.193	0.51	0.157	0.420	0.050	0.487	0.262
Butyl benzyl phthalate (ug/L)	0.213	0.52	0.398	0.505	0	10	0%	0.231	0.515	0.145	0.365	0.046	0.502	0.294
Diethylphthalate (ug/L)	0.265	1	0.430	0.488	6	10	60%	0.279	0.521	0.115	0.27	0.036	0.512	0.348
Dimethyl phthalate (ug/L)	0.134	0.52	0.381	0.505	0	10	0%	0.197	0.515	0.168	0.441	0.053	0.501	0.261
Di-n-butylphthalate (ug/L)	0.139	0.52	0.303	0.218	2	10	20%	0.140	0.506	0.179	0.591	0.057	0.431	0.175
Di-n-Octyl phthalate (ug/L)	0.174	0.52	0.389	0.505	0	10	0%	0.214	0.515	0.156	0.402	0.049	0.501	0.277
***Total Phthalates**	0.000	1.0	0.36	0.334	6	10	60%	0.000	0.937	0.383	1.05	0.12	0.64	0.09
Herbicides														
2,4-D (ug/L)	0.009	0.093	0.048	0.050	2	9	22%	0.023	0.059	0.023	0.48	0.008	0.065	0.030
Dichlobenil (ug/L)	0.020	0.052	0.046	0.051	0	10	0%	0.043	0.052	0.010	0.21	0.003	0.053	0.039
TPH														
NWTPH-Diesel (mg/L)	0.015	0.050	0.022	0.015	0	5	0%	0.015	0.036	0.016	0.71	0.007	0.041	0.003
NWTPH-Gasoline (ug/L)	2.3	25.0	6.9	2.3	0	5	0%	2.3	15.9	10.1	1.47	4.5	19.5	-5.7
NWTPH-Heavy Oil (mg/L)	0.095	0.105	0.101	0.100	0	5	0%	0.097	0.105	0.004	0.04	0.002	0.106	0.096
Bacteria														
Coliform, Fecal (CFU/100 ml)	40	490	257	220	5	5	100%	42	490	225	0.87	100	536	-22
BTEX														
Benzene (ug/L)	0.100	0.250	0.220	0.250	0	5	0%	0.160	0.250	0.067	0.30	0.030	0.303	0.137
Ethylbenzene (ug/L)	0.100	0.250	0.220	0.250	0	5	0%	0.160	0.250	0.067	0.30	0.030	0.303	0.137
m,p-Xylene (ug/L)	0.200	1.000	0.840	1.000	0	5	0%	0.520	1.000	0.358	0.43	0.160	1.284	0.396
o-Xylene (ug/L)	0.100	0.250	0.220	0.250	0	5	0%	0.160	0.250	0.067	0.30	0.030	0.303	0.137
Toluene (ug/L)	0.100	0.250	0.210	0.250	1	5	20%	0.140	0.250	0.065	0.31	0.029	0.291	0.129

Table E-24
Baseflow Data at Outfall 237B for WY2016 and WY2019

	Minimum	Maximum	Arithmetic Mean	Median	# of Detects	Count	% Detects	10th Per	90th Per	Standard Deviation	Coefficient of Variation	Standard Error	95% UCL	95% LCL
Conventionals														
Anionic Surfactants - MBAS (ug/L)	0.0125	0.0299	0.0	0.0169	4	6	67%	0.0125	0.0268	0.0	0.385	0.003	0.0	0.0
BOD (mg/L)	1	3.6	1.4	1	1	6	17%	1	2.3	1.1	0.741	0.433	2.5	0.3
Chloride (mg/L)	8.6	90.6	25.3	9.13	5	5	100%	8.63	58.072	36.5	1.446	16.337	70.6	-20.1
Conductivity (uS/cm)	261	281	272.0	273	6	6	100%	262.5	280.5	9.0	0.033	3.67	281.4	262.6
Hardness (mg CaCO3/L)	109	124	116.7	117.5	6	6	100%	110.5	122	5.4	0.047	2.22	122.4	111.0
pH (pH units)	7.1	7.7	7.4	7.4	6	6	100%	7.2	7.65	0.2	0.030	0.09	7.7	7.2
TSS (mg/L)	0.5	2.8	1.2	0.91	2	6	33%	0.5	2.3	0.9	0.758	0.38	2.2	0.3
Turbidity (NTU)	0.74	2.49	1.3	1.23	6	6	100%	0.825	1.99	0.6	0.465	0.26	2.0	0.7
Nutrients														
Nitrate+Nitrite as N (mg/L)	2.900	3.480	3.107	3.060	6	6	100%	2.910	3.350	0.220	0.07	0.090	3.337	2.876
Phosphate, Ortho (mg/L)	0.028	0.051	0.034	0.030	6	6	100%	0.029	0.043	0.009	0.26	0.004	0.043	0.024
Phosphorus, Total (mg/L)	0.028	0.037	0.033	0.034	6	6	100%	0.030	0.036	0.003	0.09	0.001	0.036	0.030
Total Nitrogen (mg/L)	2.940	3.150	3.042	3.035	6	6	100%	2.965	3.125	0.080	0.03	0.033	3.126	2.957
Metals														
Cadmium (ug/L)	0.007	0.25	0.1	0.03	0	6	0%	0.0	0	0.1	1.175	0.05	0.2	0.0
Cadmium, Dissolved (ug/L)	0.0	0.25	0.1	0.0	0	6	0%	0.0	0	0.1	1.630	0.04	0.2	0.0
Copper (ug/L)	0.1235	0.677	0.325	0.28075	3	6	50%	0.1535	0.540	0.207	0.636	0.084	0.541	0.108
Copper, Dissolved (ug/L)	0.0	0.284	0.2	0.2	6	6	100%	0.1	0	0.1	0.483	0.03	0.3	0.1
Lead (ug/L)	0.0135	0.092	0	0.039	2	6	33%	0.0	0	0.0	0.622	0.01	0.1	0.0
Lead, Dissolved (ug/L)	0.0	0.07	0.0	0.0	4	6	67%	0.0	0	0.0	0.806	0.01	0.1	0.0
Mercury (ng/L)	0.0008	0.0	0.00	0.00	0	6	0%	0.00165	0.004	0.00	0.439	0.000	0.00	0.00
Mercury, Dissolved (ng/L)	0.0	0.0045	0.0	0.0	0	6	0%	0.0	0	0.0	0.478	0.00	0.0	0.0
Zinc (ug/L)	0.9	2.760	1.635	1.545	6	6	100%	1.045	2.315	0.646	0.395	0.264	2.312	0.958
Zinc, Dissolved (ug/L)	0.8	1.83	1.3	1.3	6	6	100%	0.9	2	0.4	0.321	0.17	1.8	0.9
Insecticides														
Carbaryl (ug/L)	0.030	0.030	0.030	0.030	0	3	0%	0.030	0.030	0.000	0.00	0.000	0.030	0.030
Chlorpyrifos (ug/L)	0.026	0.030	0.028	0.028	0	6	0%	0.026	0.030	0.002	0.08	0.001	0.030	0.025
PAHs														
LPAHs														
2-Methylnaphthalene (ug/L)	0.005	0.005	0.005	0.005	1	6	17%	0.005	0.005	0.000	0.00	0.000	0.005	0.005
Acenaphthene (ug/L)	0.0025	0.023	0.008	0.005	2	6	33%	0.004	0.015	0.008	0.98	0.003	0.016	0.000
Acenaphthylene (ug/L)	0.0015	0.005	0.004	0.005	0	6	0%	0.003	0.005	0.001	0.32	0.001	0.006	0.003
Anthracene (ug/L)	0.003	0.005	0.004	0.004	0	6	0%	0.003	0.005	0.001	0.27	0.000	0.005	0.003
Fluorene (ug/L)	0.003	0.005	0.004	0.005	0	6	0%	0.003	0.005	0.001	0.23	0.000	0.005	0.003
Naphthalene (ug/L)	0.005	0.01	0.007	0.007	0	6	0%	0.005	0.009	0.002	0.27	0.001	0.009	0.005
Phenanthrene (ug/L)	0.004	0.013	0.006	0.005	0	6	0%	0.004	0.010	0.003	0.53	0.001	0.010	0.003
Total LPAHs	0.019	0.05	0.028	0.024	3	6	50%	0.019	0.040	0.011	0.40	0.005	0.039	0.016
HPAHs in ug/L														
Benzo(a)anthracene (ug/L)	0.003	0.005	0.004	0.004	0	6	0%	0.003	0.005	0.001	0.26	0.000	0.005	0.003
Benzo(a)pyrene (ug/L)	0.002	0.005	0.004	0.004	0	6	0%	0.003	0.005	0.001	0.31	0.001	0.005	0.003
Benzo(b,k)fluoranthenes (ug/L)	0.005	0.011	0.008	0.008	0	6	0%	0.005	0.010	0.003	0.33	0.001	0.011	0.005
Benzo(g,h,i)perylene (ug/L)	0.003	0.005	0.004	0.004	0	6	0%	0.003	0.005	0.001	0.27	0.000	0.005	0.003
Chrysene (ug/L)	0.002	0.005	0.004	0.004	0	6	0%	0.002	0.005	0.002	0.47	0.001	0.005	0.002
Dibenz(a,h)anthracene (ug/L)	0.002	0.005	0.004	0.004	0	6	0%	0.003	0.005	0.001	0.31	0.001	0.005	0.003
Fluoranthene (ug/L)	0.004	0.005	0.004	0.004	0	6	0%	0.004	0.005	0.001	0.19	0.000	0.005	0.003
Indeno(1,2,3-cd)pyrene (ug/L)	0.003	0.005	0.004	0.005	0	6	0%	0.004	0.005	0.001	0.22	0.000	0.005	0.003
Pyrene (ug/L)	0.003	0.005	0.004	0.004	0	6	0%	0.003	0.005	0.001	0.25	0.000	0.005	0.003
Total HPAHs	0.022	0.03	0.026	0.025	0	6	0%	0.022	0.033	0.005	0.19	0.002	0.032	0.021
Total PAHs	0.041	0.08	0.05	0.047	3	6	50%	0.043	0.073	0.015	0.29	0.006	0.070	0.038
Phthalates														
bis(2-Ethylhexyl)phthalate (ug/L)	0.190	0.5	0.35	0.35	0	6	0%	0.191	0.51	0.175	0.498	0.072	0.536	0.168
Butyl benzyl phthalate (ug/L)	0.215	0.52	0.369	0.372	0	6	0%	0.223	0.513	0.156	0.424	0.064	0.533	0.205
Diethylphthalate (ug/L)	0.140	1	0.328	0.315	1	6	17%	0.159	0.510	0.180	0.55	0.074	0.517	0.139
Dimethyl phthalate (ug/L)	0.135	0.52	0.346	0.357	0	6	0%	0.168	0.513	0.183	0.531	0.075	0.538	0.153
Di-n-butylphthalate (ug/L)	0.138	0.52	0.326	0.327	0	6	0%	0.139	0.513	0.203	0.624	0.083	0.539	0.113
Di-n-Octyl phthalate (ug/L)	0.175	0.52	0.357	0.364	0	6	0%	0.196	0.513	0.170	0.475	0.069	0.536	0.179
***Total Phthalates**	0.000	0.5	0.08	0.000	1	6	17%	0.000	0.226	0.185	2.45	0.08	0.27	-0.12
Herbicides														
2,4-D (ug/L)	0.009	0.050	0.031	0.034	1	6	17%	0.009	0.050	0.021	0.69	0.009	0.053	0.009
Dichlobenil (ug/L)	0.020	0.052	0.044	0.048	0	6	0%	0.033	0.051	0.012	0.27	0.005	0.057	0.031
TPH														
NWTPH-Diesel (mg/L)	0.015	0.050	0.022	0.015	0	5	0%	0.015	0.036	0.016	0.71	0.007	0.041	0.003
NWTPH-Gasoline (ug/L)	2.3	25.0	6.9	2.3	0	5	0%	2.3	15.9	10.1	1.47	4.5	19.5	-5.7
NWTPH-Heavy Oil (mg/L)	0.100	0.105	0.101	0.100	0	5	0%	0.100	0.103	0.002	0.02	0.001	0.104	0.098
Bacteria														
Coliform, Fecal (CFU/100 ml)	10	68	31	20	4	5	80%	11	59	25	0.79	11	62	0
BTEX														
Benzene (ug/L)	0.100	0.250	0.220	0.250	0	5	0%	0.160	0.250	0.067	0.30	0.030	0.303	0.137
Ethylbenzene (ug/L)	0.100	0.250	0.220	0.250	0	5	0%	0.160	0.250	0.067	0.30	0.030	0.303	0.137
m,p-Xylene (ug/L)	0.200	1.000	0.840	1.000	0	5	0%	0.520	1.000	0.358	0.43	0.160	1.284	0.396
o-Xylene (ug/L)	0.100	0.250	0.220	0.250	0	5	0%	0.160	0.250	0.067	0.30	0.030	0.303	0.137
Toluene (ug/L)	0.100	0.250	0.220	0.250	0	5	0%	0.160	0.250	0.067	0.30	0.030	0.303	0.137

Table E-25
Baseflow Data at Outfall 243 for WY2016 and WY2019

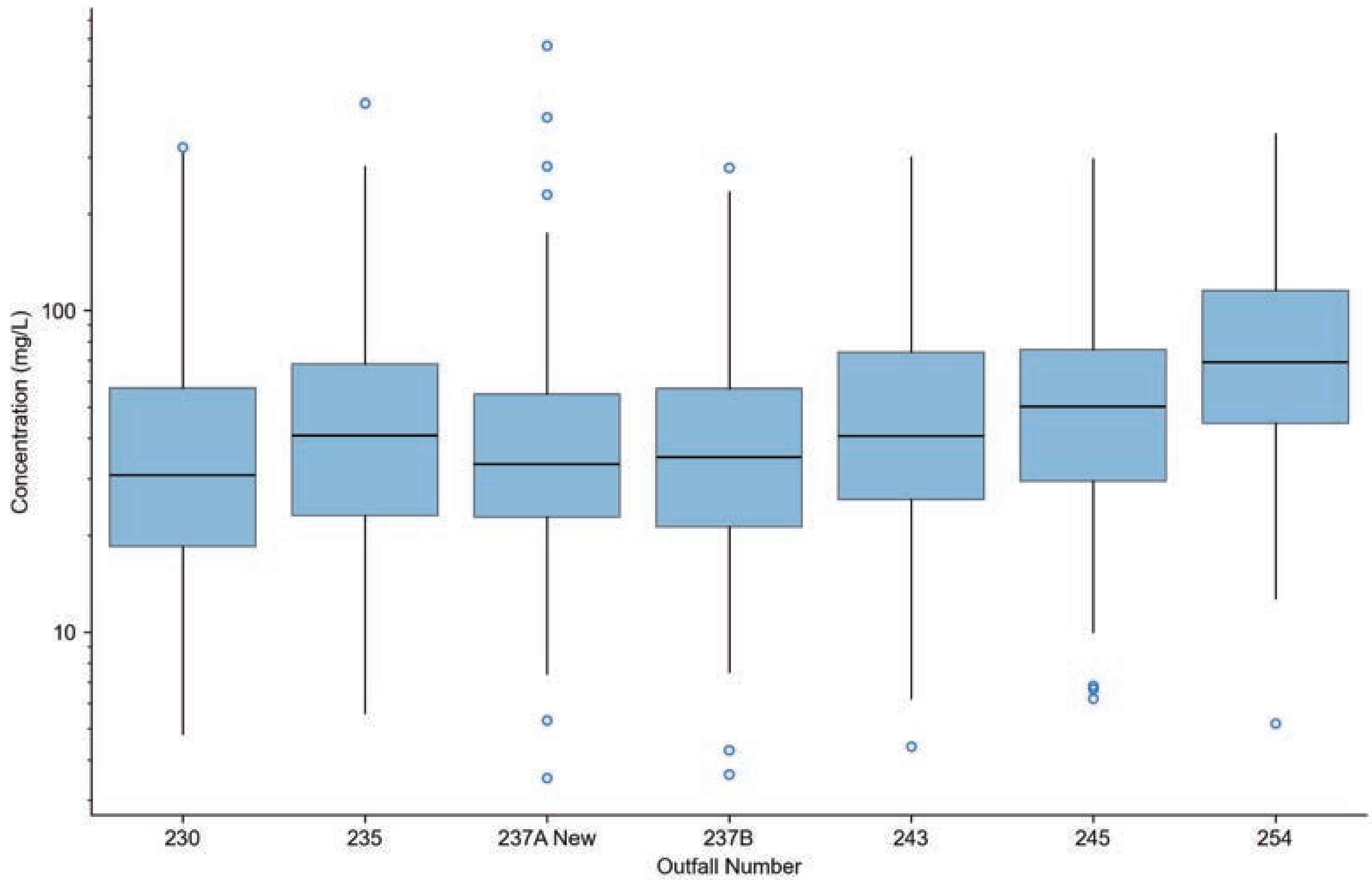
	Minimum	Maximum	Arithmetic Mean	Median	# of Detects	Count	% Detects	10th Per	90th Per	Standard Deviation	Coefficient of Variation	Standard Error	95% UCL	95% LCL
Conventionals														
Anionic Surfactants - MBAS (ug/L)	0.0267	0.0962	0.1	0.0586	7	7	100%	0.03216	0.09566	0.0	0.445	0.010	0.1	0.0
BOD (mg/L)	1	1	1.0	1	0	7	0%	1	1	0.0	0.000	0.000	1.0	1.0
Chloride (mg/L)	2490	13100	8143	8080	7	7	100%	3510	11900	3791	0.466	1433	11649	4636
Conductivity (uS/cm)	8080	35300	22685	23200	8	8	100%	12084	32990	9798	0.432	3464	30876	14494
Hardness (mg CaCO3/L)	808	3770	2214.8	1915	8	8	100%	1117.4	3497	1110.3	0.501	392.53	3142.9	1286.6
pH (pH units)	7	7.5	7.3	7.3	8	8	100%	7	7.43	0.2	0.025	0.07	7.4	7.1
TSS (mg/L)	4.92	21.8	13.7	14.9	8	8	100%	7.972	18.72	5.5	0.398	1.93	18.3	9.2
Turbidity (NTU)	7.36	27.3	15.3	14.8	7	7	100%	8.236	22.32	6.7	0.440	2.55	21.5	9.1
Nutrients														
Nitrate+Nitrite as N (mg/L)	0.046	0.306	0.161	0.151	8	8	100%	0.077	0.258	0.088	0.55	0.031	0.234	0.087
Phosphate, Ortho (mg/L)	0.003	0.139	0.070	0.063	6	7	86%	0.023	0.120	0.048	0.69	0.018	0.115	0.025
Phosphorus, Total (mg/L)	0.181	0.566	0.310	0.267	7	7	100%	0.186	0.471	0.144	0.46	0.054	0.444	0.177
Total Nitrogen (mg/L)	0.420	0.790	0.541	0.480	8	8	100%	0.427	0.748	0.143	0.26	0.051	0.661	0.422
Metals														
Cadmium (ug/L)	0.0215	2.5	0.4	0.0705	3	8	38%	0.0	1	0.9	2.281	0.30	1.1	-0.3
Cadmium, Dissolved (ug/L)	0.0	1.25	0.2	0.1	2	8	25%	0.0	1	0.4	1.856	0.15	0.6	-0.1
Copper (ug/L)	2.53	10.500	5.456	4.89	7	7	100%	3.064	8.202	2.675	0.490	1.011	7.930	2.981
Copper, Dissolved (ug/L)	0.3	3.42	1.7	1.6	7	7	100%	0.5	3	1.1	0.635	0.41	2.7	0.7
Lead (ug/L)	0.788	25.4	5	2.655	8	8	100%	1.2	11	8.2	1.511	2.89	12.3	-1.4
Lead, Dissolved (ug/L)	0.0	1.81	0.3	0.1	3	8	38%	0.0	1	0.6	1.887	0.22	0.8	-0.2
Mercury (ng/L)	0.001	0.0	0.00	0.00	6	8	75%	0.001	0.00295	0.00	0.611	0.000	0.00	0.00
Mercury, Dissolved (ng/L)	0.0	0.0045	0.0	0.0	0	8	0%	0.0	0	0.0	0.257	0.00	0.0	0.0
Zinc (ug/L)	4.33	30.300	14.839	13.4	7	7	100%	7.336	23.1	8.220	0.554	3.107	22.441	7.236
Zinc, Dissolved (ug/L)	2.5	11.9	6.4	5.3	7	7	100%	3.0	10	3.3	0.519	1.26	9.5	3.3
Insecticides														
Carbaryl (ug/L)	0.030	0.030	0.030	0.030	0	7	0%	0.030	0.030	0.000	0.00	0.000	0.030	0.030
Chlorpyrifos (ug/L)	0.026	0.031	0.026	0.026	0	8	0%	0.026	0.027	0.002	0.06	0.001	0.028	0.025
PAHs														
LPAHs														
2-Methylnaphthalene (ug/L)	0.005	0.005	0.005	0.005	0	8	0%	0.005	0.005	0.000	0.00	0.000	0.005	0.005
Acenaphthene (ug/L)	0.005	0.132	0.032	0.00925	5	8	63%	0.005	0.089	0.046	1.45	0.016	0.070	-0.007
Acenaphthylene (ug/L)	0.005	0.007	0.005	0.005	1	8	13%	0.005	0.006	0.001	0.13	0.000	0.006	0.005
Anthracene (ug/L)	0.005	0.053	0.019	0.013	6	8	75%	0.006	0.041	0.017	0.88	0.006	0.033	0.005
Fluorene (ug/L)	0.005	0.005	0.005	0.005	1	8	13%	0.005	0.005	0.000	0.04	0.000	0.005	0.005
Naphthalene (ug/L)	0.003	0.01	0.006	0.005	1	8	13%	0.004	0.010	0.003	0.48	0.001	0.009	0.004
Phenanthrene (ug/L)	0.005	0.019	0.008	0.006	5	8	63%	0.005	0.012	0.005	0.63	0.002	0.012	0.004
Total LPAHs	0.019	0.22	0.072	0.045	7	8	88%	0.022	0.163	0.071	0.98	0.025	0.132	0.013
HPAHs in ug/L														
Benzo(a)anthracene (ug/L)	0.003	0.006	0.005	0.005	2	8	25%	0.003	0.006	0.001	0.25	0.000	0.006	0.004
Benzo(a)pyrene (ug/L)	0.004	0.007	0.005	0.005	2	8	25%	0.005	0.006	0.001	0.19	0.000	0.006	0.004
Benzo(b,k)fluoranthenes (ug/L)	0.006	0.018	0.011	0.010	1	8	13%	0.009	0.013	0.003	0.31	0.001	0.013	0.008
Benzo(g,h,i)perylene (ug/L)	0.003	0.011	0.006	0.005	5	8	63%	0.004	0.010	0.003	0.52	0.001	0.008	0.003
Chrysene (ug/L)	0.005	0.014	0.007	0.005	2	8	25%	0.005	0.011	0.003	0.51	0.001	0.010	0.004
Dibenz(a,h)anthracene (ug/L)	0.004	0.005	0.005	0.005	0	8	0%	0.005	0.005	0.000	0.07	0.000	0.005	0.005
Fluoranthene (ug/L)	0.008	0.032	0.013	0.009	8	8	100%	0.008	0.022	0.008	0.65	0.003	0.020	0.006
Indeno(1,2,3-cd)pyrene (ug/L)	0.005	0.008	0.005	0.005	1	8	13%	0.005	0.006	0.001	0.21	0.000	0.006	0.004
Pyrene (ug/L)	0.007	0.053	0.018	0.012	8	8	100%	0.009	0.031	0.015	0.85	0.005	0.030	0.005
Total HPAHs	0.036	0.13	0.060	0.044	8	8	100%	0.037	0.109	0.035	0.59	0.012	0.089	0.030
Total PAHs	0.059	0.35	0.13	0.095	8	8	100%	0.061	0.235	0.099	0.75	0.035	0.215	0.050
Phthalates														
bis(2-Ethylhexyl)phthalate (ug/L)	0.197	5.6	1.10	0.51	2	8	25%	0.385	2.04	1.821	1.654	0.644	2.623	-0.421
Butyl benzyl phthalate (ug/L)	0.238	0.53	0.478	0.510	0	8	0%	0.425	0.518	0.097	0.204	0.034	0.559	0.396
Diethylphthalate (ug/L)	0.182	1	0.471	0.510	0	8	0%	0.408	0.518	0.117	0.25	0.041	0.569	0.373
Dimethyl phthalate (ug/L)	0.207	0.53	0.474	0.510	0	8	0%	0.416	0.518	0.108	0.228	0.038	0.564	0.384
Di-n-butylphthalate (ug/L)	0.142	0.52	0.352	0.365	3	8	38%	0.181	0.512	0.171	0.485	0.060	0.495	0.209
Di-n-Octyl phthalate (ug/L)	0.222	0.53	0.476	0.510	0	8	0%	0.420	0.518	0.103	0.216	0.036	0.562	0.390
***Total Phthalates**	0.000	5.8	0.84	0.099	4	8	50%	0.000	2.070	2.017	2.41	0.71	2.52	-0.85
Herbicides														
2,4-D (ug/L)	0.009	0.570	0.110	0.050	1	8	13%	0.038	0.206	0.187	1.70	0.066	0.266	-0.046
Dichlobenil (ug/L)	0.047	0.053	0.051	0.051	0	8	0%	0.049	0.052	0.002	0.04	0.001	0.052	0.049
TPH														
NWTPH-Diesel (mg/L)	0.015	0.050	0.022	0.015	0	5	0%	0.015	0.036	0.016	0.71	0.007	0.041	0.003
NWTPH-Gasoline (ug/L)	2.3	25.0	6.9	2.3	0	5	0%	2.3	15.9	10.1	1.47	4.5	19.5	-5.7
NWTPH-Heavy Oil (mg/L)	0.100	0.105	0.101	0.100	0	5	0%	0.100	0.103	0.002	0.02	0.001	0.104	0.098
Bacteria														
Coliform, Fecal (CFU/100 ml)	10	790	169	13	3	5	60%	10	482	347	2.06	155	600	-263
BTEX														
Benzene (ug/L)	0.100	0.250	0.220	0.250	0	5	0%	0.160	0.250	0.067	0.30	0.030	0.303	0.137
Ethylbenzene (ug/L)	0.100	0.250	0.220	0.250	0	5	0%	0.160	0.250	0.067	0.30	0.030	0.303	0.137
m,p-Xylene (ug/L)	0.200	1.000	0.840	1.000	0	5	0%	0.520	1.000	0.358	0.43	0.160	1.284	0.396
o-Xylene (ug/L)	0.100	0.250	0.220	0.250	0	5	0%	0.160	0.250	0.067	0.30	0.030	0.303	0.137
Toluene (ug/L)	0.100	0.250	0.220	0.250	0	5	0%	0.160	0.250	0.067	0.30	0.030	0.303	0.137

Table E-26
Baseflow Data at Outfall 245 and Outfall 254 WY2019

	Minimum	Maximum	Arithmetic Mean	Median	# of Detects	Count	% Detects	10th Per	90th Per	Standard Deviation	Coefficient of Variation	Standard Error	95% UCL	95% LCL
Conventionals														
Anionic Surfactants - MBAS (ug/L)	0.0251	0.0553	0.0	0.0468	5	5	100%	0.03106	0.05222	0.0	0.264	0.005	0.1	0.0
BOD (mg/L)	1	6.2	2.0	1	1	5	20%	1	4.12	2.3	1.140	1.040	4.9	-0.8
Chloride (mg/L)	18.2	13900	4485	3980	5	5	100%	21	10140	5673	1.265	2537	11529	-2560
Conductivity (uS/cm)	6170	38100	22695	22950	6	6	100%	9535	35600	13122	0.578	5357	36466	8924
Hardness (mg CaCO3/L)	728	4430	2581.3	2600	6	6	100%	1094	4050	1492.6	0.578	609.34	4147.7	1015.0
pH (pH units)	7.3	7.6	7.5	7.45	6	6	100%	7.35	7.6	0.1	0.016	0.05	7.6	7.3
TSS (mg/L)	2	20.8	8.4	7	6	6	100%	2.205	15.95	7.4	0.880	3.01	16.1	0.6
Turbidity (NTU)	2.75	13.8	7.1	5.06	5	5	100%	3.154	12.32	4.7	0.662	2.10	12.9	1.3
Nutrients														
Nitrate+Nitrite as N (mg/L)	0.196	3.680	0.962	0.334	5	5	100%	0.210	2.356	1.521	1.58	0.680	2.851	-0.926
Phosphate, Ortho (mg/L)	0.037	0.176	0.096	0.097	5	5	100%	0.051	0.145	0.051	0.53	0.023	0.160	0.032
Phosphorus, Total (mg/L)	0.080	0.595	0.254	0.171	4	4	100%	0.104	0.471	0.231	0.91	0.116	0.622	-0.114
Total Nitrogen (mg/L)	0.430	3.350	1.522	0.980	5	5	100%	0.566	2.842	1.194	0.78	0.534	3.005	0.039
Metals														
Cadmium (ug/L)	0.072	1.1	0.3	0.151	4	6	67%	0.1	1	0.4	1.360	0.16	0.7	-0.1
Cadmium, Dissolved (ug/L)	0.0	0.183	0.1	0.1	3	6	50%	0.0	0	0.1	0.623	0.03	0.2	0.0
Copper (ug/L)	1.43	23.700	11.977	12.85	6	6	100%	3.38	19.700	8.042	0.671	3.283	20.416	3.537
Copper, Dissolved (ug/L)	0.6	3.63	1.7	1.3	6	6	100%	0.6	3	1.3	0.759	0.52	3.0	0.3
Lead (ug/L)	0.201	2.23	1	0.678	6	6	100%	0.2	2	0.8	0.899	0.31	1.6	0.0
Lead, Dissolved (ug/L)	0.0	0.0825	0.1	0.1	0	6	0%	0.0	0	0.0	0.563	0.01	0.1	0.0
Mercury (ng/L)	0.0008	0.0	0.00	0.00	0	6	0%	0.0024	0.004	0.00	0.377	0.001	0.00	0.00
Mercury, Dissolved (ng/L)	0.0	0.0045	0.0	0.0	0	6	0%	0.0	0	0.0	0.377	0.00	0.0	0.0
Zinc (ug/L)	9.39	125.000	50.448	28.7	6	6	100%	15.345	107.3	46.221	0.916	18.869	98.954	1.943
Zinc, Dissolved (ug/L)	4.3	74.9	28.7	23.2	6	6	100%	5.1	58	26.4	0.921	10.79	56.4	1.0
Insecticides														
Chlorpyrifos (ug/L)	0.030	0.031	0.030	0.030	0	6	0%	0.030	0.031	0.000	0.01	0.000	0.030	0.030
PAHs														
LPAHs														
2-Methylnaphthalene (ug/L)	0.0015	0.029	0.008	0.005	2	6	33%	0.003	0.017	0.010	1.21	0.004	0.019	-0.002
Acenaphthene (ug/L)	0.0025	0.035	0.015	0.012	3	6	50%	0.004	0.031	0.013	0.87	0.005	0.029	0.001
Acenaphthylene (ug/L)	0.0015	0.005	0.004	0.005	0	6	0%	0.002	0.005	0.002	0.47	0.001	0.006	0.002
Anthracene (ug/L)	0.003	0.017	0.009	0.008	5	6	83%	0.005	0.014	0.005	0.53	0.002	0.014	0.004
Fluorene (ug/L)	0.003	0.013	0.005	0.004	1	6	17%	0.003	0.009	0.004	0.76	0.002	0.009	0.001
Naphthalene (ug/L)	0.006	0.02	0.010	0.009	1	6	17%	0.006	0.016	0.006	0.59	0.002	0.016	0.004
Phenanthrene (ug/L)	0.004	0.037	0.016	0.012	5	6	83%	0.007	0.029	0.012	0.76	0.005	0.028	0.003
Total LPAHs	0.026	0.12	0.057	0.049	6	6	100%	0.033	0.090	0.034	0.59	0.014	0.093	0.022
HPAHs in ug/L														
Benzo(a)anthracene (ug/L)	0.003	0.004	0.003	0.004	0	6	0%	0.003	0.004	0.001	0.16	0.000	0.004	0.003
Benzo(a)pyrene (ug/L)	0.002	0.009	0.004	0.004	1	6	17%	0.002	0.006	0.003	0.66	0.001	0.007	0.001
Benzo(b,k)fluoranthenes (ug/L)	0.005	0.019	0.008	0.006	1	6	17%	0.005	0.013	0.006	0.73	0.002	0.014	0.002
Benzo(g,h,i)perylene (ug/L)	0.003	0.008	0.004	0.003	1	6	17%	0.003	0.006	0.002	0.53	0.001	0.006	0.002
Chrysene (ug/L)	0.002	0.018	0.005	0.002	2	6	33%	0.002	0.012	0.006	1.24	0.003	0.012	-0.002
Dibenz(a,h)anthracene (ug/L)	0.002	0.004	0.003	0.004	0	6	0%	0.002	0.004	0.001	0.29	0.000	0.004	0.002
Fluoranthene (ug/L)	0.004	0.020	0.007	0.004	2	6	33%	0.004	0.014	0.007	0.95	0.003	0.014	0.000
Indeno(1,2,3-cd)pyrene (ug/L)	0.003	0.005	0.004	0.005	0	6	0%	0.003	0.005	0.001	0.27	0.000	0.005	0.003
Pyrene (ug/L)	0.008	0.038	0.016	0.009	6	6	100%	0.009	0.031	0.012	0.76	0.005	0.029	0.003
Total HPAHs	0.030	0.11	0.054	0.039	5	6	83%	0.032	0.091	0.031	0.58	0.013	0.087	0.021
Total PAHs	0.060	0.19	0.11	0.092	6	6	100%	0.069	0.173	0.051	0.46	0.021	0.165	0.058
Phthalates														
bis(2-Ethylhexyl)phthalate (ug/L)	0.189	2.8	0.63	0.19	1	6	17%	0.190	1.51	1.072	1.700	0.438	1.756	-0.495
Butyl benzyl phthalate (ug/L)	0.214	0.24	0.228	0.233	0	6	0%	0.215	0.238	0.011	0.049	0.005	0.240	0.217
Diethylphthalate (ug/L)	0.140	0	0.167	0.178	0	6	0%	0.140	0.182	0.021	0.13	0.009	0.189	0.145
Dimethyl phthalate (ug/L)	0.135	0.21	0.182	0.203	0	6	0%	0.135	0.208	0.036	0.200	0.015	0.220	0.143
Di-n-butylphthalate (ug/L)	0.142	0.51	0.232	0.145	2	6	33%	0.142	0.408	0.150	0.650	0.061	0.389	0.074
Di-n-Octyl phthalate (ug/L)	0.174	0.22	0.205	0.218	0	6	0%	0.175	0.223	0.024	0.116	0.010	0.230	0.180
***Total Phthalates**	0.000	3.1	0.61	0.000	2	6	33%	0.000	1.818	1.253	2.07	0.51	1.92	-0.71
Herbicides														
2,4-D (ug/L)	0.009	0.026	0.014	0.009	2	6	33%	0.009	0.024	0.008	0.59	0.003	0.022	0.005
Dichlobenil (ug/L)	0.020	0.047	0.037	0.046	0	6	0%	0.020	0.047	0.013	0.36	0.005	0.051	0.023
TPH														
NWTPH-Diesel (mg/L)	0.050	0.050	0.050	0.050	0	2	0%	0.050	0.050	0.000	0.00	0.000	0.050	0.050
NWTPH-Gasoline (ug/L)	25.0	25.0	25.0	25.0	0	2	0%	25.0	25.0	0.0	0.00	0.0	25.0	25.0
NWTPH-Heavy Oil (mg/L)	0.100	0.100	0.100	0.100	0	2	0%	0.100	0.100	0.000	0.00	0.000	0.100	0.100
Bacteria														
Coliform, Fecal (CFU/100 ml)	20	45	33	33	2	2	100%	23	43	18	0.54	13	191	-126
BTEX														
Benzene (ug/L)	0.100	0.100	0.100	0.100	0	2	0%	0.100	0.100	0.000	0.00	0.000	0.100	0.100
Ethylbenzene (ug/L)	0.100	0.100	0.100	0.100	0	2	0%	0.100	0.100	0.000	0.00	0.000	0.100	0.100
m,p-Xylene (ug/L)	0.200	0.200	0.200	0.200	0	2	0%	0.200	0.200	0.000	0.00	0.000	0.200	0.200
o-Xylene (ug/L)	0.100	0.100	0.100	0.100	0	2	0%	0.100	0.100	0.000	0.00	0.000	0.100	0.100
Toluene (ug/L)	0.100	0.100	0.100	0.100	0	2	0%	0.100	0.100	0.000	0.00	0.000	0.100	0.100

APPENDIX F

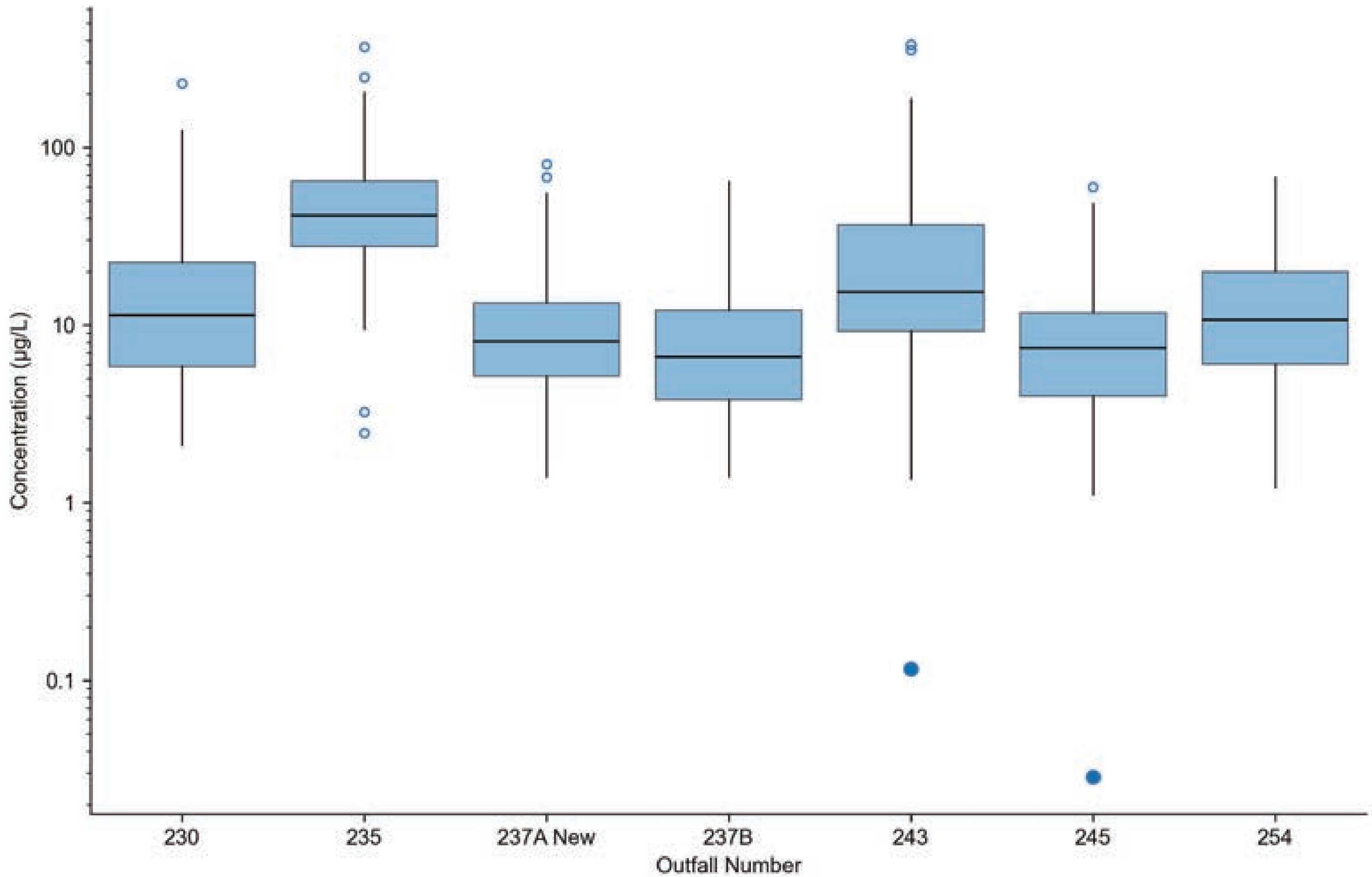
Figure F-1
Total Suspended Solids Drain-by-Drain Comparison in Stormwater
October 2001 - September 2023



— Median ○ Moderate Outlier ● Extreme Outlier

Notes: ^ Extreme outliers exceeding maximum y-scale with result posted.
Tukey Box boundaries display the interquartile range (IQR) of the distribution ranging from the first quartile to the third. The central 50% of data is within the box boundaries. The whiskers represent the remaining data minus the outliers. The moderate outlier value is greater than the third quartile plus 1.5*IQR or less than the first quartile minus 1.5*IQR. The extreme outlier value is greater than the third quartile plus 3.0*IQR or less than the first quartile minus 3.0*IQR.

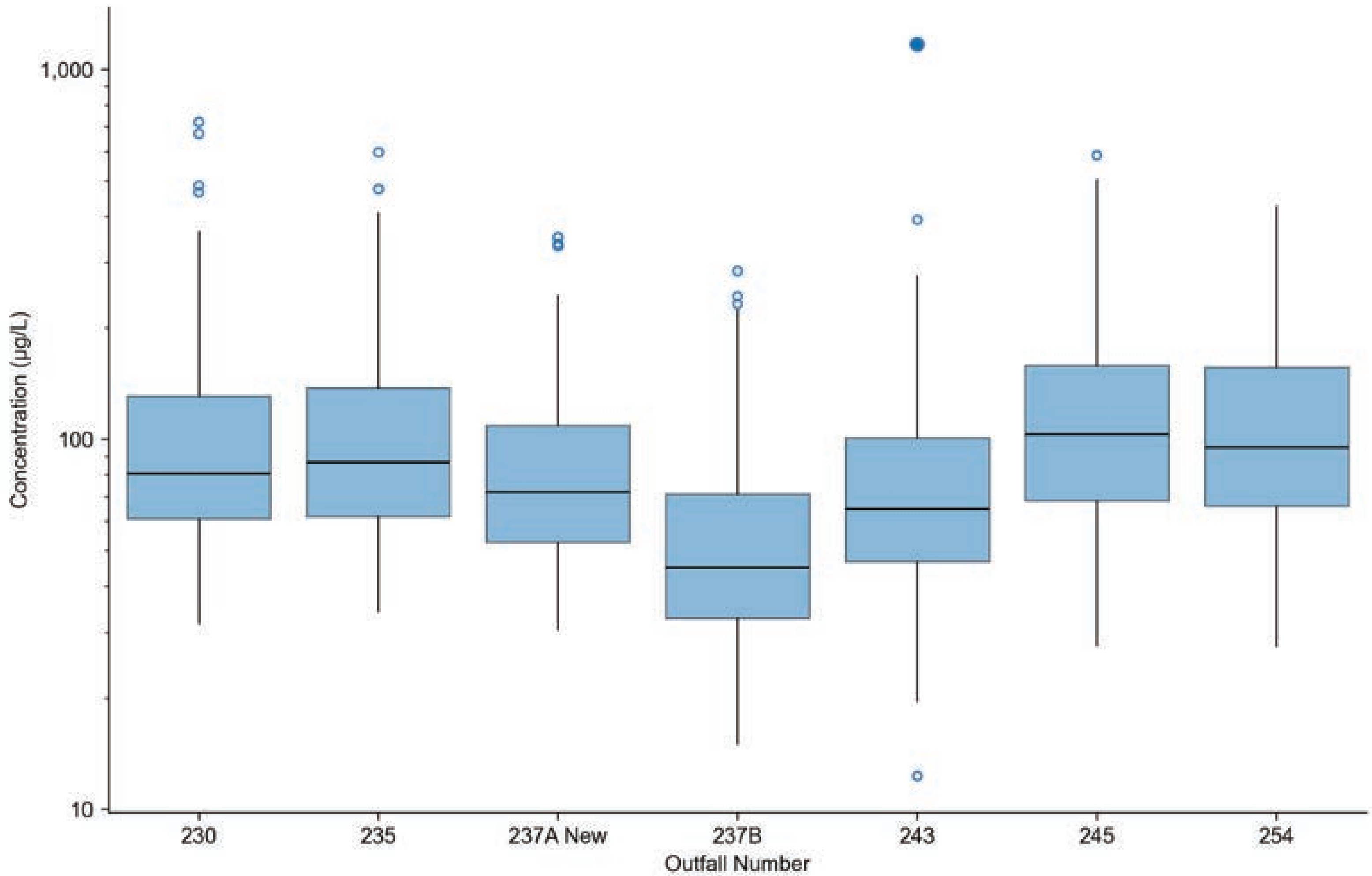
Figure F-2
Total Lead Drain-by-Drain Comparison in Stormwater
October 2001 - September 2023



— Median ○ Moderate Outlier ● Extreme Outlier

Notes: ^ Extreme outliers exceeding maximum y-scale with result posted.
Tukey Box boundaries display the interquartile range (IQR) of the distribution ranging from the first quartile to the third. The central 50% of data is within the box boundaries. The whiskers represent the remaining data minus the outliers. The moderate outlier value is greater than the third quartile plus 1.5*IQR or less than the first quartile minus 1.5*IQR. The extreme outlier value is greater than the third quartile plus 3.0*IQR or less than the first quartile minus 3.0*IQR.

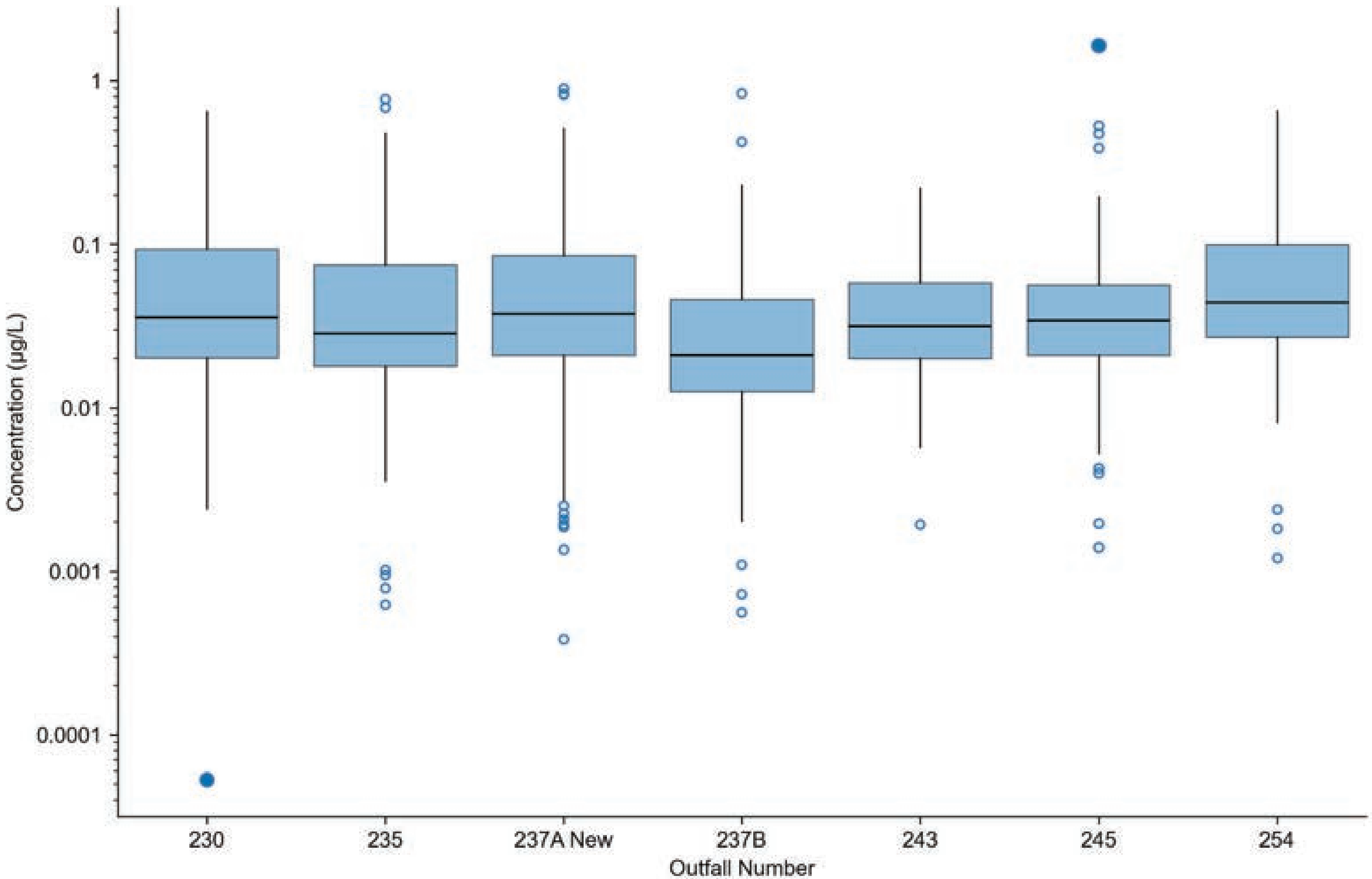
Figure F-3
Total Zinc Drain-by-Drain Comparison in Stormwater
October 2001 - September 2023



— Median ○ Moderate Outlier ● Extreme Outlier

Notes: ^ Extreme outliers exceeding maximum y-scale with result posted.
Tukey Box boundaries display the interquartile range (IQR) of the distribution ranging from the first quartile to the third. The central 50% of data is within the box boundaries. The whiskers represent the remaining data minus the outliers. The moderate outlier value is greater than the third quartile plus 1.5*IQR or less than the first quartile minus 1.5*IQR. The extreme outlier value is greater than the third quartile plus 3.0*IQR or less than the first quartile minus 3.0*IQR.

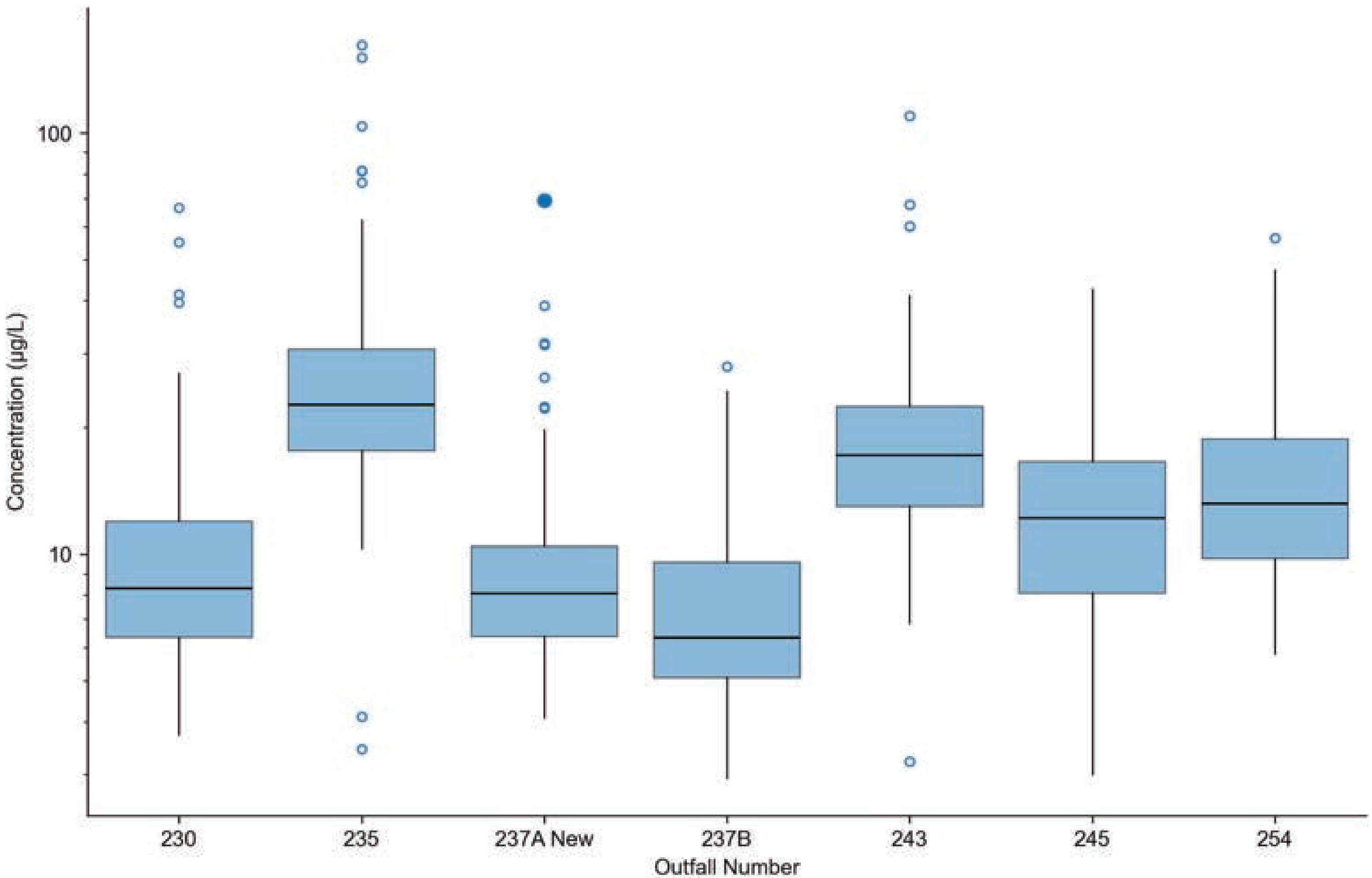
Figure F-4
Phenanthrene Drain-by-Drain Comparison in Stormwater
October 2001 - September 2023



— Median ○ Moderate Outlier ● Extreme Outlier

Notes: ^ Extreme outliers exceeding maximum y-scale with result posted.
Tukey Box boundaries display the interquartile range (IQR) of the distribution ranging from the first quartile to the third. The central 50% of data is within the box boundaries. The whiskers represent the remaining data minus the outliers. The moderate outlier value is greater than the third quartile plus 1.5*IQR or less than the first quartile minus 1.5*IQR. The extreme outlier value is greater than the third quartile plus 3.0*IQR or less than the first quartile minus 3.0*IQR.

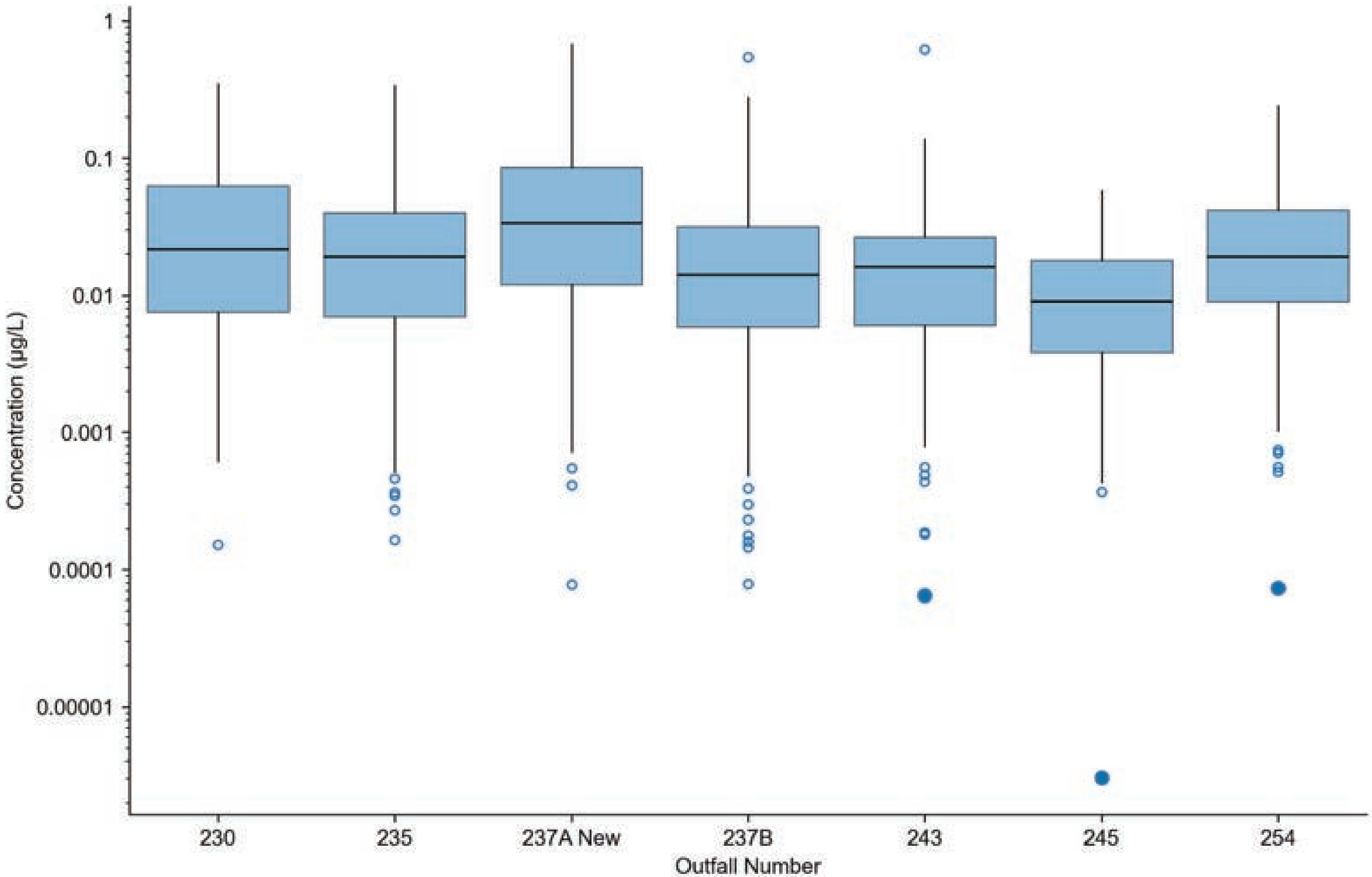
Figure F-5
Total Copper Drain-by-Drain Comparison in Stormwater
October 2001 - September 2023



— Median   ○ Moderate Outlier   ● Extreme Outlier

Notes: ^ Extreme outliers exceeding maximum y-scale with result posted.
Tukey Box boundaries display the interquartile range (IQR) of the distribution ranging from the first quartile to the third. The central 50% of data is within the box boundaries. The whiskers represent the remaining data minus the outliers. The moderate outlier value is greater than the third quartile plus 1.5*IQR or less than the first quartile minus 1.5*IQR. The extreme outlier value is greater than the third quartile plus 3.0*IQR or less than the first quartile minus 3.0*IQR.

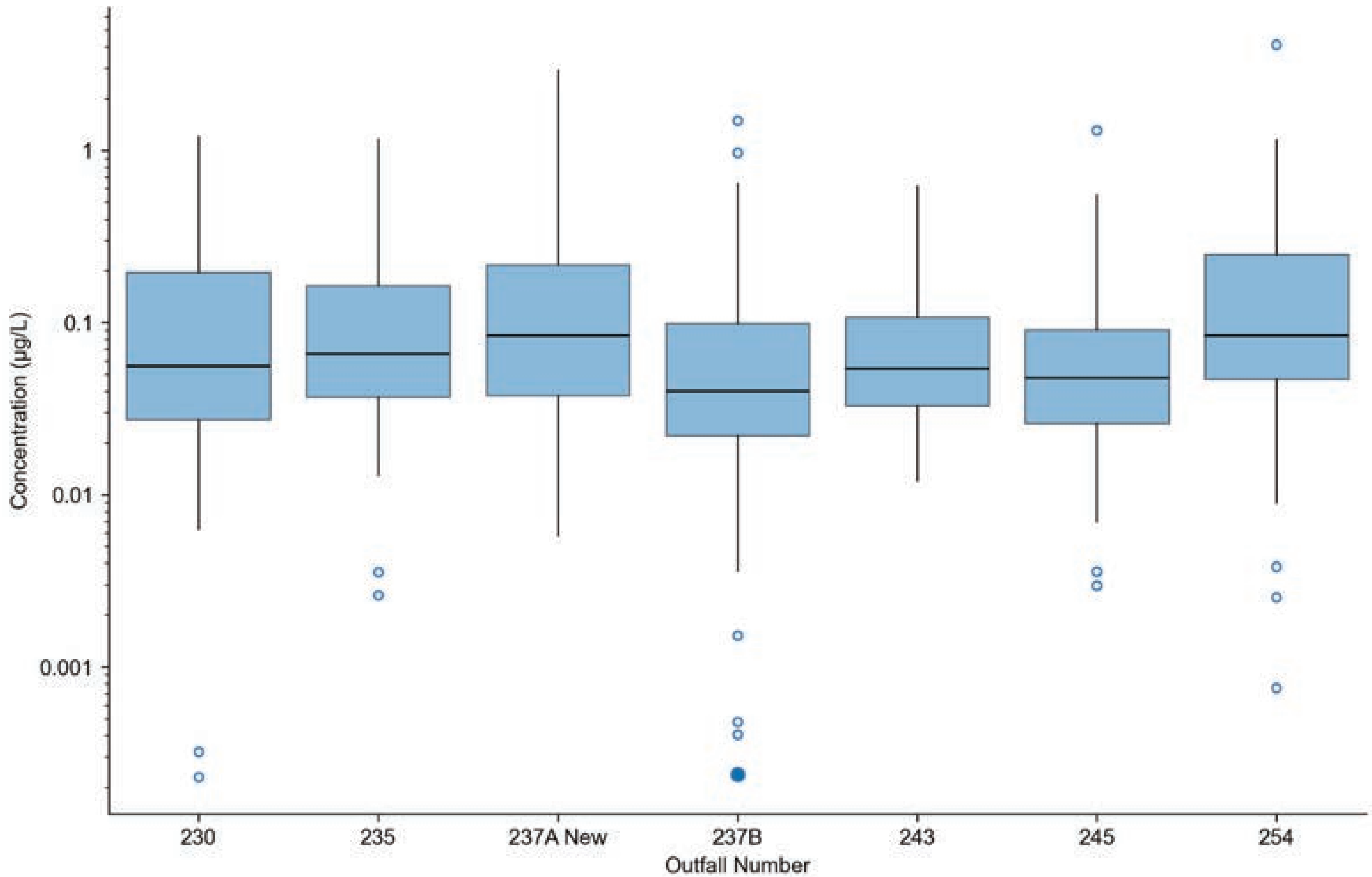
Figure F-6
Indeno(1,2,3-cd)pyrene Drain-by-Drain Comparison in Stormwater
October 2001 - September 2023



— Median ○ Moderate Outlier ● Extreme Outlier

Notes: ^ Extreme outliers exceeding maximum y-scale with result posted.
Tukey Box boundaries display the interquartile range (IQR) of the distribution ranging from the first quartile to the third. The central 50% of data is within the box boundaries. The whiskers represent the remaining data minus the outliers. The moderate outlier value is greater than the third quartile plus 1.5*IQR or less than the first quartile minus 1.5*IQR. The extreme outlier value is greater than the third quartile plus 3.0*IQR or less than the first quartile minus 3.0*IQR.

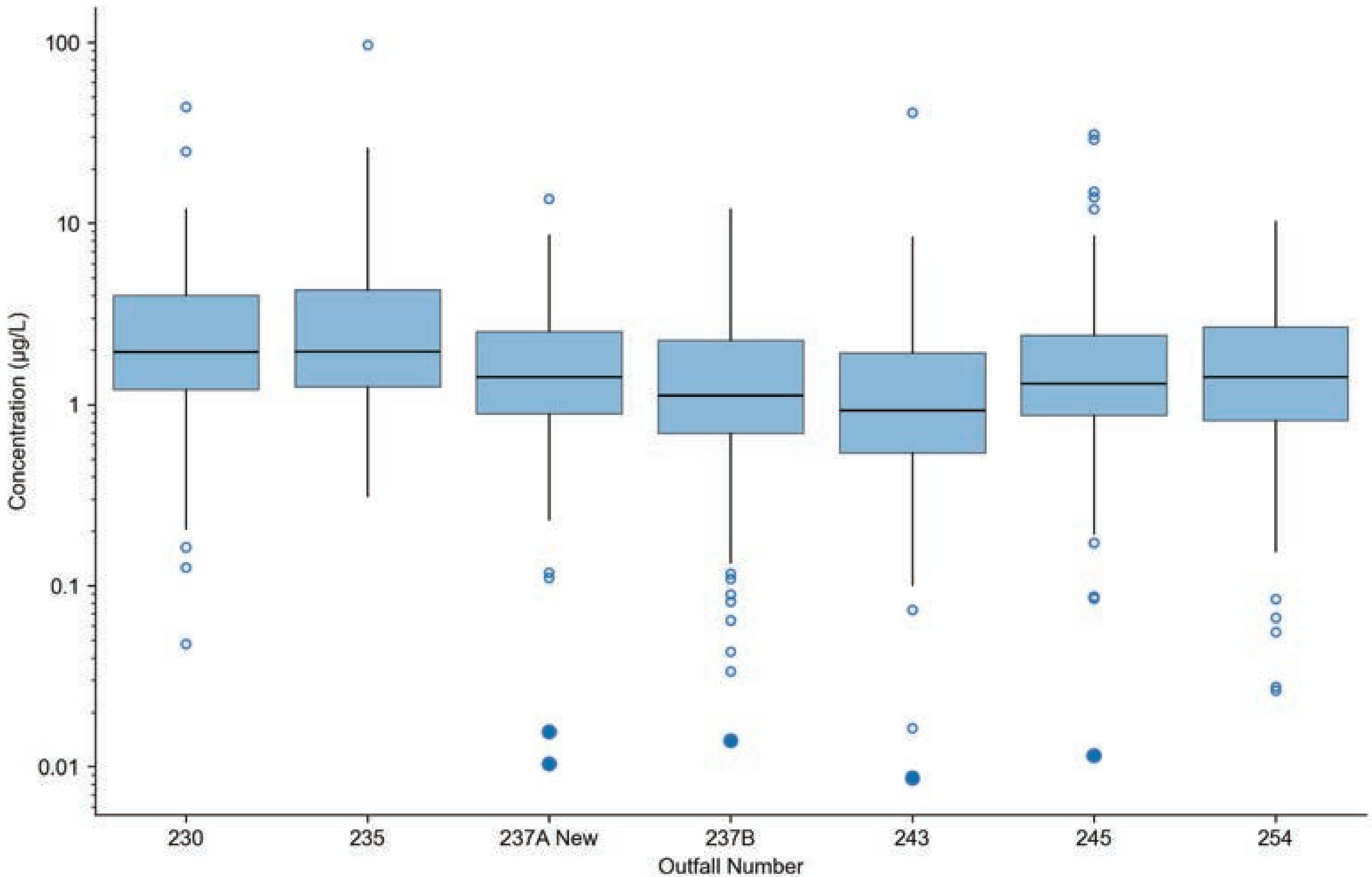
Figure F-7
Pyrene Drain-by-Drain Comparison in Stormwater
October 2001 - September 2023



— Median ○ Moderate Outlier ● Extreme Outlier

Notes: ^ Extreme outliers exceeding maximum y-scale with result posted.
Tukey Box boundaries display the interquartile range (IQR) of the distribution ranging from the first quartile to the third. The central 50% of data is within the box boundaries. The whiskers represent the remaining data minus the outliers. The moderate outlier value is greater than the third quartile plus 1.5*IQR or less than the first quartile minus 1.5*IQR. The extreme outlier value is greater than the third quartile plus 3.0*IQR or less than the first quartile minus 3.0*IQR.

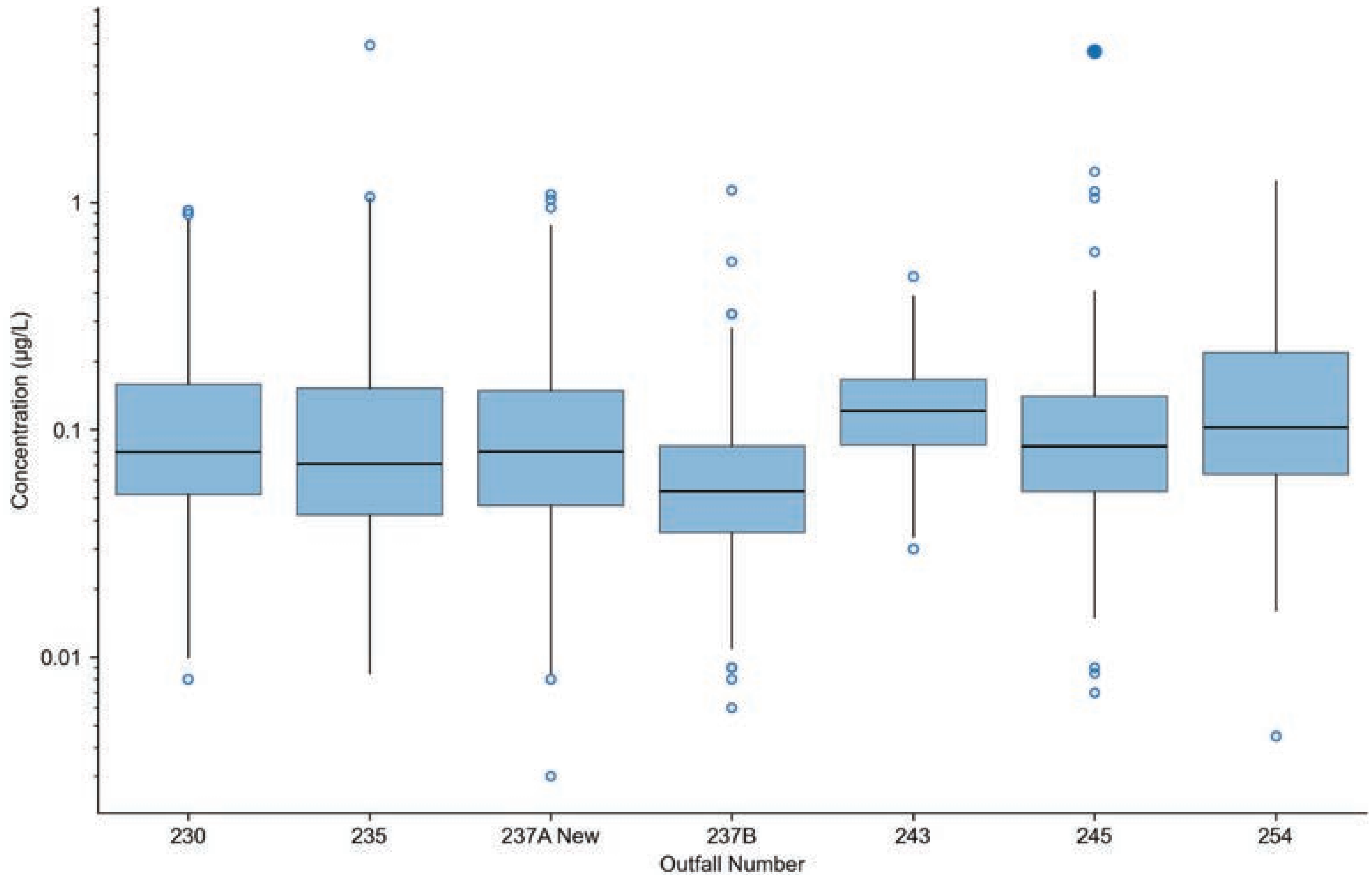
Figure F-8
Di(2-ethylhexyl)phthalate Drain-by-Drain Comparison in Stormwater
October 2001 - September 2023



— Median   ○ Moderate Outlier   ● Extreme Outlier

Notes: ^ Extreme outliers exceeding maximum y-scale with result posted.
Tukey Box boundaries display the interquartile range (IQR) of the distribution ranging from the first quartile to the third. The central 50% of data is within the box boundaries. The whiskers represent the remaining data minus the outliers. The moderate outlier value is greater than the third quartile plus 1.5*IQR or less than the first quartile minus 1.5*IQR. The extreme outlier value is greater than the third quartile plus 3.0*IQR or less than the first quartile minus 3.0*IQR.

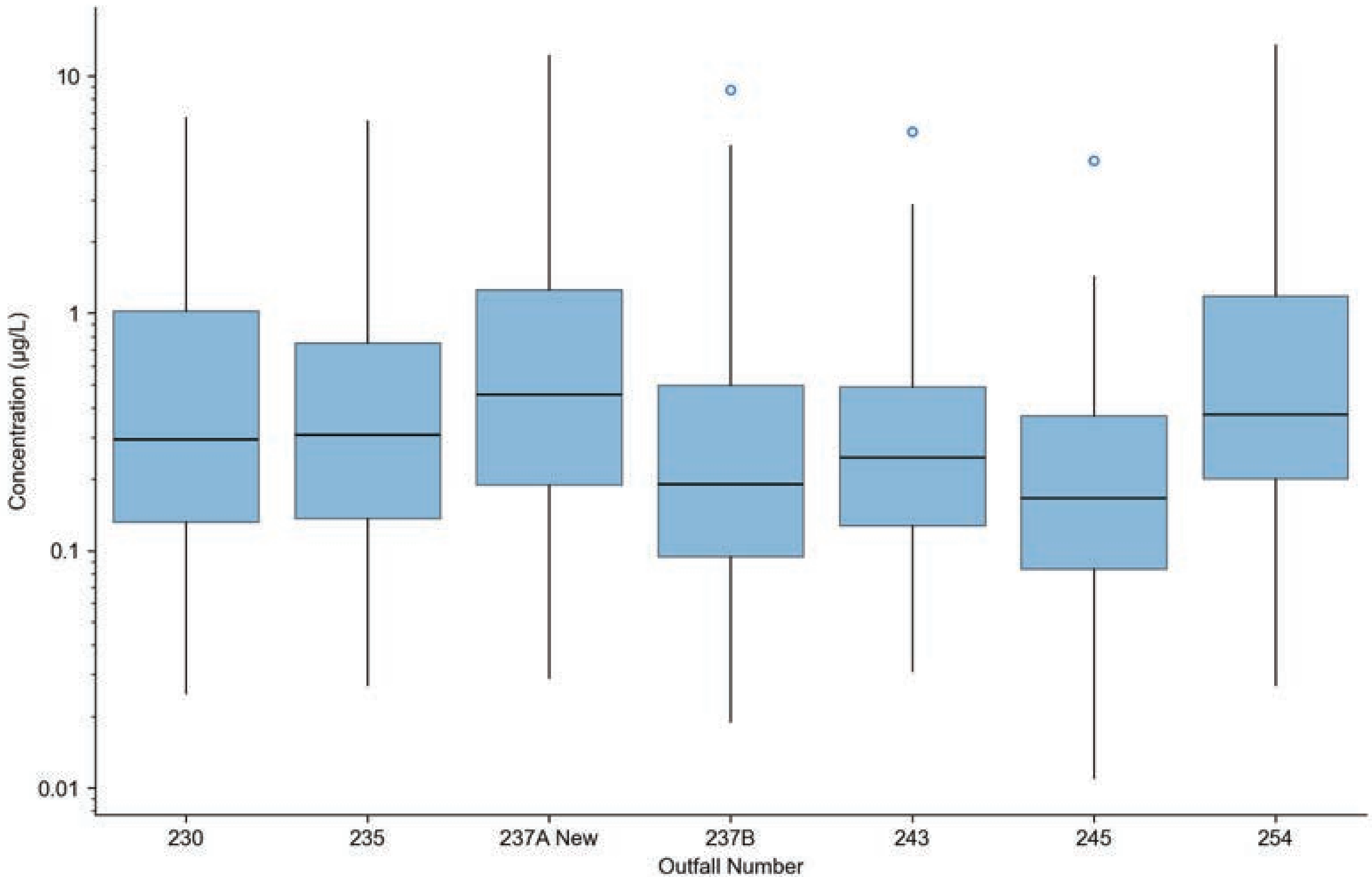
Figure F-9
Total LPAHs Drain-by-Drain Comparison in Stormwater
October 2001 - September 2023



— Median ○ Moderate Outlier ● Extreme Outlier

Notes: ^ Extreme outliers exceeding maximum y-scale with result posted.
Tukey Box boundaries display the interquartile range (IQR) of the distribution ranging from the first quartile to the third. The central 50% of data is within the box boundaries. The whiskers represent the remaining data minus the outliers. The moderate outlier value is greater than the third quartile plus 1.5*IQR or less than the first quartile minus 1.5*IQR. The extreme outlier value is greater than the third quartile plus 3.0*IQR or less than the first quartile minus 3.0*IQR.

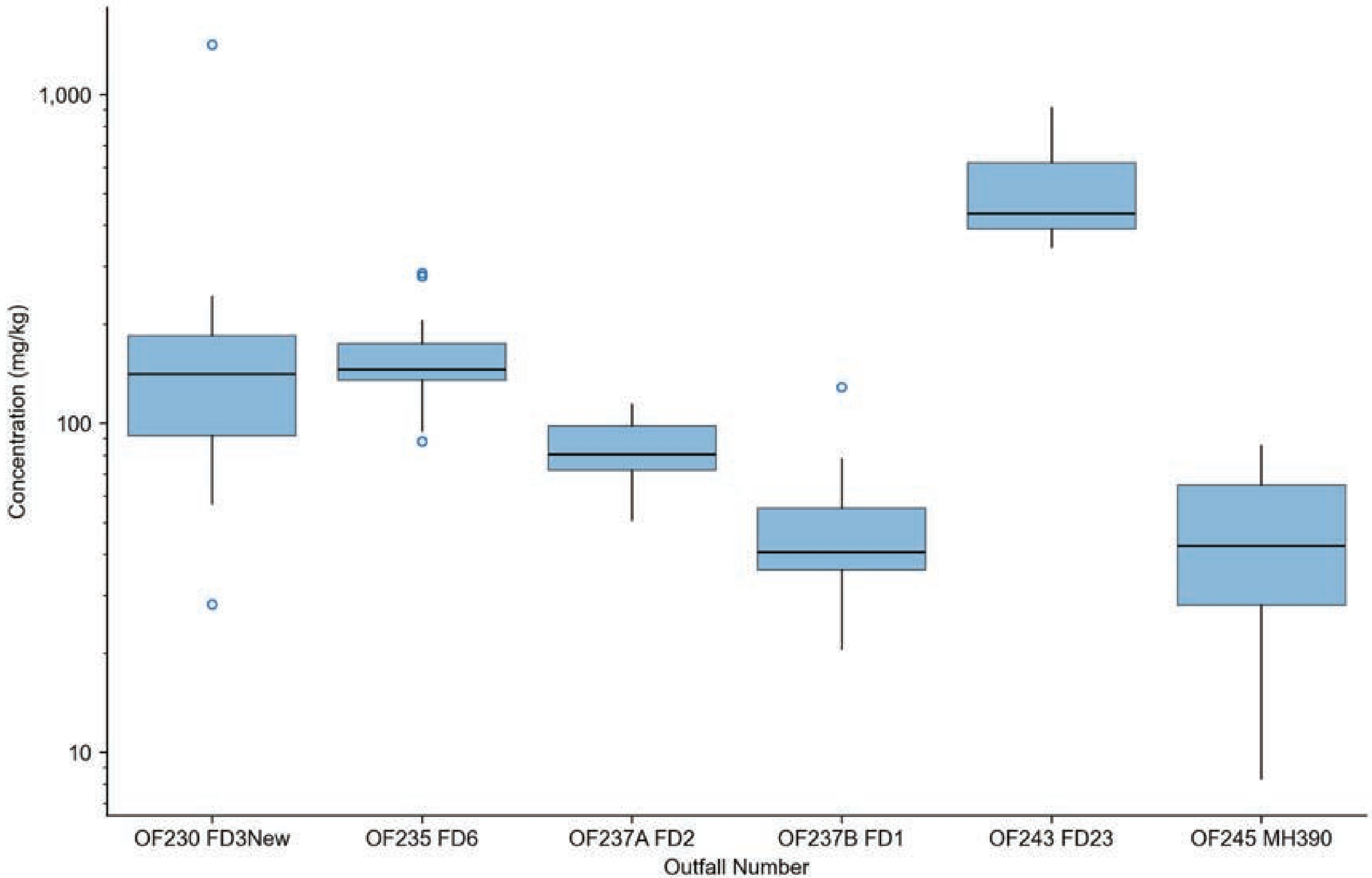
Figure F-10
Total HPAHs Drain-by-Drain Comparison in Stormwater
October 2001 - September 2023



— Median ○ Moderate Outlier ● Extreme Outlier

Notes: ^ Extreme outliers exceeding maximum y-scale with result posted.
Tukey Box boundaries display the interquartile range (IQR) of the distribution ranging from the first quartile to the third. The central 50% of data is within the box boundaries. The whiskers represent the remaining data minus the outliers. The moderate outlier value is greater than the third quartile plus 1.5*IQR or less than the first quartile minus 1.5*IQR. The extreme outlier value is greater than the third quartile plus 3.0*IQR or less than the first quartile minus 3.0*IQR.

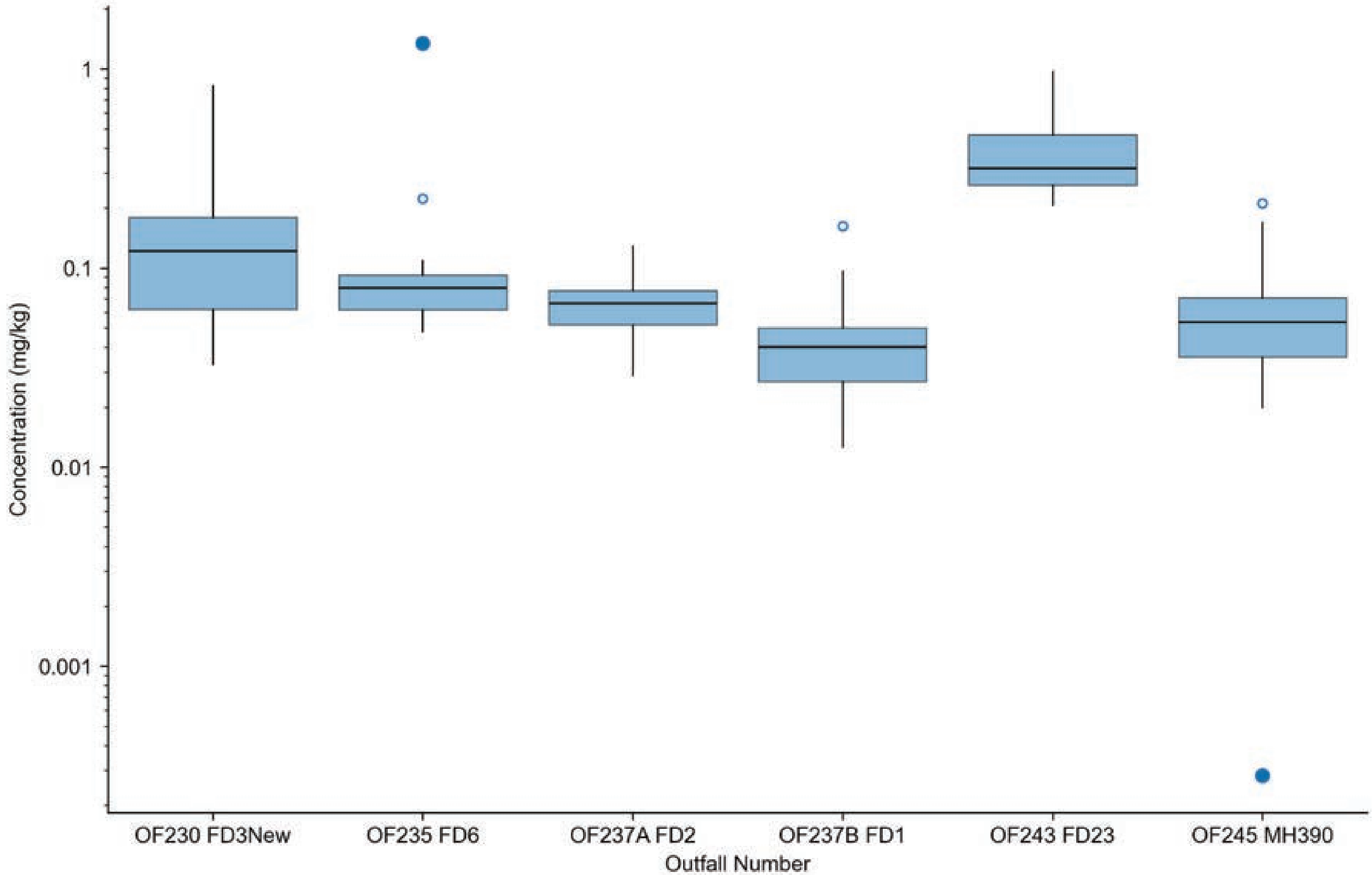
Figure F-11
Total Lead Basin-by-Basin Comparison in Sediment
Water Years 2022 – 2023



— Median ○ Moderate Outlier ● Extreme Outlier

Notes: ^ Extreme outliers exceeding maximum y-scale with result posted.
Tukey Box boundaries display the interquartile range (IQR) of the distribution ranging from the first quartile to the third. The central 50% of data is within the box boundaries. The whiskers represent the remaining data minus the outliers. The moderate outlier value is greater than the third quartile plus 1.5*IQR or less than the first quartile minus 1.5*IQR. The extreme outlier value is greater than the third quartile plus 3.0*IQR or less than the first quartile minus 3.0*IQR.

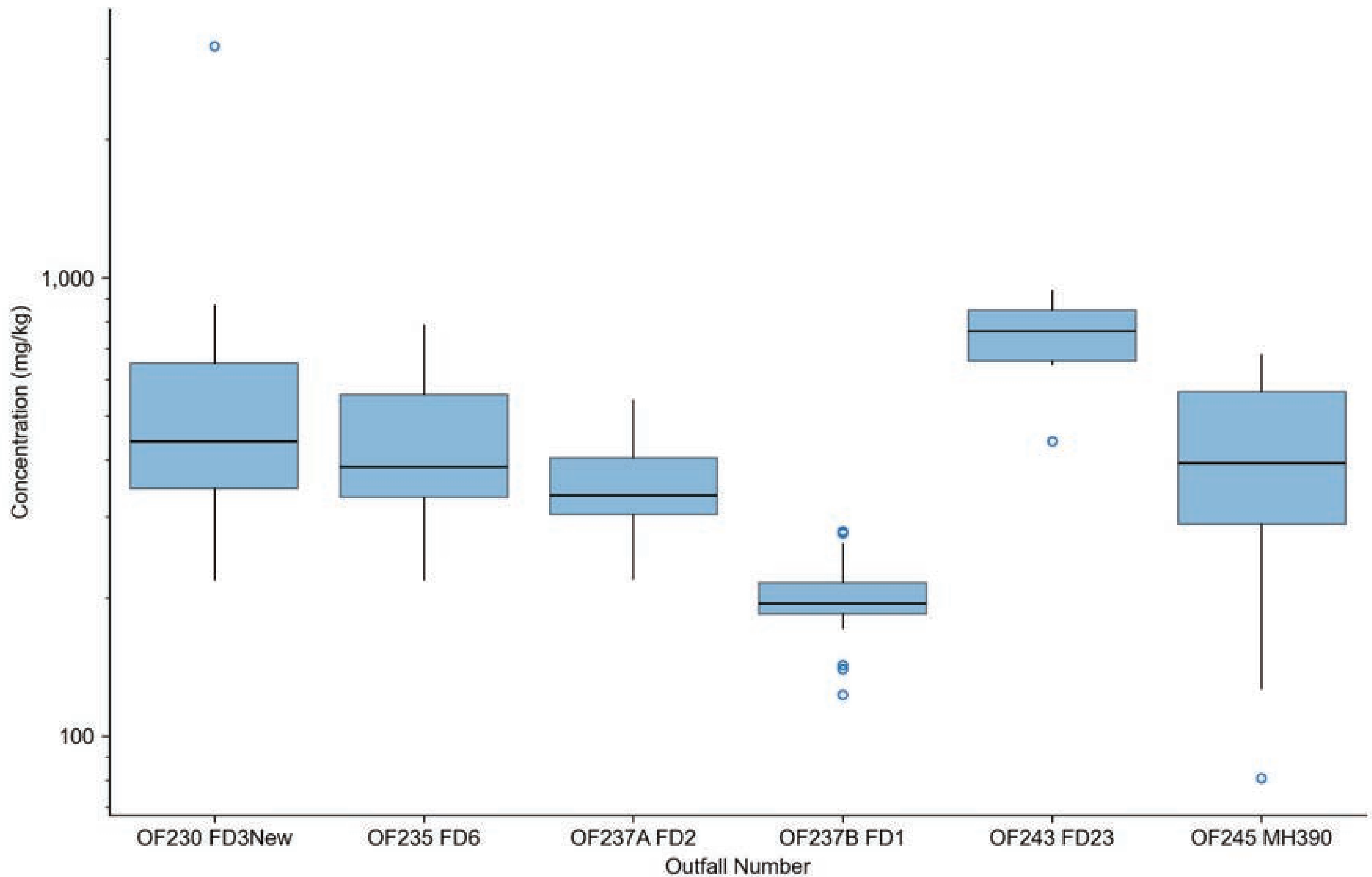
Figure F-12
Total Mercury Basin-by-Basin Comparison in Sediment
Water Years 2022 - 2023



— Median ○ Moderate Outlier ● Extreme Outlier

Notes: ^ Extreme outliers exceeding maximum y-scale with result posted.
Tukey Box boundaries display the interquartile range (IQR) of the distribution ranging from the first quartile to the third. The central 50% of data is within the box boundaries. The whiskers represent the remaining data minus the outliers. The moderate outlier value is greater than the third quartile plus 1.5*IQR or less than the first quartile minus 1.5*IQR. The extreme outlier value is greater than the third quartile plus 3.0*IQR or less than the first quartile minus 3.0*IQR.

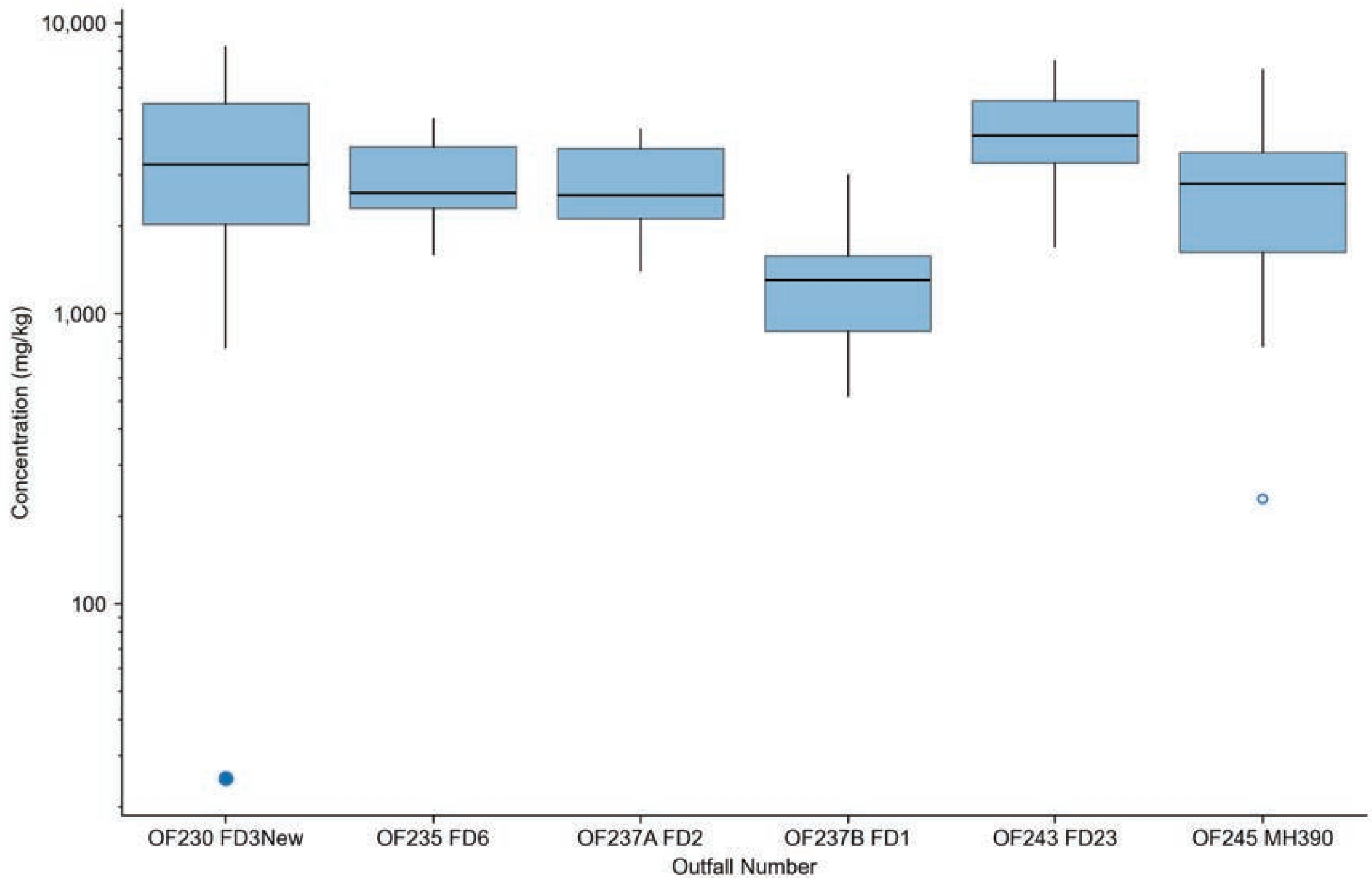
Figure F-13
Total Zinc Basin-by-Basin Comparison in Sediment
Water Years 2022 – 2023



— Median ○ Moderate Outlier ● Extreme Outlier

Notes: ^ Extreme outliers exceeding maximum y-scale with result posted.
Tukey Box boundaries display the interquartile range (IQR) of the distribution ranging from the first quartile to the third. The central 50% of data is within the box boundaries. The whiskers represent the remaining data minus the outliers. The moderate outlier value is greater than the third quartile plus 1.5*IQR or less than the first quartile minus 1.5*IQR. The extreme outlier value is greater than the third quartile plus 3.0*IQR or less than the first quartile minus 3.0*IQR.

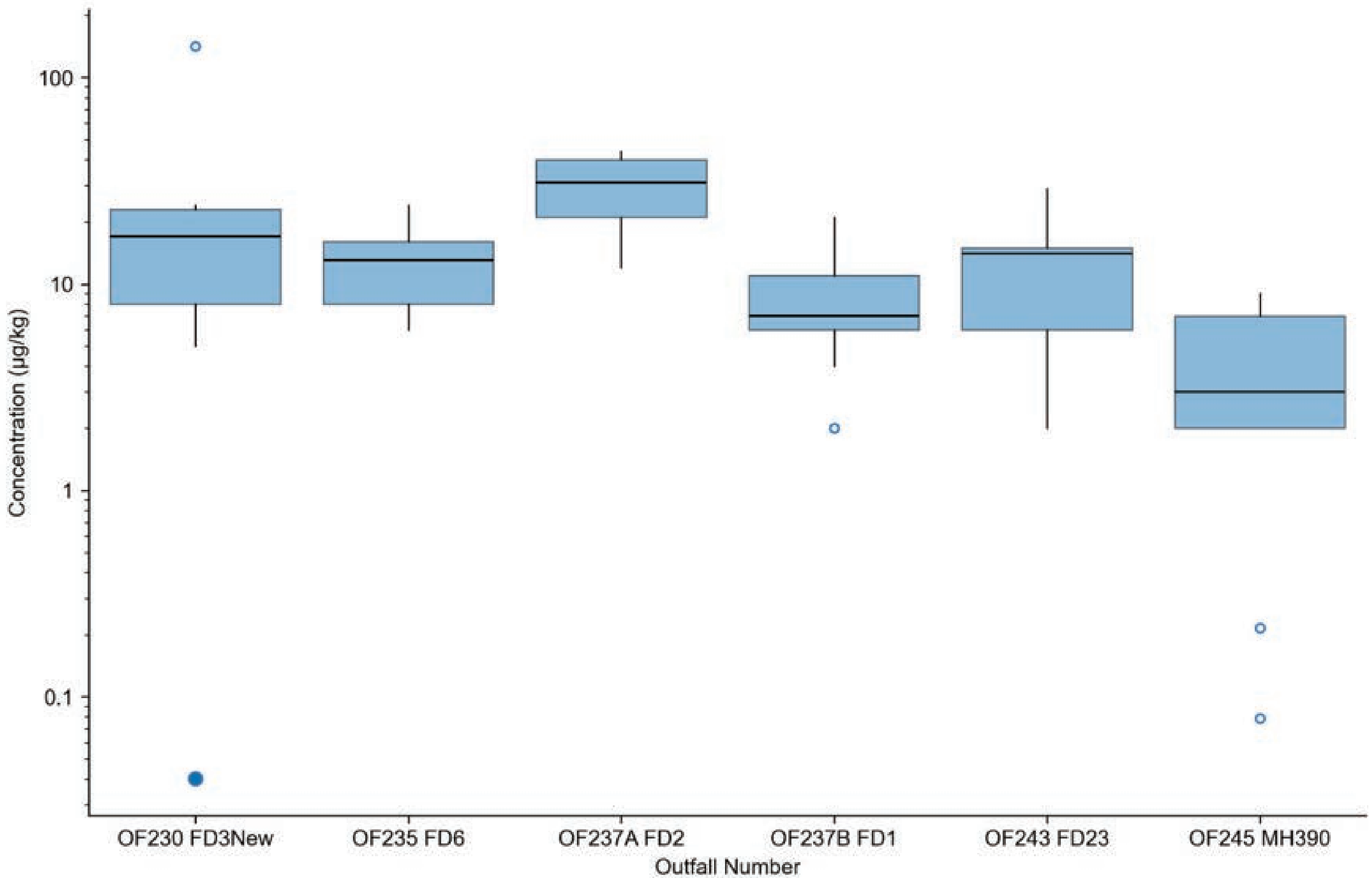
Figure F-14
Total NWTPH-Heavy Oil Basin-by-Basin Comparison in Sediment
Water Years 2002 – 2023



— Median ○ Moderate Outlier ● Extreme Outlier

Notes: ^ Extreme outliers exceeding maximum y-scale with result posted.
Tukey Box boundaries display the interquartile range (IQR) of the distribution ranging from the first quartile to the third. The central 50% of data is within the box boundaries. The whiskers represent the remaining data minus the outliers. The moderate outlier value is greater than the third quartile plus 1.5*IQR or less than the first quartile minus 1.5*IQR. The extreme outlier value is greater than the third quartile plus 3.0*IQR or less than the first quartile minus 3.0*IQR.

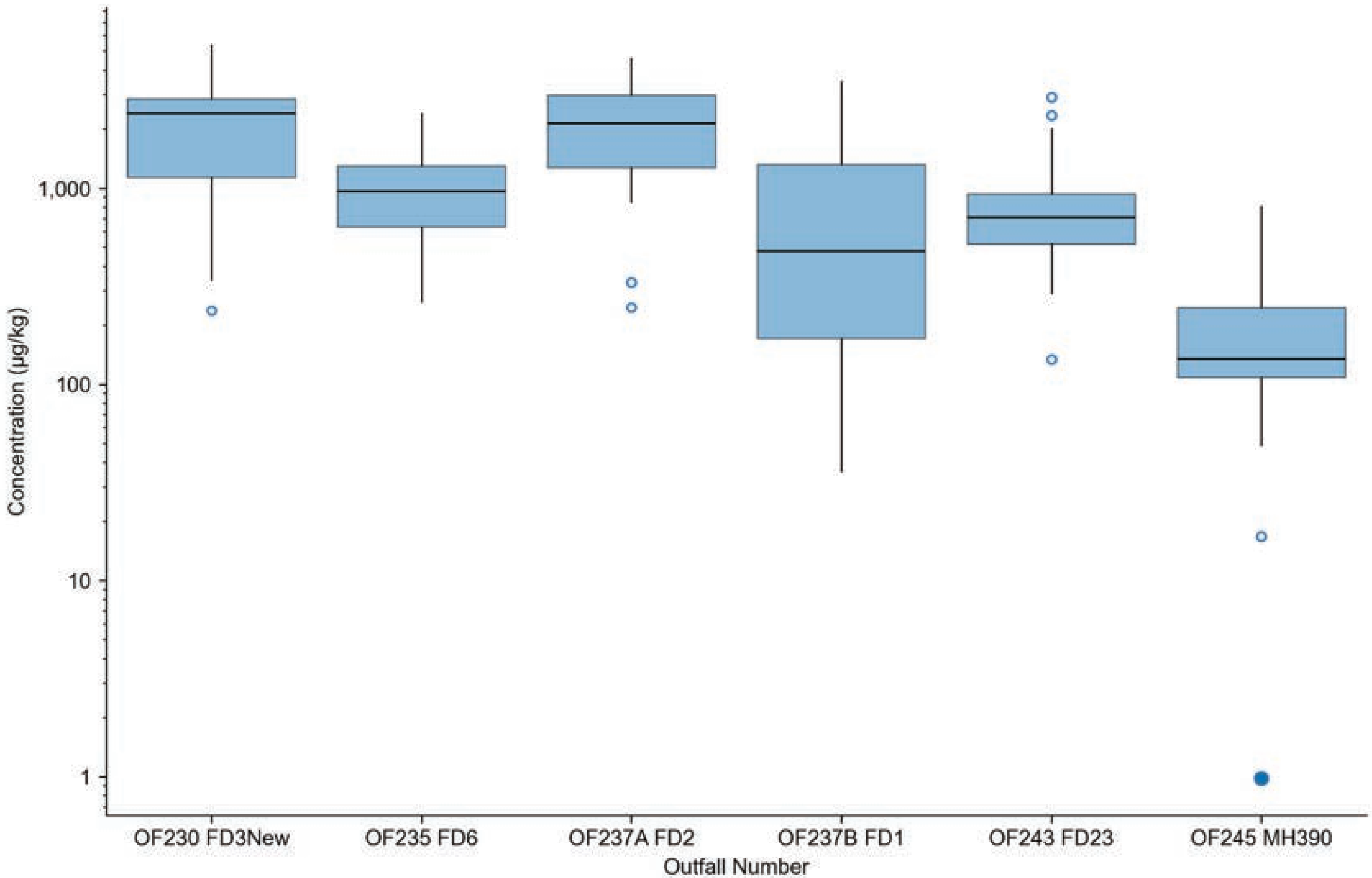
Figure F-15
Bifenthrin Basin-by-Basin Comparison in Sediment
Water Years 2002 – 2023



— Median ○ Moderate Outlier ● Extreme Outlier

Notes: ^ Extreme outliers exceeding maximum y-scale with result posted.
Tukey Box boundaries display the interquartile range (IQR) of the distribution ranging from the first quartile to the third. The central 50% of data is within the box boundaries. The whiskers represent the remaining data minus the outliers. The moderate outlier value is greater than the third quartile plus 1.5*IQR or less than the first quartile minus 1.5*IQR. The extreme outlier value is greater than the third quartile plus 3.0*IQR or less than the first quartile minus 3.0*IQR.

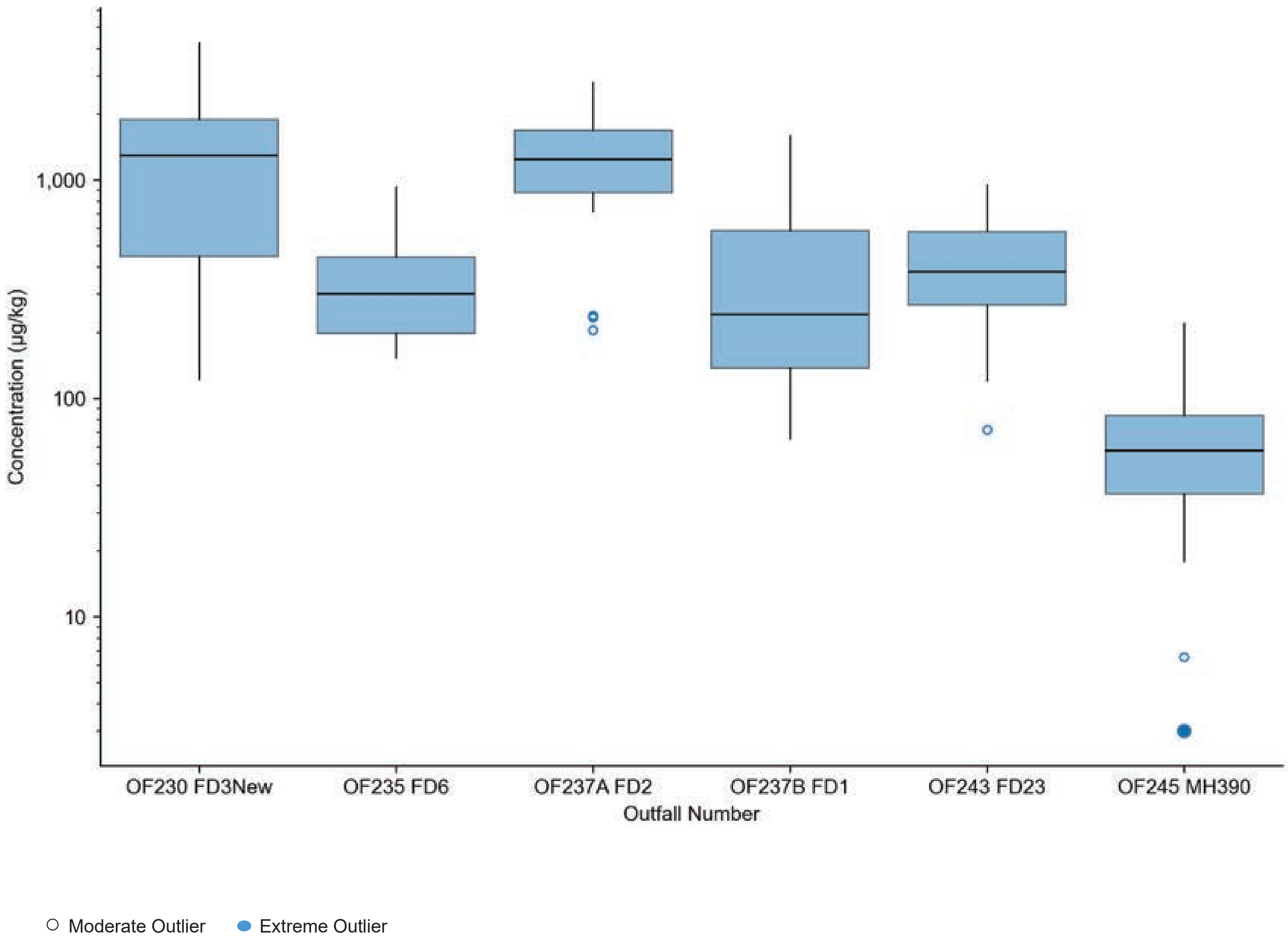
Figure F-16
Phenanthrene Basin-by-Basin Comparison in Sediment
Water Years 2002 – 2023



— Median   ○ Moderate Outlier   ● Extreme Outlier

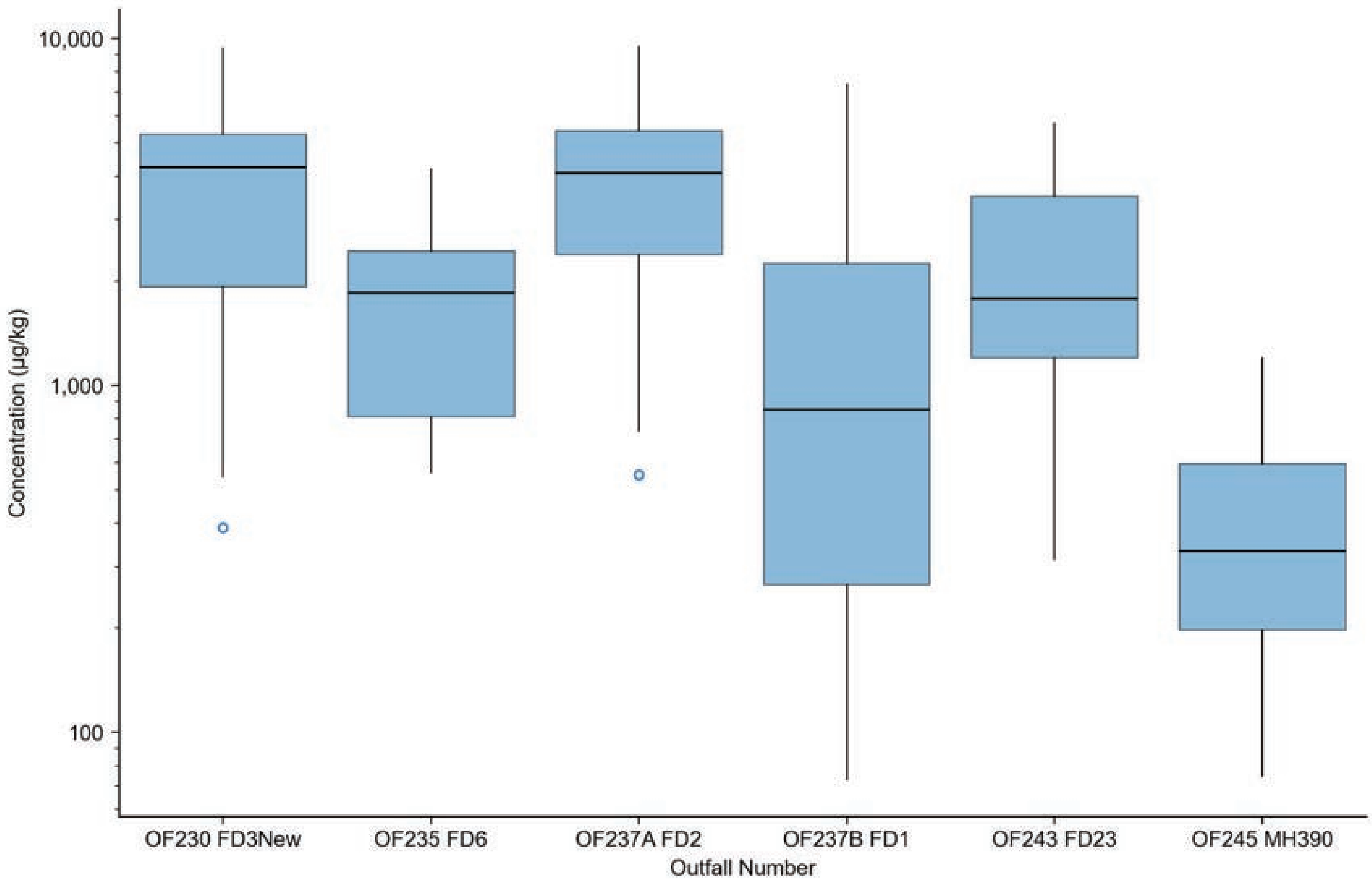
Notes: ^ Extreme outliers exceeding maximum y-scale with result posted.
Tukey Box boundaries display the interquartile range (IQR) of the distribution ranging from the first quartile to the third. The central 50% of data is within the box boundaries. The whiskers represent the remaining data minus the outliers. The moderate outlier value is greater than the third quartile plus 1.5*IQR or less than the first quartile minus 1.5*IQR. The extreme outlier value is greater than the third quartile plus 3.0*IQR or less than the first quartile minus 3.0*IQR.

Figure F-17
Indeno(1,2,3-c,d)pyrene Basin-by-Basin Comparison in Sediment
Water Years 2002 – 2023



Notes: ^ Extreme outliers exceeding maximum y-scale with result posted.
Tukey Box boundaries display the interquartile range (IQR) of the distribution ranging from the first quartile to the third. The central 50% of data is within the box boundaries. The whiskers represent the remaining data minus the outliers. The moderate outlier value is greater than the third quartile plus 1.5*IQR or less than the first quartile minus 1.5*IQR. The extreme outlier value is greater than the third quartile plus 3.0*IQR or less than the first quartile minus 3.0*IQR.

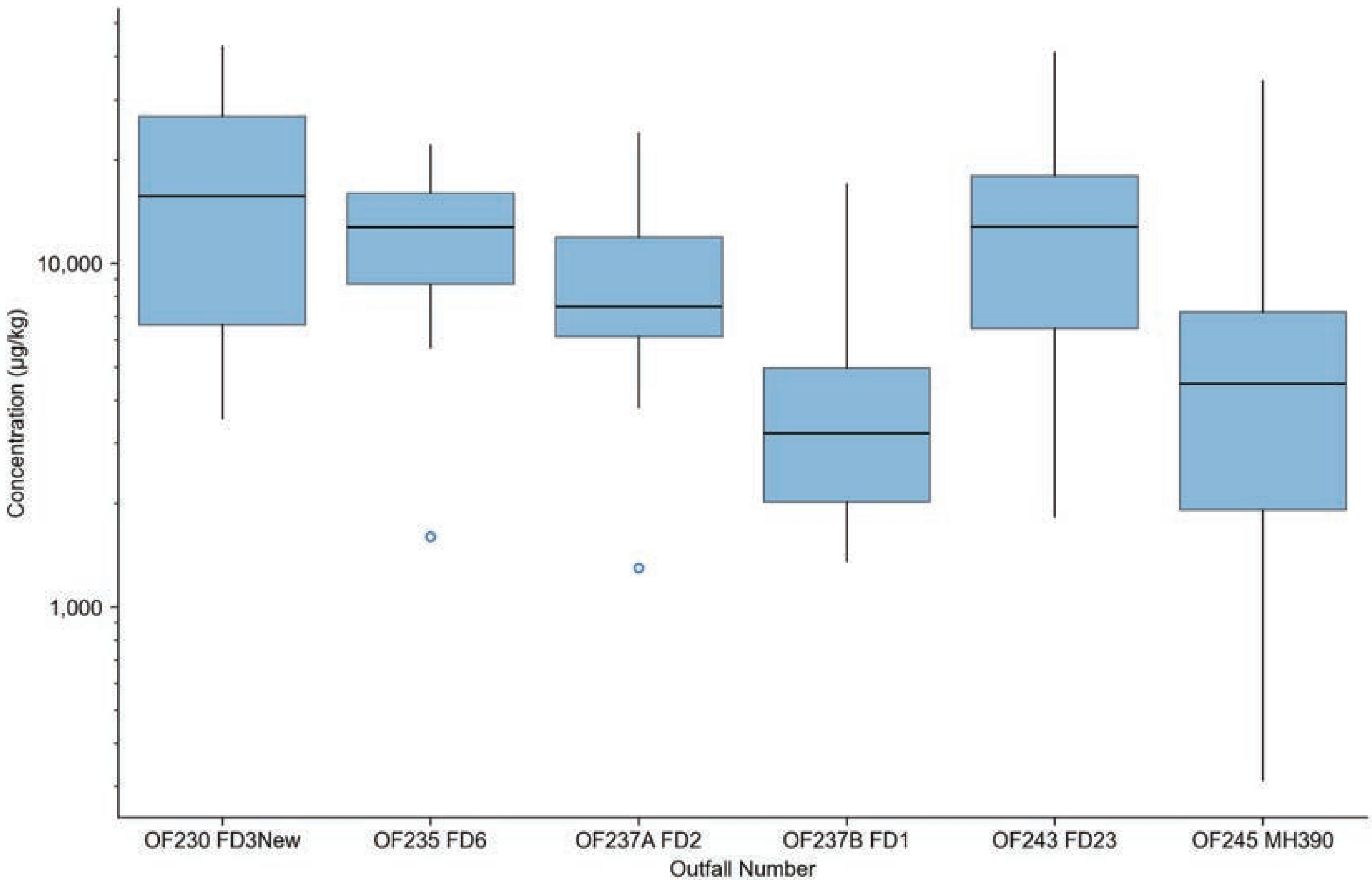
Figure F-18
Pyrene Basin-by-Basin Comparison in Sediment
Water Years 2002 – 2023



— Median ○ Moderate Outlier ● Extreme Outlier

Notes: ^ Extreme outliers exceeding maximum y-scale with result posted.
Tukey Box boundaries display the interquartile range (IQR) of the distribution ranging from the first quartile to the third. The central 50% of data is within the box boundaries. The whiskers represent the remaining data minus the outliers. The moderate outlier value is greater than the third quartile plus 1.5*IQR or less than the first quartile minus 1.5*IQR. The extreme outlier value is greater than the third quartile plus 3.0*IQR or less than the first quartile minus 3.0*IQR.

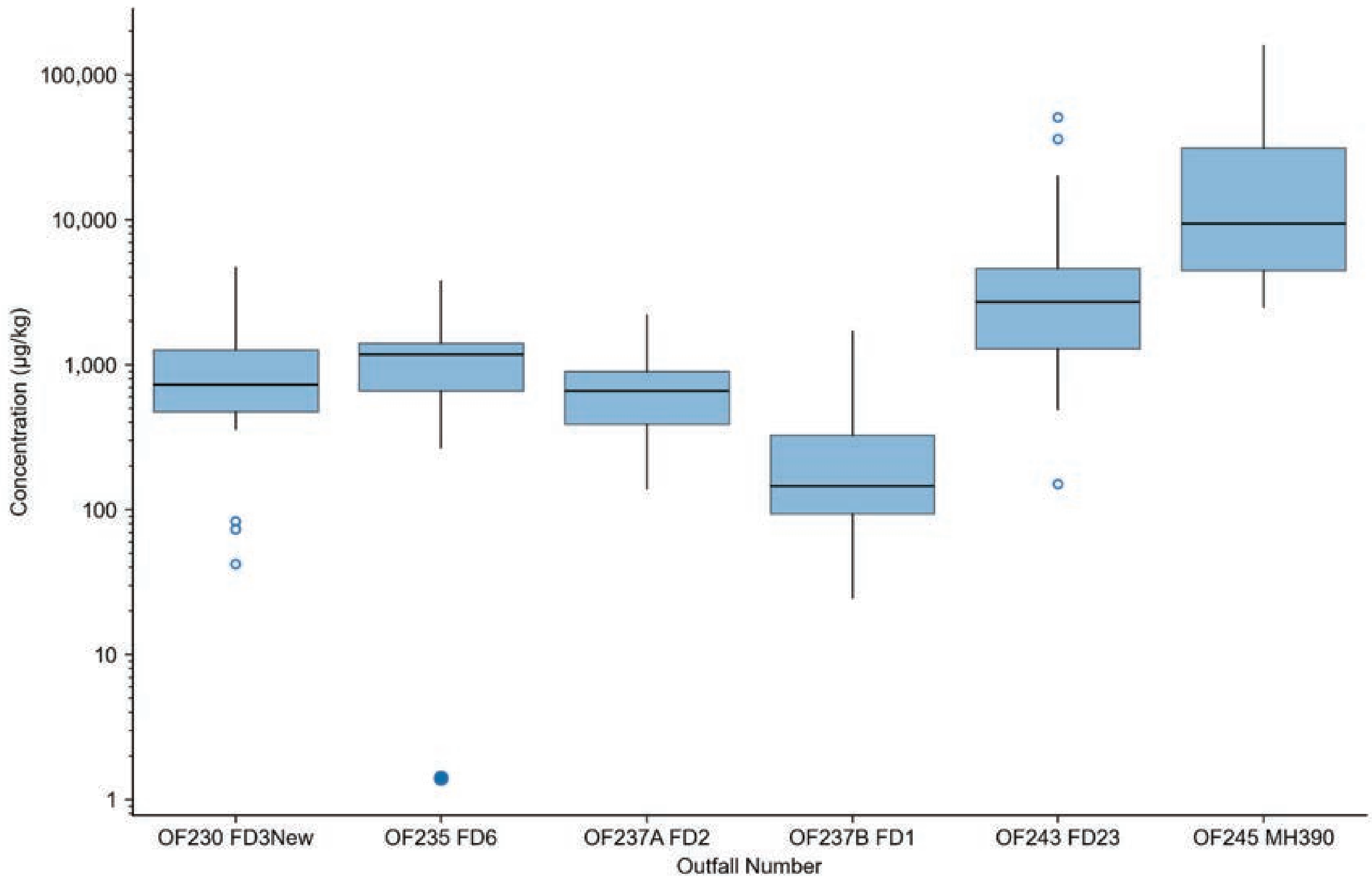
Figure F-19
Di(2-ethylhexyl)phthalate Basin-by-Basin Comparison in Sediment
Water Years 2002 – 2023



— Median ○ Moderate Outlier ● Extreme Outlier

Notes: ^ Extreme outliers exceeding maximum y-scale with result posted.
Tukey Box boundaries display the interquartile range (IQR) of the distribution ranging from the first quartile to the third. The central 50% of data is within the box boundaries. The whiskers represent the remaining data minus the outliers. The moderate outlier value is greater than the third quartile plus 1.5*IQR or less than the first quartile minus 1.5*IQR. The extreme outlier value is greater than the third quartile plus 3.0*IQR or less than the first quartile minus 3.0*IQR.

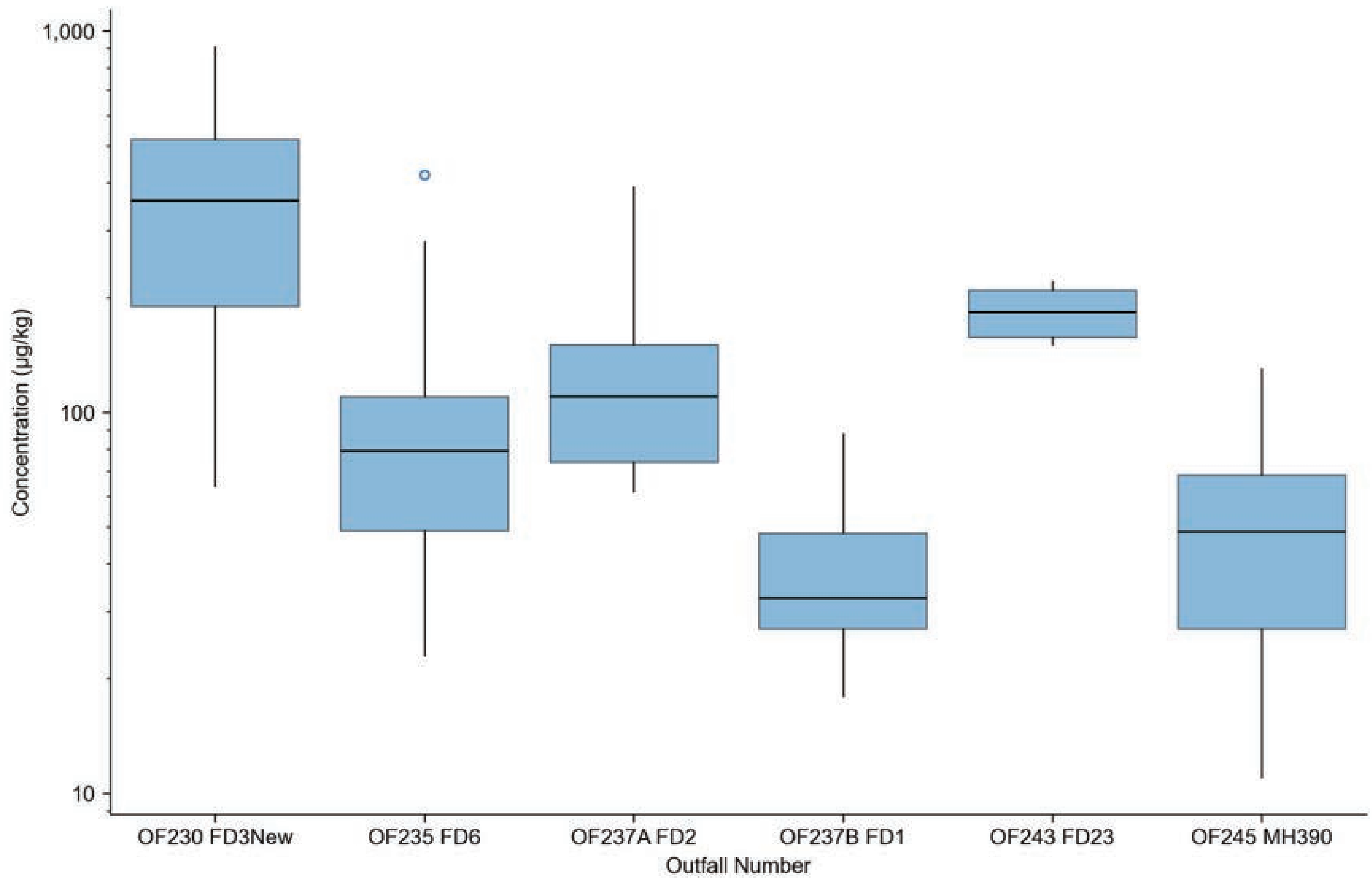
Figure F-20
Butyl benzyl phthalate Basin-by-Basin Comparison in Sediment
Water Years 2002 – 2023



— Median ○ Moderate Outlier ● Extreme Outlier

Notes: ^ Extreme outliers exceeding maximum y-scale with result posted.
Tukey Box boundaries display the interquartile range (IQR) of the distribution ranging from the first quartile to the third. The central 50% of data is within the box boundaries. The whiskers represent the remaining data minus the outliers. The moderate outlier value is greater than the third quartile plus 1.5*IQR or less than the first quartile minus 1.5*IQR. The extreme outlier value is greater than the third quartile plus 3.0*IQR or less than the first quartile minus 3.0*IQR.

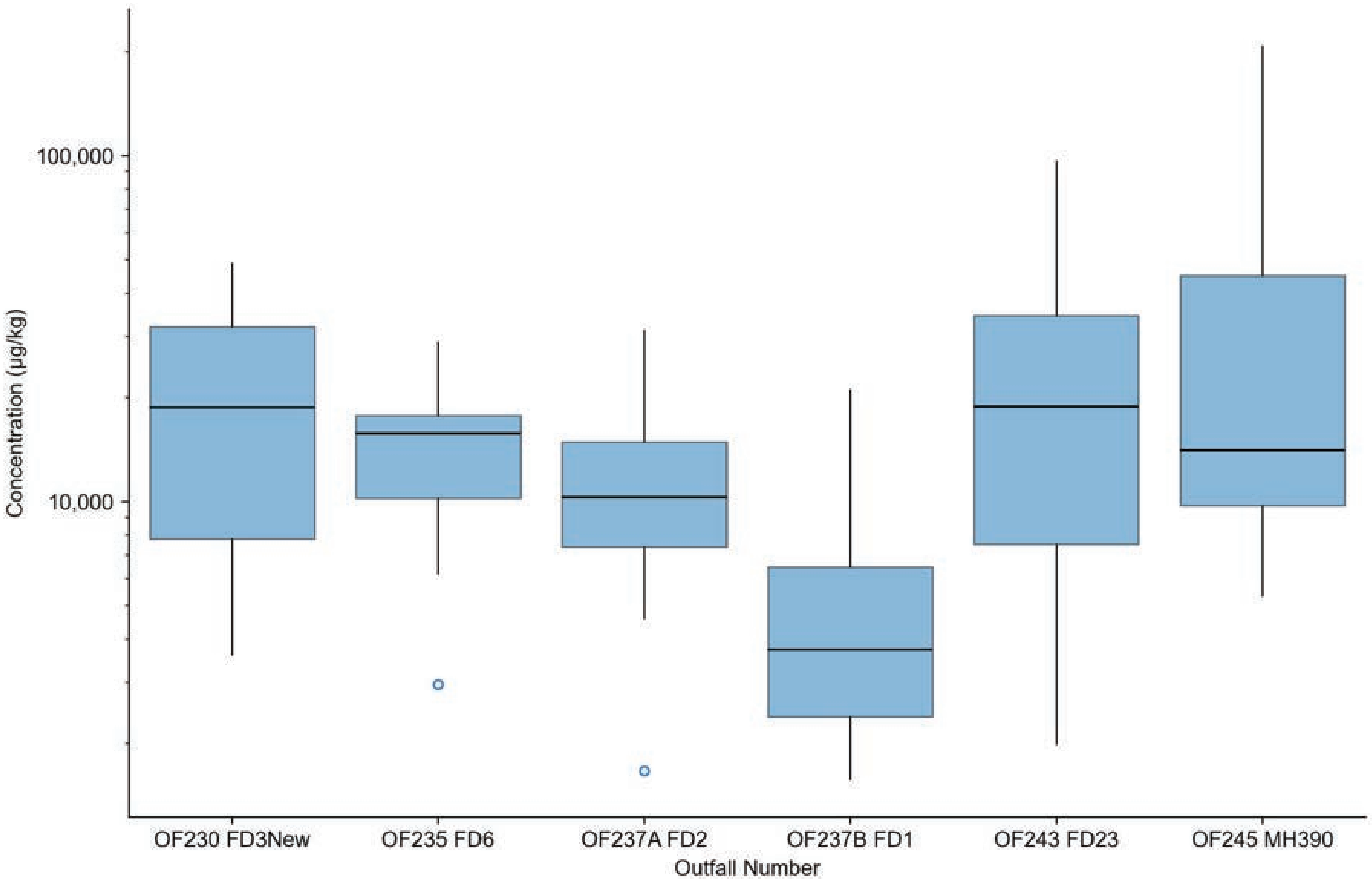
Figure F-21
Total PCBs Oil Basin-by-Basin Comparison in Sediment
Water Years 2002 – 2023



— Median ○ Moderate Outlier ● Extreme Outlier

Notes: ^ Extreme outliers exceeding maximum y-scale with result posted.
Tukey Box boundaries display the interquartile range (IQR) of the distribution ranging from the first quartile to the third. The central 50% of data is within the box boundaries. The whiskers represent the remaining data minus the outliers. The moderate outlier value is greater than the third quartile plus 1.5*IQR or less than the first quartile minus 1.5*IQR. The extreme outlier value is greater than the third quartile plus 3.0*IQR or less than the first quartile minus 3.0*IQR.

Figure F-22
Total Phthalates Basin-by-Basin Comparison in Sediment
Water Years 2002 - 2023

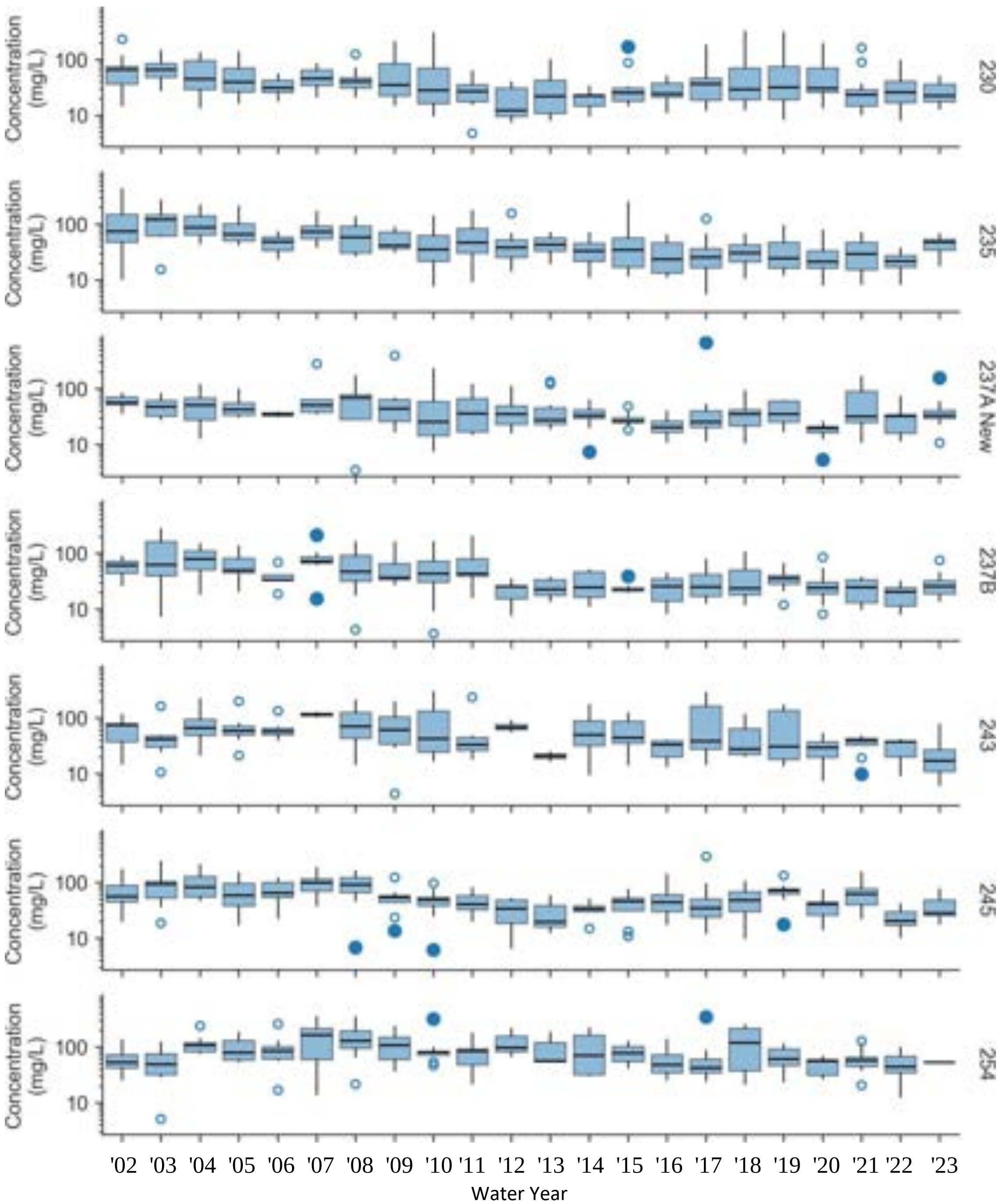


— Median ○ Moderate Outlier ● Extreme Outlier

Notes: ^ Extreme outliers exceeding maximum y-scale with result posted.
Tukey Box boundaries display the interquartile range (IQR) of the distribution ranging from the first quartile to the third. The central 50% of data is within the box boundaries. The whiskers represent the remaining data minus the outliers. The moderate outlier value is greater than the third quartile plus 1.5*IQR or less than the first quartile minus 1.5*IQR. The extreme outlier value is greater than the third quartile plus 3.0*IQR or less than the first quartile minus 3.0*IQR.

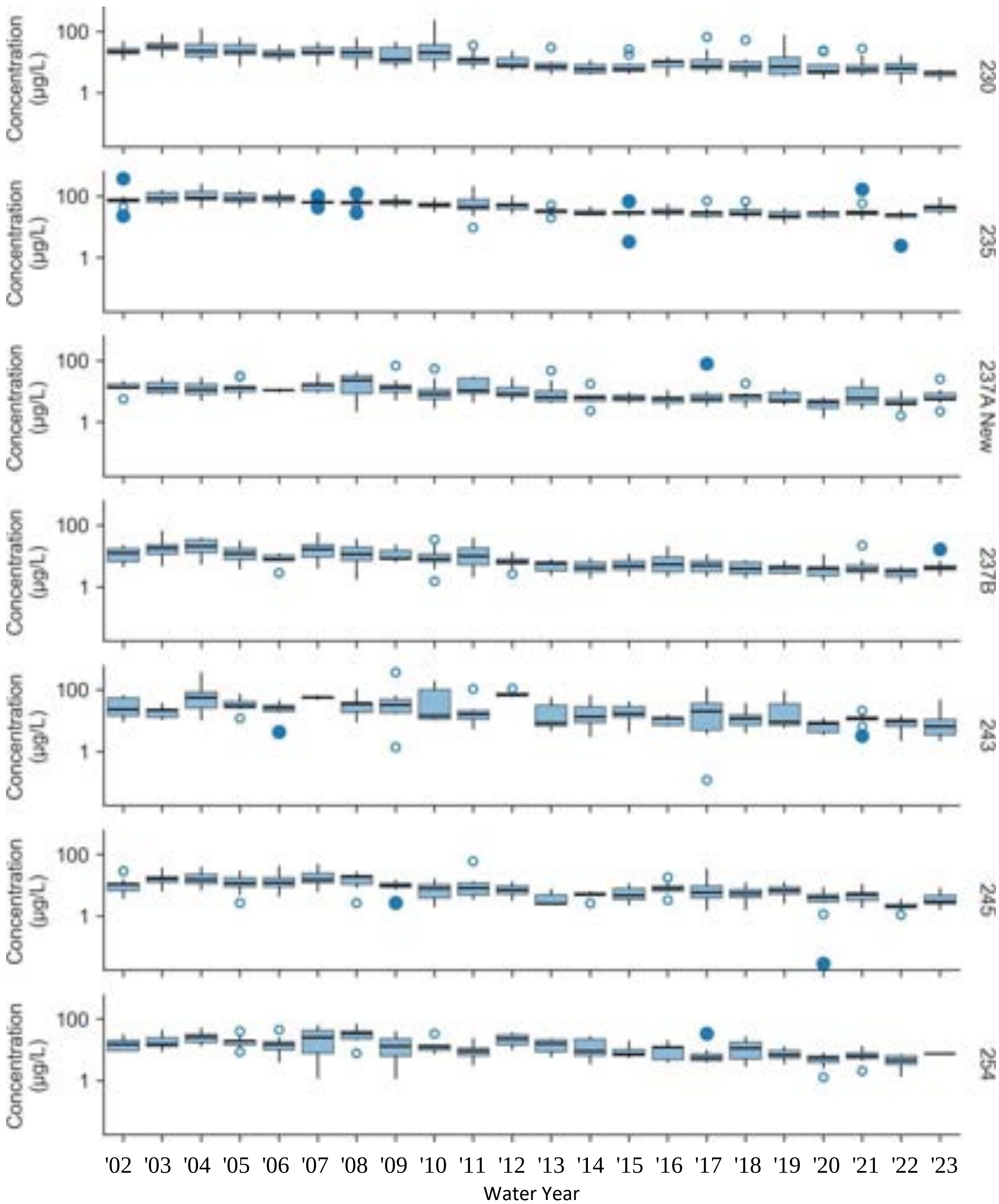
APPENDIX G

Figure G-1
Total Suspended Solids Year-by-Year Comparison in Stormwater
October 2001 - September 2023



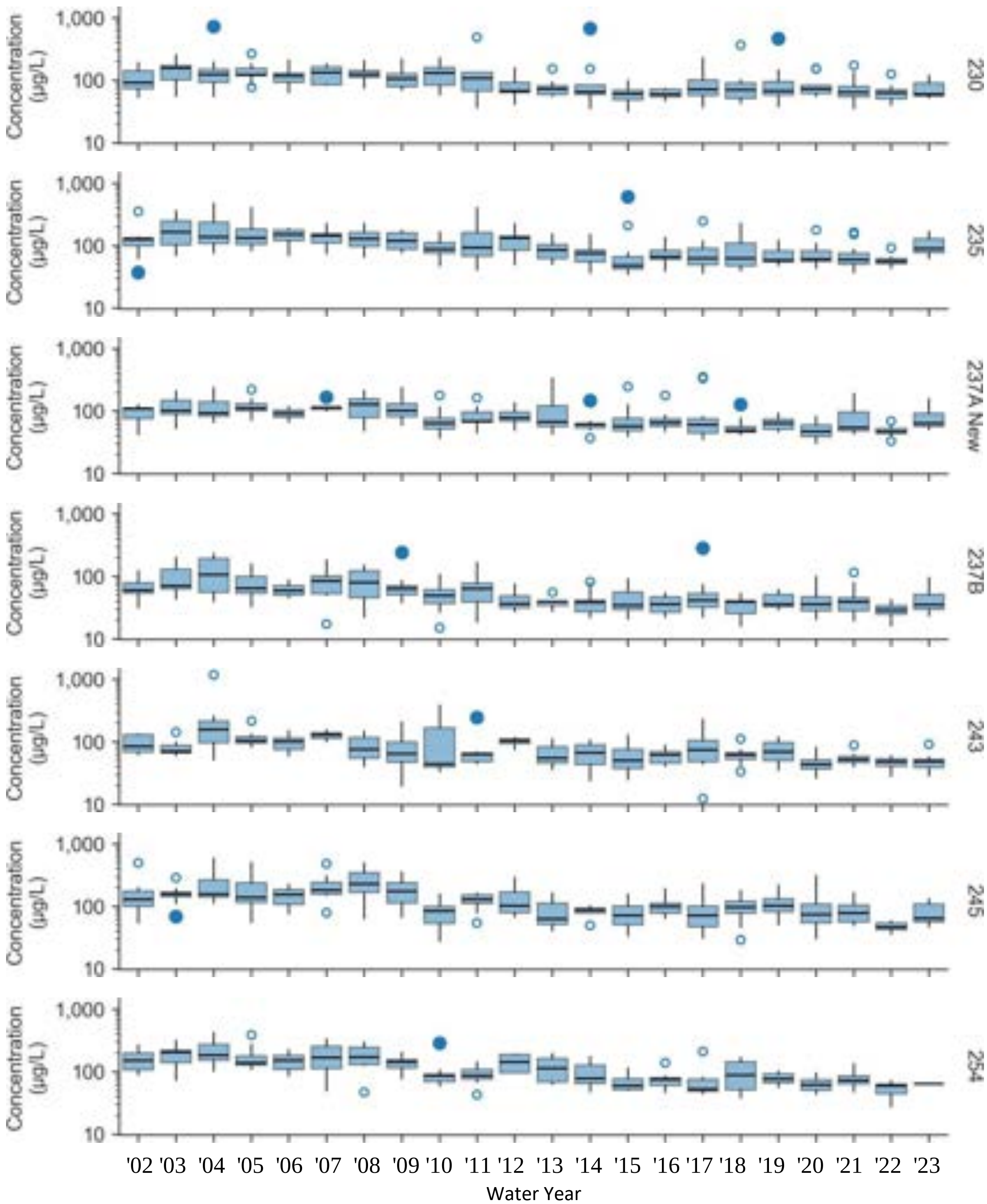
Median O Moderate Outlier Extreme Outlier Note:
Tukey Box boundaries display the interquartile range (IQR) of the distribution ranging from the first quartile to the third. The central 50% of data is within the box boundaries. The whiskers represent the remaining data minus the outliers. The moderate outlier value is greater than the third quartile plus I .5*IQR or less than the first quartile minus I .5*IQR. The extreme outlier value is greater than the third quartile plus 3.0*IQR or less than the first quartile minus 3.0*lQR.

Figure G-2
Total Lead Year-by-Year Comparison in Stormwater
October 2001 - September 2023



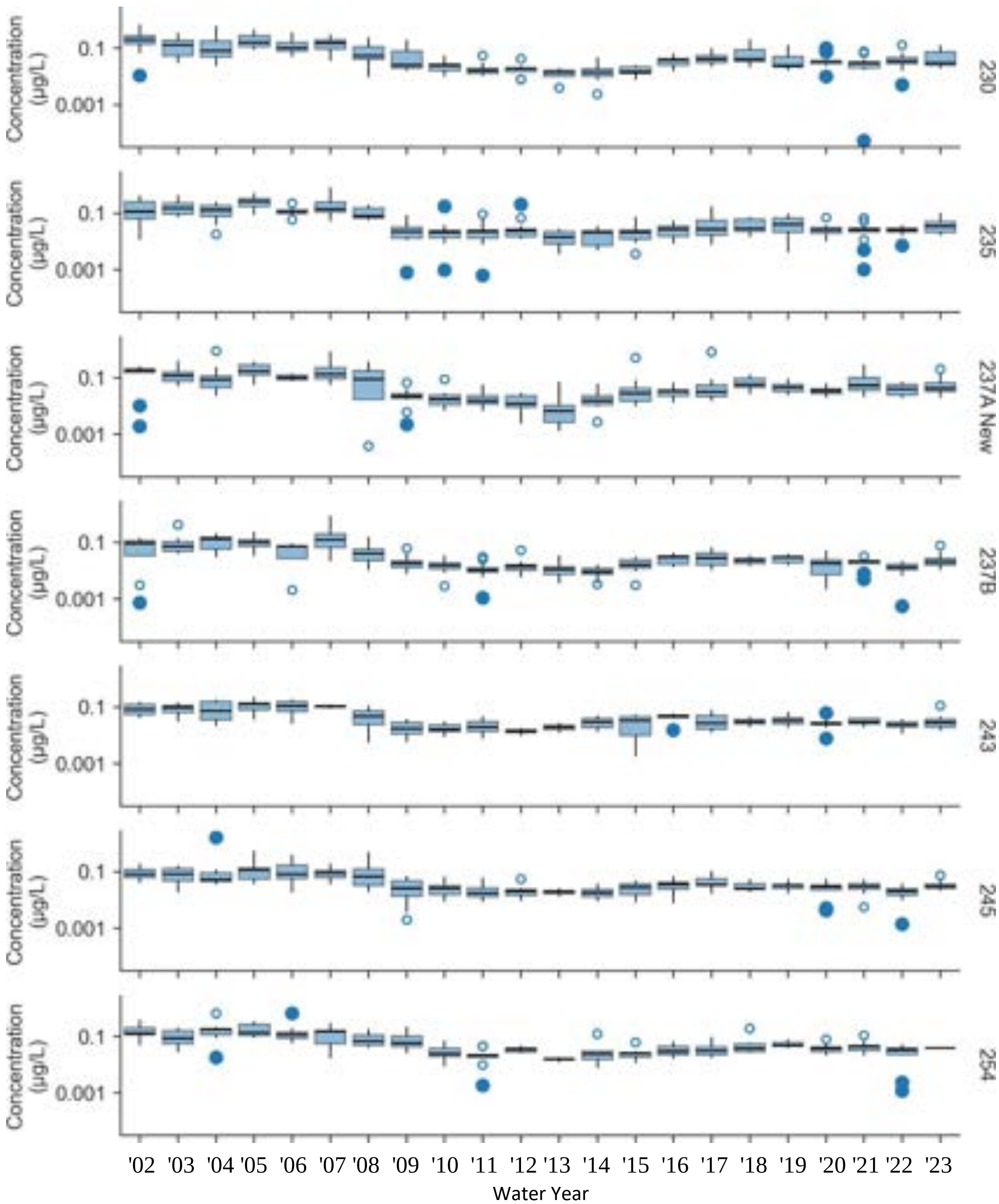
—— Median O Moderate Outlier ● Extreme Outlier Note:
Tukey Box boundaries display the interquartile range (IQR) of the distribution ranging from the first quartile to the third. The central 50% of data is within the box boundaries. The whiskers represent the remaining data minus the outliers. The moderate outlier value is greater than the third quartile plus I .5*IQR or less than the first quartile minus I .5*IQR. The extreme outlier value is greater than the third quartile plus 3.0*IQR or less than the first quartile minus 3.0*lQR.

Figure G-3
Total Zinc Year-by-Year Comparison in Stormwater
October 2001 - September 2023



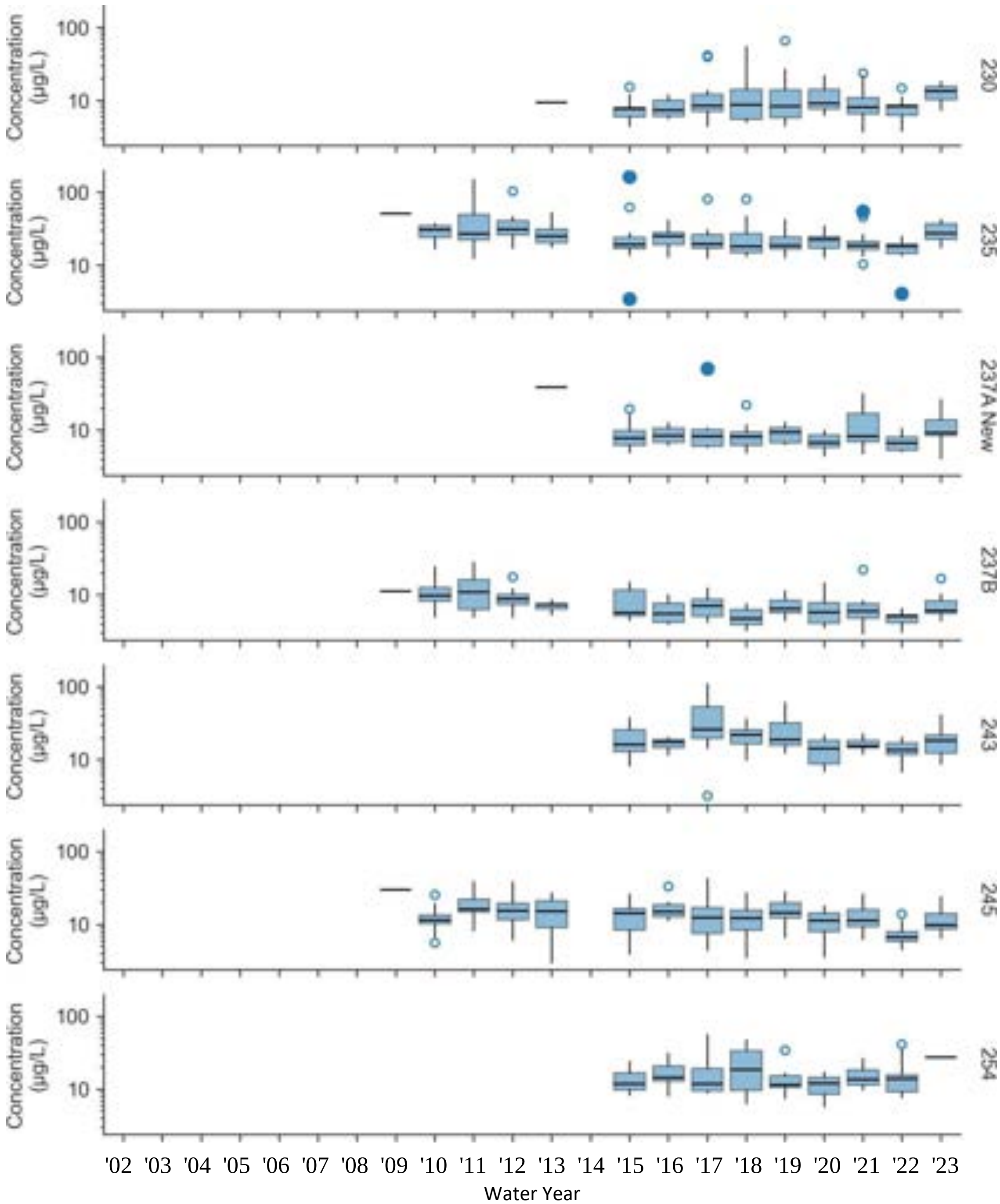
—— Median O Moderate Outlier ● Extreme Outlier Note:
Tukey Box boundaries display the interquartile range (IQR) of the distribution ranging from the first quartile to the third. The central 50% of data is within the box boundaries. The whiskers represent the remaining data minus the outliers. The moderate outlier value is greater than the third quartile plus I .5*IQR or less than the first quartile minus I .5*IQR. The extreme outlier value is greater than the third quartile plus 3.0*IQR or less than the first quartile minus 3.0*IQR.

Figure G-4
Phenanthrene Year-by-Year Comparison in Stormwater
October 2001 - September 2023



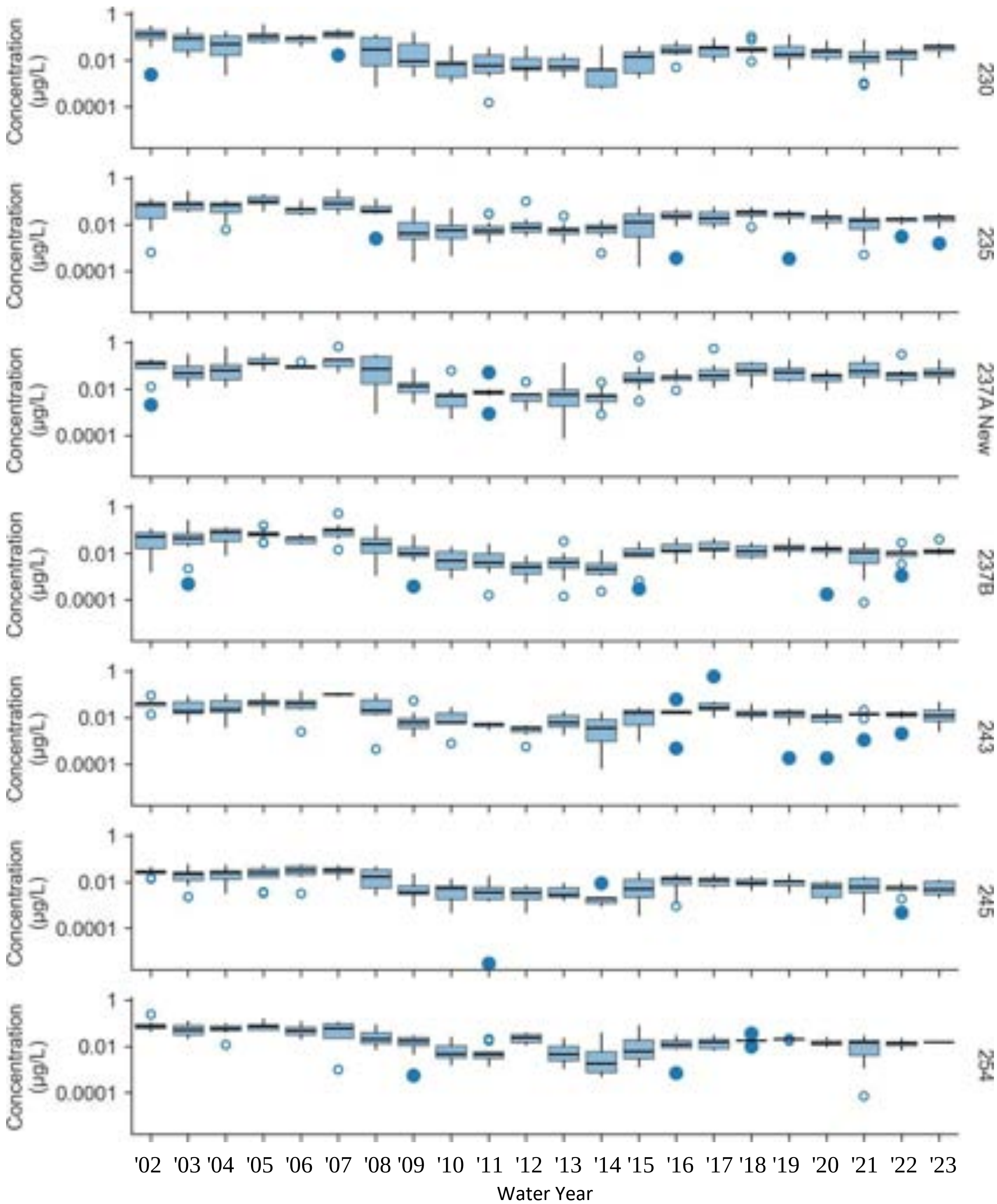
— Median O Moderate Outlier ● Extreme Outlier Note:
Tukey Box boundaries display the interquartile range (IQR) of the distribution ranging from the first quartile to the third. The central 50% of data is within the box boundaries. The whiskers represent the remaining data minus the outliers. The moderate outlier value is greater than the third quartile plus I .5*IQR or less than the first quartile minus I .5*IQR. The extreme outlier value is greater than the third quartile plus 3.0*IQR or less than the first quartile minus 3.0*lQR.

Figure G-5
Total Copper Year-by-Year Comparison in Stormwater
October 2001 - September 2023



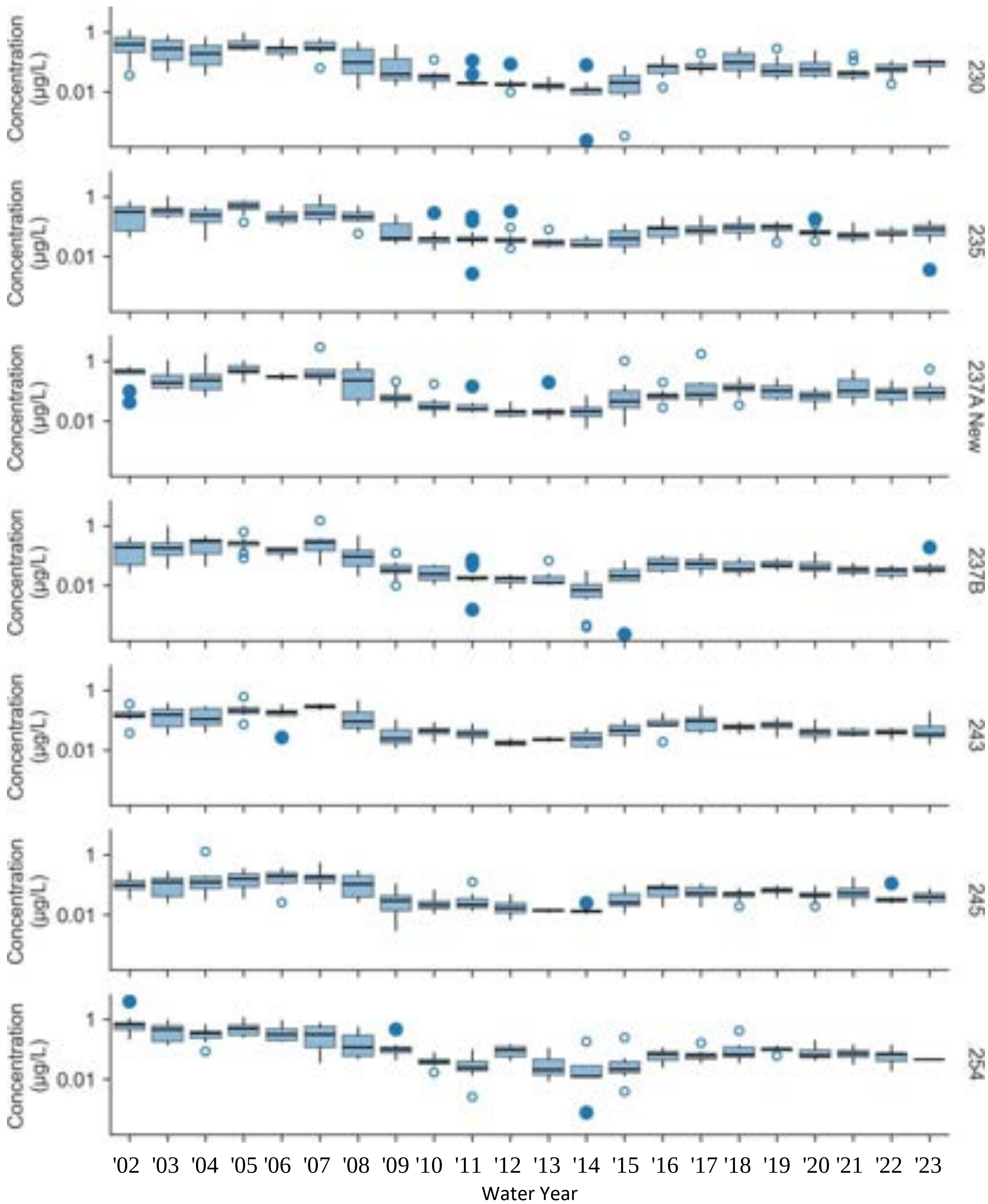
Median O Moderate Outlier ● Extreme Outlier Note:
Tukey Box boundaries display the interquartile range (IQR) of the distribution ranging from the first quartile to the third. The central 50% of data is within the box boundaries. The whiskers represent the remaining data minus the outliers. The moderate outlier value is greater than the third quartile plus I .5*IQR or less than the first quartile minus I .5*IQR. The extreme outlier value is greater than the third quartile plus 3.0*IQR or less than the first quartile minus 3.0*lQR.

Figure G-6
Indeno(1,2,3-cd)pyrene Year-by-Year Comparison in Stormwater
October 2001 - September 2023



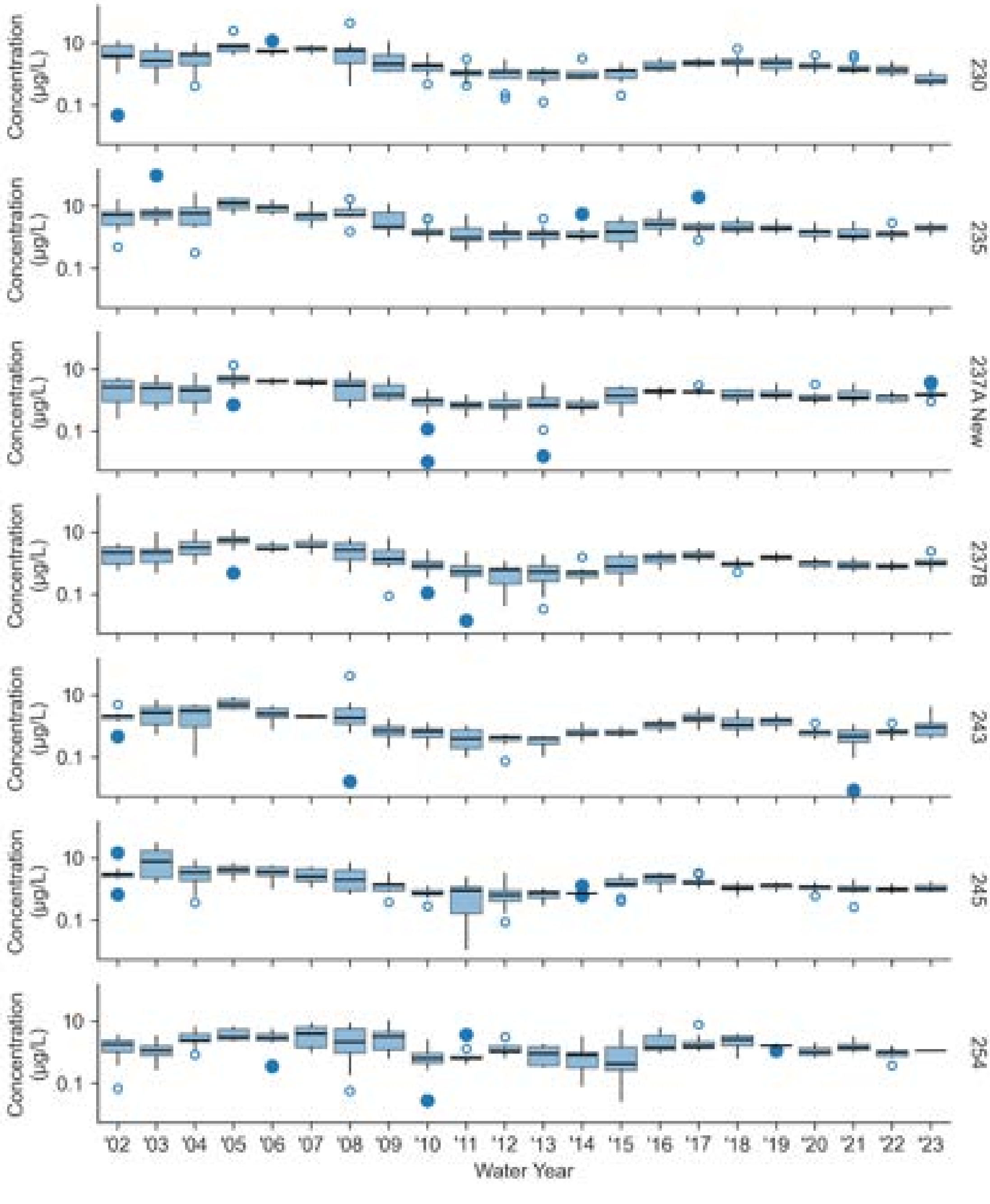
▬ Median O Moderate Outlier ● Extreme Outlier Note:
Tukey Box boundaries display the interquartile range (IQR) of the distribution ranging from the first quartile to the third. The central 50% of data is within the box boundaries. The whiskers represent the remaining data minus the outliers. The moderate outlier value is greater than the third quartile plus I .5*IQR or less than the first quartile minus I .5*IQR. The extreme outlier value is greater than the third quartile plus 3.0*IQR or less than the first quartile minus 3.0*lQR.

Figure G-7
Pyrene Year-by-Year Comparison in Stormwater
October 2001 - September 2023



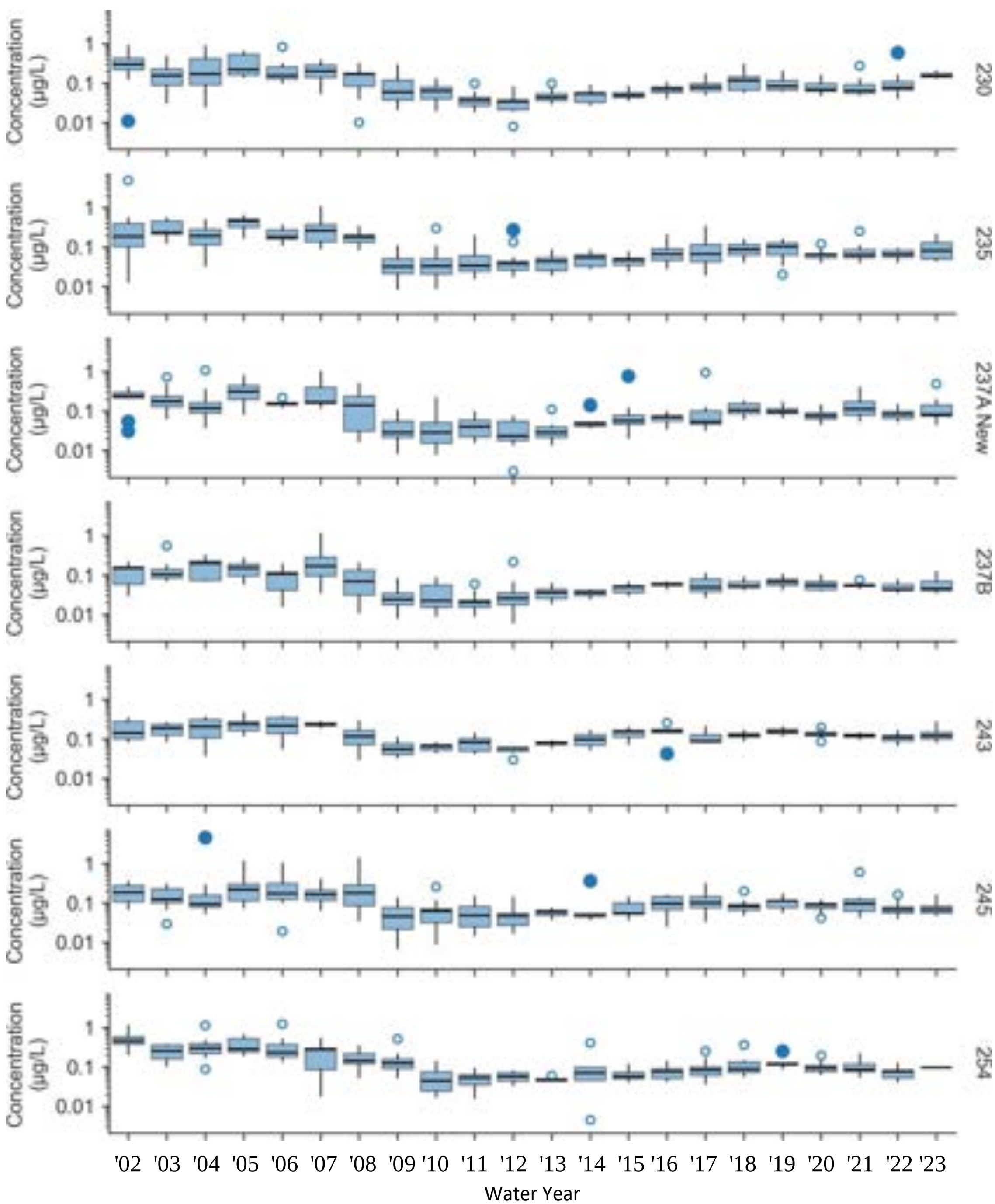
Median O Moderate Outlier Extreme Outlier Note:
Tukey Box boundaries display the interquartile range (IQR) of the distribution ranging from the first quartile to the third. The central 50% of data is within the box boundaries. The whiskers represent the remaining data minus the outliers. The moderate outlier value is greater than the third quartile plus I .5*IQR or less than the first quartile minus I .5*IQR. The extreme outlier value is greater than the third quartile plus 3.0*IQR or less than the first quartile minus 3.0*lQR.

Figure G-8
Di(2-ethylhexyl)phthalate Year-by-Year Comparison in Stormwater
October 2001 - September 2023



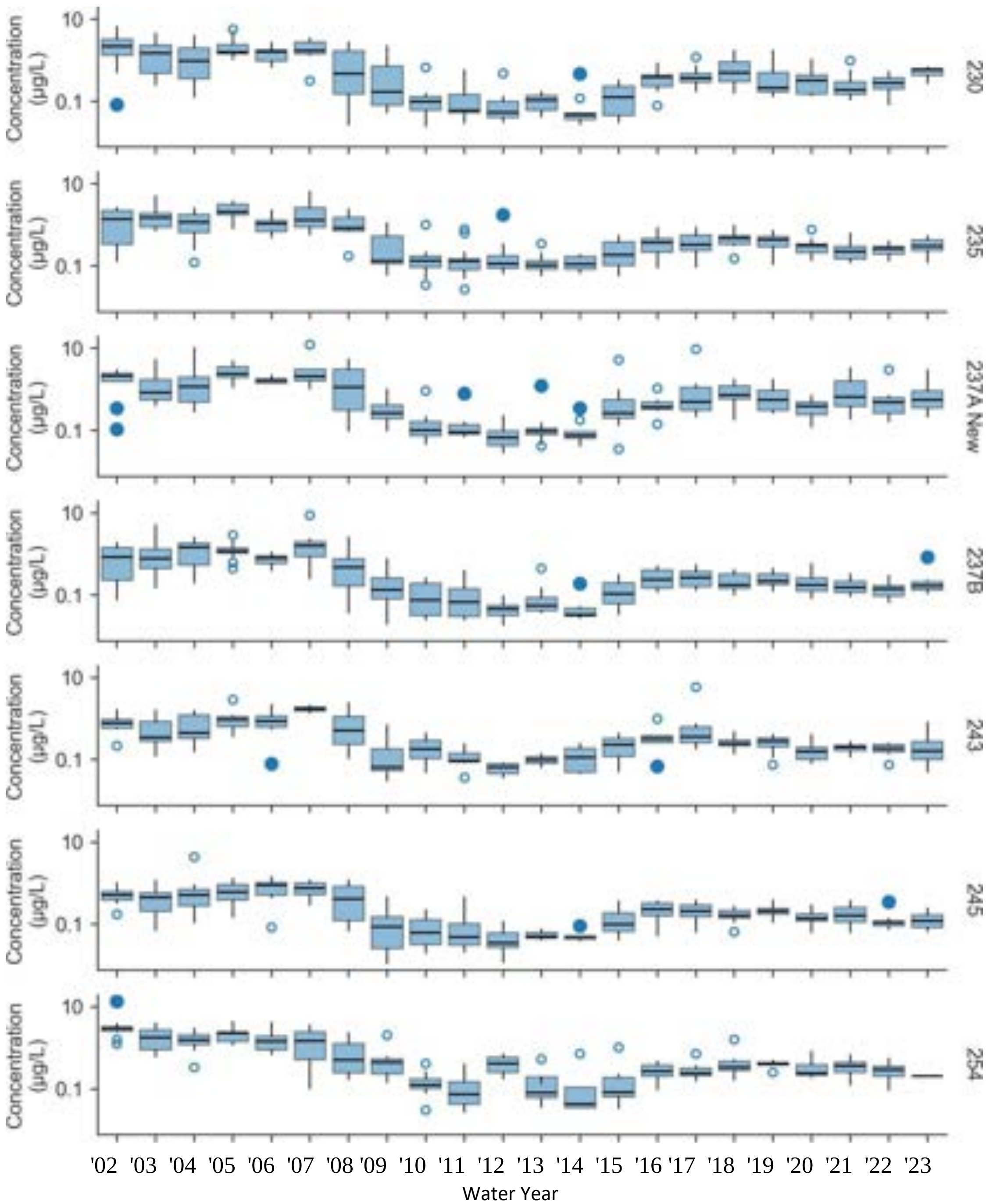
—— Median O Moderate Outlier ● Extreme Outlier Note:
Tukey Box boundaries display the interquartile range (IQR) of the distribution ranging from the first quartile to the third. The central 50% of data is within the box boundaries. The whiskers represent the remaining data minus the outliers. The moderate outlier value is greater than the third quartile plus I .5*IQR or less than the first quartile minus I .5*IQR. The extreme outlier value is greater than the third quartile plus 3.0*IQR or less than the first quartile minus 3.0*lQR.

Figure G-9
Total LPAHs Year-by-Year Comparison in Stormwater
October 2001 - September 2023



Median O Moderate Outlier ● Extreme Outlier Note:
Tukey Box boundaries display the interquartile range (IQR) of the distribution ranging from the first quartile to the third. The central 50% of data is within the box boundaries. The whiskers represent the remaining data minus the outliers. The moderate outlier value is greater than the third quartile plus I .5*IQR or less than the first quartile minus I .5*IQR. The extreme outlier value is greater than the third quartile plus 3.0*IQR or less than the first quartile minus 3.0*lQR.

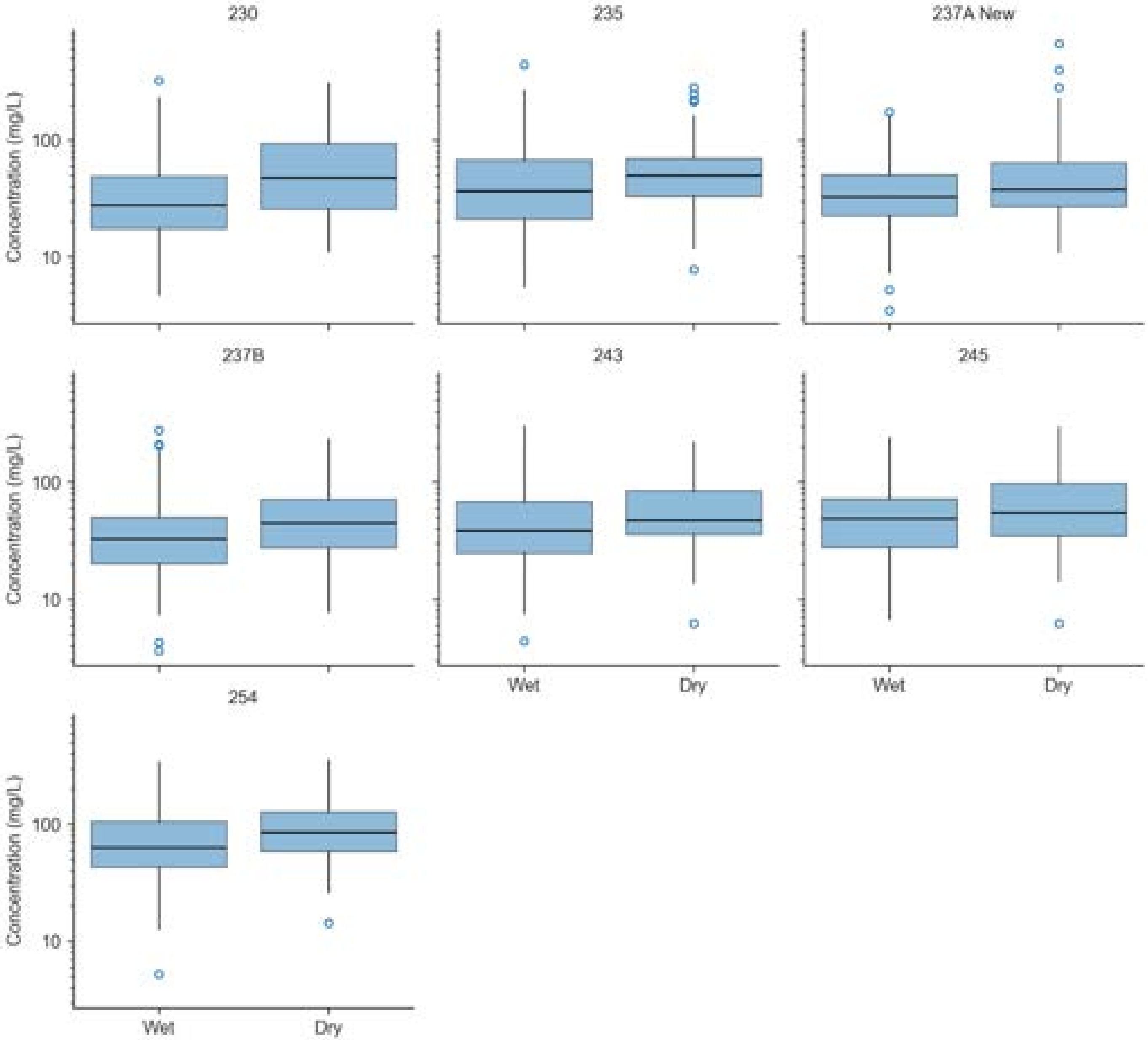
Figure G-10
Total HPAHs Year-by-Year Comparison in Stormwater
October 2001 - September 2023



—— Median O Moderate Outlier ● Extreme Outlier Note:
Tukey Box boundaries display the interquartile range (IQR) of the distribution ranging from the first quartile to the third. The central 50% of data is within the box boundaries. The whiskers represent the remaining data minus the outliers. The moderate outlier value is greater than the third quartile plus I .5*IQR or less than the first quartile minus I .5*IQR. The extreme outlier value is greater than the third quartile plus 3.0*IQR or less than the first quartile minus 3.0*lQR.

APPENDIX H

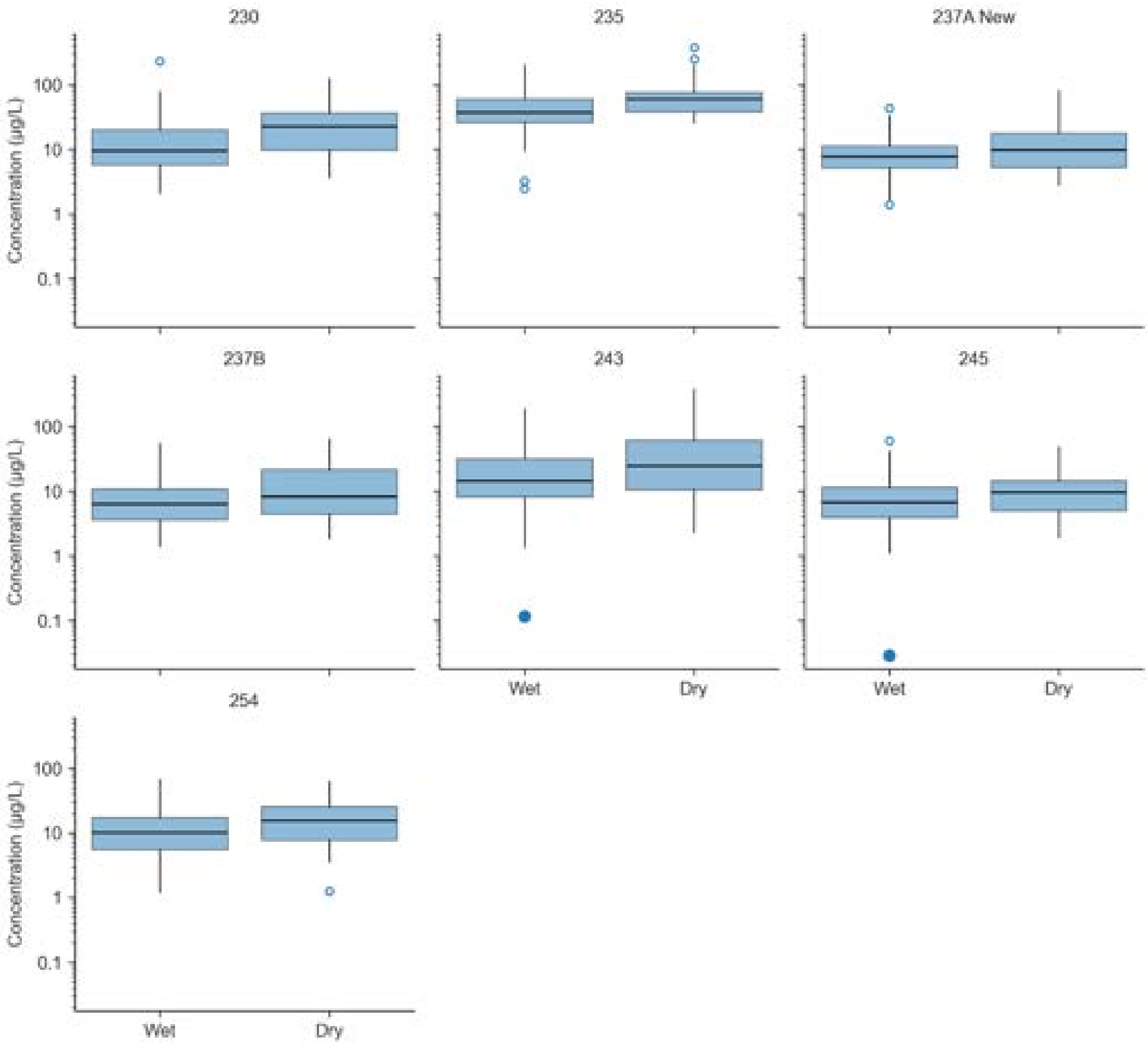
Figure H-1
Total Suspended Solids Seasonal Variation in Stormwater
October 2001 – September 2023



— Median ○ Moderate Outlier ● Extreme Outlier

Notes: ^ Extreme outliers exceeding maximum y-scale with result posted.
Tukey Box boundaries display the interquartile range (IQR) of the distribution ranging from the first quartile to the third. The central 50% of data is within the box boundaries. The whiskers represent the remaining data minus the outliers. The moderate outlier value is greater than the third quartile plus 1.5*IQR or less than the first quartile minus 1.5*IQR. The extreme outlier value is greater than the third quartile plus 3.0*IQR or less than the first quartile minus 3.0*IQR.

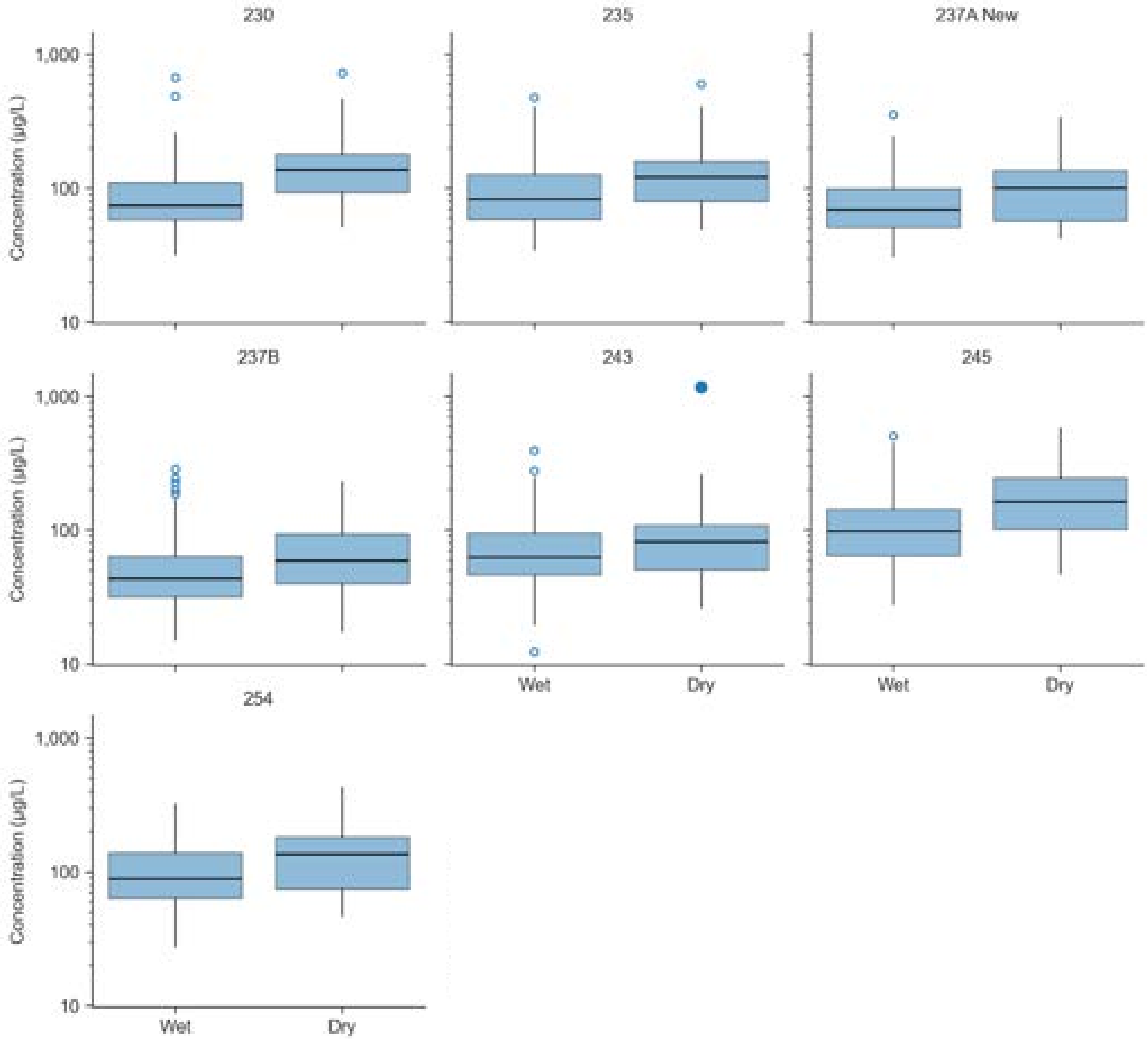
Figure H-2
Total Lead Seasonal Variation in Stormwater
October 2001 – September 2023



— Median ○ Moderate Outlier ● Extreme Outlier

Notes: ^ Extreme outliers exceeding maximum y-scale with result posted.
Tukey Box boundaries display the interquartile range (IQR) of the distribution ranging from the first quartile to the third. The central 50% of data is within the box boundaries. The whiskers represent the remaining data minus the outliers. The moderate outlier value is greater than the third quartile plus 1.5*IQR or less than the first quartile minus 1.5*IQR. The extreme outlier value is greater than the third quartile plus 3.0*IQR or less than the first quartile minus 3.0*IQR.

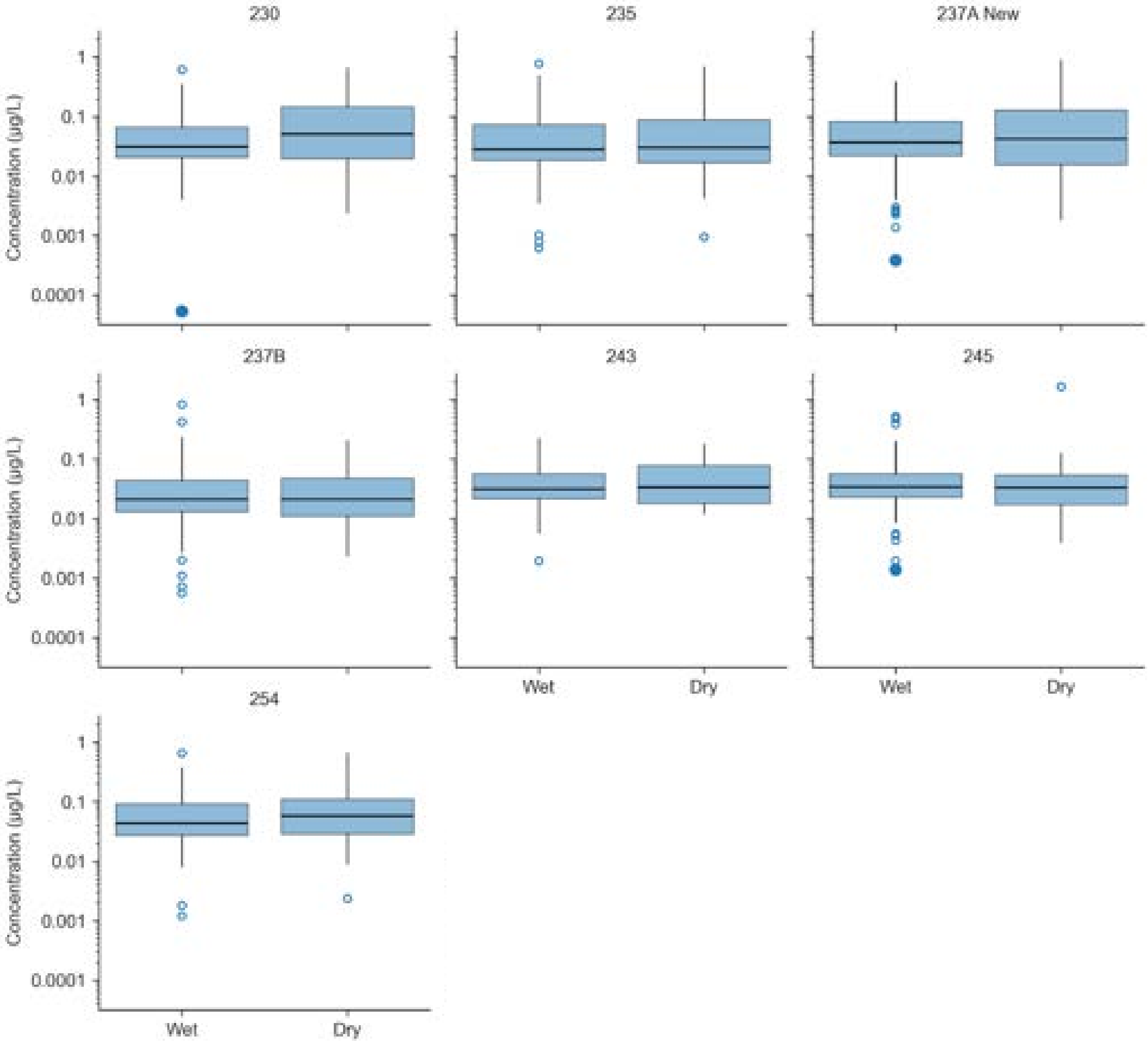
Figure H-3
Total Zinc Seasonal Variation in Stormwater
October 2001 – September 2023



— Median   ○ Moderate Outlier   ● Extreme Outlier

Notes: ^ Extreme outliers exceeding maximum y-scale with result posted.
Tukey Box boundaries display the interquartile range (IQR) of the distribution ranging from the first quartile to the third. The central 50% of data is within the box boundaries. The whiskers represent the remaining data minus the outliers. The moderate outlier value is greater than the third quartile plus 1.5*IQR or less than the first quartile minus 1.5*IQR. The extreme outlier value is greater than the third quartile plus 3.0*IQR or less than the first quartile minus 3.0*IQR.

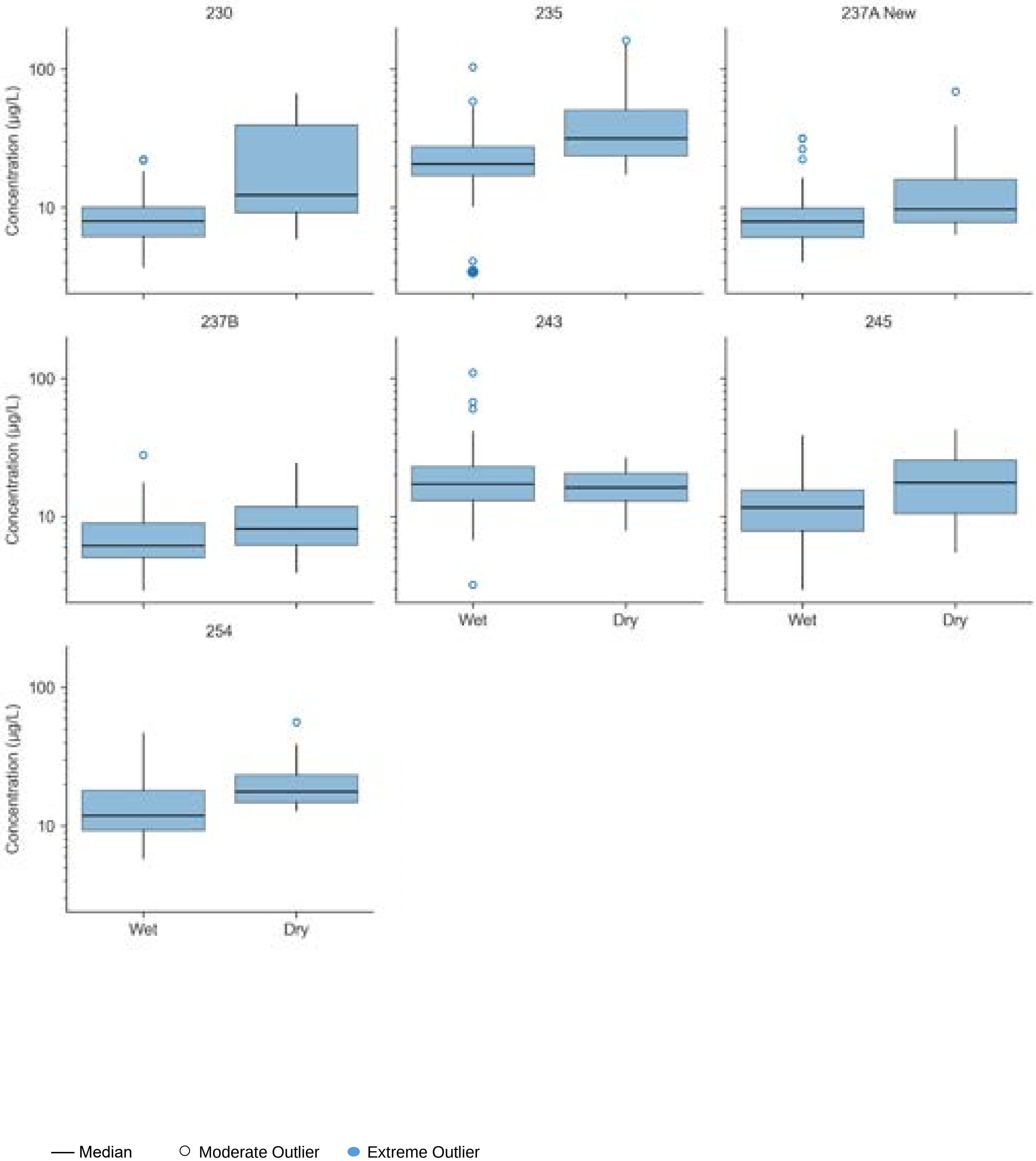
Figure H-4
Phenanthrene Seasonal Variation in Stormwater
October 2001 – September 2023



— Median ○ Moderate Outlier ● Extreme Outlier

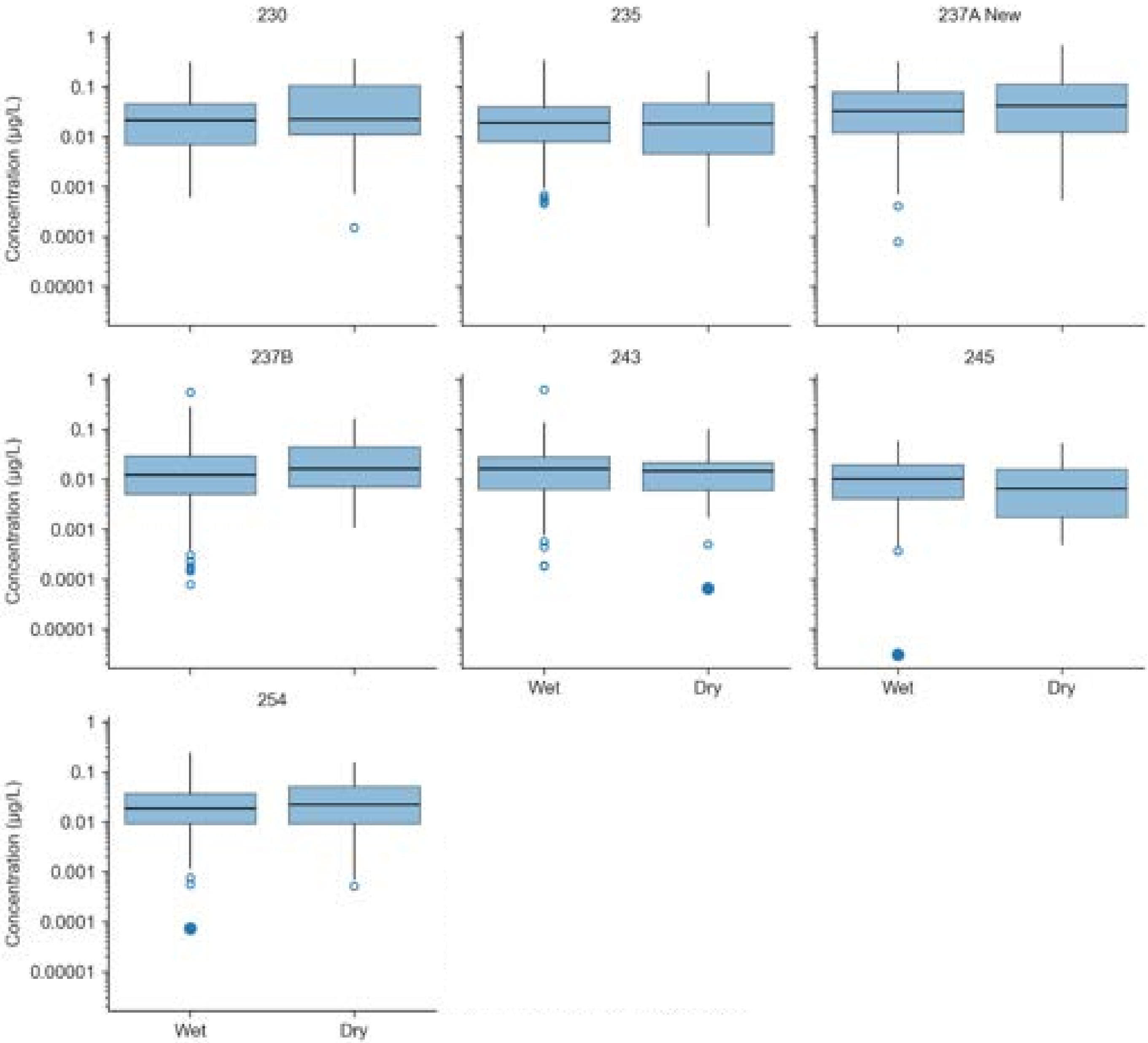
Notes: ^ Extreme outliers exceeding maximum y-scale with result posted.
Tukey Box boundaries display the interquartile range (IQR) of the distribution ranging from the first quartile to the third. The central 50% of data is within the box boundaries. The whiskers represent the remaining data minus the outliers. The moderate outlier value is greater than the third quartile plus 1.5*IQR or less than the first quartile minus 1.5*IQR. The extreme outlier value is greater than the third quartile plus 3.0*IQR or less than the first quartile minus 3.0*IQR.

Figure H-5
Copper Seasonal Variation in Stormwater
October 2001 – September 2023



Notes: ^ Extreme outliers exceeding maximum y-scale with result posted.
Tukey Box boundaries display the interquartile range (IQR) of the distribution ranging from the first quartile to the third. The central 50% of data is within the box boundaries. The whiskers represent the remaining data minus the outliers. The moderate outlier value is greater than the third quartile plus 1.5*IQR or less than the first quartile minus 1.5*IQR. The extreme outlier value is greater than the third quartile plus 3.0*IQR or less than the first quartile minus 3.0*IQR.

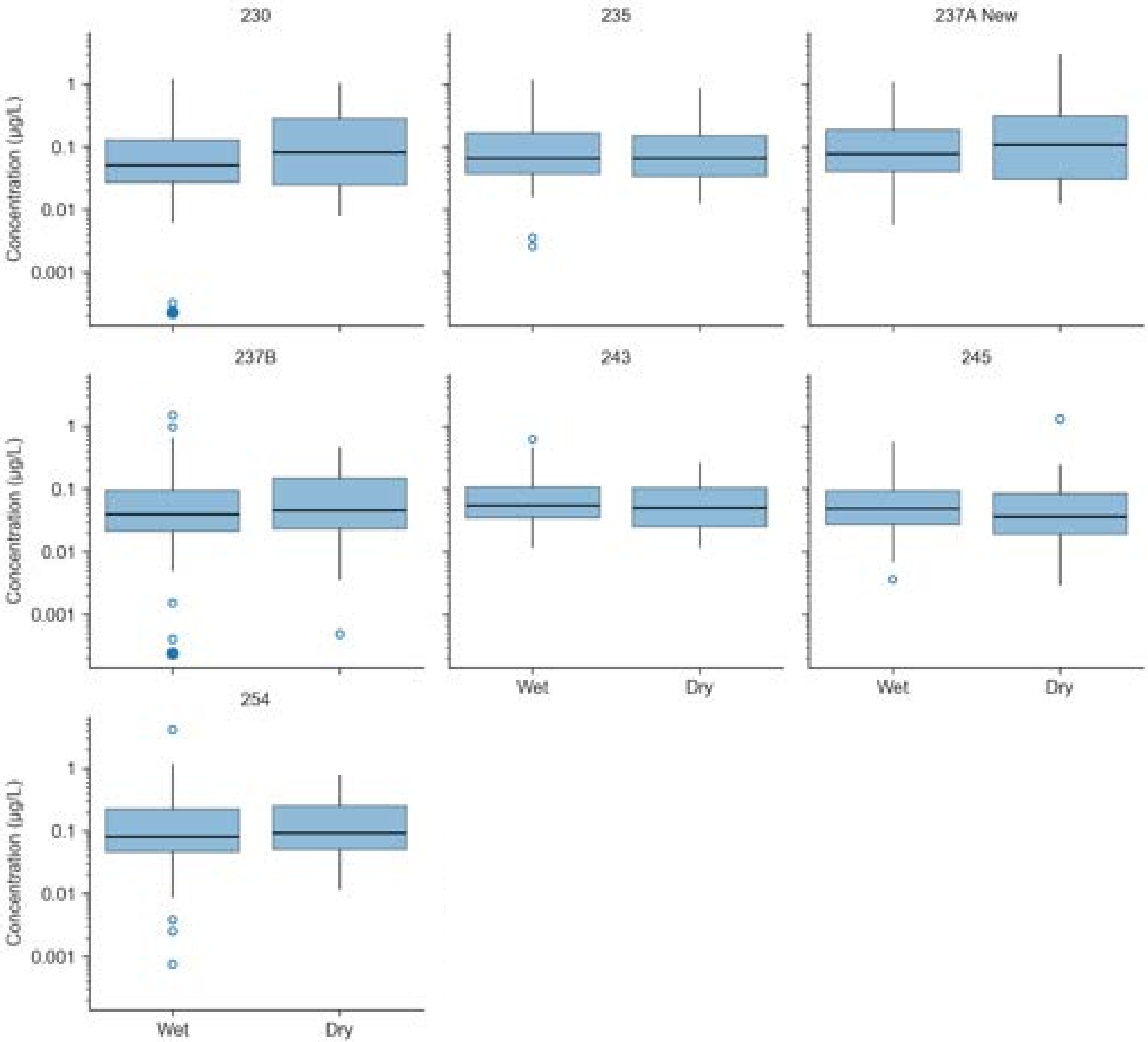
Figure H-6
Indeno(1,2,3cd)pyrene Seasonal Variation in Stormwater
October 2001 – September 2023



— Median ○ Moderate Outlier ● Extreme Outlier

Notes: ^ Extreme outliers exceeding maximum y-scale with result posted.
Tukey Box boundaries display the interquartile range (IQR) of the distribution ranging from the first quartile to the third. The central 50% of data is within the box boundaries. The whiskers represent the remaining data minus the outliers. The moderate outlier value is greater than the third quartile plus 1.5*IQR or less than the first quartile minus 1.5*IQR. The extreme outlier value is greater than the third quartile plus 3.0*IQR or less than the first quartile minus 3.0*IQR.

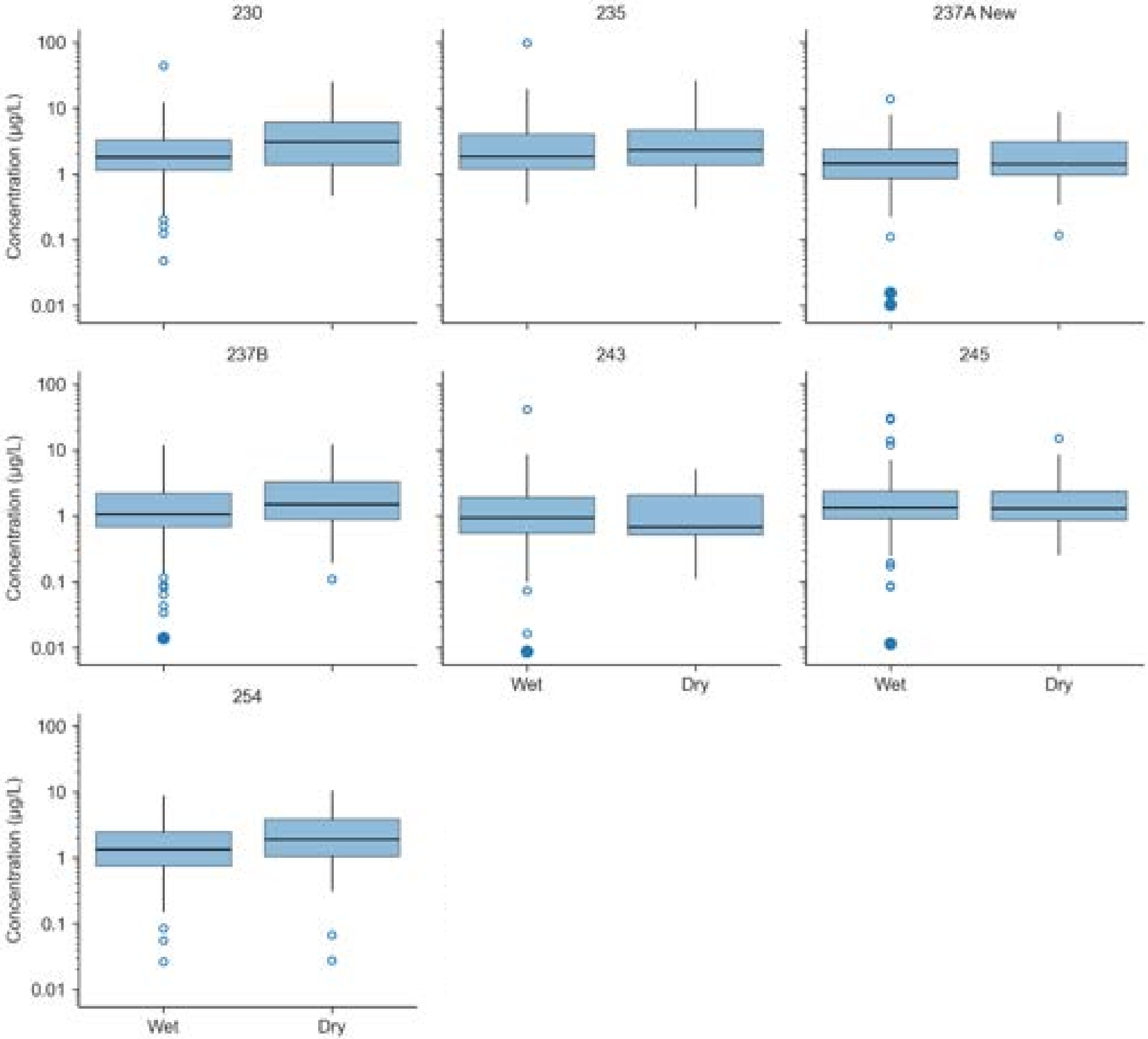
Figure H-7
Pyrene Seasonal Variation in Stormwater
October 2001 – September 2023



— Median ○ Moderate Outlier ● Extreme Outlier

Notes: ^ Extreme outliers exceeding maximum y-scale with result posted.
Tukey Box boundaries display the interquartile range (IQR) of the distribution ranging from the first quartile to the third. The central 50% of data is within the box boundaries. The whiskers represent the remaining data minus the outliers. The moderate outlier value is greater than the third quartile plus 1.5*IQR or less than the first quartile minus 1.5*IQR. The extreme outlier value is greater than the third quartile plus 3.0*IQR or less than the first quartile minus 3.0*IQR.

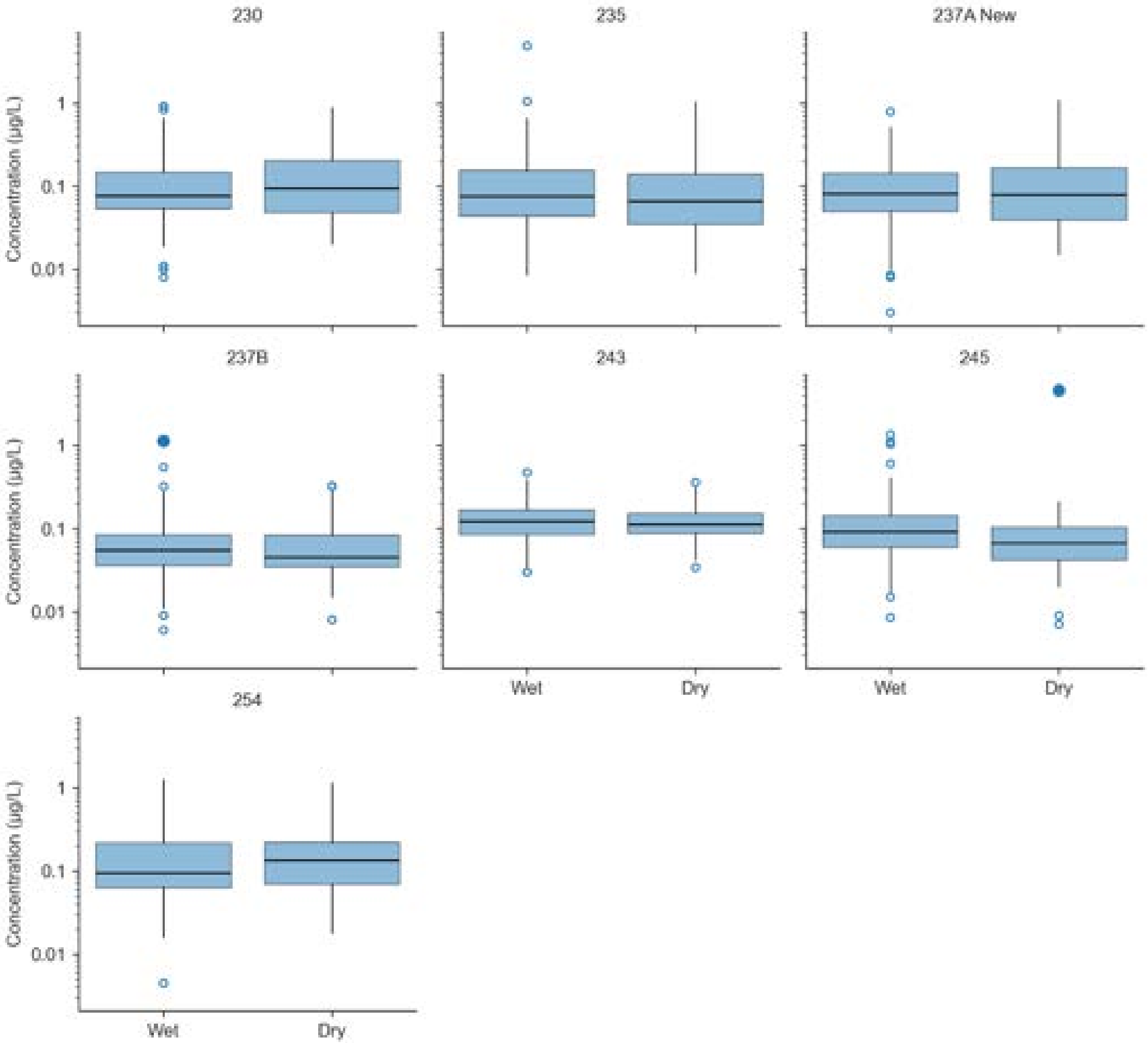
Figure H-8
Di(2-ethyhexyl)phthalate Seasonal Variation in Stormwater
October 2001 – September 2023



— Median ○ Moderate Outlier ● Extreme Outlier

Notes: ^ Extreme outliers exceeding maximum y-scale with result posted.
Tukey Box boundaries display the interquartile range (IQR) of the distribution ranging from the first quartile to the third. The central 50% of data is within the box boundaries. The whiskers represent the remaining data minus the outliers. The moderate outlier value is greater than the third quartile plus 1.5*IQR or less than the first quartile minus 1.5*IQR. The extreme outlier value is greater than the third quartile plus 3.0*IQR or less than the first quartile minus 3.0*IQR.

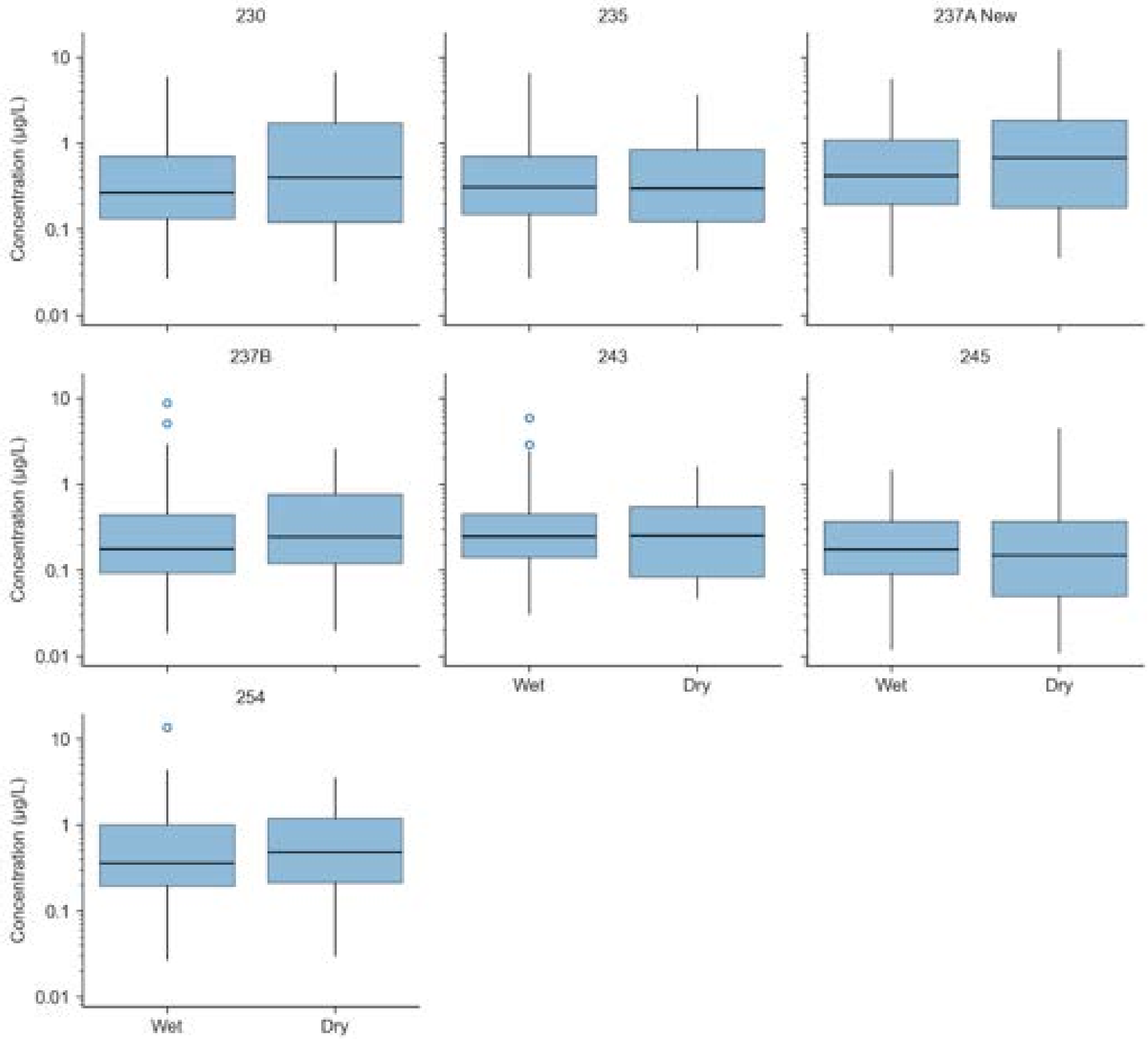
Figure H-9
Total LPAHs Seasonal Variation in Stormwater
October 2001 – September 2023



— Median ○ Moderate Outlier ● Extreme Outlier

Notes: ^ Extreme outliers exceeding maximum y-scale with result posted.
Tukey Box boundaries display the interquartile range (IQR) of the distribution ranging from the first quartile to the third. The central 50% of data is within the box boundaries. The whiskers represent the remaining data minus the outliers. The moderate outlier value is greater than the third quartile plus 1.5*IQR or less than the first quartile minus 1.5*IQR. The extreme outlier value is greater than the third quartile plus 3.0*IQR or less than the first quartile minus 3.0*IQR.

Figure H-10
Total HPAHs Seasonal Variation in Stormwater
October 2001 – September 2023



— Median ○ Moderate Outlier ● Extreme Outlier

Notes: ^ Extreme outliers exceeding maximum y-scale with result posted.
Tukey Box boundaries display the interquartile range (IQR) of the distribution ranging from the first quartile to the third. The central 50% of data is within the box boundaries. The whiskers represent the remaining data minus the outliers. The moderate outlier value is greater than the third quartile plus 1.5*IQR or less than the first quartile minus 1.5*IQR. The extreme outlier value is greater than the third quartile plus 3.0*IQR or less than the first quartile minus 3.0*IQR.